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Business cycles and the scale of economic shock

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ABSTRACT: The purpose of this paper is to determine the scale of economic shocks (SES), considering a new indicator based on the duration (in months) of contractions and expansions within Business Cycles and their amplitude, measured by GDP percent change based on chained 2000 dollars. Data of US Business cycles are used. The result is that the SES shows the real economic impact of contractions and expansions over time and serves as a warning signal that the economic system is entering into a turbulent state in the short-run.

KEYWORDS: Business Cycles, Economic shock, Contractions, Expansions

JEL-CODES: E30, E32, E37

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1. INTRODUCTION

Modern theory of economic cycles argues that long waves have four phases: prosperity, recession, depression and recovery (Kondratieff, 1926; 1935; Volland, 1987; Ayres, 1990 and 1990a; Berry *et al.*, 1993; Reati and Toporowski, 2004; Devezas *et al.*, 2005; Papenhausen, 2008). These phases form the upwave and downwave period of economic cycles. As there is correlation between rising prices and economic growth (prosperity) and conversely, basic economic theory suggests that sustained prosperity is likely to result in bottlenecks and scarcities that tends to drive prices up. By the same token, stagnation and recession tend to result in underutilization of capital and excess of supply of many commodities, hence (where the markets are unfettered) declining prices (Ayres, 1990). The stylized scheme set forth by Van Gelderen focuses on turning points between inflationary (upwaves) periods and deflationary periods (downwaves). According to Berry *et al.* (1993), upwave growth starts in recessions and ending in stagflation crises that are associated with diffusion of newly structural innovation. Downwave growth is associated with technology successions, when peaked-out paradigms are challenged by ascendant sets of techno-economic alternatives after the shocks of stagflation crises. It is important to note as within the economic cycles, there are nested the business cycles (Schumpeter, 1939). Business cycles were codified and analyzed by Burns and Mitchell (1946), that defined a recession as a period when a broad range of economic indicators falls for a sustained period, roughly at least half a year. Romer (1994; 1999) argues that the term "business cycle" is misleading. "Cycle" seems to imply that there is some regularity in the timing and duration of upswings and downswings in economic activity. However, expansions and recessions occur at irregular intervals and for varying lengths of time and for this reason, the term "short-run economic fluctuations" is preferred to "business cycle" (Romer, 1994; 1999).

Business cycles occur because shocks push the economic system above or below full employment level. This description of what causes business cycles reflects the Keynesian or new Keynesian view that cycles are the result of nominal rigidities. Only when prices and inflationary expectations are not fully flexible, fluctuations in overall demand cause large swings in real output. Whereas, the new classical framework argues that business cycles are due to disturbances in productivity and tastes, not of changes in aggregate demand. Another possible cause of recessions and expansions is the monetary policy (Friedman and Schwartz, 1963). Miles and Scott (2005) and the International Monetary Fund (IMF, 2003) have showed the behaviour of business cycles for the USA and other countries.

Although several works have provided many valuable insights into the theory of business cycle, they do not well address the question explicitly addressed here: how the impact of economic shocks can be measured?

Before describing the methodology for measuring shocks in economic systems, a fundamental part on measurement theory is introduced.

2. MEASUREMENT THEORY

The measurement of an empirical variable is a consistent assignment of numbers to the variable (Narens, 1981). Mathematicians and social scientists are interested in the representational measurement that is an attempt to understand the nature of empirical observations that can be usefully recoded, in terms of familiar mathematical structures (Luce, 1992; 2005).

Luce (1992; 2005) argues that:

> «The part that scholars analyze systematically and report on is *an empirical structure*. Empirical structure is a reduction of the reality. The use of such empirical structures is important because they come close to the way data are organized for subsequent statistical analysis or for testing a theory or hypothesis. An important cluster of objections to the concept of empirical structures exists. One is that the formal analysis of empirical structures includes only a small portion of the many problems of

experimental design. The empirical structures are just meant to isolate the part of the experimental activity and the form of the data relevant to the hypothesis or theory being tested or to the measurements being made.

The first problem for a theory of measurement was to show how the arithmetic of numbers could be constructed and applied to a variety of empirical structures. To investigate this problem, it is important the general notion of *isomorphism* between two structures. Two structures are isomorphic when they exhibit the same structure from the standpoint of their basic concepts. For instance, consider a binary relational structure consisting of a nonempty set A and a binary relation R defined on this set. In order to have the same structure precise is to require the existence of a function mapping the one structure onto the other that preserves the binary relation. Formally, a binary relation structure (A, R) is *isomorphic* to a binary relation structure (*A′*, *R′*) if and only if (in short, *iif*) there is a function *f* such that: (i) the domain of *f* is A and the codomain of *f* is *A′*, i.e., *A′* is the image of A under *f*; (ii) *f* is a one-one function: these two conditions are called *bijective*; (iii) for *a* and *b* in A, *a*R*b* iff *f* (a) R′*f* (b).

Isomorphism depends not just on a one-one function from one set to another, but also on the structure as represented in the binary relation.

The focus of measurement is not just on the numerical representation of any relational structures, but of ordered ones, that is, ones for which one of the relations is a *weak order*, denoted by ≥ which has defining properties for all elements *a, b, c* in the domain A***:***

1. *Transitivity*: if $a \geq b$ and $b \geq c$, then $a \geq c$
2. *Completeness*: either $a \geq b$ or $b \geq a$ or both
3. *Strong Monotonicity*: if $a \geq b$, and $a \neq b$, then $a > b$

Remark.
Given *a* and *b* and any *e*>0, if $|a-b|<e$, then $a \succ b$

The mapping from the weakly ordered structure via the isomorphism of the (mutually disjoint) equivalences classes to the ordered real numbers is called a *homomorphism.*

Unlike an isomorphism, which is one to one, an homomorphism is many to one. Quantification or measurement, in the sense just characterized, is important in some way in all empirical sciences. The isomorphism of structures passing from the empirical to the numerical is necessary for precise prediction or control of phenomena. Of course, such a representation is useful only to the extent of the precision of the observations on which it is based.

