MARKET EFFICIENCY HYPOTHESIS - THE CZECH FOREX MARKET CASE IN 2015

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Abstract

In this article we present the famous Eugene F. Fama hypothesis about efficient markets in the Economy. We describe the recent modern modification and critique. Moreover we discuss the options of verifications/falsification of this theory in the real dataset in the recession. For instance comparison provided with article of Kristoufek, Vosvrda "Commodity futures and market efficiency" where there were explained the evolution in the 25 commodity futures markets.

Differences from the Market Efficiency Hypothesis equilibrium can be explained with the existence of Peso problem, the bubbles in the financial assets market, the risk premium and the problems with expectations and with the imperfect processing of Information.

Theoretically most useful method of the FOREX market Efficiency verification is in the sample of CZK/EUR time series of exchange rates and forward rates. Traditional methods are the basic regression analysis, the time series cointegration method, Pedroni´s panel cointegration and non – linear adjustment of exchange rate to its equilibrium.

Key words: Efficient Market Hypothesis, ESTAR model Time Series Cointegration

JEL Code:G17, E27

Introduction

The information efficiency hypothesis, at first presented by E. F. Fama (Fama, 1970), is a basis for the financial market analysis. The most known version speaks about the impossibility of achievement a long run riskless stable profit.

Although the Fama´s hypothesis has appeared nearly 1980ties, he himself was awarded the Nobel Prize in 2014. Moreover it was in the same year as his critique R. J. Shiller. The further problem is in involvement of the real economy with financial sector. According to the efficient market hypothesis there is no space for abnormal returns in the financial market contracts.

From the beginning the efficient market hypothesis is being tested on the foreign exchange market (FOREX) of many currencies. There is always sufficient data set thank to highly volume contracts and thank to the long time series. Nowadays there appear analyses in which authors compare the level of efficiency within the markets of different goods (Kristoufek, Vosvrda, 2014). These authors are presenting their efficiency index which serves as an indicator for market efficiency hypothesis. They have analyzed 25 commodity futures across various groups. For instance metals, energies, softs, grains and other agricultural commodities. The conclusion is about the different state of efficiency among the various commodities. Most efficient markets appears within the energy commodities, followed by softs, grains and metals. The least efficient group is in agricultural commodities.

1 Current Knowledge and Methodology

This paper is based on the pure economics, and on the statistical time series analysis.We utilized mainly the synthesis method. The synthesis method unifies divided parts into one complex. The theoretical framework is the Lucas model of an economy (Lucas, 1978). In Makovsky, (Makovsky, 2014) we see in which way the main theoretical reasons for information inefficiency in the FOREX market could be proved. These are the Peso problem, the risk premium, the learning to doing problem etc.

Time series co-integration method is widely used when data are non-stationary. The financial time series data are very often non stacionary. It is their usual feature. The most modern methods for analysis of equilibrium in economics is panel co-integration or non linear adjustment methods. In this article we do not present these methods or empirical results, but there are many articles in which it is used. For instance in Makovsky (2014).

At the beginning the efficient market hypothesis is being tested on the foreign exchange market (FOREX) of many currencies, on the stock exchange indices etc. Fama´s ideas are a basic building point of the neoliberal view of macro-economy policy. This policy has been massively used with Ronald Reagan and with Margaret Thatcher till 90ties of 20th century.The Fama´s original hypothesis was a joint hypothesis about rational expectation and risk neutral consumer. The Joint Hypothesis problem refers to that testing for market efficiency hypothesis is even impossible. The problem is “How to measure abnormal risk”? We are able to define abnormal risk thank to the expected values in a utility. More see Jensen

inequality. At the end the market efficiency hypothesis is difficult to verify on the real dataset due to the definition problem.

2 Data

Herewe present the main descriptive statistic of the exchange rates and three month forward exchange rates in the currency rate CZK/EUR. Moreover we present means and standard deviation for the CZK/EUR exchange rate and forward rate in levels but even in relative changes. The period for data is from the year 2001 August to the 2015February. We have used monthly data. Each month variable represents the average of the thirty values. Together it is 163 observations.

The exchange rate of the Czech koruna to Euro (CZK/EUR) has for the observed period the mean value 27,901 CZK for one Euro. The standard deviation for this time series is 2,734. The Jargue - Bera test rejects the null hypothesis about the normal probabilistic distribution at 0,5 % level of statistical significance. More the Augmented Dickey – Fuller test (ADF test) is not able to reject the null hypothesis about the non-stationary of the time series (about existence of unit root). These information is gained in Eviews software output.
More the 3M Forward rate is characterized with the similar features. The mean value is about 28,016 with the standard deviation 2,869, moreover we reject stationarity.

The same analysis must be done for the relative changes of variables. Relative change in the exchange rate is about -0,0013, with standard deviation about 0,015 and rejected normality. The time series of relative change in the exchange rate I s according ADF test stationary.
For the 3M Forward rate we gained these solutions. The meanvalue about -0,0014 with the standard deviation 0,0144 and rejected normality. So as the exchange rate the forward rate time series is according to ADF test stationary. We observe that these two time series provide similar features and there are comparable.

