THE TREASURY TRANSACTIONS IN LEBANON: A COINTEGRATION ANALYSIS USING THE ENGLE-GRANGER PROCEDURE

Mahmoud Mourad
Faculty of Economic Sciences and Business Administration, Lebanese University, Nabatieh, Lebanon
fmmourad@yahoo.fr

(Received 4 October 2006 - Accepted 1 March 2007)

ABSTRACT

This paper treats the analysis of the seasonal integration of the time series that cover the Lebanese treasury in monthly data on the period 1998-2005 (96 observations). The seasonal integration procedure proposed by Franses and the ADF procedure proposed by Dickey-Fuller have been used to identify the type of seasonality and trend (stochastic or deterministic). The choice between two models: the first M_1 *is first order and seasonally differenced, it requires the filter* $(1-B)\ (1-B^{12})$*, the second* M_2 *considers the variable in first difference with deterministic seasonality (it is labeled the FDSD model). The comparison of the forecasting quality between the* M_1 *and* M_2 *models encourages the* M_2 *models (weak value of the MAPE criterion). A cointegration Analysis Using the Engle-Granger Procedure has succeeded to nine relations of bivariate cointegration and by consequence the existence of a long-term economic relationship from which, the ECM representation permits to integrate the fluctuations of short-term can be informed. The presence of a cointegration relationship between the Total cash in and the Total cash out offers to the Lebanese government an useful information on the future evolution showing an important deficit of the Lebanese treasury (close to USD 2 billion by year).*

Keywords: treasury, seasonal integration, forecast, cointegration

INTRODUCTION

The economic situation in Lebanon knew various evolutions during the last decade of the last century. Indeed, numerous events occurred during this period that represents the resurgence of the Lebanese state after the different wars that happened in this country. These evolutions didn't pass without negative repercussions that have created a deeper deficit in the budgets. This deficit is caused by the engagement to repay the public debt that reached the doorstep of USD 40 billion (bn) (USD 10 000 by every citizen). The political and social events had some effects on the different variables that cover the Lebanese treasury, making notice that the operations of the treasury always knew a deficit during the period designated by this research.

To analyze deeply the Lebanese treasury, the following variables have been constructed: Treasury receipts, Treasury payments, Treasury balance, Treasury balance/Treasury payments, Total cash in, Total cash out, Total deficit (surplus), Total deficit (surplus)/Total cash out, Total primary balance, Total primary balance/Total cash out. For five of these ten variables, the quarterly data (32 quarters) seem independent (using the Ljung-Box Q-statistics). These variables are: Treasury balance, Total deficit (surplus), Treasury payments, Treasury receipts and Total primary balance / Total cash out. For this reason, the monthly data to construct the AR adequate model for each variable is analysed at first. Secondly, the obtained models to calculate the quarterly forecasts are going to be used. Therefore the forecast of every quarter results from an aggregation of the associated monthly forecasts. It should be pointed out that it doesn't exist any survey in Lebanon that treats this kind of analysis. Indeed, the quarterly bulletin published by the central bank in Lebanon limits itself to describe the historical evolutions of data. The objective of this research is to choose, at the first step, between two types of seasonality: stochastic seasonality (SS) or deterministic seasonality (DS) (Mourad, 2006). Indeed, the correct specification of the type of the seasonality will have positive consequences on the forecasts (Franses, 1991). At the second step, a cointegration analysis between each pair of variables using the Engle-Granger two-stage procedure is going to be realized. Finally, for every cointegrated pair of variables, the short-term disequilibrium relationship between them will be expressed in the error correction form. If two variables are cointegrated then there is some force always pulling the disequilibrium errors (the extent of departure from the long-run relationship) back towards zero and preventing them increasing without limit. The results of this research could serve the political authorities in Lebanon to really understand the evolution of the Treasury and to lead politicians to take into account the cointegrated relationship between the different variables.

Since the publication of the Granger Theorem Representation (1987) [1], the analysis of the cointegration became the most used technique in econometrics. This technique links together short-term and long-term evolutions and it uses the long-term relationship to stop the variables from coming out of their parallel evolution. By consequence, the research of the cointegration relationships in economic time series becomes more and more important. The procedure developed by Johansen (1988), Johansen & Juselius (1990) is especially mentionned. The theory of the cointegration attracted the attention of the analysts of the time series and abundant works enriched the specialized revues[2]. Stock & Watson (1988) studied the cointegration at the zero frequency and they developed some tests to determine the number of the independent cointegrated vectors in a multivariate model with and without drift or an equivalent manner to test the presence of the common stochastic trends between different variables. Fountis & Dickey (1989) showed that using the OLS method, the biggest eigen value of the characteristic equation associated to the VAR model can be estimated and the distribution of the estimator permits to test the presence of a unit root using the Dickey-Fuller procedure. Todas & Phillips (1993) analyzed the effects of the unit roots on the autoregressive vector and they showed that if the variables are not stationary then the inclusion of a random walk that doesn't cause the components of the vector VAR, has some

[1] See Granger (1986), Engle and Granger (1987), Engle and Yoo (1987).
[2] See for example, Kunst and Neusser (1990), Doz and Malgrange (1992).

effects on the Wald statistic that doesn't follow the usual asymptotic distribution of chi-square. In the case where the variables of the VAR model are stationary then the inclusion of a random walk doesn't prevent the Wald statistic to follow asymptotically the chi-square law. Dickey *et al*. (1991) studied the cointegration relationships between the currencies and the income of the United States using the three main procedures of the cointegration elaborated by Engle and Granger (procedure of two stages), by Johansen-Juselius and finally by Stock-Watson. Their results show that the vectors of cointegration estimated by the procedures of Engle-Granger and Johansen-Juselius are very near one of the other when both procedures indicate a cointegration relationship , however it is not the case when the test of Granger-Engle or Stock-Watson doesn't announce a co-integration. However the application of these three procedures is limited because they study only the co-integration at the zero frequency (only the Granger-Engle procedure tests the frequencies 0 and ½ in the case of the quarterly data). Hylleberg *et al*. (1990) developed the HEGY procedure to test the seasonal integration at all frequencies in quarterly data. Engle *et al.* (1993) developed the EGHL procedure to analyze the cointegration to the frequencies ¼ and ¾ and by consequence with the procedure of two stages proposed by Engle-Granger and Engle-Yoo, it became possible to lead a complete survey of the seasonal cointegration at all frequencies (0, ¼, ½ and ¾). It is also signalled that a general procedure of the integration and the seasonal co-integration for quarterly data has been developed by Lee (1992). Ghysels *et al*. (1994) generalized the HEGY procedure to the SARIMA models. The generalization of the HEGY procedure to the monthly data has been made by Franses (1991), Beaulieu and Miron (1993). A publication made by Granger and Siklos (1995) treats the cointegration in the case of temporal aggregation and it concludes that the cointegration at the zero frequency can occur between an integrated time series at the zero frequency and another time series integrated at seasonal frequency. Clarida (1994) derives a structural econometric specification of the demand for imported consumer goods, and concludes that the log consumer-goods imports, the log price of imports, and the log consumption of domestically produced varieties are cointegrated and that the cointegrating vector is unique. Oskooee and Brooks (1999) used the Johansen and Juselius' cointegration procedure to test for the existence of a long-run relationship among the variables of import and export demand between the United States and each of her big trading partners.

