

20th Symposium on Banking and Monetary Economics
Birmingham, June 5-6, 2003

A MODEL OF THE DOLLARIZED CUBAN ECONOMY

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(Provisional version ; not to be quoted)

Abstract

The specificity of dollarization in Cuba is its coupling with a central control of production and markets. The domestic regime implemented since 1993 combines strict exchange controls with a double monetary duality (two legal tender currencies, with two different exchange rates between them). It has allowed the Cuban economy to survive the external shock of the collapse of the European socialist block and to start a “recuperation” process. However, the depreciation of the peso in 2001 raises the issue of the long-term viability of this monetary and exchange regime. The paper aims at showing that this regime generates an endogenous tendency to the depreciation of the national currency, which will make difficult in the future to achieve the official objective of replacing the dollar by a convertible peso.

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Introduction

The abundant literature on dollarization is based on the study of cases in which this process goes hand in hand with a liberalization of the economy, characterized among other aspects by the lifting of all restrictions on foreign exchange transactions, whether for the current account or the capital account. Under these conditions, it is difficult to distinguish between the effects – good or bad – of dollarization *per se* and those of an uncontrolled exchange market between the dollar and the national currency – of course when such a currency survives, i.e. when the legal dollarization is not complete.

It may then be interesting to study a situation in which the dollarization process is accompanied by the maintaining of exchange controls. This has been the case of Cuba since the ownership and the circulation of the dollar has been legalized in July 1993, while the “national peso” remained in use. This is the aim of the present paper, which is organized in four sections. Section 1 discusses the specificity of the Cuban monetary and exchange regime, which combines strict exchange controls with a double monetary duality (two legal tender currencies, with two different exchange rates between them). Section 2 raises the issue of the long-term viability of such a duality, in the perspective of a more circumstantial question: why did the national currency depreciate against the dollar since 2001, while it had remained stable at the end of the 1990s? Section 3 presents a simple model which demonstrates the main result of the paper: the specific kind of dollarization implemented in Cuba generates an endogenous tendency to the depreciation of the national currency, which will make difficult in the future to achieve the official objective of replacing the dollar by a convertible peso.

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Section 4 draws some conclusions, in particular about the irreversibility of the dollarization process, even when it is strictly controlled.

1. The specificity of the Cuban monetary and exchange regime

At first sight, the main feature of the Cuban economy is its *duality*: there are two currencies (the US dollar and the “national peso”), two domestic exchange rates between them (one for the firms and one for the population), two exchange regimes (with fixed and floating rates, respectively), two productive sectors (the “emerging” one and the “traditional” one), two kinds of property in these sectors (the state one and the private one), two domestic markets for goods (one in dollar and one in “national peso”), two price regimes (an administrative one and a market one), two banking sectors (one for the firms and one for the population), two ways for the population to have access to the dollar (one legal and one illegal). The situation is however still more complex: firstly, these various pairs do not overlap, so that one cannot separate two homogenous sub-economies; secondly, a third element often complements each pair, so that arbitrage possibilities are generally more triangular than bilateral, if not multilateral.

One may sum up the main aspects of the Cuban economy which are relevant for the understanding of its dollarization; they concern money, exchange, and the system of production and markets.

1.1. Legal tender and convertibility: a monetary duality:

There are not in fact two but three legal currencies which may be owned and used in circulation: the “national peso” (*moneda nacional*), the US dollar and the “convertible peso” (*peso convertible*)¹. None of them – including the US dollar – is endowed with external convertibility, because neither individuals nor firms are free to transfer abroad any currency, even on the current account². Inflows of foreign currency generated by exporting firms are centralized and allocated by the state; as for individuals, they may keep dollars legally obtained through family transfers from abroad (*remesas*) or personal activity (*por cuenta propia*).

¹ From now on, the term *peso* will designate the «national peso», to be distinguished from the (literally speaking) *convertible peso*.

