ARGENTINE EXPORTS: LONG RUN BEHAVIOR AND DYNAMICS

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1-INTRODUCTION.

Argentine exports at aggregate level have been very difficult to model. Indeed, it is usual to think that total exports are the result of adding quite different items, at least agricultural and "non-traditional" ones, which respond to special determinants. From a macroeconomic perspective, however, one can be interested in looking for the "common factors" behind them - visual inspection of the time-behavior of these aggregates (Figure 1 for agricultural, and 2, for industrial exports) suggests they may be present-. An econometric modelling based on this view appears to be critical when issues like the effect of opening up the economy, the relationship with growth and the response to exchange rate, etc are part of current debate in Argentina.

Previous studies on the aggregate for the argentine case (Diaz Alejandro,1970; Mallon and Sourrouille,1973; Navajas,1993)[1] coincide to find no definite relationship to aggregate output; although they observed demand effects, mainly derived from the industrial sector activity, and supply effects, associated with agricultural output. Such behavior appears to be maintained for the recent past as far as the stability of coefficient tests indicates. A common puzzling result of these studies was that neither contemporaneous nor long run effects of real exchange rate on exports can be detected. At the same time, most of the economic debate is focussed on such relationship. This work considers the issue, first analyzing the possibility of simultaneous bias.

Secondly, in this paper two dynamic models of aggregate exports are developed for quarterly data following a "general-to-particular" dynamic approach, in which long run behavior and dynamics are jointly analyzed. Agricultural and industrial output, along with a measure of the effective real exchange rate (ERER) -which takes into account export taxes and subsidies- are included as regressors. The first model -regarded as an approximation of the export data generating process- is in line with previous findings, apart from dynamic effects due to seasonality of quarterly data. The change in the periodicity of data does not significantly modify the results about the effects of the real exchange rate on exports. In turn, a second model of exports was developed in which long run effects of the effective real exchange rate are present through its past highest level, probably measuring "hysteresis" effects in exports. This model is evaluated by performing several encompassing tests with respect to that without long run effects of the exchange rate .

Next section considers the exogeneity of the effective real exchange rate. Section 3 briefly discusses the data of the model proposed. Section 4 and 5 report the results for the dynamic models for quarterly exports without and with long run effects of the real exchange rate, respectively. Section 6 presents the encompassing tests and section 7 interprets results in terms of theoretical models which derive hysteresis effects in trade flows. Section 8 concludes.

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[1] These studies use annual data. Whereas the first two works, accordingly to the date they were carried out, regressed only on contemporaneous variables, Navajas (1993) performed a dynamic study. In this work, the definition of exchange rate is the same as that analyzed in the last paper.

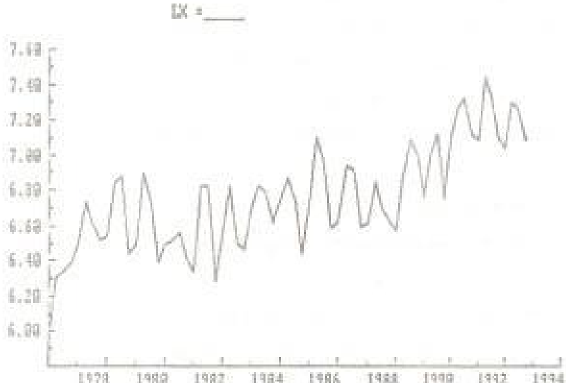

Fig 1 - Total exports

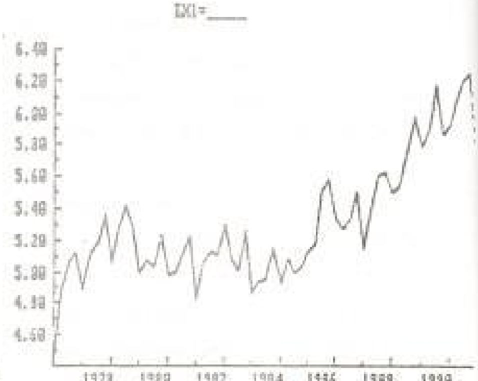

Fig 2 . Exports from the industrial sector

Fig 3. Effective (after taxes and subsidies) real exchange rate

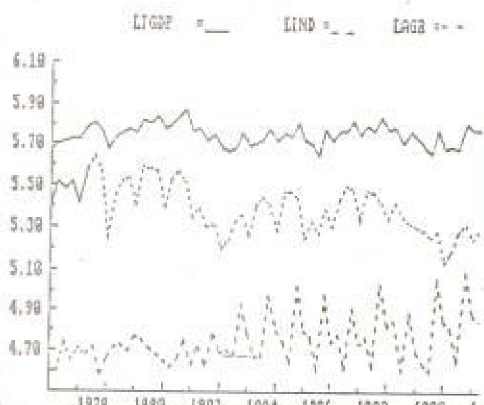

Fig 4. Total , Industrial and Agricultural GDP(graphed wit

2 THE EXOGENEITY OF THE EFFECTIVE REAL EXCHANGE RATE.

Before discussing this issue, it is important to precise the type of model more appropriate for argentine exports. Following previous work for Argentina, exports are considered as the net supply of exportable goods of a small country. This view differs from that in other recent studies on latin american exports (Moguillansky,1993 for Brazil; and Moguillansky and Titelman,1993 for Chile) which, close to Goldstein and Khan(1978) approach, simultaneously modelled the relative price of exports (external to domestic prices). Although this type of model may be relevant for the export behavior of specific products, argentine volume of exports, at aggregate level, can be assumed not to affect their relative price.[2]

Thus, the ratio of external to domestic price of exports will be taken as given to model aggregate exports.i.e. at least weak exogenous (in terms of the definition of Engle et.al.,1983; see also Ericsson,1992) when short-run (contemporaneous) as well as long run ERER elasticity of exports are regarded as "the parameter of interest". However, this assumption does not preclude the analysis of simultaneous bias in the coefficient of ERER. Being defined as the product of the relative price of export times the exchange rate, adjusted by taxes and subsidies, simultaneous bias can arise from the effect of exports volume onto the level of the real exchange rate, taxes and subsidies.[3]

Higher exports, and ceteris paribus, larger supply of foreign money would induce downwards movements in the real exchange rate in a free domestic market (in which demand and supply have traditional slopes). From the argentine experience, it is also possible to hypothesize that a low export performance, particularly in a context of chronic crisis of current account, has induced economic authorities to attempt increasing the ERER through nominal adjustments of the exchange rate (to a faster rate than inflation) and/or reducing (increasing) taxes (subsidies). (On the other hand, increasing exports may reduce the rate of adjustment of the exchange rate). The ERER rise may or may not be achieved in the long run but it could last during the period in which the reaction to exports takes place (depending, of course, on the data periodicity analyzed).

