

**An Alternative Model for the Trade
Balance of Countries with Open Economies:
The Spanish Case**

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Abstract

The aim of this work is to presents an alternative to the traditional models used to explain the behaviour of the trade balance in Spain. This model could be useful for others medium sized and fairly open countries. The specification highlights both, first the simultaneous and direct interdependence of exports and imports flows, and second the countercyclical impact of the domestic demand on exports and the impact of investment on imports and some of its theoretical implications. Non linear simultaneous estimation, cointegration techniques, and a battery of specification tests are the econometric tools applied in the paper.

Key words

Balance of trade, simultaneous equations, export and import equations, cointegration.

Resumen

El principal objetivo de este trabajo es ofrecer una alternativa a los modelos tradicionales utilizados para explicar el comportamiento de la balanza comercial en España, aunque el modelo presentado puede ser también útil para otras economías de tamaño medio y abiertas al exterior. La especificación utilizada destaca, en primer lugar, la interdependencia simultánea y directa de los flujos de exportación e importación, y en segundo lugar, el impacto contracíclico de la demanda interna sobre las exportaciones, y el impacto de la inversión sobre las importaciones, así como algunas de sus implicaciones teóricas. Las técnicas econométricas empleadas son ecuaciones simultáneas no lineales, cointegración y un conjunto de test de especificación.

Palabras clave

Balanza comercial, ecuaciones de exportación e importación, ecuaciones simultáneas, cointegración.

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1. Introduction

The primary purpose of this paper is to present and discuss econometric estimates of a two equation model, intend to explain Spanish imports and exports of goods and services (excluding tourism). This problem has been studied previously (e.g. Mauleón I. and Sastre L. 1994 and 1996). This model should be able to explain in a satisfactory way, not only the traditional determinants of this flows but also the main factors acting to explain the evolution of the trade balance evolution as a result of the transformation of the Spain in an highly open economy in the studied period.

A second purpose of the paper is to discuss specific features of the model, not found in other standard specifications of foreign trade equations that might be applicable in other cases. The discussion of some econometric and economic questions related or derived, from this model, is a third aspect of the paper.

The rest of this paper is organized as follows. In Section 2 are presented some of the main features of the evolution of the Spanish trade balance in the period 1965-2002. Section 3 presents a theoretical approach and Section 4 defines the econometric model. Section 5 presents a post-sample period forecast test and contribution of each explanatory variable

to the endogenous variable evolution. Section 6 presents a brief summary and the conclusions. Finally, in the appendix the data which has been used are presented.

2. Some of the main features of the Spanish trade balance

The main characteristics of the trade balance evolution, during the period 1968-2002, as a result of the transformation of the Spain in an highly open economy, have been: first, the strong correlation between exports and imports flows, and second the countercyclical behaviour of the trade balance that has restrained the growing cycle of the Spanish economy.

Spain is a medium sized country in the European economy and is becoming increasingly open, according to a conventional measure of the degree of openness (exports plus imports over GDP). In the Fig. 1, we can compute a growing trend in the period 1965-2002, from about ten per cent in 1965 to about sixty four per cent in 2000.

In the Fig. 2, is shown the evolution of the import and export series expressed in logarithms and is possible to observe the clear correlation between the two series.

Fig. 1
Degree of openness

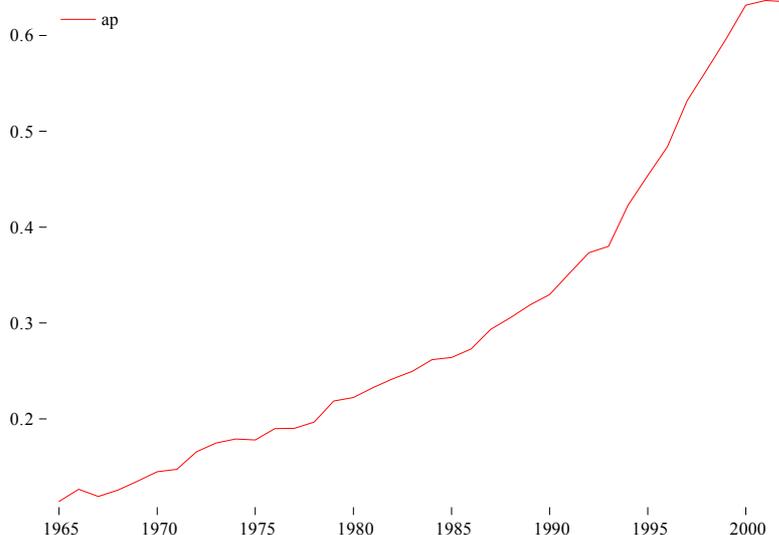
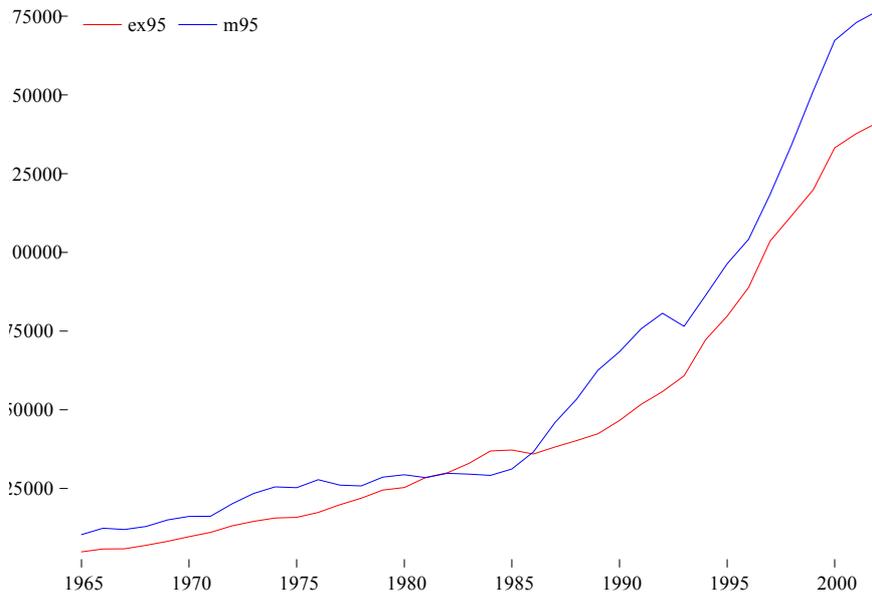


