The business cycle and its international transmission: recent changes for the Italian economy

By

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Abstract

This paper presents some general "statistical facts" about the Italian business cycle. Our results suggest that in the last decade the Italian economy has been increasingly synchronized with the Euro Area and still lags behind the US cycle (by two quarters on average). In line with other industrial countries, the Italian cycle has dampened in the 90s, when the Italian economy has integrated more intensively with the Euro Area. In the same period, the average duration and magnitude of contractions has significantly lowered. Furthermore, a structural VAR analysis shows that US expansions tend to affect the Italian economy more significantly and more strongly when the US economy is booming rather than contracting. This could be due to a transmission channel working through the dollar exchange rate.

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Section 1: Introduction

This paper studies the key features of the Italian business cycle in the last decades and the (possible) changes of its synchronization with respect to the cycles of other industrial countries. Against this background and to this aim, the paper also addresses the more general issue of whether common cycles across industrial countries exist, and whether the transmission of cyclical fluctuations amongst industrial countries has varied.

Over the last decade a number of relevant changes indeed affected the structure of many industrial countries, not necessarily in the same direction or with the same intensity. For instance, the start of the European Monetary Union has represented a structural break which has obviously affected the transmission of cyclical fluctuations within Europe and between Europe and the US; furthermore, soon after German reunification, the German cycle diverged significantly from that of other European countries. Having EU countries lost the exchange rate as an instrument to react to unfavourable phases of the cycle, large cyclical divergences are increasingly difficult to accommodate by a common monetary policy. Also, a number of technological advances and structural reforms have affected in different ways different countries, with implications on the domestic business cycles and on their interaction (e.g. the new economy bubble, the increased openness of a number of countries, the entry of new players in the international arena, the shift towards a more "service-oriented" economy, etc.).

Our aim is to provide a description of the Italian business cycle within a general framework and, in particular, to study the links and the synchronization of the Italian cycle with US and European business cycles, emphasising the main changes occurred in the 90s and the possible policy implications of these changes. We start by presenting the results of well-established studies before adding our contribution.

Section 2 summarizes the results of some recent studies on the international transmission of business cycles and their main findings, highlighting the common results- if any- and the source of disagreement. Our review focuses on Italy: hence, on the one hand, we selected those studies explicitly including Italy and, on the other hand, we extract the results for the Italian business cycle in other more general studies.

To identify business cycles is not an easy task. There are several methods and there is no unanimous agreement on which one to use. Section 3 describes the different approaches followed in the literature: namely, the "classical approach", identifying the expansions and contractions in the absolute level of aggregate economic activity, and the "trend-cycle approach", focusing on deviations in economic activity from a long term trend, so that growth expansions are described as periods when the economic activity is above the long-term trend of growth (and conversely, contractions as periods when it is below the long-run trend). As the growth cycle is defined in terms of deviations from trend, it is obviously important to be clear about the way the trend is statistically identified (Hodrick-Prescott, 1980, Baxter-King, 1999, Ouliaris-Courbae, 2002).

Section 4 describes the key features and the major changes of the Italian Business cycle in the last thirty years. According to the classical approach, we identify the turning points of industrial production for the period 1970-2002. The main results are that the average duration of the Italian cycle and the average amplitude of contractions have reduced over time. In this section, we also analyse the correlation (contemporaneous and lagged) of the Italian GDP - i.e., the most comprehensive and readily-available single measure of economic activity - with that of the major industrial partners. For this analysis the series are detrended using Hodrick Prescott filter. According to our study, Italy follows the cycle of Germany and US by at least one quarter and its cycle is now much closer to the one of Germany than it was in the 70s and 80s.

Section 5 studies the transmission of a US shock to the Italian economy with a semi-structural VAR analysis. The hypothesis we want to test is whether the transmission is different according to the phase of the US cycle. We found an asymmetry in the transmission of US shocks depending on whether the US is in a boom (transmission is faster and more intensive) or in a recession (transmission is slower and not significant).

Finally, Section 6 concludes, proposing further extensions and drawing some policy implications.

[1] To this aim it may be worth mentioning that the Italian cycle experienced much higher fluctuations than those of other European countries in the 70s and part of the 80s, due possibly to higher reliance of Italy on imported oil.

Section 2: Recent Trends in the international transmission of business cycles

In the last twenty years the study of domestic business cycles and the identification of a common dynamic component – at the world level – has been the focus of many different studies, many of them empirically centred.

There are substantial differences in the methods followed, and in the number and type of countries considered (and therefore in the results obtained). Techniques available for measuring synchronization in the timing of the cycle range from simple correlation in output (gaps, levels or growth) to more sophisticated econometric approaches (e.g. VAR analysis, spectral density analysis, common dynamic principal components, etc).

Moreover there are several issues to be solved in any case, no matter what method is used. First, there is the issue of how countries are grouped: as a matter of fact, averaging bilateral correlation in output across industrial countries may conceal changes at the regional level. Second, empirical analysis has to address the issue of the extent to which, for instance, correlation captures external influences on domestic activity. Finally, classical cycles can be very different from growth cycles (see Cashin Ouliaris 2001, for an empirical example on the Australian economy).

Despite the differences in the approach followed by different studies, some very general stylised facts on business cycle size, duration and timing can be singled out (cf. for all OECD, 2002, ECB, 2001, Agresti-Mojon, 2001, Daalgard et al, 2002, IMF, 2001 and 2002 etc).

The starting point is that the high degree of economic and financial integration, the possible similarity in industrial structure, the resemblance of the legal and institutional framework, should all imply a common business cycle between industrial countries, even though not at the world level. Indeed, the importance of economic integration is easily interpretable: countries highly integrated should exhibit similar growth rates since the high degree of integration may facilitate the transmission of a shock from one country to the other.

There is some agreement that the business cycles of industrialized economies are highly correlated amongst themselves. There seems to be agreement also on the fact that, at a national level, still considering a sample of industrial countries, the amplitude of cycles (measured in different ways) has decreased over time; there is also a decrease in the amplitude of international business cycle with respect to the 60s and this is probably due to the lower amplitude of the individual domestic cycles. However, quite surprisingly given these developments, there seems to be little evidence of an increase of synchronization over time. This lack of synchronization may have important consequences; since each domestic cycle can be either amplified or smoothed by impulses coming from abroad and the pattern of the cycle can in turn affect economic policies (cf. Giovannetti e Marimon, 1999). This is particularly important for Italy, which historically was more depending on the US cycle than some other EU countries[2].

Since there is no consensus regarding the transmission of business cycles, we briefly review the main results of the most recent work on the issue (also with the help of summary table 1). Of course we try to "read" these studies with Italy in mind.

Agresti-Mojon (2001) explicitly analyse the business cycle of Italy in relation to the aggregate Euro Area. They point out that there is a high synchronicity. This synchronicity is also observed for the main GDP components, as well as the interest rate, and is particularly high for Italy, Germany, France and UK, when compared to other European countries. According to Agresti-Mojon (2001), the stylised facts for the Euro Area economy and the US are very similar, even though the magnitude of cycles seems to be slightly higher for Europe (with possible consequences for the data filtering)[3].

The IMF (2001 and 2002) maintains (in general over a large sample of OECD countries) that recessions have become less severe and less frequent over time, booms are longer. In the 90s, recessions are synchronized within areas (this has the important implication that the world GDP has not decreased since the recession in one area could be balanced by a boom in another). In general, contractions of investments lead recessions, while booms are led by consumption and exports. Interest rates and output cycles in G7 are highly correlated. Italy shows a big change in the correlation of output gap between the 1974-2000 period and the 1991-2000 period versus US while the correlation versus Germany remained the same (cf. Table 1).

Dalsgaard et al (2001) emphasize the decrease of the output gap in the 80s and 90s in EU, US and Japan and the lower volatility and smaller size of domestic cycles over time. Despite the decrease in the amplitude of the cycles (which according to the authors reflects changes in economic structure, better policies and smaller adverse shocks), however, there is no evidence of higher synchronization of business cycles over time.

The techniques used for measuring synchronization in the timing of peaks and troughs in different countries are different, so are also the techniques to extract the low (high) frequencies component and this can explain the different results.

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[2] Germany was mirroring the US cycle, with the DM appreciating at the time when the dollar was depreciating and vice versa.

[3] They propose to widen the window to 40 rather than 32 quarters to better account of EU characteristics, since the magic 32 number was originally estimate for the US cycle.

