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Estimating Argentina's imports elasticities

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ESTIMATING ARGENTINA'S IMPORTS ELASTICITIES[♣]

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Abstract

The aim of this paper is to provide new estimates of the income and price elasticities of the demand for imports in Argentina. Given the non-stationary nature of the data and to avoid problems of spurious regression we applied co-integration techniques to quarterly data over the period 1970:1 –2005:4. Three results are worth mentioning. First, there is a statistically significant and stable long-run relationship between the level of imports, real income and the exchange rate. Second, in the long run, a very high-income elasticity and a low real exchange rate elasticity determine the demand for imports. This result confirms an old argument concerning Argentina's constraint to economic growth as originally developed by the well-known structural approach. Third, while the linear error correction models show problems of misspecification, a non-linear STAR model demonstrates that deviations from long-run equilibrium adjust not only in a non-linear way but also at a slower speed of adjustment than the linear one.

I. INTRODUCTION

Because of their close connection to balance of payment and trade policies, estimates of import elasticities have become a relevant issue in applied international economics. For Argentina, high income and low price elasticities of the demand for imports are central topics to explaining structurally constrained economic growth (Olivera 1924, Diaz Alejandro 1963, Ferrer 1963, Olivera 1963, Eshang and Thorp 1965, Braun and Joy 1968). Also, a more recent analysis has shown that these elasticities are essential elements in understanding Argentina's growth cycle (Nicolini-Llosa 2006).

Previous estimates of Argentina's import demand elasticities can be found in Diaz Alejandro (1970), Cline (1989) and Heymann and Ramos (2003). Until very recently, however, the estimation of these elasticities had suffered from a number of econometric problems such as dynamic specification, parameter stability, and links between short-run adjustment and long-run equilibrium (see Cattao and Falcetti 2002). Our aim in this paper is to overcome these problems. In particular, we will provide new estimates of the demand for imports in Argentina over the period 1970:1-2005:4. We apply recent developments in dynamic modelling and estimate the long-run income and exchange rate elasticities of the demand for imports in Argentina along with short-run linear and non-linear speeds of adjustment.

The structure of this paper is as follows. Section II provides a brief theoretical framework and relevant methodological issues related to the specification and estimation of the demand for imports. Section III presents the econometric evidence. This section starts exploring the unit root properties of the data and then applies linear

and non-linear methods of estimation. The linear approach uses the two-step procedure suggested by Engle-Granger and the Johansen methodology for estimating and testing co-integrated vectors. The non-linear approach concentrates on the Smooth Transition Error Correction Model as recently proposed by Kapetanios et al. (2006). What the econometric evidence suggests is that the non-linear approach is better suited to capture the dynamic of adjustment of the demand for imports in Argentina than the linear approaches. Section IV provides a brief economic interpretation of the results, and Section V summarises the major conclusions.

II. METHODOLOGICAL ISSUES

The familiar and widely used Marshallian function of aggregate demand for imports is:

$$M_t = Y_t^{\beta} \left(\frac{P_t^f E_t}{P_t^d} \right)^{\delta} \tag{1}$$

where M_t is the quantity of imports demanded, P_t^f are import prices, P_t^d are domestic prices, E_t is the nominal exchange rate, that is the price of domestic currency per unit of foreign currency, and Y_t is real income or real expenditure. This expression simply says that imports in volume terms is an exponential function (multiplicative) of real income and a measure of relative prices of imports and substitutes domestic goods. In applied work, the real exchange rate ($REX_t = P_t^f E_t / P_t^d$), has been frequently used to capture the decisions made by economic agents in favour of either imports or domestic goods. In (1), δ and β represent the price and income elasticity of the demand for imports respectively.

For a number of reasons (e.g., incomplete information, adjustment costs, inertia, habits, lags in perceiving changes) imports do not immediately adjust to their long-run level, following a change in any of their determinants. To describe these effects our analysis will distinguish between two time frames: the long-run path of the demand for imports and the short-run adjustment response of economic agents to changes in the explanatory variables.

As far as the specification of the long run equation is concerned, it is well known that economic theory does not provide any specific suggestion on the best functional form nor the most appropriate variables (Gandolfo & Petit 1983). In this paper we shall adopt the following standard model:

$$\text{Log } M_t = \alpha + \beta \log Y_t + \delta \log REX_t \qquad\qquad (2)$$

Before proceeding to the estimation process, we should recall that the traditional approach to measure foreign trade elasticities has a number of econometric problems and pitfalls. Dynamic specification and parameter stability over time are outstanding examples. To avoid these shortcomings, in this paper we shall apply a parametric error-correction methodology. First, we will use two well-known methodologies to estimate the long-run function; one is the Engle-Granger Ordinary Least Square (EG-OLS) co-integration regression and the other is the Johansen-Juselius Full Information Maximum Likelihood (JJ-FIML). Then, the result for the long run will be modelled as an error correction mechanism to incorporate the estimates of the short-run dynamic model.