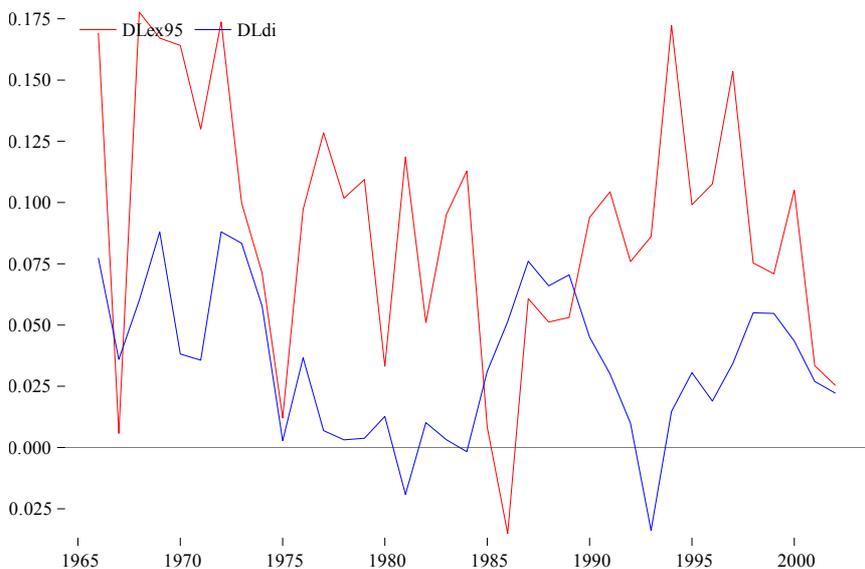
Fig. 2
Exports versus imports 1



As is well known by the experts of the Spanish foreign sector, the trade balance has a negative effect on the growing cycle of the Spanish economy. This impact is produced, and proved in the econometric analysis, not

only by the positive impact of the GDP growth on the imports but also through the negative effect of the domestic demand on exports.

Fig. 3
Domestic demand and exports
(Logarithms growth rates)



In the Fig. 3 it is shown the evolution of the exports and the domestic demand expressed in logarithm variation rate. In this period, we can observe that from 1976, year of the change in the former political and economic system and the beginning of an important opening of the economic system, the evolution of the variation rate of exports shows an opposite behaviour to that of the domestic demand. This means that export firms are more active when the domestic market is weaker.

3. A theoretical approach to the function of exports and imports

Most of the empirical studies of the trade balance in Spain are based on single equation model for exports and imports that not include the simultaneous and direct interdependence between its, as report Escribano (1996). There exist a large set of studies of this type, among this can be emphasized Fernandez y Sebastian (1991) and Buisan y Gordo (1994), this works following cointegration techniques and estimates traditional equations to the no-energetic exports and imports. Mauleón and Sastre (1994) applied cointegration analysis and outline a model as a simultaneous problem using the imports as determinant of the exports and vice versa. Alonso (1999) try to set the roll played by the trade balance as a restriction to the economic growth in Spain, the import and export equations using, in the short run, exports and imports respectively as determinants what, in part, would confirm the viewpoint of Mauleón and Sastre.

The traditional theoretical approach to obtain the demand for imports and exports is based on the assumption of small country, the national and rest of the world economies are price taker, which means that the elasticity of export supply by the national economy and the elasticity of import supply by the rest of the world are infinite. This assumption can be accepted to the imports but it is not reasonable to the exports to suppose that changes in the demand do not affect the price level. If the demand equation is estimated not taking into account the supply equation, the estimators obtained would be biased. To avoid this

possibility would be necessary add in the specification of the equation some variable of supply (see Portugal 1993).

The basic features of the theoretical model are:

- The introduction of the domestic demand in the specification of the demand for exports, what allow to consider the negative impact of the internal production, approached by the demand side, on the exports flows.
- The introduction of the national investment as an explicative variable of the import flows¹, meaning the existence of a capital import good mechanism in an environment of exchange between open economies with the subsequent shock of productivity².
- The introduction of the exports as an explicative variable of the imports flows and the short and long run. The direct impact of exports on imports results from the fact that many industries import raw or intermediate products, and then export their final output (a typical example is the import of car parts, to build and export cars). This is what Krugman (1995) calls the “slicing up of the production process” and characterizes it as one of the main causes of the growing world trade, proposing for some countries with a high degree of openness, import equations such as,

$$M = \phi(X, Z)$$

Where M is the imports, X is the exports and Z the rest of the determinants. Also others works, points out the necessity of considering the composition of the domestic demand to explain the growth of imports, knowing that each of the domestic demand components have a different composition of imports (see Giovanetti (1989) or Thirwall and Gibson (1991)).

¹ To an theoretical justification see Obstfield and Rogoff (1995) and Mauleón and Sastre (1996).

² See Pack et al (1997).

- The introduction of the imports as explicative variables of the exports and the short and long run. Mauleón and Sastre (1996), reported that the argument to this decision, confirmed by the econometric estimates, rest also in the “slicing up of the production process”. The multinational firms would react to unexpected changes of abroad demand for their products not increasing its output, what would increase its costs of production, but reallocating stocks, what would be reflected in the national account as export and import in the same period. Castillo and Picazo (1995) propose an indicator to measure the “coincided trade” defined as the situation in which a firm export and import simultaneously the same kind of good product and conclude that this kind of trade supposed in Spain, in 1988, the twelve per cent of the total foreign trade. Another aspect of the problem is the direction of casualty between exports and imports because theirs are in the equations as endogenous and exogenous variables in the short and long run. This problem only can be treated with the simultaneous estimation of the model.