As far as a (contemporaneous) negative effect of export on ERER can be assumed, it may be responsible for a simultaneous bias in the ERER coefficient when estimated by OLS from an uniequation model for exports. Moreover, the direction of the bias (if important in magnitude) is such that near null contemporaneous coefficient for ERER could be obtained. In annex a simple data (joint) generating process for exports and ERER illustrates such a case.

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[2] The mentioned works modelled the external demand for exports normalized by prices as a function of domestic exports (endogenous) and OECD output(exogenous). They suggest, but not empirically include, the level of restrictions on trade of the countries' trade partners. This can be an interesting -although difficult- extension to take into account.

[3] $ERER = (P_x/P).ER(1-T+S)$, where P_x is the aggregate index of external price of export; P, domestic prices.ER, the nominal exchange rate (pesos to dollars) and T and S, the aggregate rate of export taxes and subsidies. This variable measures the revenue per unit of exports in terms of domestic goods.

In order to empirically analyze the possible bias in the contemporaneous coefficient of ERER (and thus, in both the short and long run elasticity) Instrumental Variables (IV) Estimations[4] were performed to the unrestricted regression of quarterly exports (the Autoregressive-Distributed lag model further discussed in the following sections). It should be noticed that the possibility of bias is not invariant to the data periodicity. Whereas, in general, simultaneous bias is more often expected in annual than quarterly data (see Hendry, 1992); this is not necessarily so in this case. The reaction of the real exchange rate could be exhausted within a period, and this is more likely the longer the periodicity. Because of that and since the OLS estimation on quarterly basis showed nonsignificant coefficients of the ERER (contemporaneous and in the long run), the IVE were performed for them. Next table presents the contemporaneous coefficient for ERER resulting from such estimations and the Sargan' statistic for the validity of the instruments (Sargan, 1964) for three different sets of them: total imports (in logs.LM), the trade balance (normalized by imports, (X-M)/M) and the term of trade index (in logs LTI), with their corresponding (4) lags.

TABLE 1

Instrumental Variables Estimations(*)

INSTRUMENTS	ERER COEFFICIENT (and S.E)	SARGAN' statistic(chi^2(4))
LM	-0.08 (0.39)	2.36
(X-M)/M	0.18 (0.22)	6.48
LTI	0.09 (0.31)	1.66

(*) for the Autoregressive-Distributed Lag model of exports on agricultural and industrial output and ERER taken as endogenous.

Whichever the set of instruments used, the coefficient estimated by IV remains, similarly to that obtained by OLS, non significant; simultaneous bias seems not to be present in quarterly data. Sargan test of the validity of the instruments does not reject these sets (at traditional significance levels).[5]

[4] Since the interest is only in the export function (and not a model for ERER) IVE would be appropriate. Exogeneity analysis from simultaneous systems (Johansen,1988,1992 and Johansen and Juselius,1990) depends on the assumption that cointegration is not rejected. Here the hypothesis about the long run relationship between total exports and ERER has been rejected.

[5] The Sargan' statistic for imports as instruments for ERER in the exports equation may also be useful as a test of whether the unrestricted reduced form of the structural model (here X on ERER plus ERER on M) parsimoniously encompasses the unrestricted reduced form (X on M directly), (See Hendry, 1989). Accordingly to Edwards (1993) restrictions on imports which reduce its level would overvalue the exchange rate for exports. Thus, high correlation of import and export, in addition to import

From the approach of this section, no contemporaneous effect of the ERER on exports can be detected. Section 4 and 5 concentrate on the dynamic modelling of quarterly exports and further analyze the effect of ERER.

3-DATA ANALYSIS

Some properties of the data -which helped to build the export model- are described in this section. Figures 1 and 2 show, since the mid-seventies, the evolution of total exports and the subset coming from the industrial sector. Figures 3 and 4 present the behavior of ERER and total GDP, industrial and agricultural output. Figures 5 to 8 complement these views with the cross plot of them (taking exports in the y-axis).[6] Several features can be observed.

Firstly, total exports and the industrial component of them appear not to have very different trajectories, although the upward trend of industrial exports is steeper within the sample.

Secondly, there is no clear relationship between exports and total output, and between exports and ERER. A negative slope in the case of industrial activity and a positive one in the case of agricultural product could be assumed (neither being very neat).

Finally, but not least for modelling series on quarterly basis, most of the variables - ERER is the exception- shows large and different seasonal movements (which can be confirmed by the inspection of the correlogram not reported here). The behavior described motivates to develop the unrestricted model of section 4.

4- A DYNAMIC MODEL FOR EXPORTS (without long run effects of ERER).

Following a "general-to particular" methodology (Hendry and Richard 1982, 1983, Hendry 1989) an Autoregressive-Distributed lag model of 5th order for the logs of exports (X), the effective rate of exchange rate (ERER), industrial(IND) and agricultural(AGR) output (plus seasonal dummies(Q)) was the starting point for the econometric search on quarterly basis. This form or "balanced equation" (Granger, 1990) allows modelling jointly the dynamics and the long run relations.[7]

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and ERER would be expected. However, no significant effect of ERER on exports was found even when imports are taken as instruments.

[6] All variables as expressed in logs. Data sources are: The Economic Commission for Latin America and Caribe (ECLAC, U.N.), The National Institute of Statistics and Census (INDEC) and the Central Bank of Argentina (BCRA).

[7] For a comparison of this approach to the Granger and Engle technique see Banerjee,et. al.(1986) and Kremers, et.al.(1993). Starting from a balanced equation, the different integration orders of the variables can be taken into account. The usual practice which analyzes first the univariate unit roots statistics, may arrive to different conclusions about the long run behavior of individual series depending of the time period. Such changes in the univariate (marginal) processes do not prevent to find stable conditional models (they even can be useful to test for superexogeneity)(see,e.g. Ericsson, Hendry and Tran,1993).

