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Economic integration and industrial sector fluctuations: evidence from Italy

by

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ABSTRACT

This paper investigates the underlying sources of the Italian industrial sector fluctuations. It concentrates in particular on the role of different shocks on the manufacturing business cycle. To this end, it considers both domestic shocks (to hours worked and to technology) and external shocks (i.e. competitiveness and world trade shocks). The former concern internal conditions such as labour market and productivity dynamics; the latter relate to the effects of economic integration, globalization and the world economy scenario on the manufacturing sector performance.

The findings show that although the cyclical fluctuations are mainly determined by productivity shock, hours worked and world trade shocks also contribute significantly to explaining the manufacturing business cycle.

Keywords: Business cycle, Italian Industry performance, SVAR model, Economic integration, World trade.

JEL codes: C32, E32, F41.

INTEGRAZIONE ECONOMICA E FLUTTUAZIONI DEL SETTORE INDUSTRIALE: EVIDENZA EMPIRICA DALL'ITALIA

SINTESI

Il lavoro esamina le cause delle fluttuazioni del settore industriale italiano valutando il ruolo di diversi tipi di shock sul ciclo del settore manifatturiero. In particolare si considerano sia shock interni (alle ore lavorate e alla tecnologia) che internazionali (shock di competitività e al commercio mondiale). I primi riflettono condizioni economiche interne quali le dinamiche del mercato del lavoro e della produttività, i secondi permettono di tener conto degli effetti dell'integrazione, della globalizzazione, e dello scenario economico mondiale sulla performance del settore manifatturiero italiano.

I risultati evidenziano che nonostante le fluttuazioni cicliche siano determinate principalmente da shock di produttività, anche gli shock alle ore lavorate ed al commercio mondiale contribuiscono in maniera significativa a spiegare il ciclo del settore manifatturiero.

Parole chiave: Ciclo economico, Performance dell'industria italiana, Integrazione economica, commercio mondiale.

Classificazione JEL: C32, E32, F41

CONTENTS

1 INTRODUCTION[1]

In recent decades, important changes have occurred in the European macroeconomic scenario. Various events, such as the introduction of the common market in 1992, the adoption of a currency union in 1998 and the Euro area enlargement to Eastern European countries in 2005, have created more interconnections among economies. In the context of world and European economic integration, the Italian industrial sector has been characterized by specificities in its production processes and its internal macroeconomic conditions. Italian manufacturing industry based on traditional specialization sectors (representing the so–called "made in Italy") has been more exposed to competition by emerging markets, such as the Asian and Chinese economies, than have other European countries. The early millennium world economy slowdown, mainly determined by a fall in world demand, generated a negative cyclical phase in almost all European industrialized countries. Italian GDP accordingly deteriorated in 2001-05, with an average growth rate close to zero, while industrial production experienced stagnation/recession. However, the intensity and duration of this cyclical phase appear atypical in Italy with respect to the experience of the main European countries (European Commission, 2007).

The aim of this paper is to analyze the main sources of Italian manufacturing sector fluctuations in the context of European and world economic integration. To this end, it quantifies the response of the industrial production to domestic and external shocks. The former reflect the effects of changes in internal economic conditions, due to demand and supply shocks. The latter enable consideration to be made of effects exerted by the world economic scenario which may affect the industrial sector's performance. For this purpose, we estimate a four variables structural vector autoregressive model (SVAR) with long run restrictions (i.e. Blanchard and Quah, 1989). This structural approach allows an economic interpretation to be given to shocks because the identification is carried out using restrictions deriving from economic theory. We examine the effects of four structural innovations on manufacturing business cycle: productivity, hours worked, integration process (i.e. to world trade) and competitiveness shocks.

Following the Blanchard and Quah (1989) seminal paper, several empirical studies have examined the causes of aggregate fluctuations using

[1] I would like to thank Francesco Nucci for his helpful comments that greatly improved the paper. I am also grateful to all the participants to the workshop "Integration and Globalization: Challenges for developed and developing countries" held in Coimbra for their useful suggestions. The paper also benefited of helpful discussions with Sergio De Nardis, Roberta De Santis and Carmine Pappalardo. The views expressed in this paper are those of the author and do not involve ISAE or MEF.