The theoretical model proposed to be estimated simultaneously for the import and export flows of goods and services (excluding tourism), in Spain, would be:

$$X = \phi(R, IT, M) \quad (1)$$

$$M = \phi(I, X, PR) \quad (2)$$

The expected signs are

$$(\partial X / \partial R) > 0 \quad (\partial X / \partial IT) < 0 \quad (\partial X / \partial M) > 0$$

$$(\partial M / \partial I) > 0 \quad (\partial M / \partial X) > 0 \quad (\partial M / \partial PR) < 0$$

Being: X exports of goods and services; M imports of goods and services; R the GDP of the OECD countries; IT and PR, export and import competitiveness indicator.

3.1. OPEN ECONOMIES, HIGH CORRELATION BETWEEN EXPORTS AND IMPORTS AND MARSHALL-LERNER CONDITION

The theoretical model proposed in this work would have implications on the Marshall-Lerner condition, since:

$$X = \phi(R, tcr, M)$$

The imports function expressed in national production units, would be:

$$M = tcr * \phi(I, tcr, X)$$

Trade balance = X-M =

$$\phi(R, tcr, M) - tcr * \phi(I, tcr, X)$$

Calculating the total impact of the exchange rate on trade balance, would have:

$$dBC / dtcr = dx / dtcr - dm / dtcr$$

$$dx / dtcr - dm / dtcr = (\partial x / \partial m) * (\partial m / \partial tcr) + \partial x / \partial tcr - (m + tcr * ((\partial m / \partial x) * (\partial x / \partial tcr) + \partial m / \partial tcr))$$

Taking into account that price-elasticity of exports and imports and elasticity imports-exports and exports-imports, would be:

$$\varepsilon_{x,tcr} = (\partial x / \partial tcr) * (tcr / x)$$

$$\varepsilon_{m,tcr} = (\partial m / \partial tcr) * (tcr / m)$$

$$\varepsilon_{m,x} = (\partial m / \partial x) * (x / m)$$

$$\varepsilon_{x,m} = (\partial x / \partial m) * (m / x)$$

and in the equilibrium BC=0, therefore X= tcr*M

$$dBC / dtcr = M * (\varepsilon_{x,tcr} (1 + \varepsilon_{x,m}) + \varepsilon_{m,tcr} (1 + \varepsilon_{m,x}) - 1) = 0$$

the trade balance would improve by an exchange rate devaluation, when

$$dBC / dtcr > 0; \quad (\varepsilon_{x,tcr} (1 + \varepsilon_{x,m}) + \varepsilon_{m,tcr} (1 + \varepsilon_{m,x}) > 1) \quad (3)$$

If $\varepsilon_{m,x} = 0$ and $\varepsilon_{x,m} = 0$

$dBC / dtcr > 0$; when $(\varepsilon_{x,tcr} + \varepsilon_{m,tcr} > 1)$ will have the Marshall- Lerner Condition.

In economies with a high degree of openness $\varepsilon_{m,x} \neq 0$ and $\varepsilon_{x,m} \neq 0$.

In the long run, the impact of the exchange rate on trade balance, would depend not only of the elasticity's-prices of exports and imports but also of the cross elasticity's between imports and exports.

4. The econometric model

The LSE methodology was used with the issues of model specification and validation in

a time series context (Hendry 1994). The description of the variables used in this section is presented in the Appendix.

The two equation model is estimated, according to the theoretical approach, simultaneously by Three Stage Least Squares in the context of multiple nonlinear equations to the functions of imports and exports of goods and services (excluding tourism). The results as follows:

EQ 1

Equation for exports of goods and services (excluding tourism)

$$(1-L)x = 0.5975(1-L)m + 0.8938(1-L)r - 0.348(1-L)It - 1.849(1-L)Di - 0.0952d86 - 0.09d75 - 0.1997[x(-1)] - 1.272r(-1) + 1.7994It(-1) - 0.6397m(-1)$$

(4.75) (2.45) (-3.75) (-5.29) (3.63) (3.58)

(-7.07) (5.34) (5.06) (-8.43)

$$R^2 = 0.80; D-W = 2.04$$

$$\sigma = 0.023$$

EQ 2

Equation for imports of goods and services (excluding tourism)

$$(1-L)m = 0.8205(1-L)r + 0.5088(1-L)Cp + 0.3029(1-L)x - 0.667d76 - 78 - 0.509[m(-1)] - 0.5141x(-1) - 0.8465r(-1) + 0.3503pr(-1)$$

(6.98) (1.76) (3.61) (-3.10)

(-6.67) (-19.52) (-19.54) (18.52)

$$R^2 = 0.92; D-W = 1.89$$

$$\sigma = 0.020$$

Where the estimated t-ratio is given in parentheses, σ is the residual standard error and D-W is the Durbin-Watson statistic. All variable are measured in logarithms and expressed in real terms, with the following meanings:

L = First order difference operator

x = exports of goods and services (excluding tourism)

m = imports of goods and services (excluding tourism)

r = GDP of the OCDE countries.

It = Indicator of competitiveness of exports. (Increasing mean a loss of competitiveness)

Di = Domestic demand.

d75 = Dummy with value 1 in 1975 and 0 in the rest of the period.

d86 = Dummy with value 1 in 1986 and 0 in the rest of the period.

Ir = National Investment.

Cp = National Consumption.

