EFFECTS OF EXCHANGE RATE CHANGES ON THE ITALIAN TRADE BALANCE: THE J-CURVE

by

Daniele Antonucci

June 2003       CSC Working Paper n. 39
EFFECTS OF EXCHANGE RATE CHANGES ON THE ITALIAN TRADE BALANCE: THE J-CURVE

Daniele Antonucci
Centro Studi Confindustria
Viale dell’Astronomia, 30
00144 Roma
Tel. (39) 06-5903256
Fax. (39) 06-5918348
E-mail: d.antonucci@confindustria.it
Abstract

This paper aims at analyzing the profile and magnitude of time lags for Italy’s trade balance adjustments in response to real exchange rate changes. In order to check the validity of the J-curve theory, an error correction model embedding a polynomial distributed lag structure has been constructed and estimated. The major finding is that a devaluation improves the Italian trade balance without perverse effects both in the short run and in the long run. The 1992 devaluation following the EMS crisis confirms this result.

Keywords: J-curve, trade balance, real exchange rates, polynomial distributed lags, error correction.

JEL Classification: C22, F31, F32.

I wish to thank Giancarlo Gandolfo for reviewing a previous version of this paper. Part of the research has been conducted at the Department of Economics and Management of EHSAL - European Institute of Higher Education Brussels (Belgium). I am grateful to Johan Verrue for his support and useful suggestions. The current version has also benefited from the helpful discussions with Jan Colpaert and the comments of two anonymous referees.
Contents

1. Introduction .................................................................................................................. 5
2. Review of past literature .......................................................................................... 6
3. The model .................................................................................................................. 9
4. Empirical estimates .................................................................................................. 13
5. The case of 1992 devaluation ............................................................................... 18
6. Conclusion ............................................................................................................... 19

Tables and figures ........................................................................................................ 20
1. Introduction

The term J-curve refers to the temporary deterioration of the trade balance in response to a devaluation of a fixed exchange rate or a depreciation of a floating currency\(^1\). In fact, assuming that the Marshall-Lerner condition (or the more general Bickeldeike-Robinson-Metzler condition) has occurred, it is possible that the above-mentioned balance initially decreases (deteriorates) and only subsequently increases (improves) to a higher level than the one prior to the devaluation, therefore leading to a J slanted to the right in a diagram in which time is measured on the horizontal axis and the trade balance on the vertical one.

In effect, even if the above-mentioned critical elasticities conditions are valid, the improvement that is expected will only manifest itself in the new equilibrium position of the system, which will be reached after the adjustment process has worked itself out. In the course of this process, however, it can not be excluded that the trade balance may deteriorate because of effects of exchange rate changes on domestic prices and income and of other effects.

Many explanations have been given to this phenomenon, even if the hypothesis that it can not be related to a unitary logical scheme seems more convincing: its occurrence is rather the result of adjustment lags of various types acting on prices and quantities of international trade flows which, even if originating from a common cause (the exchange rate change), take place in successive periods and their accumulation can cause the time path of the trade balance depicted by the J-curve theory.

In the next sections we shall try to verify if the Italian trade balance more or less slowly adjusts to an exchange rate change, and analyze the time

\(^1\) This terminology was introduced for the first time after the 1967 devaluation of the pound sterling, which was followed by a persistent trade deficit that lasted until 1970 [see N.I.E.S.R. (1968)].
profile and magnitude of eventual adjustment lags. Our conclusion is that, in the case of Italy, the perverse effects of devaluation in the short period are not present and an exchange rate depreciation, assuming that the critical elasticities condition has occurred, will immediately improve the trade balance. In detail, in the second section we shall briefly review the main contributions to the theoretical analysis of the J-curve phenomenon, in the third section we shall illustrate the model underlying the J-curve theory, in the fourth and fifth sections we shall indicate the results of our empirical verification and in the last section we shall conclude with some qualifications.

2. Review of past literature

The first analysis on the effects of exchange rate changes on the trade balance is due to Magee (1973). In the framework of the elasticity approach², he identifies three distinct periods following a devaluation in which the behavior of the trade balance is affected by different factors: the currency contract period, the pass through period and the quantity adjustment period.

