Is the External Debt of Tunisia Sustainable?
Cointegration Based Analysis

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ABSTRACT--- *Foreign capital contribution can have dramatic consequences if the evolution of the external debt is not profitable. Monitoring the external debt of low-income countries and emerging economies is compulsory. The use of monitoring tools based on different approaches in terms of empirical testing is useful for studying the dynamics of debt and assessing its sustainability. We propose to apply the two approaches assessing the sustainability of external debt in Tunisia. The approach based on the assessment of an accounting officer reveals non-debt sustainability; yet, two versions of the actuarial approach confirm the opposite. Adequate budgetary management improves the performance of the debt when it is not affected by common consumption.*

Keywords-- external debt sustainability, budgetary deficit .

1. INTRODUCTION

We can admit that there are two alternatives towards resorting to the foreign capital: allow or disallow external funding.

- The first is the outcome of believing that foreign capital is required for financing investments, necessary to growth; whom national savings are unable to fund. It is therefore optimal for a country to borrow if it can make profitable investment projects ensuring the inter-temporal creditworthiness of the country, hence, repay the debt later (Artus, 1993).
- The second is based on the choice of the national economy to balance the current account (Bayoumi, 1990). It can be as well, due to the impossibility to resort to external financing and thus forcing economic agents to rely only on their internal funding sources.

Krugman (1988) and Cohen (1986) gave birth to the theory of debt overhang. This theory claims that when external debt reaches a certain level, it discourages consumption and investment and thus limits economic growth. The slow growth pattern enhances debt raising, hence the focus will be on its sustainability.

Two categories of study are discussed to test the sustainability of external debt; a first category develops an accounting approach based analysis, which consists in simulating steps. A second category of time-series studies, tests out the application of the rule of sustainability based on different econometric tests of stationarity, cointegration and qualified actuarial approach.

2. THEORETICAL DEBT APPROACH

Recourse to external borrowing to finance the development of low-income countries has based its rationale in various scientific studies that have dealt with the theoretical aspects of this phenomenon. Most economists have demonstrated the need to use external resources to boost economies in developing countries, Cohen (1985), Artus (1998) and Bastidon (2002).

The weight of the external debt is amplified with the coexistence of several endogenous and exogenous factors specific to these economies. The low level of savings, embryonic financial markets, the plight of the current account, trade degradation and the burden of external debt, are all factors aggravating debts of low-income countries.

Studies dealing with external debt issue are mostly based on the traditional theoretical frameworks. Classic scholars perceive that the debt is equivalent to future tax and causes a negative connotation to the country. In his thesis, Ricardo has claimed that the behavior of economic actors is guided by an anticipation of rising taxes. A policy of budgetary deficit financed by borrowing has no effect on economic activity since agents save an amount equivalent to the debt when they expect higher taxes to reimburse the loan, Barro (1989). Any increase in the indebtedness and its services which constitute a tax on future production, discourages investment by crowding Sachs (1989).

Contrastively, the Keynesian budgetary deficit allows the stimulation of demand that will promote the development of a real capacity for repayment and thereby contribute to the alleviation of external debt.

2.1 Sustainability, solvency and liquidity

The debt is considered sustainable if it does not lead to an "excessive" accumulation of its stocks that is to say at a level that without major changes, could not be covered by future budgetary surpluses. It requires that the debt ratio (outstanding or net present value of future cash flows) relative to its gross domestic product, its export earnings or its domestic revenue remains at an acceptable level.

Accordingly, the financing of this debt excludes the recourse to a "Ponzi game[1]" in which government would resort to new debt to pay interests and the principal at maturity.

The notion of solvency signifies that a country's debt must eventually vanish. Practically, it is important that the indebted country can continue to receive external funding and thus regularly pay interests on its outstanding debt. Hence, solvency determines the ability of the government to provide on time the service of its debt without further borrowing and accentuating the burden of debt, Raffinot (1998).

Liquidity is a short-term notion. "A debt crisis can refer to two situations, a situation of illiquidity when the debtor is experiencing temporary difficulty yet, he can pay for his debt in the future given the sufficient time .Contrastively, insolvency is when reimbursement is not possible now or in the future, "Raffinot (1993).
Within the framework of their access to global credit markets, liquidity analysis is useful for developing countries.

