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# Measuring Business Cycles: A Review

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**ABSTRACT**

This article summarizes the main findings on problems related to the measurement and identification of business cycles. The aim of this study is to define and identify the determinants of business cycles. This paper provides an overview of the methodology and its future course. Our investigation suggests that some methodological frameworks are available in the literature, but none is perfect. A new development in the field lies in spectral analysis methods for measuring business cycles, which may have advantages over existing methodologies (nonlinearity, stationarity issues). We feel that fractional integration is important in the proper monitoring and explanation of business cycles. Spectral analysis techniques have also proved to be useful for addressing the problems of stationarity and structural breaks in time series when analyzing business cycles. Another important issue that is excluded when studying business cycles is that the link between cycles and economic growth is presumed to be non-existent, implying money neutrality.

**KEY WORDS:** economic growth, cycles, contraction, recession, total factor productivity

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## Introduction

Economic expansions and slowdowns are inherent in economic systems. Finding mechanisms through which to prolong expansions and limit, or at least alleviate, recessions is in the focus of macroeconomic theory and policy. That the recent financial crisis came as a surprise to a majority of economic experts reemphasizes to those in the economic discipline the necessity of identifying turning points in the economy.

The process of measuring business cycle requires defining the cycle, defining criteria for distinguishing between business cycles and other similar fluctuations, defining procedures for the detection of business cycles and defining methods for measuring business cycles. The main aim of today's macroeconomic policy is to understand the functioning of the business cycle.

The terms business cycle or economic cycle refer to a change in the economic activity of a country during a particular period. Changes in economic activity can occur in two directions: a period of relatively rapid economic growth and expansion or a period of decline and contraction. The real gross domestic product (GDP) is a common way of measuring and determining the strength of a business cycle.

In 1819, the dominant theory was the theory of general equilibrium. That year, a paper entitled Nouveaux principes d'économie politique by Jean Charles Léonard de Sismondi was published, which studied the existence of periodic economic crises that form business cycles. Before this work, classical economists had denied the existence of business cycles. Classical

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economists blamed war as a leading cause of business cycles in the economy. However, Sismondi was the first to discover the existence of cycles by examining an economic crises that occurred during peacetime.

In recent years, economic theory has addressed monitoring and measuring economic fluctuations rather than measuring business cycles. Recent studies that used spectral analysis methods have proved the existence of business cycles in world GDP.

In this paper, we show how the theory and measurement of business cycles were developed over the years, we will define business cycles, we will show what causes business cycles, and we will assess the future of business cycle measurement.

In section 2, definitions of the business cycle are reviewed based on various theoretical and empirical explanations. Section 3 investigates the primary sources of business cycles, while section 4 present different methods for measuring cycles. Section 5 provide concluding remarks on open questions in measuring business cycles, providing new insights into how these issues can be addressed to expand knowledge in the business cycles literature.

## Defining the Business Cycle

The idea that the market economy functions under recurring fluctuations depending on a number of variables was formalized by Mitchell (1927), Burns and Mitchell (1946) as follows:

> *" Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic; in duration business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own.".*

Today, this definition serves as the foundation of modern thinking about business cycles, in so far as it concerns the measurement of business cycles or the construction of cyclical fluctuation models. Burns and Mitchell have noted that this definition creates many new issues. For example, if we look at the fluctuations in the overall economic activity of a nation, then we should take into account the differences between business cycles in different regions. Further, questions arise as to whether business cycles should be studied in an international or national context, whether there is a historical nature of business cycles, and whether business cycles change over time. Likewise, if we take into account Burns and Mitchell's remark that "expansion that occurs in many economic activities", we need to define and aggregate the activities. The fact that economic activities occur at around the same time suggests the possibility that some macroeconomic variables are formed before (leading) and after some cycles (lagging). Looking at these "recurring changes", we need to determine how we should address seasonal changes, random fluctuations and secular trends. Furthermore, the comments relating to the duration and amplitude of business cycles are based on actual observations of cyclical phenomena and the rules for excluding irregular movement and other similar changes.