The currency contract period is defined as the short period immediately after a devaluation in which contracts stipulated before the exchange rate change mature. Since during this time horizon both prices and quantities are fixed, a devaluation undertaken to correct a deficit will make the trade balance increase or decrease according to the proportion of contracts stipulated in national and foreign currency. Even if from a purely taxonomic point of view it is not possible to exclude that import contracts are stipulated in national currency and export contracts are stipulated in foreign currency, in which case the trade balance in domestic currency

² This approach abstracts from effects on income, adopting the assumption that import and export demand and supply functions depend only from relative price changes.
necessarily improves, both export and import contracts stipulated before a devaluation are generally expressed in foreign currency in order to avoid an exchange rate loss. Thus, the value of exports and imports in domestic currency will increase by the same percentage of the devaluation, so that – as the pre-devaluation value of the former was assumed higher than that of the latter – the trade deficit will also increase, therefore showing a perverse behavior.

The pass through period is defined as the period after an exchange rate variation in which prices can change – as they refer to contracts stipulated after the exchange rate has changed – but quantities remain unchanged because of frictions of various type acting on both supply and demand of exports and imports. Consider, for example, the case of a devaluation where the demand for imports by residents of the devaluing country as well as the demand for the devaluing country’s exports are both inelastic in the short run. As a consequence of a devaluation, the price of imports in national currency will increase but the demand will not change, so that the outlays for imports will increase. On the other hand, the price of exports in foreign currency will decrease by the same proportion of the exchange rate variation – assuming that domestic exporters adjust the price in foreign currency according to the devaluation – but the demand will not change, so that the foreign currency receipts will decrease and their value in domestic currency will not change. Therefore, the trade balance in domestic currency will deteriorate following a J-curve pattern.

The occurrence of these perverse effects, obviously, is not a necessity; it should be stressed that in the period preceding the adjustment of quantities there is no logical reason for the trade balance to improve, worsen or remain constant.

Finally, the quantity adjustment period is defined as the period in which both prices and quantities are free to adjust and, provided that the critical elasticities condition is satisfied, the trade balance will certainly improve in the long run. However, this is true only from a comparative
static point of view: the analysis of the dynamic transition from the old to the new equilibrium shows that a lower speed of adjustment for trade volumes with respect to prices may cause a J-curve effect on the trade balance.

Among the factors causing such rigidities, Junz and Rhomberg (1973) identify a recognition lag, in which economic agents take time to realize the change in the competitive environment, a decision lag, lasting from the moment in which the new situation has been recognized to the one in which an action is undertaken, in which producers need to be convinced that the new opportunity is long lasting and profitable enough to compensate efforts and costs to increase capacity or transfer resources elsewhere. Finally, there is a lag in production, delivery and substitution of materials and equipments of which the relative price is changed that is due to obvious technical reasons.

The traditional explanation of the J-curve theory has been widely criticized. It has been pointed out that the higher speed of adjustment of prices with respect to quantities is not the only reason for a short run deterioration of the trade balance owing to a devaluation. Such effect can also take place in presence of sticky prices and quantities free to adjust also in the time period immediately after an exchange rate variation. Therefore, the J-curve phenomenon does not necessarily imply a fast pass through: if import prices are sticky consumers will anticipate their increase as a consequence of a devaluation and revise their future purchases, eventually leading to a J-curve dynamics of the trade balance. In this context, Gerlach (1989) distinguishes between a relative price effect and an intertemporal reallocation effect, emphasizing that while higher prices in national currency of international traded goods tend to improve the trade balance, their rising provides economic agents with an incentive to increase their current purchases, which in turn tends to worsen it. According to the relative size of these effects the J-curve may eventually arise.
Other recent studies [see, for example, Mansoorian (1998)] show that a trade balance deterioration as a consequence of an exchange rate depreciation can be attributed to the persistence of habits in consumption. Also in this case, intertemporal substitution effects and other overlapping phenomena over a certain time horizon may affect trade flows and prices.

Finally, a further explanation of short run effects on the trade balance is the theory of hysteresis [Dixit (1994)]. Since import and export activities generate sunk costs, economic agents value the opportunity to wait and see whether an exchange rate change is just temporaneous; if this is the case, in fact, they would have avoided to loose such costs. In effect, the incentive to start or stop an international trade business (or to modify future trade flows) exists only if the exchange rate variation crosses a certain threshold. It is evident that even if this approach has some similarities with the J-curve theory, the adjustment lags are not defined with respect to time but rather in terms of an economic state represented by the distance between the current exchange rate and the one that would cause a market operators’ reaction.