3. EMPIRICAL APPROACHES TO SUSTAINABILITY AND CHOICE OF ANALYTICAL METHODS

We propose to examine the most used models to test the sustainability of the external debt. We have chosen to involve studies connected to empirical analysis. Thus, two study categories are highlighted to test the sustainability of external debt. The first develops a qualified accounting analysis which consists simulating steps. Based on time-series, the second category examines the respect of sustainability rule through various econometric tests of stationarity (Feve approach and Henin, 1998) and cointegration or actuarial approach (Leachman and Francis approach, 2001).

The used statistical data matches with those published by the National Institute of Statistics. They cover the period from 1983 to 2010. The data related to the government budget are extracted from the publications of the Ministry of Finance.
The debt interest rate is a blended rate, representing the interests of the debt reported to the amount of reimbursement for the period.

Another methodological technique is to calculate the so-called; exchange rate effect used to transform the variables relating to external transactions. Put in plain words; let's suppose a loan contract currency spent in year t for an amount m in one period. In terms of national currency, this amount corresponds to the sum of m * TC when TC denotes the value of the exchange rate. At the beginning of the period t +1 in domestic currency, the debt is equal to the depreciation A = m * TC, payable interests rise to r * m * TC. However, if the national currency depreciated and the TC reaches a certain value TC '> TC, the depreciation recorded and accounted becomes m * TC'> m * TC. To abstract the variation of the exchange rate, its effect will be neutralized by a correction factor, while respecting employment resources.

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[1] The game PONZI is named after Charles PONZI who scammed in Boston at the beginning of the last century. He has proposed investments for which promised a return of 40% in only 90 days. This case was based on a pyramid scheme selling: investment of new entrants used to pay former investors.

3.1 The accounting method

The approach examines through the intertemporal external constraint the external deficit sustainability apprehended by the current account or the trade balance of a country. This approach is based on the hypothesis stating that a government cannot borrow indefinitely on international capital markets to finance trade balance deficit.

Consider the following process of a country's debt accumulation noted Bt

$$\mathrm{B}_{t+1} = (1+r_t)B_t - NX_{t+1} \quad \text{or} \quad \mathrm{B}_{t+1} = (1+r_t)B_t + D_{t+1} \quad (1)$$

With:
 NXt 1: the trade balance or net export revenues
 rt: the nominal interest rate
 Bt debt at the beginning of the period
 Dt: the primary fiscal deficit excluding interest or net external deficit.

If the current account shows a negative balance NXt+1 then, the country's debt during the period increases by the (positive) amount while a surplus will decrease it. For a given process, NXT+1 and a nominal interest rate rt, the relation (1) implies a cumulative dynamic and unstable debt (a snowball effect[2]).

When dividing the equation (1) through Yt +1, which presents GDP, we obtain:

$$\frac{B_{t+1}}{Y_{t+1}} = \frac{(1+r_t)B_t}{Y_{t+1}} - \frac{NX_{t+1}}{Y_{t+1}} \quad (1)$$

Therefore:

$$\mathrm{b}_{t+1} = (1+r_t)\frac{B_t}{Y_{t+1}} - nx_{t+1} \quad (2)$$

This relationship can be rewritten taking into account the GDP growth rate n_t as:

$$\mathrm{b}_{t+1} = \frac{(1+r_t)}{(1+n_t)}b_t - nx_{t+1} \quad (3)$$

Based on the accounting approach, the condition of external debt sustainability requires the stability hypothesis of the debt ratio, that is to say $b_{t+1} = b_t$. We then obtain:

$$nx_{t+1}^g = \frac{(r_t - n_t)}{(1+n_t)}\mathrm{b}_{t+1} \quad \text{Or} \quad d_{t+1}^g = \frac{(n_t - r_t)}{(1+n_t)}\mathrm{b}_{t+1} \quad (4)$$

when:

nx_{t+1}^g is the (sustainable) required external net surplus which represents the trade surplus consistent with a stable ratio of debt over time.

The difference between the external deficit and the required net effective deficit represents a gap. This gap indicates if positive the sustainability of external imbalances, whereas if it is negative, it indicates that the deficit is unsustainable.