This paper is organized as follows: in the first section, the introduction is presented mentioning the most interesting publications in the domain of the cointegration and the necessity to lead a survey of cointegration on the monthly data that cover the domain of the treasury transactions in Lebanon from January 1998 to December 2005 (96 observations). In the second section, the main factors that influenced the historical evolutions of our data are presented. In the third section, the Franses's procedure applied to monthly data to identify the type of seasonality (stochastic or deterministic) is presented briefly. The analysis of the cointegration between two variables is made in the fourth section using the Engle-Granger Procedure. The conclusion appears in the final section.

DATA

The data used in this research are obtained from the quarterly bulletin published by the central bank of Lebanon. There are 10 variables which each contains 96 observations. The variables and their notations are presented in the following Table:

Variables and Notations

Variables	Notation
Treasury receipts = Trust accounts(Guarantees) + Municipalities +Deposits + Other.	X_{1t}
Treasury payments = Trust accounts/ Guarantees + Municipalities + Deposits + Expenditures from previous years appropriations + Expenditures from previous years(Guarantees) + Other.	X_{2t}
Treasury balance = Treasury receipts - Treasury payments	$X_{3t} = X_{1t} - X_{2t}$
Treasury balance / Treasury payments	$X_{4t} = \frac{X_{3t}}{X_{2t}}$
Total cash in = Budgetary revenues + Treasury receipts	X_{5t}
Total cash out = Budgetary expenditures + Treasury payments	X_{6t}
Total deficit(surplus) = Total cash in - Total cash out	X_{7t}
Total deficit(surplus) / Total cash out $= \frac{Total\ \ Cash\ In}{Total\ \ Cash\ \ Out} - 1$	$X_{8t} = \frac{X_{7t}}{X_{6t}}$
Total primary balance = Total cash in - Treasury payments - Budgetary expenditures excluding debt service. Total primary balance = Budgetary revenues + Treasury balance - Budgetary expenditures excluding debt service.	X_{9_t}
Total primary balance / Total cash out	$X_{10,t} = \frac{X_{9t}}{X_{6t}}$

The main factors that influenced the revenue patterns during the period 1998-2005:

1- The amelioration in tax collection in the second quarter 1997[3].

2- As a result of the tax reforms adopted by the government to raise more revenues, collected fees on real estate transactions have been improving since the middle of 1995. For the first time, the intermediate target of eliminating the primary deficit was achieved during the first quarter of 1998 and confirmed during the second quarter of 1998. The rise in revenues is

[3] Banque du Liban, Q2-1997, p. 13.

partly attributable to the rise in customs tariffs (+2 %), the hotels and restaurants additional tax (+5 %), and the enhancement of collection procedures[4].

3- The persistent efforts to improve tax collection and to implement the new tax on wages, salaries and profit distribution, enforced as of August 1999. An improvement in property taxes stemming from an increase in real estate taxes and the increase in property transfer fees. The increase in tariff rates on certain products as of April 1999[5].

4- A significant rise in transfers from the telecommunications authority. A decline in collected customs duties generated by the government's decision in December 2000 to lower customs tariffs on most imports[6].

5- The increase of revenues from the port of Beirut, and from transportation and tourism fees, and some savings from the budget of the ministry of telecommunications[7].

6- The progress in the VAT (Value-Added Tax) implementation mechanism and the collection of tax settlement and professional fees by virtue of legislations enacted at the end of 2001[8].

7- The customs duties decrease in Q1-2003 since some of them were reclassified and transformed into excise taxes, along with exemptions on some industrial raw materials. The increase in the non-tax revenues resulting from higher revenues collected, in accordance with the decision of the council of ministers, by the ministry of telecommunications on regular telephone communication and monthly subscription fees, in addition to a rise in mobile telephone proceeds[9].

The main factors that influenced the expenditure patterns during the period 1998-2005:

1- The most expenditures are current spending rendering them more difficult to compress. The primary balance surplus has resulted from the spending cuts and a ban of additional expenditures unless matched by revenues[10].

2- A fiscal reform package was presented in order to lower expenditure growth rates, reallocate a higher share to capital expenditures. The considerable rise in foreign interest payments resulting from the redeeming of the Eurobond coupons in April 1999, pushed up the level of total interest expenditures[11].

---

[4] Banque du Liban, Q1-1998, p. 34 and Q2-1998, p. 20.
[5] Banque du Liban, Q4-1999, p. 21.
[6] Banque du Liban, Q3-2000, p. 20, and Q4-2000, p. 21.
[7] Banque du Liban, Q4-2001, p. 21.
[8] Banque du Liban, Q1, 2002, p. 20, and Q4, 2002, p. 24
[9] Banque du Liban, Q1, 2003, p. 22, and Q2, 2003, p. 21
[10] Banque du Liban, Q1-1998, p. 34, and Q4-1998, p. 22.
[11] Banque du Liban, Q1-1999, p. 18, and Q2-1999, p. 19.

3- In the first quarter of 2000, the total public sector expenditures registered a significant rise because a significant rise in the cost of debt servicing and an increase in severance payments and retirement salaries[12].

4- The public expenditure growth during the first quarter of 2002 was due to a significant rise in the Budget item "Pensions and End-of-Service Allowances". The cost of the debt servicing will decline due to the soft loans granted to Lebanon by the Paris II conference[13].

5- In Q1-2003, overall expenditure registered a notable decline owing to policies adopted by the Government with aim of gradually curbing and streamlining public expenditure. Both domestic and external debt servicing decreased due to the continuation of the policy aiming at replacing domestic debt by external debt with lower interest and longer maturities. The positive results of the Paris II Conference were reflected in a reduction of the external debt cost[14].

To understand the evolution of the different variables of the Lebanese treasury, it would be very important to describe the history from the first quarter 1998 to the fourth quarter 2005. During the first quarter 1998 and for the first time, the fiscal outcomes reveals a new pattern with primary budget surplus of LBP 202 bn as revenues exceeded non-interest expenditures noting that the most expenditures are current spending rendering them more difficult to compress[15]. In the second quarter 1998, the intermediate target of eliminating the primary deficit was confirmed: The primary balance (Total budgetary revenues – Interest expenditures) registered a surplus of LBP 145.5 bn. The rise in revenues is partly attributable to the rise in customs tariffs (+2 %), the hotels and restaurants additional tax (+5 %) and the enhancement of collection procedures[16]. In Q1-1999, the customs revenues stood at LBP 509,31 bn still representing the largest share of total revenues at 52,67 %, compared to 45.34% in Q1-1998. Despite the rise in salaries and wages that implemented during this quarter, the total expenditures recorded a decrease of 5 %. compared to the Q1-1998. For the period January to June 1999, the total public sector deficit/surplus (budget deficit + treasury balance=Total cash in – Total cash out) recorded LBP 1664,69 bn (43.91% of total public sector expenditures *i.e.* Total cash out) compared to LBP 1439.8 bn (38.7% of total public sector expenditures) for the first half of 1998, increasing by 15.62%.[17] During the first nine months of the year 1999, Total public sector deficit (variable X_{7t}) , registered an 8.51 % increase compared to the same period 1998. According to the ministry of finance the main factors explaining this deficit are the following: (a) payment of commitments due under the 1998 Budget for an amount of LBP 451 bn; (b) an increase in monthly payment of municipalities claims on the treasury; and (c) installment payments on the foreign loans contracted by "Electricité du Liban" (Electricity of Lebanon). In Q4-1999, total revenues (Total cash in = variable X_{5t}) registered LBP 1499.08 bn, increasing by 34.68 % compared to Q4-1998. This result was mainly due to the noticeable rise in transfers form the budget of