² There is an exception for foreign or jointly-owned companies, which may transfer abroad the dollars they earn under particular conditions.

Inside Cuba, the three currencies are not freely interchangeable, either against one another, or as a means of exchange in domestic transactions, or as a store of wealth in bank saving accounts. No exchange market exists for the firms (*“personas jurídicas”*), who obtain from the state and return back to it the quantity of each currency required and generated by their activity. Individuals (*“personas naturales”*) have access to what the central bank (*Banco Central de Cuba*, or BCC) calls “a regime of limited convertibility, implemented through institutional channels” (BCC, 2001: 32)³: in all the exchange bureaus of the state bank CADECA, dollars may be sold for pesos at a fixed exchange rate and in unlimited quantities; in only some of these bureaus, convertible pesos may be obtained against pesos at a slightly higher exchange rate⁴ and in quantities limited to 100 convertible pesos per person and per day. Strictly speaking, the peso is therefore not convertible in dollars, but it is convertible, with limitations, in a currency issued by the BCC at par with the dollar. In domestic transactions involving firms, two mutually exclusive spheres coexist, even if a particular firm may belong to both of them: when the output is sold in convertible currency (dollar or convertible peso), the firm has to purchase its inputs from other firms in the same way; when its sales are in pesos, it may purchase the inputs in pesos, unless dollars are required and then provided by the state. In all firms, wages are paid in pesos⁵; firms selling in convertible currency may only distribute bonuses in that currency, in fixed limits. For the transactions of the population, two kinds of markets coexist, which are strictly separated according to the means of exchange: in what Cubans usually call “shoppings” (officially TRD, for *“tiendas recaudadoras en divisas”*), the goods are paid for in convertible currency (dollar or convertible peso, taken at par), and in ordinary stores they are paid in pesos. The same holds in the tourism sector and for a legally fixed list of services – catering (*“paladares”*), lodging (*“casas particulares”*), etc. – which individuals are allowed to sell, some of them in convertible currency, others in pesos. Finally, separate accounts are held in banks for each of the three currencies, and a different interest rate is served to individuals on fixed-term deposits, the highest on the peso and the lowest on the dollar, with an intermediate one on the

³ One also finds the term “informal exchange market” to designate these “institutional channels”; the “informality” comes from the fact that the exchange rate in this “market” is not the “official” one applied to firms (see below).

⁴ In March 2003, the buying price of the dollar by CADECA was 26 pesos and the selling price of the convertible peso was 27 pesos.

⁵ This means that all firms have to hold separate accounts in convertible currency and in pesos, even when their receipts from sales are not in both currencies.

convertible peso⁶. This means that, even though the convertible peso and the dollar are perfect substitutes as means of exchange, they are not considered so as stores of value, since it is necessary to induce the population to save in the former currency rather than in the latter one.

1.2. Exchange rates: an exchange duality

The Cuban monetary system is not only characterized by the coexistence of a (domestically) convertible currency (the dollar or the convertible peso, taken at par) and a partially convertible one (the “national” peso), but also by the coexistence of two exchange rates between them, one for the firms and one for the population. All the exchange operations between “*personas jurídicas*” (firms and administrations) are made at the official one-to-one rate⁷. As seen above, “*personas naturales*” (individuals, including persons selling services of their own) may sell dollars against pesos and buy convertible pesos with pesos at CADECA, at an administered exchange rate which is significantly higher (it never fell below 19 pesos since this “informal” exchange market was introduced). Besides, black-market exchange rates complement the “official” and “informal” rates, but in the recent years they did not depart much (at least in Havana) from the CADECA rates⁸, showing a rather good integration of the exchange market, whether “informal” or illegal.

If the official rate is ruled by a fixed exchange regime, there is some ambiguity about the exchange regime which regulates the “informal” rate⁹. The state bank CADECA is part of the group “Nueva Banco”, and it is then formally distinct from the central bank (BCC). It returns to the BCC the dollars purchased from the population and it gets from her the convertible pesos sold to the population. Officially, these convertible pesos are issued with a 100% backing by dollars (which makes this regime resemble a currency board), and the

⁶ For each term, the structure of the interest rates served on deposits in (respectively) pesos, convertible pesos, and dollars, is 3/2/1.