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[2] The snowball effect is an evolving circle accumulating new facts already present yet in a growing pattern, like a geometric series or even an exponential function. The label of this phenomenon is derived from the example of a snowball rolling down a slope covered with snow so we imagine that the ball will grow more and more and faster.

We have applied the accounting method on the series as published by the INS and the same data corrected for the effects of exchange rates as indicated above. Furthermore, we have calculated the required surplus (deficit) considering trade ratio surplus and current account (appendices). For all four cases, sustainability hypothesis has been verified for only one year, 1988. The study of the external debt sustainability in Tunisia by the accounting method results in its non-sustainability. In long term, the Tunisian economy will not be able to accumulate the needed wealth for the absorption of external debt.

The accounting method analysis is based on a static method; it does not take into account the cumulative effects of debt dynamics. The long term is perceived as a juxtaposition of short periods. The assessment of debt sustainability is relevant when present and future explicative trends of debt variables are considered.

The observation of Tunisian external debt data (Figure 1) shows a stable rate of debt, around 50% of GDP over the entire period of study. The same is also noticed in the case of current account balance to GDP. If this rate is not positive, it remains if it is close to zero. Maintaining these ratios at a stable level, suggest debt sustainability.
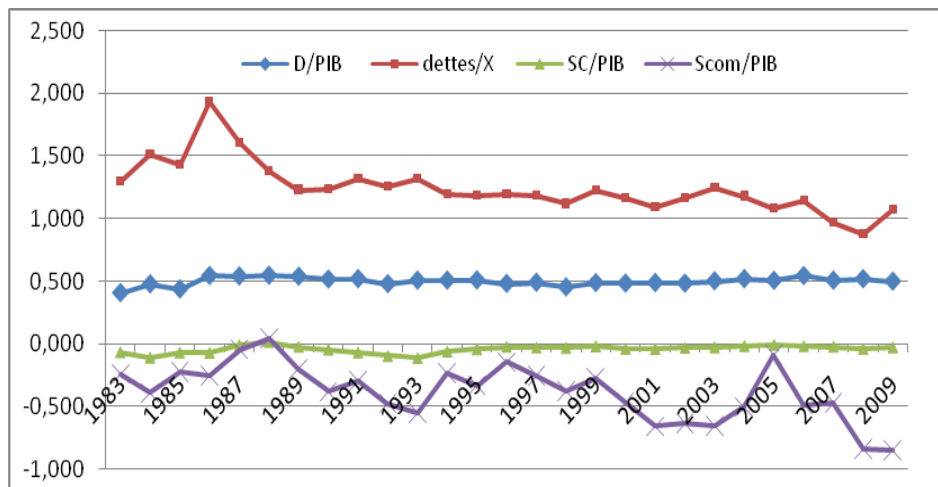

Figure1 : Evolution of principal indicators of debt sustainability

3.2 The actuarial method

This method is based on the assumption that the government as an economic agent is subject to inter-temporal budget constraint.

Highlighting the external conditions: (11) $CA_t = NX_t - rB_{t-1}$ (11)

when:
  B_t the process of external debt accumulation.
  r: the nominal interest rate on external debt assumed constant for convenience.
  NX_t: the trade balance or net revenues of goods exportation and services.
  CA_t: the current account balance.

We can write: (12) $B_t = B_{t-1} - CA_t$ (12)

The underlying assumption implies that the current account deficit generates a future debt, which increases because of the imbalance in the current account.

The dynamic of external debt is then written, taking into account the foregoing, as follows:

$$B_t = B_{t-1} - CA_t = (1+r)B_{t-1} - NX_t \quad (13)$$

Reasoning the initial date (t = 0) and with the necessary updates, we obtain:

$$B_0 = \frac{B_N}{(1+r)^N} - \sum_{t=0}^{N} \frac{NX_t}{(1+r)^{t+1}}$$

Let's consider

$$B_N = B_0 (1+r)^N + \sum_{t=0}^{N} \frac{NX_t}{(1+r)^{t-N+1}} \qquad (14)$$

The convergence condition of debt process is written:

$$\lim_{N \to \infty} \frac{B_N}{(1+r)^N} = 0 \quad (15)$$

This actuarial transversality condition is behind two approaches that involve the use of unit root tests on the one hand, and cointegration on the other hand, to assess debt sustainability. Feve and Henin (1998)'s approaches as well as Leachman and Francis (2001)'s ones will be the framework for this evaluation.