Table 1: An overview of the empirical literature on business cycles

	Period and Data sources	Countries	Corr of output gap Italy-US	Corr of output gap Italy-Ger.	Main findings	Methodology
Dalsgaard et al, 2001 (OECD)	1973-2001 (some from 1961)	OECD countries	NA	NA	Reduction of output gaps in the 80s and 90s in EU, US and Japan; However, no higher synchronization of cycles; length of cycles, measured by persistency of series, unchanged.	Hodrick Prescott filter; output gap variance
IMF, 2002	1974-2000 1991-2000 OECD QNA and IMF data	21 industrial countries	0.46 -0.28	0.74 0.75	Typical cycle lasts about six years (one year recession and five years expansion). Recessions are shorter and expansions longer; recessions are synchronized by areas in the 90s; investment lead recessions: contraction in private fixed I begin earlier, last longer and are deeper than output contraction; consumption and exports lead expansions; cycles of interest rates and output in G7 are highly correlated.	Turning points identified by Bry-Boschan; Correlation analysis;
Agresti-Mojon (2001)	1970-2000 OECD QNA, seasonally adjusted, for EU11 aggregate, ECB Area wide model	EU11 US Quarterly data from OECD QNA database. EU11 aggregate 70-98	NA	High vs EU11	EU cycle more cyclical than US (contrary to common wisdom): spectral density reaches its peak for cycles of 5 years duration, for US at 0 frequency. Booms are longer than recessions. Divergences between EU and US in the 90s. US cycle tends to lead the Euro Area cycle (2 or 3 quarters). Each national business cycle is highly correlated to the aggregate Euro Area cycle.	Band Pass filters; Data transformed into log before being filtered; correlation and cross correlations with GDP (t+k); spectral density.
Wynne and Koo (2000)	1950-1995	EU15 plus 12 federal	NA	NA	Greater synchronization among original EU6 but less than in US12.	Band pass filter;

	annual data,	districts in the US			Lower synchronization among later EU joiners, although significant co-movements among close trading partners;	
Eurostat, 2002	1991-2001	8 European countries (Belgium, Germany, Spain, France, Italy, the Nerherlands, Austria and EU8)	NA	Graph vs E8 area: degree of synchronization of Italian economy decreases up to 98 and slightly increases afterwards.	Degree of synchronization between output fluctuations (corr coefficients) declines from 94/95 to 98/99 and then increase again: for most countries is the same than a decade ago (Germany has higher degree of idiosyncrasy); decline in output variability and increased interdependence; Overall pattern of synchronization depends on offsetting trends in co-movements and variability of output fluctuations.	Cyclical component of GDP examined using correlation, covariances and standard deviations. HP filters to the level of all series. Moving correlations, covariances and SD over 12 quarters to measure for synchronization and amplitude.
ISAE, 2002	1994-2002	EU, US, Japan	0.7 in 1998-2001 vs 0.26 in 1994-1997	0.94 in 1998-2001 vs 0.41 in 1994-97	Degree of synchronization has increased. Rapid transmission of cyclical downturn in the US.	Correlation

Section 3: Approaches to measuring the Business cycle

Burns and Mitchell (1946) define the business cycle as the fluctuations of a time series representing the economic activity of a country.[4] To study business cycles, therefore, the first step is to select the appropriate time series and, secondly, to choose the procedure to measure its fluctuations.

Usually the Gross Domestic Product or the Industrial Production Index are chosen as representative series. This choice is a matter of opinion. The GDP is a quarterly variable, released by national statistical institutions with delay. It is subject to continuous revisions that may affect its use for a close-to-present analysis, but is the most comprehensive single measure of economic activity. Industrial production is a monthly variable and, although it does not account for services, it is characterised by a high correlation with the Gross Domestic Product. The main shortcoming is its large volatility (hence a low signal-to-noise ratio).

An alternative to the use of GDP or industrial production is to select a single indicator representing the whole economic activity. This has been recently constructed by aggregating a copious amount of high-frequency information in a unique series so called Coincident indicator (see Altissimo et al. 2000, for Italy recently computed also for the Euro Area).

As mentioned above, business cycles can be studied according to the classical approach, and the trend-cycle approach (growth cycles).

3.1 The classical approach

The classical approach, based upon Burns and Mitchell's paper (1946), has a long tradition in business cycle analysis: Expansions and contractions are extracted from the *level* of economic activity (or output).

A period of monotonic increase (decrease) in the level of economic activity is called *expansion* (*contraction*); when there is a change this is called *turning point*. Formally it is the moment separating expansions from contractions and vice versa. Two consecutive different phases form a *cycle*. Each phase can be characterised by the *amplitude,* i.e. the "length" and the "depth" of the fluctuation, and the *duration,* i.e. its time length.

Starting from these concepts, the classical approach consists in finding a set of *turning points*, which partition the pattern of the series into elementary movements of increasing or decreasing in the levels of economic activity.

[4] In particular, the range of periodicity must be not less then 6 quarters, and not higher then 32 quarters

The best known procedure to determine a sequence of turning points, is the algorithm proposed by Bry and Boschan (1971) for monthly series[5], According to the adopted definition of business cycle, the procedure uses censoring rules, to filter out false signals.

Once the turning points have been selected, the business cycle can be summarized through the number and the dating of its contractions, and expansions, and their relative duration and amplitude. To calculate these measures, it could be useful to think of a phase as a triangle, where the height is the amplitude and the base is the duration[6].

3.2 The trend-cycle approach

The cycle-trend approach is based on the assumption that a series, seasonally adjusted, can be decomposed into a growth component, called *trend*, plus a cyclical component. The latter is the quantitative measurement of the business cycle.

There are many ways of detrending, reviewed comprehensively in Canova (1997). The most widespread methods have been proposed by Hodrick-Prescott (HP 1980) and Baxter-King (BK 1995).

3.2.1 The Hodrick and Prescott's filter

Hodrick and Prescott propose to estimate the growth component and to derive the cyclical component as the difference between the observed value and the growth component itself. The main hypothesis is that, over long time periods, the average of the deviation of the series from the growth component (that is the cycle), converges to zero, and that the growth component varies, over time, in a sufficiently smooth way (relatively to the cyclical component). In particular, Hodrick and Prescott estimate the growth component minimizing the following loss function: the square of the cyclical component plus the *weighted* measure of the smoothness of the growth component (defined as the sum of the squares of its second difference). The weight of the latter represents a penalization for the variability of trend. To be applied, the filter requires that the researcher chooses the value of the weight to be assigned to the trend smoothness. This depends on the frequency of the time series and Hodrick and Prescott propose some precise numbers from the examination of United States' data (i.e., 14400 for monthly data, 1600 for quarterly data and 100 for annual data). King and Rebelo (1993) demonstrate that the filter removes low frequency and smooths the high frequency

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[5] A quarterly version of the algorithm has been proposed by Harding and Pagan (1999). Both versions of the Bry-Boshan algorithm are described in Appendix 1.

[6] The amplitude of a phase is simply the level of the series at the turning point minus the level at the initial one, while the duration is the number of months (quarters) between the dating of the initial turning point, and the end one.

components. It has, also, the property that it removes the unit root component of a series, and it doesn't shift its phase.

3.2.2 The Baxter and King's filter

The BK filter works in the frequency domain and defines the cycle as the component of the time series whose frequency range is between 8 and 32 quarters. The length of this window is derived by Burns and Mitchell (1946) from empirical studies on the US business cycle.

According to this approach the estimation of the business cycle leads to the construction of appropriate filters with the spectral density function. The actual filter is the best approximation of an ideal filter that would totally eliminate components with low frequency (over 32 quarters, i.e. the trend), and components with very high frequency (below 8 quarters, i.e. the irregular component). Baxter and King (1995) prove that the filter has the property to remove unit roots, does not shift the phase, and isolate business cycle frequency without reweighting past frequency.

The length of the window (8-32 quarters) of the business cycle's frequency can be modified. Agresti and Mojon (2001), for instance, propose to extend the upper bound to 40 quarters, because they claim that in several European countries the cycles lasts more then 32 quarters.

Section 4: The Italian business cycle and an International comparison

By taking the different approaches described above, we have analysed the Italian business cycle over the last thirty years, using the time series of both the industrial production and the GDP[7].

4.1 The classical approach and the Italian economy's turning points

By applying the classical approach and the Bry-Boschan algorithm, we have, first of all, extracted the turning points for Italian industrial production.[10] This variable, which has the drawback of not including the service sector, is highly correlated with the Gross Domestic Product.

