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A Cycle-Specific Approach to Business Cycles: Empirical Evidence from the G7

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INTRODUCTION

The business cycle theory has a long and outstanding tradition (see *e.g.* Haberler, 1958; Zarnovitz, 1992) which often produced an *embarasse de richesse*. It is almost obvious for a theory, which analyses the up -and downturns of the economic activity, to be itself quite cyclical. Actually, it shifts between two attracting poles: the *deterministic* (or disequilibrium) approach and the *impulse-propagation* (or equilibrium) mechanism. Most macroeconomists now analyze business fluctuations through the Slutsky-Frisch approach. According to it, fluctuations are nothing but co-movements among different aggregate time series (the *locus classicus* is Lucas, 1977), rather than the recurrence of business cycle phases (each cyclical phase carries the seeds that generates the next cyclical phase) as the NBER approach (Burns and Mitchell, 1946) was used to assume. The

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impulse-propagation mechanism further assumes that there exists a single type of shock, either real or monetary. This approach (without shocks there are no cycles) is questioned by several scholars (see Cochrane, 1994; Fuhrer and Schuh, 1998; Zarnovitz, 1999) who claim that the passage "from cycles to shocks *isn't* a progress in business-cycle theory" (the opposite view is well represented by Chatterjee, 2000).

Following Lucas' insight ("the repeated fluctuations about trend and the regularities observed in the co-movements among different aggregative time series"), Kydland and Prescott, 1990, apply the Hodrick-Prescott (1981) filter to analyze the US cyclical growth between 1954 and 1989. Their work shows that:

1. All the series are highly correlated.
2. The *real* series and M2 are pro-cyclical, while prices are counter-cyclical.
3. Investment volatility is much higher than output.
4. While inventories, employment, exports and investment lag the cycle, productivity, net exports and money lead it.

Correia *et al*., 1992, apply the same methodology to annual long-term series of UK and US, while Backus and Kehoe, 1992, use annual data for ten OECD countries. They show that relations among real quantities have been stable, prices are pro-cyclical before WWII and counter-cyclical afterward, while fluctuations in money are less correlated with output after 1945. Backus *et al*., 1995, show that international business cycles do not replicate the theoretical prescription of the standard model (see also Ambler *et al*., 1999). Bergman *et al*., 1998, analyze an international set of annual data by the Baxter and King, 1995, band-pass filter. Their finding corroborates previous studies results, with two exceptions: amplitude and symmetry of cycles have changed through time, and prices are almost always counter-cyclical. Danthine and Girardin, 1989, Danthine and Donaldson, 1993, Correia *et al*., 1992, Blackburn and Ravn, 1992, Fiorito and Kollintzas, 1992, Englund *et al*., 1992, Brandner and Neusser, 1990, Dimelis *et al*., 1992, and Christodoulakis *et al*., 1995, Heilemann and Munch, 1999, Dopke, 1999, apply the Hodrick-Prescott filter to

quarterly data of several OECD countries, basically finding that the behavior of GDP, prices, consumption, investment and net exports are similar, while government expenditure and money vary across countries.

Blanchard and Watson (1986: 92) note that there is not "any clear pattern over time supporting any single structural interpretation." In the same vein, Basu and Taylor, 1999, conclude that much more work is needed on the sources of propagation of small shocks and on the historical and institutional context in order to have an adequate understanding of fluctuations. Actually, there is a branch of research, which is neglected, but very intriguing (Schumpeter, 1951; Gayer *et al.*, 1953; Haberler, 1958) based upon an *ante-litteram cliometric* approach which conjugates historical investigation and economic analysis (Temin, 1998, and Bergman *et al.*, 1998, contributed to vitalize it).

Empirical evidence on the business cycle has focused upon two different approaches:

- The *country-specific* approach which aims to analyze the behavior of the co-movements of a series belonging to a (some) country(-ies) in a certain period of time: see *e.g.* Stock and Watson, 1998, or section 3 below).
- The *time-specific* approach, which aims to investigate if the co-movements are stable through time (by comparing the co-movements of a country, or a group of countries, between different periods of time: *e.g.* Backus *et al.*, 1995).

In the following we analyze a third aspect:

- The *cycle-specific* approach which aims to test if co-movements are persistent within each single cyclical episode (section 4 below; see also Gallegati and Gallegati, 2001).

In this paper we aim to investigate if co-movements in aggregate time series are robust, *i.e.* if they are common to various countries and cyclical phases. The approach we take is an empirical one. We use 15 economic time series (GDP and demand components, employment and wages, money

and prices, interest rates and stock price) between 1960:I-1998:IV for the G7 countries.

Anticipating some results, we may say that consumption, investment, employment and productivity are strongly pro-cyclical. Net export, the share index, the short-term rate of interest and the monetary aggregates (M1 and M1 plus quasi-money) are pro-cyclical, while prices are counter-cyclical. The long-term rate of interest and the nominal wages are, mostly, a-cyclical; while real wages and the rate of inflation show mixed evidence.

Cyclical movements of some series certainly are policy and institutional specific (Christodoulakis *et al*., 1995; Blanchard, 1999), but this is not the whole story.

In section 3 we investigate if GDP co-movements are robust within each single country by comparing the pairwise correlations coefficients of the cyclical components of some selected aggregate variables with GDP within each single cyclical phase. Only the real and *labour market* series are stable across cycles: prices, interest rates and wages are very irregular (even if some homogeneity can be detected by referring to specific cycles: *e.g*. the cycles following the oil-shocks). Moreover, the *stylized facts* reported by Kydland and Prescott hold true for the UK and the US economies.

Since our finding shows that prices, interest rates and the costs of the factors do not behave uniformly, a more cautious approach to the analysis of the business cycle should be taken. Our results question the *one-sided* impulse-propagation approach to fluctuations.[1] If business cycle theories are to be taken seriously, we have to contemplate the chance of them not being alike, because different innovations may affect the economy at different times, different distributions of agents change the propagation mechanism, or fluctuations can be self-sustained (Zarnovitz, 1998, 1999).

This paper's main message is that the business cycle is still, after all these years, a *puzzle*.

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[1] Bergman *et al*., 1998: 85, claim that "the cross-country evidence over a century of data does not suggest a single cause of recession" (see also Cochrane, 1994).

METHODOLOGY, DATA SET, AND CYCLICAL BEHAVIOUR OF SOME SELECTED TIME SERIES

A traditional decomposition of economic time series distinguishes among a *trend component*, a *cyclical component* and a *noise component*. Given an *a priori* definition of business cycle as cyclical comovements among macroeconomic variables at business cycle periodicities, business cycle analysis needs to filter out the cyclical component of the series. It means finding a filter which eliminate both low frequency fluctuations (associated to long-run trends) and the high frequency fluctuations (associated to temporary factors). The optimal filter for an infinite series will completely shut out the fluctuations at all other frequencies than those in business cycles frequencies, but for a finite series complete elimination of fluctuations at frequencies outside business cycle frequencies in not feasible. In other words, the power transfer function of a feasible filter will not be unity for business cycle frequencies and zero elsewhere, due to the finite nature of the series. As band-pass filtering permits a decomposition of a series into trend, cycle and noise components, corresponding, respectively, to the low, business cycle and high frequency of the spectrum, we apply the Baxter and King's (1995) approximate band-pass filter which isolates business cycle fluctuations in macroeconomic time series between specified frequency bands. The filter, designed to make the filtered series stationary if the raw series is integrated of order one or two, uses a centered moving average method using up to 12 weighted leads and lags. Moreover, as suggested by Baxter and King, we pass frequencies corresponding to between 6 and 32 periods, a typical business cycle frequency range with quarterly data (see Stock and Watson, 1998).

We examine the business cycle properties of real GDP, demand components, labour market, prices, money and interest rate variables for G7 countries using seasonally adjusted quarterly data over the period 1960-1998. The statistical sources are OECD Main Economic Indicators, for money, money plus quasi-money and share prices index, and OECD Business Sector Data Base (May 1999) for all other variables. All variables are expressed in natural logarithms, with the exception of net exports (which are taken as ratio to GDP), unemployment rate and interest rates.

The cross-correlation between the cyclical components of each series with the cyclical component of real GDP analysis provides information both on the procyclity, acyclity or countercyclicity of the series and if it is leading or lagging the cycle. In particular, we define a series procyclical when its value of the contemporaneous correlation with GDP is greater than 0.18 (strongly procyclical if greater than 0.60), acyclical when it is between 0.18 and –0.18, and countercyclical when it is lower than –0.18.[2] Moreover, we say that a series *x* is leading, is synchronous or is lagging the cycle if the largest value of its cross-correlation with output (in absolute terms) is in entries $x(t-i)$, $x(t)$ or $x(t+i)$, respectively.[3]

Figures 1.1 to 1.18 summarise the findings of cross-correlation analysis of the cyclical components of the series for the G7 countries. They are scatter diagrams where the pair of series for each country are the values of the contemporaneous and the maximum correlation with GDP of the series for that country. Thus, countries whose series are procyclical will be in the top right hand corner, countries whose series are countercyclical will be in the top left hand corner, and countries whose series are acyclical will be in the middle and bottom of the figure. Moreover, looking at the position of the country with respect to the 45° degree line, we may immediately see if a country's series is leading, is synchronous or is lagging the cycle .