In addition to the above mentioned methodologies, we shall consider some recent developments in time series econometrics to estimate co-integrated models subject to non-linear dynamics (Balke and Fomby 1997 and Michael et al. 1997). In particular we will use a non-linear Smooth Transition Error Correction Model as recently proposed by Kapetanios et al. (2006). Three notable features that make the use of this methodology an appealing one are: first, it is in line with recent research on non-stationarity and non-linearity in economics, where it is argued that the assumption of linear adjustment is likely to be too limited in situations where transaction costs and policy interventions are present. Second, its implementation is relatively simple, in the sense that it follows a two step residual-based approach as in Engle and Granger (1987). Third, the model considers a process where higher disequilibrium errors can be associated with larger ECM adjustment parameters and faster rates of error correction towards the long-run function.

III. EMPIRICAL ESTIMATES

The properties of the data

A preliminary analysis to explore the time-series properties of the variables is needed before applying the co-integration and ECM methodology. The data used are quarterly from 1970:1 to 2005:5, and the main sources are Instituto Nacional de Estadísticas y Censos (INDEC), Comisión Económica para América Latina and International Financial Statistics (IFS) The quarterly imports volume data are from INDEC (1986-2005) and CEPAL (1970-1985). Real GDP data (at 1993 market prices) are from INDEC and the seasonal component was removed using X-12. The real exchange rate data are from IFS. The data used in the estimations are in natural logarithms.

The series were tested using the augmented Dickey-Fuller (ADF)[2] test where the null hypothesis of a unit root is tested against the alternative that the process is stationary. Table 1 shows the results of the tests where it can be seen that the null hypothesis of a unit root in the level series under consideration cannot be rejected. Also, the results of the ADF tests applied to the first difference in logs of the time series indicate that the presence of a unit root can be easily rejected. In sum, the first differences of all the series under consideration are stationary, confirming that the series are non-stationary or I(1) in (log) level, and contain a stochastic trend over the 1970:1-2005:4 sample. Thus, in what follows we shall first test for the presence of co-integration among the volume of imports (M_t), real income (Y_t) and the real exchange rate (REX), and then alternative linear and non-linear error-correction dynamic models will be formulated.

[Table 1 around here]

The long-run function

Two estimation procedures with the corresponding co-integration test will be carried out. One is the residual-based approach proposed by Engle and Granger (1987) (EG), and the other is the Johansen (1988, 1992) and Juselius (1992) (JJ) maximum likelihood technique.

The outcome of the residual-based approach is:

$$\log M_t = -39.03 + 3.52 \log Y_t - 0.36 \log REX \qquad (3)$$

$$(1.41) \quad (0.11) \qquad (0.038)$$

$$R^2adj = 0.92 \quad ADF(0) = -4.32 \qquad KPSS = 0.139$$

Numbers in parentheses below the coefficients are standard errors. In general, these results suggest that co-integration is present. The ADF test rejects the null of no co-integration and the same conclusion is achieved by means of the KPSS test (Kwiatkowski, et. al 1992), which does not reject the null of stationarity. However, two issues are worth mentioning. First, the residual-based approach, in the case of finite sample, can be sensitive to the specific choice of the endogenous variable (see Dickey et al., 1991). Secondly, this approach ignores the situation of more than one co-integrating vector when more than two variables are included in the sample (Banerjee et al., 1993). In the light of these shortcomings, the Johansen FIML (Full-Information Maximum Likelihood) approach will also be used.

Table 2 shows the main results of the JJ Tests for the number of co-integrating vectors. The maximal eigenvalue statistic (0.150) and trace statistic (30.88) confirm the existence of only one co-integrating vector. The Johansen long-run co-integrating equation is[3]:

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[2] For a survey on new extensions of the Dickey-Fuller procedure and alternative tests such as that of Phillips and Perron PP, see Maddala and Kim (1998). Please note that PP tests yielded similar results to the ADF tests.

[3] The selected equation has been chosen on the basis of the significance of the adjustment coefficients in the ECM VAR. Moreover, the adjustment coefficients of the other two equations were not significant highlighting the existence of only one co-integrating vector.

$$\log M_t = -36.22 + 3.29 \log Y_t - 0.56 \log REX_t \qquad (4)$$

$$(0.27) \qquad\qquad (0.093)$$

[Table 2 around here]

Standard errors are in parenthesis. It is worth noting that the estimated income elasticity in the co-integrated vector is similar to that obtained by the EG static in (3) while the exchange rate elasticity slightly differs.

Dynamic adjustment estimates

Table 3 shows the main results of the Error Correction Models (ECM). Taking into account the substantial fluctuation during the sample period (see Figures 1 (a) and (b) below) it should be recognised that the model explains the changes in import demand rather accurately. An inspection of the diagnostic tests in Table 3 suggests that the model specification is correct and that a satisfactory model for import demand has been reached.[4]

[Table 3 around here]

[Figure 1 around here]

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[4] As far as the estimation is concerned, we introduced four lags of the first differenced variables on the grounds that we are dealing with quarterly data, and, this would provide a sufficient representation of the data generating process. This was followed by a general to specific simplification procedure eliminating all negligible and insignificant effects. Following the approach suggested by Hendry, the process of simplification has been based on the grounds of statistics such as F statistic, Schwarz criterion and standard error of regression.