---

[12] Banque du Liban, Q1-2000, p. 25.
[13] Banque du Liban, Q1-2002, p. 20 and Q4-2002, p. 24.
[14] Banque du Liban, Q1-2003, p. 22.
[15] Banque du Liban, Q1-1998, p. 34
[16] Banque du Liban, Q2-1998, p. 20
[17] Banque du Liban, Q1-1999, p. 18., and Q2-1999, p. 17

the ministry of telecommunication [18]. In Q1-2000, total public sector expenditure (Total cash out = variable X_{6t}) registered a significant rise of 39.54 %, reaching LBP 2123.28 bn, compared to LBP 1521.65 bn during the same period of 1999. The main factors contributing to the increase were[19]: a- a significant rise in the cost of debt servicing . As a result, the ratio of debt servicing to Total revenues (variable X_{5t}) jumped from 63.01 % in Q1-1999 to 82.31 % in Q1-2000. b- an increase in severance payments and retirement salaries. In its March 2000 fiscal performance report, the ministry of finance indicated that the rise in Treasury payments (variable X_{2t}), which registered an annual increase of 76.89 %, was caused by the repayment of matured external loans on behalf of the Electricité du Liban, the increase in claims on the treasury by municipalities, and the rise in withdrawals by public institutions from their budget appropriations. In the first half of 2000, according to the figures of the ministry of finance, the public expenditure (Total cash out) registered an annual rise of 20.44 % compared to the same period of the previous year. This rise is attributed to three main factors[20]:

a- an increase in debt service payments.

b- a growth in non-interest expenditure other than debt service payments; especially that all public administrations immediately started their spending in contrast to the monthly prorated appropriations rule that followed in the first semester of 1999.

c- a significant rise in treasury withdrawals (variable X_{2t}), caused by the new financial burdens assumed by the treasury, such as the increasing deficit of the Electricité du Liban, and the high increase of the disbursement of funds due to municipalities, reaching LBP 159 bn in the first six months of 2000, against LBP 56 bn a year earlier. In Q3-2000, the Total cash in registered a rise of 11.16 % compared with their level in Q3-1999, caused by the increase in Treasury receipts (transfers from the telecommunications authority) and non-tax revenues[21]. In Q4-2000, the Total cash out registered an annually rise of 27.72 % . Most of this rise resulted from an increase in public debt servicing and from a sharp increase of 139.92 % in treasury withdrawals related to the financing of fuel oil purchases and the servicing of the Electricité du Liban external debt[22]. During the first nine months of 2001, the foreign trade registered an improvement with exports and imports increasing annually by 21.6 % and 13.7 % respectively[23]. The Total primary balance (X_{9t}) shifted from a deficit of LBP 1673 bn in 2000 to a surplus of LBP 83 bn in 2001[24]. The debt service/Total cash in ratio dropped from 92.7 % in 2001 to 78.8 % in Q1-2002[25]. During the first half of 2002, Treasury balance ($X_{3t} = X_{1t} - X_{2t}$) registered a deficit of LBP 730.5 bn or 78% of Treasury payments,

[18] Banque du Liban, Q3-1999, p. 19 ., and Q4-1999, p. 20.
[19] Banque du Liban, Q1-2000, p. 25.
[20] Banque du Liban, Q2-2000, p. 19.
[21] Banque du Liban, Q3-2000, p. 20.
[22] Banque du Liban, Q4-2000, p. 21.
[23] Banque du Liban, Q3-2001, p. 19.
[24] Banque du Liban, Q4-2001, p. 21.
[25] Banque du Liban, Q1-2002, p. 20.

compared with 65.4 % during the same period of 2001.[26] After the success of Paris-2 conference, the first nine months of 2003 indicate that the Total cash in registered a significant rise mainly due of VAT revenues. On the other hand, the income from public institution and government represents the main source of non-tax revenues that grew due to telecom transfers. Regarding Treasury balance, the deficit reached LBP 1346.7 bn at end-December 2003, recording an annual increase of LBP 142.4 bn mainly due to the increase in Treasury payments resulted from the disbursements made to the Electricité du Liban, to the cost of operating public hospitals, and to the implementation of the law related to the environment and transportation sectors [27]. In the year 2004, the economic activity registered a remarkable recovery. This improvement is confirmed by the BDL coincident indicator and the results of the BDL business survey[28]. In Q1-2005, the sustained growth, prevailing over the last two years, was abruptly halted by the assassination of former Prime Minister Rafic Hariri. The BDL coincident indicator and the results of the BDL business survey confirm this dramatic slump. In the first half of 2005, according to the ministry of finance, the Total primary balance registered a decrease of 68.3 % compared to the same period of the previous year.[29]

The variable X_{6t} knew an aberrant point at the time t=36. This point corresponds to December of the year 2000 (the year of the liberation of the South-Lebanon). To correct this point, an AR(6) model on the period of January 1998 to the November 2000 (35 observations) was estimated. This model is used to predict the value of the December 2000. The anticipated value is 861965 and the observed value was 1 602 119. Therefore this event produced an increase of 85.9%. On the same period and for the variable X_{9t}, an AR(3) model is estimated and the value -25348 is predicted instead of the observed value -615610. Finally the observed value -64333 of the variable X_{7t} at the time t=37, has been replaced by the average value -336177 of 36 first observations. In Q1-2001, the variable X_{7t} registered a significant yearly decline by 42,09 %. According to the ministry of finance, this resulted from an 18.22% yearly decline in total public expenditure (Total cash out) associated with a 7.48 % rise in total public revenues (Total cash in).

ANALYSIS OF THE SEASONAL INTEGRATION

Franses (1991) generalized the HEHY procedure for monthly data. In such a case, the seasonal filter, $\Delta_{12} = \left(1 - B^{12}\right)$ contains 12 unit roots. These roots are ± 1, $\pm i$, $-\frac{1}{2}\left(\sqrt{3} \pm i\right), \frac{1}{2}\left(\sqrt{3} \pm i\right), -\frac{1}{2}\left(1 \pm \sqrt{3}\, i\right)$ $\frac{1}{2}\left(1 \pm \sqrt{3}\, i\right)$. The frequencies of these roots are respectively $0, \pi, \pm\frac{\pi}{2}, \mp\frac{5\pi}{6}, \pm\frac{\pi}{6}, \mp\frac{2\pi}{3}, \pm\frac{\pi}{3}$. The cycles per year associated to these

---

[26] Banque du Liban, Q2-2002, p. 22.
[27] Banque du Liban, Q3-2003, p. 20., and Q4-2003, p. 22.
[28] Banque du Liban, Q4-2004, p. 20 .
[29] Banque du Liban, Q1-2005, p. 19., and Q2-2005, p. 19 .

frequencies are $0, 6, 3, 9, 7, 5, 1, 11, 8, 4, 2,$ *and* 10. Therefore the filter Δ_{12} is written as following:

$$\begin{aligned}\Delta_{12} = \left(1 - B^{12}\right) &= (1 - B)(1 + B)(1 - iB)(1 + iB) \\ &\times \left(1 + \frac{\sqrt{3} + i}{2} B\right)\left(1 + \frac{\sqrt{3} - i}{2} B\right) \\ &\times \left(1 - \frac{\sqrt{3} + i}{2} B\right)\left(1 - \frac{\sqrt{3} - i}{2} B\right) \\ &\times \left(1 + \frac{(i\sqrt{3} + 1)}{2} B\right)\left(1 - \frac{(i\sqrt{3} - 1)}{2} B\right) \\ &\times \left(1 - \frac{(i\sqrt{3} + 1)}{2} B\right)\left(1 + \frac{(i\sqrt{3} - 1)}{2} B\right)\end{aligned} \qquad (1)$$

As the case of the quarterly data, the test of the unit roots requires the following equation[30]:

$$\begin{aligned}\phi^{*}(B)Y_{8,t} = {} & \pi_1 Y_{1,t-1} + \pi_2 Y_{2,t-1} + \pi_3 Y_{3,t-1} + \pi_4 Y_{3,t-2} \\ & + \pi_5 Y_{4,t-1} + \pi_6 Y_{4,t-2} + \pi_7 Y_{5,t-1} + \pi_8 Y_{5,t-2} \\ & + \pi_9 Y_{6,t-1} + \pi_{10} Y_{6,t-2} + \pi_{11} Y_{7,t-1} + \pi_{12} Y_{7,t-2} \\ & + \mu_0 t + \mu_1 + \sum_{k=1}^{11} m_k S_{kt} + \varepsilon_t\end{aligned} \qquad (2)$$

where S_{kt} are the seasonal dummies for monthly data.

