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A picture for the coupling of unemployment and inflation

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HIGHLIGHTS

- We performed a cross wavelet and DFA analysis over the time series for unemployment and inflation of the US.
- Although unemployment is scale invariant, inflation together with their coupling possesses a bi-scaling behaviour.
- Unemployment shows a stronger multifractal feature compared to Inflation.
- Wavelet analysis reveals a directed coupling that varies over time and scale.

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ABSTRACT

The aim of this article is to illustrate the scaling features of two well heard characters in the media; unemployment and inflation. We carry out a scaling analysis on the coupling between unemployment and inflation. This work is based on the wavelet analysis as well as the detrended fluctuation analysis (DFA). Through our analysis we state that while unemployment is time scale invariant, inflation is bi-scale. We show that inflation possess a five year time scale where it experiences different behaviours before and after this scale period. This behaviour of inflation provides basis for the coupling to inherit the stated time interval. Although inflation is bi-scale, it is unemployment that shows a strong multifractality feature. Owing to the cross wavelet analysis we provide a picture that illustrates the dynamics of coupling between unemployment and inflation regarding intensity, direction, and scale. The fact of the matter is that the coupling between inflation and unemployment is not equal in one way compared to the opposite. Regarding the scaling; coupling exhibits different features in various scales. In a sense that although in one scale its correlation behaves in a positive/negative manner, at the same time it can be negative/positive for another scale.

1. Introduction

Economy as one of the most attractive terms in our life has proved itself to be in the list of complex systems. Owing to this statement, for dealing with economical issues having a complex view point is essential [1–6]. The complexity of economy is due to two reasons; the first is that an economical issue usually consists of a large number of interacting agents, the second is that a large number of externalities such as political movements influence it. To understand an issue within the framework of complex systems, performing scaling analysis has proved to be essential. In the present study it is unemployment and inflation that are to be analysed.

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Unemployment and inflation are of the most crucial parameters in economy. Low unemployment rates usually come with high GDP growth rates; as a matter of fact the main gaol of economy policy makers is to bring down unemployment and increase GDP growth rates. The inflation rate has proved to have high impact on economic conditions. A high rate of inflation makes investments more risky since it is harder to anticipate future interest rates and nominal wage growth rates. It also imposes some other costs such as menu cost, shoe leather cost, etc. Parallel to economy policy makers, inflation and unemployment is browsed and probed by politicians. As a matter of fact a high rate of unemployment and inflation in some extent would prove adequate for the loss of an election for the governing party. Maybe even more interesting than the parameters themselves, is their correlated behaviour. This is due to the fact that the unemployment–inflation correlation is one of the most important correlations discussed in economy. In this stage it is worth stating some economical highlights that have developed the back bone of the present attitude of scientists, policy makers, and politicians. It was the year 1958 that Phillips published his observations on the rise of nominal wages and unemployment rates in the United Kingdom. Being the first to notice, he stated that not only there is a correlation between inflation and unemployment, but also this correlation is negative. In a sense that as the nominal wages in UK increases, unemployment decreases, see Ref. [7].

This negative correlation proved to be interesting for other researchers, where Samuelson and Solow also supported Phillips statement on the negative correlation in the United States [8]. This observation provide a temptation for policy makers to increase inflation for the sake of lower unemployment at the time of crisis. Such temptation initiated a debate among economists. A famous disagreeing statement was issued by Friedman that mentioned; although such a policy may stimulate the market in the short run, but it will have nothing to do with it in the long run, see Ref. [9]. However, in the 1970s the shock produced by the rapid increase of oil prices lead the world's economy in to a real recession. The consequence was that most policy makers turned to favour Friedman's point of view. This was due to the fact that the central banks by taking the stimulating policy measures (the Keynesian view point), had failed to overcome the stagnation caused by the oil crisis. This failure was in a sense that both the inflation rate and high unemployment became present at the same time, disfavouring Samuelson et al. suggestions. Nevertheless, the debate in the scientific community still remained, see e.g. Ref. [10]. It was not before the housing bubble crises that again the policymakers came back in to the debate, where the Keynesian point of view with their flag named with the Keynesian resurgence started gaining favour. This issue leads to a fresh series of work based on the Keynesian point of view, see e.g. Akerlof et al. 2009 [11].

At this point it is clear that in addition to inflation and unemployment, their correlation has also played a significant and as well complex role in the history of economy. Therefore an analysis of these parameters cannot be addressed without consideration of their coupling. The general idea is to study the coupling between inflation and unemployment and investigate how these parameters share information between each other. In this regard, for a complete description of the coupling between unemployment and inflation, fine information on its intensity, direction, scale, and evolution has to be provided.

In this work, the scaling behaviour of unemployment, inflation and their correlation is illustrated. In this line, the approach implemented is based on detrended fluctuation analysis (DFA) [12–15]. For a complete understanding of the picture, evolution of the correlation needs to be illustrated. Cross wavelet analysis (CWT) [16,17] comes handy in this regard.

It is well known that unemployment and inflation, the two players in economy are directly effected by population, technology, and economical growth. These effects cause inflation and unemployment to inherit the dynamics and trend of the economical parameters. To study the mood of a dynamical system that obeys a specific trend, two techniques may be implemented. One is DFA, which its general idea is to take away the trend of the system before studying it [18–21]. The other is the wavelet approach, where by providing a local expansion allows study of the systems dynamics in various scales. To give a good flavour of these two approaches it is worth stating the main questions each approach is designed to answer. Light is shed on the scaling properties of these fluctuations which results in a deep understanding of the flow of information in various scales. Also studying higher moments, enables extracting information from large fluctuations referred to as rare events. It should be stated that due to the fact that in DFA, a time averaging process is carried out, local information may be lost. In order to extract dynamical information of the system together with its coupling, the wavelet analysis would prove more efficient. Note that in this method the coupling is pictured scale, direction, and dynamic wise. To comply with our aims of the present work, and keeping in mind the benefits of each technique, the need for implementing both or in other words a combination of both techniques is essential.

In this manuscript we glance over the DFA and wavelet analysis methods in Section 2. We present our findings and discuss our results in Section 3, and provide our conclusions in Section 4.

2. Methods

The comply with the aims of the present work two methods are outlined; the first is the detrended fluctuation analysis (DFA), and the second is the cross wavelet transform (CWT). Each of these methods are implemented according to our needs.

2.1. Detrended fluctuation analysis

To analyse the scaling behaviour of time series, DFA has proved as a promising technique [12,22–24]. This method has been further generalised to characterise the multifractal features [25–30] of two cross-correlated nonstationary time series named as the MF-DXA technique [13,15].

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