



A wavelet filtering based estimation of output gap

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ABSTRACT

Accurate estimation of output gap is an important and challenging problem for any economy. We consider here the problem of estimating the output gap for the Indian economy. The estimation of output gap involves a hypothetical variable, the potential output of the economy. In this paper, we propose a wavelet filtering based technique for estimation of output gap using monthly the Index of Industrial Production (IIP) series. We compare the results obtained using the proposed wavelet based technique with the widely used Hodrick–Prescott filtering and Seasonal ARIMA modeling based techniques. In order to compare the output gap estimated using the proposed technique with the other techniques, we explore the causal relationship between the estimates of output gap and the growth rate of an equity market indicator. It is observed that the wavelet filtering technique gives better results than the more popular econometric and standard time-series modeling techniques.

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1. Introduction

Output gap is the difference between an economy's potential output and actual output, former being the level of production consistent with existing labor, capital and technology. When the economy is registering an output gap, either positive or negative, it is running at an inefficient rate as it is either underworking or overworking its resources and hence estimates of output gap act as good signal/indicator of inflationary pressures on an economy [1–3]. Output gap facilitates one's understanding of the impact of the excess/inadequate capacity of the economy on price determination and is thus one of the key variables in the literature dealing with monetary policy analysis in the context of inflation-targeting. In the existing literature, annual or quarterly GDP is used in determining the output gap from potential output, which, in turn, is obtained using Kalman filtering, HP filtering [4,5] and other univariate and multivariate time-series [6,7] model fitting techniques. Highly sophisticated techniques, like, spectral analysis [8] and multivariate unobserved components model [9] applied in this area deserve special mention. Since potential output, and hence output gap is not directly observable, its estimates have to be validated in conjunction with some tangible data (variable). With a strong economic theory backing its link with inflation, in most of the above studies, significance of output gap, measured from GDP, is sought in its link with inflation [2,9–12].

However, the recent phase of recession hitting several economies across the globe, which has played havoc in the market thereby resulting in a slump in the various stock indices in almost all major markets, has necessitated exploring the link between output gap and one or more major financial indicators. Viewed in this light, there is also a growing need to have estimates of output gap at a higher frequency, say, monthly. As the indicator of output of the economy, we consider the Index of Industrial Production (IIP), the magnitude of which represents the status of production in the industrial sector for a given period of time as compared to a reference period of time. It is a statistical device, giving a single representative figure to

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measure the general level of industrial activity in the economy. This indicator is of paramount importance and is used by various research, government and private organizations. It is the single most important indicator used for monitoring the business cycle movement in any economy. Changes in the structure of the industrial sector over time make it necessary to revise the IIP periodically so as to measure the real growth in the industrial sector. In the Indian context, the current index has base year is 1993–1994. Incidentally, in India, the year 1993–1994 is also the base year of the indicator of prices, the Wholesale Price Index (WPI), the index used for calculating the official inflation rate.

In this paper we use propose a wavelet filtering based technique for estimation of hypothetical potential output and hence for the estimation of output gap. In the recent past, wavelets have been used for analyzing important problems in the area of finance and econometrics. Notable among these are application of wavelets in analyzing stock market dynamics and exchange rate dynamics [13–16], business cycle prediction [17] and extracting important macroeconomic relationships [18,19]. However, the potential of the wavelet theory for analyzing financial and econometric problems has not yet been fully exploited. This communication presents one of its many possible applications for solving important problems in the field of econometrics. Thus the main focus of this paper is to use wavelets for output gap estimation. It is further important to compare and assess the proposed wavelet based technique with the other possible methods, diverse in principle, with respect to a tangible economic indicator also available at a comparable frequency. Hence we compare the wavelet based method with HP filtering [5] and SARIMA model [20–22] fitting techniques to estimate the hypothetical potential output and hence the output gap and explored its causal relationship with indicators from the real and financial sectors. We have used data from the Indian economy between the period August 1991 and August 2008. The data required for the study is collected from various publications of the Reserve Bank of India and their online data warehouse.

The rest of the paper is organized as follows. Section 2 presents the proposed wavelet based technique for estimation of potential output and output gap. In this section we also present a brief discussion of the other two possible techniques for output gap estimation. Section 3 explores the causal relationship between output gap and inflation. Section 4 introduces details of the market indicator, S&P CNX Nifty and establishes the causal relationship between its growth rate and output gap. Section 5 summarizes the results and presents the conclusions.

2. Estimation of potential output and output gap

Gross Domestic Product (GDP) is the most popular overall economic indicator representing the performance of an economy in totality. Hence, output gap determined from GDP series can truly reflect the shift of an economy from its steady state. Like most developing as well as developed economies, the Indian GDP data too is a quarterly data series and is available from the first quarter of 1996. The IIP series, on the other hand, is available in monthly frequency from 1981 onwards. Besides, justification for using IIP as a proxy for GDP follows from the fact that IIP series reflects the efficiency at which the level of technology, the abundance and quality of productive resources and labor force an economy is utilizing, which, in turn, reflect the industrial performance of the economy. This has a more telling effect on the economy in the global perspective.

In the existing literature, econometric filtering techniques such as HP filtering, Kalman filtering, etc., are employed for estimation of potential output from GDP. We propose here a wavelet filtering based estimation of potential output along with one of the standard econometric filtering (HP filtering) techniques. Wavelet filtering decomposes the actual series into two constituents that are low frequency content approximate series and high frequency content detailed series, whereby the approximate series is considered as the potential output series. We further consider estimation of potential output gap using

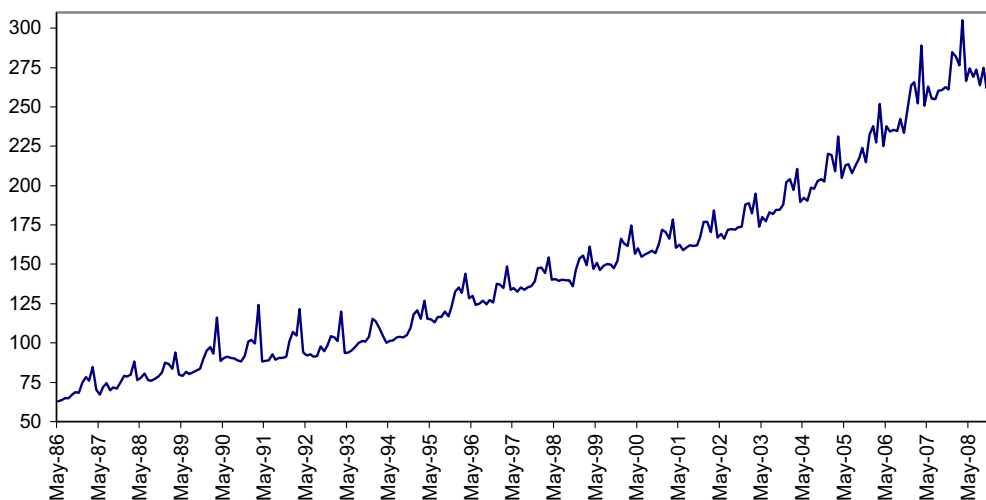


Fig. 1. Monthly IIP series.

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