Considering that the equation explains the quarterly rate of change of the demand for imports, the R^2 values (0.53 and 0.52) can be interpreted as quite good. Recursive residuals and CUSUM tests have been conducted to test for the stability of the OLS vector and the FIML vector. Figures 2 and 3 show the outcome of these tests and they confirm the goodness of fit. Note that all three of the extreme values shown in Figure 2 correspond to severe recessive devaluations, namely:

a) In 1975, there was a sharp acceleration of inflation along with a run on the currency and a sharp recessive devaluation that led to the military coup in March 1976.

b) In 1988 there was hyperinflation along with a run on the currency and a sharp recessive devaluation that lead to the anticipated change of government (Alfonsin stepped down and Menen took over)

c) In 2002 there was a run on the currency and a sharp recessive devaluation along with an institutional crisis (four presidents between December 2001 and March 2002)

However, an inspection of the RESET diagnostic test in Table 3 suggests that the model specification might be nonlinear. In the next section we shall examine a nonlinear specification of the model.

[Figures 2 and 3 around here]

The models satisfy the sign restriction as suggested by the theory of import demand (see Section II). Also, the estimated coefficient of the error-correction term has the right

sign[5] and shows a significant rate of adjustment (-0.234 % and -0.206 % each quarter in both methods of estimation, that is, the case of OLS-vector and FIML-vector respectively). The magnitude of this coefficient indicates that deviations from the long run function due to random shocks represent a significant determinant of the short-run dynamic behaviour.

In the short-run, the size and timing of the coefficients have important implications for policy analysis. In Table 3, the coefficient of the growth rate of income (ΔY) is large and shows that a change in GDP has an immediate response in the current quarter of 2.375 percent on import demand. However, a change in the exchange rate has a small (-0.15) and immediate effect on the demand for imports. These results are very similar in both methodologies, that is OLS vector and FIML vector, and also they are in line with previous works for Argentina (Aggarwal 1984, and Cline 1989). Moreover, this finding is consistent with the long-run model.

Non-linear Adjustment

In the previous analysis, the adjustment of the demand for imports to its long-run relationship has been restricted to be linear. More recently, however, there is increasing interest in analysing co-integration subject to non-linear dynamic adjustment, e.g. Terasvirta and Eliasson (2001), Saikkonen (2004), and Escribano (2004). This non-linear adjustment could be assumed to be smooth rather than discrete in the presence of heterogeneous agents (see Anderson, 1997 for an empirical application of agent heterogeneity and smooth transition in the bond market). Kapetanios et al. (2006)

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[5] This coefficient reflects the impact of previous period deviations from the equilibrium condition on import variations (ΔM) and for the purpose of dynamic stability and co-integration, it must be negative.

proposed a test to detect non-linear adjustment within a co-integrating framework.[6] In what follows, we shall concentrate on the particular case where the adjustment to the long-run relationship follows a Smooth Transition Autoregressive (STAR) process.

As previously noted, the linear ECM model might suffer a misspecification problem as shown by the RESET test in Table 3. In the light of this result we proceed to the detection of a possible non-linear adjustment mechanism in the demand for imports in Argentina. In addition to the RESET test we apply the t_{NLEG} statistic developed by Kapetanios et al. (2006) which is the non-linear analogue to the Engle and Granger statistic for linear co-integration. We obtain a value of -3.65 which is significant at the 5 percent level (critical value is -3.30). According to this result deviations from the co-integrating relationship (u_t) would follow the following process

$$\Delta u_t = -[1-\exp(-\theta u^2_{t-1})]u_{t-1} + \varepsilon_t \qquad (5)$$

This adjustment is symmetric and faster the larger the deviation in previous period (u_{t-1}). Please note that in contrast with the classical linear ECM where the adjustment coefficient is constant, in the nonlinear case the coefficient of adjustment is time varying and depends on previous period deviations. A major feature of this nonlinear ECM is that the speed of adjustment fluctuates between the following range:

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[6] The major advantage of this methodology over some others can be summarised as follows. Very recently, a number of studies (see e.g. Gallagher and Taylor, 2001; and Hansen and Seo, 2002) have used linear co-integration tests to confirm the existence of co-integration and then non-linearity is allowed to enter at the estimation stage. However, the methodology we shall apply here uses a test that is designed to have power against the alternative non-linear dynamic adjustment in the very first stage. In brief, the null hypothesis of no co-integration against the alternative of a globally stationary exponential smooth transition auto-regressive (ESTAR) co-integration is tested by examining the significance of the speed of adjustment parameter which at the same time controls the degree of non-linearity.

$$\text{Lim } u_{t-1 \to \infty} -[1-\exp(-\theta u^2_{t-1})] = -1 \tag{6}$$

$$\text{Lim } u_{t-1 \to -\infty} -[1-\exp(-\theta u^2_{t-1})] = -1$$

$$\text{If } u_{t-1} = 0, [1-\exp(-\theta u^2_{t-1})] = 0$$

The next step is to provide an estimate of the STAR form. In doing so, we apply Non-linear Least Squares to the following equation

$$\Delta u_t = -[1-\exp(-(\theta/\sigma_u)u^2_{t-1})]u_{t-1} + \Sigma\varphi\Delta u_{t-i} + \varepsilon_t \tag{7}$$

The estimated θ value is 0.39 with a p-value of 0.01. Figure 4 plots the time-varying adjustment coefficient $-[1-\exp(-\theta u^2_{t-1})]$. As can be seen, the adjustment varies from zero to -0.44. These results imply: (a) that the demand for imports in Argentina with respect to real income and exchange rate is a stable one, and (b) that its deviations adjust in a non-linear way.