GDP and Demand Components

GDP volatility and serial correlation uniformity is quite a standard result, since Maddison (1982). In our sample all the countries have standard deviations between 1.36 and 1.51 (France 0.92), while GDP correlation range from 0.92 to 0.94 (Italy 0.88). Previous studies (see *e.g.*

[2] For quarterly data a cut-off point of 0.18 is standard in the literature as it corresponds to the required values to reject the null hypothesis that the correlation coefficient is zero at the 5% significant level of the two-sided t-statistic.

[3] The results of cross-correlations of real GDP with itself and with all the other aggregate series for the whole period, not reportes here for brevity, are available on request by the authors.

Christodoulakis *et al*., 1995) have shown that the endogenous component of the GDP (Consumption and Investment) are remarkably uniform among different countries and periods of time, while its exogenous components (Government Expenditure and Net Exports) follow different patterns. G7 data only partly corroborate this finding.

Private consumption is strongly pro-cyclical and coincidental with GDP in all cases but the US and France, where it leads the cycle by one quarter (see figure 1.1). Its standard deviation is smaller than that of the GDP with the only exception of UK. Private total investment is also strongly pro-cyclical (but the UK)[4] and coincident or lagging the cycle (see figure 1.3). Its volatility is 2.86 to 4.96 times higher than GDP. A uniform behavior also emerges for the Balance of Trade: all the G7 countries show that net-exports are counter-cyclical (Germany value is on the a-cyclical border) and lead the cycle with the exception of Italy and Germany where it is lagging (see figure 1.4). Moreover, net export variability is lower than that of GDP in all countries. Only slightly less homogeneity characterizes Government expenditures (see figure 1.2). Government expenditures in the G7 are a-cyclical but UK and Canada (whose value is very close to the a-cyclical border), with most of the countries lagging the cycle (exceptions are Canada and Italy leading the cycle).

Employment and Wages

Employment measures should be interpreted with extreme caution. On the one hand, the *black labor market* is a widespread phenomenon in Italy. On the other hand, international comparisons often do not rely on common statistical set. As a measure of productivity, we prefer the standard *total output-total input ratio* with respect to the Solow residual, since this last refers, by construction, to long-run periods, which are outside the short-term horizon of business cycle fluctuations (Basu, 1998).

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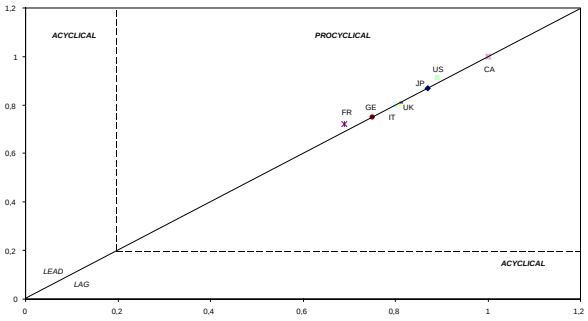
[4] UK prociclicity (0.4) is usually attributed to a value during the Bretton Woods period; according to Bergman *et al*., 1998, in fact, between 1960 and 1973, the correlation between investment and GDP was 0.28. As it will be shown in section 4, investment is acyclical in the cycle 1967-1972 and 1982-1987.

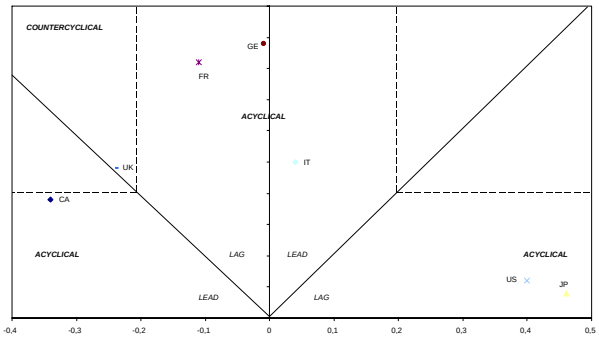
FIGURE **1**

Business Cycle Properties of the Selected Economic Time Series

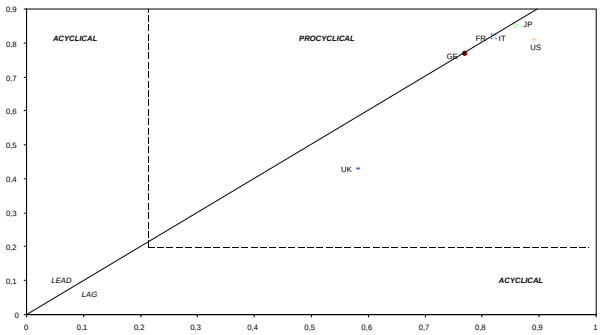
1.1 Private Consumption



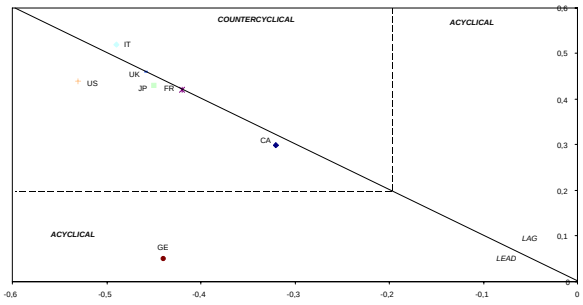
1.2 Government Consumption



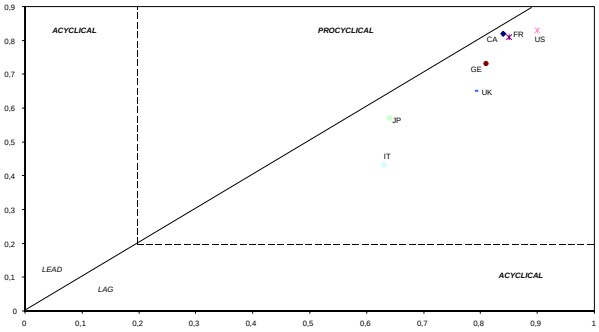
1.3 Investments



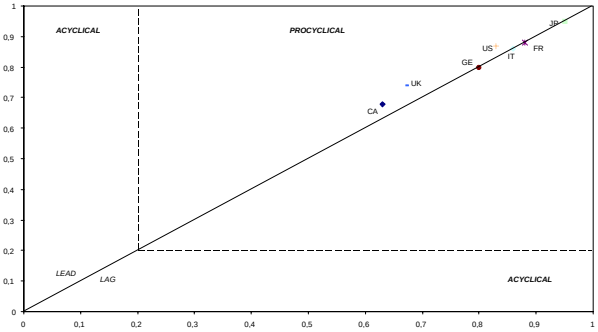
1.4 Net Exports/GDP



1.5 Employment



1.6 Labor Productivity



The rate of unemployment and total employment are, respectively, strongly counter- and pro-cyclical, lagging the cycle and far less variable than output (see figures 1.5 and 1.6). The not surprising exception is Italy where they are not strongly correlated with the cycle. Finally, labor productivity is everywhere strongly pro-cyclical, with mixed evidence of coincidence with the cycle (see figure 1.7).

Nominal wages are mostly counter-cyclical (a-cyclical in Italy and Germany) leading the cycle, with a standard deviation greater than one except in the US (see figure 1.8). Real wages behaviour (the series is obtained by dividing the nominal wage by the level of consumers' price index), is, at best, mixed. Indeed, they are a-cyclical in Canada, France, Italy and UK and pro-cyclical in US, Germany,[5] and Japan, an evidence reported even by Summers, 1986, and Abraham and Haltiwanger, 1995. These findings support the labor-hoarding view of the labor market. Moreover, G7 countries adopt different unemployment compensations, hiring and firing procedures, and jobs search policies, thus cross-countries differences in the labor market may easily emerge. Finally, nominal wages show a behaviour similar to that of the consumer price index, a finding for which a plausible explanation could be represented by the contractual indexing of the nominal wage to the CPI (quite a standard procedure after the oil shock).

Money and Prices

According to the Keynesian view, nominal money changes have real effects, since prices are sticky. The classical view, on the contrary, argues for a dichotomy between the real and the monetary sector, and no real effects can emerge from a nominal monetary change. We consider two measures of money: one *exogenous*, M1, which is under the control of the Monetary Authorities, the other *endogenous*, *M1 plus quasi-money*.

