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Business Cycles and Current Economic Analysis

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ABSTRACT

This is a brief introduction to the special issue on "New Developments in Modelling and Estimation of Economic Cycles" . The concept and definition of economic and business cycles are discussed together with two main schools of thought, the Keynesian and the neoclassical. Until the Keynesian revolution in mainstream economics in the wake of the Great Depression, classical and neoclassical explanations were the mainstream explanation of economic cycles; following the Keynesian revolution, neoclassical macroeconomics was largely rejected. There has been some resurgence of neoclassical approaches in the form of real business cycle (RBC) theory. Real business cycle theory is a class of macroeconomic model in which business cycle fluctuations to a large extent can be accounted for by real (in contrast to nominal) shocks. In a broad sense , there have been two ways by which economic and business cycles have been studied, one analyzing complete cycles and the other, studying the behavior of the economic indicators during incomplete phases by comparing current contractions or expansions whith corresponding phases in the past in order to assess current economic conditions. Two different methodologies have been applied for current economic analysis, the parametric one, that makes use of filters based on models, such as ARIMA and State Space models , and the other based on nonparametric digital filtering. Some of the invited papers of this issue deal with this second approach.

Keywords: Economic Cycles, ARIMA, Digital Filtering.

Los ciclos económicos y el análisis económico actual

RESUMEN

Esta es una breve introducción a la edición especial titulada "Nuevos Desarrollos en Modelización y Estimación de Ciclos Económicos" donde se discuten los conceptos y definiciones del ciclo económico conjuntamente con el pensamiento de dos escuelas, la keynesiana y la neoclásica. Antes de la revolución keynesiana al comienzo de la Gran depresión, las explicaciones clásicas y neoclásicas del ciclo económico fueron las dominantes; después de la revolución keynesiana, la macroeconomía neoclásica fue ampliamente rechazada. Existe hoy un resurgimiento del enfoque neoclásico bajo la forma del ciclo económico real (CER). En la teoría el ciclo económico real las fluctuaciones del ciclo pueden ser explicadas preponderantemente por medio de shocks reales en contraste a shocks nominales. En un sentido amplio, dos enfoques han sido utilizados para el estudio de los ciclos económico y de los negocios; uno de ellos analiza ciclos completos y el otro, estudia el comportamiento de indicadores económicos durante fases incompletas mediante la comparación de contracciones o expansiones actuales con las mismas fases en periodos anteriores, a fin de evaluar el estado de las condiciones económicas actuales. Hay dos métodos para modelizar las condiciones económicas actuales, una paramétrica, que usa filtros resultantes de modelos tales como los ARIMA o los modelos *State space*, y un segundo procedimiento que se basa en filtros digitales no paramétricos. Algunos de los artículos invitados en esta publicación se ocupan de este segundo enfoque.

Palabras clave: Ciclo económico, ARIMA, filtro digital.

Clasificación JEL: C22, C30, C32.

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1. ECONOMIC CYCLE, CONCEPT, DEFINITION, AND STANDPOINTS

When I was approached two years ago by Dr. José Luis Rojo García, the Chief Editor of this journal, inviting me to be in charge of this special issue on "New Developments in Modelling and Estimation of Economic Cycles" I was not sure whether to accept or refuse such honoured invitation. After a few discussions I agreed to do this job, and here I am writing this article as an introduction to the topic, and giving at the end a brief summary of the various invited and contributed articles.

Many economists and statisticians are today very committed to the study of economic cycles. The United States entered in a recession in the first quarter of 2008 till the second quarter of 2009, and this has produced a chain reaction all over the world. Moreover, there are no evidences of a fast recovery as in previous recessions. The economic growth is low and with high levels of unemployment. There is still an on-going financial crisis precipitated by the sub-prime loan problem in the financial sector and this has caused an increased interest in the linkage between financial and real economic activities. But the analysis of business and economic cycles has preoccupied economists for a long time. There were frequent crises in Europe and America in the 19th and first half of the 20th century, specifically during the period 1815-1939, starting from the end of the Napoleonic wars in 1815, which was immediately followed by the post-Napoleonic depression in the United Kingdom (1815-30), and culminating in the Great depression of 1930's, which lead into World War II.

In 1862, the French economist Clement Juglar identified the presence of economic cycles 8 to 11 years long, although he was cautious not to claim any rigid regularity. Business cycles in the OECD after World War II were generally more restrained than the earlier business cycles, particularly during the post-World War II economic expansion, also known as the *postwar economic boom*, and the *Golden Age of Capitalism*. It was a period of economic prosperity happened mainly in western countries, and which followed the end of World War II in 1945, and lasted until the early 1970s, ending with the collapse of the Bretton Woods system in 1971, the 1973 oil crisis, and the 1973-74 stock market crash, which led to the 1970 recession. Narrowly defined, the period spanned 1950/1951 to 1973, though there are some debates on dating this period, and booms in individual countries differed, some starting as early as 1945, and with the East Asian booms lasting into the 1980s or 1990s. During this time there was high worldwide economic growth; Western European and East Asian countries in particular experienced unusually high and sustained growth, together with full employment. Contrary to early predictions, this high growth also included many countries that had been devastated by the war, such as West Germany, France, Japan, and Italy.

Economic stabilization policy using fiscal policy and monetary policy appeared to have dampened the worst excesses of business cycles, and automatic stabilization due to the aspects of the government's budget also helped mitigate the cycle even without conscious action by policy-makers.

In this period the economic cycle —at least the problem of depressions— was twice declared dead; first in the late 1960s, when the Phillip curve was seen as being able to steer the economy —which was followed by stagflation in the 1970s, which discredited the theory, secondly in the early 2000s, following the stability and growth in the 1980s and 1990s in what came to be known as The Great Moderation. This phrase was sometimes used to describe the perceived end to economic volatility created by 20th century banking systems. The term was coined by Harvard economists James Stock and Mark Watson in their article written in 2002, "Has the Business Cycle Changed and Why?" The validity of this concept as a permanent shift has been questioned by the economic and financial crisis that started at the end of 2007. In the mid1980s major economic variables such as GDP, industrial production, monthly payroll employment and the unemployment rate began a decline in volatility (see Bernanke, 2004). Stock and Watson (2002) viewed the causes of the moderation to be "improved policy, identifiable good luck in the form of productivity and commodity price shocks, and other unknown forms of good luck." The greater predictability in economic and financial performance had caused firms to hold less capital and to be less concerned about liquidity positions. This, in turn, is thought to have been a factor in encouraging increased debt levels and a reduction in risk premium required by investors.

An example of the confidence of the economic profession in this period was given by Robert Lucas, in his 2003 presidential address to the American Economic Association, where he declared that the "central problem of depression-prevention [has] been solved, for all practical purposes." The period of the Great Moderation ranges between 1987–2007, and it is characterized by predictable policy, low inflation, and modest business cycles.

Note however that at the same time various regions have experienced prolonged depressions, most dramatically the economic crisis in former Eastern Bloc countries following the end of the Soviet Union in 1991; for several of these countries the period 1989–2010 has been an ongoing depression, with real income still lower than in 1989. In economics a depression is a more severe downturn than a recession, which is seen by economists as part of a normal business cycle. Considered a rare and extreme form of recession, a depression is characterized by its length, and by abnormally large increases in unemployment, falls in the availability of credit —often due to some kind of banking/financial crisis, shrinking output and investment, numerous bankruptcies— including sovereign debt defaults, significantly reduced amounts of trade and commerce —especially international, as well as highly volatile relative currency value fluctuations— most often due to devaluations.

In 1946, economists Arthur F. Burns and Wesley C. Mitchell (1946) provided the now standard definition of business cycles in their book *Measuring Business Cycles*: "*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; in duration, business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar characteristics with amplitudes approximating their own".

According to A.F. Burns (1951): "*Business cycles are not merely fluctuations in aggregate economic activity. The critical feature that distinguishes them from the commercial convulsions of earlier centuries or from the seasonal and other short term variations of our own age is that the fluctuations are widely diffused over the economy —its industry, its commercial dealings, and its tangles of finance. The economy of the western world is a system of closely interrelated parts. He who would understand business cycles must master the workings of an economic system organized largely in a network of free enterprises searching for profit. The problem of how business cycles come about is therefore inseparable from the problem of how a capitalist economy functions".*

In 1954 Schumpeter, stated that an economic cycle has four stages: (i) expansion (increase in production and prices, low interests rates); (ii) crisis (stock exchanges crash and multiple bankruptcies of firms occur); (iii) recession (drops in prices and in output, high interests rates); and (iv) recovery (stocks recover because of the fall in prices and incomes). In this model, recovery and prosperity are associated with increases in productivity, consumer confidence aggregate demand, and prices. He also proposed a typology of business cycles according to their periodicity, so that a number of particular cycles were named after their discoverers or proposers: (1) The Kitchin or inventory cycle lasting 3 to5 years (named after Joseph Kitchin,1923); (2) the Juglar economic cycle of 7-11 years ;(3) the Kuznets cycle of 15-25 years (named after Simon Kuznets,1930); and (4) the Kondratiev wave or technological cycle of 45-60 years (named after Nikolai Kondratiev,1935).

In the United States, it is generally accepted that the national Bureau of Economic Research (NBER) is the final arbiter of the dates of the peaks and troughs of the business cycle. An expansion is the period from a trough to a peak, and a recession as the period from a peak to a trough. The NBER identifies a recession as "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".

The explanation of fluctuations in aggregate economic activity is one of the primary concerns of macroeconomics. One of the frameworks for explaining such fluctuations is the Keynesian economics according to which, business cycles reflect the possibility that the economy may reach short-run equilibrium at levels below or above full employment. If the economy is operating with less than full employment, i.e., with high unemployment, Keynesian theory states that monetary policy and fiscal policy can have a positive role to play in smoothing the fluctuations of the business cycle.

Within mainstream economics, the debate over external (exogenous) versus internal (endogenous) causes of the economic cycle is centuries long, with the

classical school (now neo-classical) arguing for exogenous causes and the under-consumption (now Keynesian) school arguing for endogenous causes. These may also broadly be classed as "supply-side" and "demand-side" explanations: supply-side explanations may be styled, following Say's law, as arguing that "supply creates its own demand", while demand-side explanations argue that effective demand may fall short of supply, yielding a recession or depression.

This debate has important policy consequences: proponents of exogenous causes of crises such as the Neoclassicals largely argue for minimal government policy or regulation (laissez faire), because if these external shocks are not present, the market functions, while proponents of endogenous causes of crises such as Keynesians largely argue for larger government policy and regulation, as absent regulation, the market will move from crisis to crisis. This division is not absolute —some Classicals (including Say) argued for government policy to mitigate the damage of economic cycles, despite believing in external causes, while Austrian School economists argue against government involvement as only worsening crises, despite believing in internal causes. The view of the economic cycle as caused exogenously dates to Say's law, and much debate on endogeneity or exogeneity of causes of the economic cycle is framed in terms of refuting or supporting Say's law.

Until the Keynesian revolution in mainstream economics in the wake of the Great Depression, classical and neoclassical explanations (exogenous causes) were the mainstream explanation of economic cycles; following the Keynesian revolution, neoclassical macroeconomics was largely rejected. There has been some resurgence of neoclassical approaches in the form of real business cycle (RBC) theory. Real business cycle theory is a class of macroeconomic model in which business cycle fluctuations to a large extent can be accounted for by real (in contrast to nominal) shocks. Unlike other leading theories of the business cycle, RBC theory sees recessions and periods of economic growth as the efficient response to exogenous changes, technology shocks, in the real economic environment. According to RBC theory, business cycles are therefore "real" in that they do not represent a failure of markets to clear but rather reflect the most efficient possible operation of the economy, given the structure of the economy. RBC theory differs in this way from other theories of the business cycle such as Keynesian economics and Monetarism and sees recessions as the failure of some market to clear. RBC theory considers that economic crisis and fluctuations cannot stem from a monetary shock, only from an external shock, such as an innovation.

The debate between Keynesians and neo-classical advocates was reawakened following the recession of 2007.Mainstream economists working in the neoclassical tradition of Adam Smith and David Ricardo, as opposed to the Keynesian tradition, have usually viewed the departures of the harmonic working of the market economy as due to exogenous influences, such as the State or its regulations, labor unions, business monopolies, or shocks due to technology or natural causes (e.g. sunspots).

One alternative theory is that the primary cause of economic cycles is due to the credit cycle: the net expansion of credit (increase in private credit, equivalently debt, as a percentage of GDP) yields economic expansions, while the net contraction causes recessions, and if it persists, depressions. In particular, the bursting of speculative bubbles is seen as the proximate cause of depressions, and this theory places finance and banks at the center of the business cycle.

A primary theory in this vein is the debt deflation theory of Irving Fisher, which he proposed to explain the Great Depression. A more recent complementary theory is the Financial Instability Hypothesis of Hyman Minsky (1992), and the credit theory of economic cycles is often associated with post-Keynesian economics. In an expansion period, interest rates are low and companies easily borrow money from banks to invest. Banks are not reluctant to grant them loans, because expanding economic activity allows business increasing cash flows and therefore they will be able to easily pay back the loans. This process leads to firms becoming excessively indebted, so that they stop investing, and the economy goes into recession.

Most social indicators (mental health, crimes, and suicides) worsen during economic recessions. As periods of economic stagnation are painful for the many that lose their jobs, there is often political pressure for governments to mitigate recessions. Since the 1940s, most governments of developed nations have seen the mitigation of the business cycle as part of the responsibility of government. Since in the Keynesian view, recessions are caused by inadequate aggregate demand, when a recession occurs the government should increase the amount of aggregate demand and bring the economy back into equilibrium. This the government can do in two ways, firstly by increasing the money supply (expansionary monetary policy) and secondly by increasing government spending or cutting taxes (expansionary fiscal policy).

By contrast, some economists, notably neoclassical economists, argue that the welfare cost of business cycles is very small to negligible, and that governments should focus on long-term growth instead of stabilization.

2. ECONOMIC CYCLES MODELING AND CURRENT ECONOMIC ANALYSIS

In a broad sense , there have been two ways by which economic and business cycles have been studied, one analyzing complete cycles and the other, studying the behavior of the economic indicators during incomplete phases by comparing current contractions or expansions whith corresponding phases in the past in order to assess current economic conditions.

Concerning the former approach the pioneering econometric works by Jean Tinberger (1936,1937,1940, and 1942) have shaped business cycle research ever since and thus has framed our current understanding of the business cycle. His models, first of the Dutch economy and then of the U.S. economy, have several

essential features that are present in many modern models. In Tinbergen's models, business cycles were treated as the outcome of shocks, or impulses, that propagate through the economy over time to result in complicated dynamic patterns; even though the individual equations of the model were linear with typically single period lag structures, the resulting system could exhibit cyclical dynamics. The individual equations of the model were motivated by economic theory, and the model itself provided a framework for linking a large number of variables over time. Tinbergen used his models both for positive and normative analysis, that is, both to evaluate economic theories and to provide a tool for the analysis of macroeconomic policy. Later, Klein (1947 and 1950) and Klein and Goldberger (1955) developed macro-dynamic models that were applied till the seventies.

In the tradition of Slutsky, business cycles can be viewed as the result of stochastic shocks that on aggregate form a moving average series. However, the recent research by Korotayev and Tsirel (2010) employing spectral analysis has confirmed the presence of business (Juglar) cycles in the world GDP dynamics at an acceptable level of statistical significance.

Because the economic and business cycles are not directly observables, it is needed to remove from seasonally adjusted series, a long term trend. This was originally done by means of a long moving average using the Bry and Boschan (1971) method adopted by the NBER. Later, other methods were developed, such as those of Hodrick and Prescott (1980); Baxter and King (1999) and the Butterworth (1930) filters.

The nature and main characteristics of the cyclical asymmetries, which refer to the fact that the expansion are much longer than the recession periods, were first systematically studied by Neftçi (1984), DeLong and Summers (1986), and later by many other authors, among them, Backus et al (1992), Razzak (2001), and Boyan (2004). The duration of the business cycles phases have been studied in terms of probabilities, being Hamilton (1989) the first to find that the dependence of the duration is high during the contraction phase and very small in the expansionary phase. These results were also found by Kim and Nelson (1998) and Stock and Watson (1993). On the other hand, other authors such as Lahiri and Wang (1994), Harding and Pagan (2002) have found no evidence to support the above conclusions.

The prediction of cyclical turning points has been of great interest since the time of Burns and Mitchel (1946). Among several authors we quote Diebold and Rudebusch (1999) who used leading indicators and nonlinear models to predict their turning points.The index of leading economic indicators (LEI) is intended to predict future economic activity. Typically, three consecutive monthly LEI changes in the same direction suggest a turning point in the economy. For example, consecutive negative readings would indicate a possible recession.

In the United States the index of leading economic indicators (LEI) is a composite of the following 11 leading indicators: Average workweek (manufacturing), Initial unemployment claims, New orders for consumer goods, Vendor performance, Plant and equipment orders, Building permits, Change in

unfilled durable orders, Sensitive material prices, Stock prices (S&P 500), Real M2, and Index of consumer expectations.

On the other hand, the Index of Coincident Indicators includes Nonagricultural employment, Index of industrial production, Personal income, and Manufacturing and trade sales.

Several articles by Stock and Watson (1989, 1993, 2002 and 2005) put emphasis on the use of statistical instruments to predict cyclical turning points and to understand changes in international business cycle dynamics. Among other authors who contributed to this topic, we refer to Estrella and Miskin (1995), Hamilton and Perez-Quiros (1996), and McGukin, Ozyildirim, and Zarnowitz (2001).

Until recently statistical analysis of macroeconomic fluctuations was dominated by linear time series methods. Over the past 15 years, however, economists have increasingly applied tractable parametric nonlinear time series models to business cycle data; most prominent in this set of models are the classes of Threshold Autoregressive (TAR) models, Markov-Switching Autoregressive (MSAR) models, and Smooth Transition Autoregressive (STAR) models. In doing so, several important questions have been addressed in the literature, including: Do out-of-sample (point, interval, density, and turning point) forecasts obtained with nonlinear time series models dominate those generated with linear models? How should business cycles be dated and measured? What is the response of output and employment to oil-price and monetary shocks? How does monetary policy respond to asymmetries over the business cycle? Are business cycles due more to permanent or to transitory negative shocks? And, is the business cycle asymmetric, and does it matter? Important works on this topic are the papers published in Nonlinear Time Series Analysis of Business Cycles edited by Milas, Rothman, van Dijk and Wildase (2006) (see among others the papers due to Chauvet and Hamilton, Marcellino, Koopman, Lee, and Wong, and Kapetanios and Tzavalis). Another important study is due to Alexandrov et al. (2010) where several common methods to estimate trend-cycles are discussed.

Some of the invited papers of this issue concern current economic analysis. The basic approach to the analysis of currrent economic conditions (known as recession and recovery analysis, see Moore, *1961) is that of assessing the short-term trend of major economic indicators (leading, coincident* and lagging) using percentage changes, based on original units and calculated for months and quarters in chronological sequence. The main goal is to evaluate the behavior of the economic indicators during incomplete phases by comparing current contractions or expansions whith corresponding phases in the past. This is done by measuring changes of single time series (mostly seasonally adjusted) from their standing at cyclical turning points with past changes over a series of increasing spans. In recent years, statistical agencies have shown an interest in providing further smoothed seasonally adjusted data (where most of the noise is suppressed) and trend-cycles estimates, to facilitate recession and recovery analysis. Among other reasons , this interest originated from major economic and financial changes of global nature

which have introduced more variability in the data and consequently, in the seasonally adjusted values, making very difficult to determine the direction of the short-term trend for an early detection of a turning point.

There are two approaches for current economic analysis modelling, the parametric one, that makes use of filters based on models , such as ARIMA models (see ,among several others, Maravall, 1993, Maravall and Kaiser, 2001, and 2005) or State Space Models (see, e.g. Harvey 1985,and Harvey and Trimbur, 2001).

The other approach is nonparametric, and based on digital filtering techniques. For example, the estimation of the trend-cycle with the U.S. Bureau of Census Method II-X11 (Shiskin, Young and Musgrave, 1967) and its variants X11ARIMA (Dagum, 1980 and 1988) and X12ARIMA (Findley et al. 1990) is done by the application of linear filters due to Henderson (1916). These Henderson filters are applied to seasonally adjusted data where the irregulars have been modified to take into account the presence of extreme values. The length of the filters is automatically selected on the basis of specific values of the noise to signal ratio of the trend-cycle component.

The problem of short-trend estimation within the context of seasonal adjustment and current economic analyis has been discussed by many authors, among others, Cholette (1981), Moore (1961), Kenny and Durbin (1982), Castles (1987), Dagum and Laniel (1987), Cleveland et al. (1990), Quenneville and Ladiray (2000), Quenneville et al. (2003), Proietti (2007), Proietti and Luati (2008), and other references given therein.

Among nonparametric procedures, the 13-term Henderson trend-cycle estimator is the most often applied because of its good property of rapid turning point detection but it has the disadvantages of: (1) producing a large number of unwanted ripples (short cycles of 9 and 10 months) that can be interpreted as false turning points and, (2) large revisions for the most recent values (often larger than those of the corresponding seasonally adjusted data). The use of longer Henderson filters is not an alternative for the reduction in false turning points is achieved at the expense of increasing the time lag of turning point detection. In 1996, Dagum proposed a new method that enables the use of the 13-term Henderson filter with the advantages of :(1) reducing the number of unwanted ripples, (2) reducing the size of the revisions to most recent trend-cycle estimates and, (3) no increase in time lag of turning point detection.

The Dagum (1996) method basically consists of producing one year of ARIMA (Autoregressive Integrated Moving Average) extrapolations from a seasonally adjusted series with extreme values replaced by default; extending the series with the extrapolated values and then, applying the Henderson filter to the extended seasonally adjusted series requesting smaller sigma limits (not the default) for the replacement of extreme values. The object is to pass through the 13-term Henderson filter, an input with reduced noise. This procedure was applied to the nine Leading Indicator series of the Canadian Composite Leading Index with excellent results.Other studies such as Chhab et al. (1999), and Dagum and Luati

(2000) confirmed the above results using larger sets of series, and in a recent work, Dagum and Luati (2009) developed a linear approximation to the nonlinear Dagum (1996) method which gave very good results in empirical applications.

Other recent works on nonparametric trend-cycle estimation were done by Dagum and Bianconcini (2006) where these authors derive a Reproducing kernel Hilbert Space (RKHS) representation of the Henderson (1916) and LOESS (due to Cleveland, 1979) smoothers with particular emphasis on the asymmetric ones applied to most recent observations. A RKHS is a Hilbert space characterized by a kernel that reproduces, via an inner product, every function of the space or, equivalently, a Hilbert space of real valued functions with the property that every point evaluation functional is a bounded linear functional. This Henderson kernel representation enables the construction of a hierarchy of kernels with varying smoothing properties. The asymmetric filters are derived coherently with the corresponding symmetric weights or from a lower or higher order kernel within a hierarchy, if more appropriate. In the particular case of the currently applied asymmetric Henderson and LOESS filters, those obtained by means of the RKHS are shown to have superior properties relative to the classical ones from the view point of signal passing, noise suppression and revisions.

In another study, Dagum and Bianconcini (2008) derive two density functions and corresponding orthonormal polynomials to obtain two Reproducing Kernel Hilbert Space representations which give excellent results for filters of short and medium lengths. Theoretical and empirical comparisons of the Henderson third order kernel asymmetric filters were made with the classical ones again showing superior properties of signal passing, noise suppression and revisions.

Dagum and Bianconcini (2009.a, and 2010) provide a common approach for studying several nonparametric estimators used for smoothing functional time series data. Linear filters based on different building assumptions are transformed into kernel functions via reproducing kernel Hilbert spaces. For each estimator, these authors identify a density function or second order kernel, from which a hierarchy of higher order estimators is derived. These are shown to give excellent representations for the currently applied symmetric filters. In particular, they derive equivalent kernels of smoothing splines in Sobolev space and polynomial space. A Sobolev space intuitively, is a Banach space and in some cases a Hilbert space of functions with sufficiently many derivatives for some application domain, and equipped with a norm that measures both the size and smoothness of a function. Sobolev spaces are named after the Russian mathematician Sergei Sobolev.

The asymmetric weights are obtained by adapting the kernel functions to the length of the various filters, and a theoretical and empirical comparison is made with the classical estimators used in real time analysis. The former are shown to be superior in terms of signal passing, noise suppression and speed of convergence to the symmetric filter.

Besides the Henderson and other polynomial filters, another method widely applied to smooth noisy data is that of spline functions. Gray and Thomson (1996,

and 2002) developed a family of trend local linear filters based on the criteria of fitting and smoothing as those of smoothing spline functions, and showed that their filters are a generalization of the standard Henderson filters. Many empirical applications of spline functions can be found, among several others, in Poirier (1973), Buse and Lim (1977), Smith (1979), Silverman (1984), Woltring (1985), Capitanio (1996), and Mosheiov and Raveh (1997), Dagum and Capitanio (1998), and Dagum and Bianconcini (2009.b) and other references given therein.

3. INVITED AND CONTRIBUTED ARTICLES

In this special issue on "New Developments in Modelling and Estimation of Economic Cycles" there are three invited articles under Contributions, and two under Monographs. The first invited article entitled " Real Time Signal Extraction :A Shift of Perspective" by Marc Wildi, deals with Real-time signal extraction (RTSE) where the main goal is the determination of optimal asymmetric filters towards the end of a time series where symmetric filters can no longer be applied. Wildi proposes a nonparametric approach, the Direct Filter Approach (DFA) consisting of optimization criteria, diagnostics, and tests which accounts for alternative users relevant aspects of the estimation problem. His customization relates to an uncertainty principle which entails a fundamental shift of perspective. As a result, RTSE emerges as an autonomous discipline with exclusive concepts and statistics. The DFA can be seen as a generalization of the traditional model-based approach answering more general questions about the future than the classical one-step ahead inference. For illustrative purposes it is shown the real-time monitoring of the US-economy as well as multi-step ahead forecasting.

The second invited article is on the "Determination of the Number of Common Stochastic Trends under Conditional Heteroskedasticity" by Cavaliere, Rahbek , and Taylor. It is well known that permanent- transitory decompositions and the analysis of the time series properties of economic variables at the business cycle frequencies strongly rely on the correct detection of the number of common stochastic trends (co-integration). Standard techniques for the determination of the number of common trends, such as the well-known sequential procedure proposed in Johansen (1996), are based on the assumption that shocks are homoscedastic. A previous study by these authors (Cavaliere et al., 2010) have demonstrated that Johansen's (LR) trace statistic for co-integration rank and both the independent identically distributed innovations and wild bootstrap analogues are asymptotically valid in non-stationary systems driven by heteroskedastic (martingale difference) innovations, but that the wild bootstrap performs substantially better than the other two tests in finite samples Numerical evidence suggests that the procedure based on the wild bootstrap tests performs best in small samples under a variety of heteroskedastic innovation processes.

The third invited article under Contributions is entitled "Real Time analysis based on Reproducing Kernel Henderson Filters" by Bianconcini and Quenneville.

This article considers the problem of estimating the trend of a time series in real time by means of reproducing kernel filters associated to symmetric Henderson averages. These authors show that these filters share similar properties with the Musgrave surrogates adopted by X11 based seasonal adjustment procedures (such as X11ARIMA and X12ARIMA) that are known to minimize revisions for a certain class of time series. However, the X11 filters are derived following a different optimization criteria with respect to the symmetric Henderson filter, with the consequence that the asymmetric filters do not converge monotonically to the symmetric one. The asymmetric filters are here derived by applying the same kernel functions adapted to the length of the filter. This approach has been introduced by Gasser and Muller (1979) (called "cut-and-normalized" method) to improve the properties of kernel estimators in the boundaries. Bianconcini and Quenneville show that the corresponding asymmetric filters share similar properties to the Musgrave one in terms of polynomial reproduction. In particular, when the bandwidth parameters are all fixed to $m + 1$, where the total length of the filter is equal to $2m + 1$, the former just pass a constant, whereas the latter a linear trend with small bias. On the other hand, when the filter-specific bandwidth parameters are selected in order to optimize the spectral properties of the asymmetric filters, most of the reproducing kernel filters also pass a linear trend with small bias.

Analyzing the frequency response functions of the asymmetric filters, the spectral properties of those obtained by means of reproducing kernels are better than those of filters obtained by local polynomial regression, and similar to the Musgrave ones.

Under Monographs there are two invited papers. The first one entitled "Trend-cycle Approach to Estimate Changes in Southern Canada's Water yield" by Bemrose, Meszaros and Quenneville deals with series of annual water yield estimates for Southern Canada from 1971 to 2004. The authors estimate the movement in the series using a trend-cycle approach and found that water yield for Southern Canada has generally decreased over the period of observation. The search for trends in hydrometeorological data has become a regular undertaking given the ever-increasing need to understand how the magnitudes of present and historical components of the hydrological cycle evolve over time. The Mann-Kendall test ,one of the main methods used for trend estimation, provides a global robust estimate of the slope of the underlying trend in the series of annual water yield estimates. In this paper a methodology is introduced to complement this global estimate. The time series is decomposed separating the underlying trend-cycle from the irregulars in the series. To achieve this objective the authors first estimate a trend plus the cyclical component for the series of water yield estimates, and in a second step, they obtain the global trend over the span of the series by fitting a linear model to the trend-cycle values.

The second invited article under Monographs is "The Importance of Trend-cycle Analysis for National Statistical Institutes" by McLaren and Zhang. This

paper presents all the steps followed by National Statistical Institutes to produce trend-cycle estimates to help inform and educate users about the longer term signals of time series. Seasonal adjustment of time series only eliminates the impact of seasonality and hence the seasonally adjusted estimates still contain a degree of volatility as they are just combination of the trend-cycle and irregulars. Typically, as an analytical product, the seasonally adjusted estimates are published alongside the time series of the original estimates. In most countries the trend-cycle estimates are not published. Some countries, such as Australia, regularly publish trend-cycle as additional analytical product alongside the original and seasonally adjusted estimates to inform users.

There are three more contributed articles in this Monograph section, all written in Spanish. One, entitled" Heterogeneous Growth Cycles" by Herdz and Veleros uses the Dirichlet and the Dirichlet-multinomial distributions to analyze a definition of the cycle based on three economic performance regimens: expansion, stagnation and decrease. These authors use the Gross Domestic Product per capita from 142 countries grouped in seven clusters for the period 1950-2000.This period has been characterized by various structural changes. Furthermore, this paper investigates what are the probabilities of reaching significant positive growth rates, the frequency of the expansion regimen, which prevailed during the decade of the fifties, using Bayesian statistics.

The second contributed article is "Alternatives for Modeling Trends and Cycles in Argentina's Economy, 1880-1929" by Rabanal and Abaronio. The representations of trends and cycles have varied considerably over time depending on the changing economic definition of the cycle. Deterministic trends, based on the classical decomposition of time series, were mainly used until the early seventies, but were later on displaced by stochastic representations. However, doubt on unit root tests, especially with respect to the presence of structural changes in the series, has questioned the efficiency of stochastic models to adequately represent the trend and the cycle of economic time series. These authors review different univariate techniques used in the extraction of secular and cyclical component with special reference to the Argentina economy during 1880-1929.

Finally, the third contributed article on the Monograph section is "Supply and Demand Sides and the Economic Cycle: An Interpretation of the Current Situation" by García Lizana. This author uses Ibn Khaldûn Cyclical Model that considers simultaneously the eventual shocks of demand and supply sides. Both of them may influence the oscillatory movements of economic activity, separately (with different degrees of impact each one, depending on the moment) or simultaneously. According to the observed symptoms, García Lizana thinks that the latter offer the best explanation for what is happening today. He also observes the real complexity of economic functioning, having in mind the variety of human motivations versus the one-dimensional character of Adam Smith's *homo oeconomicus*, which is in the basis of conventional economic conceptions.

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