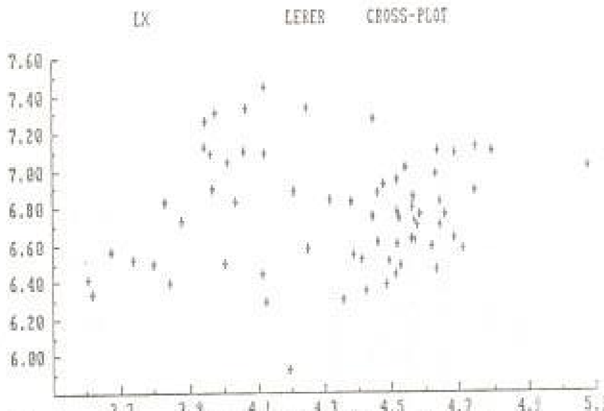

Fig 5

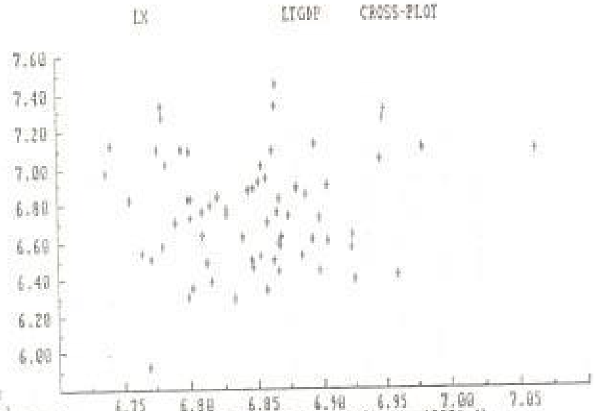

Fig 6

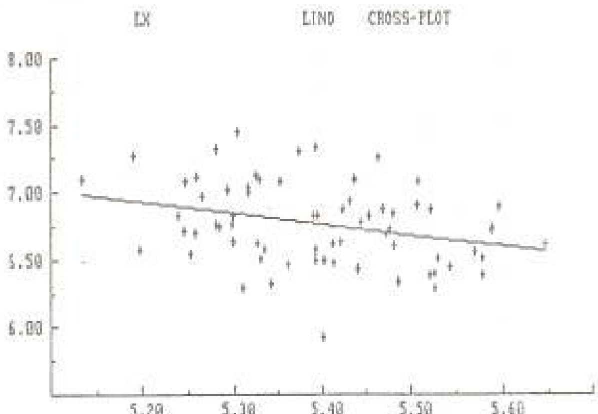

Fig 7 .

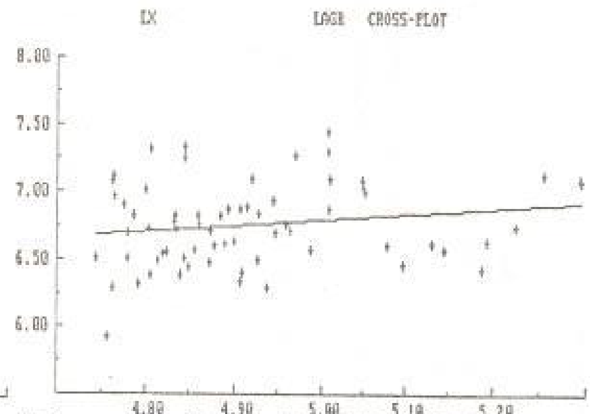

Fig 8

Annex 2 shows the unrestricted estimations[8] -after a first simplification was carried out- for the sample period 1976(1)-1992(4).[9]

From the inspection of the statistics presented (defined below equation (1)), the unrestricted form can be considered as a suitable -although overparameterized- description for exports. As far as the long run solution is concerned, however, only the relationship with agricultural output appears as significant according to the derived long run standard errors. From this behavior, an error correction term ECA (lagged 1 period) was included as regressor to explain the log differences of exports denoted by ΔLX. Other simplifications were suggested from the lag structure table reported in the annex. After they were carried out, asymmetrical effects for positive and negative ECA (deviations from the long run equilibria) and the changes in ERER were tried. Finally, a more parsimonious and orthogonal representation was obtained as follow,

$$\Delta LX_t = \underset{[0.753]}{-3.502} + \underset{[0.0556]}{0.2972}\, Q1 - \underset{[0.0301]}{0.3721}\, D81(4) + \underset{[0.0728]}{0.1893}\, \Delta LX_{t-4} - \underset{[0.0683]}{0.3149}\, \Delta_2 LX_{t-1}$$

$$-\underset{[0.124]}{0.703}\, \Delta_3 LIND + \underset{[0.0944]}{0.4636}\, {+\Delta LERER_{t-3}} + \underset{[0.145]}{0.3259}\, \Delta_3 LAGR_{t-2}$$

$$-\underset{[0.0693]}{0.2084}\, {+ECA_{t-1}} \quad -\underset{[0.0825]}{0.2997}\, {-ECA_{t-1}} \qquad (1)$$

$T=68$ $R^2=0.821$ $F(9,58)=29.569[.0000]$ $\sigma=0.103$ $DW=1.89$

AR1-5 $F(5,53)=0.3772[.8622]$ ARCH1-4 $F(4,50)=1.831[.1376]$

Normality $Chi^2(2)=1.8996$ X_i^2 $F(16,41)=0.4971[.9342]$

RESET $F(1,57)=1.2926[.2603]$

Forecast $Chi^2(8)/8=0.58909$ Chow $F(8,50)=0.5069[.8454]$

where $\Delta_i LW_{t-j} = \log W_{t-j} - \log W_{t-j-i}$. Heteroscedastic Consistent Standard Errors (HCSE) are reported in

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[8] PCGIVE (Hendry,1989 , Doornik and Hendry, 1992) was used in the estimations.

[9] At the beginning of the study the sample size was 1970-1992. The model for the larger sample does not significantly differ from the presented here except that it requires some dummy variables during 74-75. They appear to be due (i.e. exports responding with some lags) to large gaps between the commercial and "black market(financial)" quotation of the exchange rate. Such gap, however, does not resulted significant when included as regressor for the whole sample. The dummy for the 4th quarter of 1981,which remains in the equations,is due to the same type of effect, the largest fall in exports after the largest gap in the sample three periods ahead.

brackets[10]. σ is the estimated standard deviation of the residuals, AR and ARCH are the LM statistics for autocorrelation and autoregressive- heteroskedasticity; Normality Chi_2 is the Jarque-Bera statistic; X_i^2 is the statistics for heteroskedasticity quadratic in regressors; RESET is Ramsey's statistic for misspecification (see Hendry,1989, for definitions and references).

Accordingly to the statistics presented, this equation would be a satisfactory representation for quarterly data given the information set used. Figures 9 and 10 reinforce this view from the inspection of the residuals, all less than $\pm$ 2, since they have been normalized by σ. Also one-step-ahead forecasts during the last 8 quarters of the sample are all well inside the two times forecast standard error bars). Recursive estimation of the coefficients of the regression (Fig. 11 to 16) and Chow statistic -decreasing the period of forecast (Fig. 17) suggest that the stability of the parameters of the model cannot be rejected.