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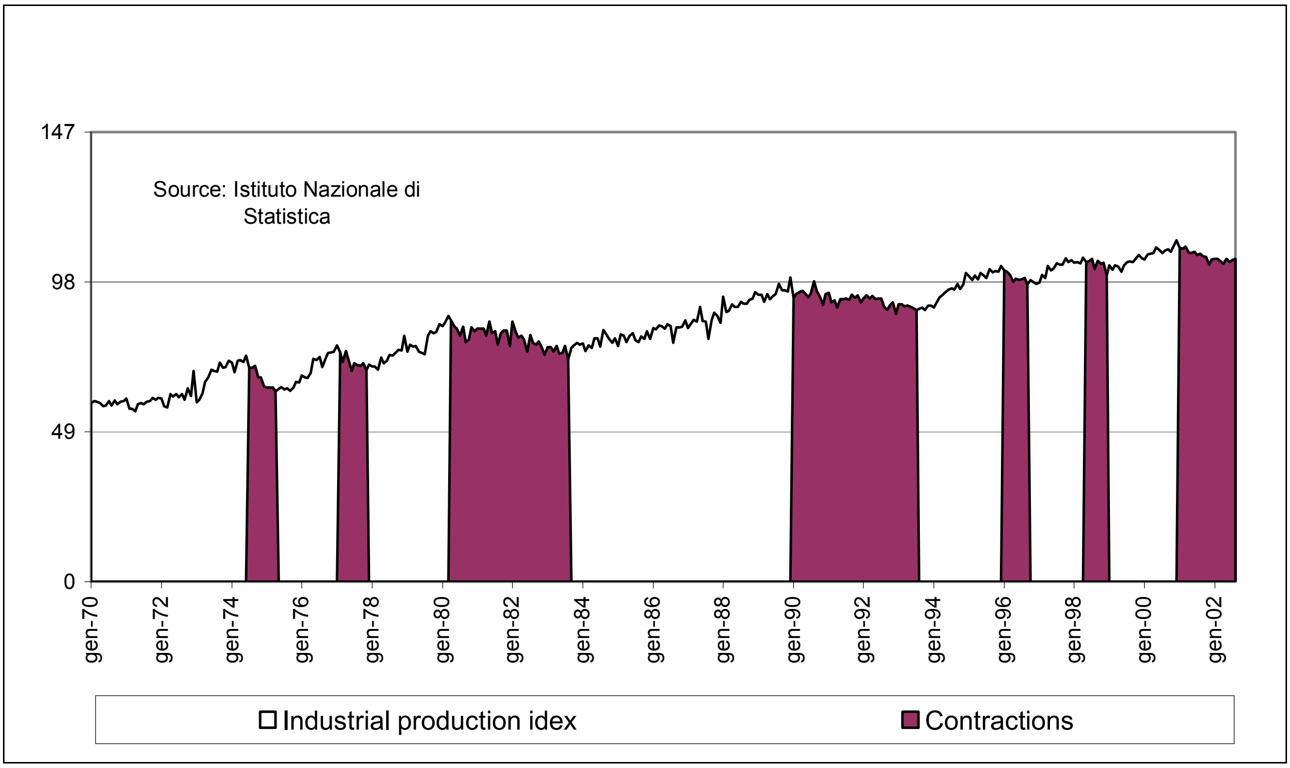
[7] We have replicated this exercise with the monthly Coincident Indicator, provided by Isae in cooperation with Bank of Italy (see Altissimo Marchetti, Oneto, 2000),. The results, available on request, are similar but are not presented because the data series is shorter (1980-2002).

[8] We have replicated this exercise with the monthly Coincident Indicator, provided by Isae in cooperation with Bank of Italy (see Altissimo Marchetti, Oneto, 2000),. The results, available on request, are similar but are not presented because the data series is shorter (1980-2002).

[9] Although originally designed only for monthly time series, we developed a program that implements the Bry-Boschan algorithm also for quarterly series to be applied on the GDP series. Monthly version of the program has been applied to the Italian industrial production in the period 1970:1-2002:08.

Figure 1 shows the pattern of the of industrial production index. The shaded areas represent recessions (peak to trough movements), as determined by the algorithm.

Figure 1: Contractions in Italy



On the basis of the extracted turning points, we have calculated a set of summary statistics. Table 2 shows the duration and amplitude of the phases for the whole sample, for the period 1974-1993 and for the last decade 1994-2002. In the calculation of the average amplitude and duration, we have neglected (*i*) respectively, the big expansion in the 80s, which appears to be, quite anomalous, (*ii*) and the initial and final phases, which, according to the algorithm, can not be precisely estimated.

In general, over the whole sample, contractions last less then expansions and the Italian economy increases more in the expansions than it decreases in contractions. About half of the phases in the whole sample, has occurred in the last decade. This means that the duration, but also amplitude, has shrunk over time, in particular for contractions. In fact, in the last decade, the average duration and amplitude has decreased respectively by 5% and 30% for expansions, and

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[10] Although originally designed only for monthly time series, we developed a program that implements the Bry-Boschan algorithm also for quarterly series to be applied later on the GDP series. Monthly version of the program has been applied to the Italian industrial production in the period 1970:1-2002:08.

65% and 48% for contractions, compared to the first twenty years of the sample. These changes are broadly in line with what found by the IMF (2001, 2002) also for other industrial countries.

Table 2: Characteristics of the Italian Cycle

	Numbers of Phases		Average Duration		Average Amplitude*	
	Expansions	Contractions.	Expansions	Contractions	Expansions	Contractions
1974-1993	3	4	25 months	26 months	16.5	-11.25
1994-2002	3	2	24 months	9 months	11.5	-5.8
1974-2002	6	6	24 months	20 months	13.7	-9.4
* In % points, Maximum-Minimum for Contractions, Minimum-Maximum for Expansions						

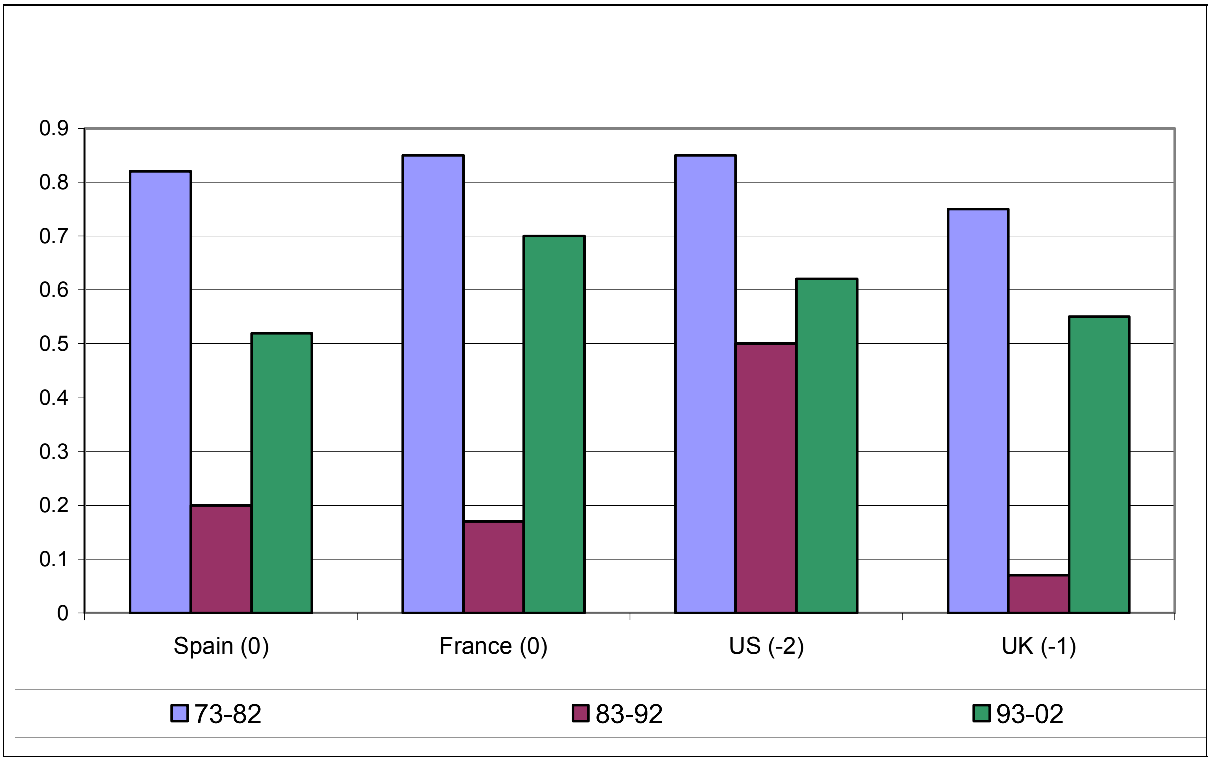
We then compare the Italian business cycle to that of other industrial countries, namely France, Spain, United Kingdom, and United States. In this case, because of the lack of comparable data for all the countries, we have used quarterly Gross Domestic Product, (volume index) from IMF.

The identification of an international business cycle (on the line of Harding and Pagan, 1999) has been performed by means of a concordance analysis. In other words for each couple of countries, and for various sub-samples, we have computed the *measure of concordance,* defined as the fraction of periods that two economies are both in the same state. This index is useful to understand if one economy is pro-cyclical or counter-cyclical. The index ranges between zero and one. If the index is close to one, the two economies are highly pro-cyclical, if vice versa is close to zero, the two economies are counter-cyclical.

We have applied the quarterly version of Bry-Boshan procedure to Gross Domestic Product over the period 1970:01 2001:04 and computed the concordance measure between countries. Figure 2 summarizes the results. More precisely, the bars present the concordance measure, in three subsamples, between Italy and the lead (or lag) most highly correlated at a contemporaneous level for each partner country.

From this analysis, we can state that in the 80s the Italian cycle was strongly counter-cyclical with all countries under exam but the US (where concordance is 0.5); however, in the last decade its concordance has substantially increased, especially with respect to France (0.7). In the whole sample it seems to be contemporaneous with Spain and France, with a higher concordance in the 70s. It lags the UK cycle by one quarter and the US by two quarters, even if the measure of concordance decreases over time.