The National Bureau of Economic Research has access to data that allow the identification of the business cycle, which occurs in two steps: first, find the cyclical peaks and troughs in the observed economic variables and, second, determine whether these changes are common enough through all the observed series. If the answer to the second question is affirmative, then the aggregate business cycle or reference cycle is identified. Once the reference dates are found, the cyclical behavior of each series is discussed as the reference cycle. As a part of this analysis, the duration, time and amplitude of each cycle are compared to those of the reference period. In its method of studying business cycles, the NBER identifies business cycles based on (absolute) declines or changes in the general level of production. Such an approach is known as a classic example of the business cycle. There are alternative approaches that consider whether the fall in the series originated as a deviation from its long-term trend, which in Zarnowitz's terminology (1992), are known as growth cycles. Note that one advantage of using the growth cycle is that expansion and contraction of the business cycle are of approximately the same duration.

In classic cycles, the recession is usually shorter than the expansion due to growth effects.

If we decide to use growth cycles, the question arises as how to identify the cyclical component of a particular series. According to King et al. (1991), models of the real business cycle (RBC), which enable a trend in technological shocks, imply that growth and business cycles are mutually determined. The practice of separating the trend and cyclical components using linear time series methods are well established. There are several approaches to de-trending economic time series. One approach is to use linear de-trending procedures that assume that the observed series has a deterministic time trend. An alternative approach is to assume that the stochastic trend is modeled with a unit root in the time series. The major contribution of Nelson and Plosser (1982) to this analysis is, in fact, that they have proved that economic time series, such as those of real GDP, usually have a unit root. However, Stock and Watson (1998) argue that linear time trends or first differentiation to eliminate the unit root do not provide satisfactory results for identifying the cyclical component series of the observed data. Note that while the first approach to linear time trends leads to the generation of false effects of business cycles in de-trending series, in the second, first differentiation exacerbates the role of short-term noise.

Several alternative approaches have been recently proposed in the business cycles literature to address the separation of the trend from the cyclical components of the time series. One of these approaches is the so-called Hodrick–Prescott (HP) filter, which minimizes the quadratic form to determine the trend component in a given series:

$$y_t = \tau_t + c_t , \tag{1}$$

where $\tau_t$ represents the trend component, and $c_t$ represents the cyclical component. $\tau_t$ may be non-stationary and may contain a deterministic and stochastic trend. The primary objective was to assess $c_t$ , a stationary cyclical component that is derived from stochastic cycles of different periods of time. The trend component is calculated as $\tau_t = y_t - c_t$ .

The properties of the HP filter are studied by many authors, including Singleton (1988), King and Rebelo (2000), and Cogley and Nason (1995). Cogley and Nason claim, in particular, that dynamic business cycles obtained using HP de-trending methods depend on the characteristics of the studied data. If they are stationary, then the de-trending procedure has favorable characteristics. If the observed data are non-stationary, the HP filter produces spurious business cycle fluctuations.

The second approach is based on the spectral analysis of economic time series. The band-pass filter, which filters and traces the long-term trend of the high-frequency changes in a observed time series, was developed by Baxter and King (1999). The approach maintains the components that are associated with the periodicity of a typical business cycle. Usually, this periodicity is between six quarter and eight years. The band-pass filter of Baxter and King (1999) is obtained by applying the Kth order moving average of a given time series:

$$y_t^* = \sum_{k=K}^{K} \alpha_k y_{t-k} , \tag{2}$$

where the ratio of the moving average is selected to be symmetrical, $a_k = a_{-k}$ for $k = 1,.....,K$ , showing that if the sum of the coefficients of the moving average is zero, $\sum_{k=K}^{K} \alpha_k = 0$ , then there is a characteristic of trend elimination.

The Baxter-King filter will eliminate deterministic quadratic trends, or it will produce a stationary series that is integrated of order two or less. This filter is designed to have a range of other features, including that the results should not depend on the sample size and not change the relationship between time series at any frequency. Baxter and King created a band-pass filter, taking into account low-pass and high-pass filters with the required properties.