3. The model

3.1 Two different approaches

The J-curve theory has been the subject of several empirical studies, some of which have confirmed the presence of trade balance adjustment lags owing to a devaluation [see, for example, Bahmani-Oskooee (1985) and Moffett (1989)], while others have denied their existence [see, for example, Rose and Yellen (1989) and Hsing and Savvides (1996)]. These studies can be classified in two groups: in the first one, the J-curve phenomenon is analyzed in the framework of a two-country model [see, for example, Felmingham (1988)], while in the second one bilateral trade flows between a country and its main trading partners are taken into account [see, for
example, Bahmani-Oskooee and Brooks (1988)]. Since a currency can simultaneously appreciate with respect to another one and depreciate with respect to a third one, the real effective exchange rate would fluctuate to a lesser extent if compared with a bilateral exchange rate, therefore leading to a misinterpretation of the dynamics of the trade balance in response to an exchange rate change. However, the J-curve is an aggregate phenomenon and the perverse effects of a devaluation are due to a variation of competitiveness among Italy and its main trading partners, which is measured by the real effective exchange rate. Therefore, the use of aggregate data in a two-country model seems more appropriate.

The studies specifically concerning the relationship between the Italian trade balance and effective real exchange rate are very few, and the results that have been obtained are contrasting: for example, Backus, Kehoe and Kydland (1994) find that a terms of trade decline corresponds to a deterioration of the trade balance that lasts eight quarters; on the contrary, Bahamani-Oskooee and Alse (1994) find that the Italian trade balance and the real exchange rate are not cointegrated variables of the same order; in this case, it is not only impossible to assess the effect of the latter on the former in the short period, but not even a long period relationship between the variables involved can be determined.

We consider the methodologies used by Rose and Yellen (1989) and by Marwah and Klein (1996) as a good starting point. In both studies, however, there are several deficiencies. Rose and Yellen (1989), in fact, base their analysis on a simple auto-regressive model rather than on an error correction model, which would enable to underline both the long and short period dynamics. Moreover, they do not use any criterion to select the number of lags in the trade balance equation, which is fixed arbitrarily. Marwah and Klein (1996), besides not using an error correction model as the previous authors, employ non stationary time series; since they use the level of the variables without checking if there are any unitary roots, their estimates may be spurious.
3.2 The adjustment process in the short period

In the model we have used for our analysis the import and export volumes respond both to income and real exchange rate changes [see for example Marwah (1995) and Marwah and Klein (1996)]:

\[
B = f(Y_w, Y, \pi)
\]

\(Y\) and \(Y_w\) are the Italian and world income in real terms respectively, while the real exchange rate, \(\pi\), is equal to the weighted geometric mean of the bilateral exchange rates between the Italian lira and the currencies of Italy's trading partners:

\[
\pi = \frac{p}{p_n r} = \prod_i \left( \frac{p}{p_n r_i} \right)^{w_i} = \prod_i \pi_i^{w_i} \sum_i w_i = 1
\]

where \(w_i\) is a measure of trading importance of country \(i\), \(p_w\) is the export price of the same country, \(p\) is the Italian export price and \(r_i\) is the bilateral nominal exchange rate, defined as units of domestic currency per unit of foreign currency.

The signs of the partial derivatives are indicated under equation (1). A priori, we shall have dB/d\(Y_w\)>0 and dB/d\(Y\)<0, as an increase of world income will make foreign demand for domestic goods change in the same direction and therefore will cause an improvement of the trade balance, while an increase of domestic income will rise domestic demand for foreign imports and therefore will cause a deterioration of the trade balance. Moreover, we shall have dB/d\(\pi\)<0, since a devaluation, assuming the validity of the critical elasticities condition, will increase export volume and reduce import volume over time, as exported domestic goods will be less
expensive in foreign currency and imported foreign goods will be more expensive in national currency.

By defining the trade balance as the ratio of the value of exports divided by the value of imports in the same currency, so that it is in equilibrium when $B=1$, in surplus when $B>1$ and in deficit when $B<1$, we express equation (1) in the form

$$B = A \left( \frac{Y_w}{Y} \right)^{\alpha} \pi^\beta \mu$$

where $A$ is a constant and $\mu$ is a stochastic error. As far as what has been said previously, we shall have $\alpha>0$ e $\beta<0$.