[Figure 4 around here]

In order to compare the linear and nonlinear adjustments we compute the Generalized Impulse Response Function (GIRF). The GIRF introduced by Koop, Pesaran and Potter (1996) successfully confronts the challenges that arise in defining impulse responses for nonlinear models. Applying their methodology, our estimated half-lives for shocks of size 20%, 40% and 60% are seven, six, and five quarters, respectively. This contrasts with the linear (irrespective of shock size) half-life of three quarters. Our results suggest

that the speed of adjustment in the ECM model is slower once the functional form of the residuals is free from misspecification.

IV. ECONOMIC INTERPRETATION OF RESULTS

The economic interpretation of these results is quite straightforward. According to the OLS residual-based approach (eq. 3), in the long run volume of imports grow 3.52 times faster than GDP and this does not change dramatically with changes in the exchange rate since its elasticity is rather low: 0.36. The Full Information Maximum Likelihood approach FIML (eq. 4) presents similar results: 3.29 and 0.56, respectively. In addition, the Error Correction Model (Table 3) presents again similar results for both short run adjustment equations. During the 1970-2004 period, several and remarkably different fiscal, monetary and trade policies were adopted. Trade policies in particular, ranged from protectionism to an all-out liberalization in the nineteen nineties. Also Argentina moved from being one of the market economies with one of the highest degrees of government involvement in infrastructure to far reaching privatizations. In addition, the exchange rate experienced large fluctuations in the 1970-1990 period, a remarkable stability in 1990-2001 followed by a large currency depreciation in 2002. Therefore, such high income elasticity seems to be a structurally stable value independent of all these changes through time.[7]

The econometric results are robust and do not indicate a co-integration problem. Such high income elasticity value, however, cannot be sustained for ever in a growing economy like Argentina. This calls for further research in the non-linear adjustment mechanism detected.

V. CONCLUSIONS

In this paper new estimates for aggregate import demand in Argentina have been presented. Given the non-stationary nature of the series under study and to avoid the problem of spurious regression results, we apply the co-integration technique to quarterly data ranging from 1970:1 – 2005:4. We have found a statistically significant long-run relationship between the level of imports, real income and the exchange rate. Then, this stationary relationship has been used to estimate short-run adjustment in import demand with an error-correction model, including first differenced variables in the dynamic model.

Of particular interest is that our estimates of the income and price elasticities do not show significant changes over the period under study. Our empirical evidence has also shown that income effects play a dominant role in determining import demand with a very high elasticity, both in the long and the short-run. An implication is that Argentina may be facing an external constraint to growth if trade imbalances emerge as a result of economic expansion. At the same time, the estimated real exchange rates elasticities are very low in both the long-run and the short-run. The implication here is that conventional balance of payments adjustment (e.g. Krueger 1983) may not be effective. Finally, our non-linear analysis suggests that the demand for imports in Argentina with respect to real income and exchange rate is stable and its deviations adjust in a non-linear way.

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[7] Figure 2 and Figure 3 show recursive residuals and CUSUM stability tests to confirm these findings

REFERENCES

Aggarwal, M. R. (1984). Devaluation, Determinants of International Trade Flows and Payments Imbalances. *Indian Economic Journal,* 31, 24-33.

Anderson, H.M. (1997). Transaction costs and nonlinear adjustment towards equilibrium in the US Treasury Bill market. *Oxford Bulletin of Economics and Statistics*, 59, 465-484.

Balke, N. S., & Fomby, T. B. (1997). Threshold Cointegration. *International Economic Review,* 38, 627-645.

Banerjee, A., Dolado, J. J., Galbraith, J. W., & Hendry, D. F. (1993). *Co-integration, Error Correction and the Econometric Analysis of Non-Stationary Data*; New York: Oxford University Press.

Braun, O., & Leonard, J. (1968). A model of economic stagnation, a case study of the Argentine economy. *The Economic Journal*, 78, 868-887.

Catao, L., & Falcetti, E., (2002). Determinants of Argentina's External Trade. *Journal of Applied Economics***,** 5, 19-57.

Cline, W. (1989). *United States External Adjustment and the World Economy.* Washington, DC, Institute for International Economics.

Dickey, D. A., Jansen, D. W., & Thornton, D. L. (1991). A Primer on Cointegration with an Application to Money and Income. *Federal Reserve Bank of St. Louis*, 58-78.

Diaz Alejandro, C. (1963). A note on the impact of devaluation and the redistribution effect. *Journal of Political Economy,* 71, 577-580.

(1970) *Essays in the Economic History of the Argentine Republic*, Yale

Engle, R., & Granger, C. (1987). Cointegration and Error Correction: Representation, Estimation and Testing,.*Econometrica,* 55, 251-277.

Escribano, A. (2004). Non linear Error Correction: The Case of Money Demand in the UK (1878-2000). *Macroeconomic Dynamic*s, 8, 76-116.

Eshang, E., & Thorp, R., (1965). Economic and social consequences of orthodox economic policies in Argentina in the post-war years. *Bulletin of the Oxford University Institute of Economics and Statistics*, February.