long run restrictions. To this end Bayoumi and Eichengreen (1992), Karras (1994) and Bergman (1996) use SVAR with long run restrictions to inspect the sources of macroeconomic fluctuations in some European countries. Gali (1992) employs a SVAR model to quantify the effects of demand and supply shocks on U.S. business cycle using a combination of short run and long run restrictions whereas Gali (1999) applies a SVAR model with long run restrictions to examine the role of technology shocks in explaining aggregate fluctuations. SVAR approach has also been used by Funkle (1997a and 1997b) to examine the effects of different shocks on German business cycle and to compare German and European fluctuations during pre-EMU period. Analogously, Gavosto and Pellegrini (1999) employ a three variables SVAR to quantify the effects of different shocks on Italian industrial output using total orders, national accounts hours worked and industrial production in their model. More recently Peersman (2006) uses a four variables VAR to analyze the effects of different shocks (monetary, oil, aggregate demand and aggregate supply shocks) on early millennium slowdown comparing U.S. and Euro Area economies using both short and long run restrictions and sign restrictions. In his findings, the early millennium world economy slowdown seems to be caused by an important role of negative aggregate spending and by the effect of a negative supply shocks. Negative effects of restrictive monetary policy in 2000 as well as negative impact of oil price increases in 1999 played a role although with a magnitude different depending on the identification approach.

With respect to the existing literature we contribute introducing the following innovations: *Firstly,* we focus on a small open economy model for Italian manufacturing sector allowing the integration process to explicitly be taken into account. We believe that globalization and the international environment can significantly contribute to explain the Italian industrial sector performance in the last decades. To this end the effects of international shocks (to world trade and competitiveness) in addition to traditional macroeoconomic internal demand and supply shocks are evaluated.

Secondly this study takes the labour-market indicator to be the qualitative hours-worked data furnished by business tendency surveys, rather than the usual hours worked reported by national accounts. This kind of data are directly collected from manufacturing firms business surveys, and indeed they are more suitable for analysis of the industrial sector. Furthermore, since they are built as balances between percentage of positive and negative answers provided by firms on the total amounts of hours worked, they are bounded and show a strong cyclical pattern.

Thirdly we employ identification assumptions, based on long run restrictions, that distinguish between domestic and foreign shocks allowing for long run zero effect of domestic shocks to the international variables.

All the shocks included in the model have been chosen on the basis of their theoretical relevance in explaining industrial business cycle. The productivity shock (i.e. to technology) is traditionally regarded as being a source of business cycle fluctuations. The hours-worked shock takes into account macroeconomic internal conditions and enables consideration to be made of labour-market dynamics which also play a central role in business cycle theory debate (see, Ravn and Simonelli, 2008, Pissarides, 2000). The competitiveness shock may play an important role in explaining the manufacturing sector's performance, since one would expect real exchange rate dynamics to affect trade balance. Finally, the world trade shocks reflect both changes in the integration process and in world demand conditions on Italian manufacturing sector performance. Over the last decades indeed world trade growth significantly accelerated as a result of international trade boost (see, Dean and Barriel, 2004). Since Italian economy is interdependent for the rest of the world for the acquisition of intermediate goods and for the allocation of its production, consideration of shocks to this variable, helps to explain industrial fluctuations.

The rest of the paper is organized as follows: section 2 introduces the structural VAR model for Italy, section 3 reports and discusses the empirical results. Section 4 concludes.

2 THE ECONOMETRIC MODEL

This section introduces the SVAR stationary[2] model and presents the structural shocks identification strategy based on long-run restrictions (see, Blanchard and Quah, 1989).

2.1 A small open economy model

Since the Italian economy appears to be strongly interdependent with the rest of the world for the acquisition of intermediate goods and for the allocation of its production, we consider a small open-economy model in which international phenomena (commerce/integration, real exchange rate/competitiveness) are important, as well as internal supply and domestic

[2] Preliminary cointegration tests on the variables did not reveal the existence of long-run equilibrium relations.