⁷ The only exception is provided by some operations between CADECA and the Minister of internal commerce (MINCIN): CADECA sells dollars for pesos to the MINCIN, at a rate slightly above the one at which it acquires them from the population; the MINCIN then uses these dollars to purchase abroad goods which it sells to the population in pesos (see Hidalgo, Tabares, Doimeadios, 2002: 24).

⁸ In March 2003, the buying and selling black-market prices of the dollar in Havana were respectively 27 and 28 pesos, i.e. one peso above the rates at CADECA. The spread is higher in the distant provinces, where the convertible currency is not always available at CADECA, and this leads to repressed trafficking.

⁹ From now on I shall consider only the buying price of the dollar by CADECA, which I shall call the CADECA rate, neglecting the constant spread with the selling price of the convertible peso.

CADECA rate is determined by the supply and demand of convertible currency against pesos from the population. In fact, this rate does not vary day after day, and its evolution shows successive plateaus, suggesting that it is administered. Hidalgo, Tabares, Doimeadios (2002: 23) speak of a dirty-floating regime (“*regimen de flotacion sucia*”), but they only mention a situation of net *purchases* of dollars by the BCC, leading between 1996 and 2001 to fluctuations constrained by an “implicit band” of 19-23 pesos per dollar (*ibid*: 24-25). There is in official or research papers no indication of net *sales* of convertible currency by the BCC since the depreciation of the peso in 2001, either through the use of her reserves or the issuance of unbacked convertible pesos. The question of the asymmetrical or symmetrical character of this dirty-floating regime, and accordingly of a strict or loose currency board, is then left open (see more on that below in section 2).

1.3. Production and markets

The literature about the Cuban economy usually distinguishes two production sectors, the “emerging” one and the “traditional” one (CEEC, 2001, 2002; CEPAL, 2000; Hidalgo and Doimeadios, 2003; Hidalgo, Tabares, and Doimeadios, 2002; Marquès Pereira et Théret, 2002; Marquetti, 2002a, 2002 b, 2003). This duality is the outcome of two interrelated factors: the reorientation of production capacities towards import-substitution and tourism since the collapse of the socialist block opened the “special period” in the early 1990s, and the legalization of the dollar in the middle of this decade.

The “emerging sector” is mainly composed of mixed and Cuban companies which developed in relation with the tourism industry (now the first provider of hard currency) and / or the domestic markets for goods in dollars; some firms also emerged in the export of high value-added products (e.g. the pharmaceutical industry). The common aspect of firms belonging to this “emerging” sector is that they sell their output in dollars (either to other firms, to the population, or abroad) and they purchase their material inputs (imported or domestically-produced) or borrow funds from banks in dollars; only the wages are paid in pesos (with some bonuses in convertible currency). Although all Cuban companies are state-owned (and also the Cuban share in mixed companies with foreign capital), a process of decentralized management has been implemented (“*perfeccionamento empresarial*”) since the late 1990s, which aims at making the production units more responsive to market signals. Nevertheless, prices are still fixed by the central authorities (the ministries corresponding to particular industries), and, as seen above, firms do not have access to a foreign exchange

market: they obtain from the central authorities the pesos they need against dollars computed at the fixed official exchange rate of one.