The variables $Y_{i,t}$ are given by:

$$\begin{aligned}Y_{1,t} &= (1 + B)\left(1 + B^2\right)\left(1 + B^4 + B^8\right)X_t \\ Y_{2,t} &= -(1 - B)\left(1 + B^2\right)\left(1 + B^4 + B^8\right)X_t \\ Y_{3,t} &= -\left(1 - B^2\right)\left(1 + B^4 + B^8\right)X_t \\ Y_{4,t} &= -\left(1 - B^4\right)\left(1 - \sqrt{3}\,B + B^2\right)\left(1 + B^2 + B^4\right)X_t \\ Y_{5,t} &= -\left(1 - B^4\right)\left(1 + \sqrt{3}\,B + B^2\right)\left(1 + B^2 + B^4\right)X_t \\ Y_{6,t} &= -\left(1 - B^4\right)\left(1 - B^2 + B^4\right)\left(1 - B + B^2\right)X_t \\ Y_{7,t} &= -\left(1 - B^4\right)\left(1 - B^2 + B^4\right)\left(1 + B + B^2\right)X_t \\ Y_{8,t} &= -\left(1 - B^{12}\right)X_t\end{aligned} \qquad (3)$$

[30] See also Beaulieu & Miron (1993) for another regression equation.

If $\pi_i = 0$ for $i = 1,...,12$ then the choice of the filter Δ_{12} is justified. If $\pi_1 = 0$ and $\pi_i \neq 0$ for $i = 2,...,12$ then the presence of a unit root is accepted and the First Difference Seasonal Dummies model (abridged FDSD) that incorporates a first difference, a constant and 11 indicatory seasonal variables is considered. The critical values of the statistical tests associated to the detached π_i (t-statistic type) and to the even pair (π_i, π_j) associated to the complex roots (F-statistic type) are given by Franses (1991) and Beaulieu and Miron (1993). In model (2), the content of μ_t depends on the null hypotheses. In this paper, this equation is going to be considered, introducing a constant, 11 indicatory seasonal variables, with and without linear trend. The advantage of this procedure in relation to those that have been presented by Hasza and Fuller (1981) (denoted HF) and Dickey, Hasza and Fuller (1984) (denoted DHF) consists in the interpretation of each of the seasonal unit roots while the HF procedure tests the presence of a multiplicative filter $\Delta\Delta_s = (1-B)\left(1-B^s\right)$, s=2,4,6 and 12, and the DHF procedure tests the presence of a seasonal filter $\Delta_s = \left(1-B^s\right)$, s= 2,4 and 12. It is signalled that if a time series requires the filter $\Delta\Delta_s$ to become stationary then the procedure of Franses can inform on the presence of this filter if it is applied on the first difference time series. Such a time series will be integrated of order 2 for the zero frequency and of order 1 for each of the other seasonal frequencies. The determination of the optimal order for the polynomial $\phi^*(B)$ results from a specification by FPE criterion and the obtained model will be validated by Ljung-Box Q-statistic. In equation (2), more importance is going to be given to the regression that contains a deterministic part constituted from a constant, and 11 indicatory seasonal variables because the omission of the seasonal variables products a deterioration in the power of statistical tests (Hylleberg *et al*., 1990). The trend in the model was not introduced because the graphical of the time series shows a big variability with very varied ruptures in the trend. As can be seen from the results in Table 1, from the individual statistics π_i, it seems that the null hypothesis of stochastic seasonality (presence of the seasonal unit roots) can not be rejected. The source of critical values is given by Franses (1991).

Table 2 reveals that using the ADF statistics (Augmented Dickey-Fuller), all the variables filtered by $\left(1-B^{12}\right)$ are stationary. On the other hand, for the statistical F in Table 1, the deterministic seasonality is appropriated.

The results in Table 3 permit to accept the first difference for all variables with a deterministic seasonality.

TABLE 1

Testing for Seasonal Unit Roots

Auxiliary regression : constant seasonal dummies and no trend										
t ratios	X_{1t} (p=11)	X_{2t} (p=12)	X_{3t} (p=12)	X_{4t} (p=12)	X_{5t} (p=12)	X_{6t} (p=12)	X_{7t} (p=12)	X_{8t} (p=12)	X_{9t} (p=12)	$X_{10,t}$ (p=12)
π_1	-1.82	-0.83	-0.48	-0.39	0.06	-1.18	-1.47	-1.18	-1.57	-0.99
π_2	-1.33	-0.50	-0.73	-1.83	-1.11	-1.04	-1.26	-1.69	-1.56	-1.38
π_3	-1.18	-1.28	-0.70	0.38	-1.27	0.6	0.44	-0.86	-1.21	-1.64
π_4	-2.17	-1.82	-2.50	-1.93	-1.83	-1.56	-2.95	-3.32*	-2.37	-1.64
π_5	-0.25	-1.71	-1.68	-1.61	-3.18	-1.82	-1.53	-1.43	-2.10	-2.10
π_6	-0.42	-2.17	-2.09	-1.99	-2.96	-2.23	-2.28	-2.62	-2.05	-2.15
π_7	0.30	1.32	1.36	1.89	0.82	0.83	0.38	1.19	1.5	1.31
π_8	-1.05	-1.69	-1.68	-2.83	-1.25	-1.93	-1.28	-1.38	-2.45	-2.20
π_9	-1.34	-0.88	-0.34	-1.61	-0.86	0.35	-0.87	-2.44	-0.67	-0.40
π_{10}	-1.42	-0.90	-1.12	-1.82	-1.49	-1.88	-1.83	-1.64	-2.43	-2.34
π_{11}	2.88	1.35	1.01	1.42	2.02	0.96	-0.13	-0.36	1.18	0.97
π_{12}	-2.55	-1.81	-1.50	-3.82**	-2.28	-0.75	-0.56	-1.82	-1.51	-1.45
F-statistics	X_{1t}	X_{2t}	X_{3t}	X_{4t}	X_{5t}	X_{6t}	X_{7t}	X_{8t}	X_{9t}	$X_{10,t}$
π_3, π_4	2.98	2.59	3.45	1.93	2.64	1.42	4.57	5.94**	3.70	2.88
π_5, π_6	0.11	2.42	2.23	1.99	5.17*	2.49	2.96	5.08*	2.35	2.47
π_7, π_8	1.48	1.49	1.43	4.93	0.95	3.78	2.41	0.96	4.56	3.73
π_9, π_{10}	1.29	0.53	0.66	2.04	1.11	3.30	1.69	3.15	3.17	3.20
π_{11}, π_{12}	5.33*	1.75	1.16	7.94**	3.25	0.51	0.28	3.13	1.26	1.09
$\pi_3,\ldots,\pi_{12}$	15.58**	9.85**	9.62**	22.54**	15.37**	14.76**	16.07**	21.12**	19.94**	17.45**

** Significant at 5 % level. It is signalled that the tests π_1 and π_2 are one-sided tests, while the other t-tests are two-sided.