The consistent assignment of numbers to the variable is called a *scale* for the variable. A variable may have several scales, and how these scales relate to one another determines the *scale type* of the measurement process. Many types of scales have arisen in science, and by far the most important of these are the *ordered* scales-ones for which there is a natural ordering of the empirical variable, which under measurement maps into the numerical ≥ relation of the real number system. *Ordinal scales* are ones for which the proper assignments consist of all strictly monotonic transformations of any single proper assignment where the resulting transformation has the same range as the given assignment (see also Luce and Suppes, 2002; Luce *et al*., 1971; 1989; 1990; Narens, 1981)».

This is a fundamental background in order to construct apt metrics (described in the next section) for measuring economic shocks over the economic systems.

3. MEASURING SHOCK OF ECONOMIC SYSTEMS

Similar to earthquakes, economic systems have shocks and movements. When an economic system experiences such turbulences, the media commonly talk about a recessions. In order to go beyond heuristic analogies, it is necessary to develop ways to measure the state of economic systems and to provide a quantitative assessment of their conditions. Currently, there is no accepted quantitative measure of economic shocks. In other fields, however, there are widely used scales to quantify an event or shock strength (for instance, the Richter scale in geophysics). There are many different ways in which shocks happen: some are slow to take off and then pick up speed and turn into avalanches, whereas others occur as one short big bang. To improve the measurements of shocks, this paper suggests a scale to assess the amplitude of these economic shocks. The advantages are that the shocks can be compared with each other risk measures. Moreover, a well-designed scale can serve as a warning signal that the economic system is entering a turbulent state.

In general, contractions and expansions of economic fluctuations are measured by Gross Domestic Product Percent change from preceding period that provides an orientation information of the economic shock impact, however the contractions and expansions depend also on temporal duration of upswings and downswings.

This paper provides a metrics concerning the impact of economic shocks, as well as their classification in a scale. This paper considers both the magnitude of the economic shock and duration (period). This metrics has several proprieties underpinned in previous theory of measurement. First of all, the following assumption is stated:

> Suppose that the economic shocks are complete, transitive and strong monotonic events over time. Then there exists a continuous function $m:\Re_{+}^{k} \to \Re$, which represents these economic shocks.

The intuitive idea is that the relation ≥ captures the ordering of the attribute that is measured.

Two distinct relations can be defined in terms of ≥:

$a > b$ iff $a \geq b$ and not $b \geq a$

$a \sim b$ iff both $a \geq b$ and $b \geq a$

The magnitude of economic shocks (MES) is given for contractions (C) and expansions (X):

$$MESC_i = \ln\frac{\left[|a| \times T\right]}{T} \text{ with } MESC_t \in [0;\ 1] \qquad [1]$$

for contractions C. This indicates a negative stress over the economic system.

$$MESX_i = \ln\frac{\left[|a| \times T\right]}{T} - 1 \qquad [2]$$

for expansions X. This indicates the positive stress over the economic system.

MES = Magnitude of Economic Shocks, $|a|$ = amplitude of the economic shock measured in Gross Domestic Product (GDP) percent change from preceding period; T = duration of the contraction and expansion in months. If η and ν $\in\Re$ (Real Number set) such that η < ν and if $MESC_i$ = η and $MESC_k$ = ν, then the contraction $MESC_k$ has an higher magnitude than $MESC_i$. MES uses natural logarithmic value (ln) because is a linear transformation that maintains transitivity property of values, which are compressed.

The MESC and MESX are calculated using economic data by the National Bureau of Economic Research (NBER, 2009) that measures US Business Cycle Expansions and Contractions since 1854. In particular, these data consider the duration (in month) of contractions and expansions of the US business cycle. In fact, the USA are a leading country for worldwide economic growth patterns and metrics based on data of its business cycle are apt precursor of economic signals that shocks and/or booms are approaching in the global economic system. The NBER does not define a recession in terms of two consecutive quarters of decline in real GDP. Rather, a recession is a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales. For more information, see the announcement from the NBER's Business Cycle Dating Committee, dated 12/01/08 (NBER, 2009). Table 1A in the Appendix A shows these data.

Whereas The Bureau of Economic Analysis (BEA, 2009) promotes a better understanding of the US economy by providing the most timely, relevant, and accurate economic accounts data in an objective and cost-effective manner; it provides the GDP percent change based on chained 2000 dollars – Quarterly (Seasonally adjusted annual rates) of US Economy since 1947. Table 2A in the Appendix A shows these data. Data of NBER and BEA are the source of this research.

In primis, the duration of contractions and expansions, using NBER data, is associated to GDP percent change based on chained 2000 dollars since 1947. In fact, this post-war period is suitable of a fair comparison among several business cycles. After that, it is calculated the arithmetic mean of the GDP percent change based on chained 2000 dollars per each contraction C and expansion X. This central tendency of the economic shock, that represent "*a*" is multiplied by the time duration (T) of each contraction and expansion respectively. In this manner, the real amplitude of each contraction and expansion is calculated.

After that, formula [1] and [2] are applied.

The values of the MES have been ordered in decreasing manner and divided in a range, in order to classify the magnitude of economic shock in a scale. Next sections provide these results.

4. RESULTS

The following tables and figures show the main results of the methodology on the measurement of economic shocks and expansion intensity, using data of US economy.