Pr = Indicator of competitiveness of imports. (Increasing mean a loss of competitiveness)

The model estimated has the following features:

- The parameters have the expected sign, as discussed previously in the theoretical approach.
- This is a simultaneous model since the exports and imports are, respectively, endogenous and explicative variables in the two equations.
- The exports show a high elasticity to the competitiveness indicator in the long run (-1.79), that is considerably reduced in the short run (-0.35).
- The domestic demand has a significant negative impact on the exports, in the short run, (-1.85).
- The imports show a high positive elasticity to the investment in the long and in the short run (0.85 and 0.82).
- The imports are not sensitive to the competitiveness indicator, in the short run, but are significant sensitive in the long run (0.35).

The dummies variables introduced in the model correspond, basically, with the change of the political system in Spain, (1975-1977), and the incorporation of the Spain to the ECC in 1986. The elimination of the dummies variables would not affect to the estimators or the strength of the model.

The check of the model (Table 1) shows the absence of autocorrelation (Lagrange test) in the residuals of the equations of exports and imports. There is no evidence of autocorrelation in the square residual (Engle test). The autocorrelation function of the residuals showed stationary process and the Box-Pierce test does not detect evidence of autocorrelation in the first eight lags. The cross residual autocorrelation function of the two equations also shows absence of autocorrelations. Therefore it is possible to conclude that there is no evidence against the validity of the estimations and this can be interpreted economically.

The first step in the implementation of the cointegration approach to modelling requires testing the existence of trends in variance in all variables considered. Standard ADF tests

accept the existence of a unit root in all variables under study. The second step would be to test for cointegration of the relevant variables in both exports and imports equations. The ADF test applied to the residuals of the cointegrating vector accepted the null of no cointegration for imports and rejected it for exports. The power of all this tests is somewhat disputed (see for example Crochane, 1991). This is why, finally, the long run estimates of both equations and the cointegrations tests have been derived from the standard Three Stage Least Squares estimates of the error correction mechanism specification. This is an advisable procedure according, for example, to the simulations reported in Brett (1993) or Benarjee et al. (1993). Therefore it is possible to maintain the existence of a long run relationship between the variables considered.

The simultaneity of the model is strong since the endogenous variables appear as explicative variables in the short and in the long run (not recursive model).

In Fig. 4, 5 and 6 are shown the original (DLX1, DLM1, BC) and simulated (DLX1S, DLM1S, BCS) series of the two equations and the trade balance as final result of the estimated model. The fit is clearly good and provides a further check on the model specification to the period 1968-2002.

Applying Johanssen methodology to the relationship $f(lm, lr, lx, lpr)$ and supposing that the vector has a VAR(2) structure, the cointegration vector obtained was:

$$Lm1 = 0.96 Lir - 0.1525 Lpr + 0.5429 Lx1$$

Osterwald-Lenum 95 %

Test λ -max	22.8	20.9
Test trace	30.5	29.7

The CUSUM and CUSUM of squares tests have been obtained for testing the stability of the model over time. The series of values are plotted against time (see Fig. 7 and 8). Upper and lower confidence bounds are the lines connecting the points.

Table 1
Validation contrasts

Test	Equation 1	Equation 2	Critic Value 5%
Box-Pierce			
Q(4)	0.53	0.73	7.81
Q(8)	1.02	1.67	14.07
Autocorrelation (Lagrange test)			
LM(1)	0.452	0.779	3.84
Heterocedasticity (Engle test)			
	0.4	2.5	3.84
Residual normality			
Bera - Jarque Test	1.6	4.3	5.99
T-Ratio			
error correction coefficient			
Benarje et al. (1993)	-7.07	-6.67	-3.91 and -3.03

Fig. 4
Export equation. Original and simulated series (Logarithms variation rates) 1

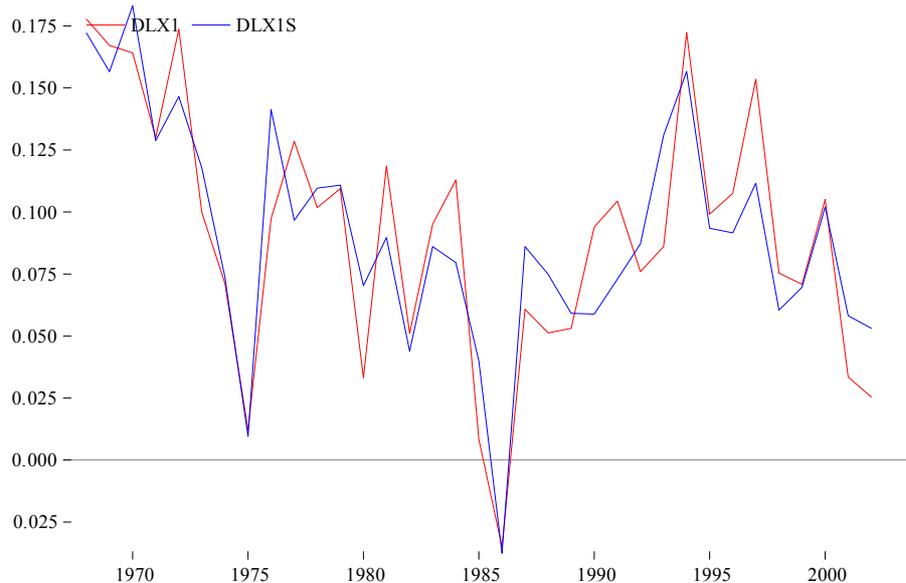


Fig. 5
Import equation. Original and simulated series
(Logarithms variation rates) 2