* Significant at 10 % level.

TABLE 2
The ADF Statistics Applied to the Variables with Stochastic Seasonality

Variables	τ_τ[a]	τ_μ	τ	Conclusion
$\Delta_{12} X_{1t}$	-4.30**	-4.27**	-4.31**	Stationary
$\Delta_{12} X_{2t}$	-3.40	-3.41**	-3.11**	Stationary
$\Delta_{12} X_{3t}$	-3.67**	-3.62**	-3.23**	Stationary
$\Delta_{12} X_4$	-3.77**	-3.95**	-2.97**	Stationary
$\Delta_{12} X_{5t}$	-2.96	-2.69	-2.43**	Stationary
$\Delta_{12} X_{6t}$	-3.58**	-3.27**	-2.95**	Stationary
$\Delta_{12} X_{7t}$	-4.1**	-2.45	-2.47**	Stationary
$\Delta_{12} X_{8t}$	-2.77	-2.07	-2.02**	Stationary
$\Delta_{12} X_{9t}$	-2.28	-2.51	-2.43**	Stationary
$\Delta_{12} X_{10,t}$	-3.53**	-3.63**	-3.43**	Stationary

TABLE 3
The ADF Statistics of the Variables with Deterministic Seasonality

Variables	P[b]	τ_τ[a]	τ_μ	τ	Conclusion
X_{1t}	10	-3.21	-3.22**	-0.18	Stationary
X_{2t}	11	-2.4	- -1.06	2.64	DS
ΔX_{2t}	8	-4.68**	-4.71**	-4.73**	Stationary
X_{3t}	6	-2.78	-1.31	2.23	DS
ΔX_{3t}	5	-7.81**	-7.86**	-8.0**	Stationary
X_{4t}	2	-8.77**	-6.69**	-0.96	TS
X_{5t}	5	-2.68	-0.44	2.55	DS
ΔX_{5t}	5	-6.83**	-6.81**	-7.24**	Stationary
X_{6t}	5	-2.41	-1.70	1.79	DS
ΔX_{6t}	4	-8.85**	-8.85**	-8.24**	Stationary
X_{7t}	6	-2.22	-1.51	-0.21	DS
ΔX_{7t}	5	-7.21**	-7.44**	-7.32**	Stationary
X_{8t}	9	-1.67	-0.34	-0.03	DS
ΔX_{8t}	5	-7.3	-7.16	-7.26	Stationary
X_{9t}	5	-3.50**	-2.07	-2.07	DS
ΔX_{9t}	4	-9.89**	-9.89**	-9.96**	Stationary
$X_{10,t}$	12	-3.33	-1.41	-1.39	DS
$\Delta X_{10,t}$	12	-3.60**	-3.61**	-3.67**	Stationary

[a] The critical values for τ_τ, τ_μ and τ (0.05 level of significance) are respectively -3.47, -2.91 and -1.95 for a sampe size 78.

[b] The statistics of Bartllett were calculated to test the significativity of the first twenty autocorrelations for each residues of each variable as well as the Ljung-Box Q statistics . The order p (p = 12 for the all variables) is obtained using the Q statistic.

The value of Q is less than its expected value $\chi^2_{0.05;20}$.

** The test is significant at 5 % level.

In the following, two types of models are going to be estimated for every variable,: M_1 incorporates the filter $\left(1-B^{12}\right)$ and M_2 is the FDSD model proposed by Franses (1991). The choice between the two models will be done according to the quality of forecasting measured by the MAPE criterion (Mean Absolute Percentage Error). The following tables contain the AR models for the two types of models M_1 and M_2.

In the following, the estimated AR models with stochastic seasonality are presented ($X_t = \Delta_{12} X_{i,t}, i = 1,2,...,10$) and with deterministic seasonality (variables in level $X_{i,t}, i = 1,2,...,10$)[31] :

Treasury receipts:

$$\hat{X}_t = -0.29 X_{t-10} - 0.38 X_{t-12}$$
$$(-2.4) \qquad (-3.0)$$

$$\hat{X}_{1,t} = -0.19 X_{1,t-8} - 0.20 X_{1,t-10}$$
$$(-1.7) \qquad (-1.6)$$

Treasury payments :

$$\hat{X}_t = 21076 - 0.487 X_{t-12}$$
$$(2.4) \qquad (-4.05)$$

$$\Delta X_{2,t} = -0.71 \Delta X_{2,t-1} - 0.53 \Delta X_{2,t-2} - 0.44 \Delta X_{2,t-3} - 0.45 \Delta X_{2,t-4} - 0.26 \Delta X_{2,t-5} - 0.19 \Delta X_{2,t-8}$$
$$(-6.2) \qquad (-3.9) \qquad (-3.1) \qquad (-3.3) \qquad (-2.2) \qquad (-2.0)$$

Figures in parentheses are, as usual, t ratios.

Treasury balance:

$$\hat{X}_t = -21323.8 - 0.513 X_{t-12}$$
$$(-2.71) \qquad (-4.28)$$

$$\Delta X_{3,t} = -0.74 \Delta X_{3,t-1} - 0.54 \Delta X_{3,t-2} - 0.47 \Delta X_{3,t-3} - 0.53 \Delta X_{3,t-4} - 0.30 \Delta X_{3,t-5}$$
$$(-6.6) \qquad (-4.1) \qquad (-3.5) \qquad (-4.0) \qquad (-2.5)$$

Treasury balance / Treasury payments:

$$\hat{X}_t = -0.053 - 0.381 X_{t-12}$$
$$(-2.45) \quad (-3.56)$$

The model for $X_{4,t}$ contains only a linear trend and a deterministic seasonality.

Total cash in :

[31] In this paper the estimation of the deterministic seasonality of different variables is not included because the paper becomes overloaded by massive calculations.

$$\hat{X}_t = 24223.6 + 0.204X_{t-1} + 0.19X_{t-3} + 0.234X_{t-4} - 0.373X_{t-12}$$
(1.9) (1.9) (1.72) (2.09) (−3.52)

$$\Delta\hat{X}_{5,t} = -0.76\Delta X_{5,t-1} - 0.93\Delta X_{5,t-2} - 0.45\Delta X_{5,t-3} - 0.36\Delta X_{5,t-4} - 0.19\Delta X_{5,t-5}$$
(−6.6) (−6.6) (−2.7) (−2.6) (−1.6)

Total cash out:

$$\hat{X}_t = 37297 + 0.222X_{t-3} - 0.444X_{t-12}$$
(2.24) (2.06) (−4.12)

$$\Delta X_{6,t} = -0.92\Delta X_{6,t-1} - 0.74\Delta X_{6,t-2} - 0.48\Delta X_{6,t-3} - 0.34\Delta X_{6,t-4}$$
(−8.5) (−5.2) (−3.4) (−3.1)

