

**CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE
FACULTY OF ECONOMICS AND MANAGEMENT
DEPARTMENT OF ECONOMICS**

Bachelor Thesis

**FOREIGN EXCHANGE –
ECONOMIC ANALYSIS OF
EUR/USD CURRENCY PAIR**

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Statutory Declaration

I hereby declare that this bachelor thesis “Economic analysis of foreign exchange rates: The EUR/USD currency pair” has been written solely by myself, the submitting individual. I have marked all quotations in the text and all materials used for this research are listed in the List of Sources Used section. Furthermore, I confirm that no sources have been used for this paper other than those indicated in the thesis itself.

In Prague, March 2014

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Summary

Bachelor thesis title: Foreign exchange – Economic analysis of EUR/USD Currency Pair

Summary:

Based on analyses of the EUR/USD from January 1999 to September 2013, this paper focuses on evaluating key factors affecting the pair and provides recommendation for its future. Economic situations in the Eurozone and in the USA are compared, with explanation for major spikes and breaks in the EUR/USD fluctuations due to sudden political and economic events. These irregularities and their causes are explained correspondingly to signals identified by technical analysis. Prominent trends, resistances and supports are also pointed out and a regression model is established using the OLS method. This project employs qualitative, quantitative, fundamental, technical, trend and regression analyses. Microsoft Office, gretl software and graph-generating websites are main tools used. The trends, resistances, supports and short-term prognosis are proved to be valid yet the estimated regression model is spurious.

Keywords: foreign exchange, interest rate, economy, Euro, USD, EUR/USD, fundamental analysis, technical analysis, regression analysis, central bank intervention.

Název bakalářské práce: Trh cizích měn - Ekonomická analýza měnového páru EUR/USD

Přehled:

Směnné kurzy jsou jedním z nepostradatelných prvků hospodářství zatímco určení směnného kurzu zůstává kontroverzní, platící zejména pro plovoucí režim. Na základě analýz dat EUR/USD od ledna 1999 do září 2013, se tato práce zaměřuje na vyhodnocení některých klíčových faktorů, které ovlivňují tuto směnnou dvojici a poskytují doporučení pro budoucnost. Ekonomické situace v Eurozóně a v USA jsou vzájemně porovnávány a společně s tím jsou vysvětleny výkyvy a nesrovnalosti v kolísání směnného kurzu jako důsledku náhlých a nepředvídatelných politických a ekonomických událostí. Tyto nesrovnalosti a jejich příčiny jsou vysvětleny odpovídajícím signálům identifikovaným technickou analýzou. Hlavní trendy, stejně jako překážky a stimulanty, jsou identifikovány, vysvětleny a za pomoci metody OLS regresní analýzy stanoveny. Hlavní nástroje použité v této práci jsou Microsoft Office, Gretl software a webové stránky pro vytváření grafů. Trend a krátkodobá předpověď jsou potvrzeny jako platné, nicméně regresní model je neprůkazný.

Klíčová slova: Směnný kurz, úroková míra, ekonomika, Euro, USD, EUR/USD, základní analýza, technická analýza, regresní analýza, intervence centrální banky.

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1. Introduction

Foreign exchange has been an indispensable part of the global open economy. Exchange rates may affect every aspect of modern life, being closely observed and scrutinized by governments, corporate giants, commercial firms and individuals. With such attention, movements of the currency rates are analysed frequently on a daily basis for both short run and long run. Recent decades have witnessed some major changes, including the adoption of floating exchange rate regimes and the launch of a supranational currency – the euro.

The EUR/USD is unique with peculiar characteristics. It is the most actively traded pair, whose rates change almost every second or even milli-second. These currencies are run by two of the strongest economic regions in the world and this pair has always been operated under the floating exchange rate regimes. It is widely recognized that each movement of the EUR/USD can affect the global economy as a whole. This new currency pair was launched a mere 14 years ago, yet had become of the utmost importance.

An enormous amount of research has been conducted to evaluate, examine and speculate about exchange rates up until now. Since the 1960s, exchange rate economics have developed remarkably, partially thanks to the improvements in Econometrics, data quality and the availability of information in real time.¹ However, many theories still remain controversial due partially to recent unexpected events, namely the financial crisis or the invasion of Iraq. In brief, no existing models are universally accepted as standing the test of time.