Figure 2: Concordance Measure with Italian Cycle



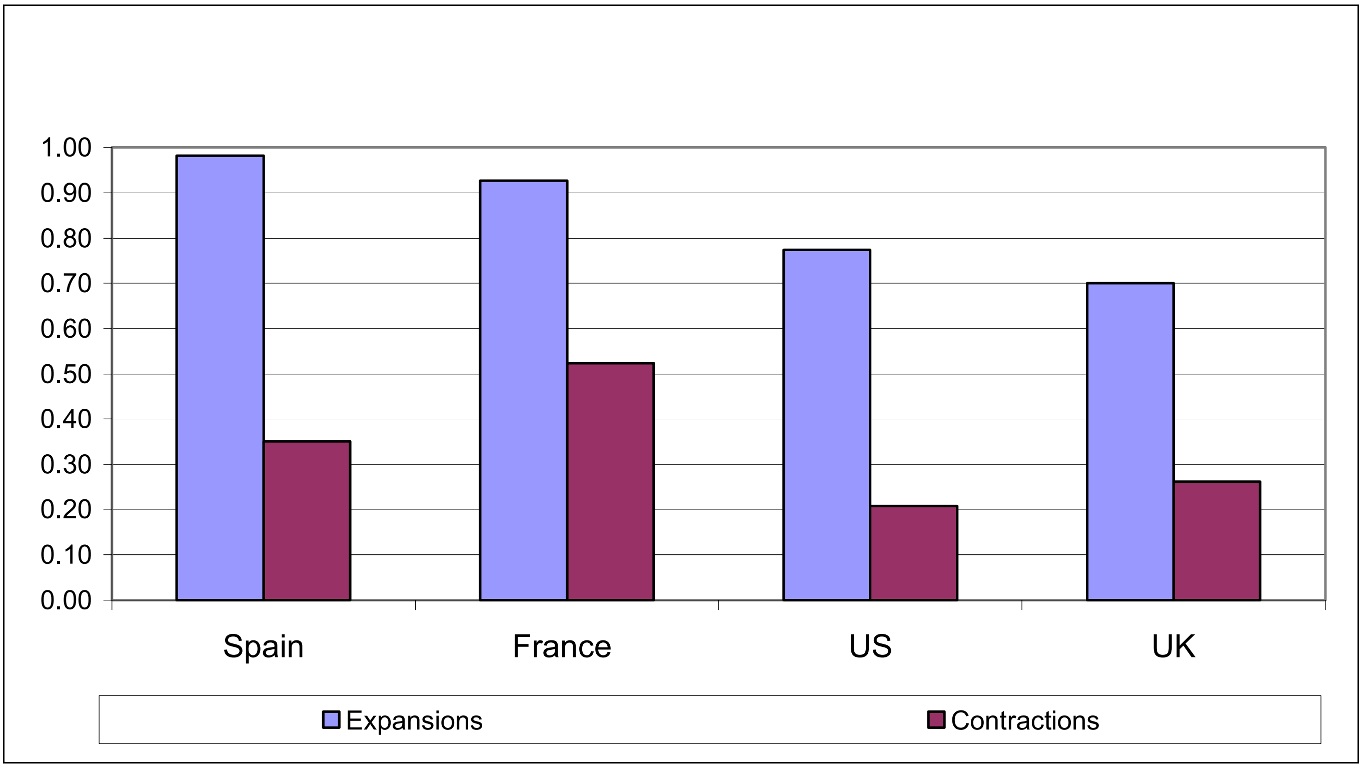
These results are in line with what observed in the literature on Italian business cycle by means of the classical approach analysis. For instance, The World Economic Outlook (IMF 2002) shows that the amplitude and the duration of recessions have reduced over time and synchronization has became higher. Krolzig and Toro (2001) show that there is a high degree of concordance among countries in Europe even if business cycles differ widely from counties.

Using the measure of concordance, we can also study if there is an asymmetry in the transmission between phases. We consider the Italian cycle as reference and we compute the concordance measure, confining ourself to either the observations of Italian contractions or of expansions.

Figure 3 shows that the concordance in expansions is higher than in contractions. The average of concordance measure during expansions is between 0.7 and 0.98 for all countries, while during contractions is between 0.20 and 0.52. It follows that the transmission during expansions is more clear-cut than in contractions.

[11] In the graph is shown only the concordance measure between the leads highly concordant with Italian cycle.

Figure 3: Measure of concordance (1973-2002)



4.2 The trend-cycle approach and the Italian economic cycle's series

To analyse the growth cycle of the Italian GDP, we extract the cyclical components by using both the BK and HP filters. Graphically these cyclical components are very similar. From Figure 4 it is clear that both filters produce similar estimates, especially for the dates of the downturns and upturns, even if the cycle obtained with the HP filter is slightly more volatile. This higher irregularity is due to the fact that the HP filter, contrary to the BK filter, by construction, includes the very short-run, irregular component.

Table 3 compares the Italian growth cycles obtained with the two filters by means of some general statistics: the two business cycle series are, as expected, very similar.

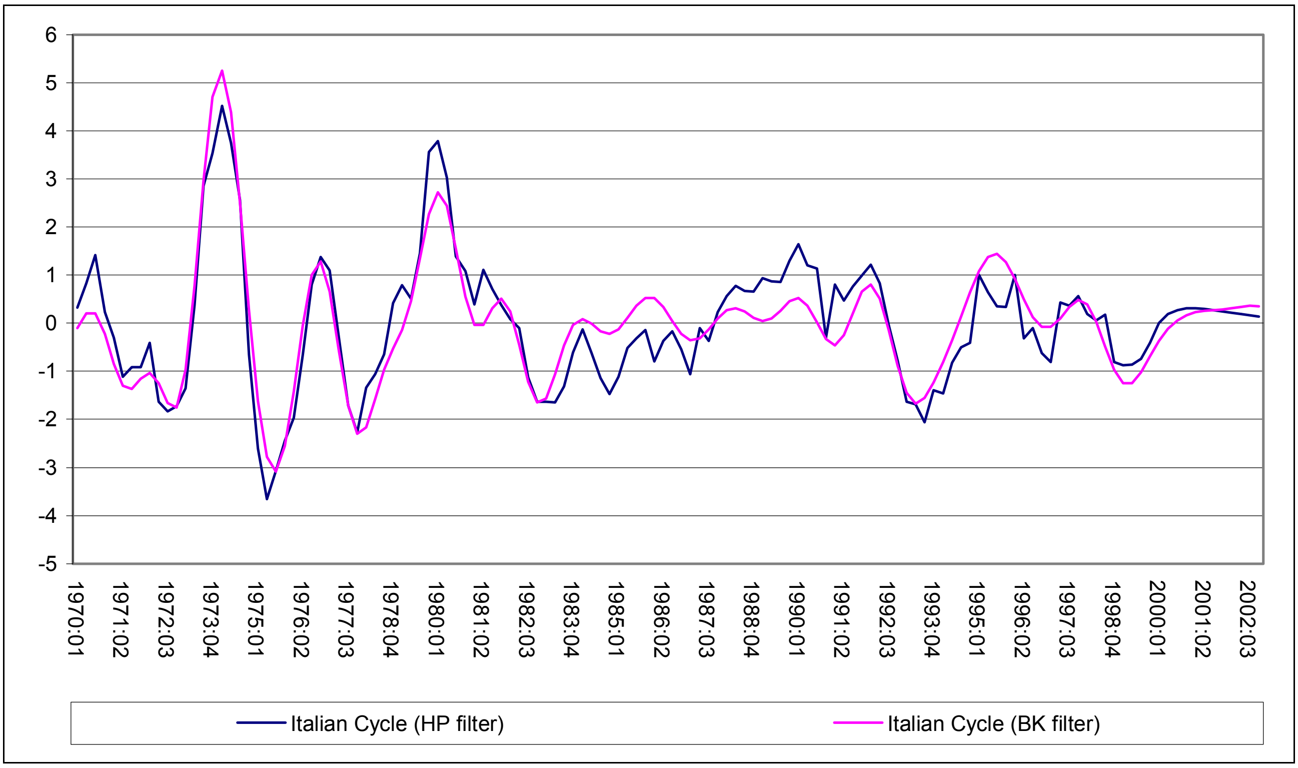
Table 3: Descriptive Statistics of the two growth cycles.

	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
BK Filter	-0.01	5.25	-3.08	1.20	1.14	7.37
HP Filter	0.00	4.52	-3.66	1.28	0.60	4.90

Only the skewness and the kurtosis differ in a significant way. The positive value of the skewness highlights, especially for the BK filter, that the upturns are slightly larger than downturns.

From the kurtosis's value we derive that the two distributions are peaked (leptokurtic) relative to the normal, which implies the selection of a higher number of turning points with respect to classical cycle.

Figure 4: HP and BK filters in comparison



The cyclical components exhibit a correlation of 0.90, hence our analysis continues on the HP-filtered series, more commonly used and hence more easily comparable with other studies.

We use the quarterly version of Bry-Boshan procedure to date the Italian *growth cycle*. Table 4 presents the main statistical properties of Italian growth cycle.

