UNIVERSITY OF LJUBLJANA
SCHOOL OF ECONOMICS AND BUSINESS

MASTER'S THESIS

APPLYING ELLIOTT WAVE THEORY AND TESTING ITS EXPLANATORY POWER ON EUR/USD EXCHANGE RATE

Ljubljana, June 2019 MIHA MOČAN

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LIST OF ABBREVIATIONS

AUD - Australian Dollar
CIP- Covered Interest Rate Parity
EME - Emerging Market Economy
EUR - Euro
EWT - Elliott Wave Theory
Forex - Foreign Exchange
FPMM - Flexible Price Monetary Model
FX - Foreign Exchange
GBP - British Pound
GDP - Gross Domestic Product
IFE - International Fisher Effect
IRP - Interest Rate Parity
JPY - Japanese Yen
MoM - Month over Month
PPP - Purchasing Power Parity
RID - Real Interest Differential Model
UIP - Uncovered Interest Rate Parity
USD - US Dollar
YoY - Year over Year

INTRODUCTION

The foreign exchange market, also known as Forex, currency market, or simply FX is the global or over-the-counter market where currencies are traded. It includes selling, buying, and exchanging currencies at current or determined prices (Record, 2003, p. 66). As stated in an analysis preformed in 2016 by the Bank for International Settlements, daily turnover in the Forex market is averaged at $5.1 trillion per day, making it a highly liquid market and the largest financial market, after the credit market. It is worth noting that not all currency pairs have the same daily turnover. Those with the highest turnover are EUR/USD (Euro/US Dollar), USD/JPY (US Dollar/Japanese Yen), GBP/USD (British Pound/US Dollar), USD/EME (US Dollar/Emerging Market Economy), and AUD/USD (Australian Dollar/US Dollar). Other currency pairs are also traded, but with a much smaller daily turnover, making them less liquid. In general, we can conclude that most turnover is made in USD with approximately 87 per cent, followed by EUR with approximately 33 per cent, JPY with approximately 23 per cent, GBP with approximately 12 per cent, and AUD with approximately 9 percent. High liquidity and the option to find a broker that gives you leverage on your trading account seems to be an appealing factor for traders and especially for beginners (BIS report, 2016, pp. 3–5).

What novice traders lack is the awareness that opening trading accounts is just the first step and before trades are filled in, certain analyses need to be made. By certain analyses I mean fundamental and technical analyses of specific assets or, in my case, currency pairings. Fundamental analyses for the currency market are usually preformed by looking at different macroeconomic data and political factors, whereas technical analyses are performed by observing past currency price charts and volume (Kirkpatrick & Dahlquist, 2016, p. 3). With the purpose of summarizing and connecting different macroeconomic data, different types of models were developed, some of which I will try to explain. I am aware that these models are not the most sophisticated, but they are important enough for understanding the fundamental factors that impact the market. In addition, I would like to emphasize that more sophisticated economic models are using big data analyses, quantum computing, high-frequency data, and advanced logarithms, and for these reasons demand high capital requirements.

On the other hand, there exist freely available methods for technical analyses that are easily understandable and often easily applicable. For these reasons, my method of choice for technical analyses is the Elliott Wave Theory, which I will present, describe, and apply in my master thesis on the chosen currency pair.

Elliott Wave Theory was first introduced in 1938 by Ralph Nelson Elliott. He based the theory on his extensive research showing that all human activities are impacted by social-economical processes, resulting in recurring series of waves or impulses forming a definite number of patterns (Poser, 2003, p. 1). R. N. Elliott first successfully applied his theory on

the Dow Jones Industrial Average. The Dow Jones Industrial Average is a stock market index composed of the 30 largest publicly owned companies based in the United States (O'Sullivan & Scheffrin, 2003, p. 290). However, it was not until 1994 – when a computer programmer named Swannell started to design a program that applied and analyzed the success of the Elliott Wave Theory in practice across different tradable asset − that it was discovered that the Elliott Wave Theory gave the best results on markets that are highly liquid (high volume markets) and that this theory functions on the principles of fear and greed (Swannell, 2003 in Kirkpatrick & Dahlquist, 2011, p. 481). Due to Swannell's finding I have chosen to apply the Elliott Wave Theory to the most liquid market and, consequently, to the most liquid currency pairs.

The purpose of my master's thesis is to introduce traditional models for exchange rate determination and, due to their insufficiencies, use an alternative approach based on the Elliott Wave Theory. Thus the main research question, which I would attempt to answer in my thesis, is to find out if the Elliott Wave Theory has better explanatory power for exchange rate determination than that provided by the fundamental data.

While writing my master's thesis, I had the following goals:

- My first goal was to present the basic functioning principles of the classical exchange rate determination models and to highlight their main drawbacks.
- My second goal was to present the Elliott Wave Theory and its main characteristics as an alternative to traditional exchange rate models.
- My final goal was to test the practical use of the theory on the most liquid currency pair (EUR/USD) and to compare it with fundamental data to see if EWT better explains currency price movements.

My thesis will be based on secondary and primary analyses. To prove my research hypothesis, I will gather economic data for the euro and the dollar separately for the chosen period of one month and four months. Further on, I will compare gathered economic data with market expectations and calculate the percentage of the economic data that meet or surpass market expectations for the euro as well as for the dollar. The currency with the higher percentage of economic data which meets or surpasses market expectations should appreciate in its value against the counterpart currency. The EWT will be applied in the same time interval during which the economic data will be gathered and compared with market expectations and based on the principles that the EWT theory describes the price movement will be assigned. Finally, I will compare price movement based on market expectations with the EWT price predictions to see if the EWT explains the price fluctuations in the same way than the market expectations suggest.

The text will be divided into several chapters. In the first chapter I will describe economic theories and models of exchange rate determination and I will try to explain the most important economic theories and models used for exchange rate determination. I will also try to describe their major limitations and their empirical validity. Furthermore, I will discuss the relevant economic data which has an influence on currencies' prices and exchange rate behaviour. Following the first chapter I will continue in the second chapter with an alternative theory named the Elliott Wave Theory. The basic concepts of the Elliott Wave Theory will be presented and I will explain the five-wave concept on which the EWT is based. I will also discuss the specifics of each wave of the five-wave concept. Different Elliott wave patterns, such as expanding diagonals, zigzag corrections, flat corrections, triangle corrections, complex corrections, alternations, price movements following fifth wave extension, and channelling will be discussed in the third chapter of my thesis. In chapter four, the application of the EWT on foreign exchange market (FOREX) will be covered and I aim to apply EWT to the most liquid currency pairs EUR/USD in order to empirically test the validity of the theory. Finally, I will summarize the results of the previous chapter and I will critically discuss them.

1 ECONOMIC THEORIES AND MODELS OF EXCHANGE RATE DETERMINATION

In this section, the emphasis will be on the macroeconomic theories of exchange rate determination, the most commonly used economic models and the economic data affecting currencies' values and exchange rate fluctuations.

1.1 Economic Theories

In the economy we use different economic theories, models, and economic data to predict the factors that affect a currency’s value, the direction of their movements, and the consequences that this variation will have on traders or on the economy. While economic theories and models are important to move currencies in the long-run, economic data are much more important for short term currency movements.

In the current liberalized, open, and modern currency market, the main aim of investors is to try to estimate the currency’s value in order to predict the exchange rates and to profit from their positive predictions.

In economic literature, we find numerous different economic models and theories that elaborate on the topic of exchange rate determination. Simplified, all of them circulate around the parity condition, the price at which two currencies should be exchanged considering factors such as inflation and interest rates. The absence of the parity condition creates arbitrage possibilities, which enables traders to profit from the price differences of

the same currency in different countries. The major economic theories of exchange rate determination are Purchasing Power Parity (PPP), Interest Rate Parity (IRP), International Fisher Effect (IFE), Balance of Payments Theory, Real Interest Rate Differentiation Model, Asset Market Model, and Monetary Model.

However, we should consider the fact that all existing theories about the exchange rate determination have poor explanatory power, which remains one of the major weaknesses of international macroeconomic theory. As I mentioned before, this poor explanatory power of the economic theories shows its imperfections especially when predicting the exchange rate in the short-run. Meese and Rogoff (1983) found that random walk better predicts the exchange rate than macroeconomic models on the short-run (Meese & Rogoff in Bacchetta & Wincoop, 2006, p. 552). On long-run, the existing theories are much more reliable. If we consider a period of 2 to 4 years, we can more easily note the relationship between the exchange rate and the fundamental macroeconomic factors (Bacchetta & Wincoop, 2006, p. 552). Despite their poor explanatory power, the economic theories on the topic are essential for better understanding the problem in this thesis. Therefore, in the following section I will introduce the main macroeconomic theories and models of exchange rate determination.

1.1.1 Purchasing Power Parity (PPP)

PPP is a macroeconomic theory of exchange rate determination. We discuss the PPP when the purchasing power of a unit of domestic currency has the same value as the purchasing power of the same unit of foreign currency, as long as the domestic currency is converted into foreign currency at the given nominal exchange rate. In this sense, we can thought of the purchasing power parity exchange rate as the level of nominal exchange rate (Taylor, 2003, p. 437). Or in its simplified form, the theory states that the price level in two different countries should be equivalent to one another after exchange rate adjustment (Pareshkumar, Narendra & Ashok, 2014, p. 54).

The "purchase power" is usually measured by recourse to indices of national prices (Taylor, 2003, p. 437).

The PPP theory is also known as the "inflation theory of exchange rates", because the theory considers price level changes as a determinant of exchange rate changes (Dornbusch, 1985, p. 1).

This theory is closely related to the one price rule, which states that the price of one good should be the same in all countries worldwide. If the rule of one price does not hold, arbitrage opportunities are created. The reason for this is that traders can easily buy the

goods in one country where its price is lower and sell it in another country where the price is higher, thereby earning a profit.

If we denote P_t as a price level of the domestic currency at time t, P_t^* as the price level of the foreign currency at time t and S_t as the nominal exchange rate or the domestic price of the foreign currency at time t, we will get the following equation:

$$P_t = {}^{P_t^*}/_{S_t} \tag{1}$$

or equivalently

$$P_t^* = P_t * S_t \tag{2}$$

The equation number (2) represents the absolute PPP theory.
When changes in purchasing power parity of two different currencies are equalized, we assume that the relative PPP theory holds (Taylor, 2003, p. 437):

$$\frac{\Delta P_t^*}{P_{t-1}^*} = \frac{\Delta P_t}{P_{t-1}} + \frac{\Delta S_t}{S_{t-1}} \tag{3}$$

where $\Delta P_t^* = P_t - P_{t-1}, \Delta P_t = P_t - P_{t-1}$ and $\Delta S_t = S_t - S_{t-1}$.

As we can see from equations 1 and 2, there is no causation between any of the variables in the formulas. If we want to express the causation of the relative prices P_t and P_t^* on the exchange rate S_t we can rewrite the equation in logarithmic form as follows (Taylor, 2003, p. 437):

$$s_t = p_t - p_{t-1}^* \tag{4}$$

The idea of writing the formula in a way that suggests causation of the relative prices on the exchange rate originates from early studies of the theory by authors who proposed the monetary approach to exchange rate determination. When the Bretton Woods's system of fixed exchange rates emerged in the 1970s, this was the most commonly used form of exchange rate determination (Taylor, 2003, p. 437). Proponents of the monetary approach put as a central assumption that the purchasing power parity in the model would hold continuously. If this assumption holds, then as the national price levels were determined by the relative excess surplus of money, the exchange rate must be determined by the same parameter (Frenkel, 1976 in Taylor, 2003, p. 437).

During the 1970s, when studies on empirical exchange rate models based on the monetary model appeared and the flexible exchange rate emerged, it became obvious that the PPP doesn't hold continuously. This assumption was easily rejected by the simple comparison of the relative volatility of nominal exchange rates and the volatility of national prices. If

this assumption held, then the volatility of nominal exchange rates should be no greater than the volatility of national prices, which certainly did not hold, since the former was much greater. The "collapse of purchasing power parity", as formulated by Frenkel (1981) was to a large extent responsible for the rise of the exchange rate models proposed by Dornbusch (1976). This model allows considerable volatility in the nominal exchange rate, because it observes the PPP as a long-term condition. Observing the PPP as a long-term condition is a much more reasonable assumption, since the prices are sticky in the short-run (Taylor, 2003, p. 438).

Kanamori and Zhao (2006) review different theoretical approaches to determine the exchange rate and classify them into three groups, namely partial equilibrium models, general equilibrium models, and disequilibrium or hybrid models. The first group of models− the partial equilibrium models− include the absolute and relative purchasing power parity (PPP) and interest rate parity (IRP). The absolute and the relative PPP consider only goods markets, while the IRP consider only asset markets. The relative PPP, also known as the inflation theory of exchange rate, states that the relative change in the exchange rate is caused by the difference of the inflation rates of two different economies (Shylajan, Sreejesh & Suresh, 2011, p. 91). According to Kanamori and Zhao (2006) the interest rate parity condition is the connection between the exchanges rate, interest rate, and inflation (Kanamori & Zhao, 2006 in Shylajan, Sreejesh & Suresh, 2011, p. 91). Apte (2006) claimed that the interest rate parity theory has two forms, the covered interest rate parity and the uncovered interest rate parity (Apte, 2006 in Shylajan, Sreejesh & Suresh, 2011, p. 91). The IRP considers the asset's prices as an important determinant of the exchange rate variations. According to this theory, the current exchange rate is determined by the expected future exchange rate and the interest rate differential (Shylajan, Sreejesh & Suresh, 2011, p. 91). The flexible price monetary model, which is built upon the combination of the monetary equilibrium and the adjustment of the price and the quantity in order to achieve their long-run equilibrium, is classified by Kanamori and Zhao (2006) as disequilibrium or hybrid model.

1.1.2 Monetary Models

The monetary models of exchange rate determination are commonly used to theoretically explain the exchange rate variations between two currencies over time. The monetary model is a very useful analytical tool because it highlights the connection between the nominal exchange rates and a group of macroeconomic factors, known as fundamental factors. Like its name suggests, the model is based on a quantitative money theory, which is determined by the countries' monetary policy. The model tries to explain the exchange rate movements between two different economies as a consequence of changes in supply and demand for the national money stock of the two economies (Shylajan, Sreejesh & Suresh, 2011, p. 92). From macroeconomics we know that the monetary policy of a

country deals with the money supply. It regulates the quantity of money put into circulation. The amount of money in circulation depends mainly on two factors, the interest rate imposed by central banks and the amount of money released by the treasury through open market operations. However, if the money supply of a country increases rapidly, there is a real threat that inflation may increase as well. Consequently, the increased inflation leads to currency devaluation.

In the literature, we find a few variations of the monetary model trying to explain the exchange rate characteristics and movements. Developed by Frenkel (1976), Mussa (1976), and Bilson (1978), the so called "flexible price monetary model (FPMM)" assumes that all prices are flexible. A further assumption of this model is that changes in the exchange rate are the consequence of changes in real income and inflation expectations, simply because these two parameters affect the money demand (Pilbeam, 1998). The model defines the relative money stock as the determinant of relative prices which further affects the exchange rate (Shylajan, Sreejesh & Suresh, 2011, p. 93). The main assumption of the flexible price model is that the PPP holds continuously (Shylajan, Sreejesh & Suresh, 2011, p. 92). The same assumption holds for the Uncovered Interest Rate Parity (UIP) and for the International Fisher Effect (IFE) (Pilbeam, 1998 in Shylajan, Sreejesh & Suresh, 2011, p. 92). The International Fisher Effect explains the relationship between expected inflation and the interest rate of a country in a way that an increase or decrease in the expected inflation rate will cause a proportional increase or decrease in the interest rate of the country (Shylajan, Sreejesh & Suresh, 2011, p. 92). Furthermore, the IFE explains that differences in the nominal exchange rates of two different economies are the result of expected changes in exchange rate (Eun & Resnick, 2010 in Shylajan, Sreejesh & Suresh, 2011, p. 92). As I already explained earlier in this chapter, the main assumption of these models was proved to be wrong and other modified variations of the monetary models gained in popularity. Dornbusch (1976) proposed the *"sticky price monetary model"* and Frenkel (1979) proposed the *"real interest rate differential model"*. These two versions of the model are the most important and the commonly used versions. The main difference between the flexible price monetary model and the sticky price model is their main underlying assumption. While the flexible price monetary model assumes that the PPP holds continuously, the sticky price model states that the PPP holds only in the long-run (Pilbeam, 1998).

When the floating exchange rate was introduced in 1973, the asset approach to exchange rate determination became the dominant approach. We distinguish between two different ways of asset modelling within the asset approach, referred to as monetary models and portfolio balance class of models. On the one hand, monetary models assume that all non-money assets are perfect substitutes and the exchange rate is determined by relative excess money supplies. On the other hand, portfolio balance class of models assumes that non-money assets are imperfect substitutes which are affecting the exchange rate by affecting the risk premium channel (MacDonald & Taylor, 1994, pp. 276–277).

The typical flexible price monetary model introduced by Bilson (1978), Frenkel (1976), and Hodrick (1978) can be formally expressed in the following way (MacDonald & Taylor, 1994, p. 277):

$$S_t = \beta_1 m_t + \beta_2 m_t^* + \beta_3 y_t + \beta_4 y_t^* + \beta_5 i_t^l + \beta_6 i_t^{l*} + \gamma_t \quad (5)$$

where S_t is the spot exchange rate (domestic price of a foreign currency), m_t is domestic money supply, y_t is the domestic income and i_t^{l*} is the long-run domestic interest rate. Their foreign equivalents are denoted with an asterisk. γ_t is a disturbance term.
In a well-working flexible price monetary model, it is expected that β_1 and β_2 take the values of -1 and +1 respectively, and β_3 and β_4 are, respectively, negative and positive with numerical values equal to the numerical values of the income elasticises of the domestic and foreign money demand functions, while β_5 and β_6 take, respectively, positive and negative values, similar to the values of interest rate semi-elasticises in money demand functions (MacDonald & Taylor, 1994, p. 277).

This model reflects the relation between the domestic interest rate (i_t^l) and the exchange rate, meaning the domestic interest rate and the exchange rate are positively correlated. If the domestic interest rate increases, the value of the domestic currency increases as well. This positive influence of the domestic interest rate on the domestic currency can be observed from the equation because the interest rate in this equation reflects the inflation premium. If the expected domestic inflation rate increases, the value of the domestic currency decreases, causing currency depreciation.

However, as Frankel (1979) suggests, in the short-run, the relationship between the interest rate and the exchange rate in the model seems to be unrealistic. Therefore, he incorporates a real interest rate differential to express the liquidity effects of the monetary policy (MacDonald & Taylor, 1994, p. 278). In the literature, Frankel's modified form of the model is known as the "real interest rate differential (RID)". The real interest rate normally refers to an interest rate with short-run maturity because such interest rates are reflecting the liquidity effects of monetary policy (MacDonald & Taylor, 1994, p. 278). Frankel's RID model can be written in the following formal form (MacDonald & Taylor, 1994, p. 278):

$$S_t = \beta_1 m_t + \beta_2 m_t^* + \beta_3 y_t + \beta_4 y_t^* + \beta_5 i_t^l + \beta_6 i_t^{l*} + \beta_7 i_t^s + \beta_8 i_t^{s*} + v_t \quad (6)$$

where i_t^s and i_t^{s*} represent domestic and foreign short-run interest rates, respectively.
The main distinction between the flexible price monetary model and the RID model is the introduction of domestic and foreign short-run interest rates. All other variables in the RID

model remain the same as in the flexible price model. It is expected that the coefficients β_7 and β_8 in the RID model take values which are, respectively, negative and positive. Since the RID model incorporates short-run influences, it cannot be tested in a long-run setting (MacDonald & Taylor, 1994, p. 278). Only the flexible price monetary model allows testing in a long-run setting.

The question if either these two models are reliable for exchange rate determination or not, seems to be the most important topic of concern. Throughout history, researchers have tested the reliability and the forecasting power of the two models and many of them came to different conclusions. For example, Frankel (1979), Bilson (1978), and Hodrick (1978) tended to be supportive of the idea that the flexible price monetary model and the RID model had reliable in-sample forecasting performance. It is important to mention here, that those reliability tests of the models were conducted with data up until the end of 1978 and tended to be static or have very limited dynamics. As MacDonald and Taylor (1992) claimed, the models didn't work well after 1978, having weak in-sample performance and insignificant estimated coefficients. Probably the main reason for the collapse of the monetary models was the finding by Meese and Rogoff (1983) that they were unable to perform a simple random-walk in an out-of-sample forecasting contest. However, the main failure of the previous tests of the monetary models was their inability to capture the dynamic data generating processes for the time periods observed (MacDonald & Taylor, 1994, p. 278).

1.1.3 Interest Rate Parity

The interest rate parity theorem is frequently used for analysing exchange rate movements. The theorem can be formally expressed through the following formula (Aliber, 1973, p. 1451):

$$(F - S)/S = r_d - r_f \tag{7}$$

where F is the forward exchange rate, S is the spot exchange rate, r_d is the domestic interest rate, and r_f is the foreign exchange rate. The first part of the equation, $(F - S)/S$, represents the exchange agio and the second part, $r_d - r_f$, is the interest agio. The formula clearly shows the relation between the forward exchange rate and the interest differential of the money-market (Aliber, 1973, p. 1451). Same as with the PPP, the interest rate parity theorem is based on the price law, stating that the price of an asset in one country should be equal to the price of the same asset in other country, thereby eliminating arbitrage opportunities. The interest rate parity theorem suggests that there be no arbitrage opportunities if the interest rates of the same asset in two different countries do not differ, thereby assuming that the asset's risk is the same in both countries. From the formula

above we can clearly see the relationship between the interest rates in two different countries and the forward and spot exchange rates.

Using the interest rate parity theorem, we base our analysis on the difference between the observed forward rate and the rate predicted from the difference between the domestic and foreign interest rate, namely, from the interest agio. However, what remains problematic here is why there are still unexploited arbitrage opportunities for profit-creation and the limited reliability of the theorem concerning expectations. On the one hand, the formula delivers misleading expectations because of measurement errors. For example, a measurement error may occur if the observations are not made in the same period of time, usually because of the different time zones. On the other hand, there are still arbitrage opportunities resulting from the difference between the exchange agio and the interest agio. As Aliber (1973) suggests, the arbitrage opportunities may appear because of transaction costs, default risk, and a combination of default risk, non-monetary returns, non-unitary correlation of returns, and premature repatriation (Aliber, 1973, pp. 1451−1452). Stoll (1968) defined the risk that arbitragers face with respect to their transaction as a default risk.

Regarding the transaction costs, Prachowny (1970) tried to explain the differences between the exchange agio and the interest agio by assuming that arbitragers borrow at the prime rate in one country and invest at the treasury-bill in other country (Prachowny 1970 in Aliber, 1973, p. 1451). This explanation holds true only if we exclude the following two types of arbitragers from the picture, those who shift from lending in one country to lending in another country and those who shift from borrowing in one country to borrowing in another country. Because the very basic principles of arbitrage are based on the trade of these two types of arbitragers, the explanation that Prachowny (1970) suggested seems to have no validity (Aliber, 1973, p. 1451).

We distinguish between two forms of interest rate parity, the covered interest rate parity and the uncovered interest rate parity. The covered interest rate parity (CIP) theorem states that, if we take in concern the interest rate differential between two different currencies, then for the theorem to hold, it should be the same as the foreign exchange forward premium (Taylor, 1986, p. 430). The CIP theorem can be formally expressed with the following formula (Taylor, 1986, p. 430):

$$\frac{F}{S} = \frac{1+r_d}{1+r_f} \tag{8}$$

where r_d is the domestic and r_f is the foreign interest rate of the similar assets of certain maturity, F is the forward rate of same maturity as the interest rates and S is the spot exchange rate.

In situations where the equation does not hold, thereby making the market inefficient, traders have the opportunity to profit from riskless arbitrage transactions. As Taylor (1986) suggests, when the market is inefficient, arbitragers get the opportunity to earn riskless profit by borrowing one currency, selling the borrowed currency on the spot in order to buy another currency which is then lended, and at the end buying back the original currency in the forward market. Such arbitrage tends to adjust the interest rates to the point where the equation holds (Taylor, 1986, p. 430).

In academic literature we can find numerous studies reporting deviations from the CIP (Taylor, 1986, pp. 430−431). Aliber (1973) claims that such departures may be explained though political risk; Branson (1969) and Frenkel and Levich (1975, 1977) explain the departures in terms of transaction costs; Prachowny (1970), Frenkel (1973), and Otani and Tiwari (1981) explain the departures as a consequence of capital market imperfections; Green (1984) focuses on the costs of adjustment; and Agmon and Bronfeld (1975) are additionally focused on the data imperfections. For an analyst to be able to measure these deviations, it is important to have the data of the exchange rates and the interest rate which is recorded at *"the same moment"* at which an investor makes the trade. If the data is not recorded at that very same moment, the analyst faces serious deviations from the CIP. Frenkel and Levich (1977), for example, used exchange rate data in their study which was recorded several hours after the interest rate data was recorded. Agmon and Bronfeld (1975) became aware of the problem concerning data recording and they pointed out that it would be incorrect to use approximations in the tests. Taylor (1986) tried to use high-frequency trading data in his study, which he personally recorded in the London exchange market in order to overcome the problem with data imperfections (Taylor, 1986, p. 431). Working with this data, he was able to verify the market efficiency hypothesis by confirming the covered interest rate condition (Taylor, 1986, p. 435). Although his analysis of the high-frequency data failed to pick up the very short-run arbitrage opportunities which motivate the arbitragers to trade, he raised attention to the importance of the data used. Therefore, we can conclude that data imperfections are one of the main reasons for CIP deviations.

According to Taylor (1987), the uncovered interest rate parity (UIP) theorem states that *"the interest differential between two financial assets, identical in every relevant aspect except currency of denomination, should be exactly offset by the expected rate of change of the exchange rate between the relevant currencies over the period to maturity"* (Taylor, 1987, p. 579). The interest rate parity condition is important for two reasons. Firstly, if we assume that market participants are risk-neutral or foreign exchange risk is completely diversifiable and that the UIP condition does not hold, then market inefficiency is created. When the market is inefficient, we say that the relative prices do not reflect all available information and that there are still unexploited market opportunities (Taylor, 1987, pp. 579−580). Only if the market is operating efficiently, can we assure an optimal resource allocation (Fama 1970; 1976). Secondly, in the literature on international monetary

economics in general and in the monetary models of exchange rate determination (in the flexible price monetary models or in the sticky price models) in particular, the UIP is treated as an identity (Taylor, 1987, p. 580). We categorize the models in which the UIP condition does not hold as portfolio balance models (Isard, 1986 in Taylor, 1987, p. 580).

Empirical studies are predominantly using the covered interest rate parity, because it is difficult to form expectations of the future spot rate. CIP together with the UIP condition secures the optimal forward rate as a spot rate predictor (Taylor, 1987, p. 580).

The UIP can be formally written as follows (Taylor, 1987, p. 581):

$$E(S_{t+n}|I_t) - S_t = r_t^* - r_t \tag{9}$$

where S_t is the exchange rate at time t, r_t is the interest rate on domestic currency, I_t is the information set available at time t and n is the number of periods to maturity of the interest-bearing assets. r_t^* is the interest rate on foreign currency and E, at the beginning of the equation, stands for expected value.

1.1.4 Balance of Payments Theory

In the theory of international monetary economics, the fundamental issue is the implication of alternative mechanisms by which a country can maintain budget constraints that are set with respect to the other economic objectives of the country. The theory elaborating this topic is called the balance of payments theory or simply the payments theory (Krueger, 1969, p. 1).

The number of policies that a country can impose in order to maintain budget constrains is actually unlimited. For this reason, the research area of the payment theory is quite wide. Nevertheless, the fundamental mechanisms to maintain the external constrain which are elaborated in the payment theory are the exchange rate adjustment, exchange control, and adaptation of the domestic economy in a way which supports the external constraint (Krueger, 1969, p. 1). The aim of these mechanisms is to create an equilibrium.

In order to determine the nature of external constraints, the payments theory focuses on current account and capital account. A current account of a country may be defined simply as the sum of all transactions that the country has with other countries. A capital account represents a net change in assets (financial or physical) that a country owns. These transactions usually include the trading of goods and services, earnings from foreign investments and transfer payments. Theoretically, a country may operate under a current account surplus of deficit, which further implies a positive or negative trade balance. A surplus or deficit comes as a result of net change in the country's asset positions.

Simplified, we can define a surplus as a situation where the country lends money, while when the country faces a deficit it borrows money. If we want to express the current account deficit through the country's imports and exports, we can say that if imports are larger than exports, the country operates under current account deficit. Or more generally, the current account deficit may be explained as a situation where a country's excess receipts of goods and services from abroad are offset by a reduction in assets. According to Krueger (1969), such a reduction in assets may result because of gold shipments, net international borrowing, the sale of foreign securities that the country holds or other financial transactions. This reduction can not last forever, because some of the assets are correcting themselves after a certain period of time. Still, not all assets have this capability of self-correction. In a static model, the focus is on current account and it is essential to assume that the deficit must correct itself eventually (Krueger, 1969, p. 2). To be able to lead a country which operates under current account deficit towards an equilibrium position, we should ask ourselves: what are the available mechanisms which we can use to accomplish this? Therefore, this basic question forms the basis of the payment theory.

However, when the floating exchange rate was introduced in 1973, the interest of many researchers shifted from the balance of payments to the economic determinants of exchange rate movements (Frenkel & Mussa, 1985, p. 680).

1.1.5 The Fisher Hypothesis

The Fisher hypothesis states that the difference between the nominal rates of return of two similar assets in all other aspects expects the currency denomination to be offset by an expected exchange rate change over the holding period in order to satisfy the market-equilibrium condition. This hypothesis is also known as the "Fisher's open hypothesis". It is important to highlight the difference between the Fisher hypothesis and the covered interest rate parity discussed above in order to avoid confusion between the two. While the covered interest rate parity theorem is risk-free, the Fisher parity involves risk. Furthermore, while the Fisher parity holds in a market where the information distribution is asymmetrical, the covered interest rate parity does not. As previously discussed, an essential assumption for the covered interest rate parity to hold is symmetrical information allocation and no transaction costs. The Fisher parity does not rely on this assumption and furthermore it states that the nominal interest differential may reflect the risk premium in addition to expected exchange rate movements (Cumby & Obstfeld, 1981, pp. 697–698).
The Fisher parity condition can be formally written in the following form (Cumby & Obstfeld, 1981, p. 698):

$$tS_{t+1} - S_t = \ln(1 + r_t) - \ln(1 + r_t^*) \cong r_t - r_t^* \qquad (10)$$

where S_t is the logarithm of the spot exchange rate; tS_{t+1} is the expected value of the algorithm S_t for the next period $t+1$, conditioned on information available at t; r_t and r_t^* are the one-period nominal interest rates on domestic and foreign bonds respectively.

In order to be able to work with the Fisher hypothesis formally presented above and to test its validity, we should assume that: 1). tS_{t+1} is an expected mathematical condition, which depends upon different events that affect the financial market and 2) the market is weakly efficient, meaning that the future expected spot rates will depend on the available information in the market place and will reflect past forecast errors (Cumby & Obstfeld, 1981, p. 698).

The first assumption can be formally written in the following form (Cumby & Obstfeld, 1981, p. 698):

$$S_{t+1} = tS_{t+1} + \varepsilon_t, \quad E(\varepsilon_t) = 0 \tag{11}$$

where ε_t is the forecast error. Since the expected value of the forecast error is zero, we can conclude that the realized spot exchange rate equals its expected value.

Through the first condition, we realize in the second condition that the stochastic process $\{\varepsilon_t\}$ is actually a white noise process, stating that the forecast errors do not correlate with one another.

Combining the first and the second condition we get the following result (Cumby & Obstfeld, 1981, p. 698):

$$S_{t+1} - S_t - r_t + r_t^* = \varepsilon_t \tag{12}$$

As mentioned previously in this section, the Fisher parity incorporates risk premium where as the covered interest parity does not. If we use the mean-variance theory of asset pricing and we assume that all investors involved are risk-averse, then we can say that ε_t is the sum of expected error and risk premium. In this case the risk premium can be expressed as the difference between the logarithm of the forward exchange rate, denoted as f_t, and the expected logarithm of the exchange rate, denoted with tS_{t+1}. Formally written this would be as follows (Cumby & Obstfeld, 1981, p. 698):

$$riskpremium = f_t + tS_{t+1} \tag{13}$$

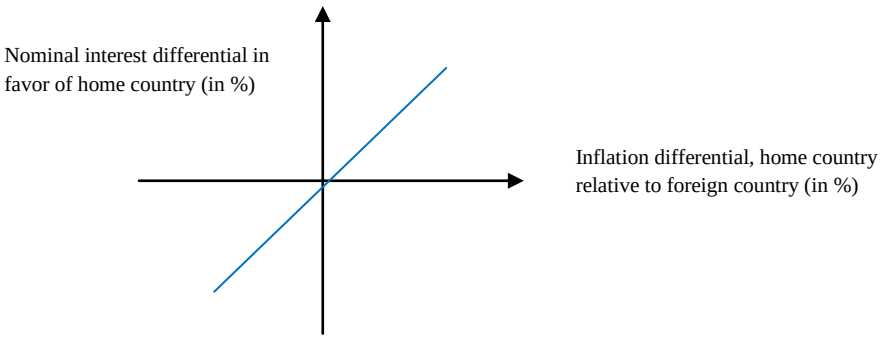
In such a constellation, the domestic and the foreign bond will not be perfect substitutes, as they would be if the market was perfectly efficient. This thesis confirms the existence of a risk premium that simply expresses a divergence between the interest rate differential and

the expected rate of depreciation over the holding period (Cumby & Obstfeld, 1981, p. 698).

The statement above explains that in such a setting the domestic and foreign bonds not being perfect substitutes is essential, because it differentiates the above described model from the random-walk model used to capture the exchange rate movements. The random-walk model was first introduced by Poole in 1967 and since then was frequently used by many researchers trying to analyze the exchange rate behaviour. The random-walk model assumes that new information arrives randomly and is independent from all other information received in the past (Poole, 1967, p. 468). This random and independent information is used by speculators to equalize the current price with the expected future spot price (Poole, 1967, p. 468). However, from the combination of the first and the second condition in the model described above and introduced by Cumby and Obstfeld (1981), we can clearly see that this statement Poole (1967) made about the nature of the new information is true only in the case where assets are perfect substitutes and interest rates are the same in all countries observed. Only in a situation with perfect asset substitutability, i.e. when interest rates do not differ across countries, are exchange rate changes unexpected. Oppositely, the model described here assumes that there is a correlation between the new information and the information set available in a past. I personally think that Fisher model is more applicable than the random-walk model, therefore I decided to focus on this model. Furthermore, the random-walk model fails to explain the market efficiency and the asset substitutability in a world where central banks follow independent inflation targets and therefore it fails to correctly determine the opportunity cost that an investor faces if he holds his wealth in the form of one currency rather than another currency (Cumby & Obstfeld, 1981, p. 699).

The Fisher effect is graphically presented in the following figure.

Figure 1: The Fisher Effect



Source: Shapiro (1998, p.165).

The horizontal axis presents the difference in the inflation rates between the domestic and the foreign country. The nominal interest rate differential between the two countries for the same period is presented on the vertical axis. The blue line is the parity line, which shows all points where the difference between the domestic interest rate and the foreign interest

rate is equal to the difference between the domestic inflation rate and the foreign inflation rate. Formally written this equation would be as follows: $r_d - r_f = i_d - i_f$, where r_d is the domestic interest rate, r_f is the foreign interest rate, i_d is the domestic inflation rate and i_f is the foreign inflation rate. The parity line in the figure above shows all possible equilibrium.

International Fisher Effect (IFE)

The International Fisher Effect differs from the Fisher Effect, because it combines two different theories, a general form of the Fisher Effect and a relative form of the Purchasing Power Parity. The general form of the Fisher Effect states that the real interest rates would be equal in all countries, after exploitation of all profit possibilities enabled with the existence of arbitrage opportunities. Following the assumption that real interest rates are equal in all countries that we analyze, we can presume that observed differences in their nominal interest rates may come as a consequence of the differences in their expected inflation rates. On the other hand, the relative form of the PPP theory states that the inflation differential is balanced by the changes in the exchange rate. Combining the general form of the Fisher Effect expressed through the nominal interest rates and the inflation rates:

$$\frac{1+r_{d,t}}{1+r_{f,t}} = \frac{[1+E(i_{d,t})]}{[1+E(i_{f,t})]} \tag{14}$$

where the notation remains the same as before, $r_{d,t}$stands for the nominal domestic interest rate at time t, $r_{f,t}$ represents the nominal foreign interest rate at time t, $E(i_{d,t})$ is the expected value of the domestic inflation rate at time t and $E(i_{f,t})$ is the expected value of the foreign inflation rate at time t,and the relative form of the Purchasing Power Parity expressed through the spot exchange rates and the inflation rates:

$$\frac{(S_{t+1}-S_t)}{S_t} = \frac{(i_{d,t}-i_{f,t})}{(1+i_{f,t})} \tag{15}$$

whereas before, S_{t+1} is the spot exchange rate at time $t+1$, S_t is the spot exchange rate at time t, $i_{d,t}$ and $i_{f,t}$ stand, respectively, for the domestic and foreign inflation rates at time t. We can formally express the International Fisher Effect through the following relation:

$$\frac{(S_{t+1}-S_t)}{S_t} = \frac{(r_{d,t}-r_{f,t})}{r_{f,t}} \tag{16}$$

From the formal expression of the International Fisher Effect we can conclude that the effect captures the difference between the changes in the spot exchange rates and the

changes in the nominal interest rates between two observed countries (Demirag & Goddard, 1994, p. 76).

From my perspective the International Fisher effect is important because it shows the relation between the nominal domestic and foreign interest rates and the spot exchange rate. Speculators are usually focused on the future spot exchange rate (S_{t+1}) when they make their predictions about future trading decisions. They speculate on this variable in order to profit from the changes in the nominal interest rates. So, if they expect that the nominal domestic interest rate will be smaller than the foreign one, they start to buy foreign assets in foreign currency and profit from the difference. Therefore, we can summarize that the nominal interest rate differential can be a good predictor of future changes in the spot exchange rate, but the empirical tests have shown that it cannot be seen as an absolutely definite predictor. It simply means that prediction errors tend to cancel over time (Shapiro, 1998, p. 172; Demirag & Goddard, 1994, p. 76).

Like with every theory, the central point in the International Fisher Effect remains as its empirical validity. We find many studies which tested exactly this problem and they came to very contradictory conclusions. For example, Giddy and Dufey (1975) tested the validity of the International Fisher Effect in the long-term. They concluded that there is a long-term tendency that the interest rate differential will eventually be neutralized by the changes in the spot rate. Aliber and Stickney (1975) came to the same conclusion that the International Fisher Effect seems to have empirical validity only in the long-term, because the average annual deviation, which was a measure for the long-term validity, tended to be zero. The maximum annual deviation was a measure for short-term validity. Other research studies elaborating on the topic have shown that the International Fisher Effect does not hold empirically, such is the case with the study of Robinson and Warburton (1980). In their work they have shown that higher interest returns can be earned, which is in direct confrontation with what the International Fisher Effect stands for. According to the Fisher Effect, the possibility to profit from the higher interest rate will be eliminated in a medium-run by the fact that the currency with higher interest rate will depreciate relatively to the currency with lower interest rate. This means that there is no possibility to earn superior profits in medium-run. Robinson and Warburton (1980) have shown exactly the opposite by testing the money movements in three-month US treasury bills and three-month Euro-deposits. Apart from these studies, we have research from Kane and Rosenthal (1982) that gave complete support to the International Fisher Effect, by testing the Eurocurrency market over a period of five years, from 1974 to 1979, for six major currencies.

1.1.6 Asset Market Model

If we are willing to determine the exchange rates as asset prices, we usually analyze their response to exogenous factors and the way that the new long-term equilibrium is reached due to a subsequent convergence. Still, this very general method of exchange rate determination has proven that it is unable to explain some basic principles of the exchange rate behaviour during the 1970s and during the early period of generalized floating. In the short-run, movements in the spot exchange rate are closely related to the movements in the forward exchange rate, which further indicates that changes in the spot rate are induced by the market's expectations of the future spot rate. On the other hand, empirical tests have proven that in the short-term, economic determinants like inflation rate differentials, differentials in rates of monetary expansion, and current account imbalances have no influence on the changes in exchange rates. These facts lead to a conclusion that exchange rates should be regarded as prices of durable assets in organized markets (Frenkel & Mussa, 1985, p. 726). In such organized markets current prices reflect the market's expectations concerning all relevant events that may affect the prices of these durable assets and price changes are highly unpredictable and reflect new information about the relevant events that may have an effect on the price changes. In this way, we explain the influence that asset markets and relative prices have on exchange rate determination.
Frenkel and Mussa (1985) have expressed the exchange rates as asset prices in the following general formal form:

$$e(t) = X(t) + aE\big[\big(e(t+1) - e(t)\big); t\big] \tag{17}$$

where $e(t)$ is the logarithm of equilibrium exchange rate at time t, $X(t)$ are the economic events that affect the exchange market at time t, the term $E[\big(e(t+1) - e(t)\big); t]$ represents the expected percentage rate of change of the exchange rate in time period between t and $t+1$, which is conditioned on the information available at time t, and a measures the sensitivity of the current exchange rate to its expected rate of change (Frenkel & Mussa, 1985, pp. 726–727).

This model will be closed with the underlying assumption that all future expectations are consistent with the application of equation number (17) in all future periods (Frenkel & Mussa, 1985, p. 727). The expected exchange rate at any $t+j$, for $j \geq 0$, which is conditioned by the information available at time t, can be expressed through the discounted sum of expected future events X relevant for the exchange market and starting at $t+j$ (Frenkel & Mussa, 1985, p. 727):

$$E(e(t+j); t) = \left(\frac{1}{(1+a)}\right) * \sum_{i=0}^{\infty} \left(\frac{a}{(1+a)}\right)^i * E[X(t+j+i); t] \tag{18}$$

This equation can be easily decomposed in two parts that affect the exchange rate, the expected change part denoted as $D^e(e(t))$ and the unexpected change part denoted as $D^u(e(t))$.

The expected change component can be formally expressed as follows (Frenkel & Mussa, 1985, p. 727):

$$D^e\big(e(t)\big) = E\big[D\big(e(t)\big); t\big] = E\big[\big(e(t+1) - e(t)\big); t\big] \quad (19)$$

or as

$$D^e\big(e(t)\big) = \left(\frac{1}{(1+a)}\right) * \sum_{i=0}^{\infty}\left(\frac{a}{(1+a)}\right)^i * E\big[D\big(X(t+i)\big); t\big] \quad (20)$$

In the equation number (20) the expected change in the exchange rate $D^e\big(e(t)\big)$ is expressed as a discounted sum of expected future changes in the relevant events, denoted as X (Frenkel & Mussa, 1985, p. 727).
The unexpected change component is formally written as follows (Frenkel & Mussa, 1985, p. 727):

$$D^u\big(e(t)\big) = e(t+1) - E(e(t+1); t) \quad (21)$$

or as

$$D^u\big(e(t)\big) = \left(\frac{1}{(1+a)}\right) * \sum_{i=0}^{\infty}\left(\frac{a}{(1+a)}\right)^i * [E(X(t+j+1); t+1) - E(X(t+j+1); t)] \quad (22)$$

In the equation number (22) the unexpected change in the exchange rate $D^u\big(e(t)\big)$ is expressed as a discounted sum of changes in the expectations about the relevant future events denoted as X, which are conditioned by the new information received in the time period between t and $t+1$ (Frenkel & Mussa, 1985, p. 727).

1.2 Economic Models for Predicting FOREX Prices

In academic literature we find plenty of so-called prediction models used to predict currencies' values. These models are especially used for FOREX predictions. In the time period between the 1970s to the 1990s the most commonly used models were statistical models and time series analysis (Pareshkumar, Narendra & Ashok, 2014, p. 55). After this period when computer science flourished, models based on artificial intelligence and data meaning analysis emerged. Nowadays, scientists are working on hybrid models, combining the best components of all previously known models and upgrading them with new ideas and techniques.

Below listed models are commonly used as prediction models (Pareshkumar, Narendra & Ashok, 2014, p. 55):

- Random Walk Model (RW Model),
- Purchasing Power Parity Model (PPP Model),
- Uncovered Interest Rate Parity Model (UIP Model),
- Sticky Price Monetary Model (SP Model),
- Econometric Model,
- Dornbusch-Frankel Monetary Model,
- Hybrid Model of Monetary Factors and Productivity Differentials (HBS Model),
- Taylor Rule Models,
- Artificial Neural Network Based Prediction Models,
- Feed Forward Neural Network (FFNN Model),
- Standard Back propagation (SBP),
- Scaled Conjugate Gradient (SCG),
- Back propagation with Bayesian Regularization (BPR).

1.3 Economic Data

Many factors affect a currencies' valuation, their movements, and their main characteristics. The most fundamental of these factors will be elaborated in the following section.

1.3.1 Inflation

One of the most important factors which affects the currency market is inflation. Inflation influences the currency value in such a way that the lower the inflation of a certain country compared to another country, the higher the export rates of the country will be. When the inflation rate of a country is low, the foreign goods become cheaper and the demand for the country's currency increases. With this stronger currency, consumers are able to purchase more goods thereby increasing overall consumption. Consequently, we can conclude that the low inflation rate of a country increases the value of the domestic currency. In this sense, the domestic currency appreciates (Pareshkumar, Narendra & Ashok, 2014, p. 53).

1.3.2 Interest rate

Another very important factor which influences the currency value is the interest rate.

If the interest rate of a country is high, investors will get higher returns from their savings (Pareshkumar, Narendra & Ashok, 2014, p. 53). Therefore, the number of savings will increase, while, at the same time, consumption decreases. Investors will be more willing to put their money in the bank and get high, riskless returns, than to invest somewhere else.

Therefore, in such an economical constellation, investments may suffer, which will negatively influence local businesses.

On the other hand, when the interest rate of a country is high, the demand for the country's currency will increase and investors will be willing to put their savings in the country's banks. For example, if the interest rate in the UK is higher, compared to the interest rates of other countries, the demand for the British pound will increase and the money inflow into the country will increase. However, this could harm the British businesses by reducing the number of undertaken investments.

Another important characteristic of the high interest rate is that it lowers the purchasing power of consumers because borrowers will have to pay higher interest rates (Pareshkumar, Narendra & Ashok, 2014, p. 53). In this sense, the high interest rates tend to cause lower consumption.

Overall, we can conclude that the high interest rate of a country appreciates the domestic currency value, especially the money inflow into the country, but can be harmful for the local businesses by reducing the actual investments.

1.3.3 Country's Debt

The debt rating of a country is one of the most important determinants of its exchange rate (Pareshkumar, Narendra & Ashok, 2014, p. 54). The above discussed inflation and the debt of a country tend to have a positive correlation. The higher a county's debt, the higher the inflation is. Consequently, a country with high inflation rates becomes unattractive, especially for foreign investors. Therefore, the country's high public debt negatively influences the currency’s value and leads to currency depreciation.

1.3.4 Unemployment Rate

The unemployment rate as another important fundamental macroeconomic factor influences not only the well-being and the economic prosperity of a country and its citizens, but to a large extent influences the value of the country's currency as well.
A low unemployment rate of a country increases the value of its currency. Overall, the unemployment rate of a country and its currency's value are negatively correlated, meaning the lower the unemployment rate, the higher the currency rate will be. However, we should consider the fact that an extremely low unemployment rate may induce higher inflation because it increases the purchase power parity (PPP) of the people and can lead to currency depreciation (Pareshkumar, Narendra & Ashok, 2014, p. 54).

1.3.5 Gross Domestic Product (GDP)

The GDP is defined as an overall sum of all finished goods and services that a country generates during a certain period, usually in one year (Forex Tutorial: Economic theories, models, feeds & data, n.d. e)

Based on the spending approach, which is also the most commonly used approach, the GDP of a country can be expressed through the overall spending in the economy. GDP is one of the best measures with which to express the well-being and the economic prosperity of a country. Countries with high GDP rates tend to attract foreign investors, because each investor would like to invest in a country which secures future returns. In conclusion, the high GDP of a country leads to better valuation of a country's currency by attracting more foreign investors and increasing the money inflow into the country.

1.3.6 Manufacturing Costs

A country which is able to reduce its costs of production will be able to offer its products at more attractive prices than other countries. By reducing the prices of its goods, domestic consumption increases. Simultaneously, the export rate increases as well. Followed by the increased export, the money inflow in the country increases and in the long-run the value of the currency increases too.

1.3.7 Current and Capital Account

The capital account of a country represents the net change in all types of assets (physical and financial) which are in ownership of a country. Countries with a surplus in their financial accounts are able to attract more foreign investments than countries with a deficit (Pareshkumar, Narendra & Ashok, 2014, p. 53). A deficit in the current account of a country leads to an increase in imports and a decrease in exports. Countries with a capital account deficit are often unable to attract foreign capital and to increase the value of their currencies.

1.3.8 Speculators

The role of speculators in the currency market is extremely important. Speculators are investors who simply try to buy low and sell high (Clearwater, 1996, p. 3). They are risk-takers who induce enormous changes in the currency prices. Their position towards exchange risk is extremely high compared to the positions of other market participants. Their aim is to earn profits from the expected change in the exchange rates (Aliber, 1973, p. 1451). If the expected change in the exchange rates is high, their exposure to the

exchange risk is high as well. However, the higher their exposure is to the exchange risk, the higher is the expected profit from the transaction.

A speculator's decision to either buy or sell is mainly based on the information he holds. In this context, a usually discussed polemic is either they hold some superior information on which they base their trading decisions or not. Still, their role is very important because they tend to stabilize the market price and increase market efficiency (Clearwater, 1996, p. 3). Speculators trade according to the information they hold. If they, for example, believe that the price for the British pound will increase in the future, they will start to buy it now, when the price is still low in order to sell it in the future when the price has increased. By buying when the price is low and selling when the price increases, they will earn a profit. Informed speculators earn at the expense of uninformed traders. This situation can be described as the zero-sum-game, when one market participant can gain only at the expense of another market participant.

The trading signals that the speculators give to the market by buying or selling assets are crucial for the trading decisions of other market participants. Other less informed market participants believe that the speculators hold superior information and according to that information they make their trading decisions. So, if the speculators start to buy a certain asset, they are giving positive signals to other traders and these traders will automatically start to buy the asset as well or vice versa. However, it is not excluded that sometimes speculators tend to manipulate the price by giving misleading signals to other market participants in order to earn higher profits. Nevertheless, in equilibrium we believe that the speculators do not have an incentive to trade against the information they hold, namely to sell on good news and to buy on bad news (Foucalt, Pagano & Roeell, 2013, p. 356).
A speculator's trading concept is different from the trading concept of an arbitrager. Arbitragers simply shift funds between national money markets to profit from the difference between the exchange agio and the interest agio (see page 8, equation number (7)). Their aim is to avoid exchange risk by finding the perfect currency mix of their assets and liabilities (Aliber, 1973, p. 1451). According to Aliber (1973) *"arbitragers supply the forward contracts that speculators demand"* (Aliber, 1973, p. 1451).

Although the domestic price of the foreign exchange is higher in forward contracts than it is in spot contracts, speculators prefer the former over the latter, because of the greater leverage they can get with the forward contracts. This is because there is no explicit margin requirement on forward contracts. This explanation is tightly related to situations when we have market imperfection in the supply of foreign exchange to the speculators. The speculators demand forward contracts, while at the same time they borrow domestic currency from other investors. So, the investors who are supplying the forward contracts to the speculators are lending them domestic currency as well. Speculators are purchasing forward contracts, thereby borrowing domestic currency, buying foreign currency in the spot market and lending foreign exchange receipts. An important question here seems to

be: why are investors offering less strict terms on forward contracts that they do on spot contracts? As Aliber (1973) suggests, maybe the answer lies exactly in the market imperfection (Aliber, 1973, p. 1452).

1.3.9 Political Stability and Economic Prosperity

The political stability, together with good economic performance, of a country is a crucial factor for attracting foreign investors and increasing the money inflow into the country. When an investor decides in which country to invest, political stability is surely one of the first factors he considers. Countries with strong and stable governments are able to make strong decisions and complete projects. By fulfilling different projects, they enhance the economic performance, thereby uplifting the economic prosperity of the country. Countries with good economic performance attract foreign capital.

Countries with weak coalitions and unstable governments are unable to make strong decisions. Consequently, foreign investors lose confidence in the ability of such countries to produce economic well-being. The lack of confidence causes money to move out from the country and this affects the economic growth and the prosperity of the country.

1.3.10 Relative Strength of Other Currencies

Countries with strong economies tend to have strong currencies when compared to other, economically weaker countries. When comparing the economic performance of different countries, the money often gravitates towards economically stronger countries.

1.3.11 Macroeconomic and Geopolitical Events

Changes of a country’s monetary policy, wars, and elections deeply affect the country currency value (Pareshkumar, Narendra & Ashok, 2014, p. 54). This is because such events induce fundamental changes in a country, thereby increasing the uncertainty of the outcome. If, for example, a country changes its monetary policy, it takes a certain amount of time to show if the policy change was successful or not. In the meantime, the uncertainty is high and investors usually avoid investing during a highly uncertain period. The lack of investments will negatively affect the currency's value, thereby depreciating it.

2 BASIC ELLIOTT WAVE CONCEPT

It often seems that markets are man-made, impacted by evolution in human emotions and reasons that follow natural order. Sad to say, we have seen that humans tend to presume structure when perhaps it is not present, although nature includes human beings among its

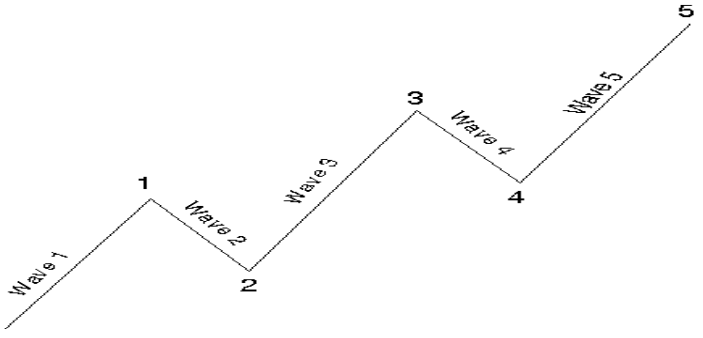
species and human beings like structure. Human behaviour in structures is believed to be cyclical following patterns. There are many observed cycles in market prices. Some of them can be explained or rationalized and others cannot. Some, like the "presidential cycle" of four years, are thought to be synthetic; others are products of nature; and most are unexplained. There are very long-term cycles like the Kondratieff and Kuznets cycles, and very short-term ones, lasting only a few minutes (Kirkpatrick & Dahlquist, 2016, pp. 509–510; Pring, 2014, p. 19). As alternative approach for understanding market cycles the Elliott Wave Theory tries to explain irregular market cycles, that can be predictable in a way that user knows where price is heading next. The Elliott Wave Theory defines waves as patterns of directional movement. More specifically, waves could be defined as observed patterns that naturally occur (Frost & Prechter, 2011, p. 21). In this chapter, I will describe, in detail, different types of waves as they were defined in 1938 by Ralph Nelson Elliott.

2.1 The Five-Wave Pattern

In this chapter I will focus on explaining market progression based on the Elliott Wave Theory.

Every analyst using EWT should be aware that the market progresses in five waves, as we can see from figure below (see figure number 2). We label these waves as 1, 2, 3, 4, 5, where waves 1, 3, 5 are known to be directional moves, meaning they unfold in direction of a trend and waves 2 and 4 move counter to the main trend. At this point it is important to highlight that wave 2 never moves beyond the start of wave 1, wave 3 is never the shortest and wave 4 never goes into the territory of wave 1 (Prechter & Frost, 1998, p. 21).

Figure 2: Basic five-wave pattern



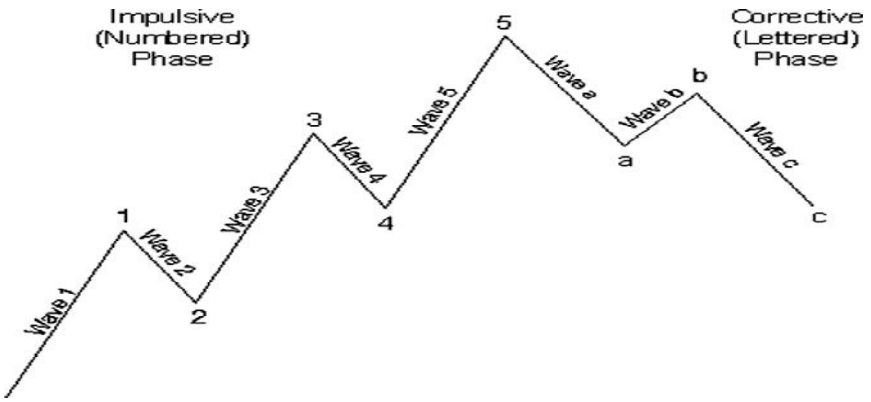
Source: Prechter & Frost (1998, p. 22).

The principles of the five-wave pattern are crucial to be understood by every trader, who is willing to base his trading decisions upon this theory. Each wave has its own structure and specific characteristics that help the trader to identify the wave correctly and to trade accordingly. Knowing well the whole concept and each separate fragment of it, would help the trader to (Gorman & Kennedy, 2013, p. 4):

- Identify the trend.
- Identify countertrend price movements within the trend. This would be much easier to do, when the trend is larger.
- Determinate in which stage of maturity is the trend.
- Determinate price targets.
- Determinate when to invalidate the trading order.

The EWT explains two wave modes, each with its own specifics. The first wave mode is described with motive waves that are five-wave structures, also known as impulses. They develop in the direction of the main trend marked with numbers 1, 3, 5. But it is worth noting that all waves from 1 to 5 make one impulse of a higher degree. The second wave mode is corrective, labelled by using letters with 2 and 4 and in detail with a, b, c or other deviations of this correction. As it is presented in figure number 3, these waves move in the opposite direction of the main trend with the exception of wave b. To better understand this concept, it is graphically presented below in figure number 3. Due to these characteristics and wave shape, they diverge from motive waves. The cycle is completed when we see eight waves, meaning we can count wave 1, 2, 3, 4, 5 and corrective waves a, b, c (Prechter & Frost, 1998, pp. 22−23). We can see this pattern in figure number 3.

Figure 3: Basic Elliott wave pattern



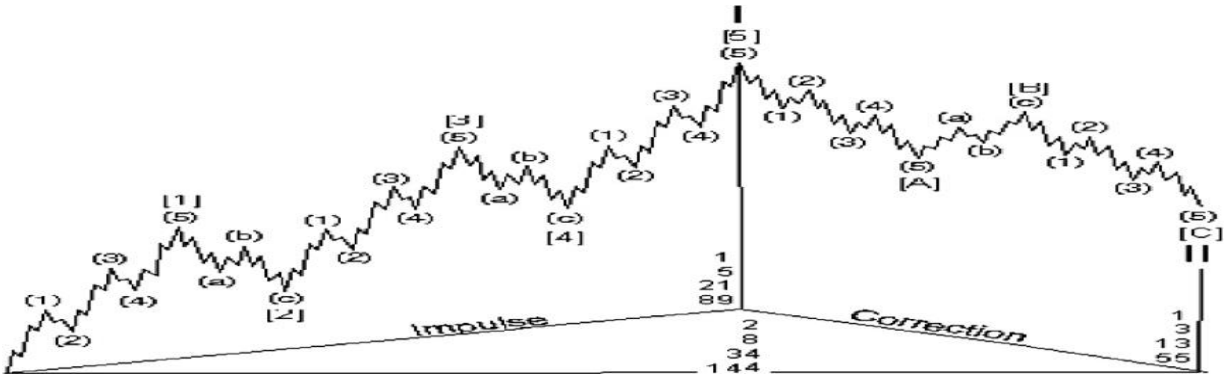
Source: Prechter & Frost (1998, p. 23).

By identifying the trend, and trend waves ether impulsive or corrective, the trader would be able to predict the price movement within the trend and to adjust its trading decision accordingly. If a movement in price appears due to a correction within a larger trend, than the trader would know how to position its trading decisions properly. Corrective waves are important for the trader, because they give him the opportunity to position itself in the direction of the larger trend that is developing but it is at the moment in corrective period (Gorman & Kennedy, 2013, p. 5).

When the entire cycle is completed, a similar cycle develops and continues in a five-wave movement, ending once again with the a, b, c corrections. This development produces a

five-wave pattern that is larger in relative size than the waves of which it is composed. For clarification, we look at figure number 4, which illustrates each same direction component of a motive wave (1, 3 and 5) and each full cycle component (1 + 2, or 3 + 4) of a complete cycle that is a smaller version of itself. It is very important to understand the following point; namely that figure number 4 not only illustrates a larger version of figure number 3, but it also illustrates figure number 3 in much greater detail. The detailed picture of the five-wave pattern also helps the trader to identify much more easily the maturity of the trend (Gorman & Kennedy, 2013, p. 5). For example, if a trader knows the decomposed picture of the five-wave pattern, he will know that if wave 5 completed only 3 of its 5 sub-waves, he should be preparing himself for trend forming a top and reversal that follows completed 5 sub-waves. If we take a closer look at figure number 4 we can see that each sub-wave 1, 3, 5 is a motive wave that must subdivide in to 5 sub-waves and each sub-wave 2 and 4 is a corrective wave that must be sub dived in to three. At this point it is also important to observe that the illustrated wave [2] in figure number 4, waves (a) and (c), which point downward, are each composed of five waves: 1, 2, 3, 4, 5. Similarly, wave (b), which points upwards is composed of three waves: A, B and C. This construction discloses the crucial point that motive waves do not always point upwards and corrective waves do not always point downwards. The mode of the wave is not determined by its absolute direction, but by its relative direction. Aside from five specific exceptions, which will be discussed later on, waves divide into motive mode (five waves) when trending in the same direction as the wave of one larger degree of which it is a part of and in corrective mode (three waves or a variation) when trending in the opposite direction. Waves (a) and (c) are motive trending in the same direction as wave [2]. Wave (b) is corrective because it corrects wave (a) and is the countertrend to wave [2]. In summary, the essential underlying tendency of the Wave Principle is that action in the same direction as the larger trend develops in five waves, while reaction against the larger trend develops in three waves, at all degrees of the trend. The phenomena of form, degree, and relative direction are carried one step further in figure number 4. As is the case with figures number 2 and 4, this larger cycle automatically becomes two subdivisions of the wave of the next higher degree. As long as progress continues, the process of building greater degrees continues. The reverse process of subdividing into lesser degrees continues indefinitely, as far as we can determine. Furthermore, all waves have component waves of a lesser degree and are also part of the higher degree of component waves (Prechter & Frost, 1998, pp. 23–25).

Figure 4: Elliott wave super-cycle



Source: Prechter & Frost (1998, p. 25).

2.2 Wave Characteristics

In this section I will discuss the fundamental principles of each type of wave as outlined in the Elliott Wave Theory. Specifically, I will explain the main characteristics and rules of motive and corrective waves, which is fundamental for better understanding my further analyses. When describing the waves in the subsection 2.2, I will stick to the notation as presented in figure 4.

Characteristics and rules for each type of wave:

- Wave [1]

  Knowing the detailed structure of the five-wave pattern, as presented in figure 4, the trader should not be mislead by the fact that motive waves (including wave 1) don't always point upwards. Therefore, we can conclude that the mode of the waves is determined by their relative and not by their absolute directions (Prechter, p. 11). Wave [1] consists of five sub-waves ((1), (2), (3), (4) and (5)), which not all of them are pointing upwards (see figure 4). Only waves (1), (3) and (5) are pointing in the same direction as wave [1] These three waves are called motive waves, because they are pointing in the same direction as the larger trend does, namely the trend of wave [1]. Waves (2) and (4) are corrective waves, because they are pointing in the opposite direction of the trend of wave [1].
  It is a hard task even for experienced EWT users to spot the beginning of a new trend, or the beginning of wave [1]. This is due to fact that when wave [1] starts, news regarding a specific market asset or general economic condition are perceived to be universally bad. Investors believe that the previous trend is still strongly in place. Market sentiment is at bearish extremes even when compared with historical data. Put options are more favoured by investors and implied volatility is often quite high since investors seek insurance for their investments. We can also observe a slight pickup in volume, but not enough to alert investors. Investors are usually lured in by deception

and the after-effect is a belief that this wave is basically just a correction in a bear market and that the negative trend will continue shortly. The same logic can be inversely applied in a bull market (Poser, 2003, p. 14).

When trying to identify the beginning of wave [1], it is suitable to look at major resistance and support levels, since major price reversals happen at monthly or weekly support and resistance levels. At this level, prices often move in the opposite direction of the news.

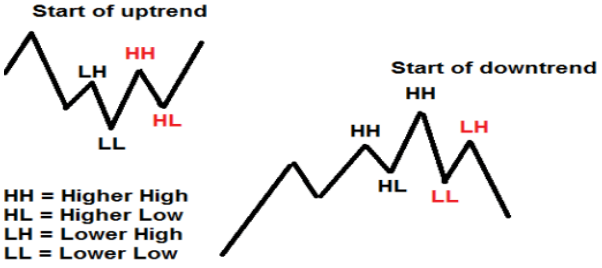
- Wave [2]

Wave [2], as presented in the figure 4, is corrective wave, because is trending in the opposite direction as the large trend I. It consists of three sub-waves, namely (a), (b) and (c) and only sub-wave (b) is pointing in the same direction as the wave [2]. Wave [2] corrects wave [1] and it is a countertrend of wave I.

At first glance, wave [2] can be perceived as a bear trend continuation, especially at the beginning of its formation. If the previous rules are a bit uncertain for the first wave, users of Elliott Wave Theory should always know that wave [2] can never go below the starting point of wave [1]. The second important rule that defines wave [2] is that the drop in wave [2] should always be in three waves, counted as [A], [B], and [C]. Wave [A] would develop in five waves, but the retracement of wave [1] should be rather small when wave [A] reaches its end. The volume in wave [2] should also be lower than it was in wave [1]. Overall wave [2] usually retraces 38 to 62 percent of wave [1], but never more than 100 percent. Literature suggests that if wave [2] retraces more than 62 percent of wave [1], we should be careful and have a second look at our wave counts (Poser, 2003, p. 15; Prechter, p. 14).

The left part of figure number 5 below shows how an EWT user can alternatively identify the beginning of a new bull trend or the ending of wave [2]. More specifically, we first have to identify the absolute low (LL) and from the absolute low we need to trace the price to a new higher high (HH). We receive confirmation that wave [2] is developed when the price reaches its higher low (HL). The same logic can be applied inversely when we are in a bear market as presented in the right side of the figure below.

Figure 5: Trend identification rules



Source: Lee (2016).

- Wave [3]

  Wave [3] is a motive wave, consisting of five sub-waves, namely (1), (2), (3), (4) and (5). Sub-waves (1), (3) and (5) are moving upwards, in the same direction as wave [3], while sub-waves (2) and (4) are moving downwards, in the opposite direction. Wave [3] moves in the same direction as the trend of larger degree.
  According to EWT users, the third wave has the most desirable features, such as the rapid increase of prices and pull backs that are short lived and shallow. Therefore, we can say that the third wave is the wave about which each EWT user dreams of. The third wave can never be the shortest wave, the volume is extremely high, and the wave is usually at least 1.618 times larger than wave [1]. Wave [3] should always develop in five clear waves and momentum almost always conforms to the price high (Poser, 2003, p. 15). If we consider the price, wave [3] is usually the longest, but never the shortest among all three motive waves, namely wave [1], [3], and [5] (Prechter, p. 14).

- Wave [4]

  Wave [4], the same as wave [2], is a corrective wave, consisting of three sub-waves (a), (b) and (c). It was the same structure as wave [2].

  Wave [4] usually retraces 38 percent of wave [3], but from time to time it happens that it retraces less than 38 percent. Fourth waves are almost always clearly corrective. The volume is usually much lower than in wave [3] and the price dips are shallow. Volatility will not rise during fourth waves, even though prices are falling. By volatility, I mean implied volatility from options pricing formulas. Implied volatility tends to rise, especially in the equity market when prices fall. An additional characteristic of wave [4] is that it tends to take a long time to complete but should not take longer than the previous impulse waves. Fourth waves are also known for their complicated sub-wave counting and pessimistic analyst opinions, which say that prices have already gone too far. Usually, investors close long positions when wave [4] is developing and try to catch another impulse when wave [4] is completed (Poser, 2003, pp. 15–16).

- Wave [5]

  Wave [5] is, again is a motive wave, consisting of five sub-waves (1), (2), (3), (4) and (5). It was the same structure as the other motives waves of the larger trend I, namely wave [1] and [3].

  The fifth waves are the final impulse moves and often end with momentum divergence. Momentum divergence means that the price is making a new higher high, but with shorter upswings. This type of price movement shows that the trend is becoming weaker and the price is making a final up run. Using the moving average convergence

divergence (MACD) indicator can be helpful for users when they want to spot price divergences in a traded instrument. Another factor is that the volume in wave [5] is relatively smaller than it was in wave [3]. However, the volume in wave [5] can be higher or the same as it was in wave [4]. Since wave [5] is still an impulsive wave, EWT users must not forget that it still needs to have a five-wave structure. The data regarding the news is usually very positive and suggests that the good times can never end (Poser, 2003, p. 16).

- Wave [A]

  Corrections are often more difficult to count than impulse waves. When wave [A] is developing, the general public is usually convinced that it is simply a minor correction of the previous trend and that prices will continue to move higher. Consequently, they are preparing to open new long positions, even though this will bring damaging consequences to their portfolio. Wave [A] sets the path for a deeper correction, meaning that wave [A] is just the first lower leg with one more leg lower yet to come (Poser, 2003, p. 16). It is also worth noting that if wave [A] is constructed of three waves, then we can expect a flat or triangle ABC correction. On the other hand, if it is constructed of five waves then we can forecast a zigzag correction (Kirkpatrick & Dahlquist, 2011, p. 485). The different types of corrections will be described in the following section.

- Wave [B]

  These waves are hardest to track and always develop in either three waves or a triangle. In flat corrections they should nearly always retrace the whole wave [A] or at least 62 percent of it. If they retrace more than 100 percent of wave [A], then we have an irregular flat correction. When wave [A] has five legs, the [B] wave retracement is usually less than 62 percent. Volume in wave [B] is usually very low (Poser, 2003, p. 17).

- Wave [C]

  Wave [C] is often very impulsive and made up of five waves. If they are part of a zigzag correction, they usually exceed wave [A] in its development time and size. Volume may be higher than it was in wave [A]. By experience, wave [C] exceeds wave [A] by 1.618 extensions. If wave [C] completes a flat correction, then its length is similar to the length of wave [A] (Poser, 2003, p. 16).

Overall, we can summarize that all motive waves consists of five sub-waves and always move in the same direction as the larger trend. They are straightforward and easy to differentiate. The main goal of the motive waves is to make a progress (Prechter, p. 14). As illustrated in figure 4, waves [1], [3] and [5] are motives waves within an upward trend

I and waves [A] and [C] are also motives waves, but within a downward trend II. Waves [2] and [3] are correctional waves within the upward trend I and wave [B] is also a correctional wave within the downward trend II.

The motive waves are further subdivided into impulses and diagonal triangles, which will be discussed in the upcoming sections.

2.3 Impulsive Waves Rules, Extensions and Truncations

Each impulse wave is composed of five sub-waves. Impulse waves determine both the trend's direction and trend's strength. Next, I will describe the basic rules for impulsive waves and their extensions.

2.3.1 Basic Rules

Any kind of violation of the EWT rules means a disagreement with the EWT and, as a result, an incorrect forecast will be given. Although there are not many rules, it is important to remember that they are strict and they cannot be violated or modified in any way.

The following six rules define impulse waves (Kirkpatrick & Dahlquist, 2011, pp. 480–481):

- Impulse waves move in the same direction as the trend of the next higher degree wave.
- Impulse waves are made up of five sub-waves.
- Within an impulse wave, sub-waves 1, 3, and 5 are themselves impulse waves of a lower degree, and sub-waves 2 and 4 are corrective waves of a lower degree.
- Within an impulse wave, sub-wave 1 and 5 might be either shaped as an impulse or as a diagonal pattern.
- Within an impulse wave, sub-wave 3 is always an impulse pattern.
- In money markets, within an impulse pattern, sub-wave 4 never overlaps any portion of sub-wave 1. This is not always true for futures markets.

Overall, we can summarize that the most common motive waves are impulses. Each impulse has its own structure, consisting of extension, truncation, alternation, equality, channelling, personality and ratio relations. All these characteristics of the impulses are what is known as guidelines of an impulse (Prechter, pp. 14–15).

Impulse waves determine a trend's direction and its strength. Each impulsive wave is made up of five sub-waves, with three of them moving in the direction of the trend and two of them moving in the opposite direction of the main trend. In a market where prices are

rising, waves 3 and 5 are the strongest, whereas in a declining market, wave 3 is the strongest and waves 1 and 5 are equal in their magnitude (Kirkpatrick & Dahlquist, 2011, p. 481).

The Elliott Wave Theory describes the character of each sub-wave in more detail. The details of these sub-waves are as follows (Kirkpatrick & Dahlquist, 2011, p. 481):

- Wave 1 can either be an impulse or a leading diagonal.
- Wave 2 can be any corrective pattern except a triangle.
- Wave 2 does not retrace more than 100 per cent of wave 1.
- Wave 3 is always an impulse.
- Wave 3 exceeds wave 2 in its length.
- Wave 3 cannot be shorter than wave 1 and 5.
- Wave 4 can take the shape of any corrective pattern.
- Waves 2 and 4 do not overlap in price.
- Wave 5 takes the shape of an impulse or an ending diagonal.
- Wave 5 retraces at least 70 percent of wave 4.
- In wave 5, patterns such as diagonals, extensions, or truncations indicate that a major reversal is coming soon.

2.3.2 Extensions

The majority of the impulse waves contain something which is called extensions. Frost and Prechter (1998) define extension as "*an elongated impulse with exaggerated subdivisions*" (Frost & Prechter, 1998, p. 32).

Extensions are present in more than half of the all impulse sub-waves. Remember, impulse sub-waves are titled waves 1, 3, 5. They are also named "actionary waves". It is also possible that extensions happen in both sub-waves 3 and 5. From time to time, the subdivisions of extended waves have almost the same amplitude and duration as the other four waves of larger impulse, giving a total count of nine waves of similar size rather than the normal count of five for the sequence. Ina nine-wave sequence, it is occasionally difficult to say which wave extended. However, it is usually irrelevant, since under the EWT, a count of nine and a count of five have the same technical significance (Frost & Prechter, 1998, p. 33).

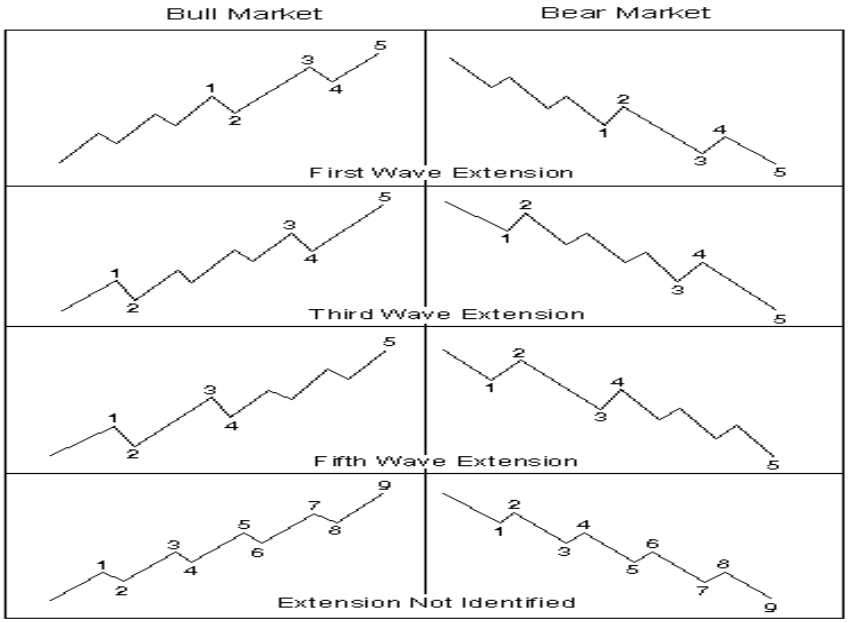
Statistically, in 90 percent of cases, extensions happen in wave 3. If this is the case, then wave 3 needs to extend past wave 1 by a factor of 1.618 up to 2.618 or even more. If we do not have an extension in wave 3, then an extension will most likely appear in wave 5. Alternatively, it could have already appeared in wave 1.

Useful rules to follow when trying to identify extensions (EWF Vlada, 2015):

- If we have an extension in wave 5, wave 3 needs to be longer than wave 1. If this is not the case, then the Elliott Wave count does not hold.
- If we have an extended wave 1, then wave 5 must be shorter than wave 3. If this is not the case, then the Elliott Wave count does not hold.
- If we have an extended wave 3, then wave 5 can take two lengths. It can have the same length as wave 1 or it can be extended for the sum of wave 1 and 3 by a factor of 1.618.
- Impulse waves that have at least one extended wave should contain a minimum of 9 swings and they could increase to 13 or 17 swings if there are more extensions within the waves.

In the figure below, different types of extensions are presented graphically. As we can see, the figure shows extensions in a bear market and a bull market for waves 1, 3, 5. In addition we can also observe the case where extension is not indentified.

Figure 6: Different types of extensions



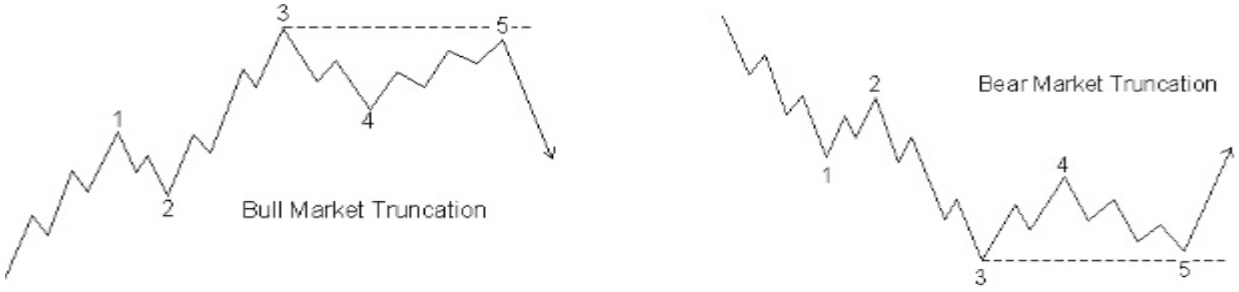
Source: Frost & Prechter (1998, p. 33).

2.3.3 Truncation

Truncation is a term used to simply describe failure, in which the fifth wave fails to make a new higher high or in other word fails to move beyond the top of wave 3 (Frost & Precher, 1998, p. 35). This is what Elliott originally called "failure", but other authors working on the topic, decided themselves for a less connotative form, "truncation" or "truncated fifth" (Prechter, p. 17). In this text, I also decided for the term "truncation".

The truncation is visually presented in the figure below. The figure illustrates that we can distinguish between bull and bear market truncations. As the right picture in figure number 7 shows, the bull market truncation is the inverse picture of the bear market truncation as shown on the left side of the same figure.

Figure 7: Bull and bear market failed fifth wave or fifth wave truncations



Source: Frost & Prechter (1998, p. 35).

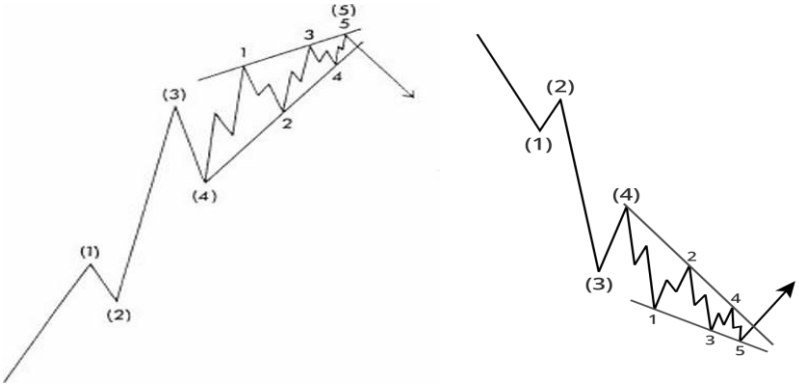
3 ELLIOTT WAVE PATTERNS

The EWT describes different types of price chart patterns such as ending diagonal, leading diagonal, expanding diagonals, zigzag corrections, flat corrections, triangle corrections and other complex forms of corrections that are composed of simple corrections.

3.1 Ending and Leading Diagonals

Ending diagonals, also known as wedges, are mainly associated with fifth waves, particularly when the main move was quick and went far in a short amount of time. Ending diagonals are characterized as impulse waves because they are constructed of five waves in the direction of the trend. Unlike other impulse waves, individual legs in ending diagonals develop in three waves and not in five, as is the case with other impulse waves, regardless of whether they are moving with or against the trend. Due to this characteristic, counting individual legs of ending diagonals are not as easy as we would like. Ending diagonals forecast sharp reversals, but before the reversal happens, first the lower support line needs to be broken in a bull market and the upper support line in a bear market. If the lower support line is not broken, then a higher price continuation can be expected in a bull market. If, on the contrary, the upper resistance line in a bear market is not broken, then lower prices can be expected. The support line in a bull market connects the dots marked as (4), 2, 4 and in a bear market the resistance line connects the dots marked as (4), 2, 4, as we can see in figure number 8. The ending diagonal should be remembered as a warning that a trend is becoming unsustainable and it is time to close any open positions. This statement is also confirmed by the legs in the ending diagonal that are getting shorter and shorter. With every new higher degree, we also get divergence displayed by indicators (Frost & Prechter, 1998, p. 37).

Figure 8: Ending diagonal bull market (the picture on the left) and ending diagonal bear market (the picture on the right)



Source: Frost & Prechter (1998, p. 37).

The trader's decision when to enter the market and where to put the protective stops for ending diagonals should be taken similarly as for impulses (Gorman & Kennedy, 2013, p. 9). However, the trading decision depends on the risk willingness of each individual trader.

If, for example, in a bull market the trader notice three-wave decline, knowing the three-wave structure (ABC), he should assume that this decline is probably the first wave (wave (a)) (see figure 4). In a bear market, the trader should expect that the three wave advance will be followed by resumption of a trend in a opposite direction as the wave (Murphy, 1999, p. 323).

According to Frost and Prechter (1998), leading and ending diagonals were not originally discover by R.N. Elliott himself, though their frequent appearance over a long period of time convinced the authors in their existence and validity (Frost & Precher, 1998, p. 35).
Ending and leading diagonals can occasionally appear in wave A as a zigzag correction (further description of a zigzag will be given in the next chapter) and as wave 1 as an impulse. They can have sub-waves of 3-3-3-3-3 or 5-3-5-3-5 (Frost & Precher, 1998, p. 37).

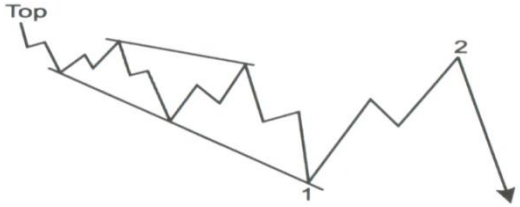
The numbers 3-3-3-3-3 mean that we have five waves in a leading diagonal and each of them is constructed of three sub-waves. The same can be applied to the sequence 5-3-5-3-5.However, only the first, third and fifth waves are made up of five sub-waves instead of three.

3.2 Expanding Diagonals

Expanding diagonals are essentially mirror images of the leading and ending diagonal patterns which were discovered by Frost and Prechter in 1998. The difference between expanding diagonals and leading/ending diagonals, as described above, lies in their shape. More specifically, the starting point in the expanding diagonal, marked in figure 9 as Top,

is the narrowest at the beginning and it progressively widens as the pattern unfolds (Goodburn, 2018).

Figure 9: Expanding diagonal



Source: Frost & Prechter (1998, p. 40).

Other characteristics of diagonals are (Frost & Prechter, 1998, pp. 87–88):

- It is possible that wave C takes the shape of an ending diagonal in a flat or a zigzag correction.
- The first, second, third, fourth and fifth waves in ending diagonals always subdivide into zigzags.
- The second wave of a diagonal never moves beyond the start of the first wave.
- The third wave of a diagonal always moves beyond the end of the first wave.
- The fourth wave never moves beyond the end of the second wave.
- In a leading diagonal, the fifth wave always ends beyond the end of the third wave.
- In a contracting diagonal, the third wave is always shorter than the first wave, the fourth wave is always shorter than the second wave and the fifth wave is always shorter than the third wave.
- In an expanding diagonal, the third wave is always longer than the first wave, the fourth wave is always longer than the second wave and the fifth wave is always longer than the third wave.
- In a contracting diagonal, the fifth wave always ends beyond the end of the third wave.
- The first, third, and fifth waves of a leading diagonal often subdivide into zigzags, but sometimes they appear as an impulse.
- If impulse wave 1 takes the shape of a diagonal, then it is highly possible that impulse wave 3 will be extended. Also, when impulse wave 3 is not extended, it is likely that impulse wave 5 will not be a diagonal.
- In a contracting diagonal, wave 5 often ends slightly beyond the end of wave 3. If it does not, then we have a truncation. If it ends beyond the line that connects the ends of the first and third wave, then we have a throw-over.
- In an expanding diagonal, wave 5 often ends marginally before reaching a line that connects the ends of the first and the third wave.

3.3 Types of Correction Patterns

In general, we classify corrections into two groups. The first group are sharp corrections where the price moves at a steep angle against the main trend. The second group of corrections are sideway corrections where the price moves in sideway motion, lacking a clear direction. It is characteristic of sideways corrections that they retrace the preceding waves or even create a movement that goes back to or even beyond its starting point.

Corrections are classified into the following four main groups:

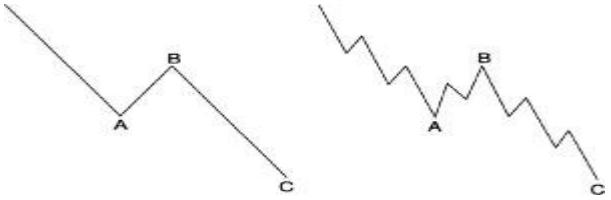
- zigzag (5-3-5),
- flat (3-3-5),
- triangle (3-3-3-3-3) and
- combinations of the above three groups develop into double and triple three.

The zigzag group of corrections consists of single, double, and triple zigzags. The flat group consists of regular, expanded, and running flats. The triangle group is built upon contracting, barrier, expanding, and running triangles.

3.3.1 Zigzag Corrections

A single zigzag in a bull market is a simple ABC correction composed of five sub-waves for wave A, three sub-waves for wave B and another five sub-waves for wave C, shortly written with the sequence (5-3-5). The same can be applied for a bear market, with one difference; the correction is inverted but constructed with the same principles.

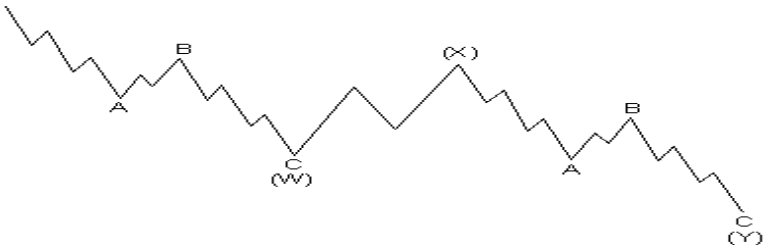
Figure 10: Single zigzag in a bull market



Source: Own work.

Very seldom zigzags can arise twice or even three times in a row, particularly when the first zigzag does not achieve its target. When we have two or three zigzags in a row then each zigzag is separated by the middle three as seen in figure 11, from (W) to (X).

Figure 11: Double zigzag separated by middle three



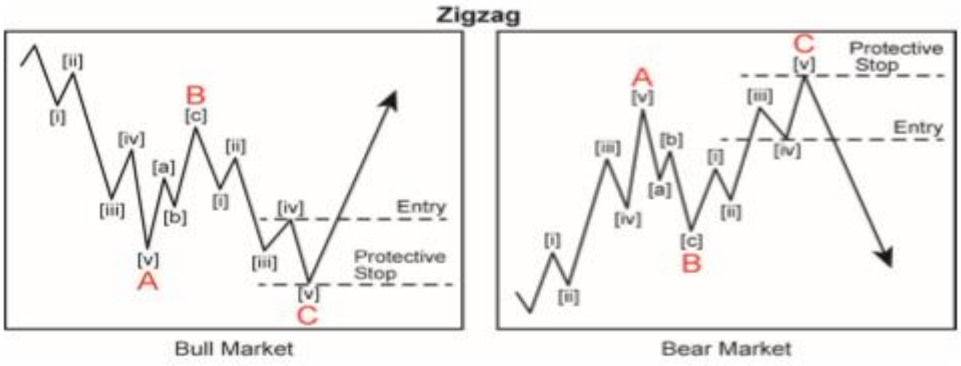
Source: Own work.

More characteristics of zigzags include (Kirkpatrick & Dahlquist, 2011, p. 484):

- Wave A can be an impulse wave, a leading diagonal or a zigzag.
- Wave C can be an impulse wave, a zigzag or an ending diagonal.
- Wave B can be a zigzag, a triangle, a flat or a combination of both.
- Wave (X) in a double zigzag can be any corrective pattern, except an expanding triangle.
- Wave (X) and (Y) are always zigzags.
- Wave (X) is smaller than wave (W).
- Wave (Y) can be same size or longer than wave (X).

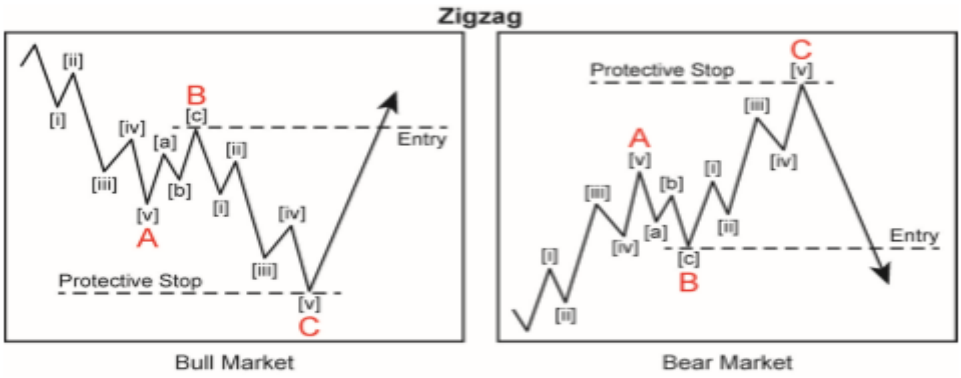
For any trader which is willing to make a profit is essential to know when to enter the market during a zigzag correction and where to set its protective stops. There are two possible scenarios for entering the market and setting protective stops and they are presented in figures 12 and 13. According to the first scenario, in both cases, namely in a bull market and in a bear market, the trader should wait for the extreme of wave [iv] of wave C to enter the trade, as presented in the figure 12. As it is noticeable from the same figure, in both markets, the entry-level is beyond the termination of wave A. In both markets, the protective stops are set at the extreme of wave [v] of wave C. The second scenario to enter the market is presented in figure 13 and it suggests that the trader should wait for wave B to end, before entering the market. The same rule is applicable in both bull and bear markets. The protective stops in both markets are set at the extreme of wave [v] of wave C.

Figure 12: Scenario 1: Entering points during a zigzag correction in a bull (left picture) and in a bear market (right picture)



Source: Gorman & Kennedy (2013, p. 12).

Figure 13: Scenario 2: Entering points during a zigzag correction in a bull (left picture) and in a bear market (right picture)



Source: Gorman & Kennedy (2013, p. 12).

3.3.2 Flat corrections

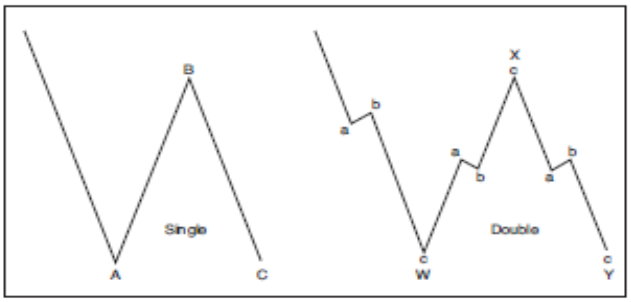
The main difference between flat and zigzag corrections is the sub-wave formation. Zigzags have a 5-3-5 sub-wave formation, whereas flats have 3-3-5 sub-wave formation. The second difference is in the wave movement. In a flat correction, waves do not move sharply up or down as in zigzags, but rather in a sideways motion with frequently overlapping sub-waves. The third important difference lies in the termination of wave C. In a flat correction, wave C ends just slightly below wave A. On the other hand, in a zigzag, wave C terminates significantly below wave A. Lastly, wave B in a flat correction retraces at least 50 percent of wave A and is much shorter than wave A (Kirkpatrick & Dahlquist, 2011, p. 485).

The retracement of previous impulsive waves in a flat correction is much shallower than it is in a zigzag correction. One reason for this is the fact that flat corrections usually happen during a very strong trend, often in wave 4 and rarely in wave 2.

Flat corrections can also occur in double and triple shapes. For double and triple flat corrections, the same classification is used for triple and double zigzags. Common characteristics of double and triple shape flats include (Kirkpatrick & Dahlquist, 2011, p. 485):

- Waves W, X, and XX can be any corrective pattern except a triangle, a double, or a triple.
- Waves Y and Z can be any corrective pattern except a double or a triple.
- Wave X retraces at least 50% of wave W.
- Wave Y is greater than wave X unless it is a triangle.
- Wave XX retraces at least 50% of wave Y.
- Wave Z is not a zigzag if wave Y is a zigzag.
- Wave Z is greater than wave XX.

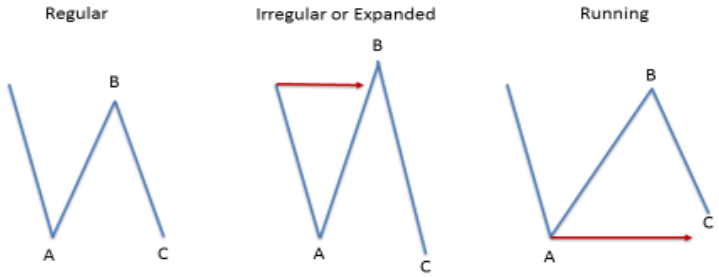
Figure 14: Single and double flat corrections



Source: Kirkpatrick & Dahlquist (2011, p. 485).

Expanded flats happen only when wave B ends well above the beginning of wave A and wave C ends substantially beyond the end of wave A (Frost & Precher, 1998, p. 45).
On rare occasions we can also find a running flat pattern. Running flats are similar to expanding flats, with the exception of wave C ending before the starting point of wave A (Frost & Prechter, 1998, p. 46).

Figure 15: Regular, expanding and running flat corrections

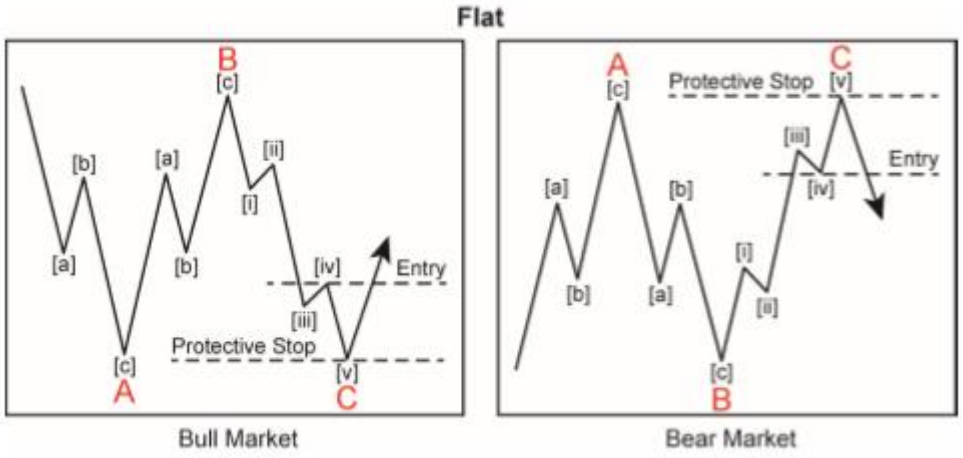


Source: Wagner (2017).

The strategy when to enter the market and where to set the protective stops during a flat correction in a bull and in a bear market is presented in figure 16. In both markets, the

trader should wait for the extreme of wave [iv] of C before entering the trade. The protective stops in both cases should be set at the extreme of wave [v] of C.

Figure 16: Entering points during a flat correction in a bull (left picture) and in a bear market (right picture)



Source: Gorman & Kennedy (2013, p. 13).

3.3.3 Triangle Corrections

A triangle correction is a sideways movement often associated with decreasing volatility and volume. Triangles are made of five waves, each of them made up of three sub-waves with a total count of 3-3-3-3-3 with overlapping waves A-B-C-D-E.

The principles to follow when identifying a triangle are (Kirkpatrick & Dahlquist, 2011, p. 486):

- Wave A can take two shapes: it can be flat or a zigzag.
- Wave B can only be a zigzag.
- Waves C and D can be any corrective pattern except a triangle.
- Waves A, B, C, and D move within the bounds of the channel lines between A to C and B to D.
- Wave E can take shape of a zigzag or a converging triangle.
- Either wave A or B is the longest wave.
- Wave E ends in the territory of wave A.
- Wave E moves within or closes within the bounds.

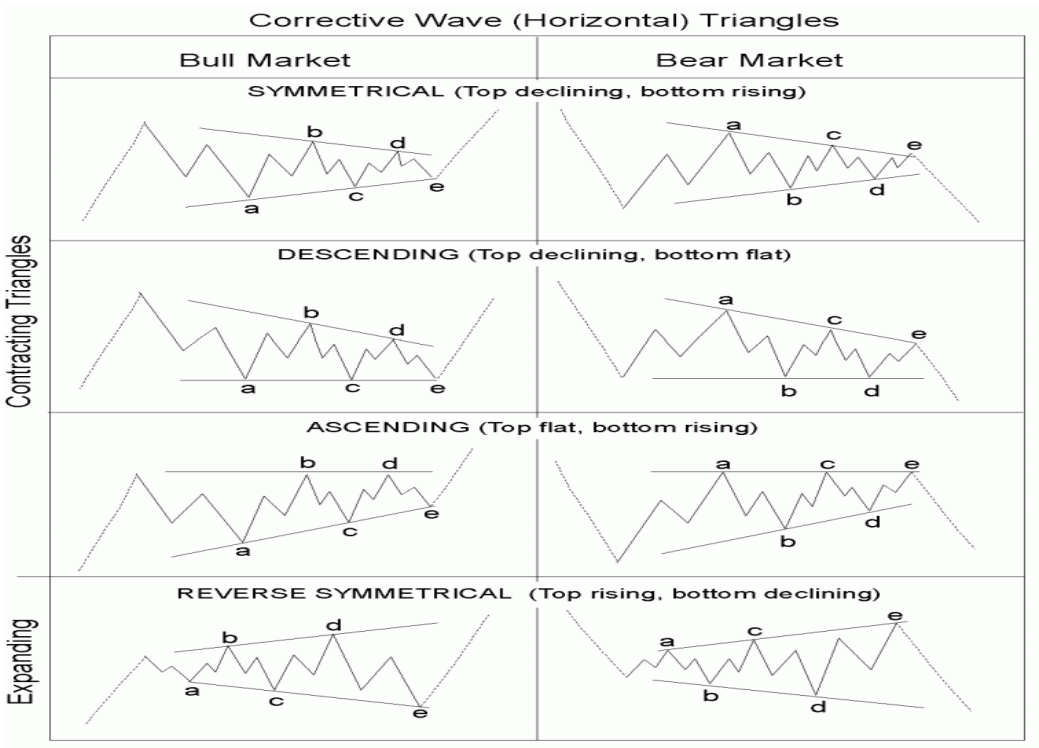
Expanding triangles, although relatively rare, have generally the same rules. The exceptions that distinguish a regular triangle from an expanding triangle are (Kirkpatrick & Dahlquist, 2011, p. 486):

- Wave B is smaller than wave C, but more than 40% of wave C.

- Wave C is smaller than wave D, but more than 40% of wave D.
- The intersection of the bounds occurs before the formation of the triangle.
- Wave E is longer than wave D.
- Wave E ends outside the territory of wave A.
- Either wave A or B is the shortest wave.

Figure number 17 displays different types of contracting and expanding triangles that are formed in a bull or bear market. In a symmetrical contracting triangle, the price moves between two converging trend lines, where the bottom trend line slopes up and the upper trend line slopes down. In a descending contracting triangle, only the upper trend line slopes down, while the lower trend line runs straight. An ascending contracting triangle is the reverse image of a descending triangle. Last, but not least, in a reverse expanding triangle, the upper and lower trend lines move apart from each other, with the price moving between them.

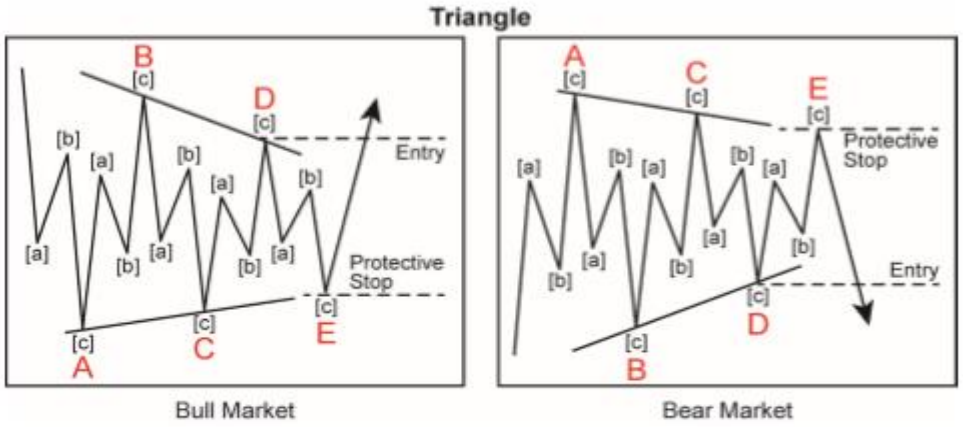
Figure 17: Different types of triangles



Source: Frost & Prechter (1998, p. 50).

Entry and protective points during a triangle correction are presented in figure 18. For both markets, bull and bear, the entry points are set at the end of wave D, precisely at the extreme of wave [c] of D. The protective points in both cases are set at the point where wave E ends, precisely at the extreme of wave [c] of E.

Figure 18: Entering points during a triangle correction in a bull (left picture) and in a bear market (right picture)



Source: Gorman & Kennedy (2013, p. 13).

3.3.4 Complex Corrections

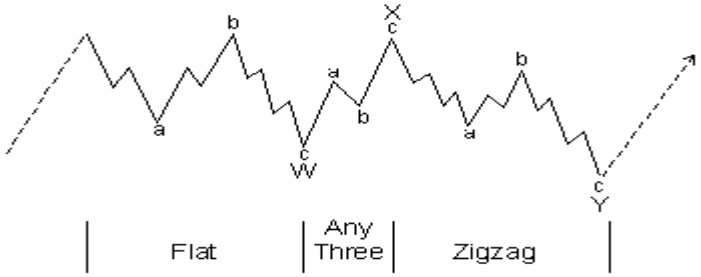
Complex corrections are composed of combinations of simpler types of corrections, such as triangles, flats and zigzags. When two simple corrections are combined, we get double three corrections and when three simple corrections are combined, we get triple three corrections (Complex corrections, 2018). In the next section I will clearly explain each of them.

The main characteristics of double three corrections are (Complex corrections, 2018; Frost & Prechter, 1998, p. 52):

- A combination of two corrective structures labelled as WXY.
- The wave W and wave Y subdivision can be a flat, zigzag, double three of a smaller degree, or triple three of a smaller degree.
- Wave X can take the shape of any corrective pattern, but is most commonly a zigzag.
- WXY has seven swings.

Figure number 19 displays a double three correction that is composed of a flat correction with waves a, b, c; any three correction that can be zigzag or flat correction; and a zigzag correction.

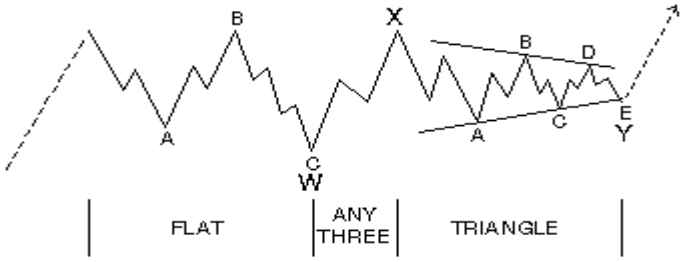
Figure 19: Correction with a flat and a zigzag



Source: EME Processing & Consulting LLC (n.d.).

A double three correction can also be composed of a flat correction, an any three correction meaning, a flat , zigzag or triangle correction, and triangle correction, as shown in figure number 20.

Figure 20: Correction with a flat and a triangle



Source: EME Processing & Consulting LLC (n.d.).

Corrections can be even more complex than the double three corrections mentioned above. These types of complex corrections are referred to as triple three corrections.

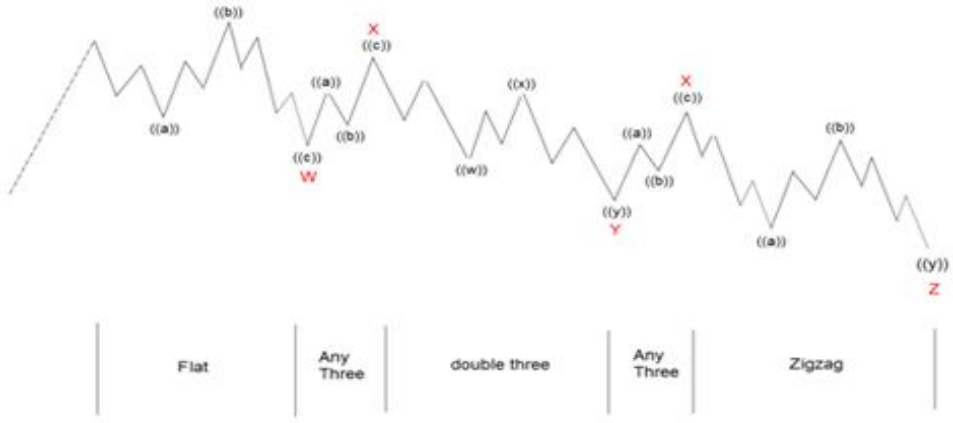
The main characteristics of triple three corrections are (Complex corrections, 2018; Frost & Prechter, 1998, p. 52):

- A combination of three corrective structures labelled WXYXZ.
- Wave W can be a zigzag, a flat, a double three of a smaller degree, or a triple three of a smaller degree.
- Wave Y can be a zigzag correction, a flat correction, a double three correction of a smaller degree, or a triple three correction of a smaller degree.
- Wave Z can be a zigzag correction, a flat correction, a double three correction of a smaller degree, or a triple three correction of a smaller degree.
- Wave X can take the shape of any three-wave correction.
- WXYZ has eleven swings.

As we can see from figure number 21, triple three corrections can be composed of three intersections, a flat correction, a double three correction and a zigzag correction. Wave W stands for a flat correction, while from point W to X there can be any three correction,

wave Y is a double three correction, while from point Y to X we can have any three correction and lastly, wave Z is a zigzag correction.

Figure 21: Correction with a flat, double three, and a zigzag



Source: EME Processing & Consulting LLC (n.d.).

3.4 Alternation

The concept of alternation can simply be described as a tendency that in a five-wave sequence the first and second correction will alternate between each other in a way that the first correction will be a sharp correction and the second correction will be a sideways correction. It is also possible that the first correction is sideways and the second is a sharp correction (Frost & Precher, 1998, p. 64).

In a five-way sequence, the first correction is in wave 2 and the second correction is in wave 4.

The guidelines for identifying alternation in an impulse wave (Frost & Prechter, 1998, p. 63):

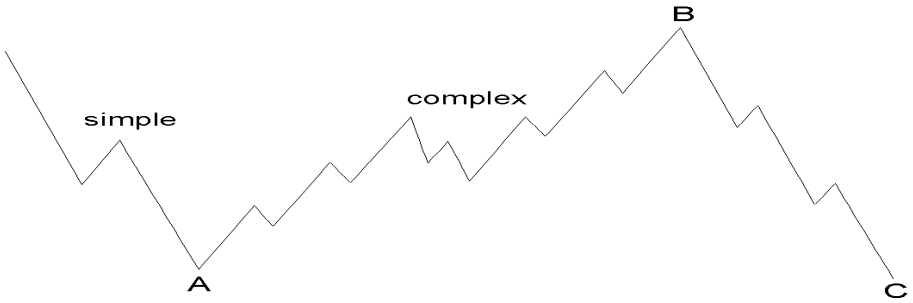
- Sharp corrections never include a new price extreme. They are mostly single, double or triple zigzags, sometimes even double threes that start with a zigzag.
- Sideways corrections sometime include a new price extreme. They can be triangles, flats, double and triple corrections.
- If wave 2 is sharp correction, then wave 4 will be a sideways correction and vice versa.

Alternation Within Corrective Waves

When correction starts with a flat ABC correction in wave A, we can expect a zigzag in wave B and vice versa.

Most of the time, when a large correction starts with a simple ABC zigzag in wave A, wave B will stretch out into a more complex subdivided ABC zigzag to achieve a type of alternation as presented in figure number 22. Wave C can sometimes be even more complex than waves A and B. Reverse order of complexity is not common (Frost & Prechter, 1998, p. 65).

Figure 22: Simple zigzag correction in wave A, developed into a more complex B wave correction

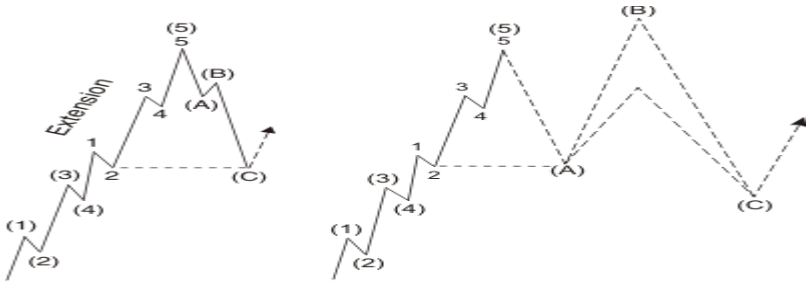


Source: Frost & Prechter (1998, p. 66).

3.5 Price Movement Following an Extended Fifth Wave

When the fifth wave is extended, the upcoming correction will be sharp and it will find its support at the low point of wave 2 in the extension. Frequently, corrections end at the low point of wave 2 in the extension, but from time to time, only wave A ends at this point.
We can observe on the left side of figure number 23 how correction ended at wave 2 of the extension in wave 5. The right side of figure number 23 illustrates the case when only wave A of the correction ended at the beginning of wave 2 of the extension.

Figure 23: Correction following the fifth wave extension



Source: Frost & Prechter (1998, p. 69).

3.6 Channelling

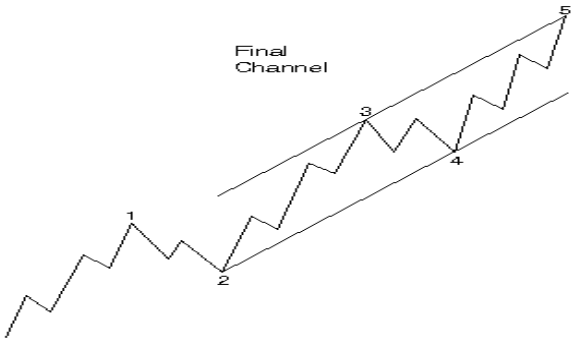
Channelling is a technique made up of two horizontal lines. The lines are applied on the lower and upper boundaries of an impulse wave. When both lines fit the upper swing high and lower swing low as tightly as possible, then we can conclude that the trend channel is drawn. Channelling is especially useful when we want to project the end of waves within

an impulse wave. First, we need at least three reference points to apply all of the rules described below (Kirkpatrick & Dahlquist, 2016, p. 519):

- Forecasting the end of wave 3 with channelling: We can forecast the end of wave 3 by drawing two horizontal lines; one from the top of wave 1 and another from the bottom of wave 2. Although this might look simple, EWT users should be well aware that wave 3 is usually very strong, long and steep. For this reason, wave 3 can easily end outside of the projected channel boundaries. It is recommended to have at least 3 reference points when we start drawing a channel. The first reference point is the top of wave 1, second is the bottom of wave 2 and the third is the top of wave 3.
- Forecasting the end of wave 4 with channelling: Forecasting wave 4 is much easier to do since we have all 3 reference points. We draw a trend line by connecting the top of wave 1 and the top of wave 3. Then we draw another parallel line from the bottom of wave 2.
- Forecasting the end of wave 5 with channelling: We draw a trend line from the bottom of wave 2 and connect it with the bottom of wave 4. Then we continue by drawing a parallel line from the end of wave 3.

The discussed trend channel can be observed in figure number 24.

Figure 24: Example of the trend channel



Source: Frost & Prechter (1998, p. 72).

EWT users should be considerate of the situation when the upper channel line is crossed. This happens when the volume in wave 5 is extremely high and the upper trend line is breached, but it is quickly confirmed that the price cannot move out of a trend channel by the price falling back into the channel. It is also possible for wave 3 to cross the upper trend line. In both cases, this price movement is called a throw-over. It is also possible that we see a penetration of the lower trend line, in this case, called a throw-under. A throw-under can be produced by wave 4 or wave 2 price movements. Often a throw-under is followed by a throw-over in the next wave. Both can happen simultaneously in a bear or bull market (Frost & Prechter, 1998, p. 73).

3.7 Volume

Observation of the volume can be very useful for verifying wave counts and predicting wave extensions. It is common that volume in the bull market expands and contracts with the speed of the price movement. During price corrections, a decline in volume often indicates declining selling interest and when the lowest possible volume is reached, which is usually an indication that the price is at the turning point, meaning buyers are coming into the market (Frost & Prechter, 1998, p. 76).

When comparing volume with waves, it is worth mentioning that volume tends to be smaller in wave 5 than it was in wave 3. If the volume is the same or even higher than it was in wave 3, then an extension of wave 5 is in progress. Volume also tends to spike during a period of throw-over in the trend line, as described in the upper subsection 3.6 (Frost & Prechter, 1998, p. 76).

4 APPLICATION OF ELLIOTT WAVE THEORY ON CURRENCY PAIR EUR/USD

In this section, I will focus on an analytical discussion of the theory that I theoretically explained in the previous chapter. My analysis was performed in time period from 04. 06. 2010 to 15. 02. 2018. In this chosen time period I have chosen 30 monthly time intervals with purpose of conducting my analyses on monthly basis (see appendices 3, 4, 5 and 6). In addition to my monthly observations and analyses, I have decided to conduct additional analyses based on longer time frame, where I gathered data for four-month time period. Chosen time period for four-month time period where I have chosen 10 time intervals was from 04. 06. 2010 to 11. 08. 2017 (see appendix 2).

For the purpose of answering my research question, if EWT can be used to explain a currency exchange rate movement in the same way as expectations based on fundamental data, I will conduct a primary analysis on the most liquid currency pair, EUR/USD. Economic data published by both economies is generally pre-classified into four main groups. Depending on the impact that the data has on the exchange price, these four groups are labelled as follows: high impact economic data, medium impact economic data, low impact economic data, and no impact economic data. By simultaneously observing exchange prices of EUR/USD and the economic data, I have come to conclusion that most of the impact on the currency exchange rate is generated by high impact economic data and medium impact economic data. Based on this conclusion, I have chosen to compare the EWT with medium and high impact economic data and see how the EWT correlates with economic data. I began my analysis by labelling waves on the EUR/USD price chart in the same way that the EWT suggests. I used the price chart available on the webpage Tradingview.com. This webpage provides current and historical price charts for different

currency pairs, commodities, stocks, futures, etc. It also provides different analytical and drawing tools that allow users to label waves on the chosen price chart. After labelling the waves appropriately, I continued my research by choosing 30 random points on the price chart. Each labelled point on the price chart represents the start of a one-month time period which I chose to observe and analyze. For the chosen one-month period, I gathered high impact and medium impact economic data. I separately organized the gathered data in an excel file for each time period. Additionally, I organized the economic data for each economy by data importance (see appendix 11). After organizing the data, I began to look for the economic factors that met or surpassed market expectations or consensus. The economy with a better ratio of economic data, that met or surpassed market consensus, determined the price movement based on the evaluated economic data. The logic behind this is that when the actual data meets or even surpasses the consensus, the expectations of investors are met or even positively surpassed. This suggests that investors are willing to buy the currency that has a higher percent of met expectations, since this also shows which economy is performing better. The higher is the percent of surpassed or met economic data, the broader the economic recovery or expansion.

According to the EWT, price direction can either go up or down during the observed time period. From an EWT standpoint, price direction is determined by observing a past EUR/USD price chart, from which I looked for past completed waves. These price movements are presented in an excel table alongside the evaluated economic data for the observed time frame. This allows for a clear comparison of the price direction between the economic factors and the EWT.

It is important to highlight here that the price is quoted in EUR/USD and not USD/EUR, meaning if the EUR has a higher percentage of met or surpassed economic data than USD, the exchange price should go up. If USD has a better percentage of met or surpassed economic data, the price of EUR/USD should go down.

The direction of the price movement that was determined by the economic data was finally compared to wave prediction based on the EWT to see if the economic data is correlated with the EWT. Therefore, I calculated the correlation coefficient between the price direction determined by met or surpassed economic data and the price direction determined by the EWT. To illustrate this, I have made an excel table where, in the first column, I gathered the price direction determined by the percentage of met or surpassed economic data exceptions and in the second column I assigned the price direction based on the EWT. If the price direction based on percentage of met or surpassed economic expectations was up, then I assigned in a third, separate column the number "1" and if the price direction based on met or surpassed economic expectations was down, I assigned the number "2" in the same column. Remember, the price direction of up was assigned if EUR had a higher percentage of met or surpassed economic expectations when compared to USD. In the fourth column, I have assigned a price direction based on the EWT theory. If

the price based on EWT was increasing, I once again assigned the number "1" or if it was decreasing, I assigned the number "2". Then I calculated the correlation with the excel function CORR.

4.1 Data Description

I found the economic data needed for the primary analysis conducted in this thesis on the webpage fxstreet.com. This webpage provides current and historical data that is pre-arranged into groups by the impact that the data has on market exchange prices. As I mentioned previously, I have downloaded economic data that is arranged into high impact and medium impact groups. The process of downloading economic data was repeated for each chosen time interval and separately for each currency, EUR and USD.

4.1.1 Gathered and Analyzed Economic Data for USD

In appendix 7 I summarized the economic data for USD that I considered in my analysis. The data is arranged into two main groups by the impact that this data has on the currency exchange price when it is published. The gathered data for the chosen time interval was later compared with expectations that the market had before the actual data figures were realized.
I will not explain each of these economic factors in detail, because the aim of my work is to compare them with market expectations, thereby seeing if they met or surpassed them. For my work, it is irrelevant how they influence each other. If you are interested in further reading on this topic, you can find definitions of these factors on the webpage fxstreet.com or any other webpage specialized in the Forex market.

4.1.2 Gathered and Analyzed Economic Data for EUR

In appendix 8 I summarized the economic data for EUR that I considered in my analysis. The same as for USD, the data is arranged into two main groups by the impact that this data has on the currency exchange price when it is published. Gathered data for the chosen time interval was later compared with expectations that the market had before actual data figures were realized.

For the same reason as explained in the previous section, I will not discuss how these factors are defined and what they mean.

As we can see in the table, some indicators are published for the European Monetary Union (EMU), and some even for specific countries, such as Germany, France, Spain, Italy, Austria, and Greece. This is due to the economic impact that those countries have on

the European economic performance. Some important abbreviations to note for clarity are; s.a. which stands for seasonally adjusted, w.d.a which stands for working day adjusted, and n.s.a. which stands for not seasonally adjusted.

4.1.3 Descriptions of High and Medium Impact Economical Data and Its Importance

As mentioned before, market participants have certain expectations about the performance of a specific economy. For this reason, it is worth analyzing high and medium impact data compared with market expectations. The higher the ratio of met or surpassed market expectations about medium and high impact economic data, the more broad-based economic recovery and growth should be. But what really determines economic growth and recovery is not a simple answer. Below, I have described the economic factors that impact economic growth or GDP and how economic factors impact each other. My purpose is to explain that, eventually, with economic growth we should witness a rise in inflation and interest rates. The higher the percentage of met or surpassed expectations about economic data, the faster the GDP and inflation rates should rise. The final result is rate hikes, which I will try to explain via exchange rate behaviour based on different economic models.

Gross domestic product: The formula that explains GDP is composed of gross domestic investments government consumption expenditures and gross investments, personal consumption expenditures, and net exports. With the rising of the GDP, comes the rising of inflation rates and interest rate hikes. Rising existing home sales, employment rate, new home sales, durable goods orders, retail sales, housing starts, personal income, personal spending, average weekly hours, import prices, and positive trade balance all positively impact GDP growth.

Interest Rate Decision: The purpose of hiking or lowering interest rates is to regulate the amount of money that circulates in an economy. Higher interest rates mean that the money supply is getting lower and money is becoming scarcer. This is due to the fact that borrowing money from banks becomes more expensive, resulting in a lower demand for bank money to make investments and for spending. For this reason, hiking interest rates is an instrument for keeping inflation under control while maintaining low unemployment. It is common that with rising GDP, comes a lower unemployment rate and rising inflation. The FED current long-term inflation target is 2 percent and long-term unemployment rate is between 4.1 and 4.7 percent. The ECB has the same inflation target of 2 percent and no target for long-term unemployment. With long-term unemployment under control and rising inflation, rate hikes will follow. Although, hiking interest rates too fast can drive unemployment up and cause the GDP to fall. Based on the flexible price monetary model, the currency with higher interest rates should appreciate against the currency with lower interest rates. Based on the International Fisher Effect, we can assume that if investors

expect that the nominal domestic interest rate will be smaller than the foreign one, they will start buying foreign assets in the foreign currency and profit from the difference. Based on the interest rate parity, money will flow from the currency with a lower interest rate to the currency with a higher interest rate, which will raise demand (price) for the currency with higher interest rate. The covered interest rate parity model asserts that the difference between interest rates is nullified by the forward premiums erasing arbitrage opportunities, since forward premiums already discount future interest rate differences. Based on the Fisher effect, an uptick in inflation needs the same uptick in interest rate. Consequently, real interest rate and inflation need to be at least the same level, with the purpose of retaining purchasing power. Judging by the Fisher hypothesis, investors should look and try to predict future inflation trends.

Building Permits: It is expected that more building permits are granted during times of economic growth because people and businesses are more optimistic about the future. Building permits also tend to increase during times of rising employment because consumers feel more monetarily secure. Rising employment rates also impact wage growth positively, meaning consumers have more money to spend. Rising numbers of building permits issued can be offset by higher interest rates and, consequently, more expensive bank loans. The above-mentioned factors should in general stimulate demand for building permits. Finally, if an increase in building permits issued also results in new housing and buildings, this should impact GDP growth positively.

Consumer Price Index: This index measures change in the price level for a selected basket of goods and services purchased by households. These goods are aggregated in to several groups: food and beverages, housing (rental costs), apparel, transportation, medical care, recreation, education and communication, and other goods and services. A rising consumer price index pressures central banks into rate hikes and it is, together with the unemployment rate, the main proxy for future rate hikes (Consumer price index, n.d. c).

Consumer Price Index Ex Food & Energy: The same definition can be applied as for The Consumer Price Index, except that in the Consumer Price Index Ex Food &Energy, we have excluded change in the price level of food and energy. This is due to the high price volatility that these two components tend to have.

Existing Home Sales: This measures the sale of existing family homes. Existing home sales are good proxy to see when a country has moved out of a recession, since home sales peak at the end of a recession. The higher the level of existing home sales, the more positive the effect should be on the GDP (Existing home sales, 2018f).

New Home Sales: A measurement of the sale of new homes. It is a good indicator of economic conditions slowing down when new home sales go into a negative trend. A higher demand for new homes impacts GDP growth positively (New home sales, 2018d).

Initial Jobless Claims: A measurement of the number of people that have filed for unemployment benefits, where if more people file for unemployment benefits, less people are employed. In better economic conditions, less people file for unemployment benefits. Consequently, the more people that are employed, the higher the consumption, growth, and inflation will be. It is also worth noting that higher employment levels should put pressure on wages to rise, since the labour force starts experiencing scarcity. This, in the end, only boosts inflation even more, creating pressure for further rate hikes (Initial jobless claims, 2017).

Durable Goods Orders: Defined as infrequent orders of items made by companies that last for 3 years or more. The higher the number of durable goods orders, the more optimistic companies are about future economic growth. Positive trends in durable goods orders are an early sign of future GDP growth. The inverse can be applied when durable goods orders start to trend negatively (Durable goods orders, n.d. b).

Consumer Confidence: This survey measures how confident consumers are in current economic growth and their personal financial situation. A positive trend in consumer confidence is the leading indicator for good economic conditions. The more confident consumers are, the more willing they are to spend money, which in the end supports economic expansion (Consumer confidence, n.d. d; Consumer confidence, 2018b).

ISM Manufacturing PMI: Indicates business conditions in the manufacturing sector and is an important indicator of economic conditions. This survey measures if activities in organizations such as production, employment, inventories, order backlogs, new export orders, imports, consumer inventories, and supplier deliveries are stagnant, increasing or decreasing. ISM manufacturing PMI is one of the first indicators that can show economic turnarounds (ISM manufacturing index, n.d. f).

ADP Employment Change: A measurement showing change in number of employed people. The more people that are employed, the higher the consumption, retail sales, growth, and inflation will be. The more people that are employed, the more scare is the labour force and this pressures wages to go up. Higher wages plus the factors mentioned before boosts personal spending, inflation, and supports economic expansion (ADP employment change, 2017).

Nonfarm Payrolls: A measurement of the number of jobs created in the non-agricultural sectors. A higher employment rate in these sectors puts pressure on wages to increase since the labour force supply becomes scarce. With the higher wages and factors mentioned previously, personal spending and inflation increase and economic expansion is supported (Nonfarm payrolls, n.d. g).

Unemployment Rate: The percentage of the civilian labour force that is not employed. A low unemployment rate should put pressure on wages to increase, since the labour force becomes scarce. I did not mention this before, but it can also be the case that wages do not raise with low unemployment, as it is currently seen in the U. S. economy. Although this is seen as a mystery, it is probably due to structural unemployment, where more jobs were created in the high-tech sector.

Retail Sales: A measurement of consumer demand for finished goods, which has big impact on GDP. Retail sales also includes the sales of food, beverages and clothing. Consequently, retail sales have impact on the consumer price index (Retail sales, n.d. h).

Capacity Utilization: This measures to what extent a nation uses its production capacity. If there is unused capacity, competition between competitors prevents price rises. Often, when capacity utilization reaches between 82 and 85 percent, price inflation rises due to competitive constraints (Capacity utilization n.d. a).

High capacity utilization can also be an early warning sign of the economy overheating and price bubbles. It can also be understood that if a nation has large amounts of unused production capacity, it still has potential for economic growth and that demand is weak. Policymakers see low capacity utilization as an indication that an economy needs a monetary or fiscal stimulus. During high capacity utilization time periods, policymakers can raise interest rates, begin fiscal austerity or let the cycle run its own course (Capacity utilization and policy makers, n.d. a).

Industrial Production: Measures of production in the industrial sector. During economic expansion, industrial production rises since there is higher demand for manufacturing goods, utilities and mining. These sectors are very sensitive to consumer demand and interest rates. Industrial product on is an important tool for forecasting future GDP growth because demand first starts in these sectors, and then follows its way down the line. High levels of industrial production can lead to higher inflation (Industrial production, n.d. a).

NAHB Housing Market Index: A rating of the relative level of current and future single-family home sales. Because this index also measures homebuyers' intentions, it can provide some insight into new housing starts (NAHB housing market description, n.d.).

Housing Starts: Measures the number of newly constructed single-family homes. Rising housing starts can be an indicator of rising prosperity or a lack of existing homes. Housing starts have a wide impact on the economic banking sector and the real estate sector. They also impact sectors that produce raw materials, furniture, appliances, and sectors that provide construction work. In the end, housing starts impact employment and GDP growth (Housing starts, 2018b).

Market Manufacturing PMI: Shows business conditions in the manufacturing sector and is an important indicator of economic conditions. This survey measures if activities in organizations such as production, employment, inventories, order backlogs, new export orders, imports, consumer inventories, and supplier deliveries are stagnant, increasing or decreasing. ISM manufacturing PMI is one of the first indicators of economic turnarounds (ISM manufacturing index, n.d. f).

Personal Income: Measures the change in personal income that comes from wages, investments, and ventures. Positive changes in personal income mean that more people have more money to spend. This boosts personal consumption, GDP, and inflation (Personal income, 2018c).

Personal Spending: Measures individuals' expenses, such as mortgages, car payments, shopping, and medical treatments. Personal spending tends to rise during economic expansion and decline during recession. Rising personal spending levels have a positive effect on economic growth and leads to higher inflation (Personal spending, n.d.).

Factory Orders: A measure of the number of new orders, unfilled orders, shipments, and inventories in the manufacturing sector. During economic expansion factory orders tend to rise and manufacturing companies spend more money for their inputs because they have to fill the demand for their goods. Rising factory orders show that the economy is expanding, but they can also imply that inflation is rising (Factory orders, 2018c).

Consumer Credit Change: A measure of the change in the amount of money that individuals have borrowed. More borrowed money means that individuals have more money to spend and are more optimistic about the future. This is reflected in higher personal consumption and retail sales (Consumer credit change, n.d. b).

Average Weekly Hours: A measure of the average weekly hours worked by workers who are not on farm payrolls. The maximum weekly hours can easily be calculated, if we have a five-day work schedule and an eight hour work day, which gives us a maximum of 40 weekly hours. The closer average weekly hours are to 40 hours, the better the condition of the labour market. This shows us that fewer people have part-time jobs and more have full-time jobs. The more people who have full-time jobs, the higher personal income levels are which leads to higher personal spending. This affects economic growth and inflation positively (Average weekly hours, n.d.).

Monthly Budget Statement: This summarizes the financial activities of federal entities, disbursing officers, and Federal Reserve banks. A positive budget statement with receipts which exceed budgetary outlays is seen as bullish for the USD (Monthly budget statement, n.d. c).

Import Price Index: A measurement of the change in the price level of imported goods and services. Rising price levels of imported goods and services have a direct effect on inflation because the end product and services will be more expansive (Import price index, 2018g).

ZEW Survey - Economic Sentiment: A survey conducted on financial analysts from banks, insurance companies, and large industrial enterprises which tries to capture expectations about the economy in the coming six months. A higher score on the ZEW survey indicates a better perception of economic growth in the next six months. Consequently, companies will be more willing to expand their businesses and the fear of a possible recession is minimal. This optimism will drive GDP up, inflation will also rise, unemployment will fall and personal consumption will rise (ZEW Survey description, n.d.).

Unemployment Change: This is the same as the unemployment rate, only unemployment change measures the change in the numbers of the unemployed labour force during the previous month. A low unemployment rate should put pressure on wages to go up, since the labour force becomes scarce. It should also stimulate retail sales, consumption, and growth.

Harmonized Index of Consumer Prices: An inflation indicator for the ECB that has been harmonized across all EU member states. This index measures change in the price level for a selected basket of goods and services purchased by households. A rising consumer price index pressures the central bank into rate hikes (Harmonised index of consumer prices, 2018a).

ZEW Survey - Current Situation: A survey conducted on financial analysts from banks, insurance companies and large industrial enterprises which tries to capture the current situation in the economy. The more optimistically the current situation is perceived, the better the situation is for GDP growth, inflation growth, and unemployment (ZEW Survey description, n.d.).

IFO - Business Climate: A highly respected German index which tries to capture early economic development in the largest European economy. It is known that many EU nations depend on the German economy and for this reason the IFO index is a good proxy for showing what could happen in the EU economy. Positive readings are seen as optimistic for GDP growth, inflation growth, and unemployment (IFO business climate, 2018e).

IFO - Current Assessment: This assessment rates current economic conditions in the largest European economy. Positive readings are seen as optimistic for GDP growth, inflation growth, and unemployment (IFO business climate, 2018e).

IFO - Expectations: A rating of economic expectations in the German economy. The higher the reading, the higher the expectations for growth, inflation, and unemployment are (IFO business climate, 2018e).

Trade Balance: Measures difference between monetary value of exports and imports. Based on the balance of payment theory, a country may operate under a current account surplus of deficit, which further implies a positive or negative trade balance. A surplus or deficit comes as a result of net change in the country's asset positions. If we want to express the current account deficit through the country's imports and exports, we can say that if imports are larger than exports, the country operates under a current account deficit (Krueger, 1969, p. 2). For example, the US prefers a strong dollar since it is not as dependent on exports as Germany and the EU-28 countries. Based on statistics, U.S exports equal 12 percent of total GDP and it runs a trade balance deficit, whereas Germany exports 47 percent of its total GDP and has a trade balance surplus while the EU-28 is exporting 46 percent of its GDP (Percent of exports in GDP, n.d.).

4.2 Statistical Results of My Research

The statistical results of my monthly-framed analysis are graphically presented in table number 1 bellow. The first column represents the time intervals, where number 1 stands for the first time interval, number 2 for the second time interval, and same system is applied until the thirtieth time interval. The second column represents the percentage of high impact data which met or surpassed the market consensus or expectations for EUR. The third column represents the percentage of medium impact data which met or surpassed the market consensus or expectations for EUR. The fourth column represents the percentage of high impact data which met or surpassed market expectations for USD, while the fifth column represents the percentage of medium impact data which met or surpassed market expectations for USD. In the sixth column we can find the currency that had a better ratio of met or surpassed market expectations about economic data in chosen time interval. In the seventh column, the price direction based on the economic data ratio is determined. Column eight represents the determined price direction based on the EWT, where as the ninth column compares if the price direction based on the EWT is aligned with price direction based on the ratio of met or surpassed market expectations about economic data. Finally, in the tenth column we have the actual price movement for the chosen time interval.

Table 1: Table of Analytical Results (monthly-framed)

T	€ % HI. imp. d. meet exp.	€ % MED. imp. d. meet exp.	$ % HI. imp. d. meet exp.	$ % MED. imp. d. meet exp.	Better data	Price forecast based on economic data	EWT signal	Economic d. aligned with EWT	Actual move
1	50	69.7	37	46.4	EUR	Up	Up	Yes	Up
2	64.7	54.5	71.9	50	USD	Down	Down	Yes	Down
3	68.8	76.3	61.5	67.6	EUR	Up	Up	Yes	Up
4	58.8	62.7	62.1	65.8	USD	Down	Down	Yes	Down
5	100	69.8	70	44.7	EUR	Up	Up	Yes	Up
6	83.3	74.5	80.8	48.6	EUR	Up	Down	No	Down
7	80	78.1	48.3	56	EUR	Up	Up	Yes	Up
8	100	74.5	57.1	57.1	EUR	Up	Up	Yes	Up
9	46.1	80.4	41.2	42.6	EUR	Up	Up	Yes	Up
10	66.7	62.5	66.7	64.9	USD	Down	Down	Yes	Down
11	100	57.4	52.9	58.3	EUR	Up	Up	Yes	Up
12	76.5	68.1	48.6	79.5	EUR	Up	Up	Yes	Up
13	54.5	42.9	64.3	42.9	USD	Down	Down	Yes	Down
14	52.2	46.9	55.6	64.7	USD	Down	Down	Yes	Down
15	55.6	44.4	67.9	57.6	USD	Down	Down	Yes	Down
16	64.3	57.1	50	50	EUR	Up	Down	No	Down
17	55	51.6	65.5	52.9	USD	Down	Down	Yes	Down
18	80	67.7	100	34.5	EUR	Up	Up	Yes	Up
19	62.5	66.7	40.7	40.5	EUR	Up	Down	No	Down
20	70	74.2	44	44.1	EUR	Up	Down	No	Down
21	80	56.3	42.9	73.1	EUR	Up	Up	Yes	Up
22	51.7	79.5	64.7	42.9	EUR	Up	Up	Yes	Up
23	80	60.5	83.3	54.8	EUR	Up	Up	Yes	Up
24	75	48.8	57.1	45.2	EUR	Up	Down	No	Down
25	61.1	57.1	58.3	52.6	EUR	Up	Up	Yes	Up
26	70.8	52.9	54.5	37.2	EUR	Up	Up	Yes	Up
27	52.4	56.3	68.2	47.8	USD	Down	Down	Yes	Down
28	62.5	50	100	54.8	USD	Down	Down	Yes	Down
29	83.3	50	85.7	56.8	USD	Down	Down	Yes	Down
30	50	67.6	50	61.5	EUR	Up	Up	Yes	Up

Source: Own work.

All thirty observed points (time intervals) that are presented in table number 1 are briefly described in appendix 9.
In addition to my monthly time frame analysis, I have done the same analysis during a four-month time frame. The result of 10 chosen time intervals is presented bellow in table number 2 and each time interval is briefly described in the appendix 10.

Table 2: Table of Analytical Results (four-month framed)

T	€ % HI. imp. d. meet exp.	€ % MED. imp. d. meet exp.	$ % HI. imp. d. meet exp.	$ % MED. imp. d. meet exp.	Better data	Price forecast based on economic data	EWT signal	Economic d. aligned with EWT	Actual move
1	60.6	56.3	60.4	47.8	EUR	Up	Up	Yes	Up
2	68.8	60.9	72.7	56	USD	Down	Up	No	Up
3	71.4	55	74.2	54.9	USD	Down	Down	Yes	Down
4	70.5	50	71.1	47.1	USD	Down	Down	Yes	Down
5	60	57.5	51.3	48.5	EUR	Up	Down	No	Down
6	56.4	47.9	58.4	58.9	USD	Down	Down	Yes	Down
7	60.4	64.5	49.5	46.6	EUR	Up	Down	No	Down
8	78.2	68.6	54.7	55.7	EUR	Up	Up	Yes	Up
9	68	75.5	50.8	51	EUR	Up	Up	Yes	Up
10	61.5	54.8	58.2	44.9	EUR	Up	Up	Yes	Up

Source: Own work.

4.3 Summarizing Analytical Results

From 30 observed monthly time intervals, the price direction based on met or surpassed market expectations about economic data was aligned with the price direction based on the EWT in 83.3 percent of the cases. In 16.7 percent of the observed time intervals, the price direction based on met or surpassed expectations of the economic data was not aligned with the price direction predicted by the EWT. This was the case in intervals number 6, 16, 19, 20 and 24. In these intervals, the price direction behaved according to the EWT.

Table 3: Overview of the Monthly-Framed Analytical Results

	Intervals where expectations about economical data were aligned with EWT	Intervals where expectations about economical data were not aligned with EWT	Intervals where price behaved based on EWT	Intervals where price behaved based on economic data
Chosen intervals	1; 2; 3;4; 5; 7; 8; 9; 10; 11; 12; 13; 14; 15; 17; 18; 21; 22; 23; 25; 26; 27; 28; 29; 30	6; 16; 19; 20; 24	1; 2; 3;4; 5; 7; 8; 9; 10; 11; 12; 13; 14; 15; 17; 18; 21; 22; 23; 25; 26; 27; 28; 29; 30	Non intervals
Percent of intervals out of 30 intervals	83,3	16,7	100	0

Source: Own work.

Further on I have calculated the correlation between the price direction based on met or surpassed market expectations of the economic data and price direction based on the EWT. The result of the calculated correlation is 0.7071, meaning that the price direction based on met or surpassed market expectations of the economic data and the price direction based on the EWT are highly positively correlated.

In addition, to see if the EWT gives the user an edge, I performed the same analysis, but this time on a four-month time interval, since that is also common for the length of waves. From the ten observed four-month time intervals, the price direction based on met or surpassed market expectations of the economic data was aligned with the price direction based on the EWT in 70 percent of the cases. In 30 percent of the observed time intervals, the price direction based on met or surpassed expectations of the economic data was not aligned with price direction based on the EWT. This was the case in interval numbers 2, 5 and 7. In these intervals the price direction behaved according to the EWT. The correlation between the price direction based on met or surpassed market expectations of the economic data and the price direction based on the EWT is 0.4082, meaning that the price direction based on met or surpassed market expectations of the economic data and price direction based on the EWT are strongly positively correlated. However, it is important to note that a correlation of 0.4082 is on the lower boundary of the strong positive correlation interval.

Table 4: Overview of the Four-Month-Framed Analytical Results

	Intervals where expectations about economical data were aligned with EWT	Intervals where expectations about economical data were not aligned with EWT	Intervals where price behaved based on EWT	Intervals where price behaved based on economic data
Chosen intervals	1; 3;4; 8; 9; 10	2; 5; 7	1; 2; 3;4; 5; 7; 8; 9; 10	Non
Percent of intervals out of 10 intervals	70	30	100	0

Source: Own work.

Based on the calculated correlation coefficient, I am able to provide answer to my research question. My main research question was to find out if the Elliott Wave Theory has better explanatory power for exchange rate determination than the fundamental data has. Since the fundamental data in both of the tested time intervals is not perfectly correlated, I can conclude that the EWT has better explanatory power of the exchange rate than the fundamental data has.

CONCLUSION

In the time following the collapse of the Bretton Woods system, countries around the world adopted the floating foreign exchange system, or at least one form of it. Abandonment of the gold standard made it clear that the PPP model does not hold continuously. Due to the stickiness of prices on the short-run, it is advised to observe the PPP on the long-run. According to the classification that Kanamori and Zhao (2006) made, the absolute and the relative PPP together with the IRP are categorized as partial equilibrium models. In accordance to the same authors, the flexible price monetary model is classified as disequilibrium or hybrid model, because it searches for monetary equilibrium and an equilibrium that is achieved by price-quantity adjustment. Furthermore, the explanatory power of the monetary models is strong, compared to the explanatory power of the other models and it has wider practical use. Therefore, monetary models are more appropriate to use when the exchange rate variation between two currencies is needed to be understood. This is due to the fact that monetary models highlight the connection between the nominal exchange rate and the fundamentals factors or macroeconomic factors. The monetary model tries to explain the exchange rate movement between two different economies as a factor of money supply, which is done by a central bank via interest rate decisions and by a treasury with open market operations. If the

money supply rises too fast, inflation will rise as well. Historically, monetary models evolved with the purpose to increase the explanatory power of exchange rate movements and their characteristics. The first developed model was the flexible price monetary model which assumed that all prices are flexible. A further assumption was that changes in interest rates are the consequence of changes in real income and inflation expectations, since those two factors have the biggest impact on money demand. Further on, the model defines the relative money stock as the determinant of the relative price which further affects the exchange rate. However, the underlying assumption of the model is that the PPP holds continuously. The same assumption about the PPP was later incorporated into the Uncovered Interest Rate Parity and the International Fisher Effect. But as we mentioned previously in this text, the PPP does not hold continuously. This fact weakened the explanatory power of these models. Alternatively, the sticky price monetary model and the real interest rate differential model were introduced. The difference between the flexible price model and the sticky price model is that in the sticky price model it is stated that the PPP holds only on the long-run. When we try to understand the real interest differential model, we must first acknowledge the positive correlation between the domestic interest rate and the exchange rate, but these correlations only hold in the long-run. Due to the liquidity effect, which plays an important role in short-run, the real interest rate differential model was developed, where interest rates with short-run maturity are used. The explanatory power of the sticky price monetary model and the real interest rate differential model was tested by numerous researchers. However, the conclusions they came to differed considerably.

A frequently used theorem for analyzing exchange rate movements is the Interest Rate Parity. This theorem states that money should flow from economies with lower interest rates to economies with higher interest rates, thereby raising demand for the currency that has a higher interest rate. What remains problematic about this theorem is why there are still arbitrage opportunities for profit generation, even when equilibrium is achieved. Additionally, the fact that the theorem has limited rabidity concerning expectations is problematic. Aliber (1973) suggested that the source of arbitrage is transaction costs, default risk, non-monetary returns, non-unitary correlation or returns, and premature repartition.

The balance of payment theory suggests that a country can use different fundamental mechanisms to maintain external constraints. These mechanisms include exchange rate adjustment, exchange control, and adoption of a domestic economy in a way which supports external constraints with the aim to achieve equilibrium. However, when floating exchange rates were introduced, interest shifted to economic determinants of exchange rate movements.

It is also important to highlight the difference between the Fisher Open Hypothesis and Covered Interest Rate Parity. The Fisher hypothesis states that the difference between the

nominal rates of return of two similar assets should be offset by the expected change in the exchange rate over time. In other words, covered interest rate parity differs from the Fisher hypothesis because it does not include risk as the Fisher hypothesis does, in the sense of expected change of exchange rate.
Regardless of the numerous drawbacks that the classical models have, we cannot ignore their importance. They give us the foundations for advanced models and the ability for an advanced understanding of the topic in concern.

As an alternative to the economic models that try to incorporate fundamental factors and different economic approaches to predict the exchange rate, technical approaches based on price chart observations were developed. The Elliott Wave Theory is one of those technical theories that tries to forecast future exchange prices based on different price chart patterns or, as the author of the theory, Ralph Nelson Elliott, defined them, waves. The main underlying assumption of the EWT is that the exchange price goes through different stages or cycles composed of different waves. The statement that is proposed by the theory is that the fundamentals are irrelevant, since waves always develop in a defined, repeating order, but with different complexity.

In this thesis I have conducted a primary analysis on the most liquid currency pair, EUR/USD. I have chosen this exact currency pair for observation because, as the author of the theory suggests, the EWT should work best on the most liquid assets and markets. Firstly, I have collected the economic data, also known as fundamental data that is published by the corresponding institutions for both economies, the US and the EU. I then compared the data for both economies with the market expectations or consensus data. First observations were made on thirty chosen monthly time intervals in time period from 04. 06. 2010 to 15. 02. 2018. Second observations were made on ten, time intervals that were not based on monthly data, but on four- month data in time period from 04. 06. 2010 to 11. 08. 2017. If in both preformed analyses the consensus about the economical data has been reached or surpassed, this should have had positive effect on currency. Currency with the better percentage of met or surpassed economic data should be favoured over the currency with lower percentage of met or surpassed economical data, meaning its value should appreciate against its counterpart currency. From thirty monthly observations I conducted, I have concluded that the price was supported by met or surpassed expectations of the economic data in twenty-five observed intervals out of thirty. The price in 83.3 percent of cases was developed accordingly with met or surpassed expectations of the economic data. Additionally, I applied the EWT to the same time intervals and compared the price movement that was formed with help of the EWT theory with the price movement that was generated from the met or surpassed market expectations of the economic data. From all conducted observations, the EWT diverged from the price movement based on met or surpassed market expectations of the economic data in 16.7 percent of the cases or in five out of thirty total observations. The results showed that met

or surpassed expectations of the economic data and the EWT theory are highly correlated, with EWT having a correlation coefficient of 0.7071.

As I mentioned before I have also performed the same analysis on a four-month time interval. From the ten four-month observations, I have concluded that the price was supported by met or surpassed expectations of the economic data in seven out of ten observed intervals. In the same seven intervals, the price direction based on met or surpassed expectations of the economic data also aligned with the price direction based on the EWT. In three out of ten intervals, where the price based on met or surpassed expectations of the economic data was not aligned with the EWT, the price behaved according to the EWT theory. The results also showed that met or surpassed expectations of the economic data and the EWT theory are strongly correlated, with the EWT having a correlation coefficient of 0.4082.

The first conclusion that I can give based on my one-month analyses is that price was highly impacted by market expectations, meaning that when expectations were met or surpassed, price moved in favour of the currency that had the higher percentage of data that met or surpassed market expectations. The second conclusion is based on comparing expectations about met or surpassed economic data with the EWT, where I have found out that most of the time the EWT follows the price movement based on the economic data expectations.

Since the price forecast based on met or surpassed expectations of the economic data and price forecast based on the EWT are not perfectly positively correlated, but highly positively correlated, I can conclude that the EWT can better explain the exchange rate movement. This was clearly illustrated when I preformed the four-month analyses and showed that the forecast based on met or surpassed expectations of the economic data has a lower correlation with the EWT. However, we must not overlook the constraints of my analysis. Since it was conducted on a monthly basis with only 30 time series and on a four-month basis with 10 time series, larger time series observation, could lead to different results.

During the process of researching and writing my thesis a few ideas for further research work came to my mind. Since I have conducted an ex-post analysis in my thesis, it would be interesting to conduct the same analysis with ex-ante data. Thereby the EWT can gain not only analytical power, but also predictive power.

Obviously, this theory could be applied, not only to the chosen currency pair in this work, but also to other currency pairs. However, we should not forget that the EWT works best on the most liquid currencies. Other assets as stocks, futures, options, and commodities can be analyzed with this theory as well.

In this final section of my text I will give myself the freedom to think outside of the box and to give some personal insights that I believe will be important in the future. One such insight is the use of quantum computing. Even though some people are convinced that, at this time, it is too early to talk about quantum computing and especially about its practical mass-use, I personally have the opinion that this will be a certainty in the future and it is much closer that we imagine. Let's allow ourselves to think for a moment about the change that quantum computing will have on all types of electronic trading, including on the topic that I explored in my thesis. The quantum "brain" of these computers and their speed will completely change the way electronic trading as we know it today functions.

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APPENDICES

Appendix 1: Povzetek (Summary in Slovene language)

V današnjem tehnološko hitro se razvijajočem svetu in dobro razvito internetno infrastrukturo, je postalo trgovanje na finančnih trgih praktično dosegljivo kjerkoli in komurkoli. Ravno dostopnost trgovanja in želja po trgovanju ter realizaciji zaslužkov sta botrovala, da sem se poglobil v trgovanje ter se odločil, da želim teoretično znanje poglobiti ter ga tudi deliti.

Svojo nalogo sem začel s predstavitvijo klasičnih ekonomskih modelov in teorij za oblikovanje deviznega tečaja. Poleg pomanjkljivosti, ki sem jih navedel, je vsem skupno to, da zelo slabo pojasnjujejo devizni tečaj na kratki rok.

Kot alternativo tradicionalnim modelom in teorijam, sem opisal Elliott Wave teorijo, ki spada v skupino tehničnih analiz. Ker je za uspešnost Elliott wave teorije potrebna visoka tržna likvidnost, sem se odločil, da bom teorijo testiral na deviznem paru EUR/USD. S testiranjem teorije na deviznem paru EUR/USD sem želel odgovoriti na vprašanje ali Elliott wave teorija bolje pojasnjuje gibanje deviznega tečaja kot makroekonomski podatki, ki so periodično objavljeni za Združene države Amerike in Evropsko monetarno unijo.

Z namenom, da bi odgovoril na raziskovalno vprašanje, sem izbral deset štirimesečnih obdobij in trideset enomesečnih obdobij za devizni tečaj EUR/USD. Svoje raziskovanje sem nadaljeval z definiranjem makroekonomskih kazalcev ter razlago, kako doseganje njihovih pričakovanj vpliva na oblikovanje deviznega tečaja. Predpostavka, ki sem jo uporabil, je bila, da monetarno območje, ki dosega večji delež pričakovanj glede ekonomskih podatkov, bo posledično doživelo apreciacijo svojega deviznega tečaja. Za isto obdobje kot sem zajel makroekonomske kazalce, sem apliciral tudi Elliott wave teorijo. Na podlagi izbranih in ovrednotenih makroekonomskih kazalcev ter z njimi povezanega doseženega deleža pričakovanj, sem določil ali se bo okrepil USD ali EUR. Ker sem v istem obdobju apliciral tudi Elliott wave teorijo, sem na podlagi teorije določil, ali bo devizni tečaj padal ali rastel. Dejansko gibanje cene sem na koncu primerjal z obema izbranima metodama.

Iz mesečno zbranih podatkov lahko zaključim, da je bilo gibanje deviznega tečaja zelo pogojeno z doseženimi pričakovanji glede makroekonomskih podatkov. Devizni tečaj se je tako oblikoval večinoma v korist valute z večjim deležem doseženih pričakovanj glede makroekonomskih podatkov. Zaključim tudi lahko, da se gibanje tečaja baziranega na pričakovanjih glede makroekonomskih podatkov ujema z Elliott wave teorijo ter da obstaja med njima pozitivna korelacija, ki pa ni popolna. Ker korelacija ni popolna, lahko zaključim, da Elliott wave teorija bolje napoveduje gibanje deviznega tečaja.

Kljub zaključku, do katerega sem prišel v svoji raziskavi, bi želel opozoriti na določene omejitve. Zanimivo bi bilo videti, ali bi prišel do drugačnih rezultatov, če bi vzel manjše časovne intervale in povečal število časovnih obdobij. Prav tako bi bilo dobro opazovati, do kakšnega zaključka bi prišel, če bi aplicirali Elliott wave teorijo za prihodnost ter se pri svoji analizi ne bi zanašal na pretekle podatke.

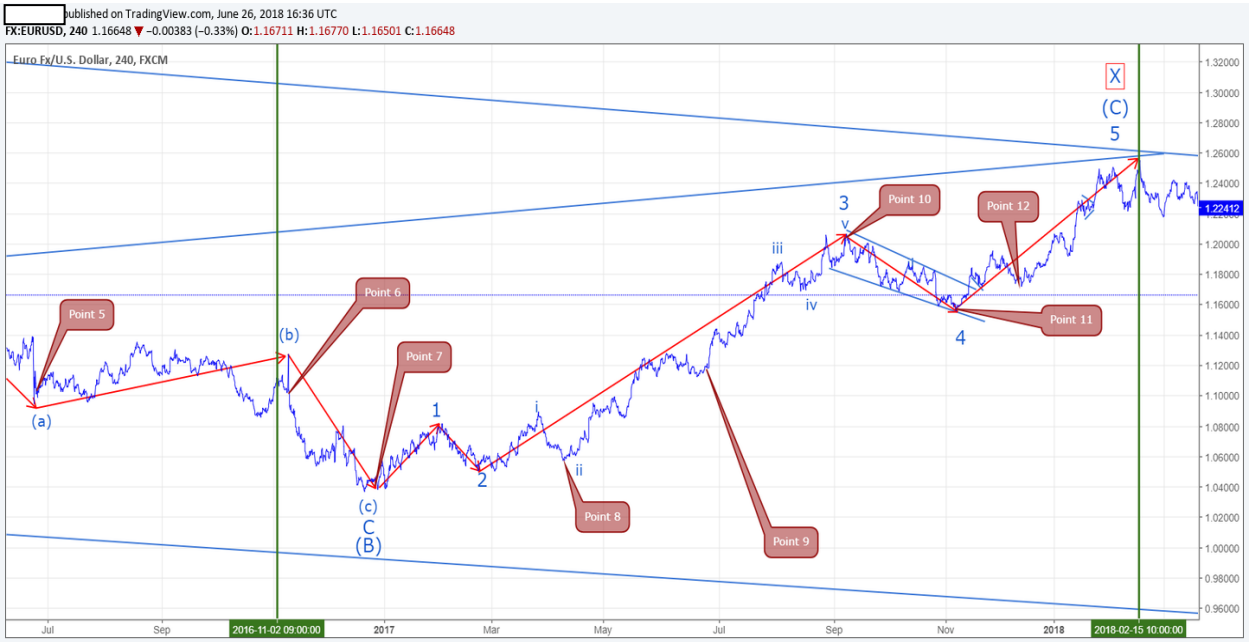
Appendix 2: Daily chart with Elliott wave count from mid 2008 till beginning of 2018.

Source: Own work.

Appendix 3: Elliott wave count with chosen starting points of observed intervals 1, 13, 2, 3, 4 and 5.

Source: Own work.

Appendix 4: Elliott wave count with chosen starting points of observed intervals 5, 6, 7, 8, 9, 10, 11 and 12.



Source: Own work.

Appendix 5: Elliott wave count with chosen starting points of observed intervals 14, 15, 16, 17, 19, 20, 1 and 1.

Source: Own work.

Appendix 6: Elliott wave count with chosen starting points of observed intervals 22, 30, 21, 18, 28, 29, 23, 24, 25, 26, 27, 14 and 15.

Source: Own work.

Appendix 7: High and medium impact economic data for USD.

HIGH IMPACT ECONOMIC DATA FOR USD	MEDIUM IMPACT ECONOMIC DATA FOR USD
Building Permits (MoM)	Capacity Utilization
Consumer Price Index (YoY)	Industrial Production (MoM)
Consumer Price Index Ex Food & Energy (YoY)	NAHB Housing Market Index
Existing Home Sales (MoM)	Continuing Jobless Claims
Initial Jobless Claims	Housing Starts (MoM)
New Home Sales (MoM)	Philadelphia Fed Manufacturing Survey
Durable Goods Orders	Consumer Price Index (MoM)
Durable Goods Orders ex Transportation	Consumer Price Index Ex Food & Energy (MoM)
Consumer Confidence	Existing Home Sales Change (MoM)
Gross Domestic Product Annualized	Markit Manufacturing PMI
Fed Interest Rate Decision	Markit Services PMI
ISM Manufacturing PMI	Gross Domestic Product Price Index
Reuters/Michigan Consumer Sentiment Index	Personal Income (MoM)
Trade Balance	Personal Spending
ISM Non-Manufacturing PMI	Chicago Purchasing Managers' Index
ADP Employment Change	Construction Spending (MoM)

(Table continues)

Nonfarm Payrolls	Factory Orders (MoM)
Unemployment Rate	Consumer Credit Change
JOLTS Job Openings	Average Weekly Hours
Retail Sales (MoM)	Monthly Budget Statement
Core CPI	Import Price Index (MoM)
Retail Sales ex Autos (MoM)	

Source: Own work.

Appendix 8: High and medium impact economic data for EUR.

HIGH IMPACT ECONOMIC DATA FOR EUR	MEDIUM IMPACT ECONOMIC DATA FOR EUR
ECB Interest Rate Decision	(Germany) Harmonised Index of Consumer Prices (MoM)
(EMU) Consumer Price Index - Core (YoY)	(Germany) Harmonised Index of Consumer Prices (YoY)
(EMU) Consumer Price Index (YoY)	(Germany) ZEW Survey - Current Situation
(Germany) ZEW Survey - Economic Sentiment	(EMU) ZEW Survey - Economic Sentiment
(France) Markit Manufacturing PMI	(EMU) Consumer Confidence
(Germany) Markit Manufacturing PMI	(Germany) Gfk Consumer Confidence Survey
(Germany) Unemployment Change	(EMU) Markit Manufacturing PMI
(Germany) Unemployment Rate s.a.	(Germany) IFO - Business Climate
(Italy) Unemployment	(Germany) IFO - Current Assessment
(Spain) Markit Manufacturing PMI	(Germany) IFO - Expectations
(Italy) Markit Manufacturing PMI	(Germany) Retail Sales (MoM)
(France) Markit Manufacturing PMI	(Germany) Retail Sales (YoY)
(Greece) Markit Manufacturing PMI	(EMU) Unemployment Rate
(Austria) Unemployment	(Spain) Markit Services PMI
(Spain) Unemployment Change	(EMU) Retail Sales (YoY)
(Germany) Gross Domestic Product s.a (QoQ)	(Germany) Trade Balance s.a.
(EMU) Gross Domestic Product s.a. (YoY)	(Germany) Gross Domestic Product n.s.a (YoY)
(EMU) Gross Domestic Product s.a. (QoQ)	(Germany) Consumer Price Index (YoY)
	(Germany) Consumer Price Index (MoM)
	(Italy) Gross Domestic Product (YoY)
	(EMU) Gross Domestic Product s.a. (QoQ)
	(EMU) Industrial Production w.d.a. (YoY)
	(EMU) Industrial Production s.a. (MoM)

Source: Own work.

Appendix 9: Brief description of the thirty observed points (time intervals) from the monthly-framed statistical analysis, as presented in table number 1 in the thesis (pp. 56−57).

The first point chosen is the time interval from 15. 4. 2015 to 16. 5. 2015. In this period EUR had 50 percent of high impact data that met or surpassed the market consensus and 69.7 percent of medium impact data that met or surpassed the market consensus. In the same, period USD had only 37 percent of high impact data that met or surpassed the market consensus and 46.7 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint, price should go up. The Elliott Wave Theory also signalled for the price to go up because wave C of wave Y was completed. Consequently the next expected wave is wave A going up. The economic data and the EWT are aligned with each other, pointing in the same upward direction.

The second point chosen is the time interval from 14. 10. 2015 to 14. 11. 2015. In this chosen period, EUR had 64.7 percent of high impact data that met or surpassed the market consensus and 54.5 percent of medium impact data that met or surpassed the market consensus. In the same time period, USD had 71.9 percent of high impact data that met or surpassed the market consensus and 50 percent of medium impact data that met or surpassed the market consensus. The overall better economic data was on the USD side, meaning that from an economic data standpoint the price should go down, favouring the dollar. The Elliott Wave Theory also signalled for the price to go down because waves (a) and (b) of wave A were completed. Consequently, the next expected wave is wave (c) of wave A going down. The economic data and the EWT are aligned with each other, pointing in the same downward direction.

The third temporal point is the time interval from 09. 03. 2016 to 08. 04. 2016. During this period, EUR had 68.8 percent of high impact data that met or surpassed the market consensus and 76.3 percent of medium impact data that met or surpassed the market consensus. In the same period, USD had a weaker ratio, in detail, it had 61.5 percent of high impact data that met or surpassed the market consensus and 67.6 percent of medium impact data that met or surpassed the market consensus. The better economic data was on the EUR side, meaning that from the economic data standpoint, the price should go up. The Elliott Wave Theory also signalled for the price to go up because waves (a) and (b) of wave B were completed, meaning that the next expected wave is wave (c) of wave B going up. The economic data and the EWT are aligned with each other, pointing in the same upward direction.

The fourth chosen point is the time interval from 03. 05. 2016 to 08. 04. 2016. In this period EUR had 58.8 percent of high impact data that met or surpassed the market consensus and 62.7 percent of medium impact data that met or surpassed the market consensus. In the same period, USD had 62.1 percent of high impact data that met or

surpassed the market consensus and 65.8 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the USD side, meaning that from an economic data standpoint, price should go down thus favouring the dollar. The Elliott Wave Theory also signalled for the price to go down because wave B was completed. The next expected wave is wave (a) of wave C pointing downward. The economic data and the EWT are aligned with each other, pointing in the same downward direction.

The fifth point chosen is in the time interval from 27. 06. 2016 to 26. 07. 2016. In this period the EUR had 100 percent of high impact data which met or surpassed the market consensus while 69.8 percent of medium impact data met or surpassed the market consensus. In the same period, USD had only 70 percent of high impact data which met or surpassed the market consensus and 44.7 percent of medium impact data which met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint price should go up. The Elliott Wave Theory also signalled for the price to go up because wave B and wave (a) of wave C were completed. The next expected wave is wave (b) of wave C going up. The economic data and the EWT are aligned with each other, pointing in the same upward direction.

The sixth point chosen spans the time interval from 09. 11. 2016 to 09. 12. 2016. In this period, EUR had 83.3 percent of high impact data that met or surpassed the market consensus and 74.5 percent of medium impact data that met or surpassed the market consensus. In the same period, USD had 80.8 percent of high impact data that met or surpassed the market consensus and 48.6 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from the economic data standpoint, price should go up, favouring the Euro. When we compare the economic data with the Elliott Wave Theory, we can see a divergence. The Elliott Wave Theory signals that the price should move downward since wave B and waves (a) and (b) of wave C were completed. Consequently, the next expected wave is wave (c) of wave C pointing to the down side. The economic data and the EWT are not aligned with each other. Judging solely from an economic data standpoint, price should go up, even though it moved down as it was signalled by EWT.

The seventh point chosen is in a time period from 26. 12. 2016 to 27. 01. 2017. In this chosen period, the EUR had 80 percent of high impact data that met or surpassed the market consensus and 78.1 percent of medium impact data that met or surpassed the market consensus. In the same time period, the USD had 48.3 percent of high impact data that met or surpassed the market consensus and 56 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side. From an economic data standpoint price should go up, favouring euro. The Elliott Wave Theory was aligned with the economical data, signalling price to go up since waves (a), (b), (c) of wave C were completed. The next expected wave is wave 1 of wave C pointing

upward. The economic data and the EWT are aligned with each other, pointing in the same upward direction.

The eighth point chosen is in the time period between 10. 04. 2017 and 12. 04. 2017. In this chosen period, EUR had 100 percent of high impact data that met or surpassed the market consensus and 74.5 percent of medium impact data that met or surpassed the market consensus. In the same period, USD had 57.1 percent of high impact data that met or surpassed the market consensus and the same 57.1 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from the economic data standpoint price should go up, favouring the euro. The Elliott Wave Theory also signalled for the price to go up since wave 2of wave C was completed. Consequently, the next expected wave is wave 3 of wave C going up. The economic data and the EWT are aligned with each other, pointing in the same upward direction.

The ninth chosen point is in the time period between 26. 06. 2017 and 28. 07. 2017. In this period, EUR had 46.1 percent of high impact data that met or surpassed the market consensus and 80.4 percent of medium impact data that met or surpassed the market consensus. In the same period, USD had 41.2 percent of high impact data that met or surpassed the market consensus and 42.6 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint price should go up, favouring the euro. The Elliott Wave Theory was aligned with the economical data, signalling for the price to go up as well, since wave 2 of wave C was completed. The next expected wave is wave 3 of wave C pointing upward. The Economic data and the EWT are aligned with each other, pointing in the same upward direction.

The tenth chosen point is during the time period from 08 .09. 2017 to 06. 10. 2017. In this chosen period, the EUR had 66.7 percent of high impact data which met or surpassed market consensus and 62.5 percent of medium impact data which met or surpassed the market consensus. In the same period, USD had the same 66.7 percent of high impact data which met or surpassed the market consensus and 64.9 percent of medium impact data which met or surpassed the market consensus. Overall, the better economic data was on the USD side, meaning that from an economic data standpoint price should go down, favouring the dollar. The Elliott Wave Theory was aligned with the economic data, signalling for the price to go down as well, since wave 3 of wave C was completed. The next expected wave is the corrective wave 4 of wave C pointing downward. The economic data and the EWT are aligned with each other, pointing in the same downward direction.

The eleventh point is the period from 7. 11. 2017 to 09. 12. 2017. In this period the EUR had 100 percent of high impact data that met or surpassed the market consensus and 57.4 percent of medium impact data that met or surpassed the market consensus. In the same

period, the USD had only 52.9 percent of high impact data that met or surpassed the market consensus and 58.3 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint the euro price should go up. The Elliott Wave Theory also signalled for the price to go up because corrective wave 4 of wave C was completed. The next expected wave is wave 5 of wave C going up. The economic data and the EWT are aligned with each other, pointing in the same upward direction.

The twelfth chosen point is during the time period between 11. 12. 2017 and 12. 01. 2018. In this period, the EUR had 76.5 percent of high impact data that met or surpassed the market consensus and 68.1 percent of medium impact data that met or surpassed the market consensus. In the same period, the USD had 48.6 percent of high impact data that met or surpassed the market consensus and 79.5 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint the euro price should go up. The Elliott Wave Theory also signalled for the price to go up because corrective wave 4 of wave C was completed. The next expected wave is wave 5 of wave C going up. The Economic data and the EWT are aligned with each other, pointing in the same upward direction.

The thirteenth chosen point is the time period between 22. 06. 2015 and 24. 07. 2015. In this period, the EUR had 54.5 percent of high impact data that met or surpassed the market consensus and 42.9 percent of medium impact data that met or surpassed the market consensus. In the same period, the USD had the same 64.3 percent of high impact data that met or surpassed the market consensus and 42.9 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the USD side, meaning that from an economic data standpoint price should go down, favouring the dollar. The Elliott Wave Theory was aligned with economic data, signalling the price to go down since wave (b) of wave B was completed. The next expected wave is corrective wave (c) of wave B pointing downward. The economic data and the EWT are aligned with each other, pointing in the same downward direction.

The fourteenth point chosen is the time period from 05. 05. 2014 to 06. 06. 2014. In this period the EUR had 52.2 percent of high impact data that met or surpassed the market consensus and 46.9 percent of medium impact data that met or surpassed the market consensus. In the same period, the USD had only 55.6 percent of high impact data that met or surpassed the market consensus and 64.7 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the USD side, meaning that from an economic data standpoint the dollar price should go down. The Elliott Wave Theory also signalled for the price to go down because wave B was completed. Consequently, the next expected wave, wave C, is going down. The economic data and the EWT are aligned with each other, pointing in the same downward direction.

The fifteenth point is between the time period from 21. 07. 2014 to 22. 08. 2014. In the chosen period, the EUR had 55.6 percent of high impact data that met or surpassed the market consensus and 44.4 percent of medium impact data that met or surpassed the market consensus. In the same period, the USD had 67.9 percent of high impact data that met or surpassed the market consensus and 57.6 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the USD side, meaning that from an economic data standpoint the price should go down, favouring the dollar. The Elliott Wave Theory was aligned with the economic data, signalling for the price to go down since wave B was completed. The next expected wave is wave C pointing downward. The economic data and the EWT are aligned with each other, pointing in the same downward direction.

The sixteenth point is the time period from 01. 09. 2014 to 29. 09. 2014. In this period, the EUR had 64.3 percent of high impact data that met or surpassed the market consensus and 57.1 percent of medium impact data that met or surpassed the market consensus. In the same time period, the USD had 50 percent of high impact data that met or surpassed the market consensus and 50 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint the price should go up, favouring the euro. The Elliott Wave Theory was not aligned with the economic data, signalling the price to go down since wave B was completed. The next expected wave is wave C pointing downward. The economic data and the EWT are not aligned with each other, judging solely from the economic data standpoint, the price should go up, though it moved down as signalled by the EWT.

The seventeenth point is in the period between 20. 10. 2014 and 21. 11. 2014. In this period, the EUR had 55 percent of high impact data which met or surpassed the market consensus and 51.6 percent of medium impact data which met or surpassed the market consensus. In the same period, the USD had 65.5 percent of high impact data which met or surpassed the market consensus and 52.9 percent of medium impact data which met or surpassed the market consensus. Overall, the better economic data was on the USD side, meaning that from an economic data standpoint prices should go down, favouring the dollar. The Elliott Wave Theory was aligned with the economic data, signalling for price to go down as well, since wave B was completed. The next expected wave is wave C pointing downward. The economic data and the EWT are aligned with each other, pointing in the same downward direction.

The eighteenth point is during the time period between 11. 03. 2011 and 08. 04. 2011. In this period, the EUR had 80 percent of high impact data that met or surpassed the market consensus and 67.7 percent of medium impact data that met or surpassed the market consensus. In the same period, the USD had 100 percent of high impact data that met or surpassed the market consensus and 34.5 percent of medium impact data that met or

surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint the euro price should go up. The Elliott Wave Theory also signalled for the price to go up because wave (B) of wave X was completed. Consequently, the next expected wave is wave (C) of wave X going up. The economic data and the EWT are aligned with each other, pointing in the same upward direction.

The nineteenth point is from the time period from 15. 12. 2014 to 16. 01. 2015. In this period, the EUR had 62.5 percent of high impact data which met or surpassed the market consensus and 66.7 percent of medium impact data which met or surpassed the market consensus. In the same period, the USD had 40.7 percent of high impact data which met or surpassed the market consensus and 40.5 percent of medium impact data which met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint the euro price should go up. The Elliott Wave Theory signalled for the price to go down because wave B was completed. Consequently, the next expected wave is wave C going down. The economic data and the EWT are not aligned with each other. Judging solely from the economic data standpoint the price should go up, however, it moved down as was signalled by the EWT.

The twentieth point is from the time period from 13. 02. 2015 to 13. 03. 2015. In this period, the EUR had 70 percent of high impact data that met or surpassed the market consensus and 74.2 percent of medium impact data that met or surpassed the market consensus. In the same period, the USD had the same 44 percent of high impact data that met or surpassed the market consensus and 44.1 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint the price should go up, favouring the euro. The Elliott Wave Theory was not aligned with the economic data, rather it signalled that the price should go down since wave B was completed. The next expected wave is corrective wave C pointing downward. The Economic data and the EWT were not aligned with each other. Judging only from the economic data standpoint the price should go up, although it moved down, as was signalled by the EWT.

The twenty-first point is in the time period between 10. 01. 2011 and 11. 02. 2011. During the chosen period, the EUR had 80 percent of high impact data that met or surpassed the market consensus and 56.3 percent of medium impact data that met or surpassed the market consensus. In the same period, the USD had 42.9 percent of high impact data that met or surpassed the market consensus and 73.1 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from the economic data standpoint the price should go up, favouring the euro. The Elliott Wave Theory was aligned with the economic data, signalling the price to go up because wave (B) of wave X was completed. The next expected wave is wave (C) of

wave X pointing upward. The economic data and the EWT are aligned with each other, pointing in the same upward direction.

The twenty-second point is from 04. 06. 2010 to 07 .07. 2010. In the chosen period, the EUR had 51.7 percent of high impact data that met or surpassed the market consensus and 79.5 percent of medium impact data that met or surpassed the market consensus. In the same period, USD had 64.7 the same percent of high impact data that met or surpassed the market consensus and 42.9 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint the price should go up, favouring the EUR. The Elliott Wave Theory was aligned with the economic data, signalling for the price to go up since wave C was completed. The next expected wave is corrective wave (A) of wave X pointing upward. The economic data and the EWT are aligned with each other, pointing in the same downward direction.

The twenty-third point is in the time period between 10. 01. 2012 and 11. 02. 2012. During this period, the EUR had 80 percent of high impact data that met or surpassed the market consensus and 60.5 percent of medium impact data that met or surpassed the market consensus. In the same period, USD had 83.3 the same percent of high impact data that met or surpassed the market consensus and 54.8 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint the price should go up, favouring the euro. The Elliott Wave Theory was aligned with the economic data, signalling for the price to go up since wave (A) of wave A was completed. The next expected wave is corrective wave (B) of wave A pointing upward. The economic data and the EWT are aligned with each other, pointing in the same downward direction.

The twenty-fourth point is from 30. 04. 2012 to 30. 05. 2012. In this period, the EUR had 75 percent of high impact data that met or surpassed the market consensus and 48.8 percent of medium impact data that met or surpassed the market consensus. In the same period, the USD had 57.1 the same percent of high impact data that met or surpassed the market consensus and 45.2 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint the price should go up, favouring the euro. The Elliott Wave Theory was aligned with the economic data, signalling the price to go up since wave (B) of wave A was completed. The next expected wave is the corrective wave (V) of wave A pointing upward. The economic data and the EWT are not aligned with each other. Judging solely from the economic data, the price should go up, however, it moved down as was signalled by the EWT.

The twenty-fifth point is from the time period from 30. 07. 2012 to 30. 08. 2012. In this period, the EUR had 61 percent of high impact data that met or surpassed the market

consensus and 57.1 percent of medium impact data that met or surpassed the market consensus. In the same period, USD had 58.3 percent of high impact data that met or surpassed market consensus and 52.6 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint the price should go up, favouring the euro. The Elliott Wave Theory was aligned with the economic data, signalling the price to go up since wave A was completed. The next expected wave is wave (A) of wave B pointing upward. The economic data and the EWT are aligned with each other, pointing in the same direction.

The twenty-sixth point is from the time period between 12. 11. 2012 and 13. 12. 2012. In this period, the EUR had 70.8 percent of high impact data that met or surpassed the market consensus and 54.5 percent of medium impact data that met or surpassed the market consensus. In the same period, the USD had 54.5 percent of high impact data that met or surpassed the market consensus and 37.2 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint the price should go up, favouring the euro. The Elliott Wave Theory was aligned with the economic data, signalling the price to go up since wave A was completed. The next expected wave is wave (A) of wave B pointing upward. The economic data and the EWT are aligned with each other, pointing in the same direction.

The twenty-seventh point is in the time period between 31. 01. 2013 and 27. 02. 2013. During this period, the EUR had 52.4 percent of high impact data that met or surpassed the market consensus and 56.3 percent of medium impact data that met or surpassed the market consensus. During the same period, the USD had 68.2 percent of high impact data that met or surpassed the market consensus and 47.8 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the USD side, meaning that from an economic data standpoint the price should go down, favouring the dollar. The Elliott Wave Theory was aligned with the economic data, signalling for the price to go down since wave (A) of wave B was completed. The next expected wave is wave (B) of wave B pointing downward. The economic data and the EWT are aligned with each other, pointing in the same direction.

The twenty-eight point is from 25. 08. 2011 to 23 .09. 2011. During this period, the EUR had 62.5 percent of high impact data that met or surpassed the market consensus and 50 percent of medium impact data that met or surpassed the market consensus. In the same period, the USD had 100 percent of high impact data that met or surpassed the market consensus and 54.8 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the USD side, meaning that from an economic data standpoint the price should go down, favouring the dollar. The Elliott Wave Theory was aligned with the economic data, signalling the price to go down since wave X

was completed. The next expected wave is wave (A) of wave A pointing downward. The economic data and the EWT are aligned with each other, pointing in the same direction.
The twenty-ninth point is during the time period from 28. 10. 2011 to 25. 12. 2011. In this period, the EUR had 83.3 percent of high impact data that met or surpassed the market consensus and 50 percent of medium impact data that met or surpassed the market consensus. In the same period, the USD had 85.7 the same percent of high impact data that met or surpassed the market consensus and 56.8 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the USD side, meaning that from an economic data standpoint the price should go down, favouring the dollar. The Elliott Wave Theory was aligned with the economic data, signalling the price to go down since wave X was completed. The next expected wave is wave (A) of wave A pointing downward. The economic data and the EWT are aligned with each other, pointing in the same direction.

The last point chosen is from 06. 09. 2010 to 08. 10. 2010. In this period, the EUR had 50 percent of high impact data that met or surpassed the market consensus and 67.6 percent of medium impact data that met or surpassed the market consensus. In the same period, the USD had 50 percent of high impact data that met or surpassed the market consensus and 61.5 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint the price should go up, favouring the euro. The Elliott Wave Theory was aligned with the economic data, signalling the price to go up since wave C was completed. The next expected wave is wave (A) of wave X pointing upward. The economic data and the EWT are aligned with each other, pointing in the same direction.

Appendix 10: Brief description of the ten observed points (time intervals) from the four-month framed statistical analysis, as presented in table number 2 in the thesis (p. 57).

The first point chosen is the time interval between 04. 06. 2010 and 01. 10. 2010. In this period, the EUR had 60.6 percent of high impact data that met or surpassed the market consensus and 56.3 percent of medium impact data that met or surpassed the market consensus. In the same period, the USD had 60.4 percent of high impact data that met or surpassed the market consensus and 47.8 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint the euro price should go up. The Elliott Wave Theory also signalled for the price to go up because wave C of wave Y was completed. Consequently, the next expected wave is wave A of wave X going up. The economic data and the EWT are aligned with each other, pointing in the same upward direction.

My second chosen point is the time interval from 10. 01. 2011 to 06. 05. 2011. In this period, the EUR had 68.8 percent of high impact data that met or surpassed the market

consensus and 60.9 percent of medium impact data that met or surpassed the market consensus. In the same period, the USD had 72.7 percent of high impact data that met or surpassed the market consensus and 56 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the USD side, meaning that from an economic data standpoint the price should go down, favouring the dollar. The Elliott Wave Theory signalled the price to go up because Wave C of wave Y was completed. Consequently, the next expected wave is wave C of wave X going up. The economic data and the EWT are not aligned with each other. Judging solely from the economic data standpoint the price should go up, however, it moved down as was signalled by the EWT.

The third point is the time interval from 25. 08. 2011 to 23. 12. 2011. In this period, the EUR had 71.4 percent of high impact data that met or surpassed the market consensus and 55 percent of medium impact data that met or surpassed the market consensus. During the same period, USD had a weaker ratio, in detail it had 74.2 percent of high impact data that met or surpassed the market consensus and 54.9 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the USD side, meaning that from an economic data standpoint the dollar price should go down. The Elliott Wave Theory also signalled the price to go down because wave X was completed, meaning the next expected wave is wave A of wave A going down. The economic data and the EWT are aligned with each other, pointing in the same downward direction.

The fourth point is the time interval from 28. 2. 2012 to 29. 06. 2012. In this period the EUR had 70.5 percent of high impact data that met or surpassed the market consensus and 50 percent of medium impact data that met or surpassed the market consensus. In the same period the USD had 71.1 percent of high impact data that met or surpassed the market consensus and 47.1 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the USD side, meaning that from an economic data standpoint the price should go down, favouring the dollar. The Elliott Wave Theory also signalled for the price to go down because wave B of wave A was completed. Consequently, the next expected wave is wave C of wave A pointing downward. The economic data and the EWT are aligned with each other, pointing in the same downward direction.

My fifth point is the time interval between 01. 09. 2014 and 03. 12. 2015. In this period, the EUR had 60 percent of high impact data that met or surpassed the market consensus and 57.5 percent of medium impact data that met or surpassed the market consensus. In the same period, the USD had only 51.3 percent of high impact data that met or surpassed the market consensus and 48.5 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint the euro price should go up. The Elliott Wave Theory signalled that the price should go down because wave B was completed. The next expected

wave is wave C going down. The economic data and the EWT are not aligned with each other and judging from the economic data standpoint the price should go up, however, it moved down as was signalled by the EWT.

The sixth chosen time interval is from 05. 05. 2014 to 06. 09. 2014. In this period, the EUR had 56.4 percent of high impact data that met or surpassed the market consensus and 47.9 percent of medium impact data that met or surpassed the market consensus. In the same period, the USD had 58.4 percent of high impact data that met or surpassed the market consensus and 58.9 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the USD side, meaning that from an economic data standpoint the price should go down, favouring the dollar. The Elliott Wave Theory also signalled for the price to go down because wave B completed. Consequently, the next expected wave is wave C pointing downward. The economic data and the EWT are aligned with each other, pointing in the same downward direction.

My seventh point is from the time period of 21. 08. 2015 to 04. 12. 2015. In this period, the EUR had 60.4 percent of high impact data that met or surpassed the market consensus and 64.5 percent of medium impact data that met or surpassed the market consensus. In the same period, the USD had 49.5 percent of high impact data that met or surpassed the market consensus and 46.6 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint the price should go up, favouring the euro. The Elliott Wave Theory was not aligned with the economic data. It was signalling for the price to go down since wave A was completed and next wave is wave B pointing down. The economic data and the EWT are not aligned with each other and judging just from an economic data standpoint the price should go up, however, it moved down as it was signalled by the EWT.

The eight point is the time period from 10. 04. 2017 to 11. 08. 2017. In this period, the EUR had 78.2 percent of high impact data that met or surpassed the market consensus and 68.6 percent of medium impact data that met or surpassed the market consensus. In the same period, the USD had 54.7 percent of high impact data that met or surpassed the market consensus and 55.7 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint the price should go up, favouring the euro. The Elliott Wave Theory also signalled for the price to go up since wave B was completed. Consequently, the next expected wave is wave C going up. The economic data and the EWT are aligned with each other, pointing in the same upward direction.

The ninth point chosen is for the time period between 26. 12. 2016 and 11. 04. 2017. In this period, the EUR had 68 percent of high impact data that met or surpassed the market consensus and 75.5 percent of medium impact data that met or surpassed the market

consensus. In the same period, the USD had 50.8 percent of high impact data that met or surpassed the market consensus and 51 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint the price should go up, favouring the euro. The Elliott Wave Theory also signalled for the price to go up since wave B was completed. Consequently, the next expected wave is wave C going up. The economic data and the EWT are aligned with each other, pointing in the same upward direction.

The tenth and final point chosen is the time period from 30. 11. 2015 to 01. 03. 2016. In this period, the EUR had 61.5 percent of high impact data which met or surpassed the market consensus and 54.8 percent of medium impact data which met or surpassed the market consensus. In the same period, the USD had 58.2 percent of high impact data that met or surpassed the market consensus and 44.9 percent of medium impact data that met or surpassed the market consensus. Overall, the better economic data was on the EUR side, meaning that from an economic data standpoint the price should go up, favouring the euro. The Elliott Wave Theory was aligned with the economic data, signalling for the price to go up since wave (a) of wave B was completed. The next expected wave is the corrective wave (b) of wave B pointing upward. The economic data and the EWT are aligned with each other, pointing in the same downward direction.

Example of data for time interval number 1: time period 15. 4. 2015 to 16. 5. 2015 as seen in table number 3 bellow.
Based on the EWT theory, on a yearly chart we can see that wave Y was completed, and this is confirmed due to a completed sub-wave C in flat correction. In the period from 14. 7. 2008 to 14. 5. 2015 we are in a completed double three correction with possibility of a triple three correction. If a triple three correction will develop, then we need another wave X and wave Z. The first wave is wave X, which can be any corrective pattern except for a triangle, double or triple three. Consequently, wave X can develop into any type of flat or single zigzag correction. If we assume that a triple three correction is not on the cards, then we can expect a new cycle of rising EUR with a big potential for a strong EUR for the next couple of years. However, if a triple three correction will manifest, then we can first expect A, B, C waves up to a complete first leg of a bigger A wave. If a flat correction is manifesting, then we should see 3 waves for sub-wave A of wave A, 3 legs for sub-wave B of wave A and five legs for sub-wave C of wave A. On the other hand, if a zigzag correction will follow, we should count 5 waves for sub-wave A of wave X, 3 waves for sub-wave B of wave X and 5 waves for sub-wave C of wave X. It is always important to check the price and wave development on a daily basis, since it is impossible to exactly forecast precisely how waves will develop in a corrective structure.

Appendix 11: Economic data for EMU and US in chosen time period from 15.4 to 16.5.2015.

	15. 4. 2015 - 16. 5. 2015					
Indentified Elliott wave pattern	Wave C of wave Y in zigzag was completed on 13.5					
Expected upcoming wave	Wave A					
Expected wave direction	Up					
Fundamentals	HIGH IMPACT DATA			HIGH IMPACT DATA		
	Event	Consensus	Actual	Event	Consensus	Actual
	(European Monetary Union) ECB Interest Rate Decision	0.05%	0.05%	(United States) Building Permits (MoM)	1.08M	1.04M
	(European Monetary Union) Consumer Price Index - Core (YoY)	0.60%	0.60%	(United States) Initial Jobless Claims	280.0K	294.00K
	(European Monetary Union) Consumer Price Index (YoY)	-0.10%	-0.10%	(United States) Consumer Price Index (YoY)	0.00%	-0.10%
	(Germany) ZEW Survey - Economic Sentiment	55.3	53.3	(United States) Consumer Price Index Ex Food & Energy (YoY)	1.70%	1.80%
	(France) Markit Manufacturing PMI	49.2	48.4	(United States) Reuters/Michigan Consumer Sentiment Index	94	95.9
	(Germany) Markit Manufacturing PMI	53	51.9	(United States) Existing Home Sales (MoM)	5.03M	5.19M
	(Germany) Unemployment Change	-13.0K	-8.00K	(United States) Initial Jobless Claims	290.0K	295.00K
	(Germany) Unemployment Rate s.a.	6.40%	6.40%	(United States) New Home Sales (MoM)	0.513M	0.48M
	(Italy) Unemployment	12.60%	13.00%	(United States) Durable Goods Orders	0.60%	4.00%
	(European Monetary Union) Consumer Price Index - Core (YoY)	0.60%	0.60%	(United States) Durable Goods Orders ex Transportation	0.30%	-0.20%
	(European Monetary Union) Consumer Price Index (YoY)	0.00%	0.00%	(United States) Consumer Confidence	101.6	95.2
	(Spain) Markit Manufacturing PMI	54.7	54.2	(United States) Gross Domestic Product Annualized	1.10%	0.20%
	(Italy) Markit Manufacturing PMI	53.5	53.8	(United States) Fed Interest Rate Decision	0.25%	0.25%
	(France) Markit Manufacturing PMI	48.4	48	(United States) Initial Jobless Claims	290.0K	262.00K
	(Germany) Markit Manufacturing PMI	51.9	52.1	(United States) ISM Manufacturing PMI	52	51.5
	(Greece) Markit Manufacturing PMI	48.9	46.5	(United States) Reuters/Michigan Consumer Sentiment Index	96	95.9
	(Austria) Unemployment	360K	352.00K	(United States) Trade Balance	$-41.2B	-$51.37B
	(Spain) Unemployment Change	-64.8K	-118.90K	(United States) ISM Non-Manufacturing PMI	56.2	57.8
	(Germany) Gross Domestic Product s.a (QoQ)	0.50%	0.30%	(United States) ADP Employment Change	200.0K	169.00K
	(European Monetary Union) Gross Domestic Product s.a. (YoY)	1.10%	1.00%	(United States) Initial Jobless Claims	280.0K	265.00K
	10/20= 50			(United States) Nonfarm Payrolls	224.0K	223.00K
				(United States) Unemployment Rate	5.40%	5.40%
				(United States) JOLTS Job Openings	5.1M	4.99M
				(United States) Retail Sales (MoM)	0.20%	0.00%
				(United States) Retail Sales ex Autos (MoM)	0.50%	0.10%
				(United States) Initial Jobless Claims	275.0K	264.00K
				(United States) Reuters/Michigan Consumer Sentiment Index	96	88.6
				10/27=37		
				MEDIUM IMPACT DATA		
	MEDIUM IMPACT DATA			Event	Consensus	Actual
	Event	Consensus	Actual	(United States) Capacity Utilization	78.70%	78.40%
	(Germany) Consumer Price Index (YoY)	0.30%	0.30%	(United States) Industrial Production (MoM)	-0.30%	-0.60%
	(Germany) Consumer Price Index (MoM)	0.50%	0.50%	(United States) NAHB Housing Market Index	55	56
	(Germany) Harmonised Index of Consumer Prices (MoM)	0.50%	0.50%	(United States) Continuing Jobless Claims	2.312M	2.27M
	(Germany) Harmonised Index of Consumer Prices (YoY)	0.10%	0.10%	(United States) Housing Starts (MoM)	1.04M	0.93M
	(Germany) ZEW Survey - Current Situation	56	70.2	(United States) Philadelphia Fed Manufacturing Survey	6	7.5
	(European Monetary Union) ZEW Survey - Economic Sentiment	63.7	64.8	(United States) Consumer Price Index (MoM)	0.30%	0.20%
	(European Monetary Union) Consumer Confidence	-2.75	-4.6	(United States) Consumer Price Index Ex Food & Energy (MoM)	0.20%	0.20%
	(Germany) Gfk Consumer Confidence Survey	10.2	10.1	(United States) Existing Home Sales Change (MoM)	3.00%	6.10%
	(European Monetary Union) Markit Manufacturing PMI	52.6	51.9	(United States) Continuing Jobless Claims	2.3M	2.33M
	(Germany) IFO - Business Climate	108.4	108.6	(United States) Markit Manufacturing PMI	55.5	54.2
	(Germany) IFO - Current Assessment	112.4	113.9	(United States) Markit Services PMI	59.5	57.8
	(Germany) IFO - Expectations	104.5	103.5	(United States) Gross Domestic Product Price Index	0.40%	-0.10%
	(European Monetary Union) Consumer Confidence	-4.6	-4.6	(United States) Continuing Jobless Claims	2.3M	2.25M
	(Germany) Consumer Price Index (MoM)	-0.10%	-0.10%	(United States) Personal Income (MoM)	0.20%	0.00%
	(Germany) Consumer Price Index (YoY)	0.40%	0.40%	(United States) Personal Spending	0.50%	0.40%
	(Germany) Harmonised Index of Consumer Prices (MoM)	-0.10%	-0.10%	(United States) Chicago Purchasing Managers' Index	50	52.3
	(Germany) Harmonised Index of Consumer Prices (YoY)	0.20%	0.30%	(United States) Construction Spending (MoM)	0.50%	-0.60%
	(Germany) Retail Sales (MoM)	0.40%	-2.30%	(United States) Factory Orders (MoM)	2.00%	2.10%
	(Germany) Retail Sales (YoY)	3.20%	3.50%	(United States) Markit Services PMI	57.8	57.4
	(European Monetary Union) Unemployment Rate	11.20%	11.30%	(United States) Continuing Jobless Claims	2.28M	2.23M
	(European Monetary Union) Markit Manufacturing PMI	51.9	52	(United States) Consumer Credit Change	$16.0B	$20.52B
	(Spain) Markit Services PMI	57.4	60.3	(United States) Average Weekly Hours	34.5	34.5
	(European Monetary Union) Retail Sales (YoY)	2.40%	1.60%	(United States) Monthly Budget Statement	$154.8B	$156.70B
	(Germany) Trade Balance s.a.	19.7B	19.30B	(United States) Import Price Index (MoM)	0.30%	-0.30%
	(Germany) Gross Domestic Product n.s.a (YoY)	1.20%	1.10%	(United States) Continuing Jobless Claims	2.24M	2.23M
	(Germany) Consumer Price Index (YoY)	0.40%	0.50%	(United States) Industrial Production (MoM)	0.10%	-0.30%
	(Germany) Consumer Price Index (MoM)	-0.10%	0.00%	(United States) Capacity Utilization	78.40%	78.20%
	(Germany) Harmonised Index of Consumer Prices (YoY)	0.30%	0.30%	13/28=46.4		
	(Germany) Harmonised Index of Consumer Prices (MoM)	-0.10%	-0.10%			
	(Italy) Gross Domestic Product (YoY)	-0.20%	0.00%			
	(European Monetary Union) Gross Domestic Product s.a. (QoQ)	0.50%	0.40%			
	(European Monetary Union) Industrial Production w.d.a. (YoY)	1.80%	1.80%			
	(European Monetary Union) Industrial Production s.a. (MoM)	0.00%	-0.30%			
	23/33=69.7					

Source: Own work.

Appendix 12: Possible example of upcoming flat correction.

Source: Own work.

Appendix 13: Possible example of upcoming Zigzag correction.

Source: Own work.