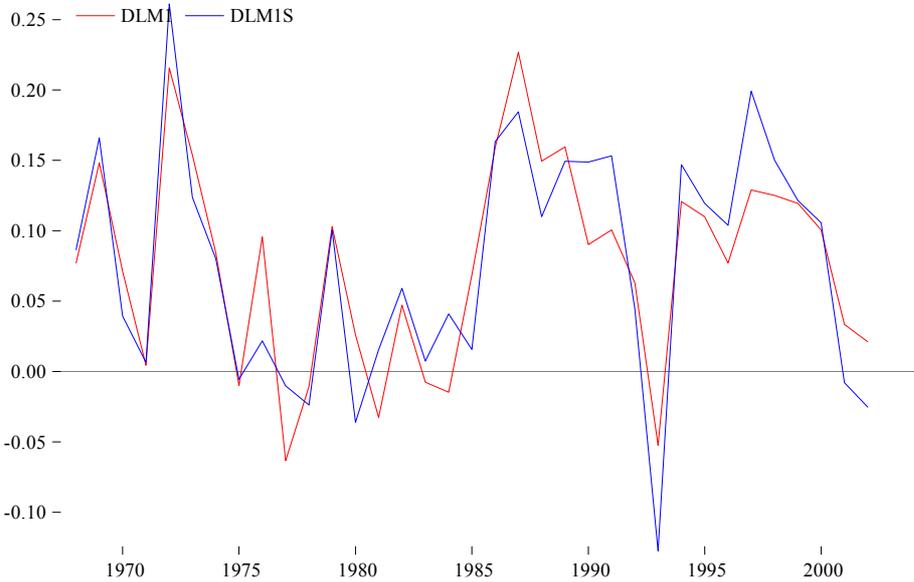


Fig. 6
Trade balance in Spain (original and simulated series in levels)

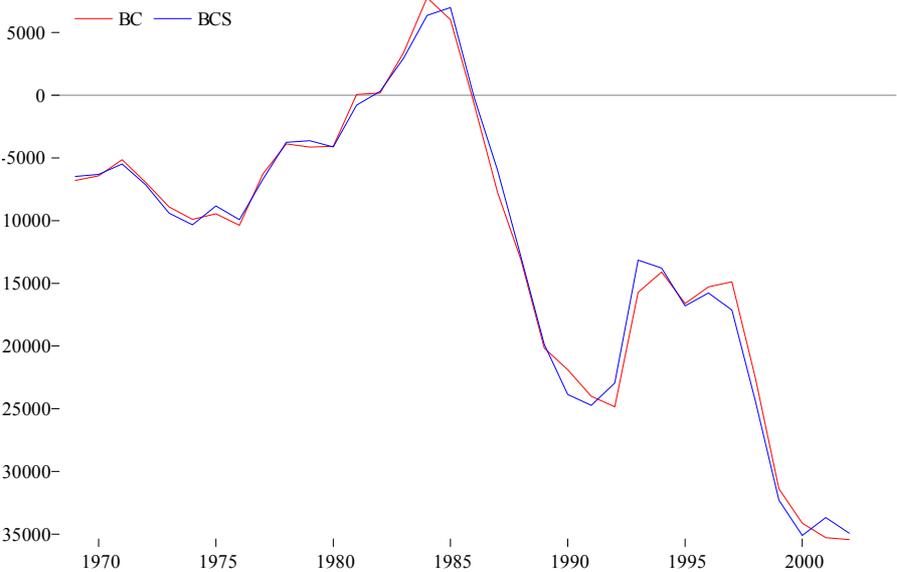


Fig. 7

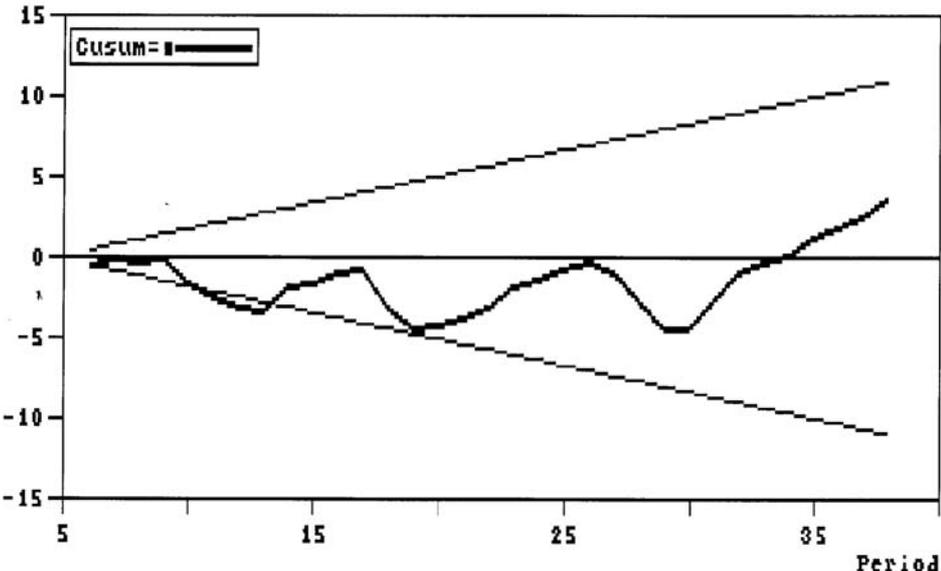
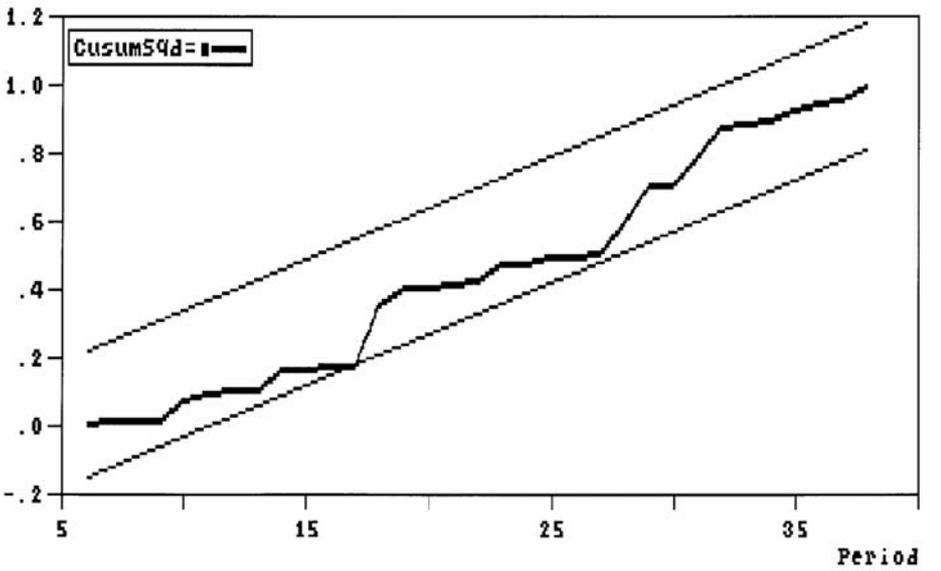