3.3 The approach of P. Feve and P.Y. Henin (1998): from an actuarial sustainability to an effective sustainability.

Assuming that the external debt is growing at a rate g, the condition of actuarial sustainability is only apparent in long-term, debt must grow slower than the interest rate (g <r). In practice, this condition may be insufficient when interest rate exceeds the growth rate (r> n). In fact, if the debt, and therefore long-term interest expense, grow at a rate g such that n <g <r, actuarial sustainability is satisfied, but debt burden is growing faster than the total resources and eventually exceed those resources. Hence, we end up with a long-term dilemma. The debt is sustainable since it increases slower than the rate of interest and at the same time it seems unsustainable due to the excess of interests' expense with respect to resources.

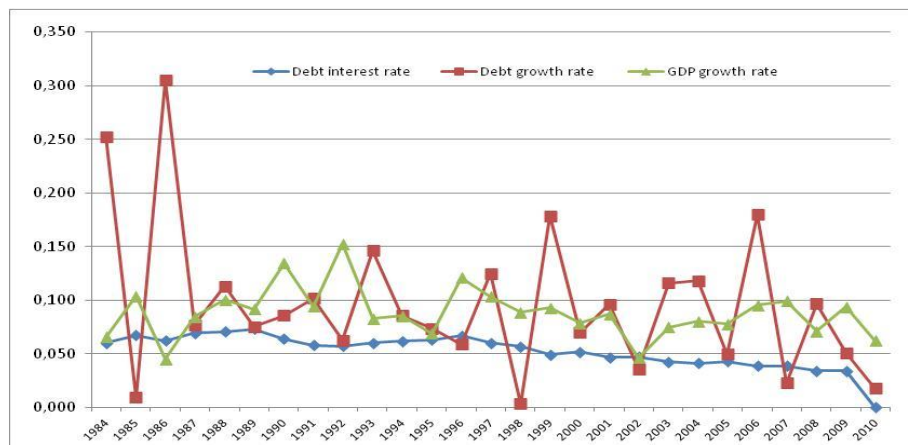The examination of the Tunisian case reveals the following facts:

Figure 2: Evolution of the debt interest rate, debt growth rate and GDP growth rate

Over the period studied, it is clear from the rate growth evolution of the product (n), the interest rate (r) and the growth rate of debt (g) for 14 out of 27 observations the relationship r <g <n is verified and in 13 cases the relation r <n <g is confirmed. In all cases, r remains less than g. This means that the sustainability condition is not verified. Furthermore, the comparative alternation between g and n gives further evidence to the unsustainability of the Tunisian debt.

To overcome the dilemma of incomplete sustainability, as in the case mentioned by FEVE and HENIN and n <g <r, when n <r but n <g, the authors have adopted the notion of *effective sustainability*. In the long-term, when debt ratio to the volume of resources tends zero, the debt service is assured.

In stochastic term, this condition implies that the standard variable debt follows a stationary process, that is to say, it does not include trend or seasonality, and more generally no factor evolving over time. These characteristics (expectation, variance and covariance) are not modified in time. Debt sustainability must be based on unit root tests.

3.4 Testing in the Tunisian case, gives the following results:

Based on the idea of Feve and Henin, the absence of a unit root for the explicative variables of the debt evolution, is enough to affirm that sustainability is accepted. Calculations for the Tunisian case (Table 1) show that the rate of debt and the current account balance relative to GDP are integrated into order zero. There is no unit root. Tunisia's external debt is sustainable. Despite the presence of a unit root for variable debt relative to exports, the Tunisian debt is considered sustainable because the rate of current account that is integrated into order zero.

Table 1: Results of ADF tests

Variable	ADF value	Critical value ; threshold accounting for 5%	Prob-critical	Integration degree
Debt / GNP	-3,91	-2,98	0,006	I(0)
Current balance / GNP	-3,68	-2,98	0,01	I(0)
Debts/Exports	-3,91	-3,58	0,02	I(1)
Current balance / Exports	-5,1	-3,61	0,002	I(0)

For Leachman and Francis (2001), unit root tests are not appropriate to analyze the sustainability of external debt. The debt can be sustainable even if the debt ratio has a unit root that is to say, it is not stationary. They propose to integrate the intertemporal dimension into the dynamics of debt accumulation by testing the existence of a cointegration relationship between exports and debt.