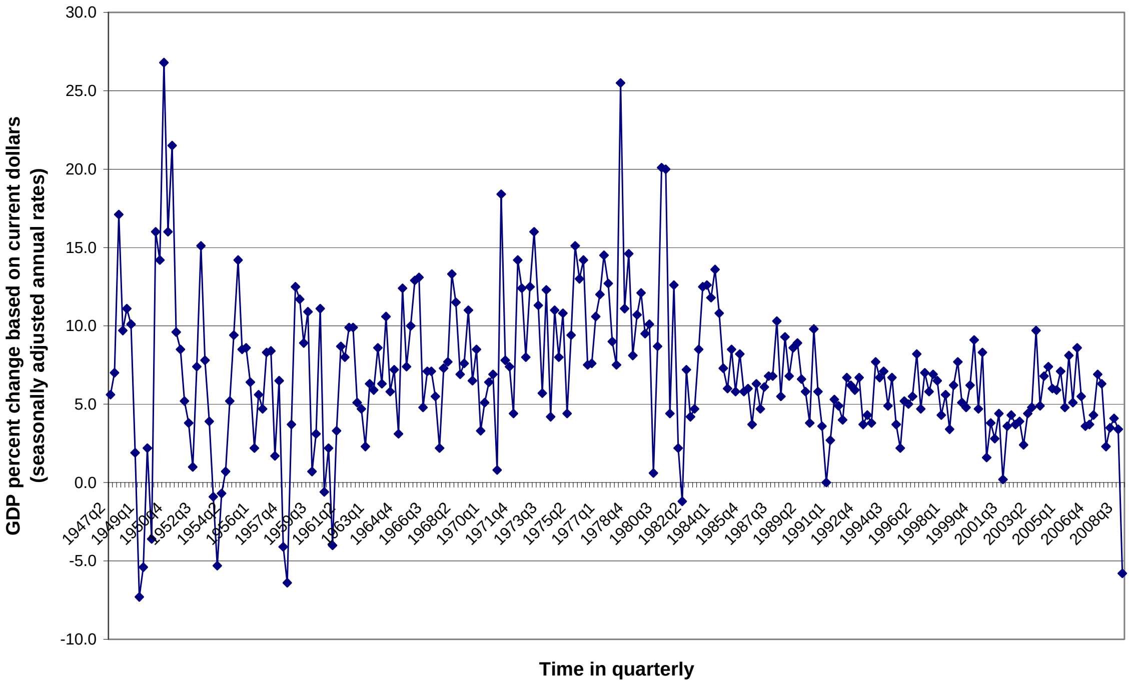

FIGURE 1: GDP PERCENT CHANGE BASED ON 2000 DOLLARS (QUARTERLY) OF US ECONOMY

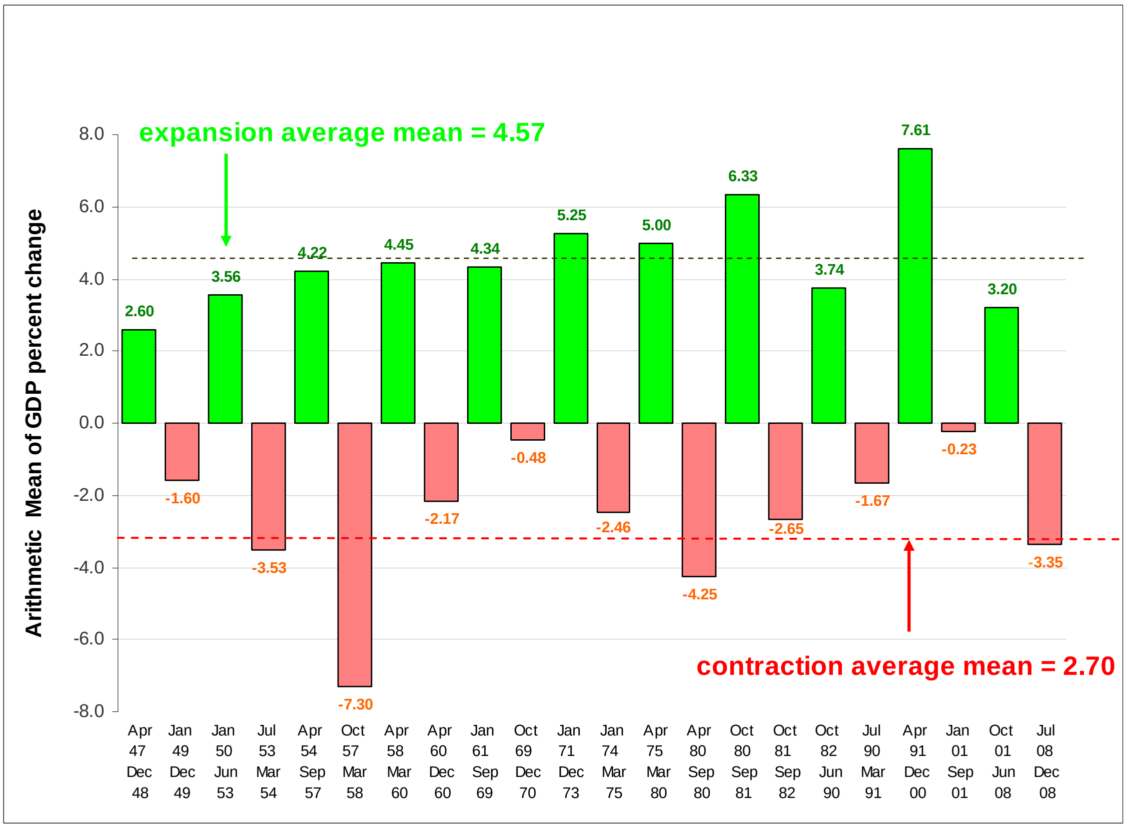

FIGURE 2: AVERAGE EXPANSION AND CONTRACTION OVER TIME OF US ECONOMY
(ARITHMETIC MEAN OF GDP PERCENT CHANGE BASED ON CHAINED 2000 DOLLARS – QUARTERLY)