Since the purpose of this analysis is to verify empirically if the dynamics of the Italian trade balance owing to a devaluation is the one described by the J-curve theory, a distributed lag structure of an unspecified length has been imposed on the effective real exchange rate:

$$B_t = A \left( \frac{Y_w}{Y} \right)^{\alpha} \pi_t^{D(L)} \mu_t$$

where $D(L)$ is a polynomial of degree $\omega$ in the lag operator $L$:

$$D(L) = \beta_0 + \beta_1 L + \beta_2 L^2 + ... + \beta_\omega L^\omega = \sum_{i=0}^{\omega} \beta_i L^i$$

Note that in this way the trade balance is independent from the unit of measurement, and it can be referred either to the ratio of exports on imports in domestic currency or to the same ratio in foreign currency [see Marwah (1995)]
and \( \beta_i \) can be approximated by another polynomial of degree \( \psi \) so that

\[
\beta_i = f(i) = \lambda_0 + \lambda_1 i + \lambda_2 i^2 + ... + \lambda_{\psi} i^\psi
\]

where \( i = 0,1,\ldots,\omega > \psi \).

In order to have short period perverse effects on the trade balance as a consequence of a devaluation, it is necessary that the distributed lag coefficients summed over \( i \)'s, should initially be positive and then become negative over time, assuming that the critical elasticities condition, which in this case can be expressed as \( \sum_{i=0}^{\omega} \beta_i \), has a negative sign (in this case there will definitely be an improvement of the trade balance in the long period).

The polynomial distributed lag (PDL) enables to fit a model with long lags with relatively short time series [see Almon (1965)], as, otherwise, the use of an unrestricted model would very likely cause a high multicollinearity. The order of the polynomial, \( \psi \), is usually taken to be quite low, rarely exceeding three or four. In addition, besides the \( \psi + 1 \) parameters, it is necessary to determine the length of the lag structure, \( \omega \). Usually the degree of the polynomial is assumed given and the number of lags to be included in the equation is determined by specifying alternative \( \omega \) values and selecting the one that provides the best result according to the Akaike or Schwartz information criteria [see the following section].

4. Empirical estimates

The econometric analysis of equation (4) is based on quarterly data from 1975:1 to 1998:4. Import and export volumes and prices, as well as the real effective exchange rate (CPI-weighted) have been taken from the
OECD Statistical Compendium, while the indexes of industrial production come from the IMF International Financial Statistics.

Being concerned about autocorrelation, the time series have been deseasonalized; however, the use of rough data does not change the results. Moreover, all the variables have been logarithmized, since the use of logarithmic transformations enables to stabilize the data variance and has the advantage that the coefficients of the estimated equation represent the values of elasticities.\footnote{Note that it has been possible to carry out the logarithm of the trade balance thanks to the fact that the latter has been defined as the ratio between the export value and the import value, that never assumes negative values.}

Consider the following static equation:

\begin{equation}
\ln B_t = \gamma + \alpha \ln IIP_t + \beta \ln RER_t + \mu_t
\end{equation}

where $RER_t = \pi_t$ is the effective real exchange rate for Italy, $IIP = \frac{IIP_w}{IIP_\alpha}$ is the ratio of the index of industrial production for industrialized countries, $IIP_w$, divided by the corresponding index for Italy, $IIP_\alpha$. The choice of this variable as proxy of the ratio of the world income divided by the Italian one, besides enabling us to avoid the problem of aggregation of the national income of Italy's trading partners to obtain $Y_w$, seems particularly suitable in the case under examination. By observing figure 2 it is evident that from 1975:1 to 1985:4 an increase of foreign industrial production as to Italian industrial production corresponds to an improvement of the Italian trade balance, while an increase of Italian industrial production as to foreign industrial production corresponds to a deterioration of the Italian trade balance. In the following period, however, this relationship is weaker and this might mean that from 1986:1 to 1998:4 the Italian trade balance has been affected by other variables. In any case,
the importance of industrial activity has been underlined by Magee (1973),
who indicated the most accelerated expansion of American industrial
production as to foreign production as one of the causes of accelerated
deterioration of the American trade balance in 1972, notwithstanding the
strong devaluation of the dollar. Moreover, Krugman and Baldwin (1987)
have used the index of relative industrial production to estimate the trade
balance equation for Japan and South Korea.

It is appropriate to check the presence of unit roots in the time series.
Table 1 shows the Dickey-Fuller and Phillips-Perron tests. By comparing
the calculated statistics with MacKinnon's critical values (1991) at 5% significance level indicated in parenthesis, it is evident that the first
differences of the variables (but not the levels) are stationary, indicating that
the variables are all I(1).