This model includes, apart from the error correction term, a positive effect from changes in agricultural output (on the supply side) and a negative effect from variations in industrial production (on the domestic demand side). As a whole, the net effect of rising activity depends on the output composition; the industrial sector has maintained in the sample the role of net consumer of exportable goods, probably as proxy for aggregate demand. This aspect is similar to that found by Navajas for annual data. Here, the large and different seasonal behavior of the series is captured by a seasonal dummy and seasonal differences, for X, a negative effect from the lagged two periods may be an indication of adjustments of exports to the one planned in horizons longer than a quarter for aggregate level.

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[10] HCSE do not significantly differ from the ordinary computed, and thus do not indicate misspecification associated with heteroscedasticity.

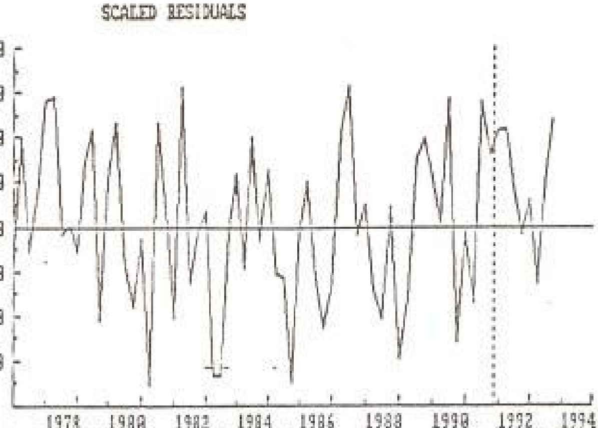

Fig 9. Scaled (by s) residuals (model without longrun effect of ERER)

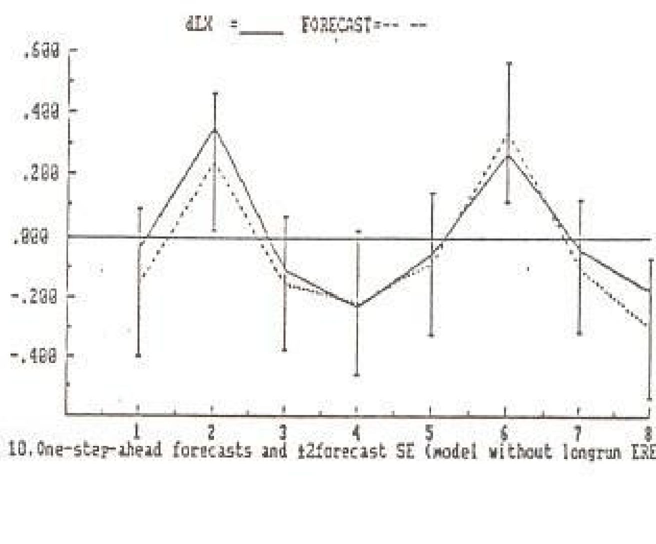

Fig 10.One-step-ahead forecasts and ±2forecast SE (model without longrun ERER)

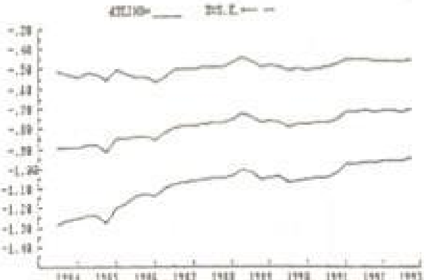

Fig 11. RLS estimates of the coefficient (model without longrun [illegible])

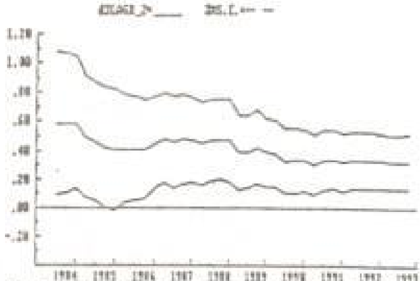

Fig 12. RLS estimates of the coefficient (model without longrun [illegible])

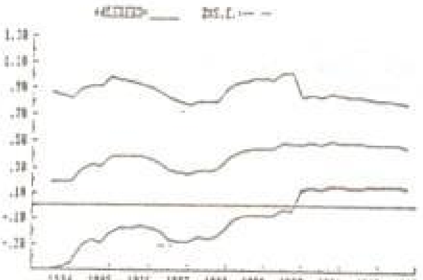

Fig 13. RLS estimates of the coefficient (model without longrun [illegible])

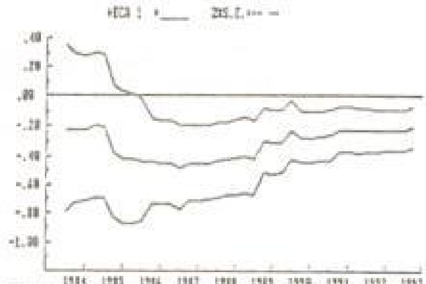

Fig 14. RLS estimates of the coefficient (model without longrun [illegible])

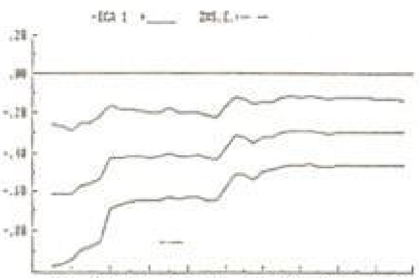

Fig 15. RLS estimates of the coefficient (model without longrun [illegible])

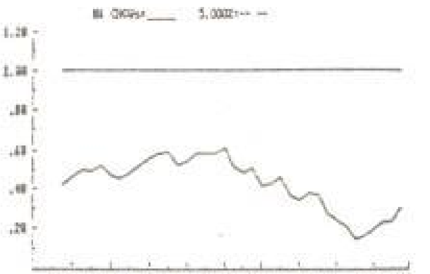

Fig 16. Sequence of break-point Chow statistics(model without longrun [illegible])