Fig. 8



5. Post sample period forecast and contribution of each explanatory variable to the endogenous variables evolution

To show the contrast of the stability of the simulated model in the period 1998-2002, the dynamics forecasts have been derived for this period with the model estimated to the period 1968-2002, with the following results:

Equation 1		Equation 2	
Observed	Forecast	Observed	Forecast
7.5	5.0	12.5	10.8
7.0	6.0	11.9	10.6
10.5	8.5	10.0	9.0
3.4	5.5	3.4	5.5
3.0	5.2	3.3	5.2

A test of extra sample forecast, which is, asymptotically equivalent to a stability test, is calculated from the dynamics forecasts. If e_t' is the sum of the square residuals of forecast in the period, it is possible to see that

$$(e_t' e_t) / \sigma^2 \cong \chi^2(5)$$

	Equation 1	Equation 2	Critical value 5%
Extra sample Forecast test	3.93	4.33	11.07

The null hypothesis about the existence of parameter structural change in the model can be accepted.

If we use the obtained forecasts with the simultaneous model to compare the forecast and real trade balance, in the period 1998-2002, would have the following results:

Years	Real Trade Balance	Forecast Trade Balance
1998	-22567	-23231
1999	-31385	-30767
2000	-34121	-34999
2001	-35285	-36075
2002	-35433	-35931

A descriptive, but otherwise powerful check of the model is provided by its ability to track the growth rate of the variables that the model intends to explain, over a long period. In this case, the years spanning from 1998 to 2002 have been selected. The results are presented in tables 2 and 3.

Table 2
Growth rate of exports of goods and services (exclude tourism)

Contribution GDP of OECD	17.3
Contribution of Domestic Demand	-16.8
Contribution of Imports	34.5
Contribution of competitiveness	-1.0
Total explained	34.0
Total observed	34.6

Table 3
Growth rate of imports of goods and services (exclude tourism)

Contribution of Investment	26.8
Contribution of Consumption	12.9
Contribution of Exports	8.2
Contribution of competitiveness	0.3
Total explained	48.2
Total observed	46.9

The trade balance suffered, in Spain, a meaningful deterioration during the period 1998-2002, due to the higher growth of imports compared to the exports.

Table 2 shows the importance of the favourable behaviour of the GDP in the OECD and the induced impact of the imports had for the positive evolution of the exports of goods and services. This positive impact was compensated, to some extent, by the negative effect that supposes the deterioration of the competitiveness and the growth of the internal demand. Table 3 shows the important growth of the imports in the period analysed; the contribution of the investment, consumption and exports has been important while the competitiveness deterioration had a slight impact.

6. Conclusions

An investigation is presented to show the important role that exports of goods and services (excluding tourism) have, in Spain, as de-

termining factor of imports of goods and services (excluding tourism) and vice versa. In this work a two equation simultaneous model is developed to show the interrelations between the two variables and also to consider the rest of the determining factors. Also, the contribution of each explanatory variable to the evolution of the endogenous variables has been considered.

The use of the exports as an explanatory variable of the imports, the interdependence between them and the simultaneous estimation of the two variables introduces a new viewpoint in relation with the traditional analysis, improving meaningfully its explanatory capacity. Theoretical implications of the model on the Marshall-Lerner condition are developed.

In this work is tested the existence of a long run relation between exports, GDP of OECD, imports and an indicator of the competitiveness. Also is tested the existence of a long run relation between the imports, investment, exports and an indicator of the competitiveness.

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APPENDIX

Statistic sources and elaboration of variables

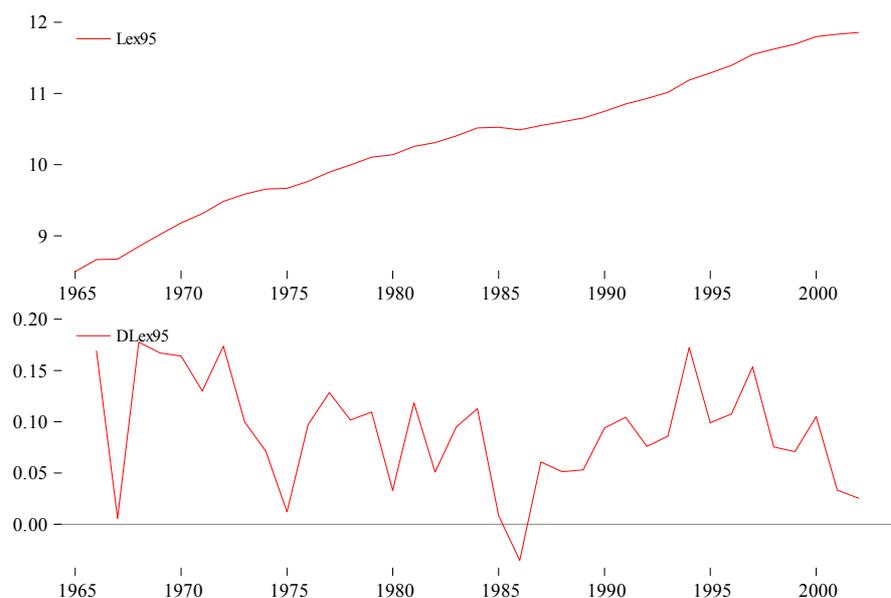
In this section is shown a descriptive analysis of the series, determining the existence of unit root for the variables in level terms by the graphic analysis.