Table 2 shows the estimated coefficients of equation (7). The Dickey-
Fuller and Phillips-Perron tests\(^5\) on the series of the residual of this equation
show that it is stationary, as illustrated in table 3. Therefore, the variables in
equation (7) are cointegrated and \(\hat{\mu}_{t-1}\), the lagged estimated residual of
the variables in equation (7), can be interpreted as the equilibrium error in the following
equation:

\[
\Delta \ln B_t = \gamma + \alpha \Delta \ln II_P + \sum_{i=0}^{6} \beta_i \Delta \ln RER_{t-i} - \rho \hat{\mu}_{t-1} + DUM_1 + DUM_2 + \varepsilon_t
\]

in which \(\alpha > 0\) and \(\beta = \sum_{i=6}^{6} \beta_i < 0\), since in the long period an increase in
foreign industrial production as to Italian industrial production, or a
devaluation \((\Delta \ln RER < 0)\), will improve the trade balance. On the

---

\(^5\) The appropriate critical values to perform the above-mentioned tests on the residual of the
cointegration equation have been supplied by Egle and Yoo (1987).
contrary, in the short period the sign of $\beta_i$ coefficients may also be positive, indicating that, after an exchange rate depreciation, the trade balance initially deteriorates and subsequently, if the critical elasticities condition has occurred, it starts to improve. The $\beta_i$ coefficients have been calculated by imposing that they lie on a polynomial, the order of which has been determined on the basis of the adjusted R squared, while the number of lags to be included in the equation has been selected using Akaike and Schwarz information criteria. Therefore, we have decided to use a polynomial of the fourth order

\begin{equation}
\beta_i = f(i) = \lambda_0 + \lambda_1 i + \lambda_2 i^2 + \lambda_3 i^3 + \lambda_4 i^4
\end{equation}

in which the near end is constrained to zero, and the number of lags is equal to 6, that is the one which minimizes both Akaike and Schwarz statistics. Table 4 shows equation (8) coefficients estimated by ordinary least squares, which, at first sight, indicate good properties, since the value of the adjusted R squared is similar to the ones calculated in other works regarding the same topic [see, for example, Brada, Kutan and Zhou (1993)] and the Durbin-Watson statistics indicates the absence of autocorrelation. Figure 3 shows actual and fitted values of the error correction equation as well as the residuals, while table 5 indicates some specification and diagnostic tests. In particular, the first three tests confirm that the residuals are independent, not correlated and normally distributed, while the last two tests confirm that the coefficients are stable and the functional form used to calculate the lags is suitable. Moreover, figures 4, 5 and 6 show equation (8) residuals calculated by recursive least squares and CUSUM and CUSUM of Squares test results. By observing the above-mentioned graphs we have another confirmation of the parameters' stability, as the calculated values are always

---

6 The constant is not significant at 5% level.
within the critical values. Finally, figure 7 illustrates the evolution of the coefficients’ estimates calculated by recursive least squares as well as that of the critical values; by using a larger number of observations, the values show less and less variations and stabilize with a relatively low amount of data.

Coefficients $\lambda_1$, $\lambda_2$, $\lambda_3$ and $\lambda_4$ are necessary to calculate the coefficients of the current value and lagged values of the effective real exchange rate shown in table 6. Since the signs of $\Delta \ln RER_t$ and $\Delta \ln RER_{t-1}$ are negative, not only a devaluation will immediately improve the trade balance, but it will also have a positive one period lagged effect. $DUM_1$ and $DUM_2$ are two dummy variables for 1980:3 and 1983:1 required to deal with outliers. The sign of the other coefficients is irregular and difficult to interpret, being positive for the following three quarters, then negative and subsequently positive again; nevertheless, individually they do not appear significant and have been maintained because, on the contrary, their sum (SUM), providing the joint effect on the trade balance, is significant and has a negative sign as expected, confirming that the critical elasticities condition has occurred. In conclusion, a depreciation of the effective real exchange rate will not cause any perverse effect on the trade balance both in the short and long periods and therefore, according to the empirical analysis carried out, the J-curve theory does not hold in the case of Italy.

---

7 Usually outliers are those observations that have a value which is far from the mean more than twice the standard deviation, since the probability of occurring is very low (less than 5%). Rather than strictly following this criterion, we have selected the two observations which are the furthest from the mean in both directions.
5. The case of 1992 devaluation

In order to support the econometric estimates indicated in the previous section, we shall consider the behavior of the Italian and British trade balances between 1992 and 1993 when, owing to the EMS crisis, the Italian lira and pound sterling both devaluated by 15% and 10%, respectively. A brief chronology is reported below:

**September 5-6** The European Union ministers of finance meet in Bath (UK) and emphasize their commitment to maintain the existing parities within the framework of the Exchange Rate Mechanism;