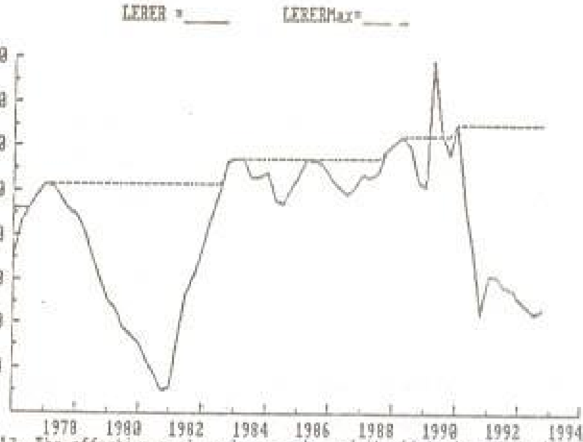

Fig 17. The effective real exchange rate and its highest peak in the past

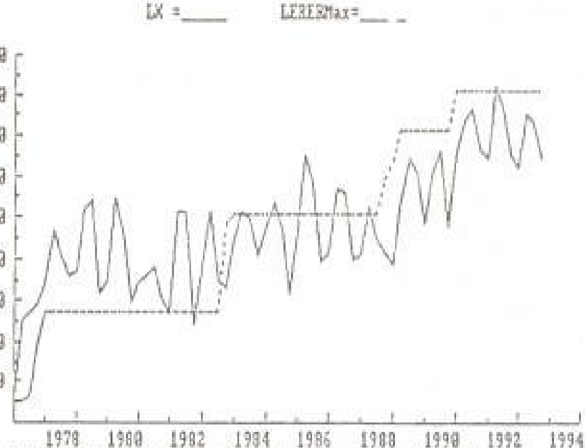

Fig 18. Total exports and the highest ERER peak in the past

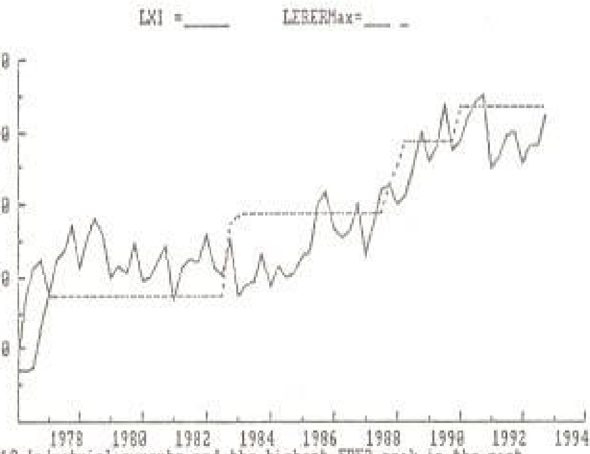

Fig19. Industrial exports and the highest ERER peak in the past

The effect of ERER merits additional comments. Firstly, the lagged difference goes to 4 quarters before but solving the dynamics (exports lags involve 5 quarters) the effect of ERER comes from 8-9 quarters ago.[11] Secondly, non significant effect of falling ERER could indicate some nonlinear relationship between this variable and exports. Figures 17 to 19 describe the behavior of exports and the last ERER peak observed in the past (MAXLERER). The following section discusses a model which adds this explanatory variable to the previous one.

5- A DYNAMIC MODEL FOR EXPORTS (with a long run effects of ERER).

When MAXLERER was included as regressor in the unrestricted model of Annex 2 the main statistics were not modify and further, σ slightly decreased. Notwithstanding, the solved long-run equation changed as follows,

$$\underset{[4.3]}{LX = -3.853}\ \underset{[0.4452]}{-0.0362\,LIND}\ \underset{[0.3758]}{+0.5011\,LAGR}\ \underset{[0.1044]}{-0.1183\,LERER}\ \underset{[0.6978]}{-\ 1.937MAXLERER}$$

where the derived long-run SE of coefficients are in brackets. The Wald ($chi^2(6)$) statistic, =85.88 indicates the joint significance of these variables (and two dummies Q1 and D81(4)).

Now, the long run relationship with agricultural output is lost and instead, the coefficient corresponding to MAXLERER becomes significant.[12] An alternative representation was then attempted for ΔLX in which the error correction term, denoted by ECERER, measures the (short-run) disequilibria between actual exports and the level of exports determined by the long run elasticity with respect to MAXERER (close to 2). Then, the following model resulted,

[11] A somewhat lagged effect was found on annual basis (Navajas, 1993). Three years was also the period estimated for the cycles in the exchange rate.

[12] Note that now the unrestricted model is nonlinear as a result of including this variable.

$$\Delta LX_t = -0.839 \;\; -0.2464\,Q1 \;\; -0.3131\,D81(4) \; + \; 0.2141\,\Delta LX_{t-4} \;\; -0.3095\,\Delta_2 LX_{t-1}$$
$$\qquad [0.252] \;\; [0.0479] \qquad [0.0276] \qquad\qquad [0.0606] \qquad\qquad [0.07281]$$

$$+\; 0.5106\,(\Delta LAGR_{t-1} + \Delta LAGR_{t-4}) \;+\; 0.7069\,\Delta_2 LAGR_{t-2}$$
$$[0.189] \qquad\qquad\qquad\qquad [0.1865]$$

$$-0.5856\,\Delta_2 LIND \;+\; 0.4107 + \Delta LERER_{t-3} \;\; -0.3577\,ECERER_{t-1} \qquad\qquad (2)$$
$$[0.1256] \qquad\qquad [0.1425] \qquad\qquad [0.0997]$$

$T=68$ $R^2=0.833$ $F(9,58)=32.172[.0000]$ $\sigma=0.0997$ $DW=1.93$

AR1-5 $F(5,53)=0.4725[.7951]$ ARCH1-4 $F(4,50)=0.5830[.6763]$

Normality $Chi^2(2)=2.088$ X_i^2 $F(16,41)=0.474[.9461]$

RESET $F(1,57)=0.6051[.4398]$

Forecast $Chi_2(8)/8=0.9167$ Chow $F(8,50)=0.6966[.6927]$

This model satisfies the data coherence criteria, as suggested from the statistics above reported.(See also Fig. 20 which analyzed the scaled residuals of the regression) [13] The stability of coefficients and forecasting confidence can be evaluated from observing Fig. 21 to 27. Consequently, this model also appears to be a close approximation -with a somewhat lower residual variance than the previous model- to the process which generates aggregate exports. Section 6 evaluate these results comparing both models.