[5] According to Abraham and Haltinwanger, 1995, real wage is mostly procyclical. Other studies, such as Braundner and Nesser, 1990, and Christodoulakis *et al*., 1995, show that the real wage rate in Germany is also procyclical, while Bergman *et al*., 1998, find it acyclical.

Our study, even if does not directly try to give an answer to the debate about the pro-counter-cyclical behavior of prices, inquires the, possibly, different properties of the consumer price index and the GDP deflator.

M1 aggregate is mostly pro-cyclical (a-cyclical in US: see Hartley, 1999) and leads the cycle (exception is US where it lags the cycle). M1 supply is not very volatile, and its variability is higher in those countries, such as Italy, France and UK, in which also inflation standard deviation is higher. The *M1+quasi money* aggregate has a higher standard deviation behavior than the M1 aggregate: it is mostly pro-cyclical, except for Italy where it is a-cyclical.

The level of the consumer price index is counter-cyclical (exception is Italy[6] where it is a-cyclical) and leads the cycle, corroborating previous inquires, while the GDP deflator is counter-cyclical in the G7 but for Germany and Italy (see figures 1.13-1.14). The debate on the cyclical behavior of prices is very intertwined and we do not ask our data to provide a definitive answer (see, among *alia*, Cooley and Ohanian, 1991; Chadha and Prasad, 1992; den Hahn, 1996; Pakko, 2000; Cover and Pecorino, 2000; Kraay and Ventura, 2000; Wolf, 2000). To discriminate between alternative theories, one needs more support from the data, and if an indication may be drawn from them it is that none of the one-sided theories explain business cycle fluctuations.

The cyclical components of the inflation rate of the consumer price index is generally weakly pro-cyclical (strongly pro-cyclical in Italy) or a-cyclical (Japan and UK) and lags the cycle (exceptions are Italy where it is synchronous and France and UK where it leads the cycle). The volatility of the standard deviation falls within the interval 0.18 and 0.38. This is puzzling for those models, like the RBCs, where correlations in levels and first differences are not contemplate (see Ball and Mankiw, 1994, but also C. Romer, 1996).

All in all: the cyclical behavior of the level prices is counter-cyclical for the CPI and the GDP indexes, while there is a striking divergence between the behavior of the levels and the rate of inflation.

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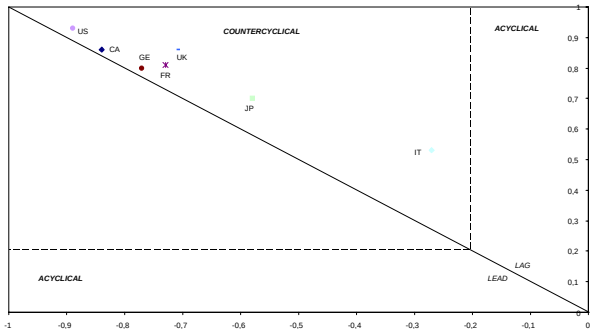
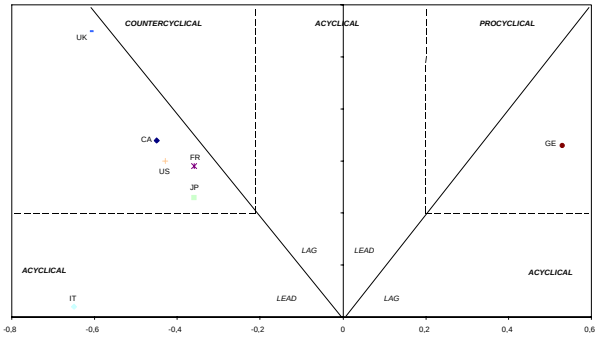
[6] Bergman *et al*., 1998, finds procyclical behavior before 1973 and acyclical afterward.

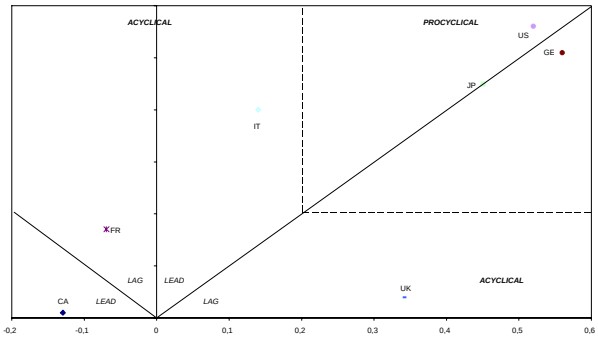
1.7 Unemployment



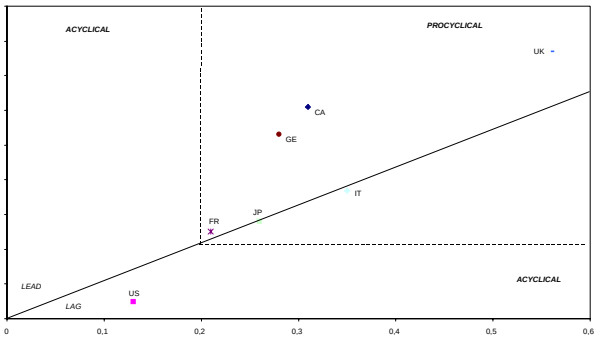
1.8 Nominal Wages



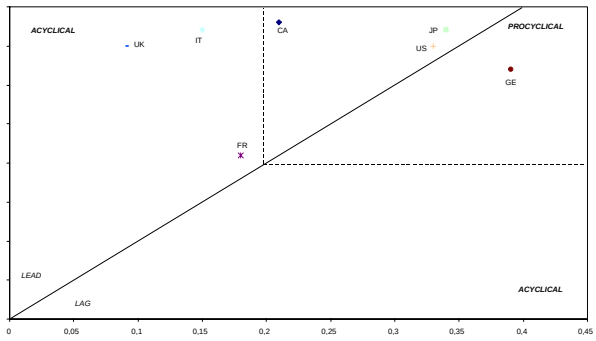
1.9 Real Wages



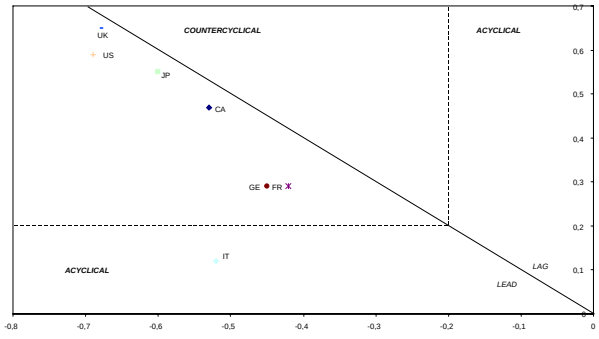
1.10 Money M1



1.11 Money Plus Quasi-Money



1.12 Consumer Price Index



Interest Rates and Stock Prices

The behavior of the interest rates and stock prices has not been the focus of previous studies (except for Stock and Watson, 1998; Canova and de Nicolò, 2000; Gallegati and Gallegati, 2001). Our data show that the short-term interest rate is pro-cyclical (the only exception is Japan: a-cyclical), mostly leading the cycle (lagging in Canada, Germany and Japan). The long-term rate of interest is mostly a-cyclical (pro-cyclical in Canada, France and Germany) and leads the cycle (lags in France and Japan). As regards the volatilities of short and long term interest rates, we find that, as expected, while the short-term interest rates are more variable than GDP (the only exception is US), the long-term interest rate is anywhere less variable than GDP.

As the real rate of interest, or the *price of capital*, we measured it as the difference between the long run nominal rate of interest and the GDP deflator's rate of change.[7] The results about the *price of capital* resemble those ones of the long-term interest rate with the difference that the real rates are much less cyclical than nominal rates. Let us also note that the cost of capital does not seem to affect capital accumulation that is mostly sensitive to GDP changes, according to the acceleration principle of the capital market imperfect approach.

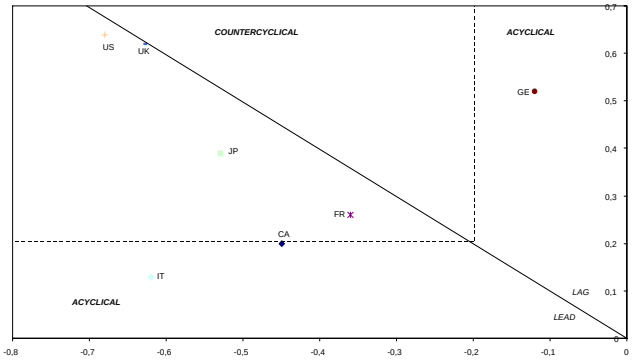
Finally, the stock market behavior is mostly pro-cyclical (a-cyclical in France and US) and leading the cycle by one to three quarters. Furthermore, the share prices index volatility is very high, ranging between 7.23 and 12.63 times GDP volatility.