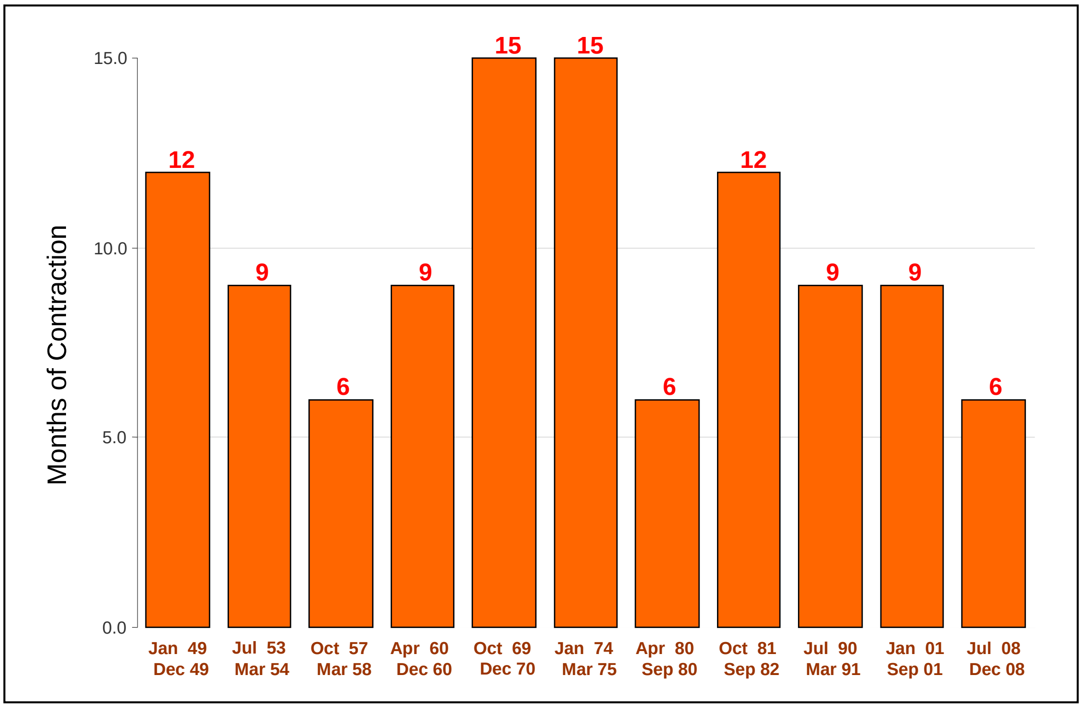

FIGURE 3: MONTHS OF CONTRACTION IN US ECONOMY

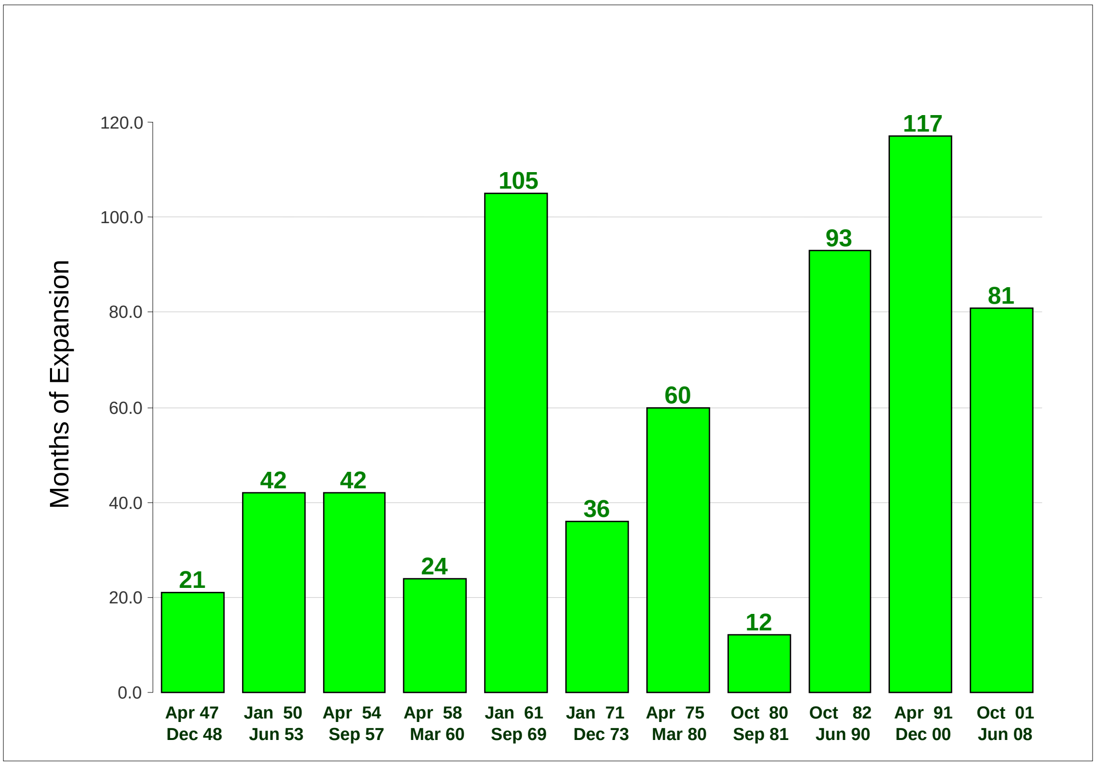

FIGURE 4: MONTHS OF EXPANSIONS IN US ECONOMY

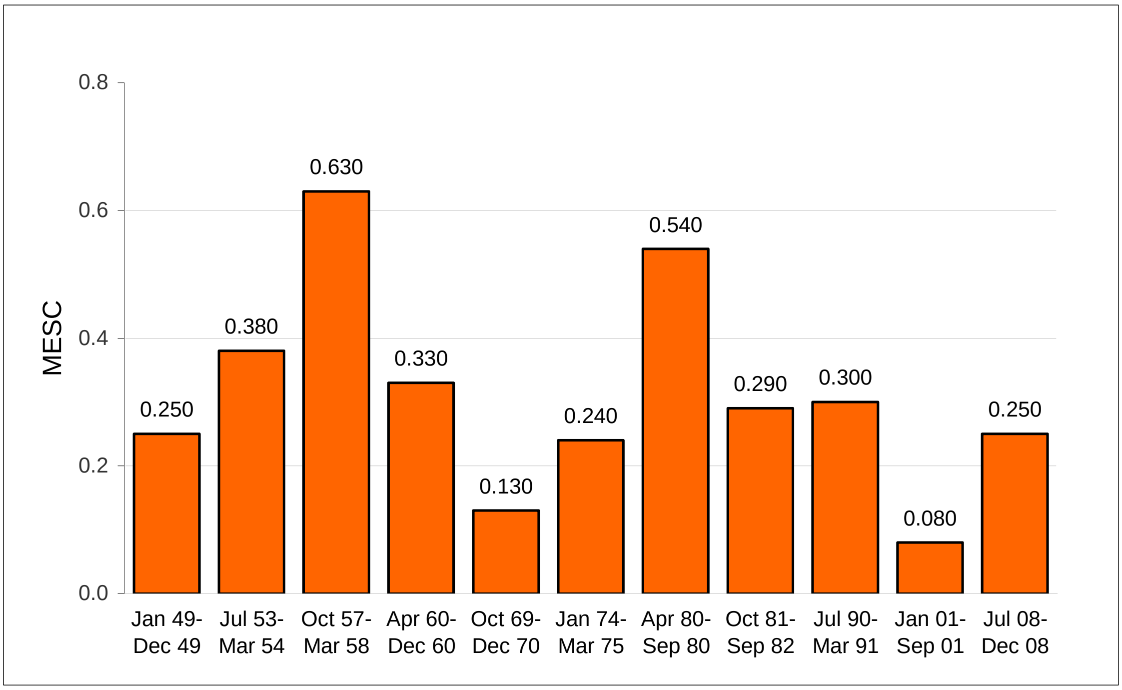

FIGURE 5: MAGNITUDE OF ECONOMIC SHOCK IN US ECONOMY

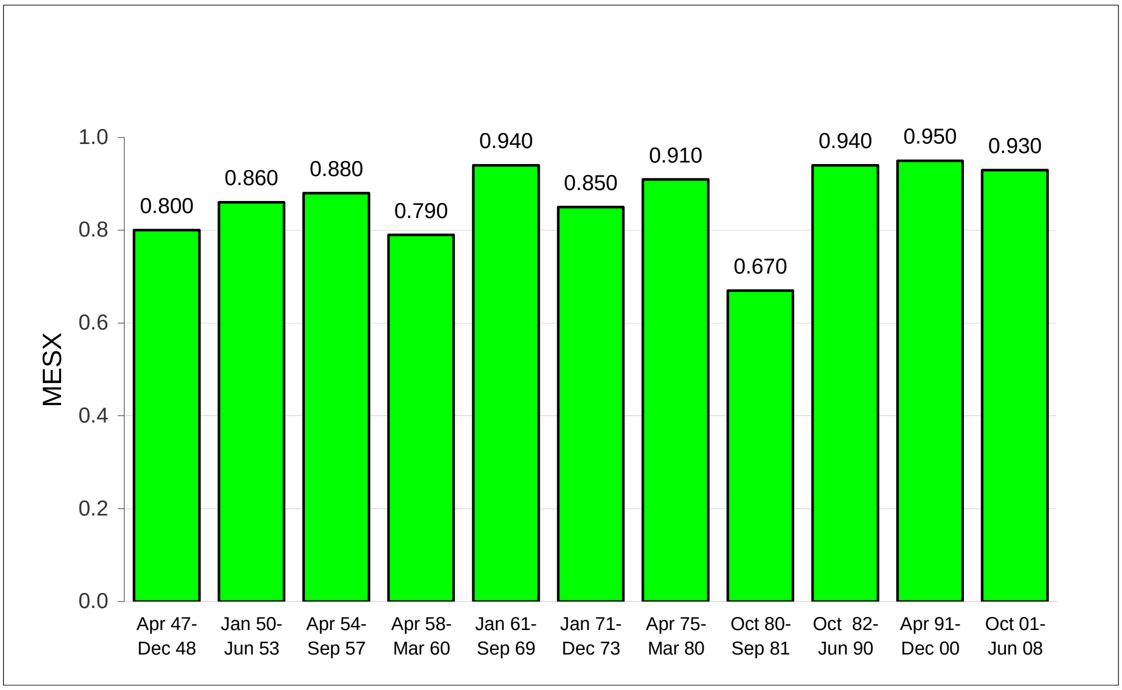

FIGURE 6: MAGNITUDE OF EXPANSION IN US ECONOMY

TABLE 1: MAGNITUDE OF ECONOMIC SHOCK IN US ECONOMY

Period	*Arithmetic mean* = a*	*Duration (in months) = T*	*Impact of contractions* $|a| \times T$	*MESC*
Jan 49-Dec 49	-1.60	12	19.20	0.25
Jul 53-Mar 54	-3.53	9	31.80	0.38
Oct 57-Mar 58	-7.30	6	43.80	0.63
Apr 60-Dec 60	-2.17	9	19.50	0.33
Oct 69-Dec 70	-0.48	15	7.20	0.13
Jan 74-Mar 75	-2.46	15	36.90	0.24
Apr 80-Sep 80	-4.25	6	25.50	0.54
Oct 81-Sep 82	-2.65	12	31.80	0.29
Jul 90-Mar 91	-1.67	9	15.00	0.30
Jan 01-Sep 01	-0.23	9	2.10	0.08
Jul 08-Dec 08	-3.35	6	20.10	0.25

