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CERIS
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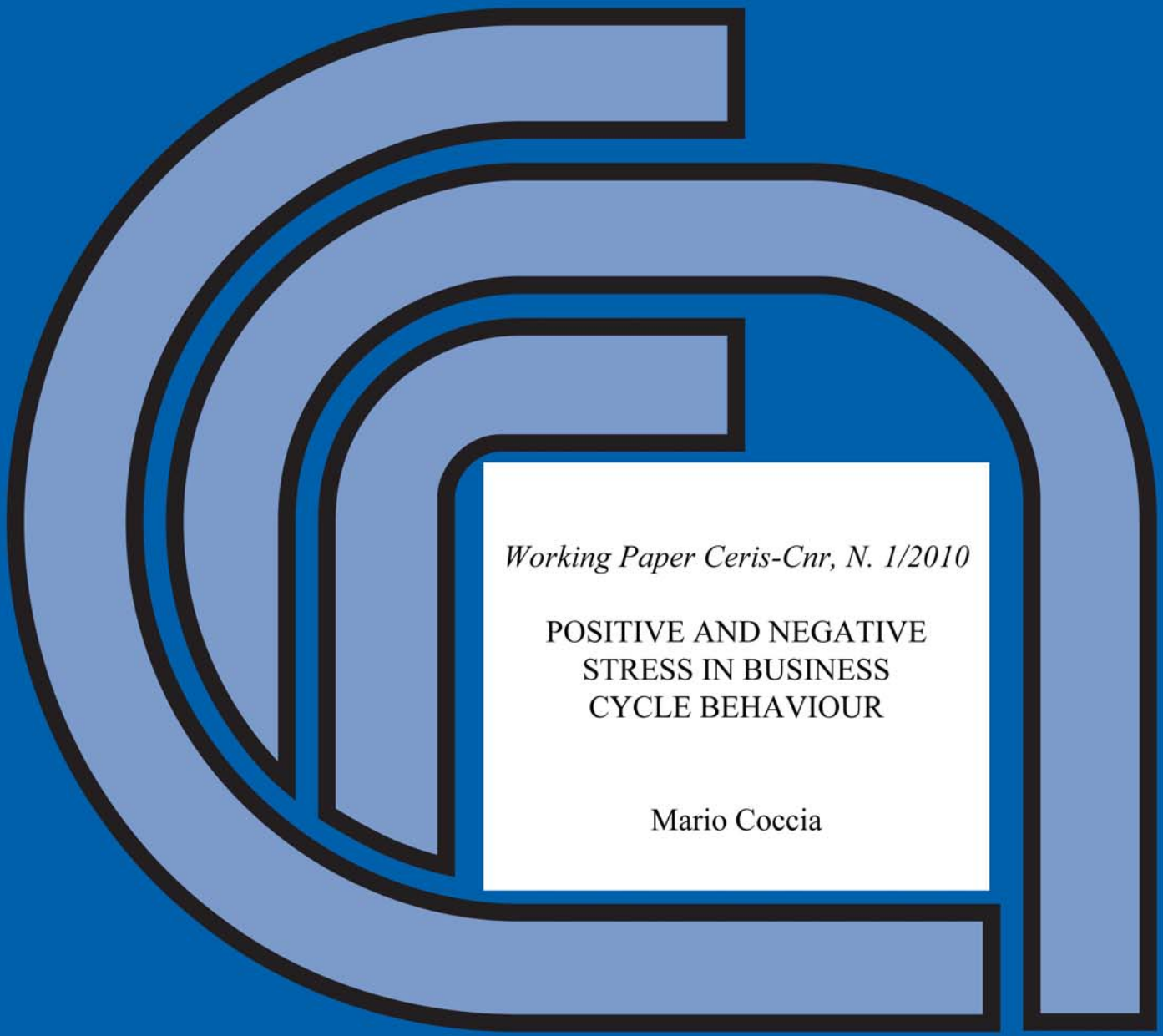
ISSN (print): 1591-0709
ISSN (on line): 2036-8216



Working Paper Ceris-Cnr, N. 1/2010

POSITIVE AND NEGATIVE STRESS IN BUSINESS CYCLE BEHAVIOUR

Mario Coccia

Working Paper

CNR -- Consiglio Nazionale delle Ricerche
Ceris-Cnr
Istituto di Ricerca sull'Impresa e lo Sviluppo

WORKING PAPER CERIS-CNR
Anno 12, N° 01 – 2010
Autorizzazione del Tribunale di Torino
N. 2681 del 28 marzo 1977

Direttore Responsabile
Secondo Rolfo

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Distribuzione
On line:
http://www.ceris.cnr.it/index.php?option=com_content&task=section&id=4&Itemid=64

Fotocomposizione e impaginazione
In proprio

Finito di stampare nel mese di Novembre 2010

Positive and negative stress in business cycle behaviour

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ABSTRACT: The economic theory shows as business cycles have longer periods of expansions than contractions. The purpose of this paper is to analyze their behaviour in order to present a metrics that assesses the negative and positive stress of the economic system. In addition, this analysis presents some forecasting implications supporting modern political economy of growth.