1. EXPORTS OF GOODS AND SERVICES (EXCLUDING TOURISM)

The exports series is obtained from two sources:

Until 1980 are dates from National Account in base 1980. Since 1980 are dates from National Account in base 1995. The series, expressed in real terms and excluding the tourism revenues, is shown in logarithms (level and variation rate) in Fig. A1.

Fig. A1
Exports of goods and services in real terms

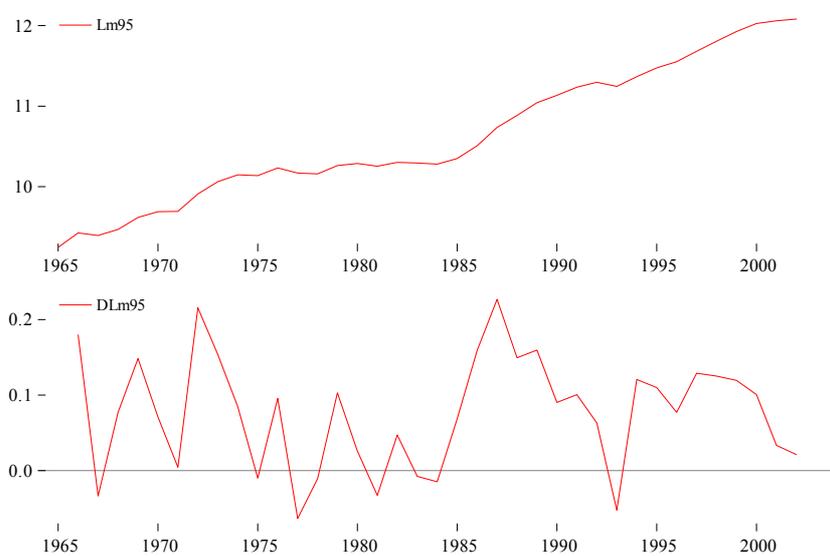


2. IMPORTS OF GOODS AND SERVICES (EXCLUDING TOURISM)

The imports series is obtained from two sources:

Until 1980 are dates from National Account in base 1980. Since 1980 are dates from National Account in base 1995. The series, expressed in real terms and excluding the tourism revenues, is shown in logarithms (level and variation rate) in Fig. A2.

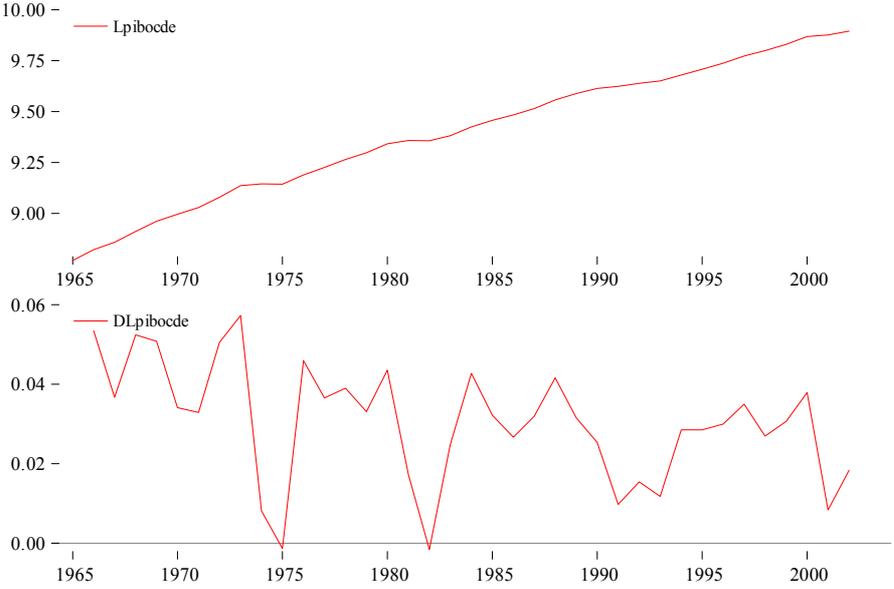
Fig. A2
Imports of goods and services in real terms



3. GDP OF THE OCDE COUNTRIES

The source of information for this series has been the foreign sector area of the Spanish Economy Ministry. The series, expressed in real terms, is shown in logarithms (level and variation rate) in Fig. A3.