demand conditions[3]. To this end, the model includes industrial production, hours worked, real exchange rate and world trade[4]. Industrial output let to consider the production process dynamics. Hours worked let to take into account internal demand conditions[5], real exchange rate allows to consider the effects of competitiveness changes on industrial sector and world trade let assess the impact of shocks to integration process among economies and to world demand conditions on industrial performance. However, it is important to notice that the labour market indicator used in our study are not the usual hours worked coming from national accounts but qualitative hours worked data deriving from business surveys on manufacturing firms. This kind of indicator appears to be highly pro-cyclical and accordingly it is able to convey accurate information on the industrial sector business cycle. The usual unit root tests show that, whereas hours worked are stationary, the remaining variables display a stochastic trend[6]. The moving average representation of the structural form is thus:

$$x_t = K + S(L)v_t \tag{1}$$

where $x_t = [hw, \Delta rer, \Delta y, \Delta wt]$ represents the vector of the endogenous variables given by hours worked (*hw*) in levels[7], log differences of real effective exchange rate (Δrer), log differences of the industrial production index (Δy), world trade in log differences (Δwt), K is a constant, $S(L)$ is a polynomial in the lag operator *L* and $v_t = [v_{HW}, v_{comp}, v_{AS,}, v_{INT}]$ represents the vector of structural shocks with variance and covariance matrix $E[v_t v_t'] = I_n$. More in detail, v_{HW} is a domestic demand shock (on hours worked), v_{comp} represents a

3 The model does not include monetary aggregates because they are not particularly significant in explaining manufacturing sector fluctuations.

4 This variable usually represents a proxy of the world economic integration process.

5 Since information on hours worked that we use is collected from firms and not from workers as in the case of official labour force survey, in our view it is more appropriate to consider this variable as a labour demand indicator rather then a labour supply indicator.

6 The results of ADF test are reported in the appendix.

7 Since this variable is stationary can be directly used in levels in the model allowing for a better consistency with theory. Quite the opposite the question concerning the stationarity of national accounts hours worked is still unresolved (Francis and Ramey, 2006). Indeed the use of hours worked in levels, as showed in several empirical works, can determine a different impact of technology shock on hours worked. However this aspect do not represent the focus of this research.

competitiveness shock, v_{AS} is a domestic supply shock (i.e. to technology)[8], and v_{INT} represents the world trade shock (to integration process). In matrix form:

$$\begin{bmatrix} hw \\ \Delta rer \\ \Delta y \\ \Delta wt \end{bmatrix} = \begin{bmatrix} S_{11}(L) & S_{12}(L) & S_{13}(L) & S_{14}(L) \\ S_{21}(L) & S_{22}(L) & S_{23}(L) & S_{24}(L) \\ S_{31}(L) & S_{32}(L) & S_{33}(L) & S_{34}(L) \\ S_{41}(L) & S_{421}(L) & S_{43}(L) & S_{44}(L) \end{bmatrix} \begin{bmatrix} v_{HW} \\ v_{dcomp} \\ v_{AS} \\ v_{INT} \end{bmatrix}$$

The reduced form of the model is:

$$x_t = \Phi_0 + \Phi_1(L)x_{t-1} + \varepsilon_t \quad (2)$$

where Φ_0 e Φ_1 are the parameter matrices of the model and ε_t represents the vector of the residuals. The moving average representation of the VAR reduced form is:

$$x_t = K + C(L)\varepsilon_t \quad (3)$$

where $K = (I - \Phi_1)^{-1}\Phi_0$ is the constant and $C(L) = (I - \Phi_1(L)L)^{-1}$ is a polinomial matrix in the lag operator *L*. In order to give a structural interpretation to the shocks, from the correlated reduced form innovations ε_t one must recover the orthogonal shocks of the structural form (v_t). Equating (1) and (3), for *L=0* we obtain:

$$S(0)v_t = \varepsilon_t \quad (4)$$

where $S(0)$ is the matrix of the contemporaneous effects of the structural shocks on the macroeconomic variables.

2.2 Identifying assumptions

The matrix, $S(0)$ can be just identified by imposing 16 restrictions. The first 10 restrictions can be recovered from the reduced form residuals variance and covariance matrix (S(0)S(0)'= Σ). The remaining 6 restrictions can be

[8] To be noted is that in this framework, as Blanchard and Quah (1989), we interpret all technology shocks as having a permanent effect on industrial output.

imposed on the long-run multipliers impact matrix $S(1)$ associated with the moving average representation of the structural form $S(L)$. In particular, we make the following assumptions:

1. First, we assume that in the short run all the shocks may impact on real exchange rate. We also assume that all the shocks except that on hours worked (labour market demand shock), can permanently affect the level of the real exchange rate. In particular:
   - we assume that competitiveness shock and integration process shock can produce permanent effects on real exchange rate;
   - we assume that technology shock can also affect long run real exchange rate according to Harrod (1933), Balassa (1964) and Samuelson (1964) effect. Indeed through this effect technology shocks can modify productivity growth differentials and thus in the long run can affect real exchange rate;
   - we require no permanent effect of hours worked shock on real exchange rate according to its cyclical pattern. The restriction will be given by:

$$S_{21}(1)=0$$

2. Second, we assume that the long-run industrial production path is not only affected by technology shocks but also by world trade[9] shocks. In the short run, we assume on the contrary that all the disturbances may impact on output. The long-run restrictions will be given by:

$$S_{31}(1)=S_{32}(1)=0$$

3. Third, we assume that the long-run pattern of world trade is only influenced by shocks to the integration process (i.e. institutional shocks). There is no permanent effect of hours worked, domestic technology shock and real exchange rate on world trade according to the small economy hypothesis. The long-run restrictions for this variable will be given by:

$$S_{41}(1)=S_{42}(1)=S_{43}(1)=0$$

[9] We assume that mainly responsible for world trade fluctuations are both world demand shocks and political/institutional shocks connected to the international integration process among economies; we interpret these latter as having a permanent effect on output in line with the small open economy hypothesis.

In the short run, we suppose that potentially all the disturbances (domestic and foreign) may impact on world trade. This last assumption for the domestic shock effects on world trade can seems in contrast with the small open economy hypothesis. However it is important to stress that we only allow for domestic shocks to play a role in explaining integration short run pattern in the model even if in actuality it can be irrelevant.

3 DATA AND EMPIRICAL RESULTS

On the basis of the Schwartz information criteria we estimated a second order VAR length. Quarterly data seasonally adjusted over the period 1981Q3 2006Q3 were used. All the data were taken from the OECD database except for hours worked (source: ISAE).[10] The model passed the usual residual diagnostics. In what follows we analyze the impulse response functions and the industrial production error variance decomposition.

3.1 Impulse response analysis

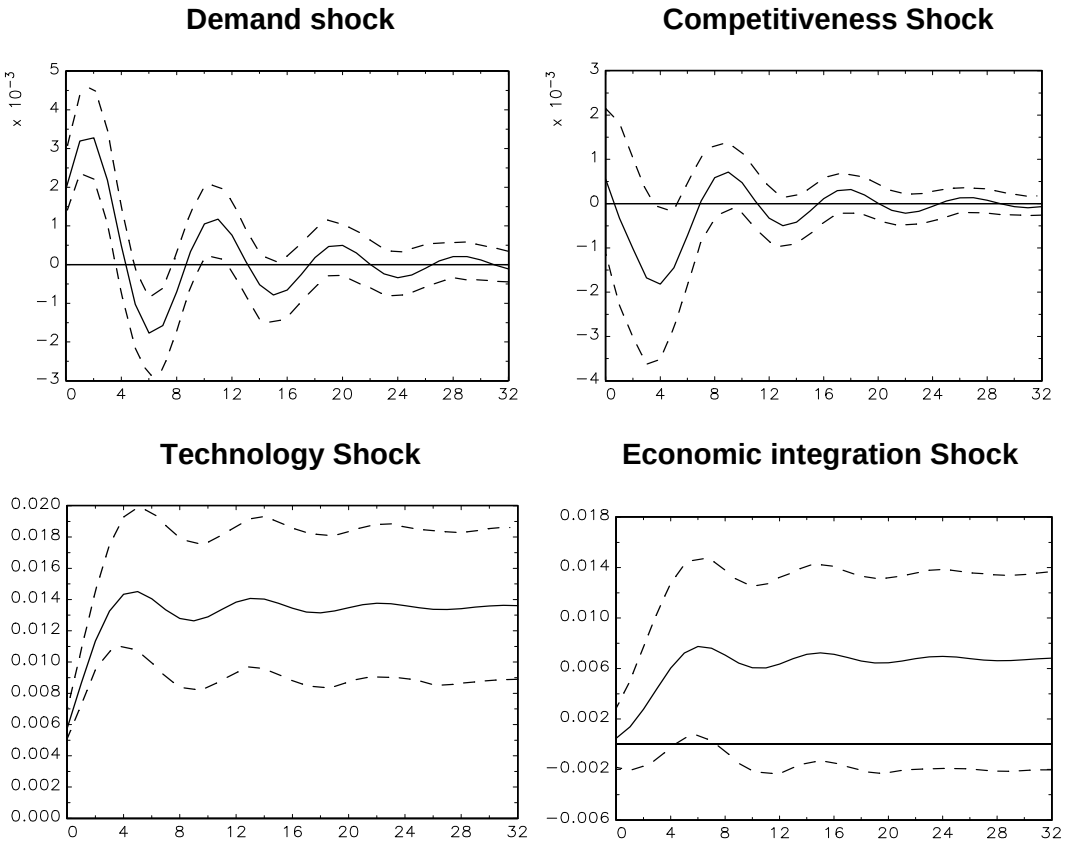
The impulse responses of the industrial production to different orthogonal shocks are reported in Figure 1. The confidence bands intervals of standard errors were calculated using a bootstrapping procedure with 2000 repetitions.

Inspection of the graphs in figure 1 shows that the response to a domestic demand shock (an increase of hours worked) is significant and immediately determines a rise in the industrial production in the first two quarters. The impulse slightly decreases, becomes negative after two quarters, it starts to go up again in the fourth quarter and dies out after roughly 4.5 years. Overall this result indicates that the labour market played a significant role in the manufacturing sector's performance in the period considered. This finding appear to be in line with thw analysis of Gavosto and Pellegrini (1999) that it based on the use of national accounts hours worked.

The competitiveness shock (loss of competitiveness) produces, as expected, a decrease in the industrial production that becomes negative after one quarter. However the response appears to be statistically significant only in the third quarter. The effect fully disappears after about 4.5 years.

[10] A full description of the variables is provided in the appendix.

Fig. 1 Impulse response of industrial production. Period 1982-06
(95% interval confidence bands: black dashed line: Hall-percentile)



The positive domestic supply shock (i.e. to technology) is statistically significant and determines as expected a rise of output.

The world trade shock, which reflects, to a large extent, positive changes in the institutional framework (such as the removal of trade barriers)[11], appears to be statistically significant (after six quarters) and produces a permanent rise in the industrial production within the first year.

3.2 Forecast error variance decomposition

In order to evaluate the relative contribution of each shock to the variance of the industrial production growth rate, table 1 reports the corresponding forecast error variance decomposition derived from the structural VAR. This kind of decomposition shows how much of a variable variation (i.e. industrial

[11] We seek to capture the idea that institutional reforms, such as the removal of barriers to trade, can produce a favourable permanent effects on integration and trade among economies, with implications for the level of economic activity.

production) is explained by different structural shocks. More in detail, the numbers contained in the table illustrate the percent of the forecast error variance of industrial production attributed to particular shocks at various horizons.

Tab 1 **Forecast Error Variance decomposition**
Industrial production growth rate
(in % of variable variance)

Forecast Horizon (in quarters)	Std error	Hours worked shock	Competitiveness shock	Technology shock	World trade shock
1	0.006146	10.3	0.8	88.3	0.6
2	0.007008	11	2.2	84.7	2.1
3	0.007670	9.2	2.6	83.1	5.1
4	0.008176	9.8	3.1	78.7	8.5
5	0.008574	12.9	2.7	73.1	11.3
6	0.008797	15.2	2.8	69.5	12.6
7	0.008886	15.6	3.4	68.3	12.7
8	0.008951	15.4	4.1	68	12.5
9	0.009043	16.0	4.4	67	12.6
10	0.009126	17.1	4.3	65.8	12.9
15	0.009291	18.3	4.6	64.1	13.0
20	0.009352	18.6	4.8	63.5	13.1

The results show that, after one period, hours worked and technology shocks, explain more than 95% of the total variance. Technology shock predominates at all time horizons although its contribution decreases over the time (from 88% after one quarter to 64% after five years). After six quarters, the contribution of hours worked shock slightly increases (from 10% to 15%). The integration process, which initially explains 2-5% of variability, becomes more important after five years and accounts for 13% of the total variance. In contrast, the competitiveness shock plays a minor role in explaining total variance at all time horizons (roughly from 1 to 5 %).

