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The Elasticity of Substitution in Demand for Non-Tradable Goods in Uruguay

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Abstract[1]

This paper's main goal is to estimate the elasticity of substitution of non-tradable goods, paying special attention to empirical problems related to time-varying parameters, missing regressors and model misspecification. To that end, the paper creates a database and estimates, via three alternative methods, quarterly series of consumption and prices of tradable and non-tradable goods for Uruguay for the period 1983-2002. The econometric estimations of the parameter of interest were performed with VEC models. These estimates give a long-run elasticity of substitution of –0.46 in the principal model and –0.71 and –0.75 in the two alternative models. Parametric stability tests are performed on the principal model, and the predictive ability of the model is also tested. It is concluded that, not only is the parameter of interest stable over time, but the model also has good predictive properties, even when tested in a very demanding environment: the period following Uruguay's change of exchange rate regime in mid-2002.

Keywords: International Macroeconomics, Elasticity of Substitution in Consumption, VEC Models.
JEL classification codes: F3, F4, C5.

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1. Introduction

The objective of this paper is to obtain estimates of the elasticity of substitution in the consumption of non-tradable goods in Uruguay. To this end the paper uses three alternative methods to construct quarterly series of consumption and prices of tradable and non-tradable goods for the period 1983-2002. To estimate the relevant parameter, multivariate co-integration models with event-specific dummies are used. The econometric strategy was especially designed to test the model's parametric consistency over time and its predictive power.

Although the paper focuses on estimating the elasticity of substitution in demand for non-tradable goods, it is interesting to note that this parameter is significant in a variety of open economy macroeconomic problems. For instance, comparison of the respective values of the intratemporal and intertemporal elasticity of substitution makes it possible to determine, from a theoretical point of view, the current account's reaction to different shocks (i.e., productivity shocks).[2] Moreover, this parameter is important in the transmission of shocks among economies.[3]

An interesting application is to determine the impact of a change in the capital flux or a sudden stop on the real exchange rate (see Calvo, Izquierdo and Talvi, 2002), given an elasticity of substitution. In a recent counterfactual exercise carried out at the Centro de Investigaciones Económicas (CINVE), using the elasticity estimated in this paper, it was found that the change in relative prices needed to balance Uruguay's current account at the end of 2001 was between 25 percent and 35 percent, while the actual change following the sudden stop in 2002 was 34 percent. These examples indicate, broadly speaking, the potential uses of the parameter's estimation.[4]

In addition, Uruguay is an interesting case for at least two further reasons. First, the real exchange rate (*RER*) was not constant during most of the period that this paper analyzes (1983.1-2002.4), and thus Uruguay offers a means of observing the effects of that circumstance on the ratio of consumption of non-tradable and tradable goods. Second, the macrodevaluation of the Uruguayan peso in the second quarter of 2002 and the significant attendant change in relative prices comprise an episode that can be used to analyze the predictive properties of econometric

[2] See Chapter 4 of Obstfeld and Rogoff (1996).
[3] See Stockman and Tesar (1995).
[4] See other examples of the relevance of this parameter in the introduction to Barja, Monterrey and Villaroel (2003).

models that provide estimates of the elasticity of substitution parameter. In particular, it is interesting to test the parameter's constancy over time.

The outline of the paper is as follows. The next section of the paper outlines the theoretical framework, and Section Three describes in detail the methodology for compiling the consumption series that will be used in the econometric analysis. Section Four is devoted to the description of the econometric method used for the estimation. Section Five presents the results, and Section Six draws the main conclusions.

2. Theoretical and Conceptual Framework

Suppose that a representative individual maximizes each period utility function

$$(1)\quad U = u(C)$$

subject to the standard budget constraint

$$(2)\quad W = PC \equiv P_T C_T + P_N C_N$$

where C is an index of the overall real consumption (P the associated price index), defined over the consumption of Tradable and Non-Tradable goods, and is given by a CES function,

$$(3)\quad C = \left[w(C_T)^{-h} + (1-w)(C_N)^{-h} \right]^{-\frac{1}{h}},$$

where W is wealth and P_T and P_N are the prices of tradable and non-tradable goods, respectively.

The first-order conditions for the consumption of tradable and non-tradable goods are:

$$(4)\quad \frac{\partial L}{\partial C_T} = u' \frac{\partial C}{\partial C_T} + l P_T = 0$$

$$(5)\quad \frac{\partial L}{\partial C_N} = u' \frac{\partial C}{\partial C_N} + l P_N = 0.$$

where l is the lagrangian multiplier.

From (4) and (5), and considering the derivative of (3), one obtains

$$(6)\quad \frac{\partial C / \partial C_N}{\partial C / \partial C_T} = \frac{1-w}{w} \left(\frac{C_N}{C_T} \right)^{-(1+h)} = \frac{P_N}{P_T}$$

then

$$(7)\quad \frac{C_N}{C_T} = \left[\frac{w}{1-w}\frac{P_N}{P_T}\right]^{-1/(1+h)}$$

Taking logarithms on both sides of (7),

$$(8)\quad \ln(C_T / C_N) = \ln a_0 - a_1 \ln(RER)$$

where $a_0 \equiv \left(\frac{w}{1-w}\right)^{\frac{1}{1+h}}$, $a_1 \equiv \frac{1}{1+h}$ and $RER \equiv \frac{P_T}{P_N}$.

The parameter a_1 in equation (8), the elasticity of substitution in the consumption of tradable and non-tradable goods, is the key parameter to estimate.

The problem could be reformulated to take into account other omitted factors that could help explain C_T/C_N. Taking into account (2), the optimal consumption of tradable and non-tradable goods could be expressed as

$$(9)\quad C_T = \frac{a_0}{a_0 + RER^{a_1 - 1}}\frac{W}{P_T} = \frac{a_0}{a_0 + RER^{a_1 - 1}}\frac{P}{P_T}C,$$

$$(10)\quad C_N = \frac{RER^{a_1}}{a_0 + RER^{a_1 - 1}}\frac{W}{P_T} = \frac{RER^{a_1}}{a_0 + RER^{a_1 - 1}}\frac{P}{P_T}C.$$

Because *homothetic* preferences are assumed, the individual's desired tradable to non-tradable consumption ratio (see equation 7) depends only on the relative price of tradables and not on wealth or total expenditure. In a more general set-up (e.g., González-Rosada and Neumeyer, 2003), not only will absolute consumption (equations 9 and 10) depend on wealth, but so too will relative consumption. Thus, the empirical analysis will use variables to control for potential wealth or expenditure effects, as in footnote 22 of Stockman and Tesar (1995). To take into account these other factors, equation (8) could be reformulated in the following terms

$$(11)\quad \ln(C_{Tt} / C_{Nt}) = \ln a_0 - a_1 \ln(RER_t) + a_2 Z_t + e_t$$

where vector Z_t contains "other" factors and e_t is a normally distributed error term (white noise).

From the econometric point of view, the main difference between equations (8) and (11) is that the latter includes a set of additional variables (Z_t) that might have relevant effects on individuals' consumption decisions. Care must nonetheless be exercised in defining the set of variables to be included in vector Z. Particular attention must be paid to a group of variables that are candidates to form part of Z but at the same time are generally considered fundamental determinants of *RER*. Therefore, it is reasonable to speculate that the most important part of the effect of these variables on the optimal consumption decisions occurs through *RER*. As will be seen below, the determinants of the real exchange rate will be proven in a NATREX approach.

The NATREX real exchange rate (RER_n) is defined as that which maintains the equilibrium in the balance of payments in the absence of cyclical factors, speculative capital movements and movements in international reserves. It is a medium-term equilibrium real exchange rate, when prices have adjusted and output has returned to its potential level.

The solution of the model leads to

$$(12) \quad I\text{-}S \equiv f(k, D, W)$$

$$(13) \quad CA \equiv f(k, D, R_n, W)$$

where I is investment, S is savings, CA is the current account balance, k is the real capital stock, D is the net external debt (k-D=W, or wealth) and W represents the exogenous fundamentals (productivity, terms of trade, propensity to save and the real international interest rate).

Movements in k and D, and therefore in W and in the exogenous fundamentals, alter the *NATREX*. When savings, investment and net capital flows change, capital stock, wealth and external debt are altered, modifying by (12) the planned investment and savings, as well as the current account balance, which leads to a new equilibrium RER_n.

The RER_n (*NATREX)* therefore depends on exogenous and endogenous fundamentals:

$$(14) \quad RER_n = RER_n\,(W, k, D)$$

It is interesting to note that the equilibrium real exchange rate depends on several variables such as the terms of trade, the government's propensity to save, and the world real interest rate, and it is tempting to include these as control variables in equation (11). Particular care must therefore be exercised in introducing into the empirical analysis determinants of relative consumption analysis that might be explanatory factors of the equilibrium real exchange rate.

In the theoretical and empirical approximation of the determinants of the real exchange rate carried out by Aboal (2003), following a *NATREX* approach, it is evident that variables such as terms of trade, international real rate of interest and the government's propensity to save, may have an equilibrium relationship with *RER*. Co-integration tests carried out on this group of variables, which is smaller than that used in Aboal (2003), where the relative productivity of the tradable sector and the propensity to save of the economy were also included, indicate that the hypothesis of the existence of a co-integration relationship cannot be rejected, which substantiates the decision to exclude them from vector *Z*.

From the empirical perspective, the inclusion in vector *Z* of a set of variables that are fundamental determinants of *RER* may imply a biased estimate of the interest parameter (a_1) or may even provoke the loss of statistical meaning and the detection of instability in the parameter over time. This problem is relevant when there are not enough observations available to estimate a system with potentially more than one equilibrium relationship; in other cases the problem could be addressed without much difficulty. The econometric estimation in this paper has taken account of these issues.

3. Estimates of Private Consumption

This section describes the main steps taken to obtain the estimates of private consumption expenditures in tradables and non-tradables and the relative price of tradable in terms of non-tradable goods.

3.1. National Accounts Procedure

NA statistics are compiled by the *Banco Central del Uruguay* (BCU) and are published in the Statistical Bulletin on a monthly and quarterly basis. The base year for the series at constant prices is 1983.[5] GDP data are disaggregated by major activity sectors at constant and current prices on an annual basis. The GDP volume index by sector is provided quarterly but the decomposition of aggregate demand by components and sectors is not available. The NA statistics only provide data for final supply (GDP and Imports) and final demand (Gross Capital Formation, Variation in Stocks, Final Private Consumption, Final Public Consumption and Exports) for the whole economy and not by sector.

Data from the Input-Output Matrix (IOM83), estimated by the BCU for 1983, are also available (BCU, 1991). There are no recent Input-Output Matrices compiled by the official statistics institutions after 1983. Therefore, an unofficial Input-Output Matrix (IOM95) for 1995

[5] A new series of NA beginning in 1983 is available. For the base year an Input-Output Matrix guarantees the coherence and compatibility of the new NA system. In 1991, annual series from 1983 to 1990 were published. In 1988, the NA were revised to include information from the 1988 Economic Census. Revised series from 1988 to 2002 were completely available until 1999. For more recent years, quarterly information is used.

and the corresponding Social Accounting Matrix for the same year (SAM95) were also used. The first was compiled at CINVE by estimating the domestic flows for 1995 (IOM95) as part of a study on trade liberalization and the Uruguayan labor market (CINVE, 1999). The latter was recently compiled using the former matrix and a disaggregation of imported flows (Laens, 2003).[6]

Private consumption expenditure in each sector was estimated in this paper for six of the nine sectors suggested. According to the IOM83 there was no final private consumption in the Mining (M) sector, so this sector was taken into account only for intermediate consumption. The reasons for eliminating the Commercial Services (CS) and Financial Services (FS) sectors were different. In both cases it was very difficult to distinguish final from intermediate consumption. Furthermore, the data from the two matrices (IOP83 and SAM95) may not hold because each of these two sectors was estimated with a different methodology.

a) Classification into Tradable and Non-Tradable Sectors

Sectors were classified as tradable or non-tradable according to the ratio of total trade to gross output. For 1983, sector-level data from the IOM83 permits the classification shown in Table 1. As can be seen, classifications obtained using each of the three values of z were quite similar. The only sector under study that raised some doubts was the Personal Services sector. This sector was classified as tradable when $z = 0.01$ and as non-tradable for all other values of z. In this case, it is very difficult to obtain trade series for another period for the purposes of comparison, and this sector was therefore assumed to be non-tradable.