Table 4: Characteristics of the Italian Growth Cycle

	Numbers of Phases		Average Duration		Average Amplitude*	
	Expansions	Contractions.	Expansions	Contractions	Expansions	Contractions
1974-1993	6	6	11 quarters	4 quarters	3.5	-3.5
1994-2002	3	3	7quarters	5 quarters	1.2	-2.2
1974-2002	9	9	9 quarters	4 quarters	2.9	-3.1
* In % points, Maximum-Minimum for Contractions, Minimum- Maximum for Expansions						

The results basically confirm our previous findings: contractions last less than expansions; both phases become less pronounced with time; expansions are shorter. The only difference with respect to the findings of the classical approach is that contractions maintain their duration stable instead of decreasing it.

The trend cycle approach, however, identifies six phases more than the classical one (as expected). The two big contractions in the first years of the 90's and 80s, selected by the previous method, here are divided into shorter elementary movements.

Contrary to what observed by Cashin and Ouliaris (2001) for Australian business cycle[12], we find that classical troughs are predictors of growth ones, they are selected with 1 quarter's average lag[13]. The dating of peaks coincides in almost all cases.

To compare the Italian business cycle with that of other countries we conduct a correlation analysis on cyclical component of Gross Domestic Product. More precisely, we compute a rolling correlation, in a 10 years window, between the Italian cycle and that of US, UK, France and Spain.[14] The results, in line with the previous concordance analysis (cf. Figure 5), show that French and Spanish business cycles seem to converge to the Italian one with a high correlation (especially France) since the 90's. Italy lags United Kingdom by four quarters but in the last few years it has bridged the gap by two or three quarters. The U.S. cycle tends to lead the Italian cycle by one or two quarters, up to four quarters from the beginning of the 90s. During the 80's the Italian cycle seems not to have a stable relationship with these countries.

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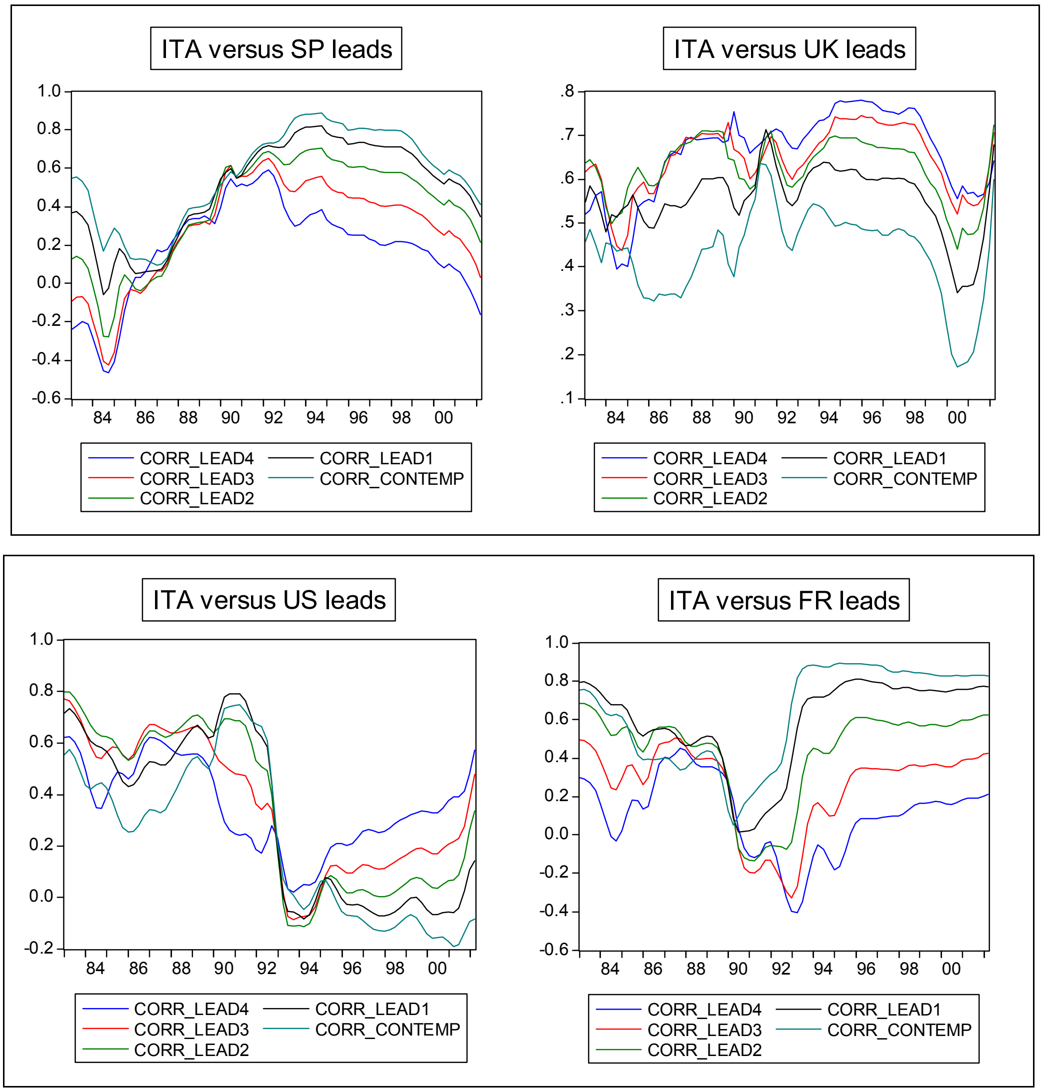
[12] "Downturns in the Australian growth cycle tends to lead peaks in Australian classical cycle, while upturns in Australian growth cycle tend to be coincident with troughs in the Australian classical cycle."

[13] The average is computed considering only common turning points.

[14] We did not include Germany for problems with the series after reunification.

Figure 5: Leads and Lags



These results are in line with what indirectly observed in literature. In their study on the Euro Area business cycle, Agresti and Mojon (2001)[16] shows that the Euro Area lags the US economy, while it is highly synchronised with Italy. Hence, the Italian and US business cycles are two or three quarters apart as in our findings. Moreover, Dalsgaard, Elmeskov and Park (2001) analysing the business cycle[17] of Italy, France, Spain, United Kingdom, U.S. and other industrial countries, show that the cycles have become less divergent over time. The amplitude has declined over the past two decades, while the duration appears to be unchanged in the major regions.

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[16] They filter the data using the Baxter and King filter and a modified version of it.

[17] They filter the data as us, i.e. using the Hodrick and Prescott filter.

Section 5: The transmission of US business-cycle impulses to the Italian economy

One of the goals of this study is to assess, both qualitatively and quantitatively, how shocks to the US business cycles are transmitted to the Italian economy. This task is not easy since there are many channels through which US impulses can affect the Italian cycle. A thorough analysis should consider both the direct and the indirect effect of US impulses, i.e. US impulses affect the Italian economy not only directly, but also through the impact on trade and financial markets in other economies that are linked to the Italian markets. For instance, the European Union and the US are main trading partners of one another and a positive shock to the US output gap may have, say, positive effects on the output gaps of Germany, France and UK; at the same time, the increase in the output gaps of these European economies may have additional effects on the Italian output gaps besides the initial *direct* impact from the positive innovation in the US economy.

The interrelationship among the major industrial countries is extremely complex and two approaches are possible for the assessment of business cycle transmission.

First, the *structural* approach, followed by major international organizations, is based on the estimation of business cycle spillovers by means of large econometric models where all the possible channels of transmission are explicit and, hence, directly evaluated. The specification of these huge models is very laborious and there is always the possibility of leaving out some hidden channels.

On the other hand, an alternative to the structural approach is represented by what we call an *agnostic* approach, i.e. a methodology that sets aside the goal of understanding the different channels of business cycle transmission and focuses simply on the sign and the intensity of the impulse spillover. The agnostic approach is a simple statistical assessment of the dynamic correlation between business cycles to which a minimum of economic “a priori” is applied. Hence, the best candidate methodology is represented by vector autoregressions (VAR) and their structural twist (SVAR), where the transmission of business cycles takes place inside a “black box”.

In this section we take this latter approach and present two applications. First, we run a traditional bi-variate VAR where we consider the direct interrelationship between the US and the Italian output gaps. The analysis is preformed by means of impulse response functions, i.e. the traditional simulation tool of the VAR and SVAR analysis. Second, we propose a new way of assessing whether innovations to the US output gap are transmitted differently on the Italian economy conditionally to the state of the US economy. In other words, we want to tackle the following question: when the US economy is booming, does the positive impulse in the US output gap affect the Italian output gap differently from the situation when the US economy is in a downturn? The question is interesting per se. The recent downturn in the US economy did not have a strong negative (contemporaneous) effect on the Italian (and European) cycle; hence, from the forecasting point of view, it is questioned whether symmetrically the future US boom will be transmitted so smoothly.

5.1. The symmetric case

As stated above, the agnostic analysis of the transmission of US shocks to the Italian output gap can be obtained by a traditional SVAR approach. The analysis does not have the goal to uncover the different channels of transmission, but simply to estimate the intensity (and the sign) of the effect of innovations in the US output gap on the Italian cycle.