Total deficit(surplus):

$$\hat{X}_t = 0.216X_{t-2} + 0.152X_{t-6} + 0.224X_{t-9} - 0.412X_{t-12}$$
(2.1) (1.5) (2.2) (−4.1)

$$\Delta X_{7,t} = -0.99\Delta X_{7,t-1} - 0.82\Delta X_{7,t-2} - 0.64\Delta X_{7,t-3} - 0.5\Delta X_{7,t-4} - 0.2\Delta X_{7,t-5}$$
(−8.8) (−5.4) (−3.9) (−3.3) (−1.8)

Total deficit(surplus)/Total cash out:

$$\hat{X}_t = 0.224X_{t-1} + 0.202X_{t-2} + 0.2X_{t-4} + 0.22X_{t-9} - 0.365X_{t-12}$$
(2.1) (1.9) (1.9) (2.1) (−3.7)

$$\Delta X_{8,t} = -0.88\Delta X_{8,t-1} - 0.71\Delta X_{8,t-2} - 0.51\Delta X_{8,t-3} - 0.38\Delta X_{8,t-4} - 0.26\Delta X_{8,t-5}$$
(−7.8) (−4.7) (−3.3) (−2.6) (−2.3)

Total primary balance:

$$\hat{X}_t = 0.204X_{t-5} + 0.196X_{t-11} - 0.444X_{t-12}$$
(1.84) (1.78) (−4.06)

$$\Delta X_{9,t} = -0.75\Delta X_{9,t-1} - 0.65\Delta X_{9,t-2} - 0.48\Delta X_{9,t-3} - 0.47\Delta X_{9,t-4}$$
(−7.3) (−5.1) (−3.8) (−4.5)

Total primary balance/Total cash out:

$$\hat{X}_t = 0.173X_{t-1} + 0.157X_{t-11} - 0.515X_{t-12}$$
(1.6) (1.6) (−5.3)

$$\Delta X_{10,t} = -0.68\Delta X_{10,t-1} - 0.57\Delta X_{10,t-2} - 0.51\Delta X_{10,t-3} - 0.46\Delta X_{10,t-4} - 0.12\Delta X_{10,t-12}$$
(−6.4) (−4.5) (−4.1) (−4.4) (−1.4)

To measure the goodness of forecasts, first the monthly forecastsare calculated, and second, the monthly predicted values are aggregated in order to constitute the quarterly forecasts. For the year 2005, the comparison of prediction performance between the two types of models is made using the MAPE criterion given by :

$$MAPE = \frac{1}{4}\sum_{h=1}^{4}\frac{\left|\hat{X}_{T+h} - X_{T+h}\right|}{X_{T+h}}$$

$\hat{X}_{T+h}$ the prediction at horizon h and X_{T+h} the real value at the time T+h.

The inspection of table 4 reveals that, in general, the model FDSD leads to the best forecasts .

TABLE 4

The Forecast Performance of the Different AR Models

	MAPE			The year 2005 in bn USD [b]		
	M_1	M_2	M_1/M_2		Predicted value	
Variables	SS	DS	Ratio	Real Value	M_1	M_2
X_{1t}	21.2 %	23.5 %	0.90	0.279	0.292	0.2917
X_{2t}	17.5 %	5.7 %	3.07	1.593	1.500	1.614
X_{3t}	19.6 %	8.4 %	2.33	-1.314	-1.204	-1.331
X_{4t}	7.95 %	6.85 %	1.16	-0.776[c]	-0.768[c]	-0.775[c]
X_{5t}	5.1 %	4 %	1.275	4.912	5.023	4.981
X_{6t}	8.2 %	3.2 %	2.56	6.768	7.281	6.797
X_{7t}	19 %	16 %	1.19	-1.856	-2.108	-1.944
X_{8t}	15.8 %	14.7 %	1.075	-0.274[c]	-0.281[c]	-0.266[c]
X_{9t} [a]	18.7 %	5.1 %	3.7	0.489	0.580	0.464
X_{10t} [a]	26.7 %	13.3 %	2.008	0.072[c]	0.092[c]	0.082[c]

[a] For this variable, the MAPE for the annual forecast is calculated.
[b] Today one US dollar is fixed at 1507.5 LBP.
[c] It is a ratio value

TESTING FOR COINTEGRATION REGRESSION

The algorithm in two stages proposed by Engle & Granger (1987) is used here:

Stage 1: the order of integration of every variable is tested. It is right to determine the type of tendency (deterministic or stochastic) of each of the variables, then the order of integration of the time series. It is signalled that if the time series are not integrated in the same order, then it doesn't have the risk of integration. let's suppose that every variable is I(1).

Stage 2: the relation of long- run or equilibrium relationship is estimated by OLS between X_t and Y_t considering the following regression (5.1): $Y_t = \alpha + \beta X_t + \varepsilon_t$. The residues e_t of this model are recovered: $e_t = Y_t - \hat{\alpha} - \hat{\beta} X_t$. That is, the disequilibrium error or the cointegrating regression. The stationarity of residues e_t implies that the variables X_t and Y_t are cointegrated. To test the stationarity of e_t , the ADF statistic (with regression equation without trend and constant) can be used. In fact, the OLS residues have zero mean, and they are not expected to have a deterministic trend, for this, both intercept and time trend are excluded from the ADF regression. Perhaps to test the null hypothesis of no cointegration, the simplest test to use is the usual Durbin-Watson (DW) statistic under certain condition.

Stage 3: estimation of the Error Correction Model (ECM).

To test the existence of an unit root in the estimated residues of the static relation, the procedure is as the following :

$$e_t = \sum_{i=1}^{p} \varphi_i e_{t-i} + v_t \tag{5.2}$$

$$\Delta e_t = \varphi e_{t-1} + \sum_{i=1}^{p-1} \varphi_i \Delta e_{t-i} + u_t \tag{5.3}$$

If the t-ratio of the coefficient $\hat{\varphi}$ is larger than the theoretical value, the null hypothesis H_0: $\varphi = 0$ is accepted, that is the variables X_t and Y_t are not cointegrated. The Durbin-Warson statistic from the cointegrating regression (static relation) can also be used. This test is titled CRDW (Cointegration Regression Durbin-Warson) and proposed by Engle and Granger (1987). Under the null hypothesis $H_0 : \rho = 1$ with $\varphi = \rho - 1$, the statistical DW is asymptotically close to 0. If H_0 is accepted then the disturbances follow a random walk and the hypothesis of cointegration between the variables X_t and Y_t is refused. However the CRDW test is only an appropriate test for cointegration when the residues follow a first-order AR process. Simulation experiments suggest that, at the 5 % level of significance with a sample size of 100, the hypothesis of stationary residues should be rejected if the DW statistic exceeds about 0.38 (Thomas, 1997). If the cointegrating relationship is accepted then the ECM representation is estimated:

$$\Delta Y_t = \varphi_0 + \sum_{i=1}^{p1} \varphi_i \Delta Y_{t-i} + \sum_{j=0}^{p2} \theta_j \Delta X_{t-j} + \lambda e_{t-1} + \varepsilon_t \tag{5.4}$$

where θ_0 is a short-run Y_t elasticity with respect to X_t. The choice of the p_1 and p_2 orders have been obtained using FPE criterion and the Ljung-Box Q statistic (that is the null hypothesis of a white noise for the residues can be accepted). First, (5.4) is estimated without the terms ΔX_{t-j} and p_1 is determined; secondly, the terms ΔX_{t-j} are introduced in the equation and the value of p_2 is specified. e_t is the disequilibrium error or extent of departure from the long-run relationship $Y_t = \alpha + \beta X_t$, λ is a short-run adjustment parameter $(-1 < \lambda < 0)$, β appears in the equilibrium relationship as the long-run elasticity of Y_t with respect to X_t and ΔY_t and ΔX_t can be regarded as proportionate changes . The equation (5.4) is so-called Granger representation theorem, and is one of the most important results in cointegration analysis. Since the FDSD models lead in general to best forecasts (see Table 4), the testing of the cointegration regression for the variables with deterministic seasonality will be treated (the regression equation contains a constant and 11 seasonal indicatory variables). The inspection of Table 5 reveals that there are nine pairs of cointegrated variables. For the these variables, there are some force which always withdraws the disequilibrium errors e_t toward zero and warns them to increase them without limit. The previous departures from equilibrium must be continually corrected, otherwise the e_t could differ substantially from zero. But this is precisely what is implied by an error correction model.