* Arithmetic mean of GDP percent change based on chained 2000 dollars – Quarterly

TABLE 2: MAGNITUDE OF ECONOMIC EXPANSIONS IN US ECONOMY

Period	*Arithmetic mean* = a*	*Duration (in months) = T*	*Impact of expansions* $\|a\| \times T$	*MESX*
Apr 1947-Dec 1948	3.20	21	67.20	0.80
Jan 50-Jun 53	7.61	42	319.50	0.86
Apr 54-Sep 57	3.74	42	156.90	0.88
Apr 58-Mar 60	6.33	24	151.80	0.79
Jan 61-Sep 69	5.00	105	525.00	0.94
Jan 71-Dec 73	5.25	36	189.00	0.85
Apr 75-Mar 80	4.34	60	260.40	0.91
Oct 80-Sep 81	4.45	12	53.40	0.67
Oct 82- Jun 90	4.22	93	392.70	0.94
Apr 91-Dec 00	3.56	117	416.70	0.95
Oct 01-Jun 08	2.60	81	210.90	0.93

* Arithmetic mean of GDP percent change based on chained 2000 dollars – Quarterly

TABLE 3: SCALE OF ECONOMIC SHOCKS BASED ON US DATA

Contraction degree	*Magnitude MESC [1]*	*Intensity of economic shock*	*Example*
V = 5th	> 0.81	Very strong	
IV = 4th	0.61-0.80	Strong	Oct 1957- Mar 1958
III = 3rd	0.41-0.60	Intermediate	
II = 2nd	0.21-0.40	Moderate	
I = 1st	0.00-0.20	Lightest	Jan 2001 – Sep 2001

Note: These values are calculated in Table 1 and showed in Figure 5

TABLE 4: SCALE OF THE ECONOMIC EXPANSIONS BASED ON US DATA

Expansion degree	*Magnitude MESX [2]*	*Intensity of expansions*	*Example*
V = 5th	> 0.95	Very strong	
IV = 4th	0.90-0.94	Strong	Jan 1961 – Sep 1969
III = 3rd	0.85-0.89	Intermediate	
II = 2nd	0.80-0.84	Moderate	
I = 1st	< 0.79	Lightest	Oct 1980 – Sep 1981

Note: These values are calculated in Table 2 and showed in Figure 6

5. DISCUSSION

Table 1 (4th column) shows as the highest impact of contraction was over October 1957-March 1958 period with -7.3 of the GDP percent change per 6 months that table 3 classifies as a strong economic shock, whereas the lowest was over the January 2001-September 2001 period with a -0.23 of the GDP percent change (based on chained 2000 dollars – Quarterly) per 9 months: the impact was -2.1 (Table 1, 4th column) and it is classified as lightest in table 3. It is important to note that higher reductions of GDP percent change do not generate ever a higher magnitude of economic shocks because the duration can be lower than other contractions.

As far as the expansions are considered, the highest impact of expansion was in January 1961-September 1969 period with an average of 5% GDP percent change (based on chained 2000 dollars – Quarterly) per 105 months (Strong magnitude in Tab. 4). The lowest impact of economic expansion was over October 1980-September 1981 period with 4.45% per 12 months (the lowest MESX in table 4). Similar considerations are that the size of expansion is important, but duration matters too.

This empirical analysis is important to pinpoint the fundamental proposition 1.

Proposition 1:
Higher intensity of expansions

Let

$|\alpha|$ = average GDP percent change based on chained 2000 dollars – Quarterly (Seasonally adjusted annual rates) of expansions;

$|\beta|$ = average GDP percent change based on chained 2000 dollars – Quarterly (Seasonally adjusted annual rates) of contractions.

Then the $|\alpha|$ is higher than the average contraction $|\beta|$ over time:

$|\alpha| > |\beta|$.

Proof.

Considering data of BEA since 1947 the expansion $|\alpha|$ phase of the US Business cycle has an average GDP percent change based on chained 2000 dollars equal to 4.57% (figure 2), whereas the average contraction $|\beta|$ = 2.70% (in modulus).

Hence $|\alpha| > |\beta|$ *Q.E.D.* □

Remark: Romer (1991) argues that volatility of economic cycle is not decreased over time, whereas Stock and Watson (2002) point out that the variability of US cyclical behaviour has been decreasing since 1984 (see also Basu and Taylor, 1999). This result that $|\alpha| > |\beta|$ can be due to the new post World War II economic policy of the US that leave the Gold Standard (Cover and Pecorino, 2005).

6. LESSON LEARNED AND CONCLUDING REMARKS

The main lessons learned by this research are:

- The magnitude of economic shocks and expansions depends on both by their reduction/increase of GDP percent change and by their duration. The highest values of GDP percent change of economic system do not generate the highest intensity of economic shock and/or positive stress of expansions across the economy.

  In fact, the amplitude of the expansion and recession is affected by their duration (period) too. Therefore, moderate reduction of the GDP percent change, of long period, can have higher intensity than recessions with strong reductions of short period;
- In general the amplitude of expansions (measured by GDP percent change) is a higher value than amplitude of recessions.

