Consumption smoothing and the current account: evidence for Mexico, 1980 - 2005

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Resumo - Este artigo estima um modelo de suavização do consumo da conta corrente Mexicana para o período 1980-2005. O modelo incorpora expectativas de distribuição de consumo intertemporal dos agentes privados em resposta a perturbações na produção, nos investimentos e nos gastos do governo. Os resultados empíricos prevêem os fluxos na conta corrente, mesmo durante as crises de 1982 e 1994, quando os controles de capital limitavam a capacidade dos residentes domésticos de captar e ceder empréstimos no mercado internacional.

Palavras-chave - México; conta corrente; suavização do consumo; co-integração; auto-regressão vetorial

Abstract - This paper estimates a simple consumption-smoothing model of the Mexican current account for the period 1980-2005. The model incorporates the expectations of intertemporal consumption distribution in response by private agents to disturbances in output, investment and government expenditure. The empirical results predicts the flow of the current account even during the 1982 and 1994 crisis, although the capital controls present at the time proved limiting to the ability of domestic residents to engage in international borrowing and lending.

Key-words - Mexico; current account; consumption-smoothing; cointegration; vector autoregression

JEL classifications - F32; F41; F47

I. Introduction

The current account of the balance of payments plays several roles in the analysis of economic developments, since a country's balances reflect the difference between exports and imports; it reflects the totality of domestic residents' transactions with foreigners in the market for current goods and services. At the same time it determines the evolution of a country's stock of net claims with the rest of the world over the time, this reflects the intertemporal preferences of domestic residents and foreigners. Therefore the movements in the current account are deeply intertwined with expectations of all market participants in an open economy (Knight and Scacciavillani 1998).

Recent literature on the determination of the current account has increasingly taken the perspective of intertemporal allocation of consumption. This model of intertemporal approximation has proven worthy. A positive description of the current account is the simple approach of intertemporal models; empiric evidence supports these models and argues that the intertemporal model provides fundamentals consistent and coherent for the policy analysis of open economies. As observed, time series models based on consumption smoothing performs very well for Sweden and Great Britain over a large historical period (Obstelfed and Rogoff 1994).

Mexico experienced large external shocks during 1982 and 1994. Prior to the mid 1980's, the context was characterized by capital controls, followed by a period of rapid economic transformations focused on macroeconomic stabilization and structural reforms.

This paper attempts to interpret Mexico's recent external performance based on consumption-smoothing model or intertemporal model, focused on the impact of current and future value of a household's expected income. Section II outlines the theoretical model and the empirical approach to testing it. Section III provides the results of the model. This indicates that the model accommodates adequately to the Mexican current account over the period 1980-2005. During this period Mexico has experimented considerable external shocks and a strong dependency on short term borrowing, thus preventing from effectively smoothing consumption spending over time. The final section offers some final observations and suggests possible extensions of our approach.

II. Theory and econometric metrods

In a small open economy with access to world capital markets and a given world interest rate, the intertemporal approach to the current account is derived from the permanent income theory. This theory focuses on the decisions of long run investment and saving of the private agents. Non-permanent shocks can have an impact on national savings and current account in the form large fluctuations.

The model used is based on a one-good framework.[1] In this simple model there exists only one traded asset, a consumption index bond with a fixed face value that pays a net interest rate (ρ) between two periods. The representative consumer will maximize an intertemporal utility function of the form:

$$E_0 \sum_{t=0}^{\infty} \alpha^t u(C_t), \qquad 0 < \alpha < 1 \tag{1}$$

where α is a discount factor, C_t is private consumption, E_0 the expectations operator, and $u(\ )$ the utility function, which has decreasing marginal returns.
The utility maximization will be subject to the following budget constraint:

$$\Delta B_{t+1} = \rho B_t + Y_t - I_t - C_t - T_t \tag{2}$$

where B_t is the bond holdings at period t, ρ the world interest rate, Y_t is output, I_t is investment, T_t are lump-sum taxes, and Δ is the first difference operator. For the government we define a balanced budget, thus the following condition is accepted:

$$G_t = T_t \tag{3}$$

where G_t is defined as government spending. Substituting equation (3) into equation (2) results in the definition of the indexed

[1] The basics of this framework have been used by several authors, including Sheffrin and Woo (1990), Gosh (1995), and Agénor, et al. (1999).

bond:

(4)

$$B_{t+1} = (1+\rho)B_t + Y_t - I_t - C_t - G_t$$

In order to prevent external lending to become a Ponzi scheme, since it is suboptimal for a lender to roll over the principal and capitalize the interest payments forever, the demand for financing will translate into the following condition:

(5)

$$\lim_{i\to\infty} \frac{B_{t+i}}{(1+\rho)^i} = 0$$

Solving equation (4) using the condition in (5), and assuming a quadratic utility function[2], consumption will be proportional to expected wealth, defined as the present discounted value of the cash flow plus interest payments on the existing stock of assets, which implies that the optimal path of consumption does not depend on uncertainty over future consumption or the degree of availability of income, thus maintaining the assumption of certainty equivalence required by the model. Formally:

(6)

$$C_t^* = \frac{\rho}{\theta(1+\rho)} E_t\left[\sum_{i=0}^{\infty} (1+\rho)^i Z_{t+i}\right] + \left(\frac{\rho}{\theta}\right) B_t$$

where

(7)

$$\theta \equiv \alpha\rho \frac{(1+\rho)}{\left[\alpha(1+\rho)^2 - 1\right]}$$

and

(8)

$$Z_t = Y_t - I_t - G_t$$

(Z_t represents net output.)

The parameter θ reflects the consumption tilting dynamics, resulting from divergences in the domestic rate of preference, $(1 - \alpha)/\alpha$, and the world interest rate. If $\theta > 1$, agents favor saving for future consumption, where if $\theta < 1$ agents favor present consumption through debt.

By definition, an expression of the current account can be derived as the sum of the trade balance plus interest income on external assets[3],

(9)

$$CA_t = Y_t + \rho B_t - I_t - G_t - C_t = Z_t + \rho B_t - C_t$$

Then the consumption smoothing component of the current account can be defined as

(10)

$$CA_t = Q_t - I_t - G_t - \theta C_t$$ [4]

which includes the consumption tilting element.

According to Agénor, et al. (1999) the main issue concerning the empirical implementation of equation (10) is the measurement of the expected changes in the cash flow variable. It is assumed then that the current account itself reflects all information about the course of the cash flow variable. In other words, national savings should help predict the subsequent movements in the national cash flow variable.

Noticing that the current account is also equal to net foreign asset accumulation, through the consumption definition in equation (6), the current account can be redefined as:

(11)

$$CA_t = -E_t\left[\sum_{i=1}^{\infty} \frac{\Delta Z_{t+i}}{(1+\rho)^i}\right]$$

Following Sheffrin and Woo (1990), this equation has a simple interpretation: a country will run a current account surplus only if it expects its net output to be falling in the future. It has also an important econometric implication: if the net output is stationary in first differences, then the current account will also be stationary in levels. Therefore these series represent a cointegrated system, which permits to test and estimate the restrictions of the theory presented in vector autoregressive (VAR) framework with net output and the current account.

To test the implications of the model, it is necessary to estimate a first order VAR that includes the cash flow variable, defined as the first difference of net output (ΔZ_t), and the actual consumption smoothing component of the current account obtained from the cointegration residual of the form , $CA_t^* = Q_t - I_t - G_t - \tilde{\theta} C_t$ or

[2] Following Sheffrin and Woo (1990), closed-form solutions, generally, do not exist for a consumption function under uncertainty because both the effective interest rate and net output will then be random. Relaxing the assumptions provides no empirical improvement over the original formulation and is out of the scope of this paper.

[3] The element, ρB, is substituted in the estimation as Ft, the balance of factorial services.

[4] By definition, Gross National Product is equal to Gross Domestic Product plus the interest income on foreign assets .For further development of the construction of the national accounts elements, see Appendix 1.

[5] The validity of this condition implies also that the first order VAR in expression (12) is perfectly determined.

formally

(12)

$$\begin{bmatrix} \Delta Z_t \\ CA_t^* \end{bmatrix} = \begin{bmatrix} \alpha_1 & \alpha_2 \\ \alpha_3 & \alpha_4 \end{bmatrix} \begin{bmatrix} \Delta Z_{t-1} \\ CA_{t-1}^* \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{bmatrix}$$

where $\varepsilon_{1,t}$ and $\varepsilon_{2,t}$ are the disturbance terms and $\tilde{\theta}$ the consumption tilting component estimated in the cointegration. Then the following implication is made:

(13)

$$E_t \begin{bmatrix} \Delta Z_{t+i} \\ CA_{t+i}^* \end{bmatrix} = \begin{bmatrix} \alpha_1 & \alpha_2 \\ \alpha_3 & \alpha_4 \end{bmatrix}^i \begin{bmatrix} \Delta Z_{t-1} \\ CA_{t-1}^* \end{bmatrix} = A^i \begin{bmatrix} \Delta Z_t \\ CA_t^* \end{bmatrix}$$

and then, by substituting equation (13) in equation (11) the estimator of the optimal consumption smoothing component of the current account is formally:

(14)

$$\overline{CA}_t = -\begin{bmatrix} 1 & 0 \end{bmatrix} \left[\frac{1}{(1+\rho)} A \right] \left[I - \frac{1}{(1+\rho)} A \right]^{-1} \begin{bmatrix} \Delta Z_t \\ CA_t^* \end{bmatrix}$$

where I is the identity matrix. This equation is only valid as long as the infinite sum expressed in equation (11) converges, which implies both series involved in the VAR system will be stationary $I(0)$[5].

Finally, this estimate can be compared to the actual consumption smoothing component for the current account to determine if a current account surplus or deficit is explained by the consumption smoothing behavior, and other testable implications.

III. Data, estimation and results

The data used in the estimations are quarterly national accounts data for the period 1980.1 to 2005.4, measured in United States' Dollars at 1993 constant prices. Since not all series were available in the appropriate bases or periods, some series were constructed using available data[7].

We first constructed the stationary consumption smoothing component of the current account. This series is obtained as the residual of the cointegration of C_t and $Q_t - I_t - G_t$. For this purpose is necessary to determine if both series are integrated in the same order to proceed. A series of Augmented Dickey-Fuller Unit Root Tests on both series conclude that both are $I(1)$ processes[7]. The cointegrating relationship was estimated using the VAR-based methodology developed in Johansen (1991) and Johansen (1995). The normalized expression obtained, proving one cointegration relationship is represented as

(15)

$$Q_t - I_t - G_t - \underset{(0.00983)}{0.963962} C_t$$

where the number in parenthesis is the standard error[8].

The estimation of the tilting element $\tilde{\theta}$ obtained in the normalized cointegration vector is statistically different from unity at a reasonable level of significance and indicates that Mexico has consumed more than its permanent cash flow and has thus foregone future consumption in favor of present one. As indicated, the residual of the cointegration relationship will be used to represent the consumption smoothing component of the current account.

The hypothesis of cointegration between C_t and $Q_t - I_t - G_t$ was tested using the Osterwald-Lenum (1992) likelihood ratio trace statistic. The eigenvalues reported for no cointegrating relationships and at most one relationship of this kind have associated trace statistics of 13.030432 and 0.006214 respectively. Considering a 5% significance level, the test reveals that exactly one cointegrating relationship exists.

The second step of the procedure was to estimate the VAR system for the first difference of net output and the consumption smoothing element of the current account. The estimated system of equations is expressed as follows:

(16)

$$\Delta Z_t = \underset{(0.10069)}{0.028218} \Delta Z_{t-1} - \underset{(0.18372)}{0.002752} CA_{t-1}$$

(17)

$$CA_t^* = -\underset{(0.02177)}{0.039526} \Delta Z_{t-1} + \underset{(0.03971)}{0.903814} CA_{t-1}$$

where the values in parenthesis reflect the standard errors.

The intertemporal model described in the previous section implied that the coefficient of ΔA_t is equal to zero and the coefficient of CA_t equal to one. Acceptance of those restriction implies that movements of the actual consumption smoothing ele-

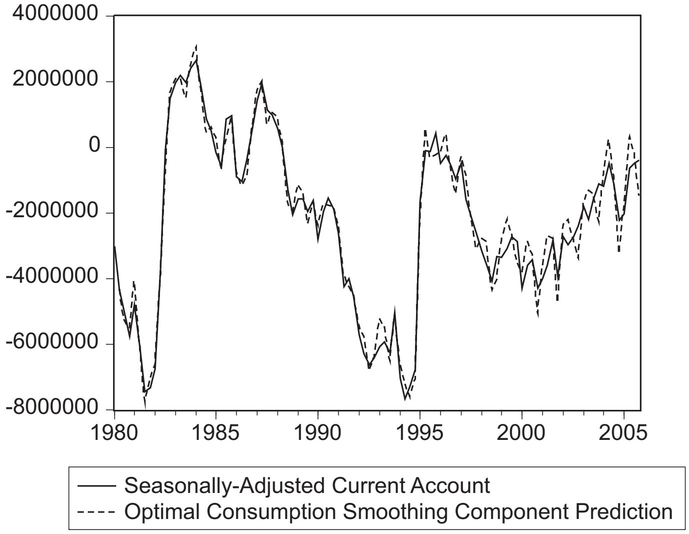
[6] The procedures for the series construction appear in Appendix I.

[7] The test results appear in Appendix II.

[8] The test results appear in Appendix II

ment of the current account reflects those of the optimal consumption smoothing account constructed trough the solution of the system of equations portrayed in equations (16) and (17).

Figure 1. Mexico: actual and predicted consumption smoothing component of the current account (thousands of United States Dollars at 1993 constant prices).



World Interest Rate: 3%

These joint restrictions were tested using a Wald test, reporting a chi squared statistic of 8.221264 and an associated p-value of approximately 0.016397. This suggests, at a reasonable confidence level, that Mexico has had difficulty in smoothing consumption through foreign lending and borrowing in face of the exogenous shocks.

IV. Summary and conclusions

In this paper we attempts to explain a simple intertemporal model of the Mexican current account over the period 1980-2005, on the basis of the consumption smoothing approach focused on expected income on saving and investment.

The key learning of model's prediction is that a country's current account will be in deficit or surplus whenever national net output is expected to rise or fall over time. If net output is expected to grow then current account deficit increases. By contrast if net output was expected to fall then current would run a surplus.

Estimation outputs suggested that Mexico has difficulty to smoothing consumption through foreign lending and borrowing. This fact is not surprising since during the 80's there were capital controls present in combination with a state controlled currency. In addition, the model of consumption smoothing fits very well with the sharp turnarounds of the current account for the period 1980-2005, particularly in 1982 and 1994 crises.

If we consider that the model is capturing the saving and investment decisions carry out by expectations of government spending, investment, interest rates, etc. deviations between actual and optimal current account indicate that Mexico is excessive borrowing for consumption. This is important since reflects the vulnerability of the Mexican economy to external shocks and will be considered as a concern for policymakers.

Finally, the possible extensions of this approach is to estimate the current account without national accounts data, this is due to the fact that this data does not fully reflect nominal capital gains and losses on net foreign assets. Thus the deflation procedure does not allow us to correct for the inflationary erosion of the real value of foreign assets.

Appendix I: construction of the time series

This appendix explains the construction of the time series that were not available, either totally or partially, using indirect methods on available data. The data used in the estimations is quarterly national accounts data for the period 1980:1 trough 2002:4, measured in United States' Dollars at 1993 constant prices. National accounts data was obtained from the National Institute of Statistics, Geography and Informatics (INEGI) and the United States' consumer price index from the FRED II database of the Federal Reserve Bank of St. Louis.

The gross domestic product and private consumption series were constructed in terms of thousands of United States Dollars at constant 1993 prices, considering the Purchasing Power Parity hypothesis:

$$S_t^{USD} = S_t^{MXP} \cdot R_t^{MXP/USD} \cdot \frac{P_t^{MX}}{P_t^{US}} \tag{18}$$

where S_t^{MXP} is the corresponding series thousands of Mexican Pesos at 1993 constant prices, $R_t^{MXP/USD}$ is the nominal exchange rate of pesos per dollar, and $\frac{P_t^{MX}}{P_t^{US}}$ the ratio of the consumer price index of Mexico and the United States with the base year settled as 1993.

Starting from the national accounts identities we have,

$$Y_t \equiv C_t + I_t + G_t + X_t - M_t \tag{19}$$

and from the fact that Gross National Product does include both net capital and labor payments from abroad, we establish that

$$Q_t \approx Y_t + F_t \tag{20}$$

where Y_t equals gross domestic product, Q_t equals gross national product, C_t equals private consumption, I_t equals investment, G_t equals government spending, X_t equals exports, M_t equals imports, and F_t equals the balance of factorial services.

Then, after working with (19) and (20) we obtain net output (Z_t) and national disposable income (Q_t - I_t - G_t) series constructed as:

$$Z_t = Y_t - I_t - G_t = C + X_t - M_t \tag{21}$$

$$Q_t - I_t - G_t = Z_t + F_t \tag{22}$$

Prior to the analysis, the Q_t - I_t - G_t , C_t , and Z_t series were seasonally adjusted using the Tramo/Seats algorithm developed by Victor Gomez and Agustin Maravall (Bank of Spain). Tramo/Seats bases its decomposition on an estimated parameteric ARIMA model.

Appendix II: time series tests

This Appendix overviews the time series properties of consumption (C_t) , national disposable income (Q_t - I_t - G_t) , net output (Z_t) and the consumption smoothing component of the current account (CA_t) obtained as the residual of the cointegration of C_t and Q_t - I_t - G_t .

The Augmented Dickey Fuller (ADF) Test used is based on a model for any series y_t of the form

$$\Delta y_t = \mu + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \delta_2 \Delta y_{t-2} + \varepsilon_t \quad (23)$$

with the null hypothesis of a unit root ($\gamma = 1$). Rejecting the null hypothesis favors stationarity in the series. The unit root hypothesis is not rejected at a 1% significance level for consumption, national disposable income, or net output measured in levels. In first differences, the hypothesis of two unit roots is rejected for these same three series at a 1% significance level.

Table 1 - Univariante unit root test, 1980.1 - 2005.4

Variable	Augmented Dickey-Fuller Statistic ($H_0: \gamma = 1$)	MacKinnon Critical Values
One unit root vs. none		
$Q_t - I_t - G_t$	-0.598352	
Z_t	-0.678136	(1%) -3.4972 (5%) -2.8906
C_t	-0.930307	
Two unit roots vs. at most one		
$\Delta(Q_t - I_t - G_t)$	-3.996312	
ΔZ_t	-3.961915	(1%) -3.4979 (5%) -2.8909
ΔC_t	-3.981362	

The cointegration procedure between C_t and Qt - It - Gt was determined through the Johansen procedure at a standard of four lags indicates exactly one cointegrating equation at the 5% significance level in a specification with neither intercept nor trend.

Table 2 - Results of the Cointegration Test of Q_t - I_t - G_t and C_t
Lag interval (in differences): 4
Log likelihood (one cointegration equation): -3130.19118

Hypothesized No. of Cointegrating Equations	Eigenvalue	Trace Statistic	1 % Critical Value	5% Critical Value
None	0.117845	13.030432	12.53	16.31
At most one	0.006214	0.617074	3.84	6.51

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