Ferrer, A. (1963). Devaluación, redistribución del ingreso y el proceso de desarticulación industrial en Argentina. *Desarrollo Económico*, Enero-Marzo

Gallagher, L. A. & Taylor, M. P. (2001). Risky Arbitrage, Limits of Arbitrage and Non Linear Adjustment in the Dividend Price ratio. *Economic Inquiry,* 39, 524-536.

Gandolfo, G., & Petit, M.L., (1983). The Functional Form of the Aggregate Import Demand Equation, Italy, 1960-1980. *Economic Letters,* 11, 145-148.

Hansen, B. E., & Seo, B. (2002). Testing for Two-Regime Threshold Cointegration in Vector Error Correction Models. *Journal of Econometrics,* 110, 293-318.

Hendry, D.F., & Mizon, G. E. (1978). Serial Correlation as a Convenient Simplification, Not a Nuisance: A Comment on a Study of the Demand for Money by the Bank of England. *The Economic Journal,* 88, 549-563.

Heymann, D., & Ramos, A., (2003). La sustentabilidad macroeconómica de mediano plazo. Mimeo, *Economic Commission for Latin America*, Buenos Aires.

Johansen, S. (1988). Statistical Analysis of Co-integrating Vectors. J*ournal of Economic Dynamics and Control,* 12, 231-254.

(1992). Testing Weak Exogeneity and the Order of Cointegration in U. K. Money Demand Data. *Journal of Policy Modeling,* 14, 313-334.

Juselius, K. (1992). Domestic and Foreign Effects on Prices in an Open Economy: The Case of Denmark. *Journal of Policy Modeling,* 14, 404-428.

Kapetanios, G., Shin, Y., & Snell, A. (2006). Testing for Cointegration in Nonlinear Smooth Transition Error Correction Models. *Econometric Theory,* 22, 279-303.

Koop, G., Pesaran, M.H., & Potter, S.M. (1996). Impulse response analysis in nonlinear multivariate models. *Journal of Econometrics,* 74, 119-147.

Krueger, Anne (1983) *Exchange Rate Determination*, CUP, NY

Kwiatkowski, D., Phillips, P., Schmidt, P & Y. Shin (1992). Testing the Null Hypothesis of Stationarity Against the Alternative of a Unit Root: How sure are WE That Economic Time Series Have a Unit Root?. *Journal of Econometrics,* 54, 159-178.

MacKinnon, J.G., (1996). Numerical Distribution Functions for Unit Root and Cointegration Tests. *Journal of Applied Econometrics*, 11,

Maddala, G. S., & Kim, I.M. (1998). *Unit Roots, Cointegration and Structural Change*. Cambridge University Press. Cambridge.

Michael, P., R. A. Nobay & Peel D.A. (1997). Transaction Costs and Nonlinear Adjustment in Real Exchange Rates: An Empirical Investigation. *Journal of Political Economy,* 105, 862-879.

Nicolini- Llosa, J.L. (2006). Growth cycle and the exchange rates in Argentina, 1953-2005. *Anales* of the Asociación Argentina de Economía Política, Buenos Aires.

Olivera, J. (1924). *Desventajas que podría ocasionar a la República Argentina el retraso de su fomento industrial,* Buenos Aires.

Olivera, J. (1963). Equilibrio monetario internacional, *Desarrollo Económico.*

Saikkonen, P. (2004). *Stability Results for Non Linear Error Correction Models.* Unpublished Manuscript, University of Helsinki.

Terasvirta, T. & Eliasson, A. (2001). Non Linear Error Correction and the UK Demand for Broad Money, 1878-1993. *Journal of Applied Econometrics,* 21, 1-47.

Table 1: Unit Root Tests for the Series Employed (1970:1 – 2005:4)

Variables	With trend	Without trend
Log M	-3.27 (0.07)	
Log Y	-2.16 (0.51)	
Log REX	-1.87 (0.66)	
ΔLog M	-10.43 (0.00)	-10.45 (0.00)
ΔLog Y	-9.04 (0.00)	-9.05 (0.00)
ΔLog REX	-10.13 (0.00)	-10.15 (0.00)

Notes: In computing the tests we have employed up to four lags to whiten the residuals, given the use of quarterly data. The estimated equations for the ADF tests were: $\Delta X_t = \alpha + \beta X_{t-1} + \Sigma\ \phi_l \Delta X_{t-l} + \delta t$. P-values are reported in parenthesis and critical values are those of MacKinnon (1996) one sided.