The various methodologies used by scholars in defining business cycles are evident from Table 1.

## The Origins of Cycles

One of the most common and challenging questions in macroeconomics is related to the business cycle: Which shocks cause business fluctuations? In economic theory, most responses to this question implicate monetary and fiscal policies or oil shocks. To that list, Prescott (1986) adds the impact of technological shocks and argues that technological shocks in the post-war period were, in more than 75 % of

**Table 1.** Methods for Identifying Business Cycles

| Authors | Methods for defining business cycles |
|---|---|
| Burns and Wesley (1946) | Business cycles are a type of fluctuation in aggregate economic activity |
| NBER (2010) | Business cycles are based on two parts: cyclical peaks and bottoms |
| Zarnowitz (1992) | Considers growth cycles where the fall in the series is determined by the deviation from the long-term trend. |
| King, Plosser and Stock (1991) | Using a model of real business cycle, they implied that growth and business cycles are mutually determined |
| Singleton (1988), King and Rebelo (1998), Cogley and Nason (1995) | An alternative approach for defining business cycles using the Hodrick-Prescott filter |
| Baxter and King (1999) | Another alternative approach for defining business cycles using spectral analysis of time series |

**Table 2.** Key Determinants of Business Cycles

| Authors | What causes business cycles? |
|---|---|
| Prescott (1986) | Considers the impact uncertainty of technological shocks in the post -war period |
| Norrbin (1988) | Measures TFP (total factor productivity) using military spending |
| Evans (1992) | Measures TFP using indicators of monetary policy |
| Gali (1999), King et al. (1991), Nelson and Plosser (1982), King and Rebelo (1999) | Discuss the importance of technology shocks as pulses in business cycles |
| Kim and Lougani (1992), Rotemberg and Woodford (1996), Finn (2000) | Consider shocks in the oil industry instead of technological progress as the main variable that causes business cycles |
| Christiano and Eichenbaum (1992), Baxter and King (1999), Braun (1994) and McGrattan (1994) | Consider fiscal shocks instead of technological progress as the main variable that causes business cycles |
| Ramey and Shapiro (1998), Burnside et al. (1996) and Fisher (2003) | Take into account the effects of changes in government spending on business cycles |
| Bernanke, Gertler and Gilchrist (1996), Dixit and Stiglitz (1977) | Consider monetary shocks instead of technological progress as the main variable that causes business cycles |
| Farmer (1999) | Takes the basic RBC model as starting point to model multiple equilibria for determining causes of business cycles |

cases, the causes of business fluctuations. The idea of technology shocks as a main driver of business cycles is among the more controversial ideas. Prescott calculates total factor productivity (TFP) and treats this as a measure of exogenous technology shocks. However, there are reasons to distrust that TFP measures real shocks in technology. TFP can be forecast using military spending, as conducted by Norrbin (1988), or using indicators of monetary policy, as conducted by Evans (1992). In both modes, observed variables are unlikely to have an impact on the rate of technical progress. This evidence suggests that TFP, which Prescott calculates, is not the pure exogenous shock he observes. Instead, they already include endogenous components. The utilization of capital variable observed by Basu (1996), and Burnside, Eichenbaum and Rebelo (1996); changes in use of labor, which are studied by Burnside, Eichenbaum and Rebelo (1993); and changes in the rates of income, which Jaimovich and Floetotto (2008) examined, all show significant differences between TFP and actual technology shocks. These differences imply that the magnitude of the real technology shock will be much smaller than that of the TFP shocks used by Prescott.

Key determinants of business cycles on growth issues, as analyzed by various authors, can be seen in Table 2.

Burnside et al. (1996), King and Rebelo (1999), Jaimovich and Floetotto (2008), argue that the fact that actual technological shocks are smaller than TFP shocks does not imply that technological shocks irrelevant. If we introduce mechanisms such as capacity utilization and revenue diversity into models of real business cycles, we obtain two effects. First, these mechanisms make technological shocks less volatile than TFP shocks. Second, they significantly increase the impact of technology shocks. This enhancement allows models with these mechanisms that generate volatility in output that are similar to the data for which we have far fewer technological shocks.