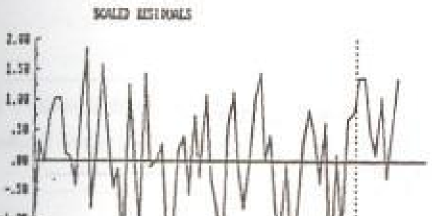

Fig 20. Scaled (by s) residuals (of the model with longrun ERER)

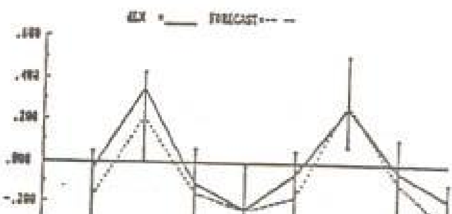

Fig 21. One-step-ahead forecasts and 2 forecast SE (model with longrun ERER)

[13] In addition, valid conditioning on the new variable was tested by instrumental variables estimations (not reported here), by which similar estimates to OLS ones were obtained. The same instruments as those in section 2 were used. Indeed, the exogeneity of MAXLERER seems not to be critical since ERER enters contemporaneously only when ERER is growing from the highest past levels (reaching a new peak).

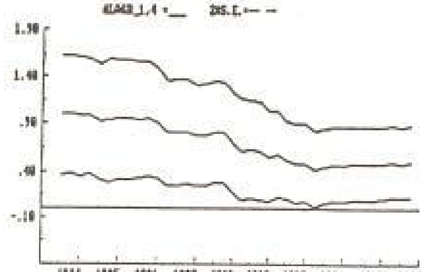

Fig 22. RLS estimates of the coefficient (model with longrun [illegible])

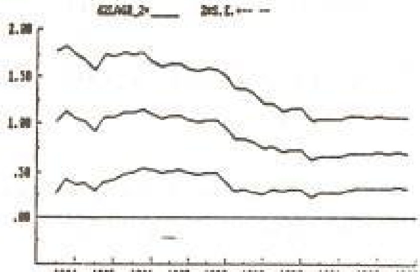

Fig 23. RLS estimates of the coefficient (model with longrun [illegible])

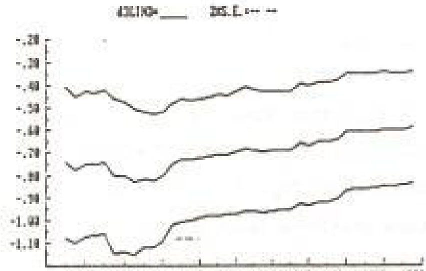

Fig 24. RLS estimates of the coefficient (model with longrun [illegible])

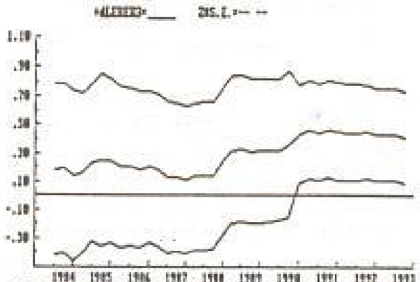

Fig 25. RLS estimates of the coefficient (model with longrun [illegible])

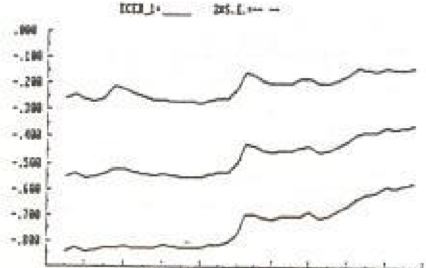

Fig 26. RLS estimates of the coefficient (model with longrun [illegible])

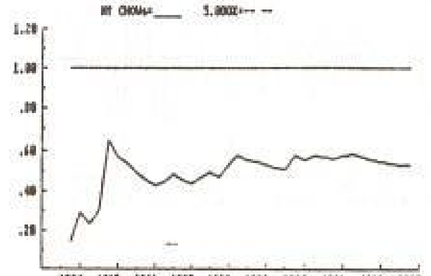

Fig 27. Sequence of break-point Chow statistics(model with longrun [illegible])

6- ENCOMPASSING TESTS.

A first and critical question is whether or not this step function is only reflecting the trend in agricultural output. To evaluate this possibility encompassing tests were performed in both directions: assuming that the model with ECER is "the" model, verify if it can account the results of "the other" model without it (with ECA), and then reversing the order of the models for the proposed and the alternative.

To this purpose both, the so-called "nonnested" tests (which only test for "variance encompassing" as well as (more proper) "encompassing tests" (for both "variance and parameter encompassing") are applied (Pesaran 1974, Ericsson 1983, Hendry, 1983, Hendry and Richard,1983 and Mizon, 1984 and for an application Ahumada, 1985). It should be noticed that the second direction of testing would not be useful if the difference in residual variances were not only significant but also maintained as a large sample result; variance dominance is necessary -but not sufficient- for encompassing. The following table reports the statistics.

TABLE 2

ENCOMPASSING STATISTICS(*)

$\sigma_E = 0.0997$ $\sigma(\text{Joint}) = 0.1004$ $\sigma_A = 0.1033$

H_0: Model E ε Model A		TEST	H_0: Model A ε Model E	
-0.5485	N(0,1)	Cox	N(0,1)	-3.1795
0.4984	N(0,1)	Ericsson IV	N(0,1)	2.7005
2.2279	$Chi^2(3)$	Sargan	$Chi^2(3)$	5.9868
0.7324	F(3,55)	Joint Model	F(3,55)	2.1102

(*) Model E denotes the model with ECERER, Model A the one with ECA, and the Joint indicates the model which embeds the two. (ε denotes "encompass").

This table reports the Cox-like statistic (Pesaran 1974), the IV statistic and Sargan's for over-identifying restrictions in the maintained relative to the embedding hypothesis (Ericsson,1983) and Wald (F) statistic for the validity of restrictions implied by Ho(Hendry and Richard,1983). Ho is in the first (second) column that Model E (A) encompasses Model A (E).

From the evaluation of these statistics, the hypothesis that the model with ECERER encompasses that with ECA cannot be rejected. Conversely, the model without the long run effect from MAXERER cannot encompass the model which includes it (for the case of the first two statistics at 5%

and for the rest at about 10%). Therefore, the step variable (MAXERER) appears to be not only a proxy for the long run behavior of agricultural output but the model with the ECERER can account for the results of the model with ECA as error correction term. Peaks which increases over previous ones appear to have additional effects on the aggregate capacity to exports; although expansions in agricultural output had responded to it.

7- INTERPRETING RESULTS : HYSTERESIS IN EXPORTS.

The equations analyzed in the last two sections represent the export behavior during 1976-1992. The model including ECERER as regressor means that the highest value of ERER has determined the level to which, in a static steady state, export will go,i.e without changes in output. That is this empirical model includes a "ratchet effect" as part of the long run behavior of exports. In this section an economic interpretation of this effect is provided following the literature on "hysteresis". Furthermore, a discussion about using "ratchet effects" as empirical measures of hysteresis is presented.