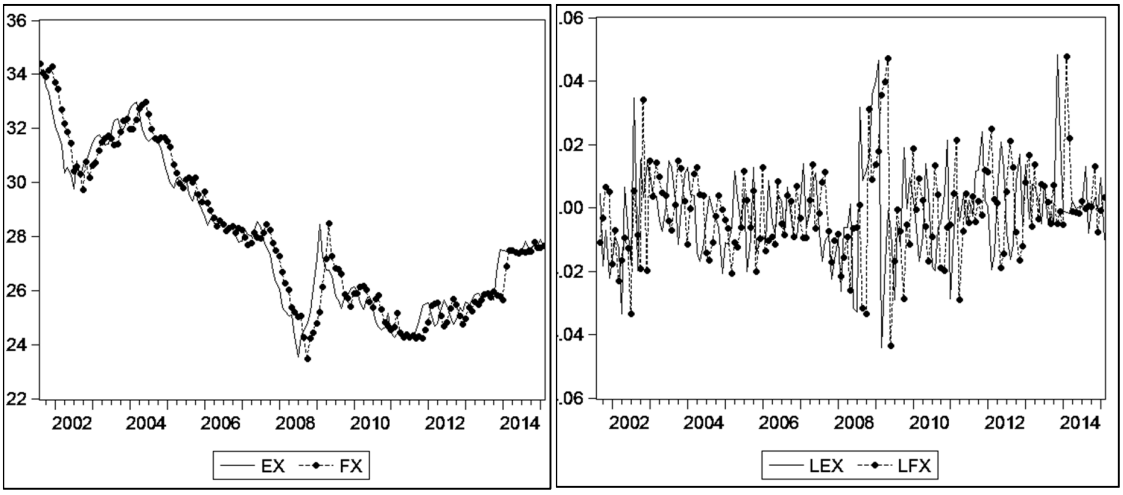
3 Regression analysis

For the first sight we tried to make regression on the variables in relative changes. We tried to explain the exchange rate with the three period lagged forward rate and with the constant. Although the regression coefficients are close to the null value (as concluded with Fama, 1970), this regression is spurious regression. The regression residuals are not normal and provide heteroscedasticity. The serial correlation of residuals is suitanable. According to t-statistics the model is inadequate. Better solutions are expected using ARMA structure or VAR, but according to own experience it will be useful to use time series cointegration.

4 Cointegration of time series

We observed that the forward rate and spot exchange rate have the similar features. In levels these are non – stationary but in the relative changes (logarithmic differences) these time series are stationary. Sincerely, it is not surprising for financial variables, at which we do observe spurious regression and have to use the co – integration method. Although these time series both are non – stationary, their common equilibrium is stationary (stochastically stable).

Fig. 1: 3M FWR, EXR Time Series (levels, relative changes)



Source: author according to data from the Czech National Bank

In order to verify that the forward rate is unbiased predictor of the future spot exchange rate we try to use two methods.

At first the co – integration analysis and at second we simply analyze the difference between the exchange rate and three month lagged forward rate. The time series of these differences should develop similar to the white noise (independent identically distributed – i.i.d.). When

we try co - integration method on the data sample in the form of levels we are not able to find a co - integration vector.

Although the vector (1,-1) is offered in the output of statistical software, both Johansen co - integration Trace test and Maximum Eigenvalue test reject the co integration.But when we have used the relative changes time series we do confirm that there is a solution. We have found the co – integration vector normalized to the form of (1;-0,9887). This vector is confirmed with the Johansen co – integration Trace test and Maximum Eigen values test. The direction of causality is confirmed with the Granger causality test.

More formally we analyze the differences between observed variables. This series provide strong autocorrelation and non – normality. It is not surprising for the financial times series. But through ADF test we reject non - stationary variables. We need to transform into logarithmic differences (approximatively the relative changes). We made division of the relative change in the spot exchange rate and relative change of the three times lagged forward rate. This rate of growth has the mean value of zero. Then it is observed suitable autocorrelation and distribution. This solution is confirmed with the value of Durbin – Watson statistics of value 1,41. The zero value coefficient is confirmed. The value of standard deviation 0,02 is suitable, so do the skewness coefficient with the value 0,278. Some problem appears with kurtosis coefficient with value 5,1. All together we can soundly confirm the co – integration analysis conclusion about the relationship between forward rate and the future spot exchange rate as it is presented in the modern economic theory and Fama´s hypothesis in the evidence of the Czech FOREX market

Conclusion

We have presented the current state of the market efficiency hypothesis. It is very stressed topic to be solved. More it differs among the commodity markets, among the financial and real economy sector etc. We have tested the FOREX market and we have used the forward rate as an unbiased predictor of the future spot exchange rate.

There were presented data sample analysis of the financial series andmore we have calculatedthe statistics.Moreover we have discussed non stationarity and autocorrelation of the time series. A method of time series cointegration has provided useful solution and has verified the existence of the co integration vector and we proved the relationship in the enough statistical significance.

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