Table 2. Johansen Tests for the number of Co-integrating Vectors

No. Cointegrating Vectors	Eigenvalue	Trace Statistic	Critical Value 0.05	P-value
None	0.1504	30.87553	29.79707	0.0374
At most 1	0.0539	8.058388	15.49471	0.4592
At most 2	0.0021	0.289953	3.841466	0.5902

Notes: Mackinnon-Haug-Michelis (1999) p-values

Table 3: Error Correction Models for Aggregate Import Demand in Argentina. 1970:01-2005:04.

| *Dependent variable: ΔM* | | |
Variables	OLS vector	FIML vector
Ecm (t-1)	-0.234	-0.206
	(0.000)	(0.000)
Δm (t-4)	0.317	0.293
	(0.000)	(0.000)
Δm (t-6)	-3.18	0.22
	(0.001)	(0.000)
Δy (t)	2.375	2.36
	(0.000)	(0.000)
Δy (t-1)	1.20	1.23
	(0.003)	(0.002)
ΔREX(t)	-0.15	-0.17
	(0.004)	(0.000)
R^2 adj.	0.53	0.52
DW	2.00	2.07
SER	0.108	0.108
LM (2)	0.93	0.87
LM (3)	0.44	0.14
LM (4)	0.16	0.21
ARCH (1)	0.90	0.93
ARCH (2)	0.94	0.12
ARCH (3)	0.45	0.00
RESET	0.06	0.05

Notes: Figures in parenthesis below coefficient estimates are p-values. SER is the standard error of the regression. LM is the Lagrange multiplier test for up to fourth-order serial correlation. ARCH is test for autoregressive conditional heteroscedasticity. RESET is a regression error specification test. Probabilities or chi-square values?

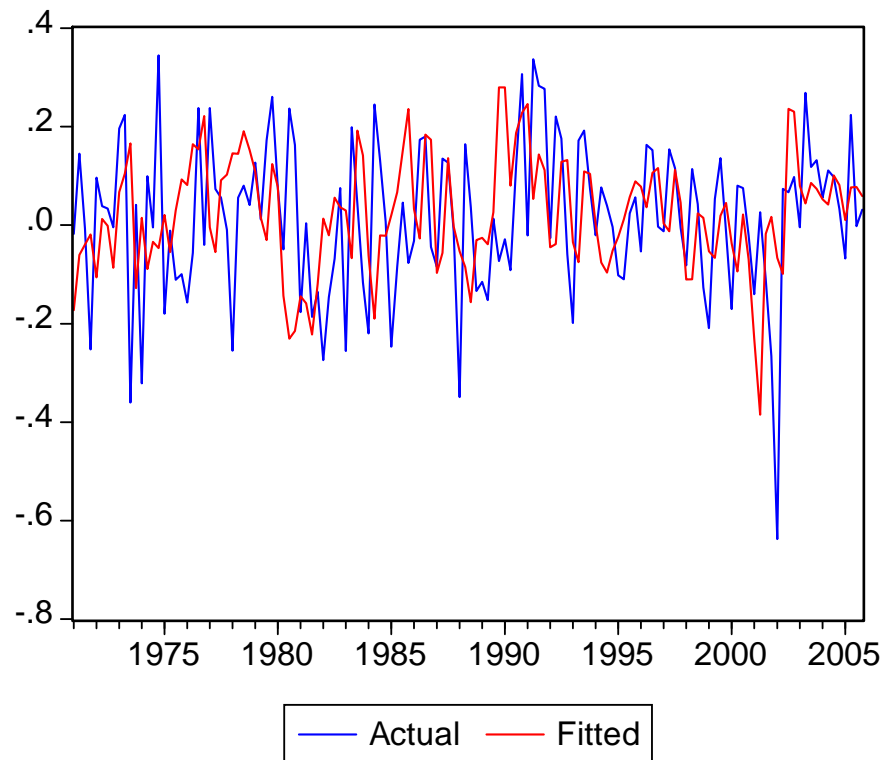Figure 1(a). Actual and fitted values of the ECM model obtained with EG procedure