KEYWORDS: Business Cycles, Contraction-compression Economic stress, Economic Forecasting

JEL-CODES: E30, E37

Previous version of this paper was submitted to TFSC Journal and one referee suggested to focus the original paper on Long Wave behaviour in order to publish it, reducing the part on business cycle behaviour, although it was interesting. This paper presents this part and I would like to thank the reviewers of TFSC and the Editor Harold Linstone for helpful comments and suggestions, as well as Enrico Filippi (University of Torino, Italy) and Secondo Rolfo (Ceris-CNR) for fruitful discussion on this topic. Silvana Zelli, Maria Zittino and Diego Margon provided capable research assistance. The usual disclaimer applies.

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Mitchell W.C. (1874-1948), Professor at the Columbia University in the City of New York (USA)
Mortara G. (1885-1967), Professor at the University of Milan (Italy)
Wagemann E. (1884-1956), Professor at the University of Berlin (Germany)

INTRODUCTION

The debate over business cycle theory has been ongoing since the first substantial evidence showed in 1920s and 1930s (Mortara, 1932; Wagemann, 1932; Mitchell, 1932, 1941; Schumpeter, 1932; Forrester, 1976; Kydland and Prescott, 1991; Hodrick and Prescott, 1997; Hansen and Prescott, 2005).

Although several works have provided many valuable insights into the theory of business cycle, there are issues that have been not yet well explored by economists such as: to evaluate the impact of contractions and expansions of business cycles over time. The purpose of this paper is to present a metrics to assess this impact in order to analyze the dynamics of upturn and downturn of business cycles. This approach can provide vital scientific information to make economic forecasting and support the new political economy of growth.

THEORETICAL FRAMEWORK

Since 1854, the National Bureau of Economic Research (NBER, 2010) has been measuring US Business Cycle Expansions and Contractions. According to this main economic institution, the average duration in months of US business cycle, from 1854 to 2001, is 56.4 months. Table 1A (in Appendix) shows that the contractions have an arithmetic mean equal to 17.4 months, whereas the average period of expansions is 38.7 months.

The analyses of these data (*i.e.* Table 1A in Appendix) as well as the economic theory, beginning with the pioneering work by Mitchell and Keynes, show that the contractions are briefer than the expansions[1]. Lenti (1972, p. 1159), confirms this asymmetric behaviour for Italian business cycles (Tab. 2A in Appendix), whereas Razzak (2001), pp. 235 ff, provides international evidence of business cycle asymmetries. Sichel (1993, pp. 225 and 226), distinguishes between two types of asymmetry represented by “steep and deep cycle”, Hansen and Prescott (2005, p. 850), *inter alia*, study how a binding capacity constraint affects the proprieties of business cycles, which are asymmetric in their model[2]. Romer (1994; 1999) argues

[1] See also Razzak (2001), p. 230 and 231; Chalkley and Lee (1998), p. 623 and 624.

[2] Kydland and Prescott (1991) also analyze the hours per worker and change in number of workers in the business cycle theory. In addition, Hodrick and Prescott (1997): “propose a procedure for representing a time series as the sum of a smoothly varying trend component and a cyclical component” (p. 1), the so-called Hodrick-Prescott filter to estimate the trend.

that expansions and contractions occur at irregular intervals, varying their temporal lengths. In particular, the period of US business cycles can be divided in 68.95% of expansions and 31.05% of contractions (see Table 1A in Appendix). These results confirm that the pattern of business cycles is characterized by temporal compression of contractions, and temporal dilatation of expansions over time. This behaviour of business cycles has been also analyzed by Miles and Scott (2005) and by International Monetary Fund for several countries (IMF, 2003). The literature is vast and not fully cited here, but a good list of references is found in Verbrugge (1997).