**September 8** Following speculative attacks to Scandinavian currencies (which were linked to the Deutsche Mark but not part of the EMS) Finnish authorities leave the Finnish Markka to freely fluctuate without any central bank intervention. As a consequence, the Finnish currency depreciates by 13%. In the meanwhile, Sweden decides to maintain its exchange rate parity and increases its overnight interest rate at 24% on a yearly basis. Two days later it rises it at 75%;

**September 10-11** The Bank of Italy intervenes heavily in order to maintain the Italian Lira parity, experiencing serious losses in reserves. Notwithstanding those operations, the Italian currency is devaluated by 7% with respect to the Deutsche Mark;

**September 16-17** The Bank of England, following heavy losses, increases the overnight interest rate from 10% to 15%. However, the speculative attack does not stop and both Italy and the United Kingdom announce their temporary exit from the EMS. In the following weeks both currencies depreciate by 10-15% and speculation involves also other countries;

**End of September** The crisis ends with Italy and the United Kingdom outside of the EMS.
The 1992 devaluation was considered a positive event by many people, since in that period both countries were in an unfavorable economic conjuncture: both in Italy and the United Kingdom the trade balance was negative and the income rate of growth was low. It was a widespread opinion that the devaluation would have improved the trade balance, by increasing the aggregate demand and therefore the income, but these forecasts revealed to be only correct for Italy. Figure 8, in fact, shows that a decline in the exchange rate not only has been followed by an improvement of the Italian trade balance substantially without any perverse effect, but as the ratio of exports on imports passed from a value of 0.90 (deficit) to a value of 1.20 (surplus), the critical elasticities condition occurred, confirming even more the empirical analysis previously carried out.

On the contrary, in the case of The United Kingdom, the trade balance remained trapped in the J effect for approximately a year and a half before starting to improve. Figure 9 illustrates that from the second quarter of 1992, during which the devaluation took place, decreasing real exchange rate values initially corresponded to decreasing values of the British trade balance, which reached its minimum during the fourth quarter of 1992 and then started to recover, by reaching a value higher than the one prior to the devaluation only in the third quarter of 1993.

6. Conclusion

In this paper we have illustrated the possibility of perverse effects of a devaluation of the real exchange rate on the trade balance, and we have empirically verified if they exist in the case of Italy. As shown in the previous sections, a depreciation of the real exchange rate causes an improvement of the trade balance both in the short run and in the long run and does not indicate the time path described by the J-curve theory.
However, we do not refuse to acknowledge the validity of this theory, which has been confirmed in several other studies regarding different countries. Actually, the fact that a depreciation of the exchange rate might produce an opposite result (i.e. a trade balance deterioration) compared to the reason why it is usually put into action (i.e. a trade balance improvement), is an essentially empirical question and varies according to circumstances. In fact, the J-curve theory does not imply that during the short period the above-mentioned perverse effects necessarily appear, but points out that they can exist under certain conditions.
Tab. 1 – Dickey-Fuller and Phillips-Perron tests for cointegration equation variables (trend and intercept included in test equations)

<table>
<thead>
<tr>
<th></th>
<th>Dickey-Fuller</th>
<th>Phillips-Perron</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\ln B$</td>
<td>-2.4005 (-3.4571)</td>
<td>-2.4809 (-3.4571)</td>
</tr>
<tr>
<td>$\ln RER$</td>
<td>-1.3258 (-3.4571)</td>
<td>-1.6435 (-3.4571)</td>
</tr>
<tr>
<td>$\ln II$</td>
<td>-3.2724 (-3.4571)</td>
<td>-3.3854 (-3.4571)</td>
</tr>
<tr>
<td>$\Delta \ln B$</td>
<td>-10.6637 (3.4576)</td>
<td>-10.6366 (3.4576)</td>
</tr>
<tr>
<td>$\Delta \ln RER$</td>
<td>-7.0277 (-3.4576)</td>
<td>-6.9978 (3.4576)</td>
</tr>
<tr>
<td>$\Delta \ln II$</td>
<td>-9.7721 (-3.4576)</td>
<td>-9.7971 (3.4576)</td>
</tr>
</tbody>
</table>