Another controversial aspect of the real business cycle model is the usage of technology shocks in generating a recession. NBER (2010) defines a 'a significant decline in the economic activity spread across the country, lasting more than a few months, normally visible in real gross domestic product (GDP) growth, real personal income, employment (non-farm payrolls), industrial production, and wholesale-retail sales. If we look at total output in the United States for the period from 1947 to 2005, we see that it dropped by 12%. Most models of real business cycles require a decline in TFP to replicate the decrease in output that we observe in this period. Macroeconomists agree that an increase in production, at least over the medium and long term, is driven by the increase in TFP derived by technological progress. In contrast, the claim that a collapse of TFP causes recessions has been met with skepticism. Simply speaking, this means that in the recession, we have technological setbacks rather than progression.

Gali (1999) prompted a discussion about the importance of technology shocks as pulses in the business cycle. Gali estimates a structural VAR model, assuming that technological shocks are the only source of long-term changes in labor productivity. He discovered that over the short run, there is a decrease in the number of hours worked in response to positive shocks to technology. This finding is in direct contradiction with the fundamentals of real business cycle models. King, Plosser and Rebelo (1988) and Baxter and King (1999) detailed the capacity of positive technological shocks to increase the number of hours worked in the real business cycle models. Christiano, Eichenbaum and Vigfusson (2003) found that Gali's results are not robust to VAR specifications for which the data are in levels rather than as first differences. Chari, Kehoe and McGrattan (2004) used a model of the real business cycle that showed that Gail's research was derived from incorrect model specifications.

The debate about the role of technology shocks in business cycles has influenced and inspired research on models in which technological shocks are less significant or play no role. These studies have strongly influenced the methods and ideas developed in the literature on real business cycle models. In fact, in most of these alternative theories, the starting point of the new models is the fundamental model of real business cycles (Khorunzhina, 2015). Shakina and Barajas (2014) explore the interesting link between firm's intellectual capital and cycles.

One of the variables that is observed instead of technological progress is a shock in the oil industry. Changes in the prices of oil and oil products are poorly linked to US recessions. Kim and Lougani (1992), Rotemberg and Woodford (1996) and Finn (2000) studied the effects of shocks in the prices of energy and real business cycle models. These shocks have facilitated the success of models of real business cycles, but they have also showed that these are not the primary causes of fluctuations in output. Although energy prices are very volatile, energy costs represent too small a share of the added value of changes in the price of energy to have a significant impact on economic activity (Lee and Mukoyama, 2015).

Another observed effect is the effect of fiscal shocks. Christiano and Eichenbaum (1992), Baxter and King (1999), Braun (1994) and McGrattan (1994), among others, have studied the impact of shocks in tax rates and government spending on real business cycle models. These fiscal shocks enhance the ability of real business cycle models to replicate the variability of consumption and hours of operation and the low correlation between hours worked and average labor productivity. Fiscal shocks also have increased volatility in output that is generated in real business cycle models. The effects of financial contagion and economic crisis on major financial markets are discussed in Dajčman (2014), showing that contagion is not strongly connected to the crisis. Fiscal stimulus can speed up economic recovery by attracting foreign direct investments, but it is supported by other non-fiscal factors, mainly infrastructure and political stability (Rădulescu and Druica, 2014).

However, there is a lack of cyclical variation in taxes and government spending for fiscal shocks to be the primary cause of business fluctuations. Cyclical movements in public expenditures are relatively small; during periods of war there is usually a temporary increase in government spending. Ohanian (1997) shows that models of real business cycles can explain the main macroeconomic elements of war episodes: a moderate decrease in consumption, a substantial decline in investment, and a significant increase in working hours. These features occur naturally in real business cycle models in which government spending is financed by lump-sum taxes. Additional government spending must eventually be funded from taxes. The wealth of households declines as the corporate taxes grows. In response to this reduction, households reduce their consumption and increase their number of working hours, reducing the number of hours used for leisure. This increase in working hours creates a moderate increase in production. Because the current marginal propensity to consume is reduced, households prefer to pay taxes related to war, so as to reduce consumption today and in the future. Because such spending cuts today occur with an increase in output, which is smaller than the increased government spending, there is a reduction in investment. Cooley and Ohanian (1997) use a model of the real business cycle to compare the social implications of different strategies of war financing. Ramey and Shapiro (1998) take into account the effects of changes in government spending. Burnside, Eichenbaum and Fisher (2004) study the impact of a large current increase in government expenditures in the presence of a taxation distortion. A possible link between labor markets and business cycles is explored in Tomić (2014).

The following observed effect is the impact of specific investments in technological change. One of the natural alternatives to technological shocks is an investment, in particular, in technological change. In the standard model of the real business cycle, positive technology shocks make both work and existing capital more productive. In contrast, specific investments in technological advances do not affect the productivity of old capital goods. Instead, new capital allows greater productivity and lower costs, resulting in an increase in the real rate of return on investment. We can measure the pace of specific investments in technological change by the relative price of investment goods in terms of consumption goods. According to the data constructed by Gordon (1990), relative prices have dramatically declined over the past forty years. Based on these observations, Greenwood, Hercowitz and Krusell (2000) use growth accounting methods to claim that 60 percent of post-war growth in the output per worker-hour ratio is derived from investments in particular technological changes. Using VAR, which is identified with long-term restrictions, Fisher (2003) believes that investing in particular technological changes affects 50 percent of the variation in hours worked and 40 percent of the variation in the quantity of output. On the contrary, he believes that technological shocks affect less than 10 percent of the variation in output and hours worked. Because of Greenwood, Hercowitz and Krusell (1997), investments in technological change, in particular, have become one of the standard shocks included in real business cycle models.

The following observed effect is the impact of monetary shocks. There are some studies on the impact of monetary shocks on real business cycle models that are extended to contain additional elements of real and nominal friction. Researchers such as Bernanke, Gertler, and Gilchrist (1996) emphasize the role of credit friction in response to the technological economy and monetary shocks. Another important element is monopolistic competition, modeled according to Dixit and Stiglitz (1977). In basic models of the real business cycle, companies and employees have acquired prices from perfectly competitive markets. Such an environment is less meaningful to observe the enterprise than are those in which they choose their prices or employees as those who want the reward (performance-based pay). Introducing monopolistic competition to the production and labor markets gives workers and enterprises the ability to make decisions on prices.

The most significant nominal frictions that have been introduced in basic RBC monetary model are sticky prices and wages. In these models, prices are determined by companies that are committed to offer goods at those prices, and salaries are determined by employees who are committed to provide their work for those wages. Wages and prices can only be changed periodically or at a cost. Firms and workers look ahead because they take into account that it might be impossible or too expensive to change prices or wages over the short term in their determinations of prices and salaries. Macroeconomic shocks also register important effects on business cycles dynamics (Cavallo and Ribba, 2015). Fluctuations in aggregate demand through the wealth effect also impact business cycles (Guo, Sirbu, & Weder, 2015). Monetary policy and inflation targeting are also accounted for, at least for the US (Araújo, 2015).

This new generation of basic RBC monetary models can generate impulse response functions to monetary shocks that are similar to the estimated responses obtained from the VAR technique. In many of these models, technological shocks are still significant, but financial forces play an increasingly important role in creating the economic response to technology shocks. In fact, Altig et al. (2011) and Gali, Lopez-Salido and Valles (2003) found in their models that the sizeable short-term impact of technology shocks requires that monetary policy be flexible.

The following observed effect is the impact that created multiple equilibrium models. Many papers examine models that show balance in multiple equilibrium expectations. Early studies of multiple equilibria rely heavily on models that extend for several generations, partly because these models can be explored without resorting to numerical methods. The latest works related to multiple equilibria are discussed by Farmer (1999). They take the basic RBC model as a starting point for their research and then look for the most appropriate modifications that will generate multiple equilibria.

In basic RBC models, we can calculate the competitive equilibrium as a solution to a concave planning problem. This problem has a unique solution, and therefore, a competitive equilibrium of the same kind. When we introduce additions to the model, such as externalities, increasing yields of return or monopolistic competition, we cannot calculate the competitive equilibrium for the concave planning problem. Therefore, these new features, which have been added to the model, open up the possibility of multiple equilibria.

Models that allow multiple equilibria have two attractive features. The first is that human beliefs and their fulfillment can generate business cycles. If participants in the economy become more pessimistic and think that the economy is in recession or will go into a recession, the economy will slow down. Second, these models have strong inner persistence, and therefore, these do not need serial correlation of shocks to generate persistence in macroeconomic time series. Starting from a model that has a unique equilibrium and introducing multiplicity implies reducing the absolute value of the characteristic root from over one to below one.

One of the drawbacks of current models of multiple equilibria is that they imply volatile beliefs, but these are coordinated through all market participants. Thus, operators have to change their view of the future continually, but they do have to coordinate that change among themselves.

## Measuring Business Cycles

Measuring business cycles provides a reference point for assessing macroeconomic theory and policy. The process of measuring the business cycle takes place in several steps. First, we must define and detect a cycle, and second, we must determine the turning point. The next phase of measuring the business cycle is determining the appropriate procedures of models that are commonly used. Further, it is essential to measure cycle features. Finally, we need to define and detect business cycles using multivariate information and automatic construction of the reference cycle. As a last resort, it is necessary to determine the underlying procedures in the model for the definition, determination and extraction of the reference cycle.

In their classic paper, *Measuring Business Cycles,* Burns and Mitchell (1946) define the specific cycles in the series $y_t$ and have since used it as a turning point for the display of the business cycle. This part is the first step in measuring the business cycle; it represents the definition and detection of the cycle. When we talk about business cycles, Burns and Mitchell simply describe $y_t$ as the level of aggregate economic activity, although it would be correct to say that this series shows that the logarithm economic activities at the turning point of cycles equal the logarithm of overall economic activity. Some, e.g., the Institute for Economic Business Cycles, have studied tilting point in cycles as opposed to $\Delta y_t$ data. At the time when Mitchell began his work on alternative views of $y_t$, which is seen as a periodic component, the sine and cosine represent waves:

$$y_t = \sum_{j=1}^{m} \alpha_j \cos \lambda_j t + \beta_j \sin \lambda_j t \,, \tag{3}$$

where $\lambda_j$ is the frequency rate, and $j$ represents the oscillation. If m=1, then there is only one periodic cycle. The problem of this representation is that it has small economic time series that shows evidence of periodicity.

As mentioned above, the next step in measuring business cycles is to locate the turning point. To be able to locate the turning points in a particular series, some way to identify them in a time series should be defined and created. One of the most practical solutions is that the peaks are local maxima in the time series $y_t$. In this case, if the carets $\vee_t(\wedge_t)$ are binary variables, having value 1 as local extrema and zero otherwise. Formally, we obtain the following (Harding and Pagan, 2004):

$$\begin{aligned} \vee_t &= 1(y_t < y_{t\pm j}, 1 \le j \le k) \\ \wedge_t &= 1(y_t > y_{tj\pm}, 1 \le j \le k) \end{aligned}. \tag{4}$$

Turning points can also be located through alternative methods. An alternative approach for locating the turning points is based on the fundamental processes in the model. The above procedure does not require any knowledge of the process generating the $y_t$ data. An alternative approach is to apply the model using $\Delta y_t$, which is then used for the location of tipping point. Today, such models are parametric and feature two modes. One of the most popular parametric models is that of Hamilton (1989), where the growth rate is treated with a Markov switching process of the form:

$$\Delta y_t = \mu_0(1-\xi_t) + \mu_1 \xi + e_t \,, \tag{5}$$

where $\mu_j$ represents the growth rates in the regimes, and they are indexed by latent binary state $\xi_t$, with $e_t$ as a normally distributed, zero mean error term μ0. This model represents a state of low growth rates, and $\mu_1$ represents a state of high growth rates. The model is completed in a manner that specifies the probability of transition from a state $\xi_{t-1} = 0$ or 1 to a state $\xi_t = 1$ or 0. The model may be more complex, and the extra dynamics and different variances of each of the arrangement thus enable the probability of transition to depend on the observed data.