As far as the causes of business cycle patterns are concerned, Moore (1983) argues that the change in business cycle behaviour is linked to a change in the dynamics of wholesale prices. Cover and Pecorino (2005, p. 452, 454, *passim*) claim that US business-cycle expansions became longer with the March 1933 expansion, a date which coincides with US leaving the gold standard (in April); in particular this decision of the US government allowed the Federal Reserve to implement monetary policy with more discretion. In fact, as predicted by many models, discretionary monetary policy can be used to reduce output fluctuations, though the price of this increased stability has been inflation. In current economy, the inflation rate has fallen and become less variable, which suggests that the price for avoiding the instabilities of the gold standard is quite low when compared to the benefits. Therefore, a change in the monetary policy was the main reason for the post-gold-standard increase of expansion length. In other word, the character of business cycles is affected by economic policies that have been improving over time because of a learning process from economic history.

METRICS TO EVALUATE THE NEGATIVE AND POSITIVE STRESS FOR THE ECONOMIC SYSTEM

Figure 1, using data of the Gross Domestic Product percent change based on chained dollars (Quarterly - Seasonally adjusted annual rates) by US Bureau of Economic Analysis[3] (BEA, 2010), shows a classical business cycle that has contractions shorter than expansions (asymmetry).

If we consider a business cycle in a close lapse of time [*a*, *c*], it might be interpolated by a polynomial function with *t*=time (explanatory variable):

$$f(t) = a_n t^n + a_{n-1} t^{n-1} + \ldots + a_0 \quad (a_n \neq 0) \quad [1]$$

with coefficients:

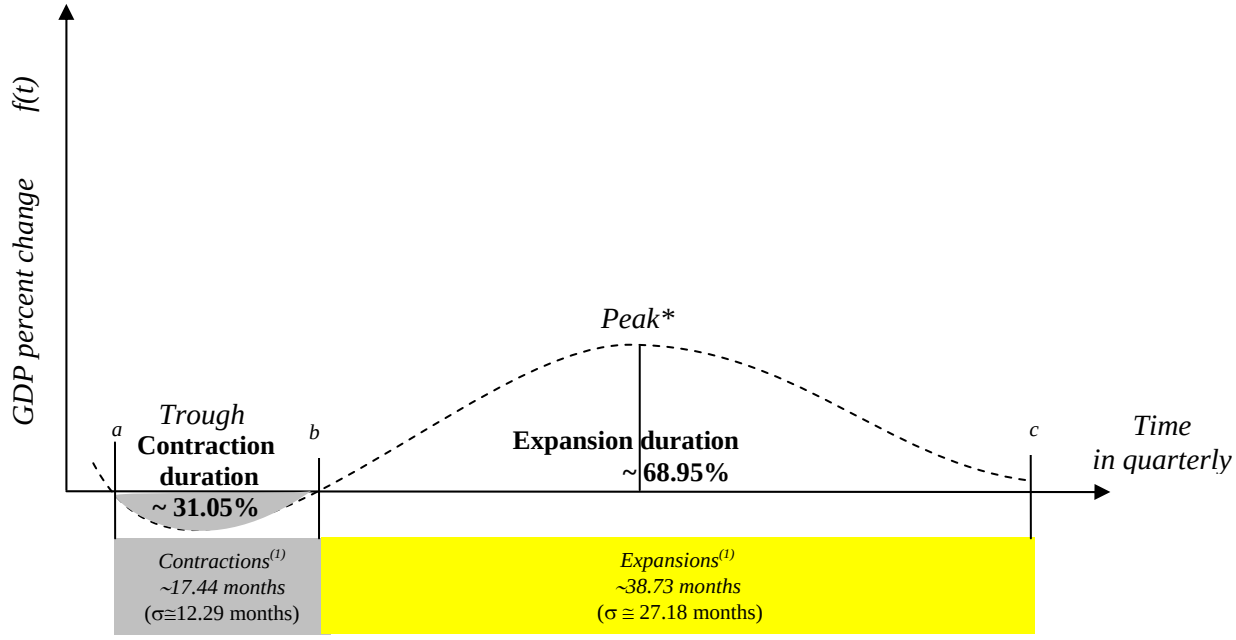
$$a_r \in \Re$$

in which the:

$$D(\text{domain}) = \Re_0^+ \text{ (Positive real number set)} .$$

[3] The Bureau of Economic Analysis (BEA), located in Washington D.C., promotes a better understanding of the U.S. economy by providing the most timely, relevant, and accurate economic accounts data in an objective and cost-effective manner.