[6] The SAM was compiled according to the framework on export-led economic strategies used in Laens and Perera (2003).

Table 1. Tradable and Non-Tradable Sectors, 1983

Sector	TTY	z = 0.01	z = 0.05	z = 0.1
Agriculture	0.200	T	T	T
Mining	1.032	T	T	T
Manufacturing	0.439	T	T	T
Utilities	0.008	NT	NT	NT
Electricity	0.008	NT	NT	NT
Gas	0.000	NT	NT	NT
Water	0.012	T	NT	NT
Construction	0.000	NT	NT	NT
Commercial Services	0.000	NT	NT	NT
Transportation Services	0.179	T	T	T
Personal and Other Services	0.045	T	NT	NT

Source: BCU, IOM83.

For Agriculture and Manufacturing, ratios of total trade to gross output were calculated for the whole period 1983-2002. The averages were 0.26 and 0.62, respectively (see Table M.2. in the Methodological Appendix). The increase of this ratio in both sectors is to be expected because of the effect of trade opening and the integration process. For Transportation Services the ratio was estimated with trade data from the Balance of Payments, and the ratio is higher than 0.1 for the whole period. Even though Transportation Services as a whole was considered a tradable sector, this is not true for every sub-sector. The main sub-sector in final private consumption (Passenger Transportation) was non-tradable, but the available data were not appropriate for the purposes of this study.

b) Consumption Estimation

As noted above, final private consumption by sectors was only available for 1983. The methodology for building final private consumption series for each of the six sectors, takes into account these data and the final private consumption for 1995 estimated at CINVE (Laens and Perera, 2003).[7] In general, the estimation followed two different approaches according to the available information and output decomposition within each sector. The first approach used for estimating final consumption series was based on:

$$(15)\quad C_{i,t} = Y_{i,t} - \sum_j IC_{ij,t} - (X_{i,t} - M_{i,t}) - I_{i,t}$$

[7] The estimation of Private Consumption in the matrix compiled at CINVE was carried out using the data from the Household Income and Expenditures Survey for 1994 (INE, 1996).

where $C_{i,t}$ = Consumption of goods from sector *i* (private and public) at time *t*, $Y_{i,t}$ = Gross output of goods from sector *i*, $IC_{ij,t}$ = Intermediate consumption of goods from sector *i* by sector *j*, $X_{i,t}$ = Exports of goods from sector *i*, $M_{i,t}$ = Imports of goods from sector *i*, and $I_{i,t}$ = Investment of goods from sector *i*.

This method was used for the estimation of final consumption for two sectors: Agriculture and Manufacturing. In both cases, the series of Gross Output, Exports, Imports and Investment could be obtained properly (see Methodological Appendix). The intermediate consumption data for each sector were also available for only two points (1983 and 1995). To overcome this problem the ratio a_i was defined and the equation (15) was written as (16):

$$(16) \quad C_{i,t} + \sum_j IC_{ij,t} = Y_{i,t} - (X_{i,t} - M_{i,t}) - I_{i,t}$$

$$(17) \quad \frac{C_{i,t}}{\sum_j IC_{ij,t}} = a_i$$

It was then assumed that the ratio of final consumption to intermediate inputs demand for both sectors followed the same trend observed for that ratio when calculated for the whole economy. The latter can be obtained from the NA statistics with annual data for the period 1983-1998.[8] The global ratio shows an increase that reflects the relative growth of final consumption during the period. The same increase was found when the ratio was obtained from the IOM83 and the SAM95.

The estimation of the ratios by sector for the period was made taking into account the sectors' ratios for the years 1983 and 1995, their own increase and the pattern of the global ratios (see Methodological Appendix, Tables M.1 and M.2). Final private consumption from other sectors was estimated using a more direct approach. In this case, it was possible to determine the share of each sector's output that went to final private consumption. This direct approach was used for Utilities, Transportation Services and Personal Services.

For Utilities (Electricity, Gas and Water) the available data only allowed a direct estimation of final consumption in the case of Electricity. The share of this sub-sector in the output of the Utilities sector was more than 80 percent in the period 1983-1998 (see

[8] The private consumption data from the NA are estimated as a residual.

Methodological Appendix Table M.3). The series was obtained using data for residential consumption of electricity (see Methodological Appendix).

The Transportation sector can be decomposed into the following sub-sectors: Railroad Transportation, Urban and Highway Passenger Transportation, Motor Freight Transportation, Transportation by Air, Water Transportation, and Warehousing and Related Services. The procedure for separate private consumption from this sector was based on data for Passenger Transportation Services. It was assumed that the output of the sub-sector Urban and Highway Passenger Transportation was a proxy of final consumption for this sector. The other sub-sectors' output was assumed to be destined to intermediate consumption. According to the IOM83 this assumption seems to be appropriate (see Methodological Appendix, Table M.4).

Even though Transportation Services is a tradable sector, this sector is classified as non-tradable given the high share of Passenger Transportation in private final consumption. Furthermore, according to the IOM83, total private consumption in the Transport Road sub-sector represents domestic production. Total foreign trade in the Transport Road sub-sector was assigned to intermediate demand.

For Personal Services, data were taken from the Other Communal, Social and Personal Services in NA. This sector can be decomposed into General Government Activities (social and communal services like health and education), Entertainment Services (movie centers, theaters, shows, radio and television) and Household and Personal Services (hairdressing, general repairs, cleaning and laundry services, domestic services, etc.). It was assumed that the output of the sector of Other Communal, Social and Personal Services net of General Government Activities was destined for private consumption.

Finally, private consumption in the Construction sector was estimated as gross production minus investment. The residential construction in the decomposition of the NA is not available for the whole period. Table 2 shows a summary of the assumptions and procedures used in each case.

Finally, the estimates were compared with the data from IOP83, from SAM95 and with total consumption data from NA. The results of this comparison are acceptable and are presented in Table 3. The differences in the case of Agriculture and Manufacturing are partly due to the absence of government consumption and stock variation in equation (16). In the Construction sector the differences in 1995 are due to differences in methodology.

Table 2. Special Assumptions and Procedures for Each Sector

Sectors	**Sub-Sectors Included**	**Comments**	**Classification z > 0.05**
Agriculture (A)	Crops, livestock, forestry and fishing	Equations (15) and (16)	Tradable
Mining (M)	Mining	Only intermediate consumption is assumed. This sector will not be considered.	Tradable
Manufacturing (MF)	Manufacturing	Equations (15) and (16)	Tradable
Utilities (U)	Electricity, gas and water supply	Gross production to residential consumption	Non-tradable
Construction (C)	Construction	Gross production minus investment in construction. Investment in construction is taken as a proxy for intermediate consumption.	Non-tradable
Commercial Services (CS)	Wholesale and retail trade, restaurants and hotels	It is not possible to distinguish intermediate consumption as well as exports and imports. This sector will not be considered.	Tradable
Transportation Services (TS)	Transportation services (freight and passenger services), storage and communication	It is not possible to distinguish intermediate consumption. Transportation consumption is estimated using data for passenger transportation.	Non-tradable
Financial Services (FS)	Financial and insurance services	It is not possible to distinguish intermediate consumption as well as exports and imports. This sector will not be considered.	Tradable
Personal Services (PS)	Other services: personal and social services, without government services	Total output was assigned to final consumption.	Non-tradable

Table 3. Comparison of Private Consumption Figures by Sector

Sector	**1983**					**1995**				
	Estimates	s/IOP83		s/NA		Estimates	s/SAM95		s/NA	
A	6,154	7,081	87%			2,703,667	3,082,000	88%		
MF	42,093	49,726	85%			23,438,594	36,880,000	64%		
U	2,510	2,510	100%			3,018,141	3,491,000	86%		
TS	5,886	5,691	103%			3,078,023	3,573,000	86%		
C	3,044	3,033	100%			4,268,474	997,990	428%		
PS	19,775	14,408	137%			17,537,720	15,500,000	113%		
Studied sectors	**79,461**	**82,449**	**96%**			**54,044,620**	**63,523,990**	**85%**		
Total sectors		**120,004**		**121,252**	**66%**		**90,607,000**		**89,265,193**	**61%**

3.2 Simplified National Accounts Procedure

The simplified procedure requires current and constant prices data for private consumption of durable goods in nominal and real terms (*NCD* and *RCD*) and private consumption of services (*NCS* and *RCS*). The procedure is based on the ad hoc assumption that consumption of services is identical to the total consumption of non-tradables and that consumption of durables represents the total consumption of tradables. The price of non-tradables is defined as $PN=NCS/RCS$ and the price of tradables as $PT=NCD/RCD$.

a) Service Consumption Series

These series were obtained from the National Accounts procedure described in the previous section.

b) Durable Goods Consumption Series

Following the classification of the National Accounting System, the activities that generate durable goods in Uruguay were identified as having the following ISIC codes: 3832, 3833, 3843, and 3844. Quarterly data are available for gross production, imports, exports and prices, but data are not available for intermediate consumption and investment for each kind of good and for the entire period. This problem was solved in a way similar to that used for the National Accounts procedure, applying (18) and (19).

$$(18)\quad (1+\frac{1}{b})C_{i,t} = Y_{i,t} - (X_{i,t} - M_{i,t})$$

$$(19)\quad \sum_j IC_{ij,t} + I_{i,t} = \frac{1}{b}C_{i,t}$$

Physical volume indexes and price indexes with quarterly frequency, corresponding to gross output, are available from the National Institute of Statistics for each type of good. With these indexes and the value of the gross production in the base year (1988), gross output at constant and current prices is estimated on a quarterly basis. The values of b are obtained in the same manner as in the National Accounts procedure for the Agriculture and Manufacturing sectors (see Methodological Appendix Table M.5).

The series of imports and exports at current prices were estimated in the same fashion as in the National Accounts procedure (see Methodological Appendix). As an export price for this type of goods, the general export price until 1993 was used, and then the export price of the goods included in Sector 38 of the ISIC classification. An import price for durable goods is available from BCU statistics for the years 1994-2002. For the previous period, the index of imports at constant prices estimated in Kamil (1997) is used.

3.3 CPI Procedure

To break down the CPI into tradable and non-tradable sectors, the series and its weights from the National Institute of Statistics (INE, 1985) are used, and the methodology presented in Cancelo et al. (1995).