The next section presents the objectives of this study and the methodology adopted, followed by an exhaustive review of theoretical foundation in section 3. The foreign exchange fundamentals are explored with relevant definitions and description of the most important properties of its market on a global and a national scales. Several approaches of foreign exchange determination are also pointed out, focusing on the studies for the floating regime under which the EUR/USD operates. The theoretical framework of foreign exchange is built upon widely acknowledged literature such as *International economics: Theory and Policy* by Krugman and Obstfeld, *The economics of exchange rates* by Sarno

¹ Sarno, L., Taylor, M., *The economics of exchange rates*, pg. 1

and Taylor, *Macroeconomics* by Mankiw, *Currency Forecasting* by Rosenberg, trusted online resources Investopedia and other materials.

Section 4 begins with a brief summary regarding two currencies and the pair in question before paying attention to main analyses. The development of the euro and the U.S. dollar is described, with much focus on the economic aspects whilst major determinants of the exchange rate are indicated and explained with underpinning reasons. More profound analyses follows, scrutinising data collected, distinctive characteristics of the pair and its dominant trends. A regression model has been built to test the statistical significance of the examined determinants of the EUR/USD exchange rates from February 1999 to September 2013. On a cross-sectional basis, which is fairly an ad hoc approach along with further improvements suggested by Kohlhagen in 1978, the most substantial macroeconomic indicators are used as independent variables in the model. It is the case provided that the widely recognized assumption is observed: long-term exchange rates reflect the true health of an economy compared to that of another. Some short-term prognoses have been made based on the available data.

Afterwards, section 5 evaluates the quality of all findings. Several statistical tests have been performed to test the validation of the model. Problems and drawbacks of the model have then been shown and examined. Finally, these forecasts have been verified by evidence that has been newly retrieved after the examined period.

2. Thesis Objectives and Methodology

2.1. Objectives

Based on analyses of the EUR/USD exchange pair during the fourteen-year period until September 2013, this paper will focus on evaluating some key determinants affecting this exchange rate and providing recommendations of its future. The comparison of the economic situations of the Eurozone and the USA will be pointed out.

Two research questions which are followed in this paper are:

1. What are the main economic factors that have determined the exchange rate of the EUR/USD from 1999 to 2013?

2. To what extent have these factors affected the movement of the pair and have these movements been short term only?

2.2. Methodology

In order to determine main economic factors influencing the EUR/USD exchange rate and evaluate the extent of their significance, the following methods are employed: qualitative, fundamental, technical, quantitative, time series, regression analysis, trend analysis, and prognosis analysis.

Particularly, the first two methods help identify the intrinsic factors in a rational way, based on reliable theories, valid grounds and historical exchange rate movement in various perspectives. Besides, the time series analysis justifies the reliability and appropriateness of retrieved data set for the purpose of later research operation. It takes such internal structure as seasonality, real or nominal basis and autocorrelation into account. The analysis concerning traders' behaviour, in addition, describes the subjective opinion and mentality of participants in the currency market. After that, regression analysis with OLS method and trend analysis will be used to identify the significance of selected variables found by the mentioned measures above. Several necessary statistical tests will also be conducted to profoundly support this thesis.

Main tools that provide aid to this thesis include Microsoft Office®, gretl software, trading platforms (Plus500™, OANDA®) and some graph-generating websites such as www.finance.yahoo.com.

3. Theoretical Foundation

3.1. Definitions

There are numerous definitions of the term “foreign exchange” (forex, or FX). Archer simplifies the term, defining foreign exchange as “the simultaneous buying of one currency and selling of another”.² From a different perspective, Cross states: “foreign exchange refers to money denominated in the currency of another nation or group of nations. Any

² Archer, M., *Getting Started in Currency Trading: Winning in Today's Forex Market*, pg. 3

person who exchanges money denominated in his own nation's currency for money denominated in another nation's currency acquires foreign exchange.”³

Foreign exchange market (or currency market) is “the market in which international currency trades take place”, in which “the price of one currency in terms of another” is an exchange rate.⁴ “The conversion of one currency to another at an agreed exchange rate”⁵ is a forex transaction; and currency exchange deals encompass everything from converting money by travellers or importing billion dollars' worth of overseas products by multinationals.

A “pip” is the smallest change of a currency price, equivalent to one unit of the last decimal point. A typical EUR/USD rate is quoted to four decimal places, say 1.2345, and when it increases to 1.2348, it is called as a growth of 3 (8 less 5) pips.

3.2. History of foreign exchange and exchange rate regimes

The history of currency exchange was traced back to the ancient time with “money changers” as an intermediary, as noted by Bromiley.⁶ He points out that money changing in this era were essential for merchants to trade animals and to pay taxes with foreign coins brought by Jews.