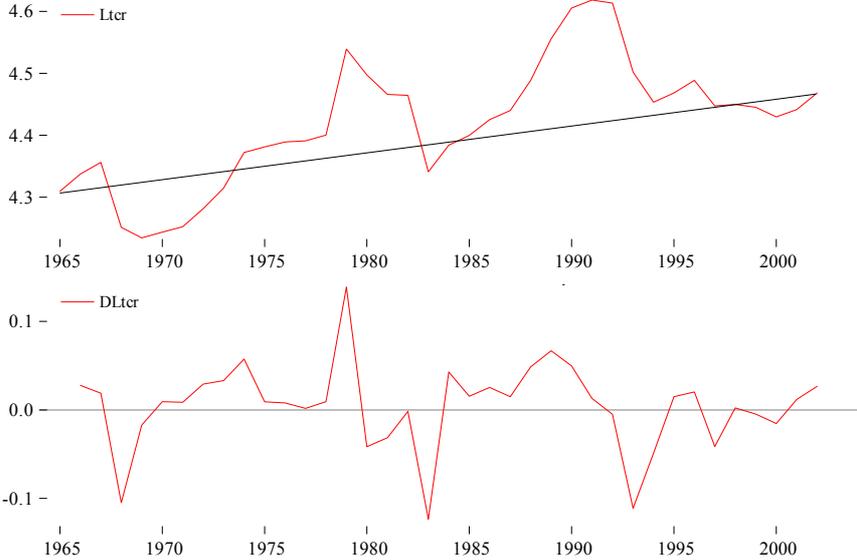
Fig. A3
GDP of the OCDE countries 1



4. EXPORTS COMPETITIVENESS

The series used has been the Spanish exports competitiveness against the industrialized countries, issue by the Spanish Central Bank. The competitiveness exports conveys a real exchange rate against the industrialized countries, defined in the way that increases would mean a revaluation against the industrialized countries and therefore a loss of competitiveness of the exports. The series is shown in logarithms (level and variation rate) in Fig. A4.

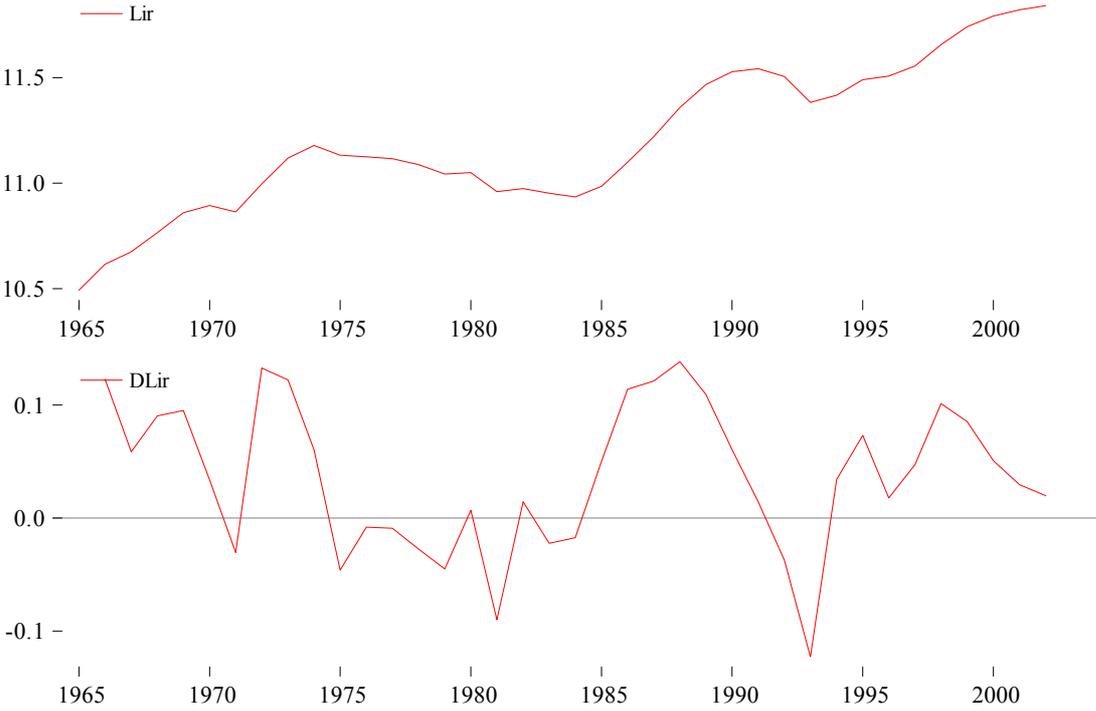
Fig. A4
Exports competitiveness 1



5. INVESTMENT

The series are dates from National Account, INE. Is shown in logarithms (level and variation rate) in Fig. A5 .

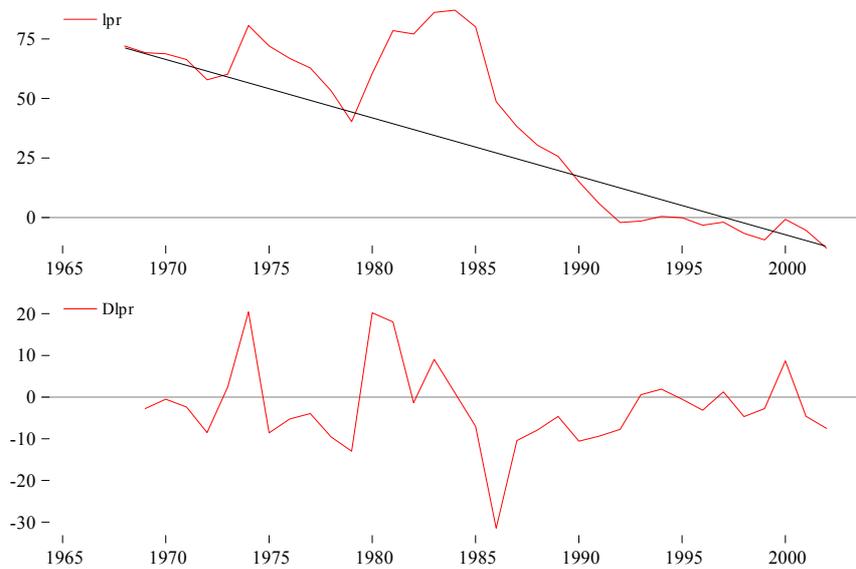
Fig. A5
Investment 1



6. IMPORT COMPETITIVENESS

As import competitiveness indicator is used the relation between the imports deflector and the Spanish GDP deflector measured in national currency (both series are dates from National Account, INE). The competitiveness imports is defined in the way that increases would mean a loss of competitiveness of the imports. The series is shown in logarithms (level and variation rate) in Fig. A6.

Fig. A6
Import competitiveness indicator 1



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