Specifically, the *tradable series* will include the following components of the CPI:

- Food and Beverages except meals outside of the home
- Apparel and Footwear
- Furniture and Accessories, except repair and cleaning services and home services
- Medicines
- Books and other education material
- Personal care articles (except hair dresser services), tobacco and cigarettes
- Books, magazines and newspapers
- Tourism and hotels services

The *non-tradable series* will include the following components of the CPI:

- Housing (rent, utilities and other services), except construction material
- Health and medical care, excluding medicines
- Transportation and communications, except for personal transport equipment and transportation by air
- Entertainment services
- Education services, except books and education material
- Other services

4. Econometric Methodology

The econometric strategy is divided into three steps. In the first, the estimation of the parameter of interest a_1 is carried out from equation (8), considering the relationship that emerges from the first-order condition of the consumer optimization problem. Specifically, in this case, the existence of a simple relationship between the logarithm of the ratio of consumption of tradable and non-tradable goods (CT_t/CN_t) and the relative price of both types of goods (RER_t) is investigated. Second, the effects of the inclusion of several "environmental" variables (Z,) on the estimate of parameter a_1 are analyzed, and thus equation (11) must be econometrically estimated in this step. Finally, the constancy of a_1 through time is evaluated in an attempt to assess whether the value of the parameter depends on the behavior of other variables that provide information on real income and credit restrictions.

In each part of the research the fundamental statistical properties of the macroeconomic series analyzed were taken into account. To this end, Augmented Dickey Fuller (ADF) unit root tests were carried out. The test results, shown in Table A1 of the Econometric Appendix, show that in all the series taken into account, with the exception of real interest rate, it was not possible to reject the hypothesis of the existence of unitary roots in the respective autoregressive representations. The empirical evidence indicates, therefore, that almost all the series analyzed are non-stationary or, in other words, are integrated on the order of 1, *I(1).* This implies that the econometric estimation must be carried out through multivariate co-integration techniques.

Because the variables are non-stationary, the existence of cointegrating relationships will be investigated following the Johansen (1988, 1995) procedure based on a vector autoregressive model of X_t, an (nx1) vector of endogenous *I(1)* time series. The error-correction form is written in first differences as:

$$(20) \qquad \Delta X_t = A_1 \Delta X_{t-1} + ... + A_{k-1} \Delta X_{t-k+1} + \Pi X_{t-k} + m + e_t$$

$$e_t \sim N(0, \Lambda) \qquad t = 1...T,$$

where A_i for all i ($i=1...k-1$) are $n \times n$ matrices of autoregressive coefficients, P are an (nxn) matrix, and m includes a (nx1) vector of constants, a set of seasonal dummies and other intervention variables, representing specific events that affect the behavior of the endogenous variables over the period analyzed. The vector e_t (nx1) represents unobserved normally distributed error terms with a mean of zero and a constant covariance matrix L(nxn).

Since DX_t is an $I(0)$ process, the stationarity of the right side of the equation is achieved only if PX_{t-k} is stationary. The Johansen procedure examines the rank of P, which determines the number of cointegrating vectors present in the system. If $rank(P) = r < n$, then $P = ab'$, where both a and b are (nxr) matrices. b is the matrix of cointegrating vectors, and the number of such vectors is r. Since the cointegrating vectors have the property that $b_j'X_t$ is stationary, then the system is stationary. The cointegrating vectors are said to represent the long-term relationships present in the system. The vector m includes constant terms.

Johansen's co-integration approach is applied in the four parts of this study. As a result of the application of this methodology, empirical estimates of the short- and long-run elasticity of substitution have been obtained. In the third part of the study, which seeks to assess the stability of parameter a_1 through time, the methodology proposed by Granger and Lee (1991) was followed. In order to explain how this procedure was applied to the problem analyzed in this investigation, parameter a_1 may be written as a linear function of a set of k stochastic and/or deterministic variables, $Y_t = (Y_{1t}, Y_{2t}, ..., Y_{kt})'$:

$$(21) \quad a_1 = a_{10} + a_{11} \ln Y_{1t} + ... + a_{1k} \ln Y_{kt} ,$$

The variables included in the vector Y, explain the eventual instability of the interest parameter. Substituting equation (21) in equation (8), a variant of equation (8) is obtained, in which it can be seen that k additional variables appear, which result from the product of RER for each Y_j (j = 1,..., k):

$$(22) \quad \ln(C_{Tt} C_{Nt}) = \ln a_0 - a_1 a_{10} \ln(RER_t) - a_1 a_{11} \ln(RER_t) \ln Y_{1t} - ... - a_1 a_{1k} \ln(RER_t) \ln Y_{kt} ,$$

The estimation of this equation may be carried out applying Johansen's procedure, including in the vector k+2 endogenous variables.

5. Econometric Results

The econometric estimates and the statistical tests presented in this section were carried out with the E-Views Program, Version 4.1. The nomenclature used to refer to the variables considered in the estimates is shown in Table 5.

The results of the econometric estimates of equation (8), which arise from the application of Johansen's procedure on logarithmic transformations of the original variables, are presented in Table 7.[9] In particular, three estimates of equation (8) were carried out. The first considers a vector of endogenous variables composed of the logarithms of variables CTt/CN_t and $RER1_t$ (Model 1). The second includes the logarithms of CT_t/CN_t and $RER2_t$ (Model 2) as endogenous variables. The third estimate considers the logarithms of CD_t/CS_t and $RER3_t$ (Model 3).

Table 4.
Definition of Macroeconomic Variables Included in Econometric Models

Variable Name	*Definition*	*Source*
$RER1=(P_T/P_N)$	Relative price of tradable goods to non-tradable goods	National Accounts Procedure; see Methodological Appendix
$RER2=(P_T/P_N)$	Relative price of tradable goods to non-tradable goods	CPI Procedure; see Methodological Appendix
$RER3=(P_D/P_S)$	Relative price of durable goods to services	Simplified National Accounts Procedure; see Methodological Appendix
CT/CN or C_T/C_N	Relative consumption of tradable goods to non-tradable goods	National Accounts Procedure; see Methodological Appendix
CD/CS or C_D/C_S	Relative consumption of durable goods to services	Simplified National Accounts Procedure; see Methodological Appendix
GDPUY	Real Uruguayan GDP	Central Bank of Uruguay
G/Y	Uruguayan public consumption as a percentage of domestic GDP	National Accounts, Central Bank of Uruguay
Cred	Real credit of commercial banks	Central Bank of Uruguay
RTI = (PX/PM)	Terms of trade	Central Bank of Uruguay and National Institute of Statistics of Uruguay
r	Real (*ex post*) international interest rate	CPI of USA: Bureau of Labor Statistics Eurodollar three-month interest rate in London: http://www.economagic.com/

[9] In all the models estimated a vector of constants and three seasonal dummies were included in *m*. The number of lags included in the transitory dynamic of the models was determined according to the Akaike Information Criteria.

Table 5. Johansen Cointegration Test

H_0: rank = r	Q_{max}	5% Critical Value	Q_{trace}	5% Critical Value
Model 1				
r = 0	18.36**	14.07	21.18**	15.41
r <= 1	2.81	3.76	2.81	3.76
Model 2				
H_0: rank = r	Q_{max}	5% Critical Value	Q_{trace}	5% Critical Value
r = 0	14.63**	14.07	17.24**	15.41
r <= 1	2.62	3.76	2.62	3.76
Model 3				
H_0: rank = r	Q_{max}	5% Critical Value	Q_{trace}	5% Critical Value
r = 0	25.84**	15.67	33.49**	19.96
r <= 1	7.65	9.24	7.65	9.24

Note: ** denotes rejection of the hypothesis at the 5% level. The lags were determined with the Schwarz Criteria (see Table A2 in Econometric Appendix).

In the three estimates carried out, the tests on the long-term coefficient matrices indicate that the existence of a long-term equilibrium relationship between the pairs of variables considered cannot be rejected at the 5 percent level of statistical significance. The result corresponding to the first estimate indicates that the relationship of cointegration estimated shows that, as was expected from the theoretical point of view, the elasticity of substitution is negative and lower than the unit (–0.46). Figure 1 shows the behavior of the data considered, and from this one can appreciate fairly well the negative correlation that leads to the estimate arising from the application of Johansen's procedure. It can be seen that the decreasing trend observed in the real exchange rate ($RER1_t$) during most of the period analyzed was processed with a less than proportional rise in the ratio between the relative consumption of tradable and non-tradable goods.

Table 6. Long-Run Equations
(Estimated with quarterly data)

Model 1: log(CT/CN) = 7.209 -0.458*log(RER1)
Period: 1983.1-2002.4
Model 2: log(CT/CN) = 8.791 -0.746*log(RER2)
Period: 1986.1-2002.4
Model 3: log(CD/CS) = 5.395 -0.712*log(RER3)
Period: 1983.1-2002.4
Note: see the short-run dynamics and standard deviations in Tables A3-A5 in Econometric Appendix.

Figure 1. Relative Consumption and Relative Prices of Tradable and Non-Tradable Goods

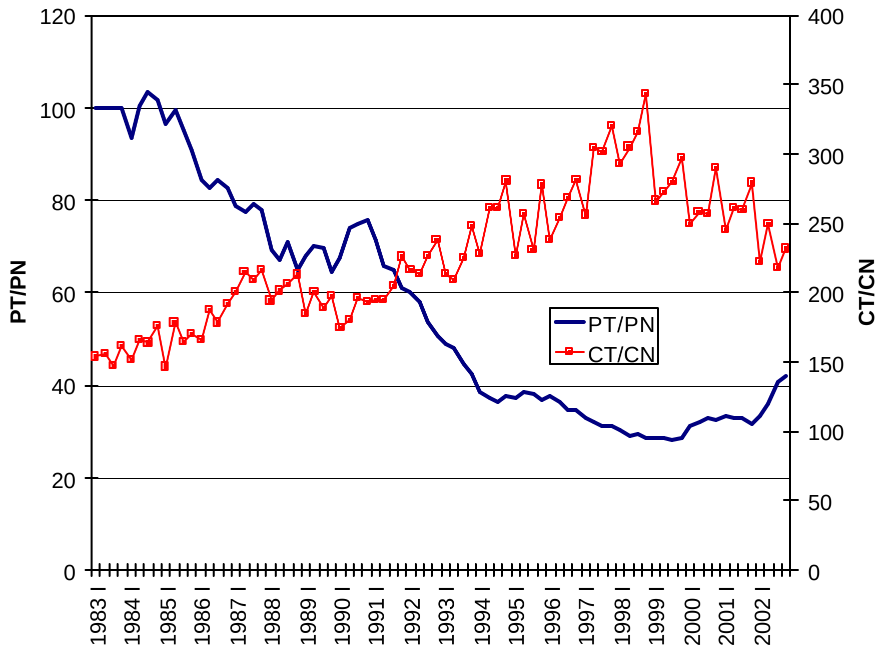


Table A3 of the Econometric Appendix shows the detailed results of the complete estimates of the multivariate model, including both the long-term equilibrium and the short-term adjustment dynamic. One aspect to stress is that the short-term elasticity of substitution (–0.43) is similar to long-run elasticity. The diagnostic statistics indicate that the remainders of the model are not correlated; in addition, the hypothesis that the joint distribution of the vector of residuals is distributed normally cannot be rejected.

Also analyzed was whether some of the variables could be considered weakly exogenous, following the methodology proposed by Johansen (1995). The test is carried out from a statistic of Likelihood Ratio (LR), which results from the estimate by Maximum Likelihood with Complete Information of the restricted and non-restricted model. This statistic is distributed asymptotically c^2, where the degrees of freedom are determined by the product between the number of variables to test and the number of co-integration relationships. The tests carried out on the *t*-statistics of the short-term adjustment coefficients and the tests presented in the Econometric Appendix indicate that none of the variables considered in the analysis can be considered as weakly exogenous. According to the results of the estimates, the re-establishment of the system's equilibrium implies a joint adjustment of the real exchange rate and the consumption ratio.