The “traditional” sector is composed of the other state-owned firms, which are strictly controlled by the respective ministries. Their activity was until the early 1990s dependent of the division of labor implemented among the various countries of the socialist block, and they have been hit by its collapse. Even the ones which generate hard currency through exports (like the sugar industry) are usually technically obsolete and heavily labor-intensive, and their output is gradually scaled down. Nevertheless, they still play a central rôle in the satisfaction of the basic needs of the population through the markets in pesos, either the quantity-rationed one (where the *“libreta”* allows the population to purchase given quantities of basic products at highly-subsidized prices), or the “free” ones (*“mercados libres”*) where the prices are also centrally-fixed. These “traditional” firms have been recently induced to increase their level of efficiency and, in this perspective, they are allowed to sell part of their output in the markets in dollars. As a consequence, they have outputs denominated in both currencies, in addition to the inputs which are already so (those imported or purchased from domestic firms selling in dollars being denominated in that currency); the conversion is done by the central authorities, at the official exchange rate of one.

Besides, a third sector exists, with aspects belonging to the other two: the small private sector, composed of the agricultural cooperatives (selling in the *“mercados agropecuarios”*) and of the individuals selling services of their own (*“por cuenta propia”*). Their output is strictly regulated by the central authorities, but their activity may be oriented either towards the markets in dollars or the ones in pesos, with a certain flexibility in the fixation of prices.

It appears then that, although the opening of domestic markets in dollars has been a strong stimulus for the development of the “emerging” sector, the duality of production sectors and the one of currency-denominated markets do not overlap exactly. The complex relation between these two dualities may be summarized in different ways. A first one is by the structure of the exchange rates of the dollar in peso. As we will see below, the huge gap between the official exchange rate (one) and the “informal” exchange rate at CADECA (which since 1996 varied from 19 to 26) testifies to an under-valuation of the dollar for firms, and its overvaluation for the population. The former is the main instrument to induce transfers from the “emerging” sector to the “traditional” one, in order to maintain the low prices in pesos of the basic consumption goods for the population. The latter is one of the instruments implemented by the State to capture part of the private receipts in dollars, in conjunction with the price system ruling in the goods markets in dollars. Prices of commodities provide then

another link. Although it is difficult to compare the prices in dollar and in peso for the same consumption good (because the quality is usually inferior in the market in pesos), it appears clearly that the purchasing power parity does not apply domestically: at the ruling exchange rate at CADECA, the price of a good in dollar is usually twice or three times its price in the “free” market in pesos, and far more its price in pesos with the “*libreta*”¹⁰. The markets in dollars then perform a double function: as a safety valve for the satisfaction of consumption needs during a “special period” when the supply in the markets in pesos has fallen, and as a pumping device of dollars for the State.

Finally, the respective weights of both kinds of production sectors and of currency-denominated markets may be appreciated through the following figures. Between 1996 and 2001, the yearly growth rate of the sales in hard-currency stores (TRD) has been in average four times the GDP growth rate (Marquetti, 2003: graph 5, p. 13); in 2001, 73.6 % of the inter-firm sales were realized in dollars (41.6 % to the TRD and 32 % to the tourism industry), while 68 % of the purchases in dollars by the tourism industry and 55 % by the TRD were of domestic products (Hidalgo, Doimeadios, 2003: 7); in 2000, 58 % of the household consumption was purchased in dollars, against 49 % in 1997 (*ibid*).

2. The viability of the monetary and exchange duality

The observation of the Cuban economy since the middle of the 1990s raises one puzzle: why did it survive the external shock of the collapse of the socialist block and the internal shock of dollarization, without the “special period” degenerating into an economic and social outburst? Two institutional factors have characterized this situation: on the one hand, some typical aspects were inherited from the socialist period, such as the centralized control of production and foreign trade, the existence of administered prices on most markets, the rationing of subsistence consumption (“*libreta*”); on the other hand, a specific monetary system, with its two (in fact three) currencies and its two exchange rates, was designed to fulfill two objectives: to maintain a collective coverage of the basic needs of the population (including health and education), through transfers from the “emerging” sector and from the private owners of dollars, and to allow an individual loosening of the sudden shortage of resources, through the inducement to dollar-hunting.