"Hysteresis" occurs when an effect persists after the cause which brought it about has been removed (Dixit, 1989a). For a firm "sunk costs" , denoted by k, can explain hysteresis. The decision to enter on production will not depend only on operating costs, w, but it will require (in a competitive market), $p > w + rk$, where r is the interest rate. If p was initially between w and $w + rk$ and then the price rise above $w + rk$, the project will be undertaken and not abandoned unless $p < w$. This explains hysteresis in production (if $w < p < w + rk$). However, as Dixit pointed out, the more interesting cases of hysteresis are derived from assuming uncertainty (in this example about p): in this case even small (but not null) sunk costs can induce wide ranges of inaction.

Applications to international trade are found in Baldwin and Krugman (1989) and Dixit (1989). Both studies analyze the case of persistent effects of the real exchange rate on imports : once a foreign firm invests in marketing, R and D., reputation, distributional networks, etc. it is profitable to remain selling in the domestic markets even at lower exchange rates. This analysis is symmetrical for exports. Main features of both models are combined in the next one to explain hysteresis in aggregate exports.

These works, however, differ on the assumptions about the temporal behavior of the real exchange rate: independent and identically distributed (iid), the former and following a Brownian motion (the continuous time representation of a random walk), the latter. The iid assumption is here preferred since simplifies the model without being too unrealistic.[14]

[14] Dixit (1989b, p.206) explains that the real exchange rate as random walk have considerable empirical support. However, when feedbacks from trade flows to the exchange rate are taken into account, different conclusions can be obtained. Baldwin and Krugman found, in a simplified model with feedbacks, that this variable can have temporary shifts in means. This is the case in which usual tests of unit roots have low power (Hendry and Neal, 1991) and thus the real exchange rate is often detected as a random walk when it could be stationary (but about different means).

Let suppose that aggregate export sector is composed by identical firms each having operating profits (in pesos),

$$Y_t = E_t \cdot P_t \cdot X_t - c\, X_t$$

$$Y_t = Y(E_t)$$

where Y is an increasing function of E, the real exchange rate. P is the foreign price of exports, X, and c are variable unit costs.[15] Also let be,

K : entry costs to new markets in pesos, k in dollars.

L : exit costs in pesos, l in dollars.

M : fixed maintenance costs in pesos, not related to the export volume, which are already included in Y.

R : total revenue in pesos.

Then,

$R_t = 0$, when the firm is not selling abroad.

$R_t = Y_t - K$, when the firm was out and gets in.

$R_t = Y_t - M$, when the firm is selling abroad.

$R_t = Y_t - L$, when the firm was in and gets out.

Each firm is assumed to maximize the expected present future value of revenues R_t discounted at the rate δ and,

δV_1 is the present future value of revenues when the firm was in the world market last period.

δV_0 is the present future value of revenues when the firm was out the world market last period.

E_1 is the value of the exchange rate so that if $E_t > E_1$, a firm will enter

E_0 is the value of the exchange rate so that if $E_t < E_0$, a firm will exit.

The solution of this problem can be obtained by dynamic programming, which simultaneously determines E_0, E_1, V_0, V_1. Notwithstanding, as Baldwin y Krugman show, it is useful to note that E_0 and E_1, can be defined by the following conditions of indifference (to enter and to exit, respectively),

$$Y(E_1) - K + \delta V_1 = \delta V_0$$

$$Y(E_0) - M + \delta V_1 = \delta V_0 - L$$

The assumption of E as iid makes V a fixed number[16], and then

$$Y(E_1) - Y(E_0) = K + L - M = k \cdot E_1 + L \cdot E_0 - M$$

[15] P can be assumed fixed or a function of exports. Competitive behavior is supposed in Dixit. Y_t can be alternatively measured in foreign currency while net operating revenue continues positively related to E, e.g. via exports.

[16] In Dixit V is a function of E which is a Brownian Motion, V(E) can be obtained from Ito's Lema, a "smooth pasting condition" should be added to the "value matching Condition".

For some value of E_1, $Y(E_1)$ is given and $Y(E_1) > Y(E_0)$, similarly given E_0. Since Y is an increasing function, then $E_1 > E_0$. Only when $E_t > E_1$ a firm will decide to export, and this decision will not be reversed unless $E_t < E_0$. If $E_0 < E_t < E_1$, exports will not be adjusted.

Note that here the "sunk cost" is given by K-M; If M > K, the firm decision is whether or not participate each period ($Y(E_t) >$ or $< K$). However, because of positive sunk costs, entry puts a firm in a favorable position later. K>0 is a necessary condition for hysteresis; L reinforces this effect being costly to exit; M-L >0 makes possible that some time it will be convenient to exit; i.e. that selling abroad is not an irreversible decision.

Baldwin and Krugman show that aggregation does not modify the main results of this analysis, in particular, if differences among industries are mainly due to "comparative advantages" rather than distinct "sunk costs". In this case, a industry which have higher E_1 will also have higher E_0.Then, industries can be ordered and a E_1* can be determined: the E_1 of the firm which has the highest one; similarly for E_0*. Between E_1* and E_0*, there will be a range of inaction, no firm will either enter or exit. Differences in sunk costs can reduce those due to comparative advantages and somewhat softened results.

Regarding now the empirical evaluation of hysteresis, some studies have used dummies to capture this kind of effects (for example, Baldwin and Krugman,1987). Others, mainly studies on the demand for money, have used a ratchet effect from including the highest value of an explanatory variable as regressor,e.g. the rate of inflation (see among others, Ahumada, 1988, Melnick, 1990 and Kamin and Ericsson, 1993). In the present case, similarly to the latter approach, the highest level of the real exchange rate appears as a long run determinant of export behavior. Two issues should be discusses in order to approximate this empirical model to the theoretical one, above described. Firstly, the maximum level of the real exchange rate in the past is a proxy for E_1*. This would be appropriate if some feedbacks of exports onto E are assumed: after reaching that level of the exchange rate, the exports expansion would make E_t decrease somewhat below E_1*, being a local maximum.

Secondly, such a ratchet effect implies that the long run expansion of exports as a consequence of increasing E_t over E_1* are irreversible. In terms of the model presented in this section they may be due to negligible M-L costs. An alternative explanation is that E_0* have been not observed within the sample considered.[17] A critical question is, therefore, left opened.

8- CONCLUSIONS.

The behavior of aggregate exports for Argentina in the last two decades has been analyzed following a "general-to particular" approach by which both the long-run relationships and the dynamics are studied. Special emphasis was put to understand the long run response of export to the exchange

[17] A symmetrical view could suggest that a downwards jump in the long run behavior of exports would occurs when E_t falls below it previous trough.

rate (here measured as the effective real exchange rate for total exports).