The estimates corresponding to the second system confirm the results obtained above regarding the existence of a long-term equilibrium relationship between the consumption ratios and the respective relative prices. However, some differences between the estimates of elasticity of substitution (see Tables A4 and A5 in the Econometric Appendix) are observed. Specifically, in the model estimated for the logarithms of CT_t/CN_t and $RER2_t$, there is a significant increase in the value of the long-run elasticity; this is situated at –0.75 and turns out to be statistically inferior to the unit (–1). This difference is wholly attributable to the fact that *RER2* must be considered as an approximation of the relative price of consumption estimated on the basis of information in the National Accounts. Hence the results of the contrasts of weak exogeneity, and the conclusion that the ratio CT_t/CN_t is not adjusted in order to establish the equilibrium rate estimated.

Finally, the estimates corresponding to the system that considers the logarithms of CD_t/CS_t and $RER3_t$ (see Figure 3) produce a value for elasticity of substitution (–0.71), although it must be pointed out that the level tests on the long-term matrix do not provide conclusive information on the existence of an equilibrium relationship between the two variables included in the system.

Figure 2. Relative Prices of Tradable and Non-Tradable Goods

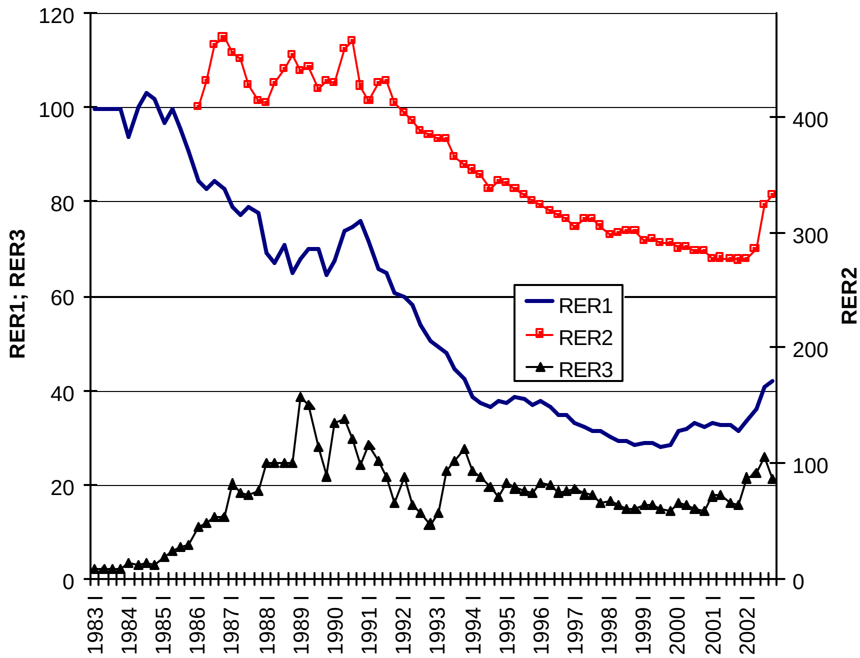
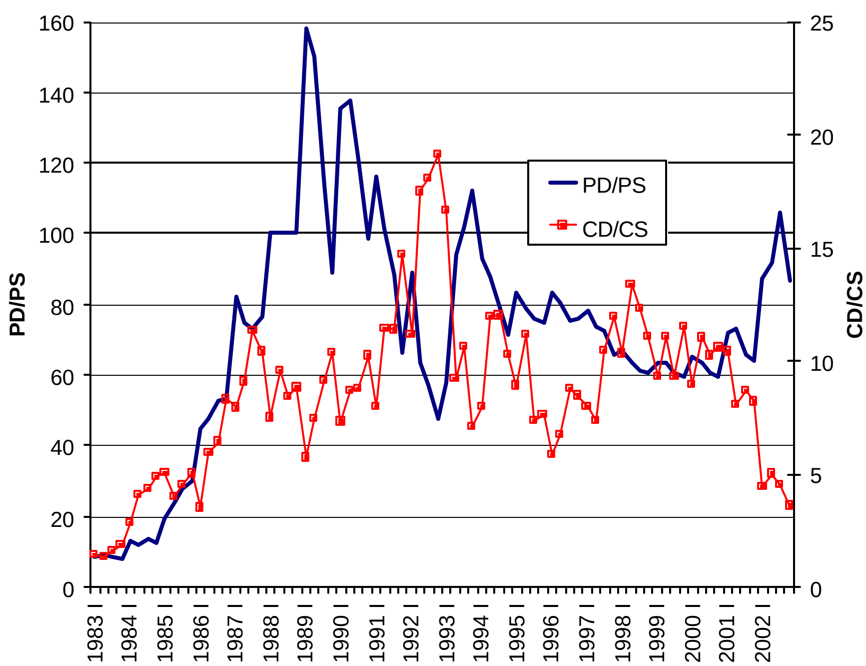


Figure 3. Relative Consumption and Relative Prices of Durable Goods and Services



Next assessed will be the influence that some other macroeconomic variables might have on the consumption structure. In other words, a model will be estimated that allows the testing of the empirical validity of equation (11). To that end, it is necessary to identify the set of variables that belong to Z_t. It is of particular interest to include in that vector some variables related to the income level, such as GDP and credit restrictions.[10] More precisely, a multivariate cointegration system was estimated considering four variables: those previously included in the estimation of equation (8), that is, the log of CT_t/CN_t and $RER1_t$, and the log of Uruguayan GDP ($GDPUY_t$) and Credit ($Cred_t$).[11]

The results of the estimate of the long-run matrix are presented in Table A6 (see Econometric Appendix). It can be observed that there is a single cointegration relationship among the variables considered.

$$(23)\quad \ln(C_{Tt}/C_{Nt}) = \ln a_0 - a_1 \ln(RER_t) + a_2 \ln(Cred_t) + a_3 \ln(GDPUY_t) + e_t$$

The equilibrium relation indicates, in the first place, that the inclusion of additional data in the estimation has significant effects on the value of the point estimate of the relevant parameter. Secondly, Table 8 (Model 4) shows that the variables' exclusion contrasts of the estimated cointegration vector clearly indicate that the log of the variable $Cred_t$ does not add any information relevant to analyzing the long-run determinants of the consumption structure. At first glance, the log of $GDPUY_t$ seems to have an effect on equilibrium, but when the variable $Cred_t$ is excluded, this effect vanishes (see Table A7, Econometric Appendix). The empirical evidence shows that the inclusion of additional information about the consumption structure does not have statistically significant effects on the estimation of the relevant parameter.

[10] As mentioned earlier, the variables that provide information about the external context, such as the terms of trade or the international interest rate, affect consumption decisions through the real exchange rate and not directly through the propensity to substitute consumption. Information about the long-run determinants of the real exchange rate is provided in the Econometric Appendix.

[11] This section is focused on the model that includes the variable $RER1_t$ as the relative price of tradables and non-tradables, since this specification yields a better estimate of parameter a_1.

Table 7. Restrictions Likelihood Ratio Test Results for Models 4 and 5

	Hypothesis, coefficient of the variable:	χ^2 Statistics	Probability
Model 4			
H_0:	$a_1 = 0$	1.872078	0.171237
H_1:	$a_2 = 0$	0.007682	0.930156
H_2:	$a_3 = 0$	16.48609	0.000049
Model 5			
H_0:	$a_1 = 0$	5.032534	0.024875
H_1:	$a_3 = 0$	0.029337	0.864003

The last aspect to consider is related to the stability of the estimates of a_1. The parametric stability was tested following the procedure described in Section 4, taking into account the hypothesis that the elasticity of substitution varies according to the function of the variables previously included in the Z_t vector plus *RTI*. Thus, a multivariate cointegration system including four variables was estimated: those considered in equation (8) and the product of log(RER_t) times the log of $Cred_t$, $GDPUY_t$ and RTI_t, respectively:

$$(8)\quad \ln(C_{Tt} / C_{Nt}) = \ln a_0 - a_1 \ln(RER_t)$$

where

$$(24)\quad a_1 = a_{10} + a_{11} \log Cred_t + a_{12} \log GDPUY_t + a_{13} \log RTI_t ,$$

The long-run matrix obtained is presented in Table A8 (see Econometric Appendix). The rank contrasts indicate that there is a single cointegration relation among the four variables included in the model. Tests of exclusion of variables from the cointegration relation were applied to the restricted model (see Table 9, Model 6), and the conclusion that can be drawn from these tests is that the substitution elasticity does not depend on the log of the variables RTI_t and $Cred_t$ (the hypothesis of nullity for the parameters a_1*a_{11}, a_1*a_{13} and both is not rejected). Consequently, the model was reestimated excluding the variable log($RER1_t$)*log($Cred_t$) and log($RER1_t$)*log(RTI_t). The exclusion tests applied to the new system (see Table 12, Model 7) show that it is not possible to reject the null hypothesis for the parameter a_1*a_{12} at a 5 percent significance level, which might suggest that there is little evidence to indicate a change in the elasticity of substitution during the period studied.

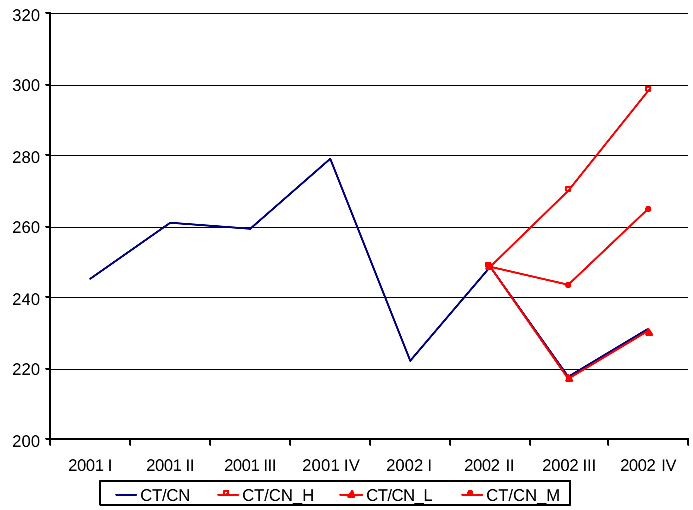
Table 8. Restrictions Likelihood Ratio Test Results for Models 6 and 7

	Hypothesis, coefficient of the variable:	χ^2 Statistics	Probability
Model 6			
H_0:	$a_1 * a_{10} = 0$	7.233557	0.007155
H_1:	$a_1 * a_{11} = 0$	1.253100	0.262961
H_2:	$a_1 * a_{12} = 0$	4.574158	0.032458
H_3:	$a_1 * a_{13} = 0$	0.028255	0.866510
H_4:	$a_1 * a_{11} = a_1 * a_{13} = 0$	1.425420	0.490314
Model 7			
H_0:	$a_1 * a_{10} = 0$	3.839389	0.050062
H_1:	$a_1 * a_{12} = 0$	2.364754	0.124103

The analyses performed above indicate that Model 1 provides the best fit for the Uruguayan data. It is further interesting to note that this model also shows good "predictive" properties in a very demanding environment.

This is illustrated by data from 2002. In June of that year exchange rate policy was substantially modified when the crawling band was abandoned in favor of a floating regime. The exchange rate doubled in the six months thereafter, causing a significant change in relative prices that is evident in Figure 2. As can be seen in Figure 4, the actual evolution of relative consumption was close to the "prediction" of the model imposing the actual evolution of the real exchange rate in the quarters immediately following the modification of the exchange rate system.