¹⁰ For example, the price in March 2003 of the pack of 20 cigarettes “Popular” was 2 pesos with the *libreta* (for a quantity limited to 3 packs per month), 7 pesos in “free sale” (“*venta libre*”), and 0.50 dollar in the “TRD” (hard-currency store), i.e. the equivalent of 13.5 pesos at the CADECA exchange rate of the convertible peso.

Most studies, in and out Cuba, conclude that this cocktail of centralization and dollarization has been successful to implement the “recuperation” of the economy and to avoid a social breakdown. They also pinpoint its perverse effects on the social distribution of wealth and on individual behaviors, which have widened the gap between the official egalitarian ideology and the actual functioning of the Cuban society. Among economists, the current debate is mainly about the future growth pattern and the institutional changes which it will require (Marquetti, 2002 b, 2003; Monreal and Carranza, 2001; and, for an analysis of this debate, Marquès Pereira et Théret, 2002). Only few Cuban economists raise the issue of the future of the monetary and exchange duality, through interrogations about a change in the official exchange rate (Marquetti, 2002 a) or the creation of an exchange market for the firms (Hidalgo and Doimeadios, 2003; Hidalgo, Tabares, and Doimeadios, 2002).

The present paper aims at addressing the broader issue of the viability of the monetary and exchange regime itself. It is generally understood by Cuban officials and academics that the dollarization is a temporary regime, which will continue as long as the “special period” will not be over, but will be dropped when the “real” economy has improved enough to sustain a convertible national currency. The future of the monetary regime would then result from an official decision to merge the present “national” peso and the dollar into the single convertible peso, the remaining problems being to determine the appropriate *external* exchange regime with foreign currencies (the euro being more and more a good candidate as anchor currency) and the appropriate exchange rate – in short the kind of problems faced by any country endowed with a national currency in an open economy.

The figures given above show a steady progress of dollarization during the past few years, up to levels (more than 70 % of inter-firm sales and nearly 60 % of sales to the population) which already cast a doubt on the reversibility of the process. Of course, these evaluations have to be taken cautiously, because they are biased by the overvaluation of the dollar at CADECA and by the low prices (or even the gratuity) of many basic goods such as housing, health, and education. There is however another element of concern which can be easily observed, even if its interpretation is not as easy. After a remarkable stability of the CADECA exchange rate between 1997 and 2001 (with variations limited between 19 and 23 pesos per dollar, and even 21-22 since mid-1998), it rose by 18 % to 26 at the end of 2001, where it has remained ever since. How can this depreciation of the peso be explained? The BCC mentions two causes linked to the international situation after September 11: the contraction of private receipts in dollars (mainly because of the slowing-down of tourism) and the deterioration of the terms of trade (BCC, 2002: 32). Whatever the impact of these

phenomena, one may ask the question: is there any other factor which may have played a rôle?

The figures about the progress of dollarization, however imperfect as they are, suggest that, apart from short-term exogenous (and external) factors, an endogenous (and domestic) medium-term tendency to the depreciation of the peso might exist. They testify to the rapid growth of a mass of wages in pesos having no counterpart in a supply of goods in pesos (since the “emerging sector” and part of the “traditional” sector sell in dollars while they pay their wage bills in pesos), and, at the same time, to the capacity of the Cuban households to purchase these goods sold in dollars. These two facts are only consistent with each other because, above the direct spending of privately-owned dollars (hence outside any exchange operation), incomes received in pesos may be exchanged for convertible currencies (convertible peso or dollar) at CADECA and in the black market. The more the dollarization spreads out, the more the supply of pesos against dollars increases (whatever the exogenous supply of dollars against pesos), and the more the peso tends to depreciate.