Moreover, this paper introduces the scale of economic shocks (SES), an event scale to classify the amplitude of shocks in economic systems over time. The advantages of this scale are that the shocks can be compared with each economic shocks over time in order to assess the intensity and to calibrate economic policy interventions. A well-designed scale can serve as a warning signal that the economic system is entering a turbulent state. The scale is necessary for prediction or control of the state of economic systems for future horizons. Of course, such a representation is useful only to the extent of the precision of the observations on which it is based.

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APPENDIX

TABLE 1A: US BUSINESS CYCLE EXPANSIONS AND CONTRACTIONS

Trough (Min)	*Peak (Max)*	*Duration (in months)*		
		*Contraction**	*Expansion*	*Cycle*
December 1854 (IV) **	June 1857 (II)	--	30	
December 1858 (IV)	October 1860 (III)	18	22	40
June 1861 (III)	April 1865 (I)	8	46	54
December 1867 (I)	June 1869 (II)	32	18	50
December 1870 (IV)	October 1873 (III)	18	34	52
March 1879 (I)	March 1882 (I)	65	36	101
May 1885 (II)	March 1887 (II)	38	22	60
April 1888 (I)	July 1890 (III)	13	27	40
May 1891 (II)	January 1893 (I)	10	20	30
June 1894 (II)	December 1895 (IV)	17	18	35
June 1897 (II)	June 1899 (III)	18	24	42
December 1900 (IV)	September 1902 (IV)	18	21	39
August 1904 (III)	May 1907 (II)	23	33	56
June 1908 (II)	January 1910 (I)	13	19	32
January 1912 (IV)	January 1913 (I)	24	12	36
December 1914 (IV)	August 1918 (III)	23	44	67
March 1919 (I)	January 1920 (I)	7	10	17
July 1921 (III)	May 1923 (II)	18	22	40
July 1924 (III)	October 1926 (III)	14	27	41
November 1927 (IV)	August 1929 (III)	13	21	34
March 1933 (I)	May 1937 (II)	43	50	93
June 1938 (II)	February 1945 (I)	13	80	93
October 1945 (IV)	November 1948 (IV)	8	37	45
October 1949 (IV)	July 1953 (II)	11	45	56
May 1954 (II)	August 1957 (III)	10	39	49
April 1958 (II)	April 1960 (II)	8	24	32
February 1961 (I)	December 1969 (IV)	10	106	116
November 1970 (IV)	November 1973 (IV)	11	36	47
March 1975 (I)	January 1980 (I)	16	58	74
July 1980 (III)	July 1981 (III)	6	12	18
November 1982 (IV)	July 1990 (III)	16	92	108
March 1991(I)	March 2001 (I)	8	120	128
November 2001 (IV)	December 2007 (IV)	8	73	81
Average, all cycles:				
1854-2001 (32 cycles)	Arithmetic mean – months	**17.4**	**38.7**	**56.4**
Deviation standard		(12.29)	(27.57)	(28.53)
Max		65	120	128
Min		6	10	17
1854-1919 (16 cycles)	Arithmetic mean (Dev. Stand.)	22 (14.14)	27 (9.720)	
1919-1945 (6 cycles)	Arithmetic mean (Dev. Stand.)	18 (12.74)	35 (25.71)	
1945-2007 (11 cycles)	Arithmetic mean (Dev. Stand.)	10 (3.250)	57 (35.00)	

Note: * The NBER does not define a recession in terms of two consecutive quarters of decline in real GDP. Rather, a recession is a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales. For more information, see the latest announcement from the NBER's Business Cycle Dating Committee, dated 12/01/08.

** Roman number are the quarterly of the year.

Source: NBER (2009)