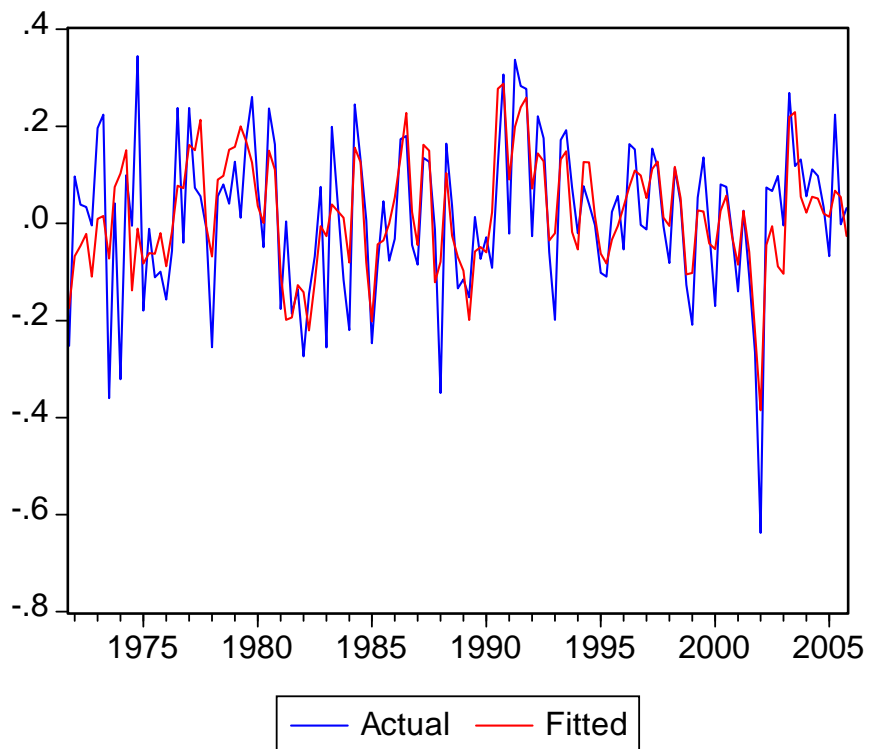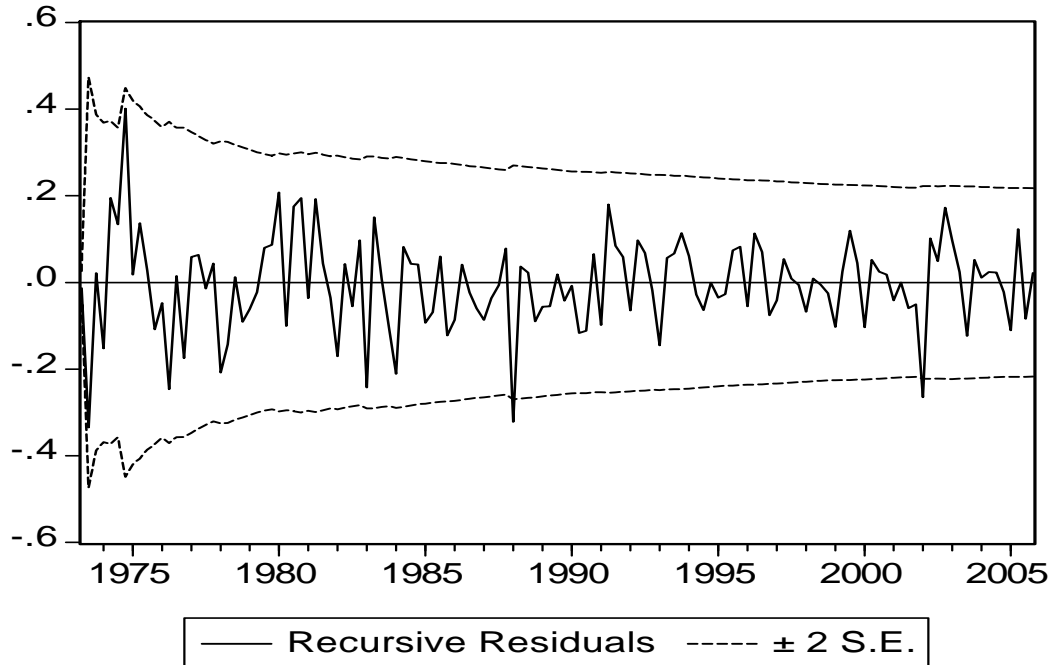Figure 1(b). Actual and fitted values of the ECM model obtained with JJ procedure

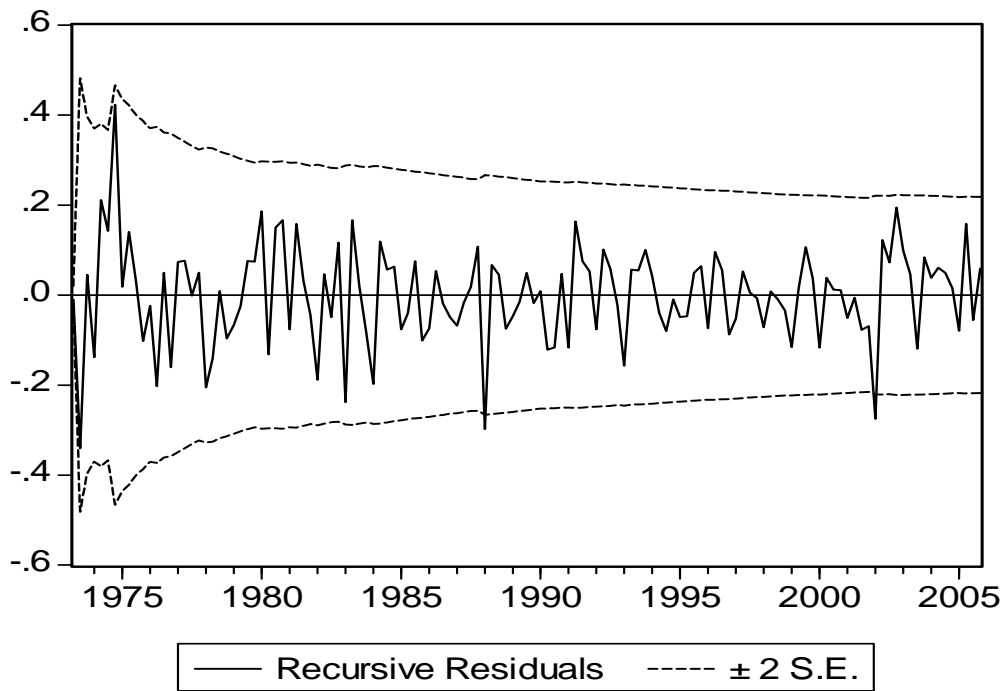Figure 2: Stability tests.

(a) OLS vector.

(b) FIML vector.