Since contemporaneous effects were absent the possibility of simultaneous bias was considered but rejected for quarterly data. Dynamic modelling of exports obtained two different models. One of them, similarly to previous studies: without long run effect from the ERER, but from the agricultural output. The dynamics were modelled as depending - apart from seasonal movements - on the variation of this rate and the changes in industrial output at different lags; lagged increases of ERER would also an explanatory variable for the changes in exports.

The other model found to be a satisfactory approximation, incorporated a long run effect from ERER through its highest level reached in the past. This representation has been proved to encompass the alternative model in which a long run effect is derived from the agricultural output. It was interpreted as reflecting hysteresis effects in exports. Since it is costly to enter into the world market, such decisions will be difficult to reverse.

Accordingly, growing exports in the long run would depend on reaching new peaks in the effective rate of exchange rate. Given this definition, the relative contribution of the real exchange rate vis.a.vis other incentives to exports is a possible extension of this research.

ANNEX 1

BIAS IN THE EXCHANGE RATE COEFFICIENT WHEN ESTIMATED FROM APPLYING OLS TO AN UNIEQUATION MODEL FOR EXPORTS: AN EXAMPLE

Let suppose that the joint data generating process of export (X) and effective real exchange rate (R), is as follows,

(1) $X = \sigma + \text{B} R + u \qquad \text{B} > 0 \quad |u|_N |0| \, |\sigma_{uu} \;\; \sigma_{uv}||$

(2) $R = \delta + \Phi X + \Theta W + v \qquad \Phi < 0 \quad |v| \quad |0| \, |\sigma_{uv} \;\; \sigma_{vv}||$

where W is an "exogenous" variable (for simplicity but without losing generality no lags are supposed). From (1) and (2) the reduced form for R is,

(3) $R = \{(\delta + \Phi \sigma) + \Theta W + (v + \Phi u)\} / (1 - \Phi \text{B})$

then the expected value,E[.], of R results as,

(4) $E[R] = \{(\delta + \Phi \sigma) / (1 - \Phi \text{B})\} + \{\Theta / (1 - \Phi \text{B})\} W$

and

(5) $\sigma_{Ru} = E[\{R - E[R]\}.u] = E[\{(v + \Phi u) / (1 - \Phi \text{B})\}.\, u]$

$= \{\Phi/(1 - \Phi \text{B})\} \sigma_{uu} + \{1/(1 - \Phi \text{B})\} \sigma_{uv}$

where σ_{ij} denotes covariance for i=j and variance for i=j.

The OLS estimates of B, b would result as,

(6) $b = \sigma_{XR} / \sigma_{RR}$

and

(7) $\text{plim } b = \text{B} + (\sigma_{Ru} / \sigma_{RR})$

(8) $$\text{plim } b - \text{B} = \frac{\{\Phi/(1 - \Phi \text{B})\} \sigma_{uu} + \{1/(1 - \Phi \text{B})\} \sigma_{uv}}{\{\Phi^2 \sigma_{uu} + \sigma_{vv} + 2 \Phi \sigma_{uv}\} / (1 - \Phi \text{B})_2}$$

which becomes for the case $\sigma_{uv} = 0$, a necessary condition for identification (see, for example, Harvey 1981, pp.325-331),

(9) $$\text{plim } b - \text{B} = \frac{(1 - \Phi \text{B}).\, \{\Phi/(1 - \Phi \text{B})\} \sigma_{uu}}{\{\Phi^2 \sigma_{uu} + \sigma_{vv}\}} = \frac{(-)}{(+)} < 0$$

that is, b underestimates B. If this effect is large enough, b can be estimated as close to zero.

ANNEX 2

Unrestricted Model for Exports (x) by OLS
Sample: 1976 (1) to 1992 (4)

Analysis of lag structure

Lag	0	1	2	3	4	5	Σ
LX	-1	0.392	0.0752	0.312	0.183	-0.296	-0.333
Std.Err	0	0.128	0.135	0.135	0.127	0.117	0.143
Constant	-1.62	0	0	0	0	0	-1.62
Std.Err	2.34	0	0	0	0	0	2.34
LERER	-0.0142	0.0401	-0.336	0.504	-0.194	0	0.0002
Std.Err	0.137	0.187	0.186	0.184	0.136	0	0.0562
LIND	-0.53	-0.202	-0.276	0.878	0	0	-0.13
Std.Err	0.263	0.249	0.223	0.215	0	0	0.24
LAGR	0.375	0.623	0.353	0.26	-0.365	-0.3	0.94
Std.Err	0.311	0.273	0.163	0.167	0.281	0.29	0.48
Q_1	-0.265	0	0	0	0	0	-0.26
Std.Err	0.0822	0	0	0	0	0	0.08
d81-4	-0.311	0	0	0	0	0	-0.311
Std.Err	0.132	0	0	0	0	0	0.132

T= 68 R2 = 0.914 F(22, 45) = 21.701 [0.0000] s = 0.108 DW = 1.76

AR-LM,F(5, 40) = 0.464 [0.802] ARCH-LM,F(4, 37) = 0.063 [0.992]
Normality Chi2(2)= 2.292 RESET F(1, 44) = 0.422 [0.519]

Solved Static Long Run equation

	LX = -4.847	+0.0004689 LERER	-0.3905 LIND
(SE)	(7.139)	(0.1688)	(0.6581)
	+2.834 LAGR	-0.7968 Q_1	-0.9342 d81-4
	(0.8952)	(0.3837)	(0.5915)

WALD test Chi2(5) = 30.947

Tests on the significance of each variable

variable	F(num,denom)	Value	Probability	
LX	F(5, 45) =	7.548	[0.0000]	**
Constant	F(1, 45) =	0.477	[0.4931]	
LERER	F(5, 45) =	1.6181	[0.1747]	
LIND	F(4, 45) =	6.5297	[0.0003]	**
LAGR	F(6, 45) =	3.9067	[0.0032]	**
Q_1	F(1, 45) =	10.438	[0.0023]	**
d81-4	F(1, 45) =	5.5462	[0.0229]	*

Tests on the significance of each lag

Lag	F(num,denom)	Value	Probability	
1	F(4, 45) =	4.3903	[0.0044]	**
2	F(4, 45) =	2.2678	[0.0766]	
3	F(4, 45) =	7.6182	[0.0001]	**
4	F(3, 45) =	1.4511	[0.2406]	
5	F(2, 45) =	5.6344	[0.0066]	**

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