Figure 4. Solution of Model 1 for CT/CN



Note: Model estimated with data up to 2002.2. The actual RER1 trend is imposed. _M = mean solution; _L=low boundary (_M - 2Std. Desv.); _H = high boundary (_M+2Std. Desv.).

6. Conclusions

There are three main findings in this paper. First, the estimations carried out reveal that the long-run elasticity of substitution of non-tradable goods for Uruguay lies in the interval (–0.46, –0.75). Second, the model that best fits the Uruguayan data departs from the assumption of homothetic preferences; in other words, no wealth effect is found. Figure 1 is eloquent on this point, and the econometric analysis is conclusive. All information relevant to explaining the relative consumption is subsumed in the RER evolution. Third, the hypothesis of elasticity stability over the period analyzed cannot be rejected. Nonetheless, care must be exercised in stating this point because there is not sufficient information available to test for a structural change in the equilibrium relationship following the exchange rate regime change in 2002. Even after allowing for this latter observation, however, the "predictive" properties of the model provide preliminary evidence against the hypothesis of structural change.

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Econometric Appendix

Table A1.
Unit Root Tests

	Level		First Difference		
Variables in logarithms	Lag length	Dickey-Fuller statistic	Lag length	Dickey-Fuller statistic	Integrated at order
CT/CN	4	-2.28	3	-3.10***	1
CD/CS	0	-2.01	0	-11.22***	1
RER1	0	-1.52	0	-6.48***	1
RER2	3	-2.90*	3	-3.21***	0-1
RER3	0	-0.87	0	-6.04***	1
RTI	0	-1.76	0	-9.22***	1
*r**	0	-5.24***			0
Cred	0	0.31	2	-3.60***	1
G/Y	3	-1.33	2	-16.41***	1
GDPUY	4	-1.78	3	-3.06***	1

Note: (1) With constant and without trend when variables are in levels and without constant and trend when variables are in first differences. The optimal number of lags was determined with the Schwarz Criteria.
(*), (**), (***) denote rejection of the hypothesis of existence of a unit root at 10%, 5% and 1% levels.

Table A2.
Optimal Number of Lags in the Autoregressive Vector

	Model 1			
Criteria	1 lag	2 lags	3 lags	4 lags
Akaike Information	-6.109077	-6.002988	-5.815969	-5.797871
Schwarz	-5.625649	-5.394208	-5.079948	-4.932676
	Model 2			
Criteria	1 lag	2 lags	3 lags	4 lags
Akaike Information	-7.397420	-7.469836	-7.346783	-7.294720
Schwarz	-6.733889	-6.666985	-6.402272	-6.206143
	Model 3			
Criteria	1 lag	2 lags	3 lags	4 lags
Akaike Information	-1.670900	-1.603619	-1.542998	-1.726050
Schwarz	-1.096830	-0.903521	-0.714974	-0.768154

Table A3. Model 1, Vector Error Correction Estimates

Sample (adjusted): 1983:3 2002:4		
Included observations: 78 after adjusting endpoints		
Standard errors in ( ) and t-statistics in [ ]		
Cointegrating Eq:	LOG(CT/CN)	
LOG(RER1)	-0.457718	
	(0.03378)	
	[-13.5515]	
C	7.205917	
Error Correction 1/:	D(LOG(CT/CN))	D(LOG(RER1))
CointEq1	-0.215486	-0.211855
	(0.11570)	(0.09290)
	[-1.86245]	[-2.28038]
D(LOG(CT/CN(-1)))	-0.300057	0.099644
	(0.12475)	(0.10017)
	[-2.40518]	[0.99471]
D(LOG(RER1(-1)))	-0.427815	0.243303
	(0.14528)	(0.11666)
	[-2.94476]	[2.08566]
C	0.000461	-0.008548
	(0.00642)	(0.00516)
	[0.07171]	[-1.65753]
D1	-0.094262	0.002656
	(0.01310)	(0.01052)
	[-7.19581]	[0.25252]
D2	0.014906	0.010805
	(0.01712)	(0.01375)
	[0.87074]	[0.78606]
D3	0.014064	0.001145
	(0.01357)	(0.01090)
	[1.03636]	[0.10508]
Diagnostic Tests		
R-squared	0.708183	0.174134
Adj. R-squared	0.683522	0.104343
S.E. equation	0.054757	0.043968
Mean dependent	0.005044	-0.011066
S.D. dependent	0.097335	0.046459

Table A4. Model 2, Vector Error Correction Estimates

Sample (adjusted): 1986:3 2002:4		
Included observations: 66 after adjusting endpoints		
Standard errors in ( ) and t-statistics in [ ]		
Cointegrating Eq:	LOG(CT/CN)	
LOG(RER2)	-0.745737	
	(0.12685)	
	[- 5.87883]	
C	8.791841	
Error Correction:	D(LOG(CT/CN))	D(LOG(RER2))
CointEq1	-0.116728	-0.101153
	(0.09114)	(0.03613)
	[-1.28072]	[-2.79936]
D(LOG(CT/CN(-1)))	-0.274787	0.078817
	(0.12046)	(0.04776)
	[-2.28113]	[1.65035]
D(LOG(RER2(-1)))	-0.455743	0.312365
	(0.22271)	(0.08830)
	[-2.04634]	[3.53768]
C	0.001258	-0.002752
	(0.00637)	(0.00253)
	[0.19729]	[-1.08904]
D1	-0.111378	-0.007854
	(0.01345)	(0.00533)
	[-8.28120]	[-1.47301]
D2	0.009799	0.020954
	(0.01758)	(0.00697)
	[0.55727]	[3.00585]
D3	0.030126	-0.012845
	(0.01363)	(0.00540)
	[2.21018]	[-2.37687]
I871	0.183307	-0.025895
	(0.05221)	(0.02070)
	[3.51113]	[-1.25106]
I904	-0.055720	-0.095527
	(0.05263)	(0.02086)
	[-1.05879]	[-4.57843]
I023	-0.131950	0.107689
	(0.05347)	(0.02120)
	[-2.46786]	[5.08020]
R-squared	0.769305	0.635540
Adj. R-squared	0.732229	0.576966
S.E. equation	0.049870	0.019771
Mean dependent	0.003210	-0.003944
S.D. dependent	0.096373	0.030398

Table A5. Model 3, Vector Error Correction Estimates

Sample (adjusted): 1983:3 2002:4		
Included observations: 78 after adjusting endpoints		
Standard errors in ( ) and t-statistics in [ ]		
Cointegrating Eq:	LOG(CDCS)	
LOG(RER3)	-0.712008	
	(0.23404)	
	[-3.04220]	
C	5.395306	
Error Correction:	D(LOG(CDCS))	D(LOG(RER3))
CointEq1	-0.079208	-0.052860
	(0.02490)	(0.01511)
	[-3.18144]	[-3.49733]
D(LOG(CDCS(-1)))	-0.224348	0.041962
	(0.11649)	(0.07072)
	[-1.92590]	[0.59336]
D(LOG(RER3(-1)))	-0.193838	0.057081
	(0.18171)	(0.11031)
	[-1.06675]	[0.51745]
D1	-0.219394	0.229511
	(0.04132)	(0.02508)
	[-5.30998]	[9.15013]
D2	0.153235	-0.059118
	(0.04980)	(0.03023)
	[3.07728]	[-1.95560]
D3	0.053527	-0.073370
	(0.03908)	(0.02373)
	[1.36961]	[-3.09242]
TC932	-0.442027	0.409566
	(0.14446)	(0.08770)
	[-3.05980]	[4.67006]
I941	0.406861	-0.551867
	(0.20389)	(0.12378)
	[1.99546]	[-4.45846]
R-squared	0.439106	0.638135
Adj. R-squared	0.383016	0.601948
S.E. equation	0.188346	0.114341
Mean dependent	0.012791	0.028967
S.D. dependent	0.239784	0.181231

Table A6. Model 4, Vector Error Correction Estimates

Sample (adjusted): 1983:4 2002:4
Included observations: 77 after adjusting endpoints
Standard errors in ( ) and t-statistics in [ ]

Cointegrating Eq:	LOG(CT/CN)
LOG(RER1)	0.119795
	(0.07860)
	[1.52405]
LOG(CRED)	0.003127
	(0.03355)
	[0.09322]
LOG(GDPUY)	1.209435
	(0.19109)
	[6.32907]
C	-1.046162

Error Correction:	D(LOG(CTCN))	D(LOG(RER1))	D(LOG(CRED))	D(LOG(GDPUY))
CointEq1	-0.309155	-0.116261	0.635605	0.046234
	(0.14146)	(0.12681)	(0.08320)	(0.07357)
	[-2.18540]	[-0.91680]	[7.63939]	[0.62847]
D(LOG(CTCN(-1)))	-0.366523	0.148826	-0.429704	-0.034430
	(0.15393)	(0.13799)	(0.09054)	(0.08005)
	[-2.38104]	[1.07852]	[-4.74624]	[-0.43009]
D(LOG(CTCN(-2)))	-0.068108	0.199598	-0.347758	0.073460
	(0.13681)	(0.12264)	(0.08047)	(0.07115)
	[-0.49781]	[1.62747]	[-4.32178]	[1.03249]
D(LOG(RER1(-1)))	-0.314825	0.162712	-0.134240	-0.143706
	(0.14980)	(0.13428)	(0.08810)	(0.07790)
	[-2.10165]	[1.21170]	[-1.52367]	[-1.84473]
D(LOG(RER1(-2)))	-0.087662	0.086702	-0.095052	-0.043190
	(0.15984)	(0.14328)	(0.09401)	(0.08312)
	[-0.54844]	[0.60510]	[-1.01110]	[-0.51959]
D(LOG(CRED(-1)))	0.112272	0.218807	-0.394401	-0.111366
	(0.18493)	(0.16578)	(0.10877)	(0.09617)
	[0.60710]	[1.31989]	[-3.62616]	[-1.15801]
D(LOG(CRED(-2)))	0.001944	0.241919	-0.418122	-0.092467
	(0.23819)	(0.21352)	(0.14009)	(0.12387)
	[0.00816]	[1.13301]	[-2.98467]	[-0.74650]
D(LOG(GDPUY(-1)))	0.203672	-0.179580	0.462347	-0.195733
	(0.24789)	(0.22221)	(0.14579)	(0.12891)
	[0.82163]	[-0.80814]	[3.17124]	[-1.51836]

Table A6., continued

Error Correction:	D(LOG(CTCN))	D(LOG(RER1))	D(LOG(CRED))	D(LOG(GDPUY))
D(LOG(GDPUY(-2)))	0.351705	-0.382781	0.256923	-0.235217
	(0.26128)	(0.23422)	(0.15367)	(0.13588)
	[1.34607]	[-1.63427]	[1.67190]	[-1.73111]
C	-0.001905	-0.011190	0.006041	0.005268
	(0.00640)	(0.00574)	(0.00377)	(0.00333)
	[-0.29756]	[-1.94951]	[1.60422]	[1.58195]
D1	-0.147668	0.006555	0.014355	-0.092714
	(0.02714)	(0.02433)	(0.01596)	(0.01412)
	[-5.44005]	[0.26938]	[0.89913]	[-6.56789]
D2	-0.000574	0.033847	0.005739	-0.002024
	(0.03518)	(0.03154)	(0.02069)	(0.01830)
	[-0.01632]	[1.07324]	[0.27738]	[-0.11061]
D3	0.070177	-0.022786	-0.016940	-0.010704
	(0.03005)	(0.02694)	(0.01768)	(0.01563)
	[2.33498]	[-0.84574]	[-0.95836]	[-0.68486]
I871	0.145908	-0.016217	-0.003949	0.050356
	(0.05162)	(0.04628)	(0.03036)	(0.02685)
	[2.82631]	[-0.35043]	[-0.13007]	[1.87567]
I023	-0.089487	0.120881	0.169313	-0.116278
	(0.05618)	(0.05036)	(0.03304)	(0.02922)
	[-1.59283]	[2.40023]	[5.12408]	[-3.97993]
R-squared	0.796052	0.284509	0.651209	0.929760
Adj. R-squared	0.750000	0.122946	0.572450	0.913899
S.E. equation	0.048836	0.043778	0.028723	0.025397
Mean dependent	0.005907	-0.011209	0.005305	0.005324
S.D. dependent	0.097673	0.046746	0.043927	0.086551

Table A7. Model 5,
Vector Error Correction Estimates

Sample (adjusted): 1983:4 2002:4
Included observations: 77 after adjusting endpoints
Standard errors in ( ) and t-statistics in [ ]

Cointegrating Eq:	LOG(CT/CN)		
LOG(RER1)	- 0.499129		
	(0.17314)		
	[- 2.88286]		
LOG(GDPUY)	-0.122340		
	(0.43563)		
	[-0.28083]		
C	7.968748		
Error Correction:	**D(LOG(CTCN))**	**D(LOG(RER1))**	**D(LOG(GDPUY))**
CointEq1	-0.342755	-0.202545	-0.021657
	(0.10757)	(0.09775)	(0.05794)
	[-3.18631]	[-2.07197]	[-0.37376]
D(LOG(CTCN(-1)))	-0.346097	0.167544	0.025001
	(0.13209)	(0.12004)	(0.07115)
	[-2.62016]	[1.39578]	[0.35139]
D(LOG(CTCN(-2)))	-0.046126	0.198828	0.105910
	(0.11919)	(0.10832)	(0.06420)
	[-0.38698]	[1.83563]	[1.64962]
D(LOG(RER1(-1)))	-0.276520	0.189987	-0.138134
	(0.13668)	(0.12421)	(0.07362)
	[-2.02308]	[1.52956]	[-1.87621]
D(LOG(RER1(-2)))	-0.021171	0.036524	-0.019370
	(0.14460)	(0.13141)	(0.07789)
	[-0.14641]	[0.27795]	[-0.24869]
D(LOG(GDPUY(-1)))	0.547288	-0.101713	-0.182439
	(0.22643)	(0.20577)	(0.12197)
	[2.41698]	[-0.49430]	[-1.49579]
D(LOG(GDPUY(-2)))	0.585013	-0.259369	-0.247350
	(0.24766)	(0.22506)	(0.13340)
	[2.36220]	[-1.15246]	[-1.85421]
C	-0.002081	-0.009772	0.004073
	(0.00602)	(0.00547)	(0.00324)
	[-0.34586]	[-1.78701]	[1.25670]
D1	-0.150812	0.014603	-0.098102
	(0.02518)	(0.02288)	(0.01356)
	[-5.98986]	[0.63821]	[-7.23360]
D2	0.000231	0.024762	0.001330
	(0.03367)	(0.03059)	(0.01813)
	[0.00686]	[0.80937]	[0.07332]
D3	0.085654	-0.013515	-0.009817
	(0.02929)	(0.02662)	(0.01578)
	[2.92441]	[-0.50778]	[-0.62228]
I871	0.158575	-0.017165	0.052303
	(0.04977)	(0.04523)	(0.02681)
	[3.18589]	[-0.37950]	[1.95082]
I023	-0.110755	0.115448	-0.121665
	(0.05250)	(0.04771)	(0.02828)
	[-2.10944]	[2.41963]	[-4.30196]
R-squared	0.803329	0.290942	0.927331
Adj. R-squared	0.766453	0.157993	0.913706
S.E. equation	0.047202	0.042895	0.025425
Mean dependent	0.005907	-0.011209	0.005324
S.D. dependent	0.097673	0.046746	0.086551

Table A8a. Model 6, Vector Error Correction Estimates

Sample (adjusted): 1983:3 2002:4
Included observations: 78 after adjusting endpoints
Standard errors in ( ) and t -statistics in [ ]

Cointegrating Eq:	LOG(CTCN)
LOG(RER1)	-1.889733
	(0.50305)
	[-3.75658]
LOG(CRED)*LOG (RER1)	0.028965
	(0.01977)
	[1.46518]
LOG(GDPUY)*LOG(RER 1)	0.305595
	(0.07867)
	[3.88435]
C	4.908031

Error Correction:	D(LOG(CTCN))	D(LOG(RER1))	D(LOG(CRED)*LOG(RER1))	D(LOG(GDPUY)*LOG(RER1))
CointEq1	-0.257280	-0.019975	0.865375	0.342489
	(0.10691)	(0.08619)	(1.54629)	(0.43058)
	[-2.40656]	[-0.23176]	[0.55965]	[0.79541]
D(LOG(CTCN(-1)))	-0.330423	0.047826	0.615159	-0.349950
	(0.12562)	(0.10128)	(1.81701)	(0.50597)
	[-2.63023]	[0.47223]	[0.33856]	[-0.69164]
D(LOG(RER1(-1)))	-0.724736	-0.416183	-8.316429	1.683619
	(0.81473)	(0.65683)	(11.7841)	(3.28143)
	[-0.88954]	[-0.63362]	[-0.70573]	[0.51308]
D(LOG(CRED(-1))*LOG(RER1(-1)))	0.010985	0.035547	0.548706	-0.027088
	(0.04339)	(0.03498)	(0.62765)	(0.17478)
	[0.25315]	[1.01607]	[0.87422]	[-0.15499]
D(LOG(GDPUY(-1))*LOG(RER1(-1)))	0.040539	-0.013846	0.245577	-0.202516
	(0.05712)	(0.04605)	(0.82621)	(0.23007)
	[0.70968]	[-0.30067]	[0.29723]	[-0.88024]
C	0.003447	-0.013521	-0.242310	-0.043764
	(0.00655)	(0.00528)	(0.09472)	(0.02638)
	[0.52629]	[-2.56097]	[-2.55817]	[-1.65925]
D1	-0.131916	-0.004144	-0.159582	-0.349439
	(0.02643)	(0.02131)	(0.38224)	(0.10644)
	[-4.99164]	[-0.19450]	[-0.41749]	[-3.28298]
D2	0.036445	0.008201	0.322202	-0.067413
	(0.02773)	(0.02236)	(0.40114)	(0.11170)
	[1.31409]	[0.36679]	[0.80321]	[-0.60351]
D3	0.023843	0.007746	0.088311	0.046697
	(0.01278)	(0.01030)	(0.18478)	(0.05145)
	[1.86638]	[0.75208]	[0.47793]	[0.90756]
TC021	-0.063175	0.081254	1.680467	0.299036
	(0.03560)	(0.02870)	(0.51498)	(0.14340)
	[-1.77436]	[2.83076]	[3.26320]	[2.08531]
R-squared	0.739242	0.256093	0.259756	0.718027
Adj. R-squared	0.704730	0.157635	0.161783	0.680708
S.E. equation	0.052891	0.042640	0.765000	0.213024
Mean dependent	0.005044	-0.011066	-0.184235	-0.032913
S.D. dependent	0.097335	0.046459	0.835571	0.376993

Table A8b. Model 6,Vector Error Correction Estimates

Sample (adjusted): 1983:4 2002:4
Included observations: 77 after adjusting endpoints
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	LOG(CTCN)
LOG(RER1)	-1.320553
	(0.38387)
	[-3.44013]
LOG(RER1)*LOG(CRED)	0.020922
	(0.01548)
	[1.35120]
LOG(RER1)*LOG(GDPUY)	0.177323
	(0.06677)
	[2.65576]
LOG(RER1)*LOG(RTI)	0.004010
	(0.02172)
	[0.18465]
C	-5.628019

Error Correction:	D(LOG(CTCN))	D(LOG(RER1))	D(LOG(RER1)*LOG(CRED))	D(LOG(RER1)*LOG(GDPUY))	D(LOG(RER1)*LOG(RTI))
CointEq1	-0.240705	-0.165059	-1.060256	-0.702997	-1.170944
	(0.11414)	(0.09549)	(1.69972)	(0.45306)	(0.60879)
	[-2.10889]	[-1.72852]	[-0.62378]	[-1.55165]	[-1.92339]
D(LOG(CTCN(-1)))	-0.391626	0.157233	1.458857	0.686066	0.959239
	(0.14670)	(0.12273)	(2.18461)	(0.58231)	(0.78246)
	[-2.66960]	[1.28110]	[0.66779]	[1.17818]	[1.22592]
D(LOG(CTCN(-2)))	-0.041920	0.141133	1.388615	1.006545	1.622212
	(0.12877)	(0.10774)	(1.91766)	(0.51115)	(0.68685)
	[-0.32554]	[1.31000]	[0.72412]	[1.96916]	[2.36182]
D(LOG(RER1(-1)))	-0.727234	-0.405137	-5.751395	0.476372	-6.971130
	(0.79360)	(0.66395)	(11.8182)	(3.15015)	(4.23292)
	[-0.91637]	[-0.61019]	[-0.48666]	[0.15122]	[-1.64688]
D(LOG(RER1(-2)))	-0.561907	-0.616020	-6.319722	0.200254	1.184591
	(0.93191)	(0.77967)	(13.8779)	(3.69916)	(4.97064)
	[-0.60296]	[-0.79011]	[-0.45538]	[0.05414]	[0.23832]
D(LOG(RER1(-1))*LOG(CRED(-1)))	0.000209	0.038753	0.516025	0.074278	0.471611
	(0.04195)	(0.03510)	(0.62475)	(0.16653)	(0.22377)
	[0.00498]	[1.10411]	[0.82596]	[0.44604]	[2.10758]
D(LOG(RER1(-2))*LOG(CRED(-2)))	-0.002689	0.057037	0.721916	0.182584	0.127880
	(0.05294)	(0.04429)	(0.78832)	(0.21013)	(0.28235)
	[-0.05080]	[1.28786]	[0.91576]	[0.86892]	[0.45291]

Table A8b., continued

Error Correction:	D(LOG(CTCN))	D(LOG(RER1))	D(LOG(RER1)*LOG(CRED))	D(LOG(RER1)*LOG(GDPUY))	D(LOG(RER1)*LOG(RTI))
D(LOG(RER1(-1))*LOG(GDPUY(-1)))	0.085894	-0.066278	-0.935697	-0.520383	-0.486306
	(0.05421)	(0.04535)	(0.80724)	(0.21517)	(0.28913)
	[1.58456]	[-1.46144]	[-1.15914]	[-2.41848]	[-1.68197]
D(LOG(RER1(-2))*LOG(GDPUY(-2)))	0.109283	-0.086167	-1.456876	-0.755170	-0.560446
	(0.05839)	(0.04885)	(0.86955)	(0.23178)	(0.31145)
	[1.87158]	[-1.76386]	[-1.67544]	[-3.25816]	[-1.79950]
D(LOG(RER1(-1))*LOG(RTI(-1)))	0.002742	0.031367	0.600028	0.186937	0.152394
	(0.02287)	(0.01913)	(0.34059)	(0.09079)	(0.12199)
	[0.11987]	[1.63925]	[1.76171]	[2.05910]	[1.24923]
D(LOG(RER1(-2))*LOG(RTI(-2)))	-0.004662	0.048940	0.834622	0.261576	-0.020747
	(0.02317)	(0.01938)	(0.34504)	(0.09197)	(0.12358)
	[-0.20121]	[2.52467]	[2.41891]	[2.84412]	[-0.16788]
C	-0.001920	-0.010007	-0.167563	-0.021840	-0.031851
	(0.00632)	(0.00529)	(0.09417)	(0.02510)	(0.03373)
	[-0.30365]	[-1.89160]	[-1.77940]	[-0.87011]	[-0.94435]
D1	-0.146701	0.025970	0.495309	-0.234917	0.293295
	(0.02623)	(0.02195)	(0.39065)	(0.10413)	(0.13992)
	[-5.59231]	[1.18331]	[1.26791]	[-2.25603]	[2.09617]
D2	-0.001791	0.021177	0.402217	0.136850	-0.027882
	(0.03587)	(0.03001)	(0.53415)	(0.14238)	(0.19132)
	[-0.04992]	[0.70568]	[0.75300]	[0.96117]	[-0.14574]
D3	0.077140	-0.032239	-0.658300	-0.244389	-0.100415
	(0.03020)	(0.02527)	(0.44972)	(0.11987)	(0.16108)
	[2.55436]	[-1.27601]	[-1.46379]	[-2.03871]	[-0.62339]
I871	0.140062	-0.015960	-0.318277	0.095215	0.239343
	(0.05216)	(0.04364)	(0.77670)	(0.20703)	(0.27819)
	[2.68542]	[-0.36575]	[-0.40978]	[0.45991]	[0.86035]
I023	-0.101449	0.107025	2.725071	0.107526	0.697647
	(0.05646)	(0.04724)	(0.84082)	(0.22412)	(0.30116)
	[-1.79677]	[2.26568]	[3.24098]	[0.47977]	[2.31657]
R-squared	0.800133	0.389246	0.402224	0.791047	0.373039
Adj. R-squared	0.746835	0.226378	0.242817	0.735326	0.205849
S.E. equation	0.049145	0.041116	0.731850	0.195075	0.262127
Mean dependent	0.005907	-0.011209	-0.184171	-0.031262	-0.019872
S.D. dependent	0.097673	0.046746	0.841050	0.379181	0.294145

Table A9. Model 7, Vector Error Correction Estimates

Sample (adjusted): 1983:3 2002:4
Included observations: 78 after adjusting endpoints
Standard errors in ( ) and t-statistics in [ ]

Cointegrating Eq:	LOG(CT/CN)		
LOG(RER1)	-1.267208		
	(0.28709)		
	[-4.41390]		
LOG(GDPUY)*LOG(RER1)	0.245643		
	(0.08627)		
	[2.84745]		
C	5.675062		
Error Correction:	**D(LOG(CTCN))**	**D(LOG(RER1))**	**D(LOG(GDPUY)*LOG(RER1))**
CointEq1	-0.373294	-0.000129	0.436211
	(0.12600)	(0.10412)	(0.51599)
	[-2.96254]	[-0.00124]	[0.84539]
D(LOG(CTCN(-1)))	-0.283419	0.017312	-0.375480
	(0.12111)	(0.10008)	(0.49596)
	[-2.34010]	[0.17299]	[-0.75708]
D(LOG(RER1(-1)))	-0.459220	0.214454	1.141147
	(0.28007)	(0.23142)	(1.14689)
	[-1.63965]	[0.92668]	[0.99499]
D(LOG(GDPUY(-1))*LOG(RER1(-1)))	0.032537	-0.017101	-0.197413
	(0.05571)	(0.04604)	(0.22814)
	[0.58401]	[-0.37148]	[-0.86530]
C	0.004046	-0.013281	-0.044609
	(0.00638)	(0.00527)	(0.02614)
	[0.63385]	[-2.51804]	[-1.70663]
D1	-0.128587	0.000357	-0.355187
	(0.02523)	(0.02085)	(0.10332)
	[-5.09651]	[0.01714]	[-3.43782]
D2	0.033340	0.005805	-0.064124
	(0.02699)	(0.02230)	(0.11052)
	[1.23529]	[0.26031]	[-0.58019]
D3	0.022258	0.007041	0.049044
	(0.01242)	(0.01026)	(0.05086)
	[1.79206]	[0.68606]	[0.96426]
TC021	-0.066099	0.090457	0.298015
	(0.03305)	(0.02731)	(0.13534)
	[-1.99989]	[3.31221]	[2.20190]
R-squared	0.747974	0.244698	0.718278
Adj. R-squared	0.718753	0.157127	0.685614
S.E. equation	0.051619	0.042653	0.211380
Mean dependent	0.005044	-0.011066	-0.032913
S.D. dependent	0.097335	0.046459	0.376993

Table A10. Model for RER1, Vector Error Correction Estimates

Sample (adjusted): 1983:3 2002:4
Included observations: 78 after adjusting endpoints
Standard errors in ( ) and t-statistics in [ ]

Cointegrating Eq:	LOG(RER1)		
LOG(G)	7.019292		
	(0.61887)		
	[11.3420]		
LOG(RTI)	0.237415		
	(0.22294)		
	[1.06494]		
C	-15.43585		
Error Correction:	**D(LOG(RER1))**	**D(LOG(G))**	**D(LOG(RTI))**
CointEq1	-0.054908	0.156575	-0.046953
	(0.02626)	(0.02564)	(0.03764)
	[-2.09119]	[6.10594]	[-1.24735]
D(LOG(RER1(-1)))	0.242458	0.228860	-0.356980
	(0.13226)	(0.12916)	(0.18960)
	[1.83325]	[1.77184]	[-1.88277]
D(LOG(G(-1)))	-0.162081	0.079091	-0.041218
	(0.12539)	(0.12246)	(0.17976)
	[-1.29264]	[0.64587]	[-0.22930]
D(LOG(RTI(-1))	0.112365	0.083618	-0.092746
	(0.08042)	(0.07854)	(0.11529)
	[1.39730]	[1.06471]	[-0.80449]
C	-0.008676	0.000967	-0.001841
	(0.00525)	(0.00513)	(0.00753)
	[-1.65177]	[0.18855]	[-0.24450]
D1	0.010465	0.051730	0.042464
	(0.01311)	(0.01281)	(0.01880)
	[0.79797]	[4.03888]	[2.25857]
D2	0.007056	-0.013724	-0.011652
	(0.01396)	(0.01364)	(0.02002)
	[0.50540]	[-1.00644]	[-0.58214]
D3	0.001845	0.031737	-0.010656
	(0.01014)	(0.00991)	(0.01454)
	[0.18188]	[3.20403]	[-0.73285]
I941	-0.055322	0.011045	0.252874
	(0.04548)	(0.04441)	(0.06520)
	[-1.21646]	[0.24869]	[3.87859]
I024	0.033261	0.009619	0.127014
	(0.04935)	(0.04820)	(0.07075)
	[0.67398]	[0.19958]	[1.79530]
R-squared	0.225985	0.844723	0.320246
Adj. R-squared	0.123541	0.824171	0.230279
S.E. equation	0.043494	0.042478	0.062354
Mean dependent	-0.011066	-0.001358	0.006115
S.D. dependent	0.046459	0.101302	0.071072

Table A11. Model 1, VEC Residual Normality Tests

Orthogonalization: Cholesky (Lutkepohl)
H0: residuals are multivariate normal
Sample: 1983:1 2002:4
Included observations: 78

Component	Skewness	Chi-sq	df	Prob.
1	0.193504	0.486769	1	0.4854
2	0.030890	0.012404	1	0.9113
Joint		0.499173	2	0.7791
Component	Kurtosis	Chi-sq	df	Prob.
1	3.056717	0.010455	1	0.9186
2	1.874405	4.117635	1	0.0424
Joint		4.128090	2	0.1269
Component	Jarque-Bera	df	Prob.	
1	0.497223	2	0.7799	
2	4.130040	2	0.1268	
Joint	4.627263	4	0.3277	

Table A12. Model 1, VEC Residual Portmanteau Tests for Autocorrelations

H0: no residual autocorrelations up to lag h
Sample: 1983:1 2002:4
Included observations: 78

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	df
1	0.333114	NA*	0.337440	NA*	NA*
2	1.689744	0.7926	1.729771	0.7853	4
3	6.303353	0.6133	6.527924	0.5883	8
4	8.501137	0.7448	8.844507	0.7162	12
5	16.15528	0.4422	17.02290	0.3841	16

*The test is valid only for lags larger than the VAR lag order.
df is degrees of freedom for (approximate) chi-square distribution

Table A13. Model 1, Roots of Characteristic Polynomials

Endogenous variables: LOG(CTCN) LOG(RER1)
Exogenous variables: D1 D2 D3
Lag specification: 1 1

Root	Modulus
1.000000	1.000000
0.819037	0.819037
-0.308474	0.308474
0.120227	0.120227

VEC specification imposes 1 unit root(s).

Table A14. Model 1, Test of Weak Exogeneity

	Cointegration Restrictions:	
LR test for binding restrictions (rank = 1):	A(1)=0	A(2)=0
Chi-square(1)	2.964519	4.382609
Probability	0.085110	0.036307

Note: A(k) is the coefficient the k-th VEC equation, and where: k = 1 is D(LOG(CT/CN)) equation and k = 2 is D(LOG(RER1)) equation.

Table A15. Model 2, VEC Residual Normality Tests

Orthogonalization: Cholesky (Lutkepohl)
H0: residuals are multivariate normal
Sample: 1986:1 2002:4
Included observations: 66

Component	Skewness	Chi-sq	df	Prob.
1	0.005304	0.000310	1	0.9860
2	0.106379	0.124481	1	0.7242
Joint		0.124790	2	0.9395
Component	Kurtosis	Chi-sq	df	Prob.
1	2.165844	1.913494	1	0.1666
2	2.586218	0.470843	1	0.4926
Joint		2.384336	2	0.3036
Component	Jarque-Bera	df	Prob.	
1	1.913803	2	0.3841	
2	0.595323	2	0.7426	
Joint	2.509127	4	0.6430	

Table A16. Model 2, VEC Residual Portmanteau Tests for Autocorrelations

H0: no residual autocorrelations up to lag h
Sample: 1986:1 2002:4
Included observations: 66

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	df
1	1.121219	NA*	1.138469	NA*	NA*
2	3.649668	0.4555	3.745932	0.4415	4
3	6.095431	0.6365	6.308160	0.6128	8
4	8.222798	0.7675	8.572776	0.7389	12
5	12.13718	0.7345	12.80801	0.6867	16

*The test is valid only for lags larger than the VAR lag order.
df is degrees of freedom for (approximate) chi-square distribution

Table A17. Model 2, Roots of Characteristic Polynomial

Endogenous variables: LOG(CT/CN) LOG(RER2)	
Exogenous variables: D1 D2 D3	
Lag specification: 1 1	
Root	Modulus
1.000000	1.000000
0.855922	0.855922
-0.246795	0.246795
0.236289	0.236289
VEC specification imposes 1 unit root(s).	

Table A18. Model 2, Test of Weak Exogeneity

	Cointegration Restrictions	
LR test for binding restrictions (rank = 1):	A(1)=0	A(2)=0
Chi-square(1)	1.804028	8.161322
Probability	0.179226	0.004279

Note: A(k) is the coefficient the k-th VEC equation, and where: k = 1 is D(LOG(CT/CN)) equation and k = 2 is D(LOG(RER2)) equation.

Table A19. Model 3, VEC Residual Normality Tests

Orthogonalization: Cholesky (Lutkepohl)
H0: residuals are multivariate normal
Sample: 1983:1 2002:4
Included observations: 78

Component	Skewness	Chi-sq	df	Prob.
1	-0.196075	0.499788	1	0.4796
2	-0.229259	0.683277	1	0.4085
Joint		1.183065	2	0.5535
Component	Kurtosis	Chi-sq	df	Prob.
1	2.437155	1.029582	1	0.3103
2	2.006422	3.208391	1	0.0733
Joint		4.237972	2	0.1202
Component	Jarque-Bera	df	Prob.	
1	1.529369	2	0.4655	
2	3.891668	2	0.1429	
Joint	5.421037	4	0.2468	

Table A20. Model 3, VEC Residual Portmanteau Tests for Autocorrelations

H0: no residual autocorrelations up to lag h
Sample: 1983:1 2002:4
Included observations: 78

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	df
1	0.862442	NA*	0.873642	NA*	NA*
2	2.291197	0.6824	2.339996	0.6735	4
3	8.850680	0.3550	9.161859	0.3288	8
4	20.55877	0.0572	21.50282	0.0435	12
5	23.63421	0.0978	24.78890	0.0736	16

*The test is valid only for lags larger than the VAR lag order.
df is degrees of freedom for (approximate) chi-square distribution

Table A21. Model 3, Roots of Characteristic Polynomials

Endogenous variables: LOG(CD/CS) LOG(RER3)
Exogenous variables: D1 D2 D3
Lag specification: 1 1

Root	Modulus
1.000000	1.000000
0.904621	0.904621
-0.212983	0.212983
0.024250	0.024250

VEC specification imposes 1 unit root(s).

Table A22. Model 3, Test of Weak Exogeneity

	Cointegration Restrictions:	
LR test for binding restrictions (rank = 1):	A(1)=0	A(2)=0
Chi-square(1)	10.19068	12.14663
Probability	0.001412	0.000492

Note: A(k) is the coefficient the k-th VEC equation, and where: k = 1 is D(LOG(CD/CS)) equation and k = 2 is D(LOG(RER3)) equation.

Methodological Appendix

The Estimation of Private Consumption in the National Accounts Procedure

As discussed in the main text, the estimation of private consumption for each sector was made with two different approaches according to the available information and the decomposition of the production in each sector.

Agriculture (A) and Manufacturing (MF)

The consumption estimation was based on equation (18):

$$(18) \quad C_{i,t} = Y_{i,t} - \sum_{j} IC_{ij,t} - (X_{i,t} - M_{i,t}) - I_{i,t}$$

From NA statistics, the GDP series were available at current and constant prices with annual frequency. To obtain this series with quarterly frequency, the production quantity index by sector and price indexes were used (domestic agriculture products price index and manufacturing products price index).

As mentioned earlier, to solve the problem that intermediate demand for sectors was only available for two years, the ratio a_i is defined as:[12]

$$(20) \quad \frac{C_{i,t}}{\sum_{j} IC_{ij,t}} = a_i$$

The estimation of the ratios by sector for the period was made taking into account the ratios for 1983 and 1995 (Table M.1), their own increase and the pattern of the global ratios. For the period 1999-2002, there is no consumption data from the NA, so the 1998 ratios were maintained (Table M.2).[13]

[12] An unofficial matrix was estimated for 1990. It is a national flux matrix, and therefore consumption data by sector is available only for national inputs, as imports are added in a row. This matrix was constructed by the Instituto de Economía and the Grupo Interdisciplinario de Economía de la Energía, in the context of the 1996 Convenio UTE-Universidad de la República.

[13] Even though there was a strong fall in consumption in 2002, the authors were unable to find reliable data to modify the *ai* coefficient.

Table M.1. Private Consumption/Intermediate Consumption Ratio

Year	Global Ratio			Ratio by Sector	
	s/NA	s/IOM83	S/SAM95		
	a_g	**a_g**	**a_g**	**a_A**	**a_{MF}**
1983	0.816	0.738		0.268	0.766
1984	0.735				
1985	0.741				
1986	0.841				
1987	0.933				
1988	0.836				
1989	0.825				
1990	0.857				
1991	0.938				
1992	1.019				
1993	1.089				
1994	1.190				
1995	1.202		1.080	0.354	1.380
1996	1.186				
1997	1.220				
1998	1.219				
1999*	1.201				

Source: Compiled from NA, IOM83 and SAM95 data.

Table M.2.
Private Consumption/Intermediate Consumption Estimations For Agriculture and Manufacturing

Years	**a_A**	**a_{MF}**
1983	0.27	0.77
1984	0.22	0.84
1985	0.22	0.85
1986	0.25	0.97
1987	0.28	1.07
1988	0.25	0.96
1989	0.24	0.95
1990	0.25	0.98
1991	0.28	1.08
1992	0.30	1.17
1993	0.32	1.25
1994	0.35	1.37
1995	0.35	1.38
1996	0.35	1.36
1997	0.36	1.40
1998	0.36	1.40
1999*	0.35	1.38
2000*	0.35	1.38
2001*	0.35	1.38
2002*	0.35	1.38

Source: Compiled from NA, IOP83 and SAM95 data.

Export and import data series for the two sectors were available at CINVE for the whole period on a quarterly basis.[14] Trade information was processed in current dollars using a correlation between NADE, NADESA and NCM (or NADI, NADISA) and ISIC sectors (rev. 2) at the 4-digit level.[15] Afterwards, the foreign trade series were converted to local currency using an average exchange rate for each quarter. In the case of imports an "internalization margin" was added, including tariffs and other duties. This margin was constructed with the data series of import duties available in the NA at current and constant prices on an annual basis. The totality of import duties was distributed between Agricultural and Manufacturing sector imports, supposing that oil imports were unaffected by import rights. Moreover, the same percentage was assigned to each quarter.

Trade series at constant prices were obtained by deflating the current dollar prices series with the export FOB price index and the import CIF price index, available from the BCU. It was not possible to obtain more specific price indexes for the whole period.[16] Thereafter, the series in constant dollars were converted into local currency using the exchange rate of the base year. Investment data for each sector were available at current and constant prices on an annual basis. The NA provided data for gross fixed investment divided into three sectors: Construction; Crops; and Machinery and Equipment. These three components were assigned as investment in the Construction, Agriculture and Manufacturing sectors, respectively. The stock variations were not considered, so the consumption series will include these variations. To obtain the series at constant prices with quarterly frequency, the investment quantity index was used, as it was available for the three components. Finally, to compile the series at current prices, prices index of construction cost, domestic agricultural products and imported capital goods, available on a quarterly basis, were used.

[14] BCU trade data do not provide an adequate disaggregation until 1999, when annual imports were disaggregated using ISIC sectors (rev. 2), at 3 digits.
[15] Sector A (agriculture) includes ISIC sectors (rev. 2), at 4 digits of division 1 (agriculture, hunting, forestry and fishing) and sector MF (manufacturing) of division 3 (manufacturing).
[16] From 1994 onwards the BCU built a more specific index series, but it was impossible to extend the methodology to the whole period.

Utilities (U)

As noted above, private consumption of Utilities was approximated by private consumption of electricity, as this sub-sector accounted for more than 80 percent of Utilities output in the period 1983-1998.

Table M.3. Utilities: Share of Electricity in GDP

Years	Utilities		Electricity	
	Production	Value added	%Prod.	%VA
1983	8,001	5,663	85	88
1984	12,046	8,790	85	89
1985	21,836	16,223	82	84
1986	41,016	31,853	81	83
1987	78,007	56,582	83	85
1988	124089	77,747	84	84
1989	225,378	112,658	84	88
1990	520,273	300,608	85	84
1991	979,333	636,163	82	81
1992	1,817,930	1,140,954	83	78
1993	2,559,738	1,583,818	79	76
1994	3,683,941	2,781,133	76	76
1995	5,809,033	4,524,614	78	78
1996	8,075,649	6,130,806	77	78
1997	9,991,449	7,771,550	77	79
1998	11,638,344	9,306,749	79	82
1999	118,92,105	9,465,316		
Average			**81**	**82**

Source: NA statistics.

For 1983, the private consumption from IOP83 was used. In the base year, private consumption was 37 percent of production. The series at constant prices was obtained using a quantity index elaborated with data on residential consumption in KW. The electrical energy consumption series by type of demand (residential, industrial, commercial, etc.) was provided by the *Administración Nacional de Usinas y Trasmisiones eléctricas* (UTE) to the *Instituto Nacional de Estadísitica* (INE), which published them in the annual statistics. The electricity quantity index from the NA was used to transform the index to a quarterly basis. The series at constant prices and a residential electricity price index were used to create the series at current prices. The residential electricity price index was obtained from the CPI on a quarterly basis.

Construction (C)

In this sector, private consumption was estimated in a different way, assuming that private consumption equaled gross production minus investment. The other option was to assume residential construction in the decomposition of the NA, but a complete series was not available, so that $C_C = Y_C - I_C$.

The NA statistics included series at current and constant prices for both variables on an annual basis. The output of the Construction sector and Gross fixed investment in construction were decomposed into public and private construction. In both cases, only private construction was considered. To construct the series at constant prices on a quarterly basis, the quantity index available for the two variables was used. For the series at current prices, the construction cost index was used.

Transport Services (TS)

It was assumed that the output of the sub-sector Urban and Highway Passenger Transportation was the final consumption from this sector (see Table M.4). The other sub-sectors' output was assumed to be destined to intermediate consumption.[17] The series at constant and current prices was available from the NA with annual frequency. To obtain the series at constant prices with quarterly frequency, a quantity index of passenger transportation was compiled on the basis of tickets sold for urban transportation. Series at current prices with quarterly frequency were estimated with an average price index constructed from prices of bus tickets (local, suburban and long distance) and taxi fares.

[17] Railroad passenger transportation is not important in Uruguay, and only a few lines remain in use.

Table M.4.
Passenger Transportation and Private Consumption in 1983

Demand Decomposition over IOP83		GDP Decomposition over NA	
Intermediate consumption	5,869	Railroad transportation	367
Public consumption	228	Motor freight transportation	4,863
Exports	2,469	Water transportation	2,317
Import duties and charges	1,947	Transportation by air	1,478
		Warehousing	1,293
Total	**10,513**	**Total**	**10,318**
Private consumption	**5,691**	**Passenger transportation**	**5,886**
Production	**16,204**	**Production**	**16,204**

Source: Compiled from IOP83 and NA.

For foreign trade services, the data from the balance of payments, compiled by the BCU, are quite insufficient. The disaggregation for the period 1999-2002 into Passenger Transportation and Freight Transportation was not sufficient to separate Highway Passenger Transportation.

Personal Services (PS)

The output data of Other communal, social and personal services can be decomposed into General Government activities (social and communal services like health and education), Entertainment services (cinemas, theaters, shows, radio and television) and Household and Personal services (hairdressing, general reparations, cleaning and laundry services, domestic help services, etc.). It was assumed that the output of the sector of Other communal, social and personal services net of Government activity was destined to private consumption. The quantity index used is that of the Other communal, social and personal services sector. The price index is the average private wage index.

Table M.5

Coefficient b Estimates

Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
b	0.12	0.23	0.24	0.27	0.29	0.26	0.26	0.27	0.28	0.30
Year	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999***	**2000***	**2001***	**2002***
b	0.32	0.34	0.35	0.35	0.35	0.35	0.43	0.43	0.43	0.43

Source: Compiled with data from NA, IOM83 and SAM95.