Figure 3: Stability tests. CUSUM test.
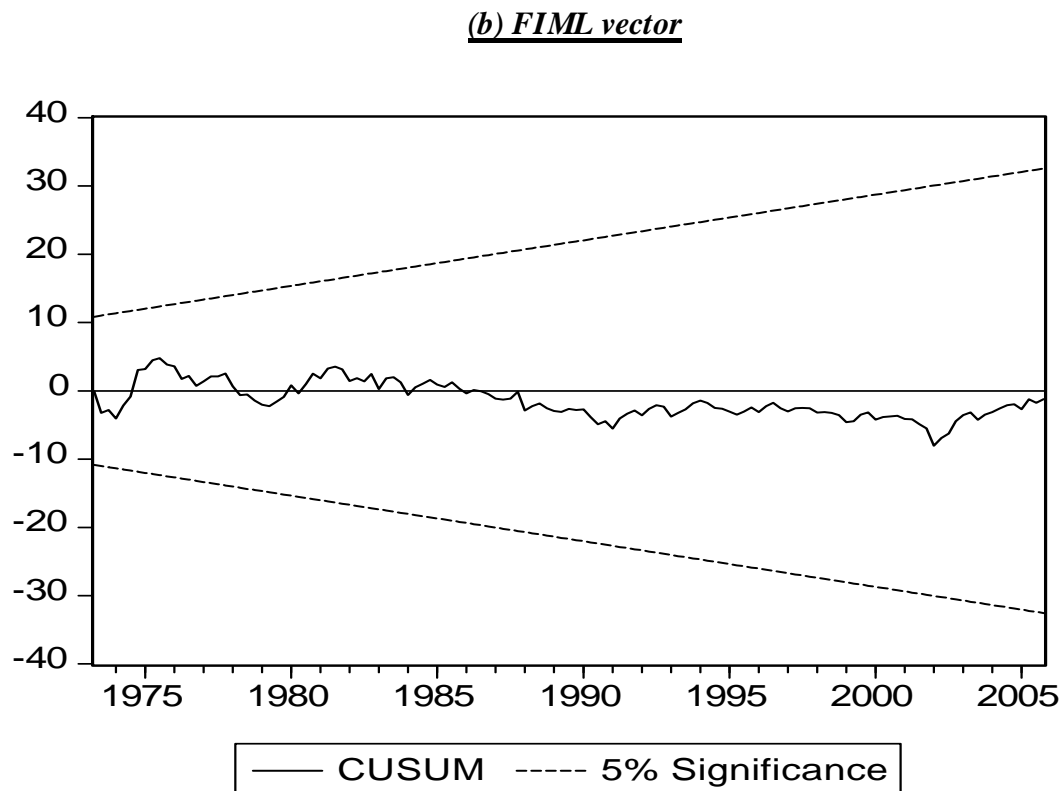
(a) OLS vector
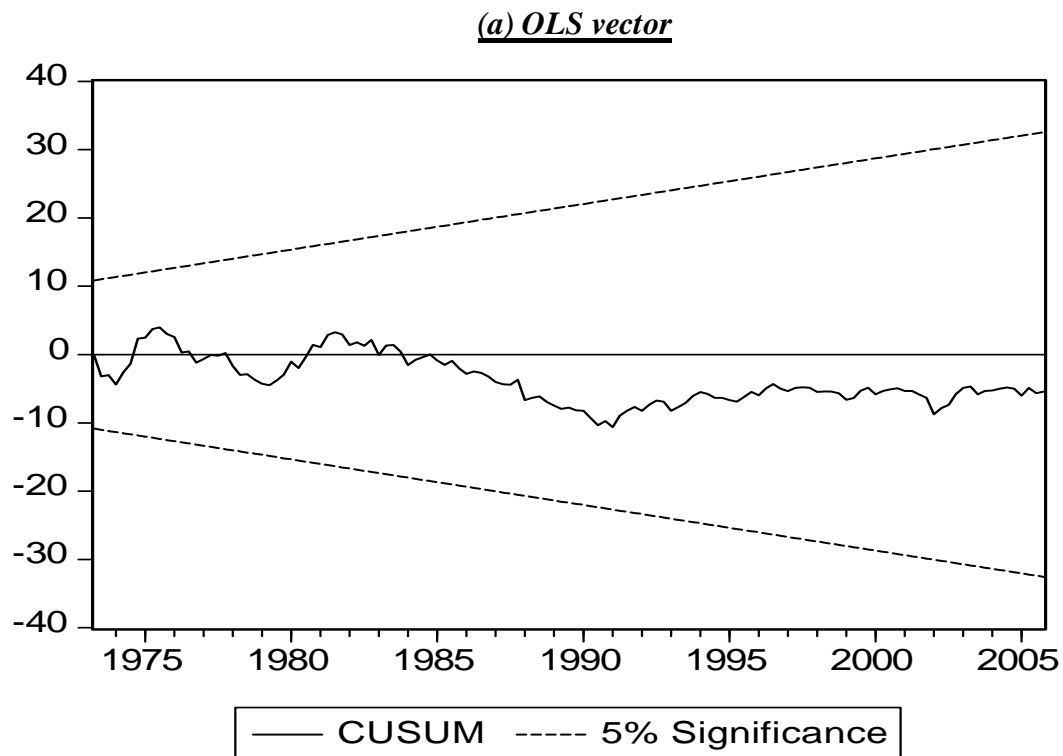

(b) FIML vector

Figure 4. Speed of adjustment coefficient in a Smooth Autoregressive (STAR) Process.