Based on the balance of payment, presented as follows;

$$\left(X_t - M_t\right) - F_t^n + dB_t = 0$$

$X_t - M_t$: the trade balance, F_t^n: the net flow of foreign capital, dB_t : the amount borrowed at date t (relative to GDP).
At date t +1, the total cumulated debt B_{t+1} is equal to $B_t + (1 + r) dB_t$. As the interest rate on the debt r is inferior to the debt growth rate g, the economy can import more than it exports, its debt will still be sustainable (it is the condition of actuarial effective sustainability).

The first step of their reasoning is to test the existence of a cointegrating vector between imports and exports, after identifying it as a process I (d).
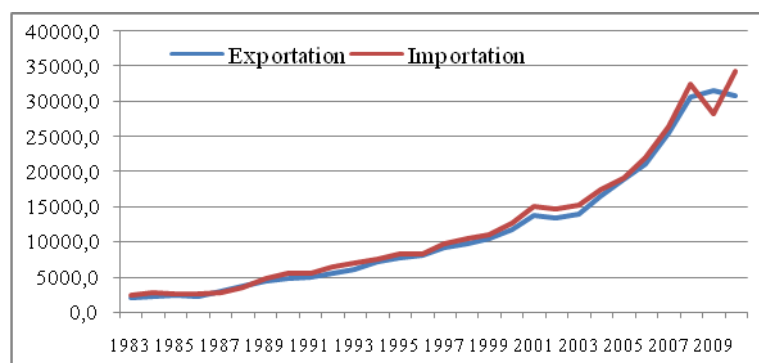

Figure 3: The evolving value of exports and imports

The Tunisian exports and imports have similar long-term evolutions that seem to reflect the existence of an equilibrium relationship or cointegration between these series

Table 2 : results of ADF tests in second difference

Variable	ADF value	Critical value ; threshold accounting for 5%	Prob-critical	Integration degree
Exportations	-6,69	-1,95	0,00	I(2)
Importations	-4,89	-1,95	0,00	I(2)
Detbs	-7,77	-1,95	0,00	I(2)

The three variables have the same order of integration. The existence of an integration vector can then be verified. If the relationship equilibrium is long term, the sustainability of external debt would be verified.

Tableau 3 : Tests of causality between export., import and stationarity of the residuals

Granger causality test	
Hypothesis	**critical probability**
M does not cause X	**0.0182**
X does not cause M	**0.0079**
Static relationship between M et X :	M = 604.45 + 1.006*X (1.9) (46.13)
H_0 : the residue of the cointegration relationship between M and X which have a unit root	

Model	critical probability	Estimated value of the ADF statistic	MACKINNON Critical value
Without trend and with a constant	**0.000**	-8.40	-1.95

The estimated value of ADF statistic (-8.40) is inferior to the critical value (-1.95) at the threshold 5%, the hypothesis of residue stationarity is verified. The estimate of the static relationship provides significant coefficients at 5% and unit root tests on the residue of this relationship conclude the existence of a cointegration relationship between exports and imports. The estimation of cointegrating relationship as it appears in E-views is:

X	M
1.000000	-0.892505
	(0.02034)

The values between parentheses are estimated standard deviations associated with the estimated coefficients. Here, we have normalized the coefficient of exports, that is to say we chose X (exports) as an endogenous variable. The coefficient of the cointegrating relationship is negative. There is a return to balance over time. The presence of this relationship may indicate the existence of permanent channels in the transmission of shocks between these variables.

Tableau 4: Causality tests between export, debt and stationarity of the residues

GRANGER causality test	
Hypothesis	**Critical probability**
X does not cause debt	**0.323**
Debt does not cause X	**0.001**

Static relationship between M et X :	X = 519,62 + 1.097*debt
	(31.51) (-4.42)

H_0 : the residue of the cointegration relationship between debt and X which have a unit root			
Model	**critical probability**	**Estimated value of the ADF statistic**	**MACKINNON Critical value**
Without trend and with a constant	**0.023**	-2.29	-1.95

The estimated value of the ADF statistic (-2.29) is inferior to the critical value (-1.95) at 5% threshold, the hypothesis of stationarity of the residue is verified. The estimation of the static relationship provides significant coefficients at 5% threshold and unit root tests on the residue of this relationship conclude the existence of a cointegration relationship between debt and exports. The estimation of cointegrating relationship as it appears in E-views is given by:

X	DEBT
1.000000	-1.245291
	(0.04536)

The coefficient of debt is negative, indicating the existence of permanent channels of shocks transmission between variables.