TABLE 2A: GROSS DOMESTIC PRODUCT QUARTERLY (SEASONALLY ADJUSTED ANNUAL RATES) OF US ECONOMY

Years	*GDP percent change based on chained 2000 dollars*	*Years*	*GDP percent change based on chained 2000 dollars*	*Years*	*GDP percent change based on chained 2000 dollars*	*Years*	*GDP percent change based on chained 2000 dollars*	*Years*	*GDP percent change based on chained 2000 dollars*	*Years*	*GDP percent change based on chained 2000 dollars*
1947q2	-0.5	1957q3	4.0	1967q4	3.1	1978q1	1.3	1988q2	5.2	1998q3	4.7
1947q3	-0.2	1957q4	-4.2	1968q1	8.5	1978q2	16.7	1988q3	2.1	1998q4	6.2
1947q4	6.0	1958q1	-10.4	1968q2	7.0	1978q3	4.0	1988q4	5.4	1999q1	3.4
1948q1	6.5	1958q2	2.4	1968q3	2.7	1978q4	5.4	1989q1	4.1	1999q2	3.4
1948q2	7.3	1958q3	9.6	1968q4	1.7	1979q1	0.8	1989q2	2.6	1999q3	4.8
1948q3	2.3	1958q4	9.5	1969q1	6.5	1979q2	0.4	1989q3	2.9	1999q4	7.3
1948q4	1.0	1959q1	7.9	1969q2	1.1	1979q3	2.9	1989q4	1.0	2000q1	1.0
1949q1	-5.8	1959q2	10.9	1969q3	2.5	1979q4	1.2	1990q1	4.7	2000q2	6.4
1949q2	-1.2	1959q3	-0.3	1969q4	-1.9	1980q1	1.3	1990q2	1.0	2000q3	-0.5
1949q3	4.6	1959q4	1.4	1970q1	-0.7	1980q2	-7.8	1990q3	0.0	2000q4	2.1
1949q4	-4.0	1960q1	9.2	1970q2	0.8	1980q3	-0.7	1990q4	-3.0	2001q1	-0.5
1950q1	17.4	1960q2	-2.0	1970q3	3.6	1980q4	7.6	1991q1	-2.0	2001q2	1.2
1950q2	12.5	1960q3	0.6	1970q4	-4.2	1981q1	8.4	1991q2	2.6	2001q3	-1.4
1950q3	16.6	1960q4	-5.1	1971q1	11.6	1981q2	-3.1	1991q3	1.9	2001q4	1.6
1950q4	7.5	1961q1	2.4	1971q2	2.3	1981q3	4.9	1991q4	1.9	2002q1	2.7
1951q1	4.9	1961q2	7.7	1971q3	3.2	1981q4	-4.9	1992q1	4.2	2002q2	2.2
1951q2	7.0	1961q3	6.6	1971q4	1.1	1982q1	-6.4	1992q2	3.9	2002q3	2.4
1951q3	8.2	1961q4	8.4	1972q1	7.3	1982q2	2.2	1992q3	4.0	2002q4	0.2
1951q4	0.7	1962q1	7.4	1972q2	9.8	1982q3	-1.5	1992q4	4.5	2003q1	1.2
1952q1	4.2	1962q2	4.4	1972q3	3.9	1982q4	0.4	1993q1	0.5	2003q2	3.5
1952q2	0.3	1962q3	3.7	1972q4	6.7	1983q1	5.0	1993q2	2.0	2003q3	7.5
1952q3	2.6	1962q4	1.0	1973q1	10.6	1983q2	9.3	1993q3	2.1	2003q4	2.7
1952q4	13.8	1963q1	5.3	1973q2	4.7	1983q3	8.1	1993q4	5.5	2004q1	3.0
1953q1	7.7	1963q2	5.1	1973q3	-2.1	1983q4	8.4	1994q1	4.1	2004q2	3.5
1953q2	3.1	1963q3	7.7	1973q4	3.9	1984q1	8.1	1994q2	5.3	2004q3	3.6
1953q3	-2.4	1963q4	3.1	1974q1	-3.4	1984q2	7.1	1994q3	2.3	2004q4	2.5
1953q4	-6.2	1964q1	9.3	1974q2	1.2	1984q3	3.9	1994q4	4.8	2005q1	3.0
1954q1	-2.0	1964q2	4.7	1974q3	-3.8	1984q4	3.3	1995q1	1.1	2005q2	2.6
1954q2	0.4	1964q3	5.6	1974q4	-1.6	1985q1	3.8	1995q2	0.7	2005q3	3.8
1954q3	4.5	1964q4	1.1	1975q1	-4.7	1985q2	3.5	1995q3	3.3	2005q4	1.3
1954q4	8.2	1965q1	10.2	1975q2	3.0	1985q3	6.4	1995q4	3.0	2006q1	4.8
1955q1	12.0	1965q2	5.5	1975q3	6.9	1985q4	3.1	1996q1	2.9	2006q2	2.7
1955q2	6.7	1965q3	8.4	1975q4	5.4	1986q1	3.9	1996q2	6.7	2006q3	0.8
1955q3	5.4	1965q4	10.0	1976q1	9.3	1986q2	1.6	1996q3	3.4	2006q4	1.5
1955q4	2.2	1966q1	10.1	1976q2	3.0	1986q3	3.9	1996q4	4.8	2007q1	0.1
1956q1	-1.9	1966q2	1.4	1976q3	1.9	1986q4	2.0	1997q1	3.1	2007q2	4.8
1956q2	3.2	1966q3	2.7	1976q4	2.9	1987q1	2.7	1997q2	6.2	2007q3	4.8
1956q3	-0.5	1966q4	3.3	1977q1	4.9	1987q2	4.5	1997q3	5.1	2007q4	-0.2
1956q4	6.7	1967q1	3.6	1977q2	8.1	1987q3	3.7	1997q4	3.0	2008q1	0.9
1957q1	2.4	1967q2	0.0	1977q3	7.4	1987q4	7.2	1998q1	4.5	2008q2	2.8
1957q2	-1.0	1967q3	3.2	1977q4	0.0	1988q1	2.0	1998q2	2.7	2008q3	-0.5
										2008q4	-6.2

Note: q is the quarterly of the year

Source: BEA (2009)

TABLE 3A: STATISTICS OF EXPANSIONS FOR US ECONOMY

		Change GDP of Expansions	*Duration of Expansions*	*Amplitude of Expansions*
N. Valid		11.00	11.00	11.00
Mean		4.57	57.55	249.41
Std. Error of Mean		0.43	10.91	45.16
Median		4.34	42.00	210.90
Std. Deviation		1.44	36.17	149.78
Variance		2.06	1308.27	22433.98
Range		5.00	105.00	471.60
Minimum		2.60	12.00	53.40
Maximum		7.61	117.00	525.00
	25	3.56	24.00	151.80
Percentiles	50	4.34	42.00	210.90
	75	5.25	93.00	392.70

TABLE 4A: STATISTICS OF CONTRACTIONS FOR US ECONOMY

		Change GDP of contractions	*Duration of contractions*	*Amplitude of contractions*
N. Valid		11.00	11.00	11.00
Mean		-2.70	9.82	-22.99
Std. Error of Mean		0.59	1.00	3.78
Median		-2.46	9.00	-20.10
Std. Deviation		1.96	3.31	12.54
Variance		3.83	10.96	157.25
Range		7.07	9.00	41.70
Minimum		-7.30	6.00	-43.80
Maximum		-0.23	15.00	-2.10
Percentiles	25	-3.53	6.00	-31.80
	50	-2.46	9.00	-20.10
	75	-1.60	12.00	-15.00

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