Measuring cycle features is the next step in the procedure. The process of locating the turning point separates the time series into stages. The expansion phase starts from the next peak; the contraction phase extends from the peak to the next base. What follows in the model is most easily described as a derivation of the information in the extension.

Two fundamental pieces of data are required in the growth stages: duration and amplitude. The length of the expansion stage represents the number of periods between the bottom and top, whereas the amplitude is a measure that shows changes in $y_t$ from bottom to top. In many cases, the $y_t$ logarithm of some variable, such as GDP or industrial production, is used, and in such cases, the amplitude is explained as the percentage change in $y_t$ between the bottom and top. Connecting the bottom and the top yields the hypotenuse. If $y_t = \ln Y_t$, then the hypotenuse represents the path followed by the variable that shows steady growth during the expansion. If this is taken into consideration, then it is instructive to study the movement of the actual data on the path of constant growth that is represented by the hypotenuse.

Burns and Mitchell's famous definition of the business cycle includes two aspects. First, we need to identify the aggregate economic activity, and the second requirement is the existence of synchronization among different variables during certain phases of the business cycle. The authors consider that GDP is a good measure of economic activity, although others, such as Moore and Zarnowitz (1986), prefer to have a weighted average of several series and not just one series. Given that GDP as a measure was not available to Burns and Mitchell, there were no data for the period that they needed, so it is natural that they have given emphasis to the second component of their definition of business cycles, i.e., the synchronization of cycle-specific series representing economic activity. Burns and Mitchell determined the turning points in number of series and then determined the reference cycle in a way that sets the dates around which peaks and troughs of business cycles revolve. Moreover, at the end of the process, it is necessary to know the extent to which each particular cycle is synchronized with aggregate cycles.

## Conclusion

In this paper, we presented a history of business cycles measurement and the problems associated with that process. In the first part, we have explained the concept and definition of the business cycle. Through the definition of the business cycle, we reached some new and unresolved issues that have emerged out of the definition. In the second part, we have addressed causes such as exogenous effects of technology shocks on business cycles. We have also considered the ratio of total factor productivity and technology shocks and emphasized the exogenous and endogenous effect of technology shocks. We have subsequently presented some other shocks (the influence of oil shocks, monetary shocks, and fiscal shocks) that can replace technological shocks in measuring business cycles. The paper also presents an overview of new models of business cycles showing differences in steps; determining the turning points, peaks and troughs of business cycles; developing the hypotenuse and automatic connection between trough and peak; and decomposing the business cycle curve.

Although Burns and Mitchell represented a relatively significant discovery in the measurement of business cycles, their findings were not initially accepted in academic circles. Today, this has changed an increasing number of people and scholars accept their method for several reasons, the most important being that today it is much easier to estimate turning points in the business cycle with individual models – an important step in their analysis. Further, it should be noted that today there enough emerging research facilitating advances through tools that simulate data much more accurately than previously possible. From our study, we can conclude that there is no one solution for measuring business cycles that would be accepted by the profession. All of the above solutions have their shortcomings, which are objectively presented in this paper.

As for the future, there are many areas that are being investigated and solutions that are being looked into. We have attempted a new approach to measuring business cycles that tries to address these shortcomings. We introduce multi-regime Markov switching VAR, HP (Hedrick Prescott) filters and spectral analysis as the latest developments in the study of business cycle movements. We are of the opinion that fractional integration is also important for proper business cycles monitoring and explanation (Škare & Stjepanovic, 2013) and that the impact of information and prices from the firm perspective also plays a role in business cycle dynamics (Mäkinen & Ohl, 2015).

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