This assumption raises however an objection: if this tendency is the consequence of the dollarization process, why did the CADECA exchange rate remain stable during four years, from 1997 till 2001? As already mentioned, Hidalgo, Tabares, and Doimeadios (2002: 23) underlines that the intervention of the BCC in the “informal” exchange market has led during this period of stability to net purchases of dollars by the central bank, which means that the band of variation observed at CADECA (19-23 pesos per dollar) was *above* the exchange rate which would have equilibrated the private supply and demand of dollars. This conjecture is confirmed by the above observation that, converted in pesos at the CADECA rate, prices for goods in the markets in dollars are higher than those in the markets in pesos. This suggests that there is a deliberate policy, implemented through the exchange rate and the system of administered prices, to induce owners of dollars to sell them to CADECA, even at the cost of an apparent under-valuation of the peso, as compared to what would be the equilibrium exchange rate in a free-floating regime¹¹.

Consequently, the stability of the *administered* exchange rate from 1997 till 2001 is not contradictory with the existence of a tendency to the *market* depreciation of the peso. This

¹¹ By equilibrium exchange rate, I do not mean the one which would exist in a hypothetical market economy, ruled by the « law of supply and demand », but one which would ensure the purchasing power parity between the domestic markets in dollars and in pesos, where the prices are administered. It would be more appropriate to speak of a no-arbitrage exchange rate.

tendency may have operated without generating an increase in the CADECA rate, which from the very beginning had been fixed at a level significantly higher than the equilibrium rate (maybe twice as high, since the deviation from the domestic purchasing power parity is around this magnitude). Therefore the (hidden) increase in the equilibrium exchange rate of the dollar did not reflect in the CADECA rate. To put it another way, the initial deliberate under-valuation of the peso not only aimed at capturing for the State part of the private receipts in dollars; it had also the effect (voluntarily or not) to open a margin for a depreciation of the peso which would be inescapable when dollarization would spread out, but unobservable in the CADECA rate. In short, a hidden crawling peg... A last advantage of this policy, in the long-term perspective of a regime with a single convertible peso, would be to then facilitate the adoption of a “realistic” exchange rate below the abnormally too high CADECA rate.

If things were like that, the sudden step down of the peso at CADECA in 2001 has not been (or not only) the consequence of an exogenous shock, which was only the pretext, through an administered devaluation, to preserve the capacity of the State to capture private dollars *and* to reconstitute a hidden depreciation margin of the peso for the future. And the endogenous tendency to the depreciation of the peso, as a consequence of the dollarization process, is not contrary to facts. A simple model may establish this point further.

3. The model

I shall focus here on the effects of the growth in the proportion of the aggregate output which is sold in dollars, what Cuban economists call “exports within borders” (“*exportaciones en fronteras*”). The argument may then be presented as if the economy were a closed one; the foreign trade will be introduced in a future stage of the research. I shall firstly examine the hypothetical case of a free-floating regime, and then the actual case of dirty floating.

3.1. The hypothetical case of a free floating exchange regime

Let us consider the “informal” exchange market (CADECA) as if the BCC did not regulate it. I shall also neglect savings and assume that, due to the shortage of goods as compared to the needs of the population, all incomes are spent. The equilibrium exchange rate e^* of the dollar in peso is then determined by the ratio between S^P , the supply of pesos

against dollars¹² and $S^{\$}$, the supply of dollars against pesos, both supplies being by individuals only:

$$(1) \quad e^* = S^P / S^{\$}$$

$S^{\$}$ is equal to the difference between $R^{\$}$, the dollars obtained by individuals through family transfers and sales of services, and $R_{\$}^{\$}$, the dollars spent by them in domestic markets in dollars:

$$(2) \quad S^{\$} = R^{\$} - R_{\$}^{\$}$$

The quantity S^P of pesos is supplied at CADECA by the workers of the firms selling in pesos and of those selling in dollars ; for each group of workers, it is equal to the difference between the wages earned (respectively Y_P^P and $Y_{\P) and the expenses made in domestic markets in pesos (respectively S_P^P and $S_{\P) :

$$(3) \quad S^P = (Y_P^P - S_P^P) + (Y_{\$}^P - S_{\$}^P)$$

I shall here consider that the various industries are integrated, so that the aggregate domestic product in pesos is equal to the value V^P of the consumer goods sold for pesos, which is itself equal to the incomes distributed for their production:

$$(4) \quad V^P = Y_P^P$$

By definition, the aggregate value of the sales in pesos is equal to the sum of the expenses made by both groups of workers :

$$(5) \quad V^P = S_P^P + S_{\P$

As seen above, the wages in the sector selling in dollars are paid in pesos, so that they are equal to the value $V^{\$}$ of the domestic sales in dollars, converted at the official exchange rate e (equal to one):

$$(6) \quad Y_{\$}^P = V^{\$} \cdot e$$

Introducing (4) to (6) in (3) gives :

$$(7) \quad S^P = V^{\$} \cdot e$$

Combining (1), (2) and (7) gives the level of the equilibrium exchange rate at CADECA :

$$(8) \quad e^* = e \cdot V^{\$} / (R^{\$} - R_{\$}^{\$})$$

If one calls α the proportion of the private receipts in dollars directly spent to purchase goods in dollars ($\alpha = R_{\$}^{\$} / R^{\$}$), equation (8) becomes :

$$(9) \quad e^* = e \cdot V^{\$} / R^{\$} (1 - \alpha)$$

¹² In fact the supply of pesos is against convertible pesos (offered by CADECA), but, as said above, I shall here consider only the exchange rate between the dollar and the peso.

The interpretation of these equations confirms what was suggested in section 2 above : the « informal » exchange rate varies positively with the official exchange rate and the level of the domestic production for markets in dollars, and negatively with the unspent private receipts in dollars. The level of the exchange rate e^* reflects four independent phenomena : the decision of central authorities concerning the official exchange rate, the decisions of firms concerning the level of their output sold in dollars, the exogenous inflows of private dollars, and the consumption behavior of that part of the population having access to dollars.

The respective influences of these factors may be studied further. In the markets in dollars, the value $V^{\$}$ of the sales is by definition equal to the sum of the expenses $R_{\$}^{\$}$ made by the owners of dollars and the expenses made by those having purchased the convertible currency at CADECA, which, in the supposed absence of any intervention of the BCC, is equal to the supply of dollars at CADECA :

$$(10) \quad V^{\$} = R_{\$}^{\$} + S^{\$}$$

which, according to (2), becomes :

$$(11) \quad R^{\$} = V^{\$}$$

This is not a surprise: the private receipts in dollars are spent directly (by their owners) or indirectly (after their transfer through CADECA) to purchase the output sold in dollars.

Substituting (11) in (9) gives:

$$(12) \quad e^* / e = 1 / (1 - \alpha)$$

The ratio of the equilibrium exchange rate to the fixed official one is then exclusively and positively determined by the proportion of the private receipts in dollars spent in the markets in dollars. Of course, this proportion is not an exogenous parameter : for an individual owing dollars, the arbitrage between using them to purchase goods and selling them to CADECA in order to purchase goods in pesos depends on the availability of goods and on the system of administered prices in both kinds of markets. It is then influenced by the decisions of the firms and of the central authorities.

3.2. The actual case of a dirty-floating regime :

We have seen in section 2 that, from the very beginning, the dollar had been deliberately overvalued by the BCC at CADECA (by contrast with its official under-valuation in the production sector), so as to induce individuals to sell the dollars they owed and to generate an increase in the foreign exchange reserves of the central bank. This means that the administered exchange rate \bar{e} at CADECA has been fixed *above* the equilibrium rate e^* (i.e. the rate which would have been observed in the absence of any BCC intervention).