In sum, the finding of the presence of cointegration relationships between exports and imports, exports and Tunisian debt reflects debt sustainability according to Leachman and Francis approach .

4. BUDGET MANAGEMENT IS A PREREQUISITE FOR MAINTAINING DEBT SUSTAINABILITY

It is worth noting that all methods of assessing debt sustainability as a starting point take into account the conditions of budgetary balance elaborated by government, which should be consistent with the constraints of repayment. In the case of the Tunisian economy, if foreign debt would be sustainable, adequate management of government accounts is required. Accordingly, we represent in Figure 4, the evolution of the share of operating expenses and equipments in the global government expenditures.
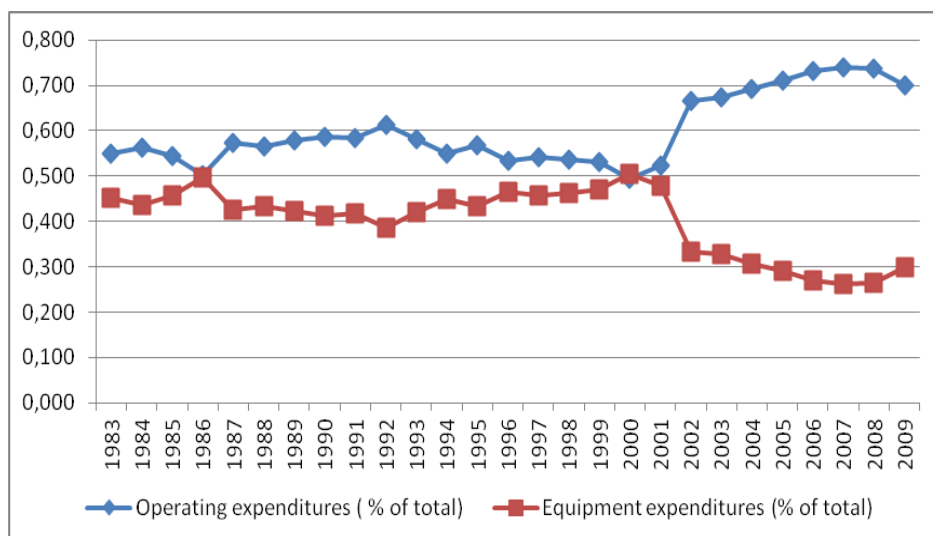
Figure 4. Evolution of operating expenses and equipment as a percentage of total budget expenditure

What is worth noticing here, is the breaking point between the two major government expenditure from 2001. The share of operating expenses in the government budget until 2000 was in a decreasing trend between 60 and 45%. From 2001, the reversal of the shared government expenses on behalf of operating expenses suggests that debt is in part

intended to be used permanently. A part of the external debt used by government will be used to cover current expenses, such as salaries or administrative functions. Better governmental debt management must impose the risk of a debt burden which will in the medium term.

5. CONCLUSION

External debt can be productive and enhance the rationing of capitals and savings in low-income countries or developing ones. The strategy proposed by this study has confirmed debt sustainability by joining debt dynamics and the current account balance. The results of the study have allowed concluding that the evolution of the external debt was not excessive. Approaches assessing debt sustainability are complementary; their use is perceived as a required monitoring tool. Apart from that, this optimistic conclusion should not obscure the fact that external debt sustainability genuinely depends on how the debt is used. Government modernization should be privileged. Rationalization of government intervention and modernization of administrative structures are sought.