Overall our findings show that the integration process shock, which here is taken into account through the inclusion of world trade, significantly contributes to explaining the Italian manufacturing sector's performance over the last twenty five years. This period roughly corresponds to the years in which the integration and globalization among countries have been deepening. As expected technology shock plays an important role in explaining cyclical fluctuations in line with others studies on Italian industry (i.e. Gavosto Pellegrini, 1999). By contrast, whereas hours worked (and thus labour market) also represent a significant source of manufacturing business cycle, the competitiveness shock seems to have played a minor role in explaining Italian manufacturing growth rate dynamics in the period considered.

Although technology shocks appears to be relevant in both studies, some remarkable differences can be noticed concerning the amount of explained variance to be attributed to them. In particular Gavosto and Pellegrini find that technology shock accounts for 40% of output variability at the beginning and becomes more relevant in the long run (56%). They also find evidence of an appreciable contribution of labour supply shock that accounts for 26% at the beginning and reaches 54% in the long run and of a significant impact of demand shock in the short run (33% in the first quarter) that strongly decreases in the long run (3%). Apparently, our results seems to be quite different from Gavosto and Pellegrini findings. However, it is important to emphasize that the finding of high contribution of technology shock in the analysis, is in part due to the inclusion of the eighties in the sample period estimates. At this purpose it is well known that the during the '80 the Italian macroeconomic scenario was very different from '90. In particular throughout '80 the output fluctuations have been mainly driven by supply side sources due to the catching up process of Italian firms whereas from the beginning of nineties demand side[12] factors became more important. This view is in addition confirmed performing the estimates on the reduced sample 1990-06; in this latter case the variance decomposition indicated as expected an higher role of demand shocks and a lower role of technology shocks. The discrepancies of our results also depend on the investigation of a different set variables (in particular the inclusion of world trade as a proxy of international scenario changes) and on the examination of a different sample period. In fact while Gavosto and Pellegrini estimate their VAR over the period 1965-94, we concentrate on the more recent sample 1982-06 providing evidence of significant changes in the role of shocks affecting business cycle dynamics with respect to the past.

[12] i.e. currency shocks.

4 CONCLUDING REMARKS

The study has analyzed the sources of cyclical fluctuations in the Italian industrial sector. It has sought to interpret the effects of different kinds of impulses on Italian manufacturing performance in the context of world economic integration. Considered for this purpose have been both domestic shocks related to internal macroeconomic conditions (i.e. technology and labour market shocks) and international shocks (competitiveness and world trade), taking account of the Italian economy's interdependence on other countries.

Assessment of the impulse response functions in the 1982-06 sample has demonstrated that the Italian manufacturing sector has reacted positively to integration process and competitiveness shock as well as to technology and hours worked shock.

The variance decomposition shows that manufacturing fluctuations are driven mainly by technology shocks. Domestic demand and world trade shocks also play a very important role. In particular the integration process, and hence the international scenario, seems to be a very important factor in explaining the industrial production growth rate dynamics in the last 25 years.

APPENDIX 1: DEFINITIONS AND DATA SOURCES

Industrial production index is the Italian production index base 2000. Source OECD.

Hours worked is a qualitative variable coming from Manufacturing Business Survey quantified through balances between positive and negative answers. This variable represents the variation in total number of hours worked in the last three months provided by manufacturing firms. Source ISAE.

Real effective exchange rate index is a chain-linked index with base period 2000. Percentage changes in the index are calculated by comparing the change in the index based on consumer prices for Italy to a weighted average of changes in its competitors indices. Source OECD.

World trade is the volume of world trade exchanges in goods and services seasonally adjusted among OECD countries in billions of 2000 US dollars. Source OECD.

APPENDIX 2

Dickey-Fuller tests of stationarity - Period 1981:Q4-2006Q4

Variable	Intercept levels lag	First Differences	Intercept and trend levels lag	First Differences
Ind. production	(1) -1.23	-4.40***	(1) -2.51	-4.39***
Word trade	(4) 1.90	-5.74***	(4) -3.64**	-6.29***
Hours worked	(3) -5.34***		(3)-5.33***	
EP*/P	(0) -1.08	-8.01***	(0) -1.65	-8.35***
*significant at 10% level **significant at 5% level *** significant at 1% level				
Note: the lags in the tests were estimated through the Swartz information criterion				

Cointegration test - Period 1981:Q2-2006Q2

Test	Value	5% Critical value	1% Critical value
Johansen eigenvalue test	11.03488	20.97	25.52
Johansen trace test	17.10893	29.68	35.65
Variables: industrial production, world trade, real exchange rate			

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