Hence, the most simple bivariate model considers the output gaps of the US and Italy, where in each equation the output gap of one country is regressed on its own lagged output gap and lagged output gap of the other country.[18] The estimation of the first stage, reduced-form VAR can be performed with ordinary least squares (OLS) and provides consistent estimates of the reduced-form coefficients. However, no economically meaningful simulation can be obtained at this stage: the contemporaneous correlation between the error terms of the two equations causes an identification problem since the innovation, say in the US output gap, contemporaneously affect the Italian output gap and, vice versa, the innovation in the Italian output gap has the same effect on the US output gap since the covariance is the same. In fact, we would like innovations on each output gap that would not affect contemporaneously the other country's cycle so that the effect of the initial innovation could be traced appropriately. The SVAR approach proposes many ways of decomposing the contemporaneous covariance between the output gap reduced-form innovations.

First, it is useful to introduce the so called *structural* innovations (as opposed to reduced-form innovations): they are both serially and mutually uncorrelated (i.e. they are orthogonal). The structural innovations can be interpreted as the own innovations of each output gap, i.e. the unexpected change in each output gap due to factors that are not related (both contemporaneously and serially) to the other output gap. For instance, the structural innovation of the US output gap can be thought of as the unexpected change in the US output solely due to domestic factors; the same can be said for the structural innovations to the Italian output gap.

Structural innovations are very convenient since the contemporaneous covariance in the reduced-form innovations that is found in the data can be made explicit as a coefficient that combines the effects of the two structural innovations. Ideally, we would like to estimate two coefficients: one that gives the effect of US structural innovations on the Italian output gap and, vice versa, one that gives the effect of the Italian innovations on the US output gap. However, the

[18] The output gap is computed by subtracting the trend obtained with the HP filter.

estimation of two distinct coefficients is not possible since from the reduced-form estimation only one covariance is available. Hence, this covariance can be used either to estimate the effect of own US innovations on the Italian cycle or vice versa.

As anticipated, economic theory and sensible a priori play a role. Regarding the two possible coefficients to estimate, the researcher will certainly choose the former one: even though feedback effects from the Italian economy to the US cannot be excluded, given the constraint of estimating just one coefficient, it is much more sensible to imagine that US innovations affect contemporaneously the Italian cycle and not the opposite; hence, the contemporaneous effect that works in the other direction is set to zero.

The estimation of the structural VAR (i.e. the VAR where the innovations are orthogonal) can be performed by imposing that the innovations in the US output gap have a contemporaneous effect on the Italian output gap, but not vice versa. In other words, in order to use structural innovations the identification choice imposes a direction in the weak causality between the two variables. Once the estimation of the SVAR has occurred, the simulation can be performed without any problem of interpretation: the impulse response functions can be considered as reactions over time of one output gap to the structural innovation in the other output gap.

The estimation of the bivariate VAR has been performed with quarterly data on the output gap of the US and Italy for the period 1974:1-2001:4. In Figure 6 we report the result of our simulation by showing the reaction of the Italian output gap when the structural innovation in the US raises the output gap by 1 per cent. The graph reports also 95 per cent confidence bands to assess the significance of the impulse response functions.

The picture shows that the Italian output gap positively reacts to the innovation in the US output gap, but it is significantly different from zero only after three quarters. The peak in the transmission is reached at the fifth quarter when the Italian output gap rises by 0.4 per cent. We ought to notice that this result is in line with what has been presented with simple correlation analysis, according to which the US cycle leads by some quarters the Italian cycle.

The standard SVAR approach is symmetric by construction and recessive or expansive shocks are spread exactly with the same intensity (apart from the sign). We next use the SVAR approach to obtain different impulse response functions by conditioning the US innovations to occur in expansions (i.e., situations of positive US output gap) or in recessions (i.e., situations of negative US output gap).

5.2. Are impulses transmitted differently if the US is in a recession or in a boom?

As observed above, since the beginning of the US slowdown at the end of 2000, both the European and the Italian economy have not followed closely: although their growth rates decreased, the US downturn did not seem to be transmitted so strongly. As a consequence, the related question is whether this weak relationship will persist also in the case of the future US upturn.

As discussed above, the SVAR methodology is not designed to originate different impulse response functions depending on the sign of the innovation.[19] Our purpose is to design the "controlled experiment" so as to obtain different impulse response functions not conditional to the sign of the innovation, but *conditional to the state of the US economy*.

In other words, we estimate two different SVAR models: one includes the time series of *positive* values in the US output gap (zero otherwise) and the entire Italian output gap; the other one considers the time series of *negative* values in the US output gap (zero otherwise) and the entire Italian output gap. The structural identification scheme is the same as in the previous section and we impose that innovations to the US series can affect contemporaneously the Italian output gap, but not vice versa.

Structural innovations to the first SVAR may be different from the other and represent innovations *conditional* to the expansive state of the US economy. On the contrary, innovations from the second VAR are conditional to the recessive state of the US economy. Our aim is to evaluate whether these two types of innovations are transmitted differently on the Italian cycle.

Hence, we do not answer strictly to the question whether US expansion shocks are transmitted differently from US recession shocks, but we are able to give evidence on the following, strictly related issue: is the transmission of shocks from the US to the Italian cycle different depending on whether the US economy is in a boom or in a downturn?

In Figure 7 and 8 we present the impulse response functions of the Italian output gap when the US output gap is shocked exogenously and increases or decreases by 1 per cent. More precisely, in the graphs two impulse response functions of the Italian output gap are shown (plus 95 per cent confidence bands): the black (red) response is the reaction of the Italian cycle when (i) the US output gap increases (decreases) by 1 per cent, and (ii) initially the US output gap is positive (negative). The two graphs are referred to different estimation periods: 1974-2001 for Figure 7, whereas the most recent period 1988-2001 is used to produce Figure 8.

A number of features ought to be noticed according to these findings.

First, it is reassuring to observe that the response of the Italian output gap has the same sign as the US shock independently from the state of the US cycle: not differently from Figure 6 a one percent change in the US output gap is transmitted in the maximum range of 0.4-0.6 percent points to the Italian economy after four-five quarters with the same sign.

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[19] VARMAX models are nonlinear versions of the traditional VAR models and can deal with asymmetric impulse response functions generated by innovations with different signs.

However, responses are different when we condition to the state of the US economy. Figure 7 shows that US shocks conditional to expansions are transmitted significantly after three quarters – instead of two quarters for shocks conditional to US recessions – but have a longer impact on the Italian cycle (they last for four quarters instead of three quarters). Also the maximum quantitative impact is different: it occurs after one year for US shocks conditional to expansions and is around 0.6 percentage points, whereas shocks conditional to recessions have their maximum impact slightly before (after three quarters) and the intensity is lower (0.5 percent).

Figure 8 confirms these findings also for the most recent period (estimation is based on the sample 1988-2001 instead of starting in 1974). Shocks conditional to US recessions are significantly lower in terms of point estimates and statistically do not have any significant impact on the Italian output gap. Instead, shock conditional to US expansions maintain a similar time profile and quantitative impact, but are statistically significant for just two quarters.

In conclusion, innovations from the US economy seem to be transmitted differently depending on the state of the US economy. When the US economy is in an expansion, the degree of sensitivity of the Italian economy to US shocks is higher than in the case of a US slowdown. Our graphs have simplified this message by showing that expansionary shocks when the US economy is already in an expansion are transmitted stronger than negative innovations when the US economy is in a contractionary state.

Although quite robust, this is a pure statistical finding and further economic investigation is needed in order to better understand the different channels of this special kind of asymmetry. A possible explanation may involve the role of the exchange rate. Indeed, when the US economy is in an expansion, US interest rates are likely to increase and the dollar may appreciate. As a consequence, the traditional locomotive effect coming from the US shock may be boosted by the exchange rate depreciation on the Italian economy. On the contrary, when the US economy is in a recession, US interest rates are decreased, the dollar depreciates and the sensitivity of the Italian economy may be dampened by the offsetting role of the exchange rate. This simple working hypothesis may offer an initial explanation, but further work is needed to validate it.

Figure 6: Impulse Response Function of the Italian Output Gap when the US Output Gap increases by 1 per cent

(percentage; estimation period 1974:1-2001:4; 95% confidence bands)

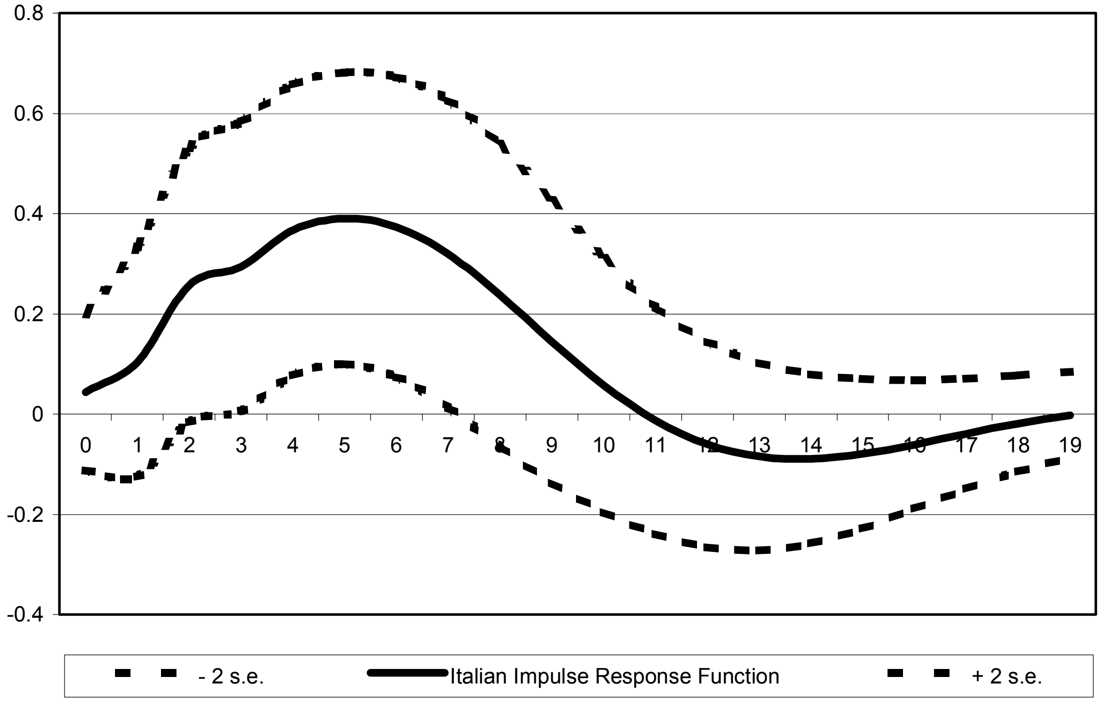


Figure 7: Impulse Response Functions of the Italian Output Gap Conditional to the US Cycle: Increase (Decrease) of the Italian Output Gap when the US Output Gap Rises (Lowers) by 1 per cent and the US Output Gap is Positive (Negative)

(percentage; estimation period 1974:1-2001:4; 95% confidence bands)

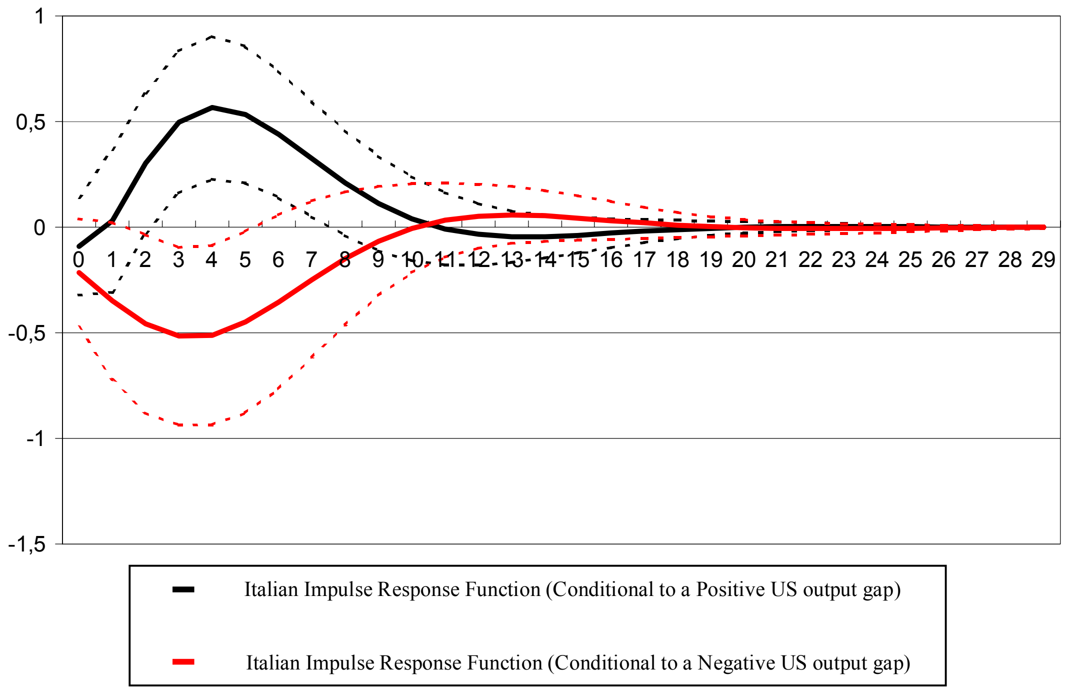
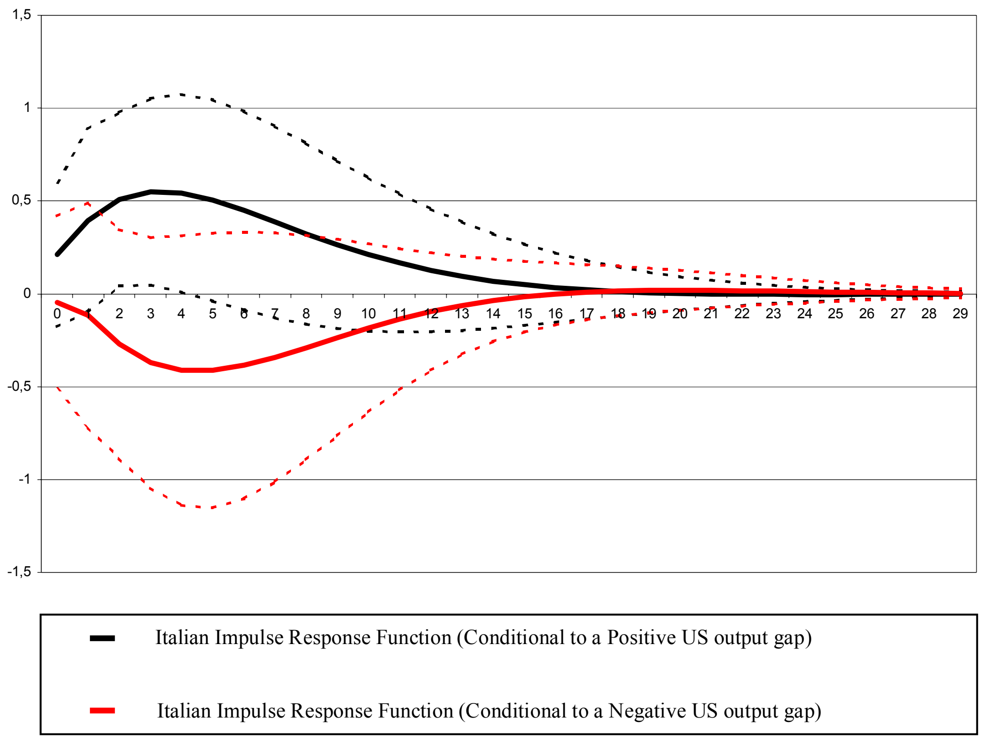


Figure 8: Impulse Response Functions of the Italian Output Gap Conditional to the US Cycle: Increase (Decrease) of the Italian Output Gap when the US Output Gap Rises (Lowers) by 1 per cent and the US Output Gap is Positive (Negative)

(percentage; estimation period 1988:1-2001:4; 95% confidence bands)



Section 6: Conclusion and future work

The analysis of the domestic business cycle and its international interactions has always been considered as a useful tool to address and help policymakers' decisions. Both the assessment of the importance of transmission channels and to the capability of sketching out the magnitude and the length of the economic phases, are indeed very important for an efficient conduct of fiscal and monetary policies.

Recently, all the main international organisations (amongst the other, the OECD and the IMF) have contributed to renew the studies on the business cycles.

Some stylised facts outlined by this growing empirical literature (i.e. OECD, IMF and many others), show that during the '90s business cycles have undergone a number of important changes: the cyclical phases have become shorter and more frequent; recessions have been more shallow and have lasted less than the previous decades, whereas expansions have seemed to be as intense as before but less long than during the '80 and the '70s. Nonetheless, during the '90s the volatility of the output gaps decreased even though synchronicity indicators did not increase.

Starting from this general background, the aim of this paper has been twofold. On one hand, it has explored the principal features of the Italian Business cycles during the ‘90s in comparison to the previous decades and has identified the main influences on the Italian economic fluctuations. On the other hand, it has focused on the transmission of the international shocks coming especially from the U.S. economy.

In the first part, the detection of the Italian phases has been dealt with adopting both the trend-cycle approach, (the Hodrick-Prescott and the Baxter and King filters) and the classical cycle approach[21]. All of these methods have provided uncontroversial proves on the behaviour of the Italian cycle.

To sum up, it seems that the Italian cycle is in line with the general findings provided by the OECD and IMF. Our results confirm that, during the ‘90s the Italian cycle has been characterised by milder but more frequent recessions, while the booms, even if shorter, have been almost as intense as before.

As far as the international transmission is concerned, the results provided by the measure of cyclical concordance have shown that, even though the US influence can still be considered as significant, its strength was strongly reduced over the ‘90s. Accordingly, the influences coming from other European Union countries (France and Spain) have grown significantly with respect to the ‘80s. The Italian economy, thus, has shown an increasing coordination and integration with the European partners.

Further support to this latter evidence is provided by the last evidence of the paper. By taking a SVAR approach it has been proved that, although the Italian economy continues to lag behind the US one, the shocks to the US output are transmitted to the Italian economy with a different magnitude and with different lags according to the fact that the US economy is either in a recession or booming. Specifically, the transmission of shocks is more intense and quicker when the US economy is in expansion rather than in a recession.

Furthermore, despite this kind of asymmetric transmission of shocks, the SVAR model suggests that, in the last decade, the direct influence of the US cycle on the Italian output has gradually reduced. The model shows that, especially during US recessions, the impact of an innovation to the US cycle on the Italian economy is not statistically significant.

The SVAR experiment can be considered as a method to infer the effect of external shocks to the Italian economy in an easy and comprehensible way. On one hand, by conditioning to the US recession or US expansion the SVAR methodology can help to sketch out the magnitude of the international diffusion in the cyclical fluctuations and to measure their asymmetries. On the other

[21] In this light, the plurality of the approaches can be considered as an evidence of the robustness of our results.

hand, it can help to determine the lag structure existing between the cycles of different countries on a (slightly) more structural basis, partly overcoming the shortcomings and the lack of causality hypothesis typical of the bivariate correlation methods.

Finally, the SVAR model can be considered as a reliable model to implement forecast analysis allowing to measure in a quantitative manner the number of periods required before an expansionary or recessionary international innovation should start to exert its own effect on an economy.

In conclusion, the whole set of stylised facts collected in the paper suggests that the Italian cycles is becoming more and more synchronised with that of European countries while the US influences have been progressively reduced with respect to the previous decades.

The reasons of this shift deserve a deeper future analysis. In general it could be said that the increasing synchronization with the European countries cycles has been favoured by:

- the increasing trade relations among the European economies;
- the adoption of fiscal and monetary policies aimed to achieve the convergence to the European Currency Union;
- the transmission channel that passes through the developments of the exchange rate.

All these reasons may represent significant elements in explaining the changes in the Italian business cycle, but they explain just a part of the whole story. In fact, the financial market liberalization and the communication technologies spillovers may have determined a more efficient allocation of resources among the industrialised countries and thus they may have contributed to smooth the cycles and to reduce the international transmission of shocks. In this regard, a further analysis on the sources of business cycles and on the mechanisms of propagation of shocks is necessary to better clarify the extent and the magnitude of these changes.

In conclusion, the results presented in this paper represent a first set of evidence on the characteristics of the Italian business cycles. Nonetheless these findings allow to draw some initial policy implications.

Appendix 1: The algorithm of Bry-Boschan

For quarterly data, the procedure is very simple and can be summarized in the following few steps:

- Step 1: Determine a potential set of turning points, defined as local maximum or minimum in a centred interval of 5 quarters.
- Step 2: Ensure that peaks and troughs alternate. If the procedure selects two consecutive troughs, eliminates the higher, in the level of the series, otherwise the lower.
- Step 3: Censoring rules: restriction on the duration and amplitudes of phases and complete cycle.
- Step 4: Re-combine the turning points in order to satisfy the rule that peaks and troughs alternate, according to the set of rules expressed in the previous points.

For monthly data the procedure is a little more complicate.

The following table summarizes the monthly Bry-Boschan's procedure.

Table A1: Procedure for programmed selection of turning points for monthly data

I. Determination of extremes and substitution of values
II. Determination of cycles in 12-month moving average (extremes replaced).
    A. Identification of points higher (or lower) than 5 months on either side
    B. Enforcement of alternation of turns by selecting highest of multiple peaks (or lowest of multiple troughs).
III. Determination of corresponding turns in the Spencer curve (extremes replaced)
    A. Identification of highest (or lowest) value within ± 5 months of selected turns in 12-month moving average.
    B. Enforcement of minimum cycle of duration of 15months by eliminating lower peaks and higher troughs of shorter cycles.
IV. Determination of corresponding turns in short-term moving average of 3 to 6 months, depending on MCD (months of cyclical dominance).
    A. Identification of highest (or lowest) value within ± 5 months of selected turns in Spencer curve.
V. Determination of turning points in unsmoothed series.
    A. Identification of highest (or lowest) value within ± 4 months, or MCD term, whichever is larger, of selected turn in short-term moving average
    B. Elimination of turnswithin6 months of beginning and end of series.
    C. Elimination of peaks(or troughs) at both ends of series which are lower (or higher) than values closer to end.
    D. Elimination of cycles whose duration is less than 15 months.
    E. Elimination of phases whose durations is less than 5 months.
VI. Statement of final turning points.

Source Bry and Boschan 1971, p. 21

Appendix 2: Data description and sources

Table A2: Data description

<table>
<tr><th></th><th>Classical approach</th><th>Trend-cycle approach</th></tr>
<tr><td rowspan="2">The Italian Case</td><td>Industrial Production
(Source Istat,
Sample:1970:01-2002:08)</td><td rowspan="2">Gross Domestic Product, Volume Index
(Source Imf,
Sample: 1970:01-2002:02**)</td></tr>
<tr><td>Coincident Indicator
(Source Isae, Bank of Italy,
Sample: 1980:01-2002:06)</td></tr>
<tr><td>International Comparison*</td><td>Gross Domestic Product, Volume Index
(Source Imf
Sample: 1970:01-2002:02**))</td><td>Gross Domestic Product, Volume Index
(Source Imf
Sample: 1970:01-2002:02**))</td></tr>
<tr><td colspan="3">* France, Spain, Italy, United Kingdom, United States
** Except for Italy where the sample is: 1970:01-2001:04</td></tr>
</table>

References

Agresti A. M. and B. Mojon, (2001). “*Some Stylized Facts on the Euro Area Business cycle*”, ECB Working Paper n. 95.

Altissimo F., Bassanetti A., Cristodoro R., Forni M., Lippi M., Reichlin L.,Veronese G. (2001). “*A real time coincident indicator of the Euro Area business cycle*” Bank of Italy Working Paper n.436.

Altissimo F., Bassanetti A., Cristodoro R., Forni M., Lippi M., Reichlin L.,Veronese G. (2001). “*The construction of coincident and leading indicators for the Euro Area business cycle*” Bank of Italy Working Paper n.434

Altissimo F., Marchetti D. J.and G. P. Oneto, (2000).”*The Italian Business cycle: Coincident and Leading Indicators and Some Stylized Facts”* Bank of Italy Working Paper n.377.

Artis, M., Krolzig, H.-M., Toro, J. (1999). “*The European Business cycle*” CEPR Discussion Paper 2242.

Baxter M., R. King (1995). “*Measuring Business cycle Approximate Band-Pass Filters for Economic Time Series*” NBER Working Paper n. 5022.

Bry, G., Boschan, C. (1971). *Cyclical Analysis of Time Series: Selected Procedures and Computer Program*s. New York: NBER.

Burns, A. F., Mitchell, W. C. (1946). *Measuring Business cycle*s. New York: NBER.

Cashin P, Ouliaris S., (2001) “*Key features of Austrialian Business cycle*” Imf Workig paper. Wp/01/171, November, Washington DC.

Harding, D., and Pagan, A. (1999). “*Dissecting the cycle”* University of Melbourne, Working Paper 13/99.

Canova F. (1998). ”*Detrending and business cycle facts*”. Journal of Monetary Economics 41: 475-512.

Christiano L. (1999). “*The Band Pass filter*” NBER Working Paper n.7257.

Daalgard T., J. Elmeskov and Cyn-Young Park (2002) ,” *Ongoing changes in the Business cycles-Evidence and causes”*, OECD Working Paper n. 315.

Eurostat, Economic Forecast, (2002) “*Business cycle synchronization and variability in the Euro Area”*, Spring 2002, charter 5, special Topics.

Forni M., Hallian M., Lippi M. and Reichlin L. (1999). ”*Coincident and leading indicators for the* Euro Area”. Miméo, UCL de Brussels, www.Dynfactor.com.

Guay A., St-Amant P. (1997). “*Do the Hodrick-Prescott and Baxter-King Filters Provide a good Approximation of Business cycle?*” , Université du Québec a Montéal Working Paper n. 53.

Hebling T and T. Bayoumi, (2002), "*G-7 Business cycle Linkages Rivisited"*, IMF, mimeo, forthcoming.

Hodrick R. J, Prescott E. C. (1980). "*Postwar U.S. Business cycles: An Empirical Investigation*" Carnegie-Mellon University, Working Paper.

ISAE, (2002) Nota Mensile, (febbraio). "*Il punto sul ciclo industriale italiano*"

King and Rebelo (1993) in "*Low Frequency Filtering and Real Business cycle"* Journal of Economic Dynamics and Control, Vol. 12, n.21, 207-231.

Krolzing H. M., Toro J.,(2001) "*Classical and Modern Business Cycle Measurement: The European Case*", University of Oxford, Discussion Paper n. 60.

OECD, 2002," *International Linkages and changes in the Business cycles*", October CO/CPE/WP1 (2002) 10.

Schlitzer G. (1993.) "*Business cycle in Italy: A Retrospective Investigation*" Bank of Italy, Working Paper n.211.

Wynne M. and Koo J, 2000, "*Business cycles under monetary union: a comparison of the EU and the US*", Economica, vol 67.

IMF (2002), *World Economic Outlook*, April.