The ECM representations for different cointegrated pairs are the following:

1- Treasury payments and Treasury balance: $X_t = X_{2t}, Y_t = X_{3t}$

$$\Delta Y_t = -0.61\Delta Y_{t-1} - 0.53\Delta Y_{t-2} - 0.39\Delta Y_{t-3} - 0.37\Delta Y_{t-4} - 0.12\Delta Y_{t-5}$$
$$(-1.94) \quad (-1.99) \quad (-1.99) \quad (-2.72) \quad (-2.62)$$
$$-0.88\Delta X_t - 0.53\Delta X_{t-1} - 0.47\Delta X_{t-2} - 0.31\Delta X_{t-3} - 0.21\Delta X_{t-4}$$
$$(-27.4) \quad (-1.97) \quad (-2.08) \quad (-1.83) \quad (-1.93)$$
$$+0.06\Delta X_{t-6} - 0.52 e_{t-1} + \varepsilon_t$$
$$(1.98) \quad (-1.55)$$
$$\hat{\sigma} = 14560,\ Q(20) = 20.9$$
$$p_1 = 5, p_2 = 6$$

There is a significant short-run Treasury balance elasticity (-0.88) with respect to Treasury payments.

TABLE 5

Testing for Cointegration Regression between Two Variables

Pairs		p	$t_{\hat{\varphi}}$	Conclusion [a]
X_{2t}	X_{3t}	2	-7.19	cointegrated
X_{2t}	X_{5t}	7	-1.41	Not cointegrated
X_{2t}	X_{6t}	3	-3.41	Cointegrated
X_{2t}	X_{7t}	2	-4.52	Cointegrated
X_{2t}	X_{9t}	5	-1.85	Not cointegrated
X_{3t}	X_{5t}	7	-1.52	Not cointegrated
X_{3t}	X_{6t}	3	-3.52	Cointegrated
X_{3t}	X_{7t}	2	-4.51	Cointegrated
X_{3t}	X_{9t}	5	-1.88	Not cointegrated
X_{5t}	X_{6t}	2	-5.15	Cointegrated
X_{5t}	X_{7t}	2	-4.88	Cointegrated
X_{5t}	X_{9t}	2	-6.0	Cointegrated
X_{6t}	X_{7t}	5	-1.42	Not cointegrated
X_{6t}	X_{9t}	5	-1.82	Not cointegrated
X_{7t}	X_{9t}	5	-2.32	Not cointegrated
X_{7t}	X_{9t}	5	-2.32	Not cointegrated

[a] The test is just the t-ratio of the coefficient φ ; the appropriate critical values are those reported in Engle & Yoo (1987). For a sample of 100: -3.03 at the 10 % level, -3.37 at the 5-percent level and -4.07 at the 1-percent level.

2- Treasury payments and Total cash out: $X_t = X_{2t}, Y_t = X_{6t}$

$$\Delta Y_t = -0.49\Delta Y_{t-1} - 0.46\Delta Y_{t-2} - 0.26\Delta Y_{t-3} - 0.18\Delta Y_{t-4}$$
$$(-3.51) \quad (-3.22) \quad (-1.96) \quad (-1.73)$$
$$+0.80\Delta X_t - 0.49 e_{t-1} + \varepsilon_t$$
$$(4.61) \quad (-3.29)$$
$$\hat{\sigma} = 95224,\ Q(20) = 12.9$$
$$p_1 = 4, p_2 = 0$$

The significant short-run Total cash out elasticity with respect to Treasury payments is (0.80).

3- Treasury payments and Total deficit (surplus): $X_t = X_{2t}, Y_t = X_{7t}$

$$\Delta Y_t = -0.67\,\Delta Y_{t-1} - 0.56\,\Delta Y_{t-2} - 0.35\,\Delta Y_{t-3} - 0.27\,\Delta Y_{t-4}$$
$$(-3.72) \qquad (-3.04) \qquad (-2.17) \qquad (-2.22)$$
$$-\,0.30\,\Delta X_{t-2} - 0.31 e_{t-1} + \varepsilon_t$$
$$(-1.61) \qquad (-1.80)$$
$$\hat{\sigma} = 107383\ ,\ Q(20) = 16.2$$
$$p_1 = 4, p_2 = 2$$

4- Treasury balance and Total cash out: $X_t = X_{3t}, Y_t = X_{6t}$

$$\Delta Y_t = -0.51\Delta Y_{t-1} - 0.48\Delta Y_{t-2} - 0.28\Delta Y_{t-3} - 0.20\Delta Y_{t-4}$$
$$(-3.58) \qquad (-3.34) \qquad (-2.07) \qquad (-1.93)$$
$$-0.79\Delta X_t - 0.48 e_{t-1} + \varepsilon_t$$
$$(-4.30) \qquad (-3.20)$$
$$\hat{\sigma} = 96462,\ Q(20) = 13.3$$
$$p_1 = 4, p_2 = 0$$

The significant short-run Total cash out elasticity with respect to Treasury balance is (-0.79).

5- Treasury balance and Total deficit(surplus): $X_t = X_{3t}, Y_t = X_{7t}$

$$\Delta Y_t = -0.67\,\Delta Y_{t-1} - 0.51\Delta Y_{t-2} - 0.32\,\Delta Y_{t-3} - 0.26\,\Delta Y_{t-4}$$
$$(-3.75) \qquad (-2.87) \qquad (-2.02) \qquad (-2.24)$$
$$-\,0.41\Delta X_{t-3} - 0.28 e_{t-1} + \varepsilon_t$$
$$(-2.21) \qquad (-1.66)$$
$$\hat{\sigma} = 105783\ ,\ Q(20) = 18.3$$
$$p_1 = 4, p_2 = 3$$

6- Total cash in and Total cash out : $X_t = X_{5t}, Y_t = X_{6t}$

$$\Delta Y_t = -0.31\Delta Y_{t-1} - 0.17\Delta Y_{t-2} + 0.41\Delta X_t - 0.68 e_{t-1} + \varepsilon_t$$
$$(-2.19) \qquad (-1.64) \qquad (3.04) \qquad (-4.14)$$
$$\hat{\sigma} = 103335,\ Q(20) = 13.3$$
$$p_1 = 2, p_2 = 0$$

The significant short-run Total Cash Out elasticity with respect to Total Cash in is (+0.41).

7- Total cash in and Total deficit(surplus) : $X_t = X_{5t}, Y_t = X_{7t}$

$$\Delta Y_t = -0.45\Delta Y_{t-1} - 0.35\Delta Y_{t-2} - 0.30\Delta Y_{t-3} - 0.20\Delta Y_{t-4}$$
$$(-2.56) \qquad (-1.99) \qquad (-1.95) \qquad (-1.84)$$
$$+0.39\Delta X_t - 0.55 e_{t-1} + \varepsilon_t$$
$$(2.93) \qquad (-2.99)$$
$$\hat{\sigma} = 101667,\ Q(20) = 7.7$$
$$p_1 = 4, p_2 = 0$$

The significant short-run Total deficit(surplus) elasticity with respect to Total cash in (+0.39).

8- Total cash In and and Total primary balance : $X_t = X_{5t}, Y_t = X_{9t}$

$$\Delta Y_t = -0.22\Delta Y_{t-4} + 0.53\Delta X_t - 0.97 e_{t-1} + \varepsilon_t$$
$$(-3.01) \qquad (5.37) \qquad (-9.01)$$
$$\hat{\sigma} = 80533,\ Q(20) = 19.3$$
$$p_1 = 4, p_2 = 0$$

The significant short-run Total Primary Balance elasticity with respect to Total cash in is (+0.53).

9- Total deficit(surplus) / Total cash out and Total primary balance / Total cash out: $X_t = X_{8t}, Y_t = X_{10,t}$

$$\Delta Y_t = -0.136\Delta Y_{t-4} + 0.775\Delta X_t - 0.835 e_{t-1} + \varepsilon_t$$
$$(-2.03) \qquad (9.10) \qquad (-7.65)$$
$$\hat{\sigma} = 0.098,\ Q(20) = 12.9$$
$$p_1 = 4, p_2 = 0$$

The significant short-run (Total primary balance/Total cash out) elasticity with respect to (Total deficit(surplus) / Total cash out) is (+0.775).

CONCLUSION

This paper provides several points of a big interest for the politicians in Lebanon. Indeed the Lebanese Treasury attracts the daily political speeches, and therefore the identification of models of the variables associated to the Treasury informs us from the future evolution of every variable. The comparison of the forecasting quality between the M_1 models with stochastic seasonality and the M_2 models in first difference with deterministic seasonality (FDSD), encourages the M_2 models (weak value of the MAPE criterion). Therefore the variables of the Lebanese Treasury are non-stationary time series and they evolve with first difference and deterministic seasonality. The cointegrated relationships between nine pairs of variables inform to the existence of a long-term economic relation from which, the ECM representation permits to integrate the fluctuations of short-term. The error correction term e_{t-1} has the correct sign and has a highly significant t ration in the case of the pairs: Treasury payments and Total cash out, Treasury balance and Total cash out, Total cash in and Total cash out, Total cash in and Total deficit (surplus), Total cash in and Total primary balance, Total deficit(surplus) /Total cash out and Total primary balance /Total cash out. Therefore for these pairs of variables, the ECM representation is validated and the strength leading every pair toward the long-term equilibrium is marked well. The short-run elasticity coefficient is very significant for seven pairs of variables.

The presence of a cointegration relationship between the Total cash in and the Total cash out, and the Total deficit (variable X7) of USD 1.856 bn in the year 2005, offer to the Lebanese government an important information showing a deficit of the Lebanese treasury. This problem is in direct relation with the public debt since the Total primary balance (variable X9) is USD 0.489 bn in the year 2005. It means that the big problem of the deficit of the Lebanese Treasury results from the public debt. So the efforts of the Lebanese state must concentrate on the weakening of this debt encouraging the economic activities of all domains notably the attraction of the Foreign Direct Investment (FDI). It is clear that the scope of efforts to attract FDI must encompass all economic sectors. If the tendency in the past was to focus almost exclusively on infrastructure, in the future more and more FDI will be market seeking investment in service sectors as well as investment in tourism and offshore services. To really start resolving the problem of the public debt, the political stability of Lebanon is primordial. As well, the modernization of the public sectors will facilitate the outflows of FDI.

REFERENCES

Banque du Liban. http://www.bdl.gov.lb

Beaulieu, J.J. and Miron, J.A. 1993. Seasonal unit roots in aggregate U.S. data. *Journal of Econometrics,* (55): 305-328.

Clarida, R. H. 1994. Cointegration, aggregate consumption, and the demand for imports: a structural econometric investigation. *The American Economic Review,* 84(1): 298-308.

Dickey, D.A., Hasza, D.P., Fuller, W.A. 1984. Testing for unit root in seasonal time series. *Journal of the American Statistical Association*, 79(386): 355-367.

Dickey, D.A., Jansen, D.W., Thornton, D.L. 1991. A primer on cointegration with an application to money and income. *Federal Reserve Bank of St. Louis*, March/April: 58-78.

Doz, C. and Malgrange, P. 1992. Modèles VAR et prévisions à court terme. *Economie et Prévision,* (106) : 109-122.

Engle, R.F. and Yoo, B.S. 1987. Forecasting and testing in co-integrated systems. *Journal of Econometrics,* (35): 143-159.

Engle, R.F. and Granger, C.W.J., Hylleberg, S., Lee, H.L. 1993. Seasonal cointegration : the Japanese consumption function. *Journal of Econometrics*, (55): 275- 298.

Engle, R.F. and Granger, C.W.J. 1987. Co-integration and error correction : representation, estimation and testing. *Econometrica,* 55(2): 251-276.

Fountis, N.G. and Dickey, D.A. 1989. Testing for a unit root nonstationarity in multivariate autoregressive time series. *The Annals of Statistics,* 17(1): 419-428.

Franses, P.H. 1991. Seasonality, non-stationarity and the forecasting of monthly time series. *International Journal of Forecasting*, (7): 199-208.

Granger, C.W.J. 1986. Developments in the study of cointegrated economic variables. *Oxford Bulletin of Economics and Statistics,* 48(3): 213-228.

Granger, C.W.J. and Siklos, P.I. 1995. Systematic sampling, temporal aggregation, seasonal adjustment, and cointegration theory and evidence. *Journal of Econometrics,* (66): 357- 369.

Ghysels, E., Lee, H.S., Noh, J. 1994. Testing for unit roots in seasonal time series. *Journal of Econometrics,* (62): 415- 442.

Hylleberg, S., Engle, R.F., Granger, C.W.J., Yoo, B.S. 1990. Seasonal integration and cointegration. *Journal of Econometrics*, (44): 215-238.

Johansen, S. 1988. Statistical analysis of cointegration vectors. *Journal of Economic Dynamic and Control,* 12(213): 231-254.

Johansen, S. and Juselius, K. 1990. Maximum likelihood estimation and inference on cointegration with applications to the demand for money. *Oxford Bulletin of Economics and Statistics,* 52(2): 169-210.

Kunst, R. and Neusser, K. 1990. Cointegration in a macroeconomic system. *Journal of Applied Econometrics,* (5): 351-365.

Lee, H.S. 1992. Maximum likelihood inference cointegration and seasonal cointegration. *Journal of Econometrics*, 54: 1-47.

Mourad, M. 2006. Tests de racines unitaires et performance prévisionnelle des modèles AR : application sur les variables du transport en France. *Lebanese Science Journal*, 7(1): 113-131.

Oskooee, M.B. and Brooks, T.J. 1999. Cointegration approach to estimating bilateral trade elasticities between U.S. and her trading partners. *International Economic Journal,* 13(4): 119-128.

Stock, J.H. and Watson, M.W. 1988. Testing for common trends. *Journal of the American Statistical Association,* 83(404): 1097-1107.

Thomas, R.L. 1997. *Modern econometrics: an introduction*. Addison Wesley Longman, England.

Todas, H.Y. and Phillips, C.B. 1993. The spurious effects of unit roots on vector autoregressions. *Journal of Econometrics*, 59: 229-255.