As a consequence of this dirty-floating regime, the individuals no longer exchange at CADECA their supply of pesos S^P against the private supply of dollars $S^{\$}$, but they only obtain in return an amount of dollars equal to S^P / \bar{e} , the remaining quantity $B^{\$}$ being absorbed by the BCC :

$$(13) \quad S^{\$} = (S^P / \bar{e}) + B^{\$}$$

which according to (2) and (7) gives :

$$(14) \quad R^{\$} - R_{\$}^{\$} = (V^{\$} \cdot e / \bar{e}) + B^{\$}$$

Equation (10) stating the equality between supply and demand in the markets for goods in dollars must be rewritten as :

$$(15) \quad V^{\$} = R_{\$}^{\$} + (V^{\$} \cdot e / \bar{e})$$

One may check from (14) and (15) that equation (11) is replaced by :

$$(16) \quad R^{\$} = V^{\$} + B^{\$}$$

which simply means that the private receipts in dollars which are channeled to the BCC through CADECA can no longer be captured by state firms through sales : the «informal» exchange market and the administered goods markets in dollars are two *alternative* ways for the central authorities to recuperate private dollars, and what is captured by one channel is lost for the other.

Rearranging (14) and (15) gives the following relation between the «informal» and the official exchange rates :

$$(17) \quad \bar{e} = e \cdot (R^{\$} - B^{\$}) / (R^{\$} - R_{\$}^{\$} - B^{\$})$$

Equations (12) and (17) provide two determinations of the exchange rate in the “informal” exchange market, the first one for the equilibrium rate e^* , the second one for the administered rate \bar{e} . Let us call \mathbf{d} the relative deviation between the two rates $(\bar{e} - e^*) / e^*$, and \mathbf{b} the proportion of the private receipts in dollars captured by the BCC ($\beta = B^{\$} / R^{\$}$); after some manipulations (and remembering that $\alpha = R_{\$}^{\$} / R^{\$}$) one obtains :

$$(18) \quad \beta = \delta (1 - \alpha) / (\delta + \alpha)$$

or, put in another way:

$$(19) \quad \beta = (1 - \alpha) / [1 + (\alpha / \delta)]$$

For $1 > \alpha > 0$, \mathbf{b} is an increasing concave function of \mathbf{d} , the position of which is higher when \mathbf{a} decreases. The recuperation of dollars by the BCC through CADECA then varies positively with the deliberate depreciation of the peso, measured by \mathbf{d} , and negatively with the proportion \mathbf{a} of the private receipts in dollars which is spent directly in the goods markets (this confirms that the two recuperation processes are alternative). As noted above, \mathbf{a} is itself

negatively related to d , which, everything being equal (i.e. for a given availability of goods and a given system of prices in the markets in dollars and in pesos), switches the arbitrage of the owner of dollars towards a sale to CADECA. A positive level of d has then two favorable impacts on b : it mechanically reduces in favor of the BCC the quantity of dollars obtained through CADECA by the owners of pesos, and it reduces a , counteracting the tendency of the owners of dollars to spend them in the goods markets.

4. Concluding remarks

Two main conclusions may be derived from the model. The first one is contained in equation (9): for a given official exchange rate and a given allocation of dollars by their owners between the goods markets and CADECA, the peso tends to depreciate with the increase in the production sold in dollars and to appreciate with the private receipts in dollars from family transfers and personal services. The decline in these receipts did certainly play a rôle in the 2001 devaluation, but the positive impact of dollarization on the “recuperation” of the Cuban economy had also its counterpart in the tendency of the peso to depreciate. The second conclusion is contained in equation (18): the sophisticated exchange policy of the BCC has taken full advantage of the specific kind of dollarization implemented, since the under-valuation of the peso at CADECA has increased the foreign exchange reserves and hidden the inescapable tendency of the peso to depreciate. But the likely outcome of the process is a complete dollarization of the Cuban economy.

Three extensions of the model will have to be developed, in order to introduce the foreign trade, to endogeneize the spending behavior of the owners of dollars, and to make room for the banking sector. This will require to distinguish between various types of goods, instead of reasoning with aggregates, and to deal with an important aspect which has been left aside here: the over-liquidity of the Cuban economy. In its simple form, however, this model illustrates the irreversibility of the dollarization process, even in a centrally-controlled economy.

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