Tab. 2 – Cointegration equation: coefficients’ estimates and main statistics

<table>
<thead>
<tr>
<th>Var.</th>
<th>Coeff.</th>
<th>S.E.</th>
<th>t-stat.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Const.</td>
<td>3.9484</td>
<td>0.2472</td>
<td>16.1345</td>
</tr>
<tr>
<td>$\ln RER_t$</td>
<td>0.4784</td>
<td>0.1058</td>
<td>4.5201</td>
</tr>
<tr>
<td>$\ln II_t$</td>
<td>-0.8130</td>
<td>0.0513</td>
<td>-15.8400</td>
</tr>
<tr>
<td>Adj. $R^2$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DW</td>
<td>0.7238</td>
<td>0.7783</td>
<td>96</td>
</tr>
<tr>
<td>DW</td>
<td>125.4526</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tab. 3 – Dickey-Fuller and Phillips-Perron tests for cointegration equation residuals (no trend or intercept included in test equation)

<table>
<thead>
<tr>
<th></th>
<th>Dickey-Fuller</th>
<th>Phillips-Perron</th>
</tr>
</thead>
<tbody>
<tr>
<td>Res.</td>
<td>-4.9297 (-2.8900)</td>
<td>-4.9930 (2.8900)</td>
</tr>
</tbody>
</table>
Tab. 4 – Error correction equation: coefficients’ estimates and main statistics

<table>
<thead>
<tr>
<th>Var.</th>
<th>Coeff.</th>
<th>S.E.</th>
<th>t-stat.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta \ln IIP_t$</td>
<td>0.7058</td>
<td>0.1713</td>
<td>4.1194</td>
</tr>
<tr>
<td>$\mu_{t-1}$</td>
<td>-0.4172</td>
<td>0.0810</td>
<td>-5.1513</td>
</tr>
<tr>
<td>$\lambda_1$</td>
<td>-0.7748</td>
<td>0.2425</td>
<td>-3.1945</td>
</tr>
<tr>
<td>$\lambda_2$</td>
<td>0.5248</td>
<td>0.1837</td>
<td>2.8566</td>
</tr>
<tr>
<td>$\lambda_3$</td>
<td>-0.1110</td>
<td>0.0429</td>
<td>-2.5880</td>
</tr>
<tr>
<td>$\lambda_4$</td>
<td>0.0074</td>
<td>0.0031</td>
<td>2.3799</td>
</tr>
<tr>
<td>$DUM_1$</td>
<td>-0.0921</td>
<td>0.0292</td>
<td>-3.1529</td>
</tr>
<tr>
<td>$DUM_2$</td>
<td>0.0854</td>
<td>0.0289</td>
<td>2.9514</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Adj. R²</th>
<th>DW</th>
<th>Akaike</th>
<th>Schwarz</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4686</td>
<td>2.1224</td>
<td>-4.1964</td>
<td>-3.9727</td>
</tr>
</tbody>
</table>

Tab. 5 – Specification and diagnostic tests

<table>
<thead>
<tr>
<th>Test</th>
<th>$\chi^2$-stat.</th>
</tr>
</thead>
<tbody>
<tr>
<td>J-B Normality</td>
<td>0.6243 (0.7319)</td>
</tr>
<tr>
<td>B-G Serial Correlation (4 lags)</td>
<td>5.9673 (0.2016)</td>
</tr>
<tr>
<td>White Heteroscedasticity</td>
<td>10.4551 (0.7282)</td>
</tr>
<tr>
<td>Ramsey RESET (4 fitted values)</td>
<td>5.0654 (0.2806)</td>
</tr>
<tr>
<td>Chow Forecast</td>
<td>28.4210 (0.4955)</td>
</tr>
</tbody>
</table>
Tab. 6 – Effective real exchange rate current and lagged coefficients

<table>
<thead>
<tr>
<th>Var.</th>
<th>Coeff.</th>
<th>S.E.</th>
<th>t-stat.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta \ln RER_t$</td>
<td>-0.3535</td>
<td>0.1038</td>
<td>-3.4053</td>
</tr>
<tr>
<td>$\Delta \ln RER_{t-1}$</td>
<td>-0.2196</td>
<td>0.0766</td>
<td>-2.8677</td>
</tr>
<tr>
<td>$\Delta \ln RER_{t-2}$</td>
<td>0.0025</td>
<td>0.0773</td>
<td>0.0323</td>
</tr>
<tr>
<td>$\Delta \ln RER_{t-3}$</td>
<td>0.0909</td>
<td>0.0732</td>
<td>1.2411</td>
</tr>
<tr>
<td>$\Delta \ln RER_{t-4}$</td>
<td>0.0015</td>
<td>0.0694</td>
<td>0.0211</td>
</tr>
<tr>
<td>$\Delta \ln RER_{t-5}$</td>
<td>-0.1323</td>
<td>0.0938</td>
<td>-1.4115</td>
</tr>
<tr>
<td>$\Delta \ln RER_{t-6}$</td>
<td>0.0005</td>
<td>0.1177</td>
<td>0.0044</td>
</tr>
<tr>
<td><strong>SUM</strong></td>
<td>-0.6100</td>
<td>0.2854</td>
<td>-2.1379</td>
</tr>
</tbody>
</table>
Fig. 1 – Italian trade balance and real effective exchange rate
Fig. 2 – Italian trade balance and index of relative industrial production
Fig. 3 – Error correction equation

