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From Fundamental Analysis to Wavelet Analysis in the Performance of the Australian Dollar

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Fundamental analysis has been employed in identifying factors including interest rate, inflation and employment rate affecting the performance of the exchange rate. In this paper a new method, called waveform dictionaries, is proposed to analyze the trend of the exchange rate of the Australian dollar. The wavelet transform extracts the features and displays the results in a time-frequency (scale) map. The results indicate possible insights into market behaviour such as the dominant market reaction to news.

Field Of Research: Economics

1. Introduction

Factors including inflation, employment rate and interest rate affect the movement of the exchange rate. According to the Purchasing Power Parity, if the goods abroad are more expensive than goods at home, people are likely to purchase more of the goods produced at home. This means the relative demand for domestically produced goods will rise, which should increase domestic prices or decrease the exchange rate, moving the currency to purchasing power parity.

The framework of balance of payments and capital flows dictate that an increase in the interest rate above the world level will attract capital from abroad and improves the exchange rate.Decline in unemployment rate will improve the performance of the economy and has a positive effect on the exchange rate.

Recently, waveform dictionaries have been accepted as new data analysis tools for non-stationary data and thus applied in the financial market (Ramsey 1997). The waveform dictionaries are a new data analysis technique which is comprised of both windowed Fourier transform and wavelet transform (Daubechies 1992). Each waveform is parameterized by location, frequency and scale. The waveform dictionaries can analyze signals that have highly localized structures in either time or frequency space, as well as broadband structures. Waveforms can, in principle, detect everything from shocks represented by Dirac Delta functions, to short bursts of energy within a narrow band of frequencies that occur sporadically, and finally to the presence of frequencies that hold over the entire observed period.

In this paper, waveform dictionaries are used to analyze the trend of exchange rate of the U.S. dollar with the Australian dollar.

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2. Literature Review

Several theories have been developed on the determination of exchange rates. Behind these theories, two general hypotheses lie, the Purchasing Power Parity hypothesis and the Uncovered Interest Rate Parity hypothesis.

Under the Purchasing Power Parity hypothesis, exchange rates will be adjusted in proportion to changes in national price indices, which means that a currency's real value will be the same at any time. Under the Uncovered Interest Rate Parity hypothesis, the difference in the interest rates among countries will be equal to the rate of change of the exchange rates.

Many of the studies of exchange rates are pursued with classical data analysis techniques which can be mainly classified into three ways. First, the distribution of daily foreign exchange rates is pattern recognized. The normal distribution with its mean and standard deviation parameters, the symmetric stable Paretian distributions with the characteristic exponent bounded by zero and two, the Student distribution characterized by its mean, standard deviation and degrees of freedom and a mixture of two normal distributions with one mean, two standard deviations and a mixing parameter are used to test the exchange rate distribution. Second, the statistical values such as means or second moments of data are used to find the degree of temporal correlation. The Autoregressive Conditional Heteroskedasticity (ARCH) model has been used to study the relationship between the exchange rates and other economic variables. Third, the degree of stationarity in the data is analyzed. Since daily foreign exchange rates have been extended to the new intra-daily data on postings of bid and ask quotes on foreign exchange rates using tick-by-tick observations obtained world-wide, the intra-daily data have not really been accepted to be stationary. Recently waveform dictionaries have been accepted to be new data analysis tools for non-stationary data and applied in foreign exchange rate studies.

3. Methodology

Insights are explored using waveform dictionaries to analyze foreign exchange rate. The specific data used were sampled from daily observations collected by the University of British Columbia. The raw data were from 1/2/98 to 15/4/99. The exchange rate examined was the U.S. dollar/Australian dollar.The sampling rate on a daily basis may avoid the periodicity that is induced by the institutional structure of the international market for exchange rates in the major world currencies.

4. Findings

The wavelet transform decomposes the exchange rate into time-frequency (scale) map (see Figure 1). Figure 1 shows the US$/Australian dollar exchange rate. The time-frequency map indicates the highest energy location with the deepest colour. That is, 159 working days from the starting date 1/2/1998. The d1(detail at level 1) map detects a high spike of the exchange rate on that day. The detail d1 usually shows the high frequency activities of the exchange rate market as the low frequency a1 approximates the trend of the market. Also, the maximum energy level is found at

the scale 1 (level 1) of the y-axis. This indicates that the signal nature is smooth and regular.

The high spike of the US$/Australian dollar exchange rate is possibly due to the unemployment rate in America remaining below 5 % for one year and below 6% for almost four years in the mid-1990s (see figure 1). Inflation decelerated significantly between 1994 and 1998 which allows the Federal Reserve not to raise the short-term interest rates after early 1997, and even lower them in late 1998 (Gordon 1998).

The wavelet features at the details d1, d2 and the approximate a2 for the US$/A$ exchange rate is shown in Figure 2. The signal s is compared to the a2 that indicates the trend of the dollars. D1 shows the high frequency market activities at the sampling rate, 1 datum per 2 days, and d2 shows the lower frequency market activities at half of the frequency of d1, i.e. 1 datum per 4 days. It is shown that the low frequency cycle is approximately 20 working days from the curve d2 in Figure 2.

The cumulative frequency of the signal US$/A$ is shown in Figure 3. The highest activity moving the price level is found at US$0.623 within the inter-quartile range. Histograms of the low frequency 'approximate' a1 and the high frequency 'detail' d1 of US$/A$ are shown in Figures 4, 5.

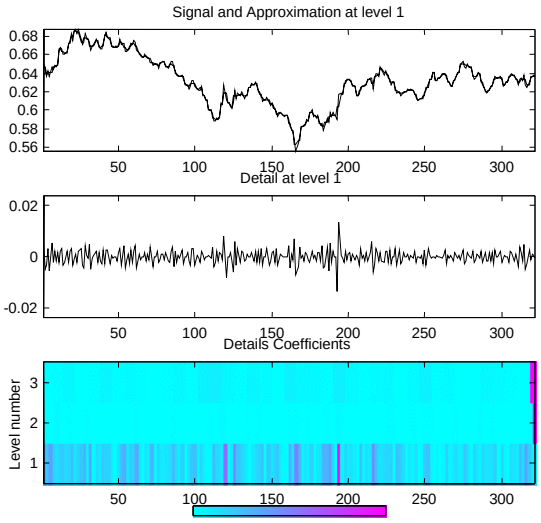

Figure 1: US$/A$ in 1998

The color map (bottom) shows the time and frequency localization of the exchange rate: x-axis shows the working date starting from 1/2/1998; y-axis shows the frequency (scale) resolution. The deepest color location on the map shows the highest energy location.

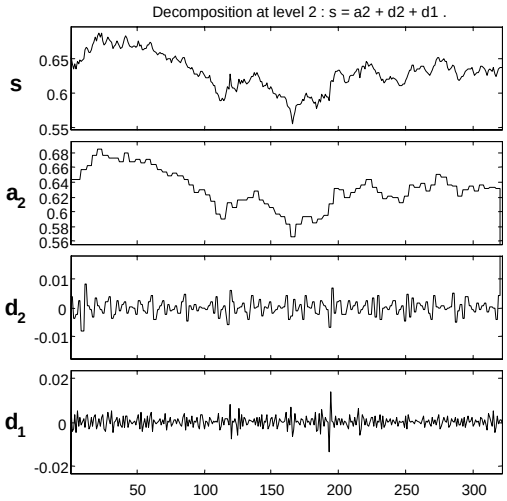

Figure 2: Wavelet transform decomposes

US$/A$ exchange rate to the wavelet

Coefficients approximate a2, details d1 and d2

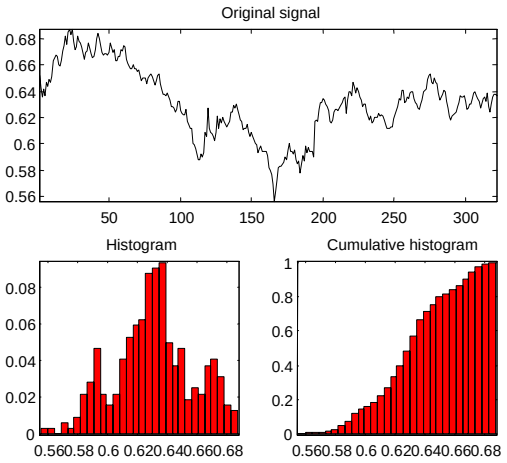

Figure 3: Cumulative frequency of the signal US$/A$ in 1998

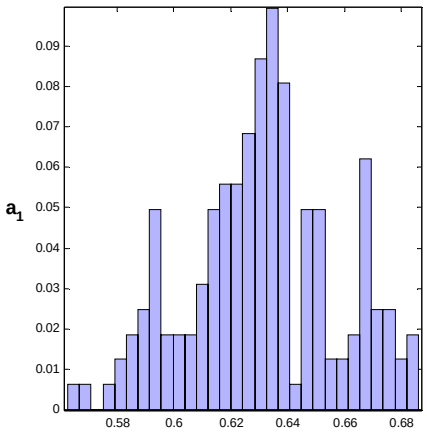

Figure 4: Histogram of the approximate a1 of the signal US$/A$ in 1998

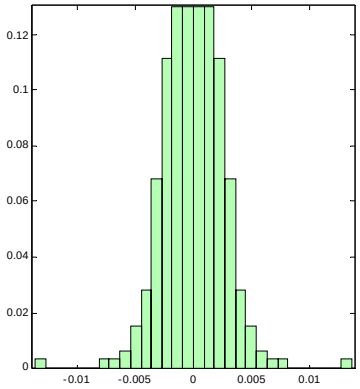

Figure 5: Histogram of the high frequency d1 of the signal US$/A$ in 1998

5. Discussion

The results indicate that the waveform dictionaries can cut up non-stationary exchange rate data into different frequency components, for example: scale levels 1 and 2 shown in Figures 1-2. This approach provides an alternative way to extract useful information from spikes or short bursts of energy that may not be sustained throughout the entire period of observation of the data contaminated by noise. Further, the short bursts of energy or spikes of the data may represent short-run bursts of market activity or energy over a narrow range of contiguous frequencies. These localized frequency bursts represent most of the energy of the signal in them but also indicate possible insights into market behaviour. These bursts may be viewed as the dominant market reaction to news. They can be observed clearly at the first difference or detail d1:Dirac Delta functions are found. The median of changes is nearly invariant at zero for d1. This indicates an almost even chance that the price will rise or fall.

To improve forecasting potential, more data and experiments need to be carried out.

6. Conclusion

The fundamental analysis has been used to analyze factors affecting the movement of the exchange rates in the long run. The proposed waveform dictionaries approach is shown to provide new information on time and frequency behaviour of exchange rates.

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