This function is a continuous function on that lapse of time [*a*, *c*]. The estimation of this business cycle function can be carried out by the least squares method, using *f* to be *cubic*, *quartic* or *quintic*, according to economic data scatter.



Note: (1) Arithmetic mean of all US Business Cycle over 1854-2001 period
Average period of US Business Cycle is ~56.17 months (σ ≅ 28.53 months)

FIGURE 1: COMPRESSION OF CONTRACTION AND DILATATION OF EXPANSION OF US BUSINESS CYCLES

Considering the classical pattern of the business cycle, represented by a continuous function [1], as in the Figure 1, the recession can be defined as a *negative stress of the economic system*, and given by:

$$R = \text{Recession or negative stress for economic systems} := \int_a^b |f(t)|dt$$

Whereas the expansion phase can be defined as *positive stress of the economic system* and given by:

$$E = \text{Expansion or positive stress for economic systems} := \int_b^c f(t)dt$$

In general, considering the theoretical background that shows the asymmetry for the business cycle[4], it is valid the following inequality over a lapse of time [*a*, *c*]:

[4] See also Coccia (2009) for other metrics concerning the business cycle, Coccia (2010) for an analysis on the asymmetric path of long waves and Devezas (2010, pp.749-751) for interesting remarks on these findings.

$$\int_a^b |f(t)|dt < \int_b^c f(t)dt$$

i.e.: Negative stress < Positive stress

This inequality can be easily demonstrated using data recorded by NBER (2010).

In addition, as the economic cycle processes can change over time and space, it is instructive to introduce the *t**, the travel time of the contraction (*or* expansion) divided by the geo-economic factor in a region (*e.g.* country):

$$t^* = \frac{t}{Q} = \frac{\text{travel time}}{\text{geo - economic factors}}$$

In a socio-economic system, *Q* is a function of several elements such as energy resources of the country, social and political elements, geo-economic ones, and so on. These forces can affect the economic cycle process by a high or low attenuation of the travel time and amplitude of contractions and expansions over time and space.

This metrics can support economic decisions of policymakers in order to apply, more and more, efficacious counter-cyclical mechanisms aimed to reduce economic fluctuations. In particular, this metrics can play a vital role for supporting economic policies that minimize the negative effects of contractions (*negative stress* for the economic system) and maximize the positive sides of expansions (*positive stress*). These economic policies can foster a steady-state growth of the aggregate demand. In fact, stabilization policy of the aggregate demand has been contributing to the improvement of economic conditions after the World War II by higher economic wealth and well-being of countries in the long run.

DISCUSSION AND ECONOMIC FORECASTING IMPLICATIONS

A main research objective of economists is the prediction of the *positive* and *negative stress* for business cycles by reliable precursors of recessions and expansions (cf. Bresciani Turroni, 1932) and the evaluation of the impact of these shocks on the economic system (Cf. Coccia, 2009). Modern economics argues that the precursors of the economic activity are affected by the dynamics of monetary and stock exchange markets that drive the capitalistic systems. Persons (1931), analyzing the business barometer, showed that some time series provide early warnings in comparison to others: *e.g.* the speculation activity, financing to and debt load of firms and households as well as some indicators of monetary market are apt precursors of economic forecasting. Time series of these precursors provide vital signals that precede the decline of industrial and manufacturing activity across economic systems[5]. In fact, to increase the stability of economic systems, it is important to analyze the behaviour of business cycles (*positive* and *negative stress*) by apt

[5] Cf. Lenti (1972), Cap. XI, pp. 1055-1206.

metrics in order to apply, in advance, precautionary counter-cyclical interventions of political economy, when there are the early warnings and premonitory signals that the recession phase is approaching.

As described by economic theory, business cycles have expansions longer than contractions over time. This paper has patterned this economic behaviour to conjecture the impact of the *positive* and *negative stress* for the economic system, based on the reduction or increase of GDP percent change.

In general, business cycle behaviour has lower negative stress than positive one: *e.g.* this behaviour is confirmed on economic data of US, and Italian economies, two nations located in different geo-economic areas. The metrics and results of this paper may have vital forecasting implications for supporting counter-cyclical interventions of political economy in modern economies; considering that the average period of contraction of business cycles is roughly 17-18 months (with an error of measurement equal to $\sigma \approx 12$ months, see Table 1A in Appendix and figure 1), it is possible to plan two main scenarios:

1. *optimistic negative stress*: the recession phase (*negative stress*) of the business cycle has a temporal duration lesser than 1 year (*i.e.* it is 5-6 months);
2. *pessimistic negative stress:* the contraction of the business cycle has a temporal duration of about 2.5 years, after that the natural economic forces of markets trigger the recovery and prosperity phase.