However, not until the nineteenth century was the first official mean of foreign exchange created – the Gold Standard System. The system predetermined a fixed exchange rate of each pair of currencies whose value was backed by a certain quantity of gold. From 1821 to 1914, the Gold Standard was adopted by the majority of developed countries, including England, Germany and the U.S., showing its success throughout the period of world prosperity. The inability of gold as a base of global monetary system was then proved during and after the World War I, since the Gold Standard seemed to aggravate the contemporary economic difficulties. As a result, the system was gradually suspended all over the world, leaving no links between a currency and gold by 1971.

³ Cross, S., *All about the Foreign Exchange Market in the United States*, pg. 9

⁴ Krugman, P., *International Economics*, pg. 310

⁵ Western Union, *Foreign exchange transactions – Product disclosure statement*, pg. 5

⁶ Bromiley, G., *The International Standard Bible Encyclopedia*, pg. 408-409

In July 1944, the Bretton Woods System was devised to enable some flexible movements of exchange rates within narrow limits whilst ensuring its steadiness, mentioned by Weisweiller.⁷ The author claims that these limits were set by ‘intervention points’; such that fixed parity of a currency against the U.S. dollar was allowed to fluctuate within a maximum margin of 1% either side of that parity, and might be intervened by central banks whenever the exchange rate tended to exceed that level. Meanwhile, despite proving beneficial to the dramatic economic growth of Western nations, the Bretton Woods system was still criticized by him and other scientists mainly due to its relative inflexibility. Eventually, this system was totally abandoned in 1971⁸, paving the way for flexible exchange rates.

The period of floating exchange rates commenced in the late 1970s. A publication of the International Monetary Fund (IMF) lists eight regimes existing nowadays: (1) exchange arrangements with no separate legal tender (i.e. dollarization and euroization), (2) currency board arrangements, (3) other conventional peg arrangements, (4) pegged exchange rates within horizontal bands, (5) crawling pegs, (6) exchange rates within crawling bands, (7) managed floating with no predetermined path for the exchange rates and (8) independent floating.⁹ As can be seen in the report, the regimes number (1), (3), (7) and (8) as the *de facto* regimes supported by the vast majority of nations. In the independent floating that the exchange rate is market-determined, “with official [...] intervention aimed at moderating the rate of change”, explained the article.

3.3. Overview of current forex markets and main participants

It is obviously true that foreign exchange has been an indispensable part of international trade, foreign-exchange reserves and economic stabilization of all nations. The global currency market is the largest financial market in the world. According to BIS Triennial Central Bank Surveys in 2013, this market has witnessed massive volume of trade every

⁷ Weisweiller, R., *Introduction to Foreign Exchange*, pg. 48-53

⁸ Geisst, C., *Encyclopedia of American Business History*, pg. 58

⁹ IMF, *Classification of Exchange Rate Arrangements and Monetary Policy Frameworks*

day that continuously rockets, with average daily turnover of \$5.3 trillion in April 2013, a 61% increase at current exchange rate from 2007 and a fourfold rise from 2001.¹⁰

Two unique features of the foreign exchange markets are the hours and location of trading. The international market operates in multiple time zones; hence it is open 24 hours a day from 5 p.m. on Sunday until 4 p.m. on Friday (EST time). During this period, numerous financial institutions, firms and individual dealers all over the world may access to continuous possibility to trade major currencies, to which the EUR/USD belongs. On the other hand, many less popular pairs such as the EUR/CZK are only open during certain market hours. With regards to the trading location, whereas in the past a few physical meeting places called “foreign exchange bourse”¹¹ are reported to exist, there is no trading floor for currency nowadays, discounting such places as exchange kiosks or cash desks at commercial banks. Electronic communication networks (ECNs) and phone networks instead play the role of the marketplace, which connect major currency trading centres. Some serve institutional investors and some are designed for individuals.

Based on the purpose of currency trading, four major groups of actors in the forex market are (1) governments and central banks, (2) banks and other financial institutions, (3) hedgers and (4) speculators. The first two groups are the most influential.

The first class of market participants consists of decision makers of monetary policy aiming at achieving certain economic goals by controlling reserve volumes. Effects of central bank transactions might be large regardless of the volume, pointed out by Krugman and Obstfeld.¹² Central bank intervention in the markets possibly results in significant impact, which will be discussed in section 4.5.4. Meanwhile, commercial banks and non-bank financial institutions dominate the market in terms of both volumes and number of transactions. They transact massive values of interbank trading and are able to determine the less favourable retail price of currencies for individual traders.