ANNEXES

	Gap between net external deficit and deficit required net effective											
	Calculations on raw series						Calculations adjusted series					
Années	*SC/GDP	Surplus (deficit) required	Gap	SCom/P IB	Surplus (deficit) required	Gap	SC/GDP*	Surplus (deficit) required	Gap	SCom/P IB*	Surplus (deficit) required	Gap
1984	-0,111	0,000	-0,110	-0,118	0,000	-0,118	-0,136	0,000	-0,136	-0,136	0,000	-0,136
1985	-0,071	-0,002	-0,069	-0,062	-0,002	-0,060	-0,059	-0,002	-0,057	-0,059	-0,002	-0,057
1986	-0,073	0,000	-0,073	-0,067	0,000	-0,067	-0,054	0,000	-0,054	-0,054	0,000	-0,054
1987	-0,012	0,000	-0,012	-0,012	0,000	-0,012	-0,011	0,000	-0,011	-0,011	0,000	-0,011
1988	0,015	-0,001	0,015	**0,009**	-0,001	**0,010**	0,008	-0,001	0,009	**0,008**	-0,001	**0,009**
1989	-0,024	-0,001	-0,023	-0,040	-0,001	-0,039	-0,038	-0,001	-0,037	-0,038	-0,001	-0,037
1990	-0,047	-0,004	-0,042	-0,068	-0,003	-0,065	-0,063	-0,003	-0,060	-0,063	-0,003	-0,060
1991	-0,069	-0,003	-0,066	-0,048	-0,002	-0,046	-0,045	-0,002	-0,043	-0,045	-0,002	-0,043
1992	-0,098	-0,010	-0,088	-0,067	-0,006	-0,061	-0,064	-0,005	-0,058	-0,064	-0,005	-0,058
1993	-0,115	-0,001	-0,114	-0,072	-0,001	-0,071	-0,065	-0,001	-0,065	-0,065	-0,001	-0,065
1994	-0,063	-0,001	-0,062	-0,028	-0,001	-0,028	-0,028	-0,001	-0,027	-0,028	-0,001	-0,027
1995	-0,044	0,000	-0,043	-0,037	0,000	-0,037	-0,037	0,000	-0,037	-0,037	0,000	-0,037
1996	-0,025	-0,001	-0,023	-0,015	-0,001	-0,014	-0,015	-0,001	-0,014	-0,015	-0,001	-0,014
1997	-0,031	-0,001	-0,029	-0,023	-0,001	-0,022	-0,022	-0,001	-0,020	-0,022	-0,001	-0,020
1998	-0,033	-0,001	-0,033	-0,031	-0,001	-0,031	-0,031	-0,001	-0,030	-0,031	-0,001	-0,030
1999	-0,020	-0,002	-0,019	-0,021	-0,001	-0,019	-0,018	-0,001	-0,017	-0,018	-0,001	-0,017
2000	-0,039	-0,001	-0,038	-0,033	-0,001	-0,032	-0,032	-0,001	-0,031	-0,032	-0,001	-0,031
2001	-0,041	-0,001	-0,040	-0,043	-0,001	-0,041	-0,042	-0,001	-0,041	-0,042	-0,001	-0,041
2002	-0,033	0,000	-0,033	-0,039	0,000	-0,039	-0,039	0,000	-0,039	-0,039	0,000	-0,039
2003	-0,028	-0,001	-0,028	-0,038	-0,001	-0,037	-0,036	-0,001	-0,035	-0,036	-0,001	-0,035
2004	-0,018	0,000	-0,018	-0,027	0,000	-0,027	-0,026	0,000	-0,026	-0,026	0,000	-0,026
2005	-0,010	-0,001	-0,009	-0,005	-0,001	-0,004	-0,005	-0,001	-0,004	-0,005	-0,001	-0,004
2006	-0,020	-0,001	-0,018	-0,022	-0,001	-0,021	-0,018	-0,001	-0,017	-0,018	-0,001	-0,017
2007	-0,024	-0,002	-0,022	-0,020	-0,002	-0,018	-0,019	-0,002	-0,017	-0,019	-0,002	-0,017
2008	-0,041	-0,001	-0,040	-0,032	-0,001	-0,031	-0,029	-0,001	-0,028	-0,029	-0,001	-0,028
2009	-0,028	0,000	-0,028	-0,030	0,000	-0,030	-0,029	-0,003	-0,027	-0,029	-0,003	-0,027
2010	-0,050	0,000	-0,050	-0,056	0,000	-0,056	-0,054	0,000	-0,054	-0,054	0,000	-0,054

*: SC: currant account balance; Scom: the trade balance

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