These critical scenarios are important for policymakers that can apply different interventions of political economy based on counter-cyclical investments[6] (of capital and/or R&D) in order to minimize the *negative stress* (duration of the recessions for the economic system) and support economic recovery.

The results discussed here are focused on US economy which is again a leading country for worldwide economic growth (but not the only one)[7]. In fact, the behaviour of US economic cycles provides apt signals that shocks and/or booms are approaching in the global economic system. In addition, it is important to consider that the turbulent and dynamic world has often stochastic shocks affecting the business cycle behaviour (as the last financial crisis, see Goldstein, 2009, pp. 263-267)[8]. Romer (1994; 1999), analyzing economic cycles, argues that their volatility is not decreased over time, though Stock and

[6] See Tan and Mathews (2010) for an interesting study on semiconductor industry.

[7] The current and future global economy will be based on the increasing importance of Asian economies (such as China, India and Japan), as well as of the Brazilian and Russian economies, etc. (most of these countries are called BRIC countries, an acronym that refers to the fast-growing economies of Brazil, Russia, India, and China). These economies can affect the pattern of future long waves and next researches have to consider the crucial role of these countries.

[8] For instance, next economic shock (*double deep*) may be due to expansive economic policies, for fostering economic recovery, that have generated huge public debts of countries.

Watson (2002) point out that the variability of US cyclical behaviour has been decreasing since 1984 (see also Basu and Taylor, 1999).

Anyhow, economic shocks and turmoil may be unexpected and unforeseeable events that often occur in economic systems suddenly, generating a *negative stress*, which reduces the performance of nations in fast-changing economies. These shocks are due to irregular behaviour of human being such that Keynes used the term "animal spirits" in order to describe the behaviour of investors. Although the regularity of business cycle, based on an asymmetric behaviour, has been showed, a margin of uncertainty remains about the exact length of the upturn and downturn period as well as its *negative/positive stress* (duration and intensity), due to the multidimensional forces that drive capitalistic systems. It is important to note that the economic future is something that public and private economic subjects construct day-by-day and in different ways[9]. As a matter of fact, the analysis of business cycle behaviour, affected by different socio-economic-technological factors, is a difficult task because of instability generated by not ever rational human behaviour and continuous new events added to old ones, such as financial shocks, terrorism warfare, primary energy resources crisis, changes of geo-economic equilibrium, political instability, technological revolutions, and so on (Devezas, 2007, 2010; Goldstein, 2009). These events increase the turbulence of global and symbiotic socio-economic systems. Therefore, reliable metrics of business cycle behaviour, to evaluate its positive and negative stress, are more and more important to support the pro-cyclical decisions of policymakers in upturn phase, as well as the counter-cyclical investments in capital and R&D during the recession period.

As far as the economic forecasting, with the current socio-economic background, it is possible to conjecture what likely will happen and will be the behaviour of business cycles since the human factors permit us only orientation economic forecasting that, in turn, it has to be updated continuously to have more reliability for designing future worldwide scenarios in the long-run economic horizon.

[9] Economic forecasting is different from weather forecasts: if the rainfall is forecasted, and this weather forecast is correctly done, we cannot prevent that the rainfall takes place. Whereas, in political economy, if the expansion is forecasted, the economic subjects use this information to change their (rational and irrational) expectations in order to have an economic advantage from this positive scenario; but so behaving, the economic subjects affect the economic cycles that can choose different trajectories.

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APPENDIX: DATA OF BUSINESS CYCLES

TABLE 1A: US BUSINESS CYCLE (EXPANSIONS AND CONTRACTIONS)