![Error correction equation graph](image-url)

- Residual
- Actual
- Fitted
Fig. 4 – Recursive residual
Fig. 5 – CUSUM test
Fig. 6 – CUSUM of Squares test
Fig. 7 – Recursive coefficients

![Graphs showing recursive coefficients for C(1) to C(8) with ±2 S.E. error bands.]
Fig. 8 - Italian trade balance and real effective exchange rate during the 1992 devaluation
Fig. 9 – British trade balance and real effective exchange rate during the 1992 devaluation
References


Working Paper pubblicati

1. Testing purchasing power parity between Italy and the US with maximum likelihood methods, di Marco Malgarini, Ottobre 1996


3. Commercio estero e occupazione in Italia: una stima con le tavole intersettoriali, di Sergio de Nardis e Marco Malgarini, Ottobre 1996

4. La mobilità territoriale delle imprese dal 1970 ad oggi, di Fabrizio Traù e Massimo Tamberi, Ottobre 1996

5. La mobilità dimensionale delle imprese nell'industria italiana, di Fabrizio Traù, Ottobre 1996


8. Stock e costo del capitale con misure di deprezzamento non geometrico, di Paolo Annunziato e Ioannis Ganoulis, Febbraio 1997


11. Inflazione e disoccupazione in Europa: determinanti strutturali e politiche macroeconomiche, di Marco Malgarini e Francesco Paternò, Giugno 1997

12. Legislazione, sindacato e licenziamenti collettivi - Un'analisi su dati aziendali, di Paolo De Luca e Ioannis Ganoulis, Settembre 1997


35
15. Un approccio "interattivo" alla teoria del reddito permanente, di Edoardo Gaffeo, Giugno 1998


17. Specializzazione settoriale e qualità dei prodotti: misure della pressione competitiva sull'industria italiana, di Sergio de Nardis e Fabrizio Traù, Ottobre 1998


19. La discontinuità del pattern di sviluppo dimensionale delle imprese nei paesi industriali: fattori endogeni ed esogeni di mutamento dell' "ambiente competitivo", di Fabrizio Traù, Settembre 1999

20. Investigating the credit channel: a parallel between the US case and the Italian one, di Francesco Paternò, Febbraio 2000

21. Formazione aziendale, struttura dell'occupazione e dimensione dell'impresa, di Andrea Montanino, Marzo 2000

22. Regulation in Europe: justified burden or costly failure?, di Sandrine Labory e Marco Malgarini, Marzo 2000


27. Allargamento a Est dell'Unione Europea: gli effetti sul mercato dei beni, di Stefano Manzocchi e Beatrice Pierluigi, Maggio 2001


29. Allargamento a Est dell'Unione Europea: il quadro di riferimento per le politiche comunitarie di sviluppo regionale e coesione, di Giuseppe Mele, Giugno 2001
30. Ristrutturazione bancaria, crescita e internazionalizzazione delle Pmi meridionali, di Giovanni Ferri e Ugo Inzerillo, Novembre 2002

31. L’aritmetica del congiunturalista: misure di confronto temporale e loro relazioni, di Ciro Rapacciuolo, Dicembre 2002

32. Specializzazione produttiva e struttura dimensionale delle imprese: come spiegare la limitata attività di ricerca dell’industria italiana, di Giovanni Foresti, Dicembre 2002

33. Judicial branch, checks and balances and political accountability, di Nadia Fiorino, Fabio Padovano e Grazia Sgarra, Dicembre 2002

34. Tax credit policy and firms’ behaviour: The case of subsidies to open-end labour contracts in Italy, di Piero Cipollone e Anita Guelfi, Febbraio 2003

35. Tendenze di lungo periodo della filiera legno-arredamento, di Fabrizio Traù, giugno 2003

36. Un semplice modello univariato per la previsione a breve termine dell’inflazione italiana di Ciro Rapacciuolo, Giugno 2003

37. Misure del potere di mercato degli esportatori italiani di beni tradizionali, di Sergio de Nardis e Cristina Pensa, Giugno 2003