¹⁰ BIS, *Triennial Central Bank Survey Foreign exchange turnover in April 2013: preliminary global results*, pg. 9

¹¹ Weisweiller, R., *Introduction to Foreign Exchange*

¹² Krugman, P., *International Economics*, pg. 311

Differently, hedgers are mostly risk-avoiding corporations and companies whose operations require foreign currencies. These bodies usually use forwards or futures contracts to settle their payments at a desirable exchange rate, thus eliminating uncertainty and potential losses. Speculators, in contrast, are risk takers who expect to obtain profits from fluctuations of exchange rates. George Soros, Stanley Druckenmiller and Andy Krieger are well-known for their forecasting ability and transactions with multimillion dollar profit. When they gained, others lost; it is undoubted that speculators can remarkably affect a nation's economy and its currency value.

As a matter of fact, it is apparent that traders of the EUR/USD have not been located centrally in prominent exchange centers since almost every nation's financial institutions, banks and individuals involve in trading of this pair.

3.4. Some approaches to exchange rate determination and assessments

According to Weisweiller in 1984, most of the popularly accepted theories by then are intrinsically valid neither to explain past movements of exchange rates nor to forecast their future trends. He argues that popular academic support of these theories at a particular period along with the influence of the media turned these theories into self-fulfilling prophecies, because the so-called "pointers" inferred from them "will be acted upon".¹³ Later on, a number of studies in the recent two decades, with the help of advanced econometric and computerized tools, attempted to prove the validation, revive those theories and added improvements to minimize their unrealistic assumptions.

3.4.1. Purchasing Power Parity (PPP) and Real Exchange Rate

As one of the oldest theories, purchasing power parity theory of money regards inflation rates as the sole indicator of exchange rate development. In most of foreign exchange literatures, this theory is based upon the *law of one price*. Simply put, identical goods have the same price in all countries if expressed in terms of one single currency when there is no profitable arbitrage, provided that the goods are tradable and perfectly homogenous, stated

¹³ Weisweiller, R., *Introduction to Foreign Exchange*, pg. 134-135

Rosenberg.¹⁴ Being generally considered as “absolute PPP”, this concept emphasizes that one unit of a currency would have the same purchasing power in both countries concerned. In particular, the ratio of a country’s price level (P_A) to the other’s price level (P_B) entirely determines their currency exchange rate ($R_{A/B}$) at equilibrium in the long-run:

$$R_{A/B} = P_A/P_B. \quad (Formula\ 4.4.1.1)$$

The simple form of PPP was disproved due to some apparent drawbacks. Obviously, when the price level is driven by the supply-demand relation of money and exchange rates depend on price levels, it can be inferred that monetary factors totally control the level of forex rates. However, in most cases, the law of one price fails to hold owing to real life factors and various complicated issues, such as product differentiation across countries and resource discoveries.¹⁶

In order to avoid the above restrictive assumptions and disadvantages, the relative version of PPP focuses on changes instead of price indices. According to Rosenberg’s *Currency Forecasting*, the percentage changes in the price levels in the two economies directly control the percentage difference of the equilibrium forex rate:

$$\% \Delta R_{A/B} = \% \Delta P_A - \% \Delta P_B. \quad (Formula\ 4.4.1.2)$$

As a result, the exchange rates will alter correspondingly to the relative differential rates of inflation. Most importantly, Rosenberg then emphasized that the relative PPP is believed to hold valid until the stability of the factors causing deviations from absolute PPP maintains overtime, despite such systematic problems as the choice of price indices and their base period.

The concept of real exchange rates (i.e. nominal rates adjusted to relative price level) was then established as a further development of the PPP theory:

$$R_{A/B\ (real)} = R_{A/B\ (nominal)} \times P_A/P_B. \quad (Formula\ 4.4.1.4)$$

¹⁴ Rosenberg, M., *Currency forecasting: A Guide to Fundamental and Technical Models of Exchange Rate Determination*, pg. 12

¹⁵ Ibid, pg. 8

¹⁶ Sarno, L., Taylor, M., *The economics of exchange rates*, pg. 52-54

A variety of research, both theoretically and empirically, has then undergone to solve a difficult question of whether the real exchange rates follow a process of mean reverting or random walk. Since the changes in nominal rates offset that in relative price level, only if the real exchange rates gravitate around an unchanged level will PPP valid in the long-run.¹⁷

In order to explain the position of PPP in currency determination, some prominent assessments since 1970s to date should be considered. An article related to the collapse of PPP written in 1981 by Frenkel totally rejected the PPP theory due to significant departures from PPP occurring in the short-term as recorded in the past. Yet long-term reverting to PPP is proved to be valid thