A FIRST APPROXIMATION MODEL OF MONEY, PRICES AND EXCHANGE RATES IN REVOLUTIONARY CUBA

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INTRODUCTION

This paper traces the interrelationship between money, black market prices and black market exchange rates in Revolutionary Cuba, that is, in the post-1958 Cuban economy. The research was originally designed as a study of foreign exchange rates, with the objective of developing predictive equations of foreign exchange rates of the Cuban peso. The predictive functions of exchange rates were to be used in adding the economic contributions of the foreign and domestic sectors of the Cuban economy in the context of a model of foreign aid requirements of the Cuban economy (Alonso & Lago, 1994). However, the interrelationships between black market exchange rates and black market prices made us abandon the initial objective to develop a single- equation model of foreign exchange rate determination in favor of the more complex multi- equation model presented in this paper.

Numerous data problems complicated the research design and its execution. For example, black market prices in Cuba are considered sensitive information and have never been published by the Cuban government. Our effort to collect black market prices was only partially successful, since black market prices were assembled for only 14 years in the post-1958 period.

Other problems encountered were conceptual in nature. The Cuban authorities and Cuban professional journal articles use solely currency in circulation and savings deposits of the household sector to define money supply, completely ignoring the enterprise sector's demand for money in the broadest sense of the money supply definition. Credits to state enterprises and foreign credits are typically ignored by Cuban analysts when analyzing trends in money aggregates, so that data on the monetary mass and its components are never published in Cuban official statistics. It would seem as if the Cuban government does not recognize that price inflation can occur from excess credits in the state enterprise sector. The lack of data on the components of the monetary mass became a significant handicap to this research study on the interrelationship of money, prices and exchange rates. Because of data problems and the conceptual difficulties with the Cuban monetary statistics alluded above, this research can be deemed as a first approximation.

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A CONCEPTUAL OVERVIEW OF MONETARY POLICY IN SOCIALIST CUBA

As discussed in greater detail in the International Monetary Fund's Study of the Soviet Economy (IMF, 1991), monetary and financial policy in the former Socialist bloc (and as well in Socialist Cuba) played a secondary and subordinate role to the detailed quantitative enterprise production targets contained in the Central State Plan. This subordination was explicitly designed so that there would be no feedback from monetary policy to the production targets. Thus, the role of monetary policy (Unanue, 1985) was to ensure that liquidity in the economy would correspond to the production targets and fixed prices contained in the Central State Plan.

As discussed by several Cuban analysts, such as Infante (1986) and by Chaviano, Rico and López (1986), the Global Financial Plan is the counterpart of the Central State Plan. The Global Financial Plan groups incomes/revenues and expenses from the Budget (prepared by the Comité Estatal de Finanzas), the Credit Plan (prepared by the Banco Nacional), the Balance of Income and Expenditures of the Population and the Balance of Payments (both prepared by JUCEPLAN), so that some attempt is indeed made at achieving financial balance. But this may be misleading, since Infante (1986) complains that little attention is actually paid to achieving material-financial equilibrium in the enterprise/state sector of the economy.

To ensure that monetary policy would have no feedback effect on production and prices, the supply of credit to the state enterprises and their financial flows are kept completely separated from the household sector money flows and credit. The financial flows to enterprises are regulated through the Credit Plan (Unanue, 1985), which groups and adds the planned demand for credit at the enterprise level, whereas the household financial flows are regulated through the Cash Plan. Currency can be withdrawn by state enterprises only for payroll purposes and cash- holding by enterprises is severely limited, if not actually prohibited. The credit extended to the enterprise sector is mainly of a short-term nature, designed to finance working capital. Investments are financed through budget allocations and the enterprises must remit most of the profits to the State budget. Enterprises face a soft budget constraint (Kornai, 1980 and 1982), so that credit repayment shortfalls are covered from budgetary transfers. Kornai also mentions the problem of intra-enterprise transactions, which are generally unpaid in times of shortages and which are usually absorbed by the government deficit. The enterprise demand for money depends on the quantitative requirements contained in the Central State Plan (transaction demand) and on the opportunity costs of holding money in terms of inventories (as a store of value), since inventories substitute for money in times of shortages in socialist economies (Kornai, 1980)

That socialist enterprises accumulate larger inventories than their free-market counterparts has been documented by several other authors. Fogel and Rosenthal (1994) mention that large strategic reserves of food, spare parts and machinery and equipment are kept in Cuba under the control of several government organizations, including the Instituto Nacional de Reservas del Estado (INRE), the reserves of the Ministry of Armed Forces, the reserves at the Provincial level under the control of the officials of the Poder Popular, and the special reserves under the direct control of the commander-in-chief, Fidel Castro himself. According to the above referenced authors, at the beginning of the decade of the eighties, Cuba had a two-year strategic reserve of spare parts, and of machinery and equipment replacements.

The Cash Plan focuses mainly on household financial flows and specifies the factors that contribute to the growth of currency in circulation and its flow into the banking sector. Households can hold saving deposits, but currency is the only means of payment. Households are not allowed to purchase enterprise securities nor to receive loans from the enterprise sector. The Cash Plan is reflected in the Balance of Money Incomes and Expenditures of the Population, reported annually in the *Anuario Estadístico de Cuba* (Comité Estatal de Estadísticas, 1989), in contrast to the information on enterprise credits, which is rarely reported. The reader should appreciate by now that

there is some degree of liquidity in the short-term financial assets of the household sector, in contrast to the low degree of liquidity in the enterprises's financial assets.

It is important to note the impacts of monetary expansion, that is, of excess demand for money in socialist economies. Since official prices are controlled and foreign exchange operations restricted, excessive money growth leads to general merchandise shortages throughout the official economy and to price inflation in black market transactions and deterioration in black market exchange rates. The socialist government authorities have always believed that the merchandise shortages induced by excessive money growth can be dealt with through administrative procedures with no feedback on the rest of the economy, but as will be seen in this paper, that is not the case in Cuba.

While the information contained in the Credit Plan (enterprise credits) and in the Cash Plan (currency in circulation and household savings deposits) in principle cover the components of the monetary mass, in practice statements by Cuban authorities on stabilization policies focus solely on the Cash Plan when analyzing the monetary overhang of the economy. It is as if enterprise credits played no role in overheating the Cuban economy.

Unanue (1985) complains about the insufficient search for material-financial equilibrium and balance between JUCEPLAN, the Banco Nacional de Cuba and the Comité Estatal de Estadísticas and proposes a system of national income accounting identities to achieve the material-financial balance. According to Unanue (1985) the material-financial balance requires that the sum of: 1) consumption for social purposes, 2) net investments, 3) social security pensions and transfers, and 4) salaries paid in the non-productive sphere be equal to a) changes in household liquidity, b) the net balance of payment imbalance, plus c) what socialist economists call the "plusproducto", or the excess of national income over the addition of salaries paid in the productive sector plus income of the non-state sector plus consumption of agricultural products at the farm. The reader should note the lack of the usual monetary concepts in Unanue's model, which won a Cuban award.

All the discussions and econometric models of monetary circulation in Cuba—that is, including those of Martínez Fagundo (1989), Espinosa and Quintana (1989) and Alpízar (1992)—focus solely on the component flows into the Balance of Incomes and Expenditures of the Population, completely ignoring the "quasi-money" inter-enterprise transactions and credits. For example, Mejías (1985) looks into the interrelationship between monetary issue and budgets deficits, but only recognizes as increases in money supply those transactions which result in higher incomes and salaries of the population, reductions in household taxes and user charge payments and reductions in household expenditures. One of the few analysts to recognize the importance of the state enterprise sector is Echeverría (1992), but he has yet to formulate a precise quantitative economic model.

Disequilibrium and Shortage Views in Socialist Economies

Traditional views of inflation in socialist economies have maintained that the demand for money in these societies is of little relevance to the functioning of the economy, since money holdings are not a subject of choice, but merely the by-product of the Central Plan. Thus, it is argued that the households' money holdings are somewhat involuntary and unwanted, the result of forced savings. As a consequence, it is claimed that there is a "monetary overhang" in the economy. To bring market equilibrium, prices would have to be set free and would have to rise substantially, contributing to the conclusion that there is "repressed inflation" in socialist societies; that socialist economies are in persistent disequilibrium under central planning.

A variation of the traditional view, called the disequilibrium school (Portes, 1987, and Portes and Winter, 1980), argues that due to central planners' mistakes in a closed economy, or foreign trade shocks in an open economy, when aggregate demand exceeds aggregate supply in the presence of rigid or sticky prices, then the economy is indeed subject to repressed inflation. However, if aggregate demand and aggregate supply are in equilibrium, excess supply or ex-

cess demand in some markets only requires adjustment to relative prices but no changes in the overall price level.

A competing view is that socialist economies are economies operating under chronic shortages (Kornai, 1980 and 1982) and that households accumulate monetary balances because they have a shortage of goods in which to spend their earnings. The shortage theorists point out that in socialist economies there are often large unofficial markets—free agricultural markets and black markets—where the household consumer can purchase goods unavailable at official rationed markets and can also substitute for the goods originally desired. Kornai (1980) mentions that shortages may lead to "forced spending" on other goods, particularly since goods also play a role as a store of value in the midst of shortages. It is also argued that in the presence of the chronic shortages, the households amass monetary balances as a precaution, artificially increasing their savings rate. The end result of the discussion between the two schools is that the size of the forced saving may overestimate the amount of genuine macroeconomic disequilibrium. More on this discussion is presented in later sections of this paper.

A BRIEF SYNOPSIS OF POST-1958 DEVELOPMENTS IN MONEY, PRICES AND EXCHANGE RATES

As a way of background into the subjects of money, prices and exchange rates in Cuba, a brief summary of developments and events in the post-1958 period are discussed next.

Created in 1948, the Banco Nacional de Cuba maintained, since its inception, a freely-convertible Cuban peso at par with the U.S. dollar. Prices were stable previous to the onset of the Revolution, growing at 1.9% annually from 1955 to 1958 according to the general price index compiled by the Banco Nacional de Cuba (1957-1958, p.198) and there were no undue pressures on the Cuban peso which remained at par with the dollar. However by the late fifties Cuba began to experience a deterioration in its balance of payment due to a boom in imported consumer durable goods that remained basically unchecked until the revolutionary government led by Fidel Castro took power by force of arms on January 1, 1959.

Almost from its beginning, the Castro government sought the monopoly of foreign exchange and trade. Once the government took over control of the economy, it increased the money supply and imposed foreign exchange controls. This led to the development of a black market for Cuban pesos as early as 1959. The controls enforced by the central bank consisted of declaring illegal for any citizen to own and trade gold and foreign currency and to have bank balances abroad. In addition, international trade of goods and services remained the exclusive domain of the government. By December 31, 1959, (Figure 1), the peso was trading at 1.67 per dollar in the black market[2] (Pick's, 1970). By March 1961, the year when the entire banking sector was nationalized without compensation, the gold reserves of the Banco Nacional were exhausted, and the value of the peso plunged to 6.25 per U.S. dollar in the black market. Since then the peso has become a non-convertible currency worldwide.

As the government applied its expansionary monetary policy, inflation and foreign exchange deterioration became apparent during the early years of the Revolution. The Cuban monetary mass, defined as comprising money in circulation plus bank deposits of both households and enterprises, grew from 1,342.7 million pesos in 1958 to 1,765.2 million pesos in 1960 (Grupo Cubano de Investigaciones Económicas, 1963). Using Dudley Seers' (Seers, Bianchi, Joy and Nolff, 1964) general price indexes, the price inflation rate was 3.5% in 1960 and 16.13% in 1961, that is, the previous record of price stability had been broken.

2. These black market rates for foreign exchange refer to trades and/or un-licensed transfers to international financial centers. They are generally higher than the black market rates for small volume transactions inside Cuba. See *Pick's Currency Yearbook* (1970) for explanations.

In August 1961 the Cuban government instituted a currency reform, issuing new bank notes which replaced all the previously-circulating paper money. Since the currency reform stipulated that no individual was allowed to exchange more than 200 pesos, it achieved a major reduction in circulation. In fact, the currency in circulation dropped from 1,045 million Cuban pesos in 1960 to 478 million pesos in 1961, while the peso appreciated in black markets to 5.0 pesos per dollar by September 1961. But soon afterwards the slide of the peso continued and by September 1962 the dollar traded at 11 pesos per U.S. dollar in the black markets for Cuban currency.

The aftermath of the Cuban missile crisis generated further transactions in the currency black markets, as the repatriated Soviet bloc technicians and armed forces exchanged pesos for dollars to take home under the very noses of the Cuban state security agents that would not arrest them for these otherwise illegal activities. In March 1963, the black market rates for the Cuban pesos reached 25.0 pesos per U.S. dollar and stayed at this rate for the rest of 1963. (Figure 1). By the end of 1964, the peso had appreciated slightly to 23.0 pesos per U.S. dollar and remained at 22.0 pesos per dollar up to the Spring of 1967. Currency in circulation during this period was 540 million pesos in 1964 (654 million pesos if currency, notes and savings deposits are included in the monetary mass) and 811 million pesos (including, currency, notes and savings deposits) in 1966 according to Rodríguez (1990).

By the end of 1967, black- and free-market transactions in Cuban pesos declined. The black market currency premiums declined sharply and the value of the peso appreciated to 8.0 pesos per dollar in December 1967, 5.0 pesos per dollar in December 1968 and 6.0 pesos per dollar in December 1969. The sources of these reduced levels of foreign exchange transactions, not exceeding a few thousand dollars per week, were Cuban delegates attending meetings abroad and Soviet bloc technicians and forces returning to Eastern Europe after the completion of their duties in Cuba. The population did not participate in these transactions since foreign currency trading was illegal. However, the economy also showed deterioration and exhaustion. This period coincided with the failure of the grand plan to produce ten million tons of sugar for the purpose of cornering the international sugar market. This event not only delivered the "coupe de grace" to the chosen economic model but depleted all available resources, forcing the leadership to publicly admit economic failure.

Cuba began in the mid-sixties to increase its outstanding debt and economic dependency on the Soviet Union. Mesa-Lago (1981) has reported that trade with the Soviet Union set a record in 1967 and trade deficits began to rapidly increase. By 1969 the trade deficit reached more than half billion pesos. Money in circulation began to increase, according to Pick's (1975), from 850 million pesos at the end of December 1968 to 3,478 million pesos (with savings deposits included) in 1971. By 1969, Cuba owed its trading partners close to 10.0 million tons of sugar. Therefore, the political leadership was caught confronting a serious economic deterioration resulting from a colossal "sugar" mistake, the exhaustion of the economic model and being politically at odds with the Soviet Union, as Cuba openly criticized the invasion of Czechoslovakia in the summer of 1968. As a result of the serious fracas with the Soviet leadership, oil shipments were halted beginning in 1968. However, as the Soviets began to reconsider the amount of economic assistance provided, the black market boomed in 1969-70 in response to the crisis. The peso/dollar black market exchange rate in December 1970 was 7.0 pesos per U.S. dollar and it kept climbing until September 1972 when it hit 10.15 pesos per dollar.

In order to positively respond to the economic crisis of the late sixties and earlier seventies, the leadership installed a new economic model suggested by the Soviet economic advisors. This model required a complete reorganization of the politico-economic relationships in the country. The new model known as the SDPE (Sistema de Dirección y Planificación Económica) was very similar to the Soviet centrally planned model known as "Calculi Económico". Cuba's SDPE model was implemented under the guidance of Humberto Pérez, the head of JUCEPLAN, the Central Planning Board. As the country em-

barked in a new experiment, expectations improved, economic activity revived and by 1972 money supply decreased to 2,648 million pesos. The black market exchange rate reflected the economic improvement, with the peso appreciating to 9.0 pesos per dollar by 1973 from its early trading of 10.15 pesos in September 1972. However, sugar did not recover as fast as others sectors and the country began to accumulate sugar deficits with the Soviet Union, made up by purchasing sugar in the world market (USIA, 1988).

Currency in circulation was estimated by Pick's (1975) at 850 million pesos at the end of December 1968, growing to 3.478 billion pesos (with households savings deposits included) in 1971 and then falling to 2.648 billion pesos in 1972. In 1974 the Banco Nacional's gold reserves were close to US$ 474.0 million, an increase of 127% over 1973, in great part due to increases in short-term debt with overseas creditors. Early in 1973, the U.S. dollar suffered a 10.0 percent devaluation and, as a consequence, the Cuban peso appreciated to 9.0 pesos per dollar in the black market.

There were irregular variations in the black market value of the peso in 1974 and 1975, but by early 1976 the dollar traded at 8.45 pesos per U.S. dollar. Black market transactions were still small in volume, seldom exceeding a few hundreds pesos per week and still involved mostly Soviet bloc personnel.

In addition to the implementation of the new economic model and the resumption of Soviet aid, several events during the early seventies affected Cuba's international financial transactions. Among those were:

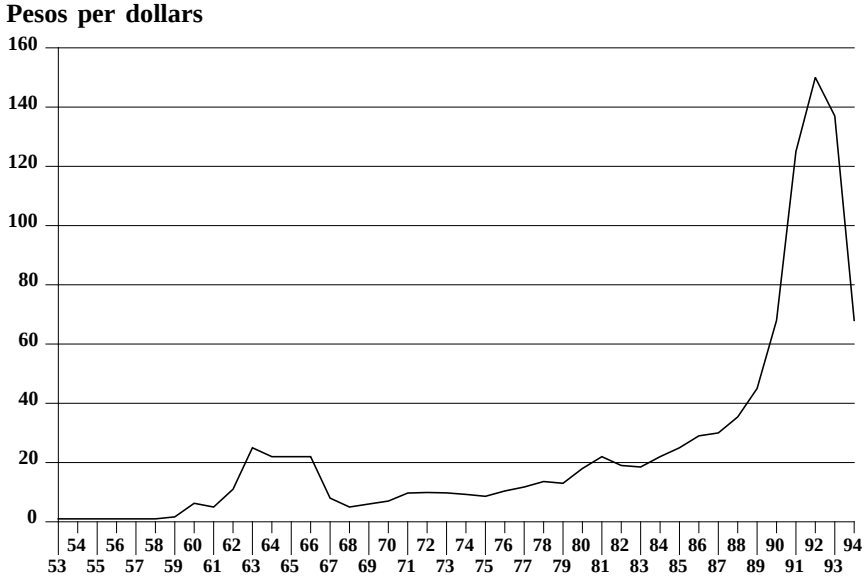
1. the floating of the U.S. dollar in August 1971, and its devaluation in December 1971, which lead to a slight appreciation of the peso,

2. the 10.0 percent further devaluation of the U.S. dollar on February 13, 1973,

3. the increased indebtedness of Cuba, via short term loans and trade credits, with hard currency countries, mostly West Germany and other western European countries and

4. the rise in sugar prices from U.S. $0.03 / lb. at the end of 1968 to U.S. $0.09/ lb. at the end of 1972, to U.S. $0.63 / lb. in November 1974, only to descend to U.S. $0.27 / lb. in early 1975.

Figure 1. Cuba: Free market foreign exchange rate



Source: Pick's Currency Yearbook

However, as was the case of 1963-64 and later in 1980-81, these increases in sugar prices contributed to the worsening of the balance of payments deficits and to the growth of short-term foreign debt.

The sugar price decline in 1977 to U.S. $0.05 / lb. reduced foreign trade in hard currency, forcing Cuba to borrow in the international market. By 1977 the country's hard currency debt with the West had grown to US $1.4 billion dollars; its servicing of U.S. $400.0 million annually comprised 44.0 percent of Cuba's hard currency export earnings. The debt was the result of short term borrowing during the early-and mid-seventies (Table 1). In addition, Soviet debt and trade credits began to increase. As a result of the borrowing and increase in economic activity, bank notes in circulation increased 202.0 percent in 1977 and the value of the Cuban peso deteriorated in the black market to 11.74 pesos per dollar. By September of 1979, it had achieved a low of 15.0 pesos per U.S. dollar.

Cuba's outstanding debt has three principal components: 1) development assistance and credits in convertible currency and transferable rubles from the Soviet Union, 2) trade credits from Eastern Europe, the former CMEA (Council of Mutual Economic Assistance) countries, and 3) credits from the West in convertible currency. From 1960 to 1975, the Cuban debt to the Soviet Union was mostly the result of development assistance and trade financing, as was the debt with the rest of the CMEA countries. Cuba's debt to the Soviet Union exceeded U.S. $5,000 million in 1976 (Mesa-Lago, 1981). In the meantime, the convertible currency debt with capitalist countries began to rise in the mid-seventies and continued growing until 1986. Convertible currency debt grew from 1975 to 1986, as shown in Table 1, and was mostly used for purchasing capital equipment and intermediate goods. This debt exceeded $4,900.0 million of U.S. dollars in 1986. In addition, Soviet debt during this period exceeded 20.0 billion transferable rubles as a result of trade subsidies and credits, including oil sales on the Soviet account for convertible currency (Rodríguez, 1992). However, faced with the impossibility of repaying the hard currency debt, in September 1982 Cuba halted payments, declaring a moratorium. In May 1982 the dollar sold at 23.50 pesos per dollar in the Cuban black markets and continued to lose in value during the eighties in spite of the flow of foreign tourists into Cuba; by December 1989 the dollar traded at 45.0 pesos per dollar. The risk associated with Cuban loans although high was not exorbitant. In 1983 Cuba was borrowing at LIBOR + 2.25% rates from European and central banks, rates which declined to LIBOR + 1.88% in 1984, and to LIBOR + 1.50% in 1985 according to José Luis Rodríguez (1990). These rates pale in comparison to the current 1995 LIBOR + 8% rate charged Cuba by the Dutch "ING Bank" to finance the purchase of inputs for the 1995-96 sugar harvest.

A word is in order about the behavior of black market prices in Cuba during the eighties. A price index of black and parallel market prices (using 1980 commodity basket weights) revealed only slight inflationary pressures during this decade. The black market price index P_{89} = 100.00, behaved as follows: P_{80} = 90.31, P_{83} = 91.15, P_{85} = 90.98, P_{86} = 89.98, P_{87} = 100.09 and P_{88} = 97.55; that is, a growth of only 10% during a ten-year period. These low price inflation rates were the result of large increases in the supply of goods through the massive Soviet foreign aid program and the government fiscal discipline during this period. While no budgetary information has been published for the pre-1978 period, the data published since reveals that government deficits never exceeded 2% of GDP from 1978 to 1986. By 1988, the government fiscal discipline had begun to wane, with budget deficits (including public enterprise deficits) rising to 6% of GDP in 1988 and to 7.2 % of GDP in 1989. The result of this fiscal constraint and massive foreign subsidies was a remarkable price stability up to 1989.

The decline in trade subsidies and foreign aid from the former USSR and the socialist bloc resulted in a major drop in Cuba's ability to import the raw materials, oil, and machinery needed to run its economy, and as a consequence Cuba's gross domestic product (GDP), measured in current pesos, dropped 48.28% from 1989 to 1993 (Table 2). With the Cuban government's precipitous announcement of a 0.7% re-

covery in 1994, GDP declined 47.92% from 1989 to 1994. These declines measured in current pesos pale when compared with the declines in constant pesos, considering that by 1993 the index of black market prices had increased by a multiple of 15.5 times compared to the 1989 black market price levels. As the Cuban economy plunged, tax revenues decreased appreciably and the government was unable to hold on to its precarious fiscal discipline. The government deficit rosed to 26.33% of GDP in 1991, to 39.72% of GDP in 1992 and peaked at 50.50% of GDP in 1993. The liquid assets owned by households grew both as the result of the increased government deficit and as a consequence of the drop in the available supply of goods (both domestic and foreign). Liquidity, comprising currency in circulation and household saving deposits, which in 1989 stood at 21.5% of GDP, grew to 49.8% of GDP in 1991, to 69.5% of GDP in 1992 and actually outstripping GDP, to 120.0% of GDP in 1993. The net result of the lack of fiscal discipline and the drop in supply was the significant inflationary precess that Cuba is still trying to control today.

The end of Soviet foreign aid to Cuba after 1990 accelerated the deterioration in the value of the peso, which successively dropped to 68.0 pesos per dollar in December 1990, to 125.0 pesos per dollar in December 1991, and to 165.0 pesos per dollar in June 1993. On 13 August 1993, the government enacted Law Decree 140 decriminalizing the use of foreign currency by citizens to conduct domestic transactions. The passage of this law signals the end of currency transaction controls. But, controls remain imposed in international trade and buying and selling of gold. In July 1993, the Cuban government estimated that US $200.0 millon were circulating in Cuba (Fogel and Rosenthal, 1994). José L. Rodríguez confirmed this high rate of dollar holdings in Cuba (*Cuba-Business,* Jan/Feb. 1995), stating that 21.0 percent of cuban households admitted having access to U.S. currency.)

A few weeks later, in September 1993, the Cuban government legalized self-employment (trabajo por cuenta propia) for selected categories of employment. In August 1994, the government announced a series of stabilization measures to reduce the excess demand in the economy. These stabilization measures included some increases in taxes and user fees, as well as reductions in the deficits of state enterprises. In August 1994, the U.S. government prohibited the sending of remittances in dollars to the Cuban relatives of U.S. residents. The combined result of the Cuban government stabilization policies has been to reduce the government deficit, thereby dampening price inflation and improving the value of the Cuban peso in black market transactions. Thus, the value of the peso appreciated to 137.0 pesos per dollar in December 1993 and to 68.0 pesos per dollar in December 1994. By January 1995, the dollar sold for 66.0 pesos in Cuban black markets.

Commodity prices in black markets exhibited similar behavior. By 1990 black market prices were still stable enough, only 2.4% above 1989. But the end of foreign aid and trade subsidies from Russia and the loss of fiscal discipline (noted above) had a dramatic adverse effect on increasing demand while decreasing the supply of goods and services, and as a result, prices began to grow appreciably in black markets. The black market price index $P_{89} = 100.00$ rose as follows: $P_{90} = 102.43$, $P_{91} = 263.43$, $P_{92} = 509.84$, $P_{93} = 1552.54$, $P_{94} = 1396.48$.[3] Black market prices probably peaked in September 1994 and have been diminishing since as a consequence of the Cuban government stabilization policies (Figure 2). On October 1, 1994, the Cuban government authorized the re-opening of free farmers markets, which had been closed since the mid-eighties, and whose opening provided a legal outlet for purchasing goods not available in the rationing cards. By the end of 1994, Cuba's stabilization policies had reduced the budget deficit to 14.0% of GDP, while a combination of increased taxes on liquor and tobacco, higher rents and

3. These prices indexes are slightly larger than the un-weighted indexes presented by Mirta Rodríguez Calderón in *Bohemia.* (1993). Rodríguez Calderón's indexes add individual commodity prices without any commodity basket weights.

Table 1. Cuba: Outstanding convertible currency debt - selected years 1969-1994
In million of dollars

Year	Total debt	Official bilateral	Official multilateral	Suppliers	Financial institutions	Other credits
1969	291.0	n/a	n/a	n/a	n/a	n/a
1975	1338.0	n/a	n/a	n/a	n/a	n/a
1978	2883.8	n/a	n/a	n/a	n/a	n/a
1979	3267.3	n/a	n/a	n/a	n/a	n/a
1980	3226.8	1353.6	7.9	27.0	1837.1	1.2
1981	3169.6	1293.7	15.2	33.4	1334.9	0.9
1982	2668.7	1275.8	18.2	46.8	1327.3	0.7
1983	2789.7	1332.5	25.0	96.7	1334.9	0.7
1984	2988.8	1578.7	17.2	228.5	1164.2	0.2
1985	3621.0	1820.4	21.5	433.2	1345.7	0.2
1986	4985.2	2082.1	23.3	1129.1	1750.5	0.2
1987	6094.3	2656.9	23.2	1365.9	2048.1	0.2
1988	6605.5	2905.5	47.5	1496.7	2108.7	47.1
1989	6165.2	2817.4	60.7	1408.0	1837.0	42.1
1990	6686.6	n/a	n/a	n/a	n/a	n/a
1991	n/a	n/a	n/a	n/a	n/a	n/a
1992	6377.0	2914.0	n/a	1338.0	2125.0	n/a
1993	8784.7	4046.8	438.3	1867.1	2405.5	27.0
1994	9082.8	3991.7	502.5	2057.8	2501.4	29.4

Sources*:* For years 1969, 1975 and 1980 to 1992 see: José Luis Rodríguez, "La Deuda Externa Cubana: Una Evaluación Actual (II), *Boletín de Información Sobre Economía Cubana*, Centro de Investigación de la Economía Mundial (CIEM), Vol.1, No. 11/12, Noviembre/Diciembre, 1992, p.8. and for other years A.R.M. Ritter, "Cuba's convertible currency debt problem," *Cepal Review* No. 36, December, 1988, p.120. and for 1993 and 1994, Banco Nacional de Cuba (August 1995).

uses charges and higher prices in the black markets, also contributed to decrease household liquidity to 97.3% of GDP. The consequence of these policies was to reduce the rate of inflation, while the Cuban peso appreciated in black markets in the island and abroad. Based on newspaper articles in *The Washington Post* and in *The Miami Herald,* and on information provided by the Instituto Cubano de Economistas Independientes (1996), we have estimated that black market prices fell to P_{95} = 1282.55 by March 1995 and P_{95} = 739.64 by December 1995. These price indexes indicate that the Cuban population is now paying a multiple of 7.4 times the 1989 level of commodity prices with no comparable adjustment in wages and salaries.

The task at hand is to develop predictive relationships that explain these financial results and events in Cuban black markets.

MARKETS IN SOCIALIST CUBA

There are at least four types of markets in socialist Cuba: 1) government-run official rationed markets, 2) government-run parallel market stores, 3) free

Table 2. Cuba: selected macroeconomic indicators 1989-1994
(All figures in millions of current pesos, unless otherwise specified)

Year	Gross Domestic Product	Executed Government Deficit	Liquidity	Black market Price Index	Black Market Foreign Exchange Rate (Pesos/Dollar)
1989	19335	1403.4	4163	100.00	45
1990	18735	1958.1	4986	102.43	68
1991	14051	3764.8	6663	263.43	125
1992	12084	4869.0	8361	509.84	150
1993	10000	5050.6	11043	1552.55	137
1994	10070	1421.4	9940	1396.48	68

Note*:* Black market foreign exchange rate as of December 31st of each year. Liquidity includes currency in circulation plus household saving deposits.

Source*:* Appendix A and Banco Nacional de Cuba (August 1995).

farmers' and artisan markets, and 4) the unofficial black markets that have always existed in Cuba irrespective of repression and coercion by the Cuban Government. A brief discussion of these markets is in order before getting immersed with the formulation of the economic model.

In response to shortages and inflationary pressures in the early years of the Revolution, food rationing was introduced in Cuba in 1962. The introduction of rationing in effect created two markets in Cuba: the official rationed market and the ever- present black market. Dumont (1971) compared official rationed and free black market prices in 1969, confirming the strength of the black markets in spite of all of the government efforts to suppress them. To minimize the importance of the black markets, the government created a state-controlled parallel market in the seventies which charged prices more attuned to production costs and supply/demand conditions. By 1977-78, the prices charged at parallel market stores were three to eight times greater than the official rationed and subsidized prices (Mesa-Lago, 1981)

The State-owned parallel market stores assisted in soaking up the excess liquidity resulting from expansionary monetary policies, but did not displace the black markets altogether. Because of problems of poor work quality and absenteeism, deemed by government authorities as related to the lack of outlets for spending the excess liquid assets accumulated by the households, a decision was taken by the government to open free farmers' markets in April 1980. According to Deere and Meurs (1992), more than 200 free farmers' markets were operating across the island in 1981, resulting in significant increases in the supply of agricultural products.

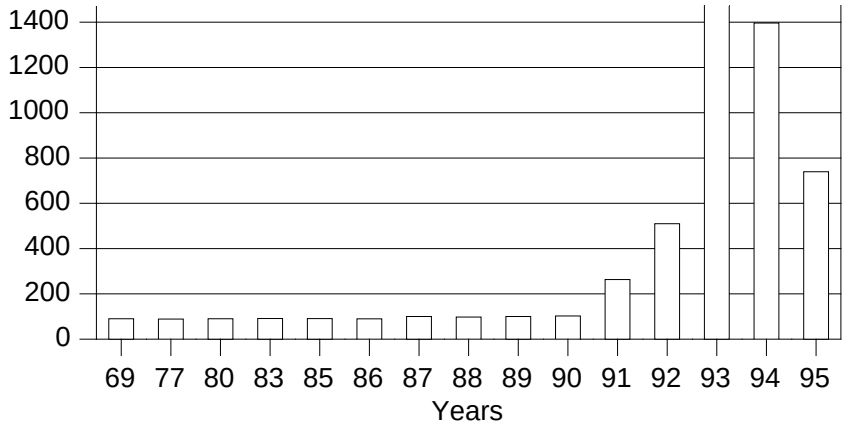
The free farmers' markets of the early eighties were opened as a result of an increasing consumer demand for better quality and more abundant agricultural produce and goods. The consumer had accumulated excess liquidity as a result of the government inability to provide sufficient goods. Therefore, to alleviate the shortage of supplies and to increase production, the government authorized the farmers' markets to begin functioning. The farmers' markets charged prices which sometimes were above or similar to the parallel market prices. The results were an increase in supplies which benefitted consumers and producers. However, producers and other market operators began to accumulate earnings which created income in-

equalities and the government disliked those results. The income inequalities created favored mostly the small farmers and other operators, but that was not to be tolerated. By 1982, complaints arose and Fidel Castro and other leaders began to criticize the operations of the farmers' market. In addition, regulations were enacted to tightly control market operations. Among those regulations were: a tax increase on sales, documentary evidence to prove compliance with "acopio" and limiting access to ANAP members, excluding the cooperatives. By the middle of 1982, the end of he free farmers' markets was evident. The government was no longer in favor of the experiment. In May of 1986, the free farmers' market were closed, supposedly because of many complaints by ordinary consumers who had limited access to the market, but also because basically the State could no longer sustain competition, not wanting to allow prices to fluctuate and not letting the market determine agricultural production without state interference.

After the end of the free farmers' market experiment, the black markets for agricultural produce and other scarce goods continued to exist and became the only source of additional agricultural produce and other supplies for the consumer. Soon, the Socialist Bloc (CMEA) ceased to exist. By November 1989, the countries of Eastern Europe became politically- and economically-free and after their liberation all economic assistance to Cuba ceased. Only Russia continued to fulfill the previously promised assistance. Supplies after 1991 became scarce, as the ration card no longer could provide a minimal quantity of necessity items. Consequently, the black markets grew in importance. Economic activity declined dramatically in a short period of time and shortages of all sorts of goods became apparent. Supplies were difficult to obtain for the average citizen. Prices in the black market suddenly increased to unprecedented high levels while wages did not keep pace with inflation. Inflation became a reality in socialist Cuba and real income has severely declined.

In the meantime, the leadership had to confront problems of several dimensions. It had to control the budget and the excess liquidity, it needed to reduce the size of the employed labor force and increase production and productivity to curtail the free fall in economic activity. In order to address the difficult economic situation, respond to the supply difficulties and the excessive amount of money in the hands of

Figure 2. Cuba: Black Market Price Index



Source: Appendix A

the consumer, the government introduced new taxes and authorized the re-enactment of a free farmers' and other markets which included other type of stores such as hardware, artisans and special stores known as "shoppins" which only operated with convertible currency and sold specialized goods.

The new farmers' and other markets introduced in October 1994, were created to achieve a multitude of political-economic goals and participation is more open than in the previous market. It now includes the UBPC (Unidades Básicas de Producción), the Army cooperatives and anyone in the private agricultural sector. The functioning of the market is controlled by the central government and the local governments and is restricted to sales in domestic currency only. Among those economic goals are: a) to reduce money in the hand of the consumer, b) to increase budget revenues, c) to increase production and productivity, and d) to make an attempt to introduce private property rights. However, in order to achieve the desired goals, participants must provide goods at reasonable prices. Until now few of those necessary conditions have been attained and these markets can only be qualified as a partial success. In the meantime, the black market still operates and attracts people engaged in prohibited commercial activities or farmers/operators who seek dollars for their produce rather than domestic currency. In addition the black market is an outlet to obtain goods not available in the special government stores such as the "shoppins"or any other official outlets.

There is a wide discrepancy in the estimates of the relative shares of the official rationed, parallel and free farmers' markets in the Cuban economy. Deere and Meurs (1992) quote Eugenio Rodríguez Balari's (then Director of the Instituto de Estudios de la Demanda) estimates that by 1980 the parallel market accounted for 70% of all expenditures in consumer goods and that free farmers' markets accounted for the following shares of expenditures in food: 1980: 8.8%, 1981: 9.8%, 1982: 6.2%, 1983: 2.9%, 1984: 3.9% and 1985: 3.4%.

These shares are different than those from other sources. The United Nations' Economic Commission for Latin America and the Caribbean (1984, pp. 248) published the following shares of total consumer expenditures for 1983 and 1984: for free farmers' markets: 1983: 1.0% and 1984: 1.3%; for parallel markets: 1983: 54.5% and 1984: 58.7% and for the official rationed market: 1983: 44.5% and 1984: 40.0%.

Finally the 1988 *Anuario Estadístico de Cuba* (Tables X.18 through X.20) presents another different set of market shares for the government-run parallel market stores. The shares of total retail sales reported by the Comité Estatal de Estadísticas in the above referenced publication are: 1982: 1.1%, 1983: 10.3%, 1984: 14.0%, 1985: 15.2%, 1986: 15.4%, 1987: 15.6% and 1988: 16.0%. The *Anuario Estadístico* also reports different figures for food retail sales, but these are not presented here since there is no need to over-stress the point.

This wide discrepancy in the shares of the three types of markets affected the research design. It was decided not to attempt to develop a general consumer price index of the Cuban economy (combining official rationed, parallel and free farmers' markets), but instead to concentrate solely on the black market prices which now dominate the Cuban scene in 1995. As a result the authors decided to use the official GDP deflators for the Pre-1989 period, but to use black market price indexes after 1989. The development of the black market price indexes is explained in Appendix A.

A REVIEW OF THE LITERATURE ON THEORIES AND APPROACHES TO EXCHANGE RATE DETERMINATION

Before immersing ourselves in the details of specifying the first approximation model, a short review and background on the theories of exchange rate determination is in order. The old traditional view of exchange rate determination is that exchange rates equilibrate the international demand for flow of goods. This view was reflected in the classic Biderdicke-Robinson-Metzler model (Krueger, 1983), according to which the exchange rate is determined by the flow of supply and demand for foreign exchange.

Closely related to the traditional view is the purchasing power parity theory of exchange rate determina-

tion, which in its absolute version states that the equilibrium exchange rate equals the ratio of domestic to foreign prices. The more reasonable relative version of the purchasing power parity theory states that exchange rates are simply related to changes in the price ratios. We dispense here with all the arguments on which foreign price index to use, foreign consumer prices vs. foreign wholesale prices vs. foreign GNP price deflators (Frenkel, 1976).

A third viewpoint on exchange rate determination is the monetary asset view (Dornbusch, 1976), in which monetary factors predominate. According to this theory, exchange rates are determined as the result of balancing portfolios of domestic and foreign currency so as to equilibrate the rates of return on holdings of foreign and domestic currency. Exchange rates thus equilibrate the international demand for stocks of assets. The real rate of return on assets, so claims this theory, will be equal and independent of the currency denomination of the assets. This postulate is referred to as the interest rate parity, and in its simplest formulation argues that interest rate differentials are paramount in the determination of exchange rates. In these portfolio models the nominal rate of interest will be equal to the real rate of interest plus the expected rate of inflation, a proposition that will lead us later to the last theory of exchange rate determination, which depends on expectations of rates of return on domestic and foreign assets.

Within the monetary asset theory of exchange rate determination there are two variants depending on the degree of price and wage flexibility of the economy. When prices are flexible, there is a positive relationship between nominal interest rates and exchange rates, since when domestic interest rates rise relative to foreign rates, it is due to the fact that the domestic currency is expected to lose value through inflation and depreciation. In these conditions of price flexibility, the demand for domestic currency falls relative to foreign currency, which causes it to depreciate instantly. This view appears to be valid when inflation differentials are large, as in the German hyperinflation of the twenties.

When prices and wages are sticky, a negative relation emerges between nominal interest rate differentials and exchange rates. This result comes about because under sticky prices and wages, changes in nominal interest rates no longer reflect changes in the expected inflation rate, but instead reflect changes in the tightness of monetary policy. Thus, when domestic interest rates rise relatively to foreign rates, it is due to a contraction in domestic supply without a matching fall in prices, with these higher domestic interest rates attracting capital inflows which cause the domestic currency to appreciate. This variation is applicable to scenarios where inflation differentials are small.

The final view of exchange rate determination takes into account the special role of expectations (Frankel, 1979), where demand for domestic and foreign money depend—like the demand for any other asset—on the expected rates of return. Thus, current values of exchange rates incorporate market expectations concerning the future course of events. A modern variation of this viewpoint is the rational expectations theory (Bilson, 1978), in which market price and exchange rate expectations will be equal to the actual predictions of the underlying models being estimated.

The applicability of all these theories to the Cuban situation is analyzed below. However, at the outset the peculiarities of the Cuban scenario must be recognized. Prices, wages, domestic interest rates and official exchange rates have remained fixed in Cuba for long periods of time. Until July 26, 1993 it was illegal for Cuban citizens to hold foreign currency and the citizens have remained barred from participating in international trade transactions up to this point. The presence of exchange controls and exchange restrictions has led to the development of black markets for foreign money and for the sale of goods and commodities at prices different than the subsidized rationed market. The exchange rate and the commodity prices in the black market are freely determined by market forces and respond to disequilibria in the domestic money market and to changes in the supply of goods throughout the economy. Since official exchange rates are administratively determined by the government, the differential between the official rate and the black market rate provides an incen-

tive for the additional inflow of dollars into the black market. Because of the stickiness of prices and wages in Cuba, black market exchange rates have no effect on domestic interest rates, nor on the official exchange rates.

Since the stock of U.S. dollars held by Cuban households is large, with 21% of Cuban households having access to U.S. dollars (see José Luis Rodríguez, *Cuba Business*, January-February 1995), the analysis of black markets for foreign exchange in Cuba can proceed in the fashion of a dual exchange rate market with elements of currency substitution and portfolio diversification between domestic and foreign currencies. However, one of the key differences between the dual exchange model with portfolio and currency substitution elements (Lizondo, 1987 and Calvo and Rodríguez, 1977) and the Cuban scenario is that foreign currency in Cuba is used for purchasing goods and services in black markets as well as for capital-type transactions, and thus the first approximation model specified in this paper must include a proviso that covers current account transactions in the black markets.

THE MACROECONOMIC MODEL

This section formulates a macroeconomic model that traces the short-term interactions between government monetary policies and black markets for prices and exchange rates in Cuba. The macroeconomic model incorporates elements of all the theories of exchange rate determination but relies, to some extent, on purchasing power parity, currency substitution and forward-looking rational expectations concepts.

The inclusion of expectation variables in the macroeconomic model translates into the assumption that the results of government stabilization policies have an impact beyond the quantitative magnitudes of the policies announced. The macroeconomic model follows the "monetary approach to the balance of payments" (Polak, 1957 and IMF, 1977) in the sense that excess money supply plays a key factor in determining black market prices and exchange rates. Unfortunately, the lack of comprehensive definitions of the Cuban monetary mass by the Cuban authorities and the lack of published data on the components of the monetary mass do not allow us to trace all the interrelationships between the excess money supply and output.

The macroeconomic model contains several component modules, namely: output and supply, balance of payments, liquidity, prices and foreign exchange rates. Each of these modules is discussed next.

OUTPUT AND SUPPLY MODULE

The output module begins with a variation of the production function estimated earlier by the authors (Alonso and Lago, 1994). The new production function estimated in this paper explicitly recognizes the significant role played by the Cuban balance of payment crisis in lowering output. Thus, apart from the usual labor and capital variables, we include two new explanatory variables: the addition of fuel and intermediate imports as one variable, and food and consumer goods imports as a second variable. Imports of fuel, raw materials and intermediate products have a direct effect on output, since factories and farms cannot be operated efficiently without raw materials, fertilizers and insecticides and fuel. Imports of food have a less direct effect on output, since they affect the labor supply and labor productivity through absenteeism and shoddy work quality. The new production/output function to be estimated is of the type:

$$(1a)\ Y_t = A_0\, K^{\alpha}_t\, LABOR^{1-\alpha}_t\, IMFOOD_t\, (IMOIL_t + IMINT_t)^{\Gamma}$$

where:

Y_t =	real gross domestic product in constant pesos in year t.
K_t =	stock of real capital, inconstant pesos during year t.
$LABOR_t$ =	labor employed in year t.
$IMFOOD_t$ =	food imports in constant pesos in year t.
$IMOIL_t$ =	oil imports in constant pesos in year t.
$IMINT_t$ =	imports of raw materials and intermediate products in constant pesos in year t.
A_0 =	costant (intercept) to be estimated.
α, β, Γ	represent output elasticities to be estimated

An aggregate demand model, adapted from Khan and Knight (1981),will also be researched to estimate the change in gross domestic product [Δ (Y_t)] as function of changes in household liquidity balances [$\Delta(L_t)$], lagged values of capacity utilization (CAPUTILt-1), exports (X_t), gross investments (I_t), and changes in the import variables noted above. This formulation is expressed in equation (1b), presented next:

$$(1b)\ \Delta(Y_t) = f_{01b}\ [\Delta(L_t), CAPUTIL_{t-1}, \Delta(IMOIL_t + IMINT_t), \Delta(X_t), I_t]$$

where$\Delta(Y_t$) denotes the change in output, IM-$MACH_t$ represents machinery and equipment imports and f_{01b} represents the aggregate income function to be estimated. The employment level is estimated through the substitution of equation (1b) into equation (1a). The capital stock is estimated from:

$$(1c)\ K_t = K_{t-1} + I_t - D_t ,$$

where:

I_t = investments in constant pesos during year t.

D_t = depreciation charges in constant pesos during year t (default value = 2% of capital stock).

The annual flows of investments are estimated as function of machinery imports, the terms of trade, and accelerator variables (Alonso & Lago, 1994) in the following manner:

$$(1d)\ I_t = f_{01d}\ [\Delta\ (Y_{t-1}) , IMMACH_t , (PSUGAR_t /POIL_t)]$$

where $POIL_t$ represents the price per ton of Cuban oil imports, $PSUGAR_t$ denotes the price per ton of Cuban sugar exports, and f_{01d} represents the investment equation to be estimated.

Both total exports and total imports contain components in transferable rubles and in convertible currencies. Imports in convertible currencies are considered endogenous, whereas all the exports and the imports in transferable rubles are considered exogenous. The following definitions apply:

$$(1e)\ X_t = X^c_t + X^r_t$$

$$(1f)\ IM_t = IM^c_t + IM^r_t$$

where X_t and IM_t represent total exports and total imports respectively, while the superscript **c** denotes transactions in convertible currencies and the superscript **r** denotes transactions in transferable rubles.

Because of the role that aggregate supply plays in the determination of prices and liquidity in Cuba, we define two supply variables to be tested in the macroeconomic model, namely: 1) absorption, which was used by Lipschitz (1984) in the analysis of demand for money and price inflation in Korea and 2) marketed supply, used by Sundarajan (1984) in the analysis of money and prices in India.

$$(2)\ ABS_t = Y_t + IM_t - X_t$$

$$(3)\ SU_t = Y_t + IM_t$$

where:

ABS_t = absorption, measured in constant pesos during year t.

SU_t = aggregate supply of goods and services, measured in constant pesos during year t.

IM_t = total imports in constant pesos during year t.

X_t = total exports in constant pesos during year t.

Exports (X_t) are assumed exogenous to the Cuban economy in this first approximation, whereas imports in convertible currency (IM^c_t) are deemed endogenous and their estimation explained in the balance of payments module presented next.

Balance of Payments Module

The balance of payment module covers international transactions and estimates the volume of imports and their composition, and the changes in foreign reserves. The first start is the import equation specified through the following identity:

$$(4)\ IM_t = X_t + F_t + \Delta(R_t)$$

where:

F_t = net foreign capital flows in constant pesos during year t.

$\Delta (R_t)$ = net change in international foreign reserves, in constant pesos during year t,

and all the other variables as specified above in equation (2).

The net foreign capital flows (F_t) are deemed exogenous in the model, but the annual change in international foreign reserves in convertible currencies$\Delta(R^c_t)$ are considered endogenous. Ordinarily, a monetary approach to the balance of payments (Khan and Knight, 1981) would estimate equations where changes in foreign reserves would be estimated as functions of gross domestic product, exchange rates, lagged real money supply, current and lagged price indexes, expected price inflation and balance of payment deficits among other variables. Similarly, Ottani and Sassanpour (1988) estimate changes in foreign reserves as function of domestic assets of the banking system, lagged foreign reserves, interest rates, lagged money supply and gross domestic product. But these free-market specifications do not fit the Cuban case. In Cuba, imports and changes in foreign reserves are determined through administered allocation methods by the Cuban authorities, mostly JUCEPLAN and the Banco Nacional, so that the conventional monetary variables do not play a part in the Cuban exchange control system.

Because of the existence of foreign exchange controls in Cuba, a different specification must be chosen. Lipschitz (1984) presents an interesting formulation where desired reserves are calculated as the product of average reserves to import ratios times peak imports divided by import prices. But even this formulation fails in Cuba, where imports have currently dwindled to one quarter of their peak 1989 values. As a consequence we specify a foreign reserve equation where changes in foreign reserves are estimated as function of lagged values of foreign reserves, current values of exports and foreign capital flows, lagged ratios of foreign reserves to imports, lagged money supplied, terms of trade and overseas interest rates. The equation to be estimated, which is specified next, is close to the foreign exchange control allocation equation specified and estimated by Hemphill (1974). The proposed equation is:

$$(5)\ \Delta(R^c_t) = f_{05}\,[\,R^c_{t-1}, X^c_t, L_{t-1}, F_t, (R^c_{t-1} / IM^c_{t-1}), oi_t, (PSUGAR_t / POIL_t)]$$

where:

$\Delta(R^c_t)$ = First difference of series of international foreign reserves in convertible currencies, in constant pesos.

R^c_{t-1} = level of international foreign reserves in convertible currency, in constant pesos, during year t-1.

L_{t-1} = lagged household liquidity

oi_t = overseas interest rates during year t, and

f_{05} represents the function that needs to be estimated, while the superscript **c** denotes transactions in convertible currency.

To complete the balance of payments module all that remains is to estimate the imports of food, oil and intermediate products, and the imports of machinery. The import components are estimated via the following equations that specify ratchet effects:

$$(6)\ IMFOOD_t / IM_t = f_{06}\,(IM_t, IM_t / IM_{peak})$$

$$(7)\ IMMACH_t / IM_t = f_{07}\,(IM_t, IM_t / IM_{peak})$$

where $IMMACH_t$ represents the imports of machinery and equipment (in constant pesos) during year t, while the subscript peak denotes the peak year value of the subscripted variable during the years on or previous to the observation year. Functions f_{06} and f_{07} are to be estimated later. The imports of oil, raw materials, chemicals and intermediate products are estimated as residuals in the following expression:

$$(8)\ (IMOIL_t + IMINT_t) / IM_t = 1 - [\,(IMFOOD_t / IM_t) + (IMMACH_t / IM_t)],$$

where all the variables have been defined earlier.

The import components are estimated as having ratchet effects, that is, the adjustment paths of the import components are different when the economy is growing than when it is contracting; this is accomplished through the use of the variable "peak year" values of imports.

Liquidity Module

This section begins by reiterating the discussion on the unavailability of estimates of the monetary mass in Cuba. Thus, the usual definition of "broad" money as in equation (9) cannot be estimated except for a

handful of years. This broad money supply definition is given by:

$$(9)\ \Delta(M_t) = GDEF_t + \Delta(ENTCRED_t) + \Delta(HHCRED_t) + \Delta(PRIVCRED_t) + \Delta(R_t)$$

where the increases in broad money $\Delta(M_t)$ are the results of adding the strictly-government budget deficit ($GDEF_t$) to changes in government enterprise credits $\Delta(ENTCRED_t)$, plus changes in household credits $\Delta(HHCRED_t)$, plus changes in credits to private farmers $\Delta(PRIVCRED_t)$, plus changes in foreign reserves $\Delta(R_t)$. Only data on the government deficits are available regularly. The losses of the government enterprise sector are included in the government deficit, but since 1989 have not been published. The data on enterprise credits, household credits and credits to the small private sector are available only for a handful of years in the mid-eighties. Thus, it is virtually impossible to estimate the broad money definition presented in equation (9).

The only recourse we have left is to estimate the liquidity of the household sector, the so-called balance of income and expenditures of the population, which has been estimated using statistical methods by several Cuban researchers (Espinosa and Quintana, 1989; and Martínez Fagundo, 1989, among others). According to the monetary definitions used in Cuba, the annual net result of the balance is equal to the changes in currency in circulation and household bank deposits at the Banco Popular de Ahorros during the year in question. The Cuban models of the balance of incomes and expenditures of the population include several sources of income and expenditures and are estimated with pre-1989 data. However, these models estimated in Cuba are not structural in any sense of the word. They have jointly-dependent variables as explanatory variables and contain a mish-mash of variables included for the sake of high correlations. To complicate the matter, the Cuban government has not released any data on components of the balance of incomes and expenditures of the population since 1989. After 1989, the Cuban government has only published the net results of the balance of income and expenditures of the population and not its components. Because of these monetary data limitations, we turn our attention to the estimation of changes in household liquidity, that is, the changes in the balance of income and expenditures of the population (or the sum of changes in money in circulation held by households and household saving bank deposits).

Changes in household liquidity in socialist economies have been researched by several authors. Cottarelli and Blejer (1992) studied changes in the balance of expenditures (household consumption) which were estimated as functions of the rate of growth of output, the difference between domestic interest rates and inflation rates (as proxy for the opportunity costs of holding money balances), dependency ratios (defined in terms of the proportions of pensioners and children under 16 years old), ratios of black market prices to rationed prices, lagged values of household liquid assets, lagged values of household wealth (including housing) and benefit ratios (defined as the ratio of wages to the social payments paid to non-workers). In his analysis of household's demand for money in Poland, Lane (1992) used the following explanatory variables: the expected rate of inflation, the expected changes in consumption lagged one-year, the percent changes in official prices and black market prices and lagged values of liquid assets. Another pertinent study is one by Charemza and Ghatak (1990) on the demand for money in Hungary and Poland, in which changes in real per capita household liquidity are estimated as function of changes in real income, differences between interest rates and expected inflation rates and ratios of consumption and of private investments to national income. What is important from these earlier studies is their use of portfolio concepts (i.e, the opportunity costs of holding money), black market prices and of price expectations in affecting the demand for money. Another further comment is their lack of inclusion of shortage concepts, such as Sundararajan's (1986) use of marketed output and Lipschitz' (1984) use of an absorption variable, to reflect the effect of shortages on the household demand for money.

We now turn our attention to the specification of the demand for money in developing countries. Olgun (1984) uses expected inflation rates and real income

to estimate the demand for money in Turkey, while Sundarajan (1986) uses expected inflation rates and marketed output to specify the demand for money in India. Khan and Knight (1981) use expected inflation rates and current and lagged values of income for a cross-section study of the demand for money in developing countries. Haque, Lahiri and Montiel (1990) add current interest rates and lagged values of the money mass to the earlier specification. Lipschitz (1984), as mentioned earlier, adds absorption, whereas Agénor (1990) specifies a demand for money equation that includes a variable to measure the expected rate of return on foreign currency-- this variable is defined as the difference between the expected devaluation rate in the black market foreign exchange market and the expected changes in world price inflation. Agénor's formulation, which is among the first to recognize the effect of foreign exchange rates and holdings of foreign money, also includes the expected rate of inflation, as well as current and lagged values of income among the explanatory values of the demand for money.

Two alternative formulations are presented of household liquidity. The most standard formulation, following Agenor (1990), specifies that household liquidity (L_t) adjusts with a lag to the difference between desired demand (L^d_t) in the current period and the actual money holdings at the begining of the period (L_{t-1}).

$$(10a)\ \Delta L_t = v\,(L^d_t - L_{t-1})$$

where v is the speed of adjustment.

The desired demand for money balances is a positive function of household incomes measured by their proxies (i.e. current government deficits, enterprise loses and current gross domestic product) and depends negatively on current and expected of rate of price inflation and the expected devaluation rate.

$$(10b)\ L^d_t = \alpha_0 + \alpha_1\,(GDEF_t + ENTLOSS_t) + \alpha_2\,(Y_t) - \alpha_3\,(\Delta\,PBM_t) - \alpha_4[E\,(\Delta PBM_t - i_t)] - \alpha_5\,[E\,(e_t - \Delta\,PW_t)]$$

substitition of (10b) into (10a) results in :

$$(10c)\ \Delta L_t = \beta_0 + \beta_1\,(GDEF_t + ENTLOSS_t) + \beta_2\,(Y_t) - \beta_3\,(\Delta\,PBM_t) - \beta_4\,[E\,(\Delta\,PBM_t - i_t)] - \beta_5\,[E\,(e_t - \Delta\,PW_t)] - \beta_6\,(L_{t-1})$$

where:

$\Delta\,(L_t)$ = changes in the real balance of incomes and expenditures of the population during year t.

L_{t-1} = lagged values of real household liquid assets, measured in constant pesos as currency in household circulation plus and household savings bank deposits in year t-1.

Y_t = real gross domestic product, in constant pesos, during year t.

ABS_t = absorption of goods and services, in constant pesos during year t (an alternative to this shortage-related variable is to use aggregate supply (Su_t), defined earlier).

PBM_t = index of black market prices during year t.

i_t = real interest rate paid on savings deposits at the Banco Popular de Ahorros during year t.

$\Delta\,(BM_t)$ = annual change in the black market price index during year t.

$E(e_t)$ = expected black market exchange rate in terms of Cuban pesos per US dollar in year t, based on the information available in year t-1.

$E\,(\Delta(PBM_t))$= expected price inflation rate in the black market during year t, based on information available in year t-1,

$E\,(e_t)$ = expected foreign exchange depreciation rate in year t, based on information available in year t-1.

$E\,(\Delta\,PW_t)$ = expected world price inflation in year t, based on information available in year t-1.

A second formulation specifies the components of the exchange in household money balances. On the one hand increases in liquidity assets arise from the current government deficit, enterprise losses and the current gross domestic product. Decrease in house-

hold liquidity assets occur because of household expenditures, which themselves are a function of the current and expected rates of inflation, the expected devaluation rate and the supply of marketed commodities. The addition of the marketed supply -represented by the absorption variable- denotes that in situation of scarcity households spends liquid assets only if goods are indeed available for consumption. The second specificiation is:

$$(10d)\ \Delta L_t = \zeta_0 + \zeta_1 (GDEF_t + ENTLOSS_t) + \zeta_2 (Y_t) - \zeta_3 (\Delta PBM_t) - \zeta_4 (ABS_t) - \zeta_5 [E (\Delta PBM_t - i_t)] - \zeta_6 [E (e_t - \Delta PW_t)] - L_{t-1}.$$

whose variables have been defined earlier.

The liquidity modules to be estimated reflect concepts of currency substitution between the Cuban peso and the U.S. dollar, portfolio concepts (such as the opportunity costs of holding money balances and of holding foreign currency) and forward-looking rational expectations; that is, expectations formed in year t conditionally based on the information available in year t-1. Also included are measures of shortages (such as changes in supply of marketed output and/or changes in absorption) and measures of monetary disequilibrium (such as ratios of household liquidity to gross domestic product).

Note that the difference between the domestic rate of interest and the price inflation rate measures the opportunity cost of holding domestic money balances, while the difference between the expected foreign exchange devaluation rate and the expectations of world prices measure the opportunity cost of holding foreign currency.

Price Module

As discussed earlier, official prices in Cuba are controlled and correspond to official rationed markets. Because the rationed markets are hardly ever able to satisfy the demand for goods and services in the Cuban economy, the unsatisfied demand spills over into the black markets, where transactions are more in tune with demand and supply conditions. The task at hand is to develop predictive relationships that trace interaction between monetary conditions, exchange rates and prices in conditions approximating free markets as in the Cuban black markets.

Studies of black market prices in developing countries are few and far between, among them Olgun's (1984) study of Turkey shows that among the key variables affecting black market prices in Turkey are the black market exchange rates, the level of foreign prices, the real stock of money and the ratio of money to income. Agénor (1990) adds to the above variables the excess demand for money, the expected rate of inflation and the official exchange rate.

In Korea, Lipschitz (1984) considers capacity utilization and lagged absorption as important variables explaining price inflation, also adding the usual stock of price-explanatory variables: lagged real money stock, lagged price levels and changes and lagged import prices. In their study of Singapore, Ottani and Sassanpour (1988) related price inflation to lagged real money stock, interest rates, and price changes in exports, imports and wholesale domestic price indexes. Khan and Knight (1981) used lagged real money stock, current income, expected inflation rates, current and lagged black market exchange rates, lagged foreign prices, and lagged domestic price levels in their estimation of price equations. Aghevli and Sassanpour (1982) added the ratio of prices of tradable goods to the prices of non-tradeable goods to the following explanatory variables: lagged real money stock, current income, and changes in import price levels and wholesale price indexes. Finally Sundararajan's (1986) added marketed output to expected inflation rates and to the current and lagged real stock of money in explaining price inflation in India.

The following discussion relies on Olgun's (1984) black market price model, to which we have made changes to reflect concepts of shortage economies. The percentage rate of change in the domestic price level ($\Delta \ln P_t$) is the weighted average of the percent change in the price of internationally traded goods ($\Delta \ln PT_t$) and the percent change in non-traded goods ($\Delta \ln PNT_t$).

$$(11)\ \Delta \ln P_t = r (\Delta \ln PT_t) + (1- r) (\Delta \ln PNT_t)$$

where r is the share of internationally-traded goods in total expenditure, ln denotes natural logs, and Δ represents first differences.

The percent price change of internationally-traded goods ($\Delta \ln PT_t$) is a function of the exogenously- determined percentage changes in the world price of traded goods ($\Delta \ln PW_t$) and a weighted average of the rate of change of the official exchange rate ($\Delta \ln oe_t$) and the rate of change in the parallel or black market ($\Delta \ln e_t$), such as:

$$(12) \Delta \ln PT_t = \Delta \ln PW_t + s\,(\Delta \ln oe_t) + (1 - s)\,(\Delta \ln e_t)\,,$$

where s denotes the proportion of transactions carried out at official exchange rates. However, the officially-fixed foreign exchange rate in Cuba is not relevant to the determination of market prices of traded goods, so that s approximates s = 0 for current conditions in Cuba, where only a small group of privileged communist party-connected importers have access to the official rate.

The demand for the non-traded goods is assumed dependent on the money supply (monetary disequilibria) and on the aggregate supply of goods and services and/or absorption (both shortage concepts) as well as on forward looking future price expectations, that is, price expectations for year t formed on the basis of information available in year t-1. Thus, home prices are determined by domestic supply and demand. A disequilibrating increase in the money supply should affect prices according to the capacity for increasing output or imports and thereby raising real absorption. Because of the inadequacy of Cuban monetary statistics regarding the definition of the monetary mass, we use two related variables: household liquidity (L_t) defined as the sum of household's money in circulation plus household savings deposits, and the total government deficit ($TGDEF_t$) defined to include the deficits of the state enterprises ($ENTLOSS_t$) and the strictly-government deficit ($GDEF_t$), as in:

$$(13)\ TGDEF_t = ENTLOSS_t + GDEF_t\,,$$

whose terms have been defined previously.

The price equation for non-tradeable goods is then given in equation (15) as follow:

$$(14) \Delta \ln PNT_t = \Lambda_0 + \Lambda_1\,(\Delta \ln TGDEF_t) + \Lambda_2\,(\Delta \ln L_t) + \Lambda_3\,(\Delta \ln ABS_t) + \Lambda_4\,\mathbf{E}(P_t)$$

where $\mathbf{E}\,(P_t)$ = expected price inflation in time t, based on information available in time t-1.

Finally equations (12) and (14) are substituted into equation (11), rendering a function in which the rate of change in domestic prices is a function of official (oe_t) and black market exchange rates (e_t), the rate of change in the prices of imports ($\Delta \ln PW_t$), current [$\Delta(L_t)$] and lagged changes in household liquidity [$\Delta(l_{t-1})$], the total government deficit ($TGDEF_t$), including the deficits of the state enterprises, the aggregate supply SU_t, (or its absorption alternative, ABS_t) and the expected rate of price inflation $\mathbf{E}\,(P_t)$. The resulting price equation is:

$$(15) \Delta \ln P_t = \varepsilon_0 + \varepsilon_1\,(\Delta \ln TGDEF_t) + \varepsilon_2\,(\Delta \ln L_t) + \varepsilon_3\,(\Delta \ln ABS_t) + \varepsilon_4\,\mathbf{E}\,(P_t) + \varepsilon_5\,(\Delta \ln PW_t) + \varepsilon_6\,(\Delta \ln oe_t) + \varepsilon_7\,(\Delta \ln e_t).$$

where equation (15) represents the price equation to be estimated, while the other variables have been defined earlier. The reader should note that if we assume that the bulk of the transactions take place in the parallel or black market, as is the case of Cuba today, then s approximates the value of s = o, and the black market prices can be substituted for the rationed official domestic price level in the above formulation, as is probably the case of Cuba today.

The Foreign Exchange Module

The last module to be considered is the foreign exchange module, which essentially completes this first approximation of the interrelationship between money supply, and prices and foreign exchange rates in the black market. We approach the design of the foreign exchange module with some trepidation and modesty, since recent research on the predictive ability of foreign exchange models have shown them not to have better predictive abilities than random walk models (Meese and Rogoff, 1983). A short review of the literature on the prediction of black market exchange rates is provided below before entering into the specification of the foreign exchange equation to be estimated.

Early approaches to the estimation of predictive equations of foreign exchange followed a simple single-equation formulation. Culbertson (1975), devel-

oped a single-equation that predicted black market exchange rates in India, the Philippines and Turkey using as independent variables: official exchange rates, variables which reflected purchasing power parity concepts (such as the ratio of domestic price indexes to world price indexes), the percent change in foreign reserves and the ratio of foreign reserves to the domestic assets of the Central Bank. Gupta (1980) developed another single equation model of foreign exchange valuation of the Indian rupee, which used as explanatory variables the price of gold and silver, domestic interest rates, the real monetary stock, gross domestic product, and the U.S. GNP price deflator. Blejer's (1978) single equation model predicted the foreign exchange rates of Brazil and Chile as function of current and lagged values of the rate of change of domestic monetary assets of the Central Bank net of the rate of change in money balances and net of the world rate of inflation.

Portfolio concepts related to the opportunity cost of holding foreign exchange were introduced by Dornbusch et al. (1983) in their Brazil study, which approximated this opportunity cost through interest rate differentials adjusted for devaluation (by adding foreign interest rate in dollars to the rate of devaluation of the cruzeiro net of the domestic interest rate in cruzeiros). Closely related to the Dornbusch et al. model is the work of Phylaktis (1992) for Chile, which predicted changes in the black market exchange rate premia as function of changes in money and demand deposits, purchasing power parity ratios (using the U.S. consumer price index), values of total wealth expressed in dollars, changes in official exchange rates and changes in interest rate differentials adjusted for devaluation. Other variables used by Phylaktis included changes in import tariffs, travel allowances, repatriation of profits and preferential rates on foreign loans.

In one of the few studies of demand for money in the Soviet bloc, Charemza and Ghatak (1990) estimated real black market exchange rates in Hungary and Poland as function of real incomes, real money balances, the ratio of domestic interest rates to expected inflation rates, and the ratios of private investments and consumption to income. Ottani and Sassanpour (1988) used lagged values of black market exchange rates, ratios of foreign prices to domestic prices (i.e. a purchasing power parity concept) and ratios of foreign to domestic assets of the Central Bank to predict foreign exchange rates in Singapore. Edwards' (1988, 1989) massive cross section studies of exchange rates in developing countries considers the following variables as affecting real exchange rates: excess credit (measured as the differential between the rate of growth of domestic credit and the rate of growth of gross domestic product), the rate of growth of domestic credit, the lagged ratio of the fiscal deficit to the money supply M1, the terms of trade, the ratio of tariff revenues to imports, the real rate of growth of gross domestic product, the changes in nominal exchange rates, the lagged real exchange rate, capital inflows and the ratio of government consumption in non-tradeable goods to gross domestic product.

One of more important works, important because of its multiple-equation black market linkages is Olgun's (1984) study, which used official exchange rates, expected inflation rates and purchasing power parity (using the U.S. consumer price index) to predict black market exchange rates in Turkey. Finally, we focus on Agénor's (1990) cross-section study which uses as explanatory variables forward-looking expected inflation rates, purchasing power parity ratios, the rate of change in money balances, the changes in gross domestic product, the official exchange rate and the differential between the expected rate of devaluation and the rate of foreign inflation. Agénor's formulation contains just about every factor applicable to Cuba, except for the lack of concepts related to a shortage economy.

The formulation of the foreign exchange module begins by distinguishing stocks from flows in the foreign exchange market following Kharas and Pinto (1989), and Lizondo (1987). The stock of foreign exchange is held as part of a diversified wealth portfolio that includes domestic liquid assets, foreign exchange stocks, housing and other wealth. The equilibrium conditions for the stock of foreign exchange have been worked out by Phylaktis (1992) among others and they are the usual equilibrium condition for an asset. Phylaktis assumes the stock demand for black

market dollars to be proportional to total wealth (which includes non-dollar assets evaluated at the existing black market rate of exchange) and to interest rate differential adjusted for the rate of depreciation of the domestic currency in the black market. The equilibrium conditions (Phylaktis, 1992) for the stock of dollars requires that the rate of change in the black market premium be equal to the interest rate differentials adjusted for devaluation minus a function of the ratio of wealth in domestic assets to wealth in foreign assets. However we do not pursue the analysis of the stock of dollars held- for which there is no data available- and instead pursue the analysis of the flow market for foreign exchange.

In Cuba, the flow market for foreign exchange arises from family remittances from the Cuban exiles, tips from tourists visiting the island, from transactions of foreign personnel stationed in Cuba (specially those from the former Soviet bloc) and from corruption by the Cuban authorities. In July 1993 the government estimated that as much as US $200 million were freely circulating in Cuba (Fogel and Rosenthal, 1994), figures which at the existing rate of 100 pesos per U.S. dollar were double the liquid assets of the Cuban households. This high rate of foreign currency holding in Cuba is validated by José Luis Rodríguez' statement (*Cuba Business*, January-February 1995) that 21% of Cuban households had access to U.S. dollars, figure which rises to 25.5% in Havana. Following Olgun (1984), the flow supply function for foreign exchange is assumed to be dependent on the level of spread between official and black market exchange rates, that is, family remittances are assumed to be a function of the spread between the two exchange rates. The flow supply is also

assumed to depend on the other important source of foreign exchange that is, tourist expenditures (or the number of tourists visiting the island, because the information on tourist expenditures is sometimes not available for recent years). The flow supply function is given by:

$$(16)\ \Delta \ln FES_t = f_{16}\left[\left(e_t / oe_t \right), TOUR_t \right],$$

where $\Delta \ln FES_t$ represents the rate of change of the supply of foreign exchange, $TOUR_t$ represents tourists expenditures in year t, oe_t denotes official exchange rates and e_t is the exchange rate in the black market.

The flow demand for foreign exchange in the black market arises because of the use of foreign currency as a medium of exchange in the black markets, since the government authorities cannot satisfy the total demand for goods and services in the economy. The flow demand is assumed to be dependent on the level of liquid assets (L_t), on deviations of domestic prices from foreign prices evaluated at the black market rate (i.e. a purchasing power parity concept), on the level of shortages in the economy [measured in terms of aggregate supply (SU_t) or of absorption (ABS_t)], on gross domestic product (Y_t), on the opportunity cost of holding domestic money, which is equal to domestic interest rates (i_t) minus the expected domestic inflation rate [$\mathbf{E}\ (\Delta P_t)$], assuming that expectations are formed at time t-1 for period t and on the opportunity costs of holding foreign money, defined as the difference between the expected rate of devaluation and the expected rate of world inflation [$\mathbf{E}\ (\Delta Pw_t)$].

$$(17)\ \Delta \ln FED_t = f_{17}\{ L_t, Y_t, ABS_t, (P_t / PW_t), \mathbf{E}\left[i_t - (\Delta \ln P_t)\right], \mathbf{E}\left[(\Delta e_t / e_t) - (\Delta PW_t)\right]\}$$

where $\Delta \ln FED_t$ represents the flow demand for foreign currency, $\mathbf{E}\ [(\Delta e_t)/e_t]$ represents the forward-looking expectation of foreign exchange depreciation. All the other term have been defined earlier.

Agénor (1990) presents an interesting formulation whereby both the flow demand and flow supply functions are introduced into the equilibrium conditions in the stock for foreign currency to develop a reduced-form equation to predict the foreign exchange rate in black markets. Borrowing literally from Agénor (1990), the following reduced-form function is proposed:

$$(18)\ e_t = \gamma_0 + \gamma_1 (oe_t) + \gamma_2 (ABS_t) + \gamma_3 (L_t) + \gamma_4 (TOUR_t) + \gamma_5 (Y_t) + \gamma_6 (P_t / Pw_t) + \gamma_7\, \mathbf{E}\left[i_t - (\Delta \ln P_t)\right] + \gamma_8\, \mathbf{E}\left[(\Delta e_t / e_t) - (\Delta PW_t)\right]$$

where equation (18) is the foreign exchange function to be estimated. This function combines elements of currency substitution, portfolio approaches, shortag-

es concepts and rational expectations, but before the estimated results are analyzed a brief discussion of estimation methods is in order.

ESTIMATION METHODS

Estimation of the model specified earlier presented two main difficulties. The first difficulty concerned the presence of endogenous variables among the regressors in several of the equations. For example, the black market prices (P_t), foreign exchange (e_t) and household liquidity (L_t) variables are all simultaneously-determined, necessitating the use of simultaneous equation estimation techniques. In addition, both gross domestic product (Y_t) and household liquidity (L_t) are jointly determined. In this paper the technique used for estimating equations with jointly dependent variables is two-stage least squares. However, as will be described later, we were unable to estimate statistically-significant coefficients for black market exchange rates—a jointly-dependent variable--in the price module (equation 15), which negated one of the reasons for using simultaneous equations estimation techniques. We also ended up redefining the liquidity variable to include both lagged liquidity (L_{t-1}) plus the government budget deficit ($GDEF_t$ + $ENTLOSS_t$), in effect redefining liquidity as an exogenous variable and annulling its joint-dependency with gross domestic product (Y_t).

Another difficulty concerns estimating the (unobserved) rational expectation variables.[4] These variables measure expectations of events in year t, expected on the basis of information available in the year before, that is, year t-1. These expectation variables are assumed to follow rational expectations, and are equal to actual (realized) values plus a stochastic error term. There are two general approaches for the estimation of rational expectations models. The most obvious and common sense approach is the substitution method, in which the rationally-expected variables are replaced by their forecasts. Thus, in the substitution approach, unrestricted reduced-form equations of the expectation variables are estimated and their predicted forecasts are substituted for the unobserved expectations. However, this otherwise common sense approach had to be abandoned because it leads to inconsistent and not fully efficient estimation unless the estimation approach follows cumbersome non-linear estimation methods with constraints placed on the parameters to be estimated (Wallis, 1980).

In view of the above referenced difficulties, the approach chosen relied on errors-in-variables formulations, and estimated the coefficients of the expectations variables through instrumental variables techniques. In the errors-in-variables approach, the expected variables are replaced by the realized (observed) values of the expected variables. Instrumental variables chosen in this paper are: all the exogenous variables lagged one year, values of all the endogenous variables during the previous year, plus the constant/intercept term. Care was taken to insure that an expected and a realized value of the same variable do not appear in the same equation and that an endogenous variable and its expected value also do not appear in the same equation (Wickens, 1982).

Rational Expectation Variables

Two rational expectations variables were analyzed, namely: 1) the rate of return on domestic currency ($RRDOM_t$), and 2) the rate of return on foreign currency ($RRFORG_t$), with both of these variables incorporating portfolio concepts into the demand for money, prices and foreign exchange. The rate of return on domestic currency ($RRDOM_t$) is defined as the percent annual interest rate on savings deposits at the Banco Popular de Ahorros minus the percent annual rate of domestic price inflation. The rate of return on foreign currency ($RRFORG_t$) is defined as the percent annual rate of black market foreign exchange rate depreciation minus the percent annual rate of import price inflation. Both of these portfolio-type variables show negative values on selected

4. Some critics will be amused at the mere thought of rational expectations in Cuba and will call the application of this concept to Cuba to be an oxymoron, that is, a contradiction in terms. However, the rational expectations variables used in this paper apply only to household liquidity and to black market exchange rates, and not to government-run processes, where the application might indeed be construed as an oxymoron.

years and as a consequence do not appear in logarithmic form in the equations estimated in Table 3.

The rational expectation variables: **E** (RRDOM $_{t,}$) and **E** (RRFORG$_{t,}$) represent expectations about these portfolio variables for year t, formed on the basis of expectations formed in year t-1. These rational expectation variables are estimated via instrumental variables techniques, as explained earlier.

ANALYSIS OF ESTIMATED MACROECONOMIC, BALANCE OF PAYMENTS, MONEY, PRICES AND EXCHANGE RATE EQUATIONS

The following paragraphs describe and analyze the modules and functions estimated, which are displayed in Table 3. The data sources used are described in detail in Appendix A. The original data series is not uniform. Data is available only for specific time periods that vary depending on the module analyzed. For example, all the modules and equations that require data on government budgets and deficits are necessarily constrained to the post-1978 period, since the Cuban government has not published any government budget data for the pre-1978 period (Mesa-Lago, 1994). Similarly no data on international foreign reserves have been published previous to 1977 and after 1990, restricting the data based used in the estimation of demand for foreign reserves to the period 1977- 1990. Finally, the data on components of imports are not available (with the exception of 1970) for the period previous to 1975, thereby restricting the historical period analyzed in the production, investment and import functions to the period 1975-1994.

Estimation of Output and Supply Equations

The production function estimated in equation (1a) of Table 3 is of the Cobb-Douglas type, which assumes constant elasticity of output as functions of inputs. The variable I_{t} , representing gross investment, had to be used in lieu of the capital stock figures (K_t) because of difficulties with the highly erratic capital depreciation figures used in the Cuban material product accounting system. The investment capital share of output is 43%, with the labor share (100% - 43% = 57%) accounting for the remainder of output. The capital share is slightly larger than the one previously estimated by the authors (Alonso & Lago, 1994), but still within the ranges of the Latin American developing countries (Bruton, 1967). But what is interesting about the production function estimated in Table 3 is the influence of imports on the Cuban output level. It is not surprising that the imports of oil, raw materials and intermediate products affect output, but what is noteworthy is that the imports of food and consumer goods also significantly affect labor productivity, especially in these recent times of food shortages. The plausible influence of food and consumer goods on labor productivity had already been mentioned in the Report of the Task Force on Cuba (Banco Nacional, 1989), but this is the first time that it has been measured. Because of the presence of multi-colinearity between the two import categories used in the production function, it became necessary to express the influence of the food and consumer goods imports on output through the ratio shown in equation (1a) in Table 3.

Machinery imports also affect output through their impact on gross investments, as shown in equation (1d). Again as in our previous modeling work (Alonso & Lago, 1994), we were unable to estimate statistically significant coefficients for the investment accelerator variable (ΔY_{t-1}). Perhaps the lack of flexibility implicit in the development of multi-year investment plans in socialist economies precludes the importance of accelerator variables in driving annual investments. Our investment formulation is borrowed from Adelman and Chennery (1966) who, while successfully estimating investment functions in open economies - like Greece - also failed to develop statistically significant coefficients for the accelerator variable.

The aggregate demand function, presented in equation (1b) of Table 3, portrays the significant effect on aggregate income of lagged household liquidity (L_{t-1}) plus the government deficit (GDEF $_{t}$ + ENTLOSS$_{t}$), as a proxy for money supply. In fact, in other simultaneous-equations estimated (but not shown in Table 3), a current household liquidity (L_t) variable was estimated as a significant quadratic variable, de-

noting that up to a certain point the effect of money on income is positive, but that after the maximum effect is reached any other increases in money supply result in decreases in real income because of the adverse effects of money on the rate of inflation, a topic to be discussed later. The other two variables in the aggregate demand equation are the usual exogenous macro- economic variables of gross investments (I_t) and total exports (X_t). Capacity utilization was not used as a variable because published values are available for only two recent years.

Estimation of Balance of Payment Equations

The demand for annual changes in foreign reserves in convertible currencies is estimated in equation (5) as functions of lagged reserves, exports and net payments and capital inflows in convertible currency, and lagged levels of household liquidity, among others. In addition, the import component shares estimated in equations (6) and (7), show the presence of ratchet effects that take into account the fact that the time-paths of adjustment are different when total imports are growing than when they are contracting. As a general rule, the share of food and consumer goods imports grows when the economy is in the downswing and diminishes during economic recovery and growth. The opposite is true of machinery imports.

We also estimated Hemphill's (1974) import-predictive function for economies with foreign exchange controls and, to our surprise, Hemphill's formulation fits better the Cuban data than do any of the other developing countries in his sample. Hemphill's equation is not used in this study because its alternative [equation (5)] proved to be superior in all respects, including the statistical significance of its coefficients and the tests of serial correlation of residuals.

Estimation of Liquidity Equations

Household liquidity, measured as currency in circulation and household saving deposits at the Banco Popular de Ahorros, is specified as an endogenous variable in the model and estimated in equations (10c) and (10d) in Table 3. Equation (10c) estimates the annual changes in liquidity as function of the government budget deficit, the price level (P_t), and lagged levels of liquidity (L_{t-1} / P_{t-1}). Equation (10c) uses the original series (not the first difference) and substitutes real gross domestic product (Y_t / P_t) for the lagged levels of liquidity (L_{t-1} / P_{t-1}). What is interesting about this equation is that it reflects both shortages and monetary disequilibria views. It shows that the so-called "monetary overhang" is partly due to shortages (i.e., supply scarcities reflected in the variable ABS_t) and to subsidized prices (i.e reflected in P_t) as well as due to the usual monetary expansion variables, such as lagged liquidity (L_{t-1} / P_{t-1}) and government budget deficits ($GDEF_t + ENTLOSS_t$). The two rational expectations variables reflecting the rates of return on domestic currency holdings [$E(RRDOM_t)$] and foreign currency holdings [$E(RRFORG_t)$] were found not to be statistically significant.

Estimation of Price Equation

Equation (15) estimates prices (P_t) as a function of the government budget deficit ($GDEF_t + ENTLOSS_t$), import prices (Pw_t), absorption (ABS_t) and lagged household liquidity (L_{t-1}). It is interesting to note the importance of the absorption supply variable (ABS_t) in affecting prices, denoting that the balance of payments influence the level of prices through its effect on imports, and thereby on supply. We were unable to estimate a statistically-significant foreign exchange rate (e_t) variable as affecting prices, thereby throwing some doubt on our ex-ante hypothesis of the joint-simultaneity of prices and foreign exchange rates. However, it is still too early in this research to abandon our hypothesis of simultaneity of prices and exchange rates, more research awaits the final conclusion of this issue. We did not include any forward looking expectation variables that made the current inflation rate dependent on expectations about next year's inflation rate because this procedure implies that the error terms follow a moving average of order 1 and would result in biased standard errors of the coefficients (Agénor, 1990).

Estimation of Foreign Exchange Rate Equation

Two alternative foreign exchange rate equations are presented in Table 3. In equation (18a) the foreign exchange rate (in pesos per U.S. dollar) is estimated

Table 3. Estimated Aggregate Demand, Balance of Payments, Money, Price and Exchange Rate Functions

OUTPUT AND SUPPLY MODULE

Production Function Equation:

(1a) $\ln (Y_t / P_t / LABOR_t) = - 1.4917 + 0.4292 \ln [(I_t / P_t) / LABOR_t]$
(0.7316) (0.0975)

$+ 0.4521 \ln [(IMOIL_t + IMMINT_t) / P_t] + 0.4947 \ln [IMFOOD_t / (IMOIL_t + IMINT_t)]$
(0.1101) (0.1519)

($R^2 = 0.9972$; D. W. = 1.8066; N = 18 observations from 1977 to 1994)

Aggregate Demand Equation:

(1b) $Y_t / P_t = 1.0649 (I_t / P_t) + 2.4752 (X_t / P_t) + 0.2393 [(L_{t-1}/P_{t-1}) + (GDEF_t + ENTLOSS_t)/P_t]$
(0.4735) (0.3355) (0.0721)

($R^2 = 0.995273$; D. W. = 1.6982 ; N = 17 observations from 1978 to 1994)

Investment Equation:

(1d) $(I_t / P_t) = 3.4689 + 1.6232 (IMMACH_t / P_t) + 59.0464 (PSUGAR_t / POIL_t)$
(85.9545)(0.0376) (10.6995)

[$R^2 = 0.9918$; D. W. = 2.0691 ; N = 20 observations from 1975 to 1994--

The serial correlation of residuals in the original data set was adjusted through maximum likelihood iterative techniques (RHO autocorrelation coefficient is equal to

- 0.2452)]

BALANCE OF PAYMENTS MODULE

Demand for International Reserves Equation:

(5) $\Delta \ln (R^c_t / P_t) = 20.3209 - 1.0673 \ln (R^c_{t-1} / P_{t-1}) + 0.7716 \ln [(X^c_t + F^c_t) / P_t] - 2.7527 \ln (L_{t-1}/P_{t-1}) + 0.9389 \ln (PSUGAR_t / POIL_t$
(5.4074) (0.1796) (0.2408) (0.5874) (0.3437)

$R^2 = 0.8875$; D. W. = 1.8230 ; N = 13 observations from 1978 to 1990, and where the superscript c denotes convertible currency transactions)

Food and Consumer Goods Import Equation:

(6) $\ln (IMFOOD_t / IM_t) = 1.9604 - 0.4298 \ln (IM_t / P_t) - 0.1600 [(IM_t / P_t) / (IM_{peak} / P_{peak})]$
(0.5200) (0.0597) (0.0150)

($R^2 = 0.8991$; D. W. = 1.6438; N = 17 observations from 1977 to 1993)

Machinery Imports Equation:

(7) $\ln (IMMACH_t / IM_t) = - 0.0653 - 0.1224 \ln (IMMACH_t / P_t) + 0.2700 \ln [(IM_t / P_t) / (IM_{peak} / P_{peak})]$
(0.5576) (0.0646) (0.0596)

(R^2= 0.8422 ; D. W. = 2.2083 ; N = 19 observations from 1975 to 1993)

Liquidity Module

(10c) $\Delta (L_t / P_t) = 2068.640 + 0.5409 [(GDEF_t + ENTLOSS_t) / P_t] - 132.422 P_t - 0.7485 (L_{t-1} / P_{t-1})$
(714.86) (0.3116) (41.3359) (0.2645)

(R^2 = 0.4660 ; D. W. = 1.2774; N = 17 observations from 1978 to 1994)

(10d) $\ln (L_t/P_t) = 3.6491 + 0.0001986 [(GDEF_t + ENTLOSS_t) / P_t] + 0.4414 \ln (Y_t / P_t) -1.1032 \Delta \ln (ABS_t / P_t) - 1.2461 \Delta \ln P$
(0.2437) (0.00003886) (0.0260) (0.3954) (0.5048)

(R^2 = 0.9780 ; D. W. = 1.1493 ; N = 17 observations from 1978 to 1994)

Price Module

(15) $\ln P_t = 8.5494 - 0.9175 \ln (ABS_t / P_t) + 0.0693 \ln [L_{t-1} / P_{t-1} + (GDEF_t + ENTLOSS_t)/P_t] + 0.6989 \ln PW_t$
(0.2317) (0.0135) (0.0280) (0.0648)

(R^2 = 0.9981 ; D. W. = 1.8000 ; N = 17 observations from 1978 to 1994)

Foreign Exchange Rate Module

(18a) $\ln e_t = 12.1828 + 2.1756 \ln (L_t / P_t) - 1.3495 \ln (P_t / Pw_t) - 2.6655 \ln (ABS_t / P_t) + 0.004152 \mathbf{E} (RRFORG_t)$
(3.0174) (0.1227) (0.3062) (0.2912) (0.0008351)

(R^2 = 0.9945 ; D. W. = 2.1687 ; N = 17 observations from 1978 to 1994. The serial correlation of residuals in the original data set was adjusted through the Cochrane-Orcutt iterative technique after two iterations, Rho autocorrelation coefficient = - 0.0710)

(18b) $\ln e_t = 0.3596 \ln (Y_t / P_t) + 3.2637 \ln oe_t + 0.9349 \ln (P_t / Pw_t) - 0.8680 LEGAL_t + 0.006535 \mathbf{E} (RRFORG_t)$
(0.0078) (0.4054) (0.0657) (0.3741) (0.001750)

(R^2 = 0.9760 ; D. W. = 2.3952 ; N = 17 observations from 1978 to 1994. The serial correlation of residuals in the original data set was adjusted through the Cochrane-Orcutt iterative technique after two iterations, Rho autocorrelation coefficient = - 0.3527)

Notes: R^2 represents the square of the multiple correlation coefficient. D. W. represents the Durbin-Watson coefficient for testing the serial correlation of residuals. Δ represents the first difference series of the variable in question, while ln denote natural logarithms. Figures inside parentheses represent the standard errors of individual regression coefficients.

VARIABLE DEFINITIONS USED IN TABLE 3:

ABS_t = absorption, in millions of pesos in year t. ($ABS_t = Y_t + IM_t - X_t$).

e_t = black market exchange rate, in pesos per U.S. dollar as of December 31 of year t.

$ENTLOSS_t$ = public enterprise losses financed out of the budget, in millions of pesos in year t.

$E(RRFORG_t)$ =expectations of percent rate of return on holdings of foreign currency in year t given the information available in year t-1.

F^c_t = net foreign capital and payment flows in convertible currency, in millions of pesos in year t.

$GDEF_t$ = government budget deficit, in millions of pesos in year t. (excludes $ENTLOSS_t$)

I_t = gross investments, in millions of pesos in year t.

IM_t = total imports, in millions of pesos in year t.

$IMOIL_t$ = imports of oil and oil products, in millions of pesos in year t.

$IMINT_t$ = imports of raw materials and intermediate products, in millions of pesos in year t.

$IMFOOD_t$ = imports of food, beverages and consumer goods, in millions of pesos in year t.

$IMMACH_t$ = imports of machinery and equipment, in millions of pesos in year t.

L_t = currency in circulation and household savings deposits, in millions of pesos in year t.

$LABOR_t$ = labor, in thousands of employed persons in year t.

$LEGAL_t$ = proportion of no. of months in year t during which it was legal to hold foreign currency.

oe_t = official exchange rate, in pesos per U.S. dollar as of December 31 of year t.

$PSUGAR_t$ = price per ton of exported sugar, in pesos in year t.

$POIL_t$ = price per ton of imported oil, in pesos in year t.

P_t = price deflator index for the gross domestic product , in year t. (P_{1989} = 100.0)

PW_t = import price index during year t. (P_{1989} = 100.0)

R^c_t = international foreign reserves in convertible currency, in millions of pesos in year t.

$RRFORG_t$ = rate of return on holdings of foreign currency, measured as the difference between the percent annual devaluation rate and the percent annual rate of inflation in import prices, in time t.

X_t = total exports, in millions of pesos in year t.

X^c_t = exports in convertible currency, in millions of pesos in year t.

Y_t = gross domestic product, in millions of pesos in year t.

as a function of purchasing power parity concepts (P_t / Pw_t), monetary-related influences (L_t / P_t), supply-related variables, such as absorption (ABS_t/P_t), and expectations on the rate of return on holdings of foreign currency [**E** ($RRFORG_t$)]. The significance of the absorption variable reflects the fact that the Cuban households take dollars from the stock under their mattresses when there are goods available to be bought. An expectations variable representing expectations on the rate of return on domestic currency **E** ($RRDOM_t$) was estimated as statistically significant but with an incorrect sign and is therefore excluded from the final formulation.

A second formulation of the foreign exchange rate equation is presented in equation (18b) and estimates exchange rates as functions real gross domestic product (Y_t / P_t), official exchange rates (oe_t), purchasing power parity (P_t / Pw_t), expectations on the rate of return on holdings of foreign currency [**E** ($RRFORG_t$)] and on the legalization of holding foreign currencies in Cuba ($LEGAL_t$). Another dummy variable denoting the August 1994 Clinton Administration restrictions on remittances to Cuba was estimated with the correct sign but was found to be statistically insignificant. Perhaps the flow of remittances through third countries has made the Clinton Administration restrictions less effective than originally thought. The expectations variable about the rate of return on holdings of domestic currency [**E** ($RRDOM_t$)] was estimated as statistically significant, but with an incorrect sign. Equation (18b) was estimated without an intercept because in the presence of official exchange rates equal to one (oe_t = 1), the data matrix is singular and cannot be inverted to estimate the relevant coefficients. A selection between these two equations for forecasting purposes must await the results of policy simulations to be conducted in a subsequent second approximation study by the authors.

OPERATION AND HIGHLIGHTS OF THE FIRST APPROXIMATION MODEL

The First Approximation Model of Money, Prices and Foreign Exchange Rates has been changed from its original simultaneous-equation design into a recursive system of equations. The recursive nature of the model was specified because of the failure to estimate statistically-significant simultaneous equation linkages between prices and foreign exchange rates. Thus, prices were found to affect foreign exchange rates via purchasing power parity concepts, but the reverse, namely that foreign exchange rates affect domestic prices, could not be estimated with any significant degree of confidence. In addition, due to the problems of defining monetary mass in socialist Cuba, we opted for an exogenous measure of liquidity that included lagged levels of liquidity plus the current government budget deficit. At the end, none of the equations estimated required simultaneous equation estimation techniques, except for those functions which contained rational expectations, which were estimated via instrumental variables.

The application of the First Approximation Model is relatively easy and requires performing the following analytical steps:

Step One: Exogenous exports, payments and capital flows, lagged levels of liquidity and international reserves are used to estimate the change in reserves in equation (5). Next, total imports are estimated from equation (4) and the import components are estimated from equations (6), (7) and (8).

Step Two: Machinery imports, previously estimated from equation (7), and the exogenous ratio of sugar to oil prices are used to predict gross investments from equation (1d); while gross investments, exports, lagged levels of liquidity and the exogenous government budget deficit are used to forecast aggregate income from equation (1b). Finally employed labor is estimated from the production function estimated in equation (1a).

Step Three: Absorption [estimated from equation (2)], lagged levels of liquidity, the exogenous government budget deficit, and the exogenous import price level are used to forecast prices in equation (15).

Step Four: Lagged levels of liquidity, absorption, prices, gross domestic product and the exogenous government budget deficit are used an inputs to esti-

mate the forecasts of household liquidity in equation (10d) or the change in liquidity in equation (10c).

Step Five: The expected rate of return on foreign currency holdings is forecasted as function of all of the rest of the variables in the model (after a one-year lag) and along with purchasing power parity, household liquidity and absorption is used to project foreign exchange rates in equation (18a).

We have postponed the exercise of simulating the effects of Cuban government policy initiatives because the model is still in its initial stage. In addition, care must be exercised in selecting policy initiatives to be simulated, since our objective is not to provide advise to the Castro government. In summary, we do not want to help "build the bridge over the river Kwai."

To summarize, imports of food and consumer products were found to affect labor productivity (equation 1a) and some of the decline in labor productivity in recent years is partly due to the scarcity of food and consumer products. The allocation of foreign exchange for import food, machinery, oil and other import components follows a "ratchet effect," with the shares of import components varying significantly depending on whether the economy is in an upswing or downswing (see equations 6 and 7). Household liquidity, sometimes referred to as the monetary overhang, depends on shortage concepts-- like changes in supply (i.e., absorption) and price inflation-- as well as monetary disequilibrium (such as government budget deficits). The reader is referred to equation (10d) for the analysis of household liquidity. The black market price level (see equation 15) is affected not only by liquidity considerations and government budget deficits, but also the supply variables, such as absorption. That is, an increase in supply leads to reductions of black market prices. Finally, monetary considerations, purchasing power parity ratios, supply variables (such as absorption) and rational expectation about the rate of return on foreign currency holdings affect the foreign exchange rate (equation 18a), providing an eclectic combination of several theories of exchange rate determination. In summary, money, expectations, government budget deficits and supply considerations do matter even in a socialist non-market economy like Cuba.

Appendix A
DATA SOURCES AND DATA DEVELOPMENT PROCEDURES

This section describes the data base assembled and the procedures used in their development.

BLACK MARKET EXCHANGE RATES

The black market exchange rates come from Pick's Currency Yearbook and from its successor, the World Currency Yearbook. These black market exchange rates are compiled from currency transactions conducted in international money exchange centers and as such they are different from the black market exchange rates observed in currency exchange transactions inside Cuba. While the sources of the currency information exchange services are proprietary and confidential, we noted that one of the earlier issues of Pick's mentioned that the black market exchange rates were compiled from currency transactions data in Zurich, Paris, London, New York, Mexico and Miami. A long 1959-1994 time series is available from observations on currency transactions outside Cuba.

Black Market Prices

The basket of commodities is a 1980 consumption basket assembled from several sources: most of the commodity weights come from Brundenius (1984), complemented by weights from

Pérez-López's (1987) production figures net of exports. A few of the 1980 commodity weights also come from several issues of the U.N. Economic Commission for Latin America and the Caribbean's (ECLAC) *Economic Survey of Latin America*. The commodity basket includes foods, drinks and tobacco, clothing, textiles and miscellaneous consumer industrial products (television and radio sets, refrigerators etc.) and covers 91 commodities.

Individual black market commodity prices come from several sources. Pre-revolutionary prices for 1953 come from Oshima (1961) and from Oscar Lewis (1977), while 1957 prices are available from Sánchez-Herrero (1995). The 1969 black market prices come from René Dumont (1970) and from Lewis (1977). The 1977-78 commodity prices come from Mesa-Lago (1981) and from the World Bank (Hultin, 1979), while the 1980 prices come from Brundenius (1984). The 1983 prices come from Medea Benjamin et al. (1986) and from ECLAC's *Economic Survey of Latin America* (1983). Black market commodity prices for the period 1985-1989 and for 1990 come from ECLAC's *Economic Survey of Latin America* (1988, 1989, and 1992).

Other 1989 black market prices come from Juan Clark (1990) and from observations collected by José F. Alonso, who also contributed some price observations for the period 1992-1994. Price observations for 1993 were complemented by data contributed by Marta Beatriz Roque-Cabello (1993) of the Asociación de Economistas Independientes de Cuba (ANEIC) and by data contributed by the Partido Pro-Derechos Humanos de Cuba (1993). The black market price observations in 1994 were assembled mostly from ANEIC's 1994 expenditure surveys, complemented by data from issues of the magazines *Contrapunto* (1994 and 1995), Areíto (1995), and from reports in *The Washington Post* (Farah, 1995) and *The Miami Herald* (Pérez, 1995). December 1994 black market prices also come from Marta Beatriz Roque-Cabello (1995) of ANEIC. Black market price data for 1995 are available from Sánchez-Herrero (1995), and from articles in *The Miami Herald* (Alfonso, 1995 and Alvarez, 1995) and from *Contrapunto* (1995). The Instituto Cubano de Economístas Independientes (ICEI, 1996) supplied December 1995 price data from their surveys of black market prices.

The price indexes were estimated using 1989 as the base year, since 1989 is the year for which the largest amount of individual price information is available. Pair-wise comparisons of individual commodity prices were conducted comparing the 1989 commodity price with the commodity price for the year in question. If one of the commodity prices in the pair-wise comparison years was not known, both prices were set equal to zero to estimate pair-wise compared ex-

Table A-1. Comparison of Gross Domestic Product, Price Deflator Index with Black Market Price Index- 1969-1994

Years	Black Market Prices		Official GDP Price	Price Index Used
	Index	No. Pairwise Matches	Deflator	in this Study
1953	12.66	9	n/a	n/a
1957	9.56	9	n/a	n/a
1969	90.08	30	91.55	91.55
1970			92.25	92.25
1973			98.18	98.18
1974			99.38	99.38
1975			100.09	100.09
1976			98.75	98.75
1977			93.17	93.17
1978	88.79	16	97.13	97.13
1979			97.96	97.96
1980	90.31	11	104.14	104.14
1981			102.36	102.36
1982			102.69	102.69
1983	91.15	15	103.93	103.93
1984			102.98	102.98
1985	90.98	13	101.49	101.49
1986	89.98	14	97.55	97.55
1987	100.09	14	97.92	97.92
1988	97.55	14	98.74	98.74
1989	100.00	Not applicable	100.00	100.00
1990	102.43	13	100.89	102.43
1991	263.43	31	84.73	263.43
1992	509.85	23	82.34	509.84
1993	1552.55	24		1552.55
1994	1396.48	32		1396.48
1995	739.64	36		

Notes: Black market price indexes are based on comparisons of prices of identical products/goods between each respective year and 1989. Source: See text in appendix A.

penditures. The estimation of annual consumer expenditures used the 1980 commodity weights mentioned earlier. The black market price indexes and the number of commodity pair-wise price comparisons are presented in Table A1 .

Total Exports, Imports and their Components
The pre-1990 figures of exports, imports and the components of imports come from the *Anuario Estadístico de Cuba* (1990). The post-1989 exports and imports totals come from Ariel Terrero's *Bohemia* article (1994), while the components of imports from 1989 to 1993 come from the Central Intelligence Agency (1994). Imports and exports data for 1994 come from the Comité Estatal de Estadísticas (Agence France Press, 1995).

International Trade in Convertible Currency
Figures for international trade in convertible currency for the periods 1970-1979 and 1981-1983 come from Turits (1987), while the 1980 figures come from CEPAL (1989). International trade figures for 1984 were estimated by the authors from the *Anuario Estadístico de Cuba* (1989), while the source of the trade figures in convertible currency for the period 1985-1989 is CEPAL's *Notas para el Estudio Económico de América Latina y el Caribe 1989: Cuba* (CEPAL, 1991)

The trade figures for 1990 and 1991 come from a combination of sources, including the Central Intelligence Agency (CIA, 1994) and from José Luis Rodríguez (1993). The CIA's (1994) international trade estimates were used for years 1992 and 1993.

Foreign Monetary Reserves
The source of foreign monetary reserves in convertible currency for the period 1977-1982 is the United Nations Conference on Trade and Development (United Nations, 1984). Total reserves (which include reserves in transferable rubles) and convertible reserves for 1981 come from Turits (1987) and from the Banco Nacional de Cuba (1982). For the period 1982-1989, data on total reserves and on reserves in convertible currency come from CEPAL's Notes (1991). For 1990, the authors were forced to use--for the lack of better figures-- those for June 1990 presented by the Banco Nacional de Cuba's *Informe Económico Semestral* (June 1990).

Gross Domestic Product (GDP)
The GDP series (in both constant and current prices) assembled by Hidalgo and Tabares (1992) was used for the period 1975-1989. For 1971-1974, the series comes from the Banco Nacional de Cuba (1982) after adjusting for overlapping with the more extensive and more recent Hidalgo and Tabares' (1992) series. GDP for the period 1961-1971 was estimated by assuming that the annual rate of change in the gross material product estimated by Mesa-Lago (1981) would be the same for the GDP. This assumption is reasonable, since the gross material product of socialist national income accounting is the closest concept to the gross domestic product. GDP figures for the period 1958- 1960 were taken from José Luis Rodríguez (1985), while the figures for the pre-revolutionary period come from the Banco Nacional de Cuba (1958).

Finally, GDP figures for the more recent period 1990-1993 come from information published in *Bohemia* (Terrero, 1994), while the 1994 GDP estimate takes at face value[5] the January 27, 1995 precipitous announcement in Davos, Switzerland by Cuban pediatric psychiatrist and Minister Carlos Lage, MD (*Cuba Business*, April, 1995 and Evans, 1995) in charge of economic policy, to the effect that Cuba had experienced growth of 0.7% in GDP at constant prices during 1994.[6]

GDP Price Deflators
Hidalgo and Tabares (1992) are the source for the GDP price delator series for the period 1975-1989. The post-1989 price deflators were estimated from Terrero's (1994) current GDP figures and from the constant GDP figures presented in Consultores Aso-

5. The Cuban government has begun to correct Lage's precipitous announcement. Thus, in a Radio Taíno interview of June 28, 1995 two Cuban journalists, Fernando Dàvalos of Radio Taíno and Osvaldo Rodríguez of *Bohemia* refer to a lower 0.4% growth rate for 1994. We should not be surprised that when all the adjustments are done the rate of growth will turn to a slight rate of further decline.

6. This practice of having medical doctors in charge of the Cuban economy is not new. In the early sixties, Ernesto "Che" Guevara, MD, became Minister of Industry and President of Banco Nacional de Cuba. This period was characterized by a disastrous management of Cuba's economy . Therefore, this revolutionary practice of putting a psychiatrist in charge of the Cuban economy should not be missconstrued to mean that the Cuban economy is necessarily a "crazy" economy, that is, an economy in need of psychiatric therapy.

ciados S.A. (CONAS, 1994) and Oficina Nacional de Estadísticas (1995). The price deflators for the GDP series for the pre-1975 period come from the GSP deflators published by José Luis Rodríguez (1990) and from Cardoso and Helwege (1992). Since the post-1989 GDP price deflators were found unreliable and non-sensical, they were substituted for the black market price index after 1989. The reader should note that the price inflation rates that result from the use of Hidalgo and Tabares (1992) GDP price deflators are very different from those quoted by Mesa-Lago (1994) based on gross social product (GSP) price deflators.

Because the GDP price deflators published in Cuba show an erratic behavior in the post-1990 period, the black market price index is substituted for the GDP price deflator in some of the equations estimated. This precaution was taken because the official GDP price deflators show a declining trend after 1990, in marked contrast to the black market price inflation amply corroborated by journal articles and even official statements from the Cuban authorities.

Gross and Net Investments

The investment figures used throughout this study exclude inventory changes. Gross investments for years 1958, 1959 and 1961 come from Felipe Pazos (1961, 1962), the founder and first President of the Banco Nacional de Cuba. The 1960 figure comes from Pérez-López (1987) and covers solely public investments.

Gross investment and productive depreciation for the period 1962-1974 come from Brundenius (1984) with two exceptions concerning the 1971 and 1972 depreciation charges, whose values were not published and were imputed at 2% of capital values. Gross investments and depreciation for the years 1975-1989 come from the *Anuario Estadístico de Cuba* (1990). The post-1989 investment figures have not been published officially and had to be imputed from references in the literature. Gross investments in 1990 were estimated as declining 6% from the peak year 1989, a decline which corresponds to the reduction in imports of machinery and transport equipment published by the CIA (1994). Gross investments in 1991 and 1992 come from Casanova (1994) and differ from the earlier 1991 estimates by Carranza (1993) used in our previous research (Alonso & Lago, 1994), and from the 1992 estimates published by the government-run Consultores Asociados S. A. (CONAS, 1994). The 1994 gross investment estimates come from José Luis Rodríguez' December 20, 1994 speech to the Asamblea Nacional del Poder Popular (Foreign Broadcast Information Service, January 1995).

Depreciation for the missing years was estimated as follows. The depreciation for the pre- revolutionary period 1949-1957 was estimated from the Banco Nacional de Cuba as comprising 1.2% of capital values, clearly an underestimation of depreciation, but by 1957, the annual depreciation figure was 1.75% of capital values. As a consequence the depreciation for the missing years 1958- 1961 and 1971-1972 was estimated at 2.0% of capital, the same rate used in our previous work (Alonso & Lago, 1994). The 2.0% depreciation charge fits closely the depreciation charges during the revolutionary period 1962-1970 published by Brundenius (1984). The Cuban authorities increased the depreciation charges annually to 4.22% of capital values in 1979 and to 4.90% in 1989. Accordingly, the missing value for the 1990 depreciation charge was imputed at 4.90% of capital values, then lowered to a more reasonable 4.0% of capital for the post-1990 period of economic decline. The average depreciation charge for the entire period 1958-1994 that results from the mix of actual figures and our estimates is 4.0% of capital values. The Cuban government has not published any depreciation figures since 1989.

Sugar Prices and Oil Prices

Sugar and oil prices per ton for the pre-1989 period come from the *Anuario Estadistíco de Cuba* (1990) and correspond mainly to the trade with the Soviet Union. The sugar and oil prices for 1990 and 1991 come from José Luis Rodríguez (1992). After 1991, all the figures are expressed in world market prices. The world sugar prices come from GEPLACEA (1995) and from the U.S. Department of Agriculture (1994). The oil prices come from the World Bank (IBRD, 1994).

Labor and Employment

The pre-1980 employment figures come from Mesa-Lago (1981) and the 1980-1989 come from CEPAL's several publications, including Notas..... (1990) and the *Economic Surveys of Latin America and the Caribbean.* (Selected 1ssues 1983-1990). Mesa-Lago's pre-1980 employment figures were adjusted to reflect the private farm labor estimates presented by Ghai, Kay and Peek, (1988). The 1992 and 1993 employment figures come from the Concertación Democràtica Cubana (1993) and from the Asociación Nacional de Economistas Independientes de Cuba (ANEIC, 1994)[7]. The 1994 employment estimate comes from the Reuters' interview with the Cuban union leader Pedro Ros Leal (Kerry, 1995). Labor figures for the year 1990 were imputed assuming changes proportional to the GDP change for that year. Labor estimates for 1991 were projected in between the above figures. Labor figures for June 1995 come from Salvador Valdez (1995), while unemployment rates and labor figures for 1989 originate from Enid Felipe (1995).

Foreign Trade Price Indexes

Unit values of Cuban imports estimated by Mesa-Lago and Pérez-López (1991) for the period 1975 -1987 were used as the primary source for world prices facing Cuba's imports, an important exogenous variable for the prediction of both black market prices and black market exchange rates. This index was projected for the period 1988-1989 from the Russian export unit values reported in the IMF's Study of the Soviet Economy (IMF, 1991). For the earlier pre-1975 period, the unit value indexes for Russian exports to the CMEA countries (Marer et al., 1992) were used as the basis for interpolating backwards in time the later Mesa-Lago and Pérez-López' indexes. Post-1989 import prices were projected proportional to the Russian oil prices charged to Cuba for 1990 and to the world oil price for the period 1991-1994.

Interest Rates

The interest rates on savings accounts offered by the Banco Popular de Ahorro (BPA) of Cuba for saving deposits under 1,000 pesos are used as proxy for interest rates available to households. The source of the interest rate data previous to 1993 is the Banco Nacional de Cuba's Report by the Task Force to Cuba (1989). The post-1992 data comes from Marta Beatriz Roque-Cabello of the ANEIC.

Budgetary Expenses, Taxes and Deficits

According to Mesa-Lago (1994), no budgetary data has been published for the period 1966-1977. Figures on government expenses, taxes and deficits for the period 1978-1989 are available from CEPAL's *Economic Survey of Latin America and the Caribbean* (Several issues). Figures solely on the deficit are presented for the period 1981-1993 in CEPAL's *Cuba: Evaluación económica durante 1993* (Junio 1994), while budgetary deficit figures for 1990-1993 are available from *Bohemia* (Terrero, 1994). Deficit figures for 1990 to 1992 are available from Casanova (1994) and for 1992- 93 from José Luis Rodríguez' Radio Progreso interview (1994). Finally, deficit figures for 1994 come from *Cuba Business* (Jan/Feb 1995) and from the Economic Press Service (Diciembre 1994, and Enero 1995).

Household Liquidity: Money in Circulation and Savings Deposits

Household liquidity figures, covering both money in circulation and savings deposits, are available from 1975 to 1990 from Alpízar (1992). The components of the balance of income and expenses of the household sector are presented from 1975 to 1989 in the *Anuario Estadístico de Cuba* (1990). The sums of money in circulation and savings deposits (but not data on the components) are available from *Bohemia* (Terrero, 1994) for the period 1990-93, while similar data for 1994 are available from Economic Press Service (Enero 1995). Household liquidity figures, sometimes called the monetary surplus, are available without details on the components for the period

7. Employment figures for 1992 were supplied by Marta Beatriz Roque-Cabello of the ANEIC based on the research of Angela Fauriol of CIEM in La Habana

1970 - 1978 from Mesa-Lago (1981), whereas the monetary surplus for the period 1961-1988 are available (in aggregate form) from José Luis Rodríguez (1990). Earlier monetary data for 1959 and 1960 and for the pre- revolutionary period are available, with details on the components, from the Grupo Cubano de Investigaciones Económicas (1963).

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