CYCLE-SPECIFIC ANALYSIS OF BUSINESS CYCLE FLUCTUATIONS

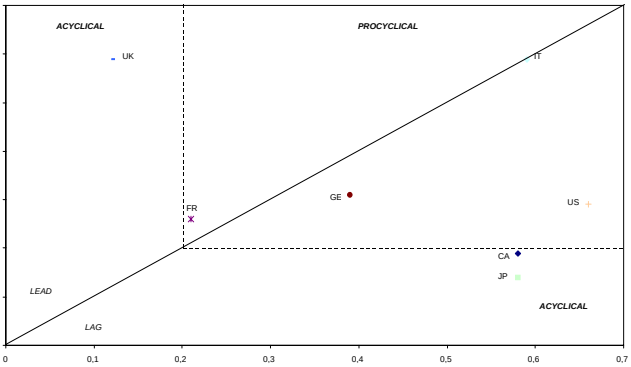
The previous section has shown that real series (aggregate demand components besides Government, employment and productivity), price levels, M1 and the rates of interest behave quite similarly among different

[7] This construction technique deeply affects the results: the countries with pro-cyclical behavior of the long term rate of interest are those also pro-cyclical where the real rate is concerned.

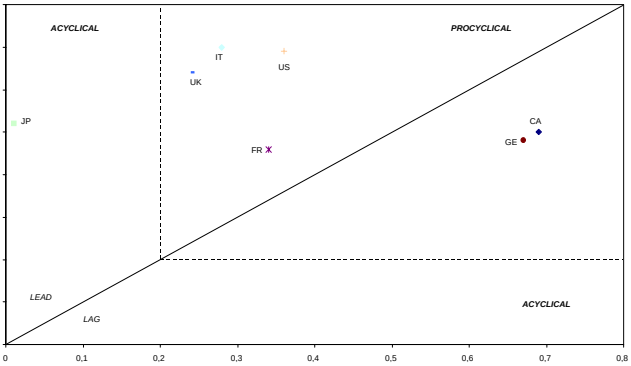
1.13 GDP Deflator



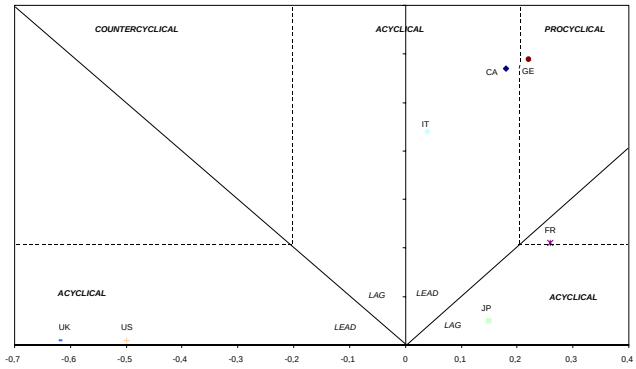
1.14 Inflation Rate



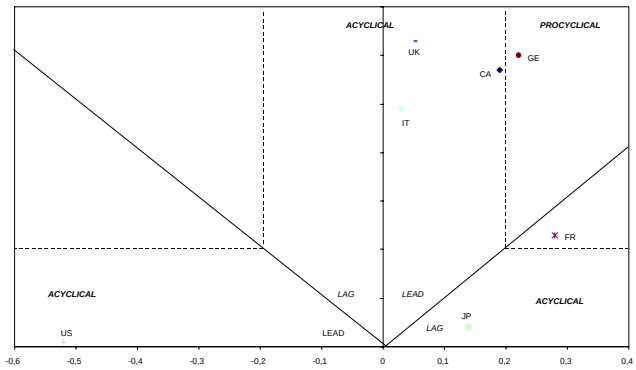
1.15 Short Term Interest Rate



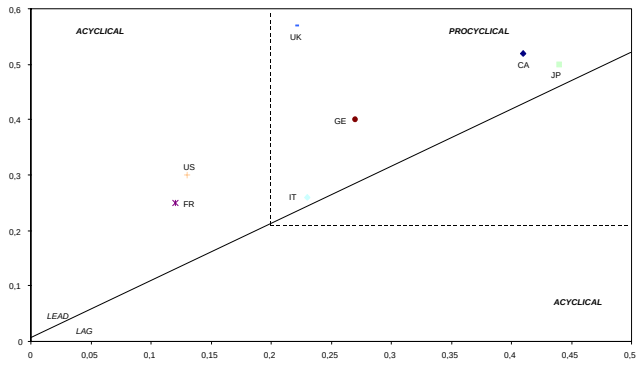
1.16 Long Term Interest Rate



1.17 Real Interest Rate



1.18 Share Prices Index



countries in the time period under investigation. The correlation statistics basically tell us the *average* behavior of a series with respect to the series we have chosen as a reference (in our case the GDP). As usual, exist statistical tests which ascertain the confidence level of a parameter. Here the issue is somewhat different, since we are looking for homogeneous behavior of the co-movements of a series within *all* the business cycle episodes.[8] In other words, this section is dedicated to the question: is there *a* business cycle, *i.e.* a definable entity with established characteristics, or are there *many* business cycles?[9]

A graphical analysis of the US price variables (see Stock and Watson, 1998) shows that of the 9 cycles after 1949, 6 are different from each other, *i.e*. they have substantial differences among the series. Fluctuations of variables with the same behaviour concern the cycles between 1958

[8] It has been argued that the issue about the pro- or counter-cyclical behavior of prices allows discrimination between competing theories (Fiorito and Kollintzas, 1992). Pakko, 2000, shows that this conjecture is, at the best, badly posed. In the New-Keynesian literature, *e.g*., an impulse on the nominal wages may cause both aggregate curves to shift.

[9] Before the post-Lucas 1977 mainstream dominance, scholars of the business cycles were used to adopt a very flexible view: see *e.g*. Harberler, 1958.

and 1970, and between 1970 and 1982. It is a robust signal against the hypothesis of the one-side explanation of the business cycle and the underlying idea of "all alike business cycle". To test whether this hypothesis is rejected from European data, we analyse the behaviour of the time series within different cycles by isolating each episode and calculating the correlation with output for the European countries belonging to the G7 group.[10]

In order to perform the cycle-specific analysis of business cycle fluctuations we adopt a two stages approach:

- Determine business cycles chronology through the TP5 procedure.[11]
- Perform, within each single cyclical episode, the cross-correlation analysis between GDP and all the other variables.[12]

The real GDP filtered series for the G7 countries, with downturns dates evidenced, are reported in figure 2.[13] Business cycles chronology obtained through the TP5 method shows that between 1960 and 1998, the G7 countries experienced from 6 (5: France and Italy) to 8 (7: Canada and Japan) downturns (upturns), and a great deal of synchronization, which

[10] A longer term analysis of the hypothesis of a representative cycle in the G7 economies has been performed by Gallegati and Stanca, 1998.

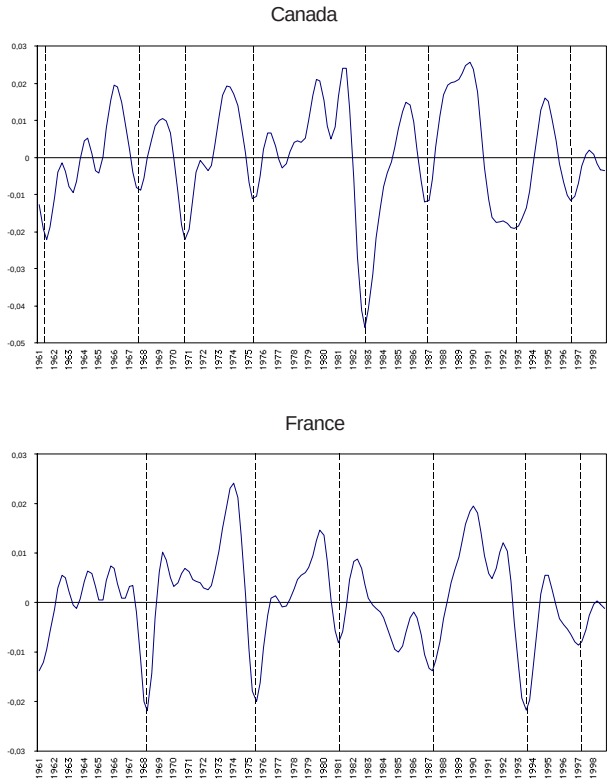
[11] The TP5 procedure (Gallegati and Stanca, 1998) is a simplified version of the Bry and Boschan one (1971). The procedure starts with the elimination of the high frequencies applying a Whittaker-Henderson type-A filter to the original series. On the transformed series a preliminary selection of the turning points is made through a recursive maximisation (minimisation) over a five quarter interval. The list of tentative turning points is selected imposing a minimum duration of 5 quarters for cycles (peak to peak and trough to trough) and of 2 quarters for phases. Moreover turns within 2 quarters of beginning and end of the series are eliminated. Finally, the process of turning points selection requires a test for the proper alternation of peaks and troughs, and an amplitude from peak to trough and from trough to peak to be at least as large as one-third of the standard deviation of the series.