Cycle [a]		*Duration*				
		in months			*Contraction*[b] *%*	*Expansion*[b] *%*
		Contraction	*Expansion*	*Cycle*		
December 1854 (IV)	June 1857 (II)	--	30			
December 1858 (IV)	October 1860 (III)	18	22	40	45.0	55.0
June 1861 (III)	April 1865 (I)	8	46	54	14.8	85.2
December 1867 (I)	June 1869 (II)	32	18	50	64.0	36.0
December 1870 (IV)	October 1873 (III)	18	34	52	34.6	65.4
March 1879 (I)	March 1882 (I)	65	36	101	64.4	35.6
May 1885 (II)	March 1887 (II)	38	22	60	63.3	36.7
April 1888 (I)	July 1890 (III)	13	27	40	32.5	67.5
May 1891 (II)	January 1893 (I)	10	20	30	33.3	66.7
June 1894 (II)	December 1895 (IV)	17	18	35	48.6	51.4
June 1897 (II)	June 1899 (III)	18	24	42	42.9	57.1
December 1900 (IV)	September 1902 (IV)	18	21	39	46.2	53.8
August 1904 (III)	May 1907 (II)	23	33	56	41.1	58.9
June 1908 (II)	January 1910 (I)	13	19	32	40.6	59.4
January 1912 (IV)	January 1913 (I)	24	12	36	66.7	33.3
December 1914 (IV)	August 1918 (III)	23	44	67	34.3	65.7
March 1919 (I)	January 1920 (I)	7	10	17	41.2	58.8
July 1921 (III)	May 1923 (II)	18	22	40	45.0	55.0
July 1924 (III)	October 1926 (III)	14	27	41	34.1	65.9
November 1927 (IV)	August 1929 (III)	13	21	34	38.2	61.8
March 1933 (I)	May 1937 (II)	43	50	93	46.2	53.8
June 1938 (II)	February 1945 (I)	13	80	93	14.0	86.0
October 1945 (IV)	November 1948 (IV)	8	37	45	17.8	82.2
October 1949 (IV)	July 1953 (II)	11	45	56	19.6	80.4
May 1954 (II)	August 1957 (III)	10	39	49	20.4	79.6
April 1958 (II)	April 1960 (II)	8	24	32	25.0	75.0
February 1961 (I)	December 1969 (IV)	10	106	116	8.6	91.4
November 1970 (IV)	November 1973 (IV)	11	36	47	23.4	76.6
March 1975 (I)	January 1980 (I)	16	58	74	21.6	78.4
July 1980 (III)	July 1981 (III)	6	12	18	33.3	66.7
November 1982 (IV)	July 1990 (III)	16	92	108	14.8	85.2
March 1991(I)	March 2001 (I)	8	120	128	6.3	93.8
November 2001 (IV)	December 2007 (IV)	8	73	81	9.9	90.1
Average, all cycles: 1854-2001 (32 cycles)	**(in months)**					
	Arithmetic mean	**17.44**	**38.73**	**56.17**	**31.05%**	**68.95%**
	(*Dev. Standard)*	*(12.29)*	*(27.18)*	*(28.53)*		
	Max (months)	65	120	128		
	Min (months)	6	10	17		
1854-1919 (16 cycles)	Arithmetic mean	22.53	26.63	48.93		
	(*Dev. Standard)*	*(14.14)*	*(9.72)*	*(18.05)*		
1919-1945 (6 cycles)	Arithmetic mean	18.00	35.00	53.00		
	(*Dev. Standard)*	*(12.74)*	*(25.71)*	*(32.16)*		
1945-2007 (11 cycles)	Arithmetic mean	10.18	58.36	68.55		
	(*Dev. Standard)*	*(3.25)*	*(35.01)*	*(36.02)*		

Note:

[a] Roman Numbers in column 1 and 2 are the quarterly of the year.

[b] Contraction or Expansion % is: $\left(\frac{cycle\ period}{\text{duration of contraction or expansion}} \right) \times 100$

Source: NBER, 2010 (accessed March)

TABLE 2A: ITALIAN BUSINESS CYCLE 1945-1965

Cycle	*Turning points 1945-1965 periods*			*Duration (in months)*			*Duration %*	
				Expansion	*Contraction*	*Cycle*	*Expansion*	*Contraction*
I	May 1945	September 1947	March 1948	28	6	34	82.35	17.65
II	March 1948	July 1949	March 1950	16	8	24	66.67	33.33
III	March 1950	Apr 1951	June 1952	13	14	27	48.15	51.85
IV	June 1952	June 1955	February 1956	36	8	44	81.82	18.18
V	February 1956	September 1957	August 1958	19	11	30	63.33	36.67
VI	August 1958	July 1960	January 1961	23	6	29	79.31	20.69
VII	January 1961	October 1963	January 1965	33	15	48	68.75	31.25
	Average, all cycles: 1945-1965 (in months)			**24**	**9.71**	**33.71**	**70.05%**	**29.95%**
			(Dev. Standard)	*(8.68)*	*(3.68)*	*(8.99)*		
			Max (months)	36	15	48		
			Min (months)	13	6	24		

Source: Lenti, 1972, p. 1159

Working Paper Ceris-Cnr

ISSN (*print*): 1591-0709 ISSN (*on line*): 2036-8216

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