[12] Statistical analysis of individual cycles have to be interpreted with some caution because of the paucity of the data of our sample.

[13] The period between two consecutive minimum defines the time span of each single cyclical episode in the cycle-specific analysis of business cycle fluctuations of section 3.

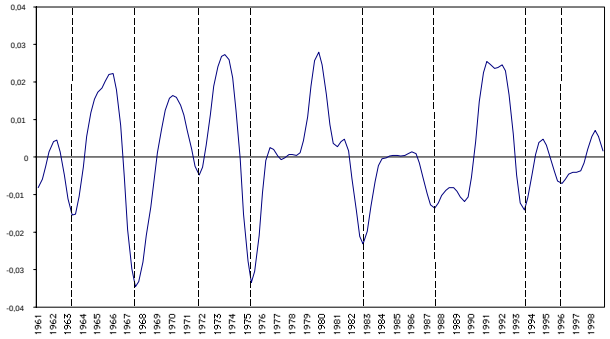
made scholars talk about an "international business cycle" (*e.g.* Bergman *et al.*, 1998).[14] In fact, the G7 countries, with a few or no exceptions, had *troughs* between 1965:I-1968:II, 1970:IV-1972:IV, 1974:IV-1975:IV, 1981:I-1983:II, 1986:IV-1987:III, 1991:III-1993:III and 1996:III-1997:1, and *peaks* between 1963:IV-1966:II, 1968:III-1970:II, 1973:II-1974:I,

FIGURE **2**
Business Cycle Chronology (BK Filtered Real GDP)

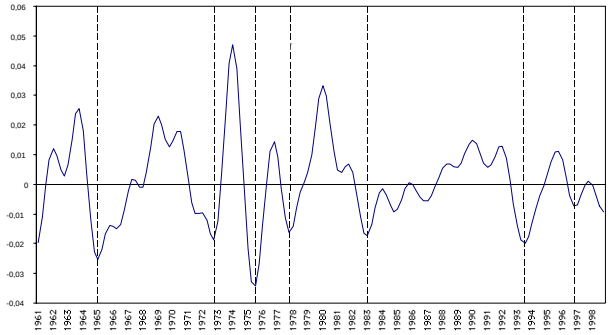


[14] One can fully appreciate the increasing synchronization by comparing our data with the secular analysis by Maddison (1995).

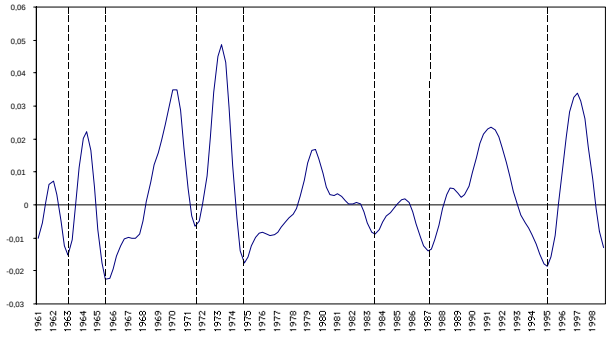
Germany

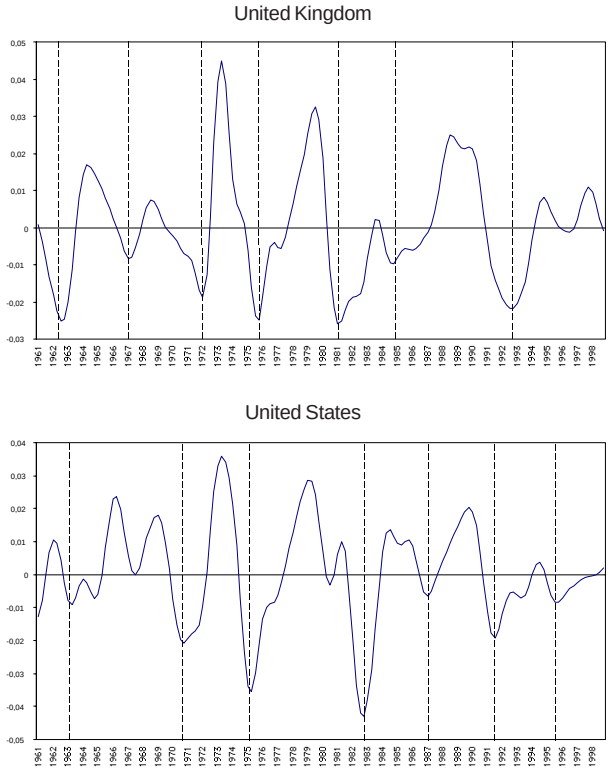


Italy



Japan





1979:I-1981:II, 1983:III-1986:I, 1988:III-1991:II and 1994:III-1995:IV. Cyclical synchronization suggests that business cycle has lately become an international phenomenon. Maddison (1995) shows that before the WWII, downturns of real GDP were rather unsynchronized, depending mostly on domestic impulses. After 1945, the business cycle is an international matter since, whatever the source may be, a single country can't swim against the tide.

In table 1 we report some evidence of asymmetry between expansions and contractions. In particular, we present average phase durations, cyclical amplitude and *steepness* of expansions and contractions for G7 countries.

The analysis of phase durations shows that expansions are generally longer than contractions (from 2 to 4 quarters) with the only exception of UK (Sichel, 1993), while cyclical amplitude of expansions and contractions is almost identical. Thus, as the average quarterly change of output in recessions is larger in magnitude than that of expansions (*steepness*), we find that contractions are by far *sharper* than expansions (but for UK again).

In a similar paper on the business cycles' characteristics of 17 European countries (Gallegati and Gallegati, 2001) we find robust signals against the hypothesis of the one-side explanation of the business cycle and the underlying idea of "all alike business cycle". To test whether this hypothesis is rejected from the G7 data, we analyze the behavior of the time series within different cycles by isolating each episode and calculating the cross-correlations of the series with output.[15]

Kydland and Prescott (1990) among other stylized facts of the US business cycle show that "the *real* series and M2 are procyclical, while prices are countercyclical." Anticipating our findings, we may say that the coherence of such a claim is corroborated in our analysis *only for the UK and the US*, in each individual cyclical episode. This evidence is quite *puzzling*. After 1960, different impulses affected the G7 and it has been argued that wages and interest rate correlations can be very erratic because of different institutional environments (monetary policies, wage setting and fiscal rules: Blanchard, 1999). Moreover, if the US economy is not representative of *the* economy, the issue of *economic laws*, *i.e.* of the economic system as a *natural one* has to be questioned (since they are, at best, country-dependent; but some works suggest they can also be time-dependent, Fuà, 1981).

Within each single cycle, we performed the statistical analysis of the previous section.[16] The results show that both the *real* and *labour* series

[15] A longer term analysis of the hypothesis of a representative cycle in the G7 economies has been performed by Gallegati and Stanca, 1998.

[16] Statistical analysis of individual cycles have to be interpreted with some cautioness because of the paucity of the data of our sample. The results are available on request by the authors.

are very uniform within cycles, *i.e.* they reply (and corroborate) the empirical evidence of section 2, while, on the contrary, wages and prices series as well as policy variables vary considerably and no uniform behavior can be detected (price level is not an exception but after the first oil shock). The cross-correlogram[17] for the wages and prices series are presented in figures 3 to 6. They display the cross-correlation coefficients of a variable at date t with GDP at date $t-k$ and $t+k$ for various values of k[18] for every single cyclical episode (represented with different colored lines) in the G7 countries. As we evidence later in this section the results show large differences in the cross-correlation coefficients across the individual cycles and/or countries.

TABLE **1**
Business Cycles Asymmetry for G7 Countries

	*Phase Durations**		*Cyclical Amplitude°*		*Steepness^*	
	Upturns	*Downturns*	*Upturns*	*Downturns*	*Upturns*	*Downturns*
Canada	12	7.3	3.88	3.73	0.34	0.53
France	13.3	10.6	2.99	2.90	0.28	0.34
Germany	10.6	7.4	3.45	3.92	0.33	0.60
Italy	12	8.6	4.56	4.38	0.60	0.65
Japan	11.8	8.1	4.05	3.67	0.43	0.58
UK	9	9.8	3.54	3.53	0.45	0.39
USA	9.6	7.6	3.76	3.71	0.42	0.48

*Number of average quarters. °Distance between business cycles turning points is expressed as percentage. ^Quarterly changes given by the ratio between the second and the first column are expressed as percentages.

GDP and Demand Components

Private consumption (except for Japan 1983:III-1987:I and Germany 1993:III-1996:III) and investments (but for UK 1981:I-1984:IV) are always pro-cyclical (mostly strongly pro-cyclical), while Government spending

[17] A cross-correlogram plots the correlation coefficients between two variables for different values of k.

[18] The lenght of the cross-correlogram for each single cyclical episode differ according to the number of data points used in estimating correlation coefficients.

behavior is quite erratic. Net exports are generally counter-cyclical (always in Italy and US), with the exception of Germany where they are mostly a-cyclical. The same regularity can be found in term of both GDP standard deviation and relative variance. Overall, one may say that aggregate demand components, with the exception of the policy variable, are quite supportive of the view of business cycle conformity.

Employment and Wages

Employment, unemployment rate and labor productivity are with a few rare exceptions, strongly coherent from cycle to cycle. Employment (except for Germany 1982:IV-1987:III, Italy 1993:III-1996-IV, and UK 1981:I-1984:IV where it is a-cyclical) are always pro-cyclical, labor productivity is always strongly pro-cyclical (except for Canada, France UK, and US where it is only pro-cyclical), and the unemployment rate is always counter-cyclical (except for Japan where it is a-cyclical, and Italy 1975:III-1977:IV and 1993:III-1996-IV where it is pro-cyclical).

A very different conclusion can be drawn if one looks at the wage behavior (keeping this fact in mind, it is not very surprising to see how many different *empirical* view have been proposed: Abraham and Haltinwanger, 1995). The nominal wage co-movements are very erratic, being counter-cyclical during the two oil-shocks, but mostly pro-cyclical before 1974 (when full-employment was quite close in most of the G7 countries). As the behavior of the wage-series within each individual cycle, we may emphasize that the nominal wages and price level move together after the first oil shock, when the indexation procedure was largely adopted. This procedure was not very successful as a defense against the erosion of real wages, whose behavior looks very erratic (exceptions are the US where it is always pro-cyclical, and Germany where it is pro(counter)-cyclical before (after) 1983).

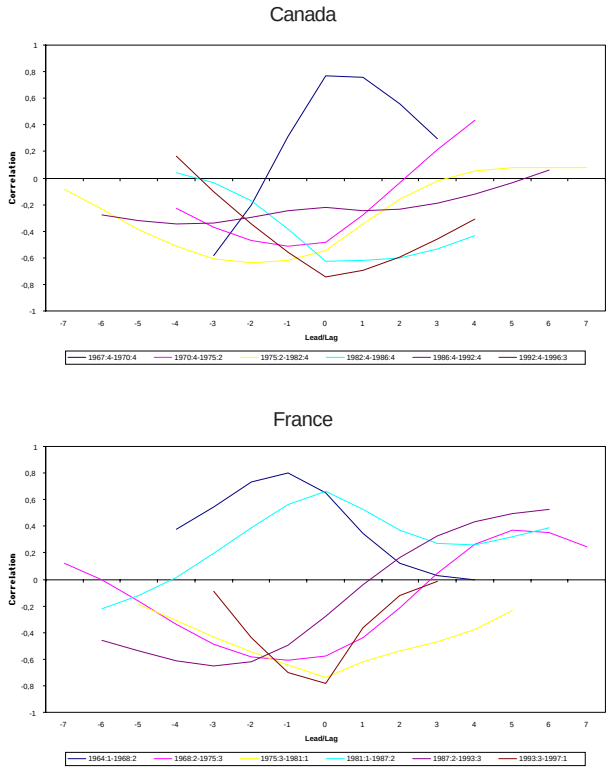
Money and Prices

M1, almost never a-cyclical (exceptions are Canada 1992:IV-1996:III, France 1968:II-1975:III, Germany 1971:IV-1975:II, and US 1991:III-

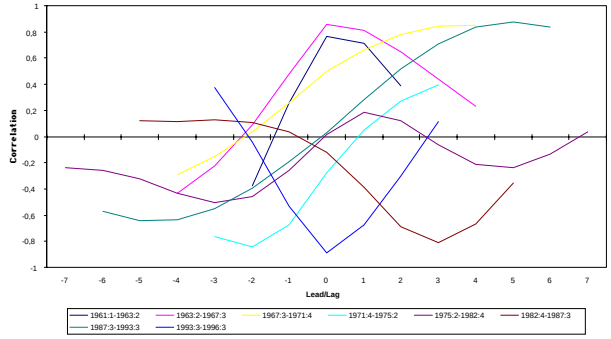
1995:III), is pro-cyclical from the early 70's to the early 80's, and counter-cyclical in the mid 80's. From the late 80's it is again pro-cyclical only in Japan and UK, as a consequence of the Fed *new* policy and of the EMU requirements for the European countries. The individual cycle analysis shows that *M1+quasi money* is more erratic than M1 as no clear uniform behavior emerges both across cycles and countries.

As the consumers' and GDP' price levels are concerned, the G7 data show they are quite volatile across different cycles, but homogeneous if

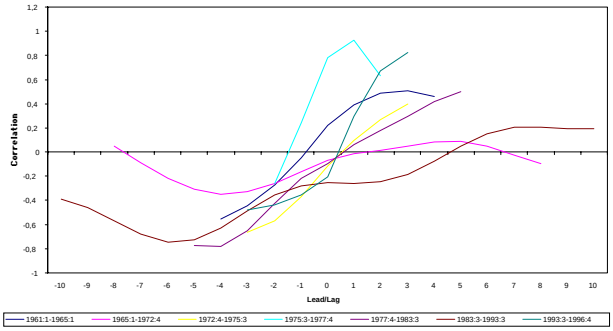
FIGURE **3**
Individual Cycles' Cyclical Properties of Nominal Wages with GDP



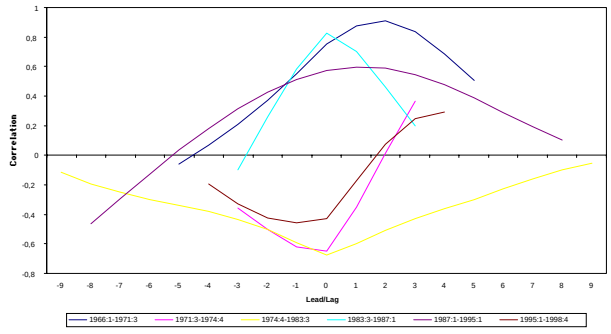
Germany



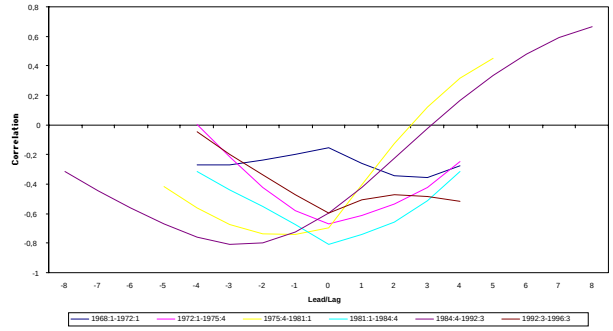
Italy



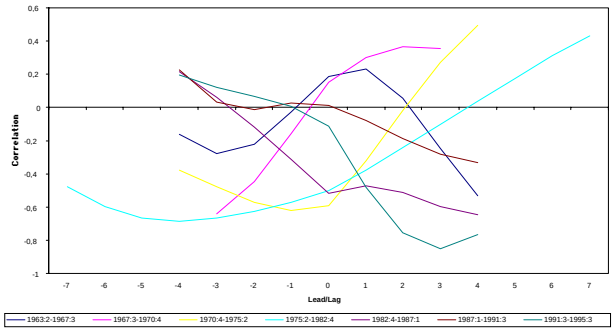
Japan



United Kingdom



United States

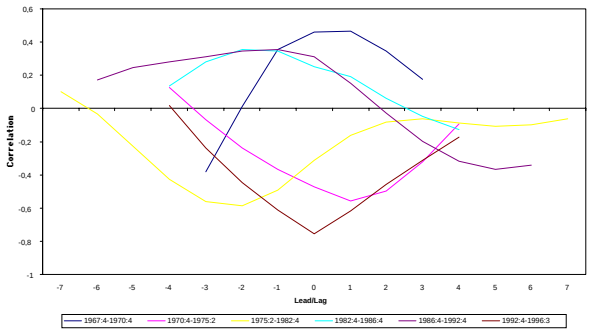


we look at the individual oil shock episodes (see figure 5). According to individual cycle analysis of the consumer price index there does always appear to exist a negative relationship between the price level and the GDP only for Canada (but 1967:IV-1970:IV) UK and US. In the other G7 economies, but Italy, prices are everywhere counter-cyclical only when the 2 oil shocks hit the economy. Finally, the behavior of the rate of inflation is also very erratic but in Italy where it is always pro-cyclical (strongly pro-cyclical in some cases).

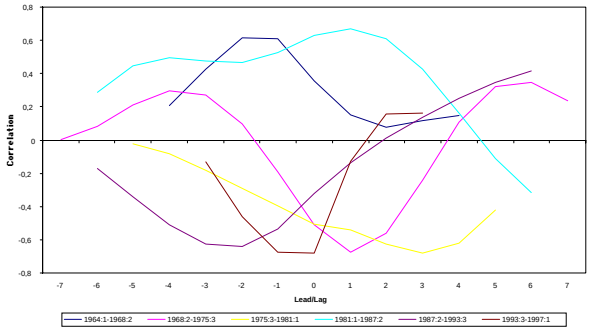
FIGURE **4**

Individual Cycles' Cyclical Properties of Real Wages with GDP

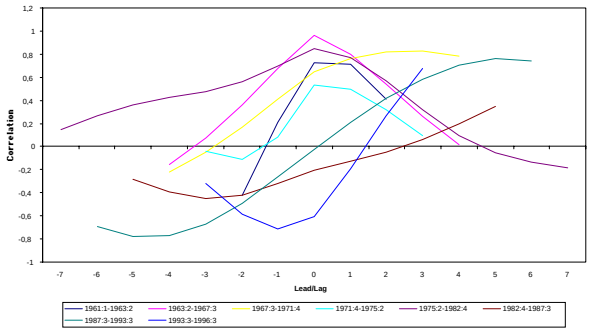
Canada



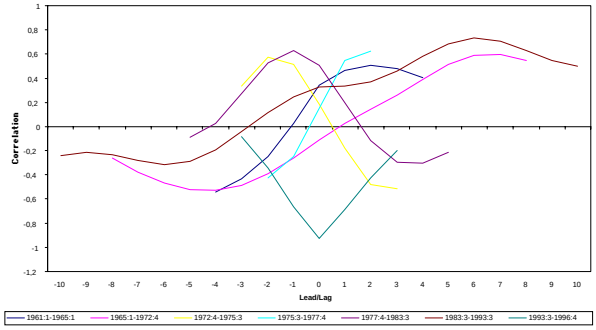
France



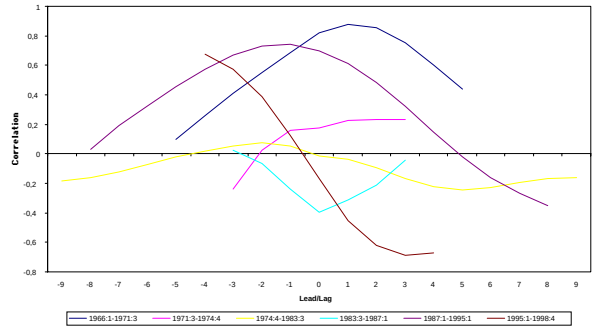
Germany



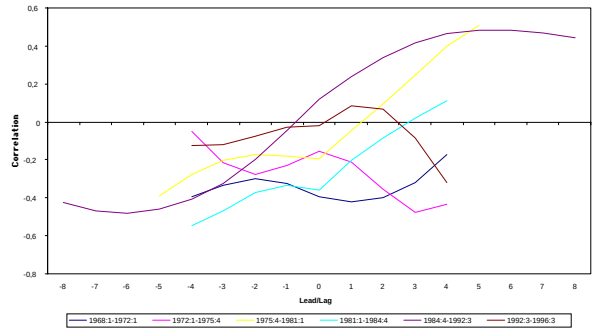
Italy



Japan



United Kingdom



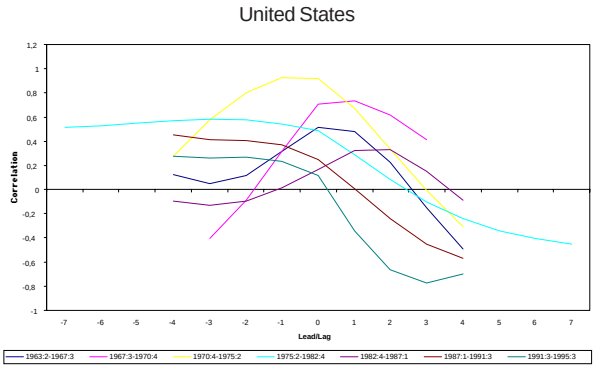
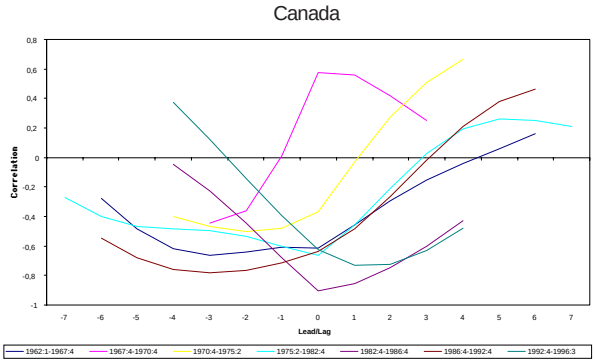
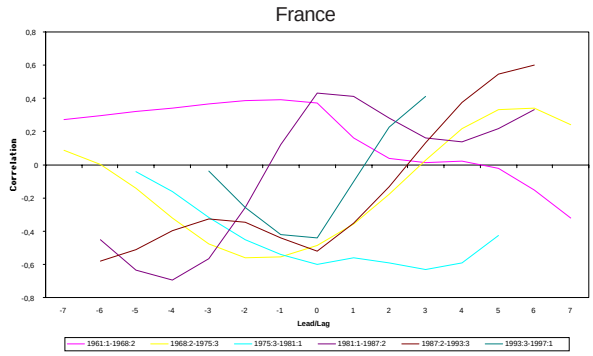


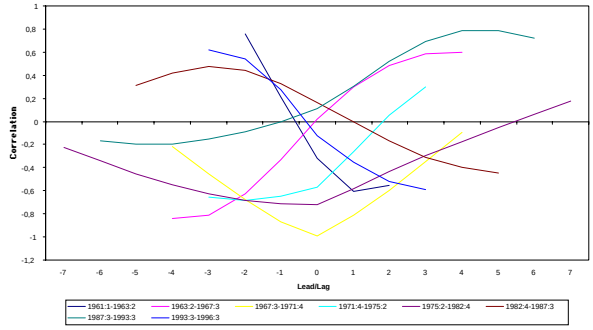
FIGURE **5**

Individual Cycles' Cyclical Properties of Consumer Prices Index with GDP

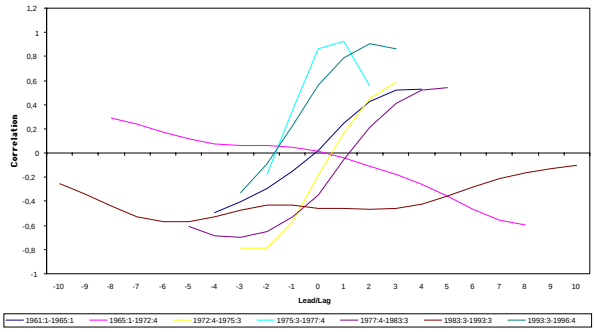




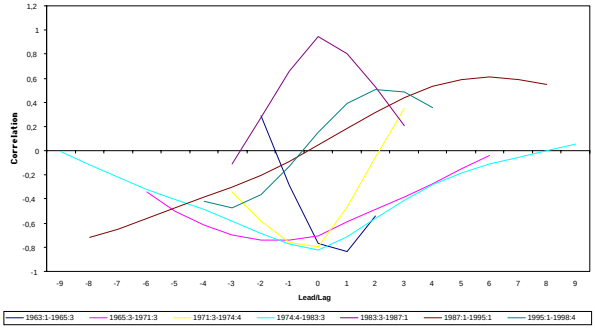
Germany

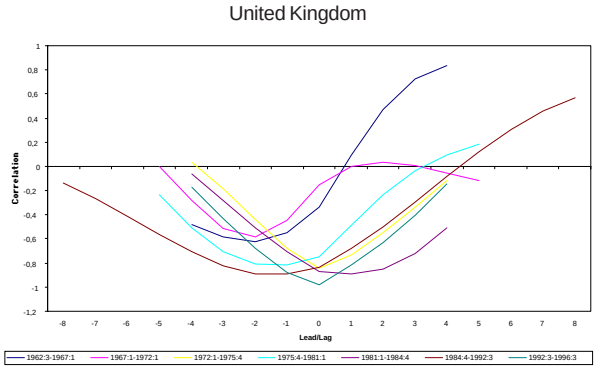


Italy



Japan





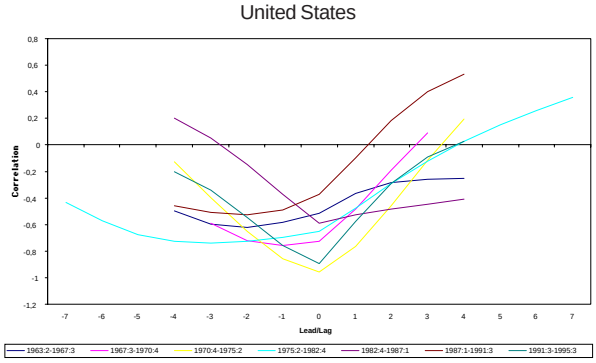
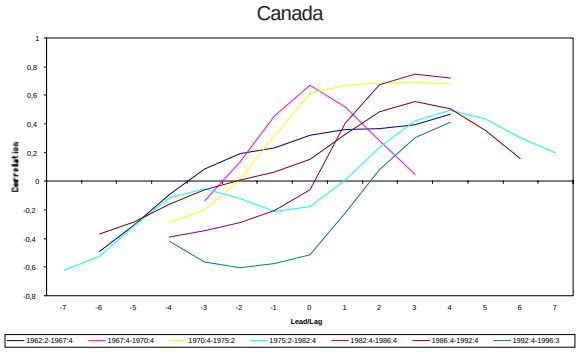
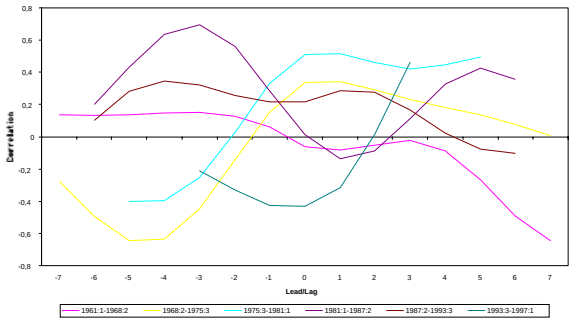


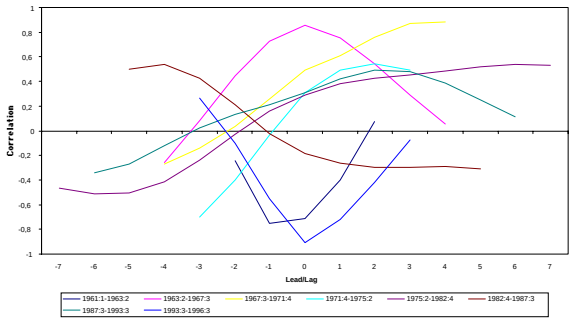
FIGURE **6**
Individual Cycles' Cyclical Properties of Inflation Rate with GDP



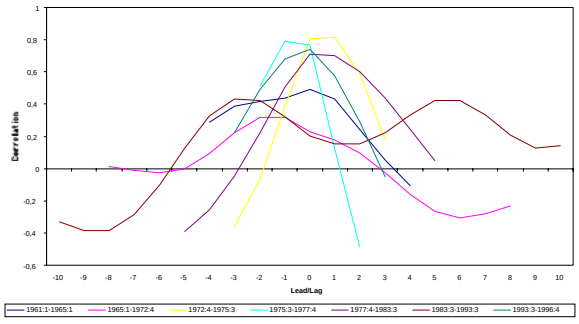
France



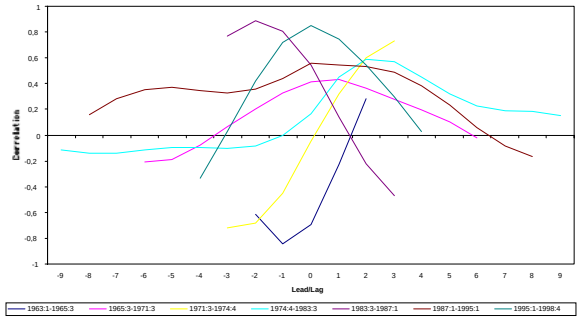
Germany



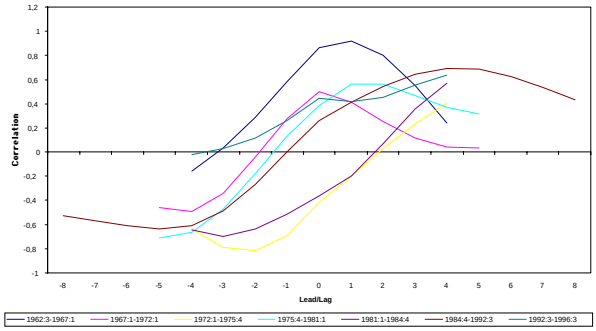
Italy



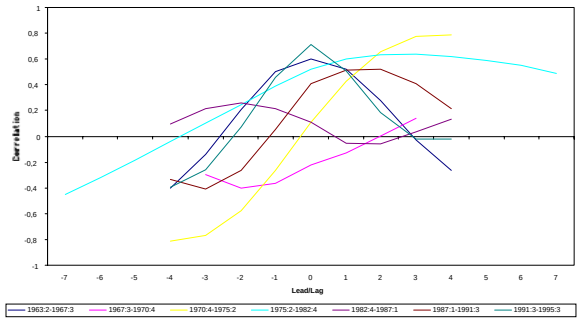
Japan



United Kingdom



United States



Interest Rates and Stock Prices

The short term interest rate is mostly pro-cyclical with a few exceptions for some countries: Italy in the 80's, Japan in the 70's and UK from the mid 70's to the early 90's. The dynamics of the short term interest rate seems to be more country-specific if compared to the one of both the long and the real rate of interest which show more uniformity across cycles. Indeed, they are mostly pro-cyclical until the early 70's, counter-cyclical after the two oil shocks, and pro-cyclical from the mid 80's on. Finally, the share price index is always pro-cyclical before the first oil shock, never counter-cyclical in Canada and Germany, and counter-cyclical in US from the early 80's. In the other cases no uniform behaviour seems to emerge.

All in all, the empirical evidence emerging from the cross-correlation analysis of individual cyclical episodes suggests a distinction between those series whose behaviour is very coherent within cycles, *i.e.* the *real* and *labour market* variables, and those series whose behaviour looks quite irregular within cycles, *i.e. policy*, wages and prices variables. In fact, with the execptions of UK and US, the variables whose co-movements with GDP are stable across countries, such as the *real* and the labour market variables, are the same whose co-movements are stable even through individual cycles. And, vice versa, the variables whose co-movements with GDP are not stable across countries, such as the policy, wage and price variables, are the same variables whose co-movements are not stable even across individual cycles. If we take a look at the G7 behavior, we may claim that Kydland-Prescott's assertion holds true for the UK and the US only. In fact, real aggregative series are uniform within each cycle (exception is Germany), but prices are not counter-cyclical everywhere (but for the 2 oil shocks).

CONCLUSIVE REMARKS

In this paper we propose a cycle-specific analysis of business cycles looking at co-movements in some selected time series with GDP in each single cyclical episode using quarterly data about 18 economic time series for the G7 countries in the post-war period. We find *regularity*, in terms

of co-movements and periodicity with respect to the GDP, in most of the series. In particular, consumption and investment among the aggregate demand components, *labour market variables,* and, to a lesser degree, net exports, price indexes, their inflation rates and the stock market index, are stable through cycles and across countries, while the *exogenous* component of the national income series, the monetary variables, the interest rates and wage series are not. Moreover, UK and US' regular behaviour of wages and price series represents an interesting exception for its economic policy's implications in terms of the existence of a sort of *natural economic law* governing market economies and the need of a *cycle-specific* as well as a *country-specific* policymakers *reaction function*.

Even if this paper is empirical and can only offer a contribution to the empirical analysis of the cycle, it is quite clear that the empirical evidence of the G7 does not support the hypothesis of *stylized facts* of the business cycle[19] and questions the *one sided* (either as impulses or deterministic) approach to business cycle, since no uniform behavior emerges if we look at the individual cycles.

As Schumpeter (1951) suggested, business cycle scholars should analyze "how industries and individual firms rise and fall and how their rise and fall affects the aggregates and what we loosely call general business conditions." Panel data analysis (Stokey, 1993) and historiographical tools (Temin, 1998) may be of help in describing business cycle. It has been suggested that economies respond differently to the same shock because of their *vulnerability* (Zimmerman, 1998) or *financial fragility* (Delli Gatti and Gallegati, 2000). Moreover, both vulnerability and financial fragility may change during the cycle affecting the propagation mechanism.

[19] The late Richard Goodwin once sourly said that a thing called *business cycle* probably does not exist. Even not being a nihilist, it is difficult to assume that there exists only a unique *causa causans* of the business cycle. *E.g.*, there is no questioning that the first oil shock was a *supply shock* which shifted the aggregate supply curve; but there was a monetary response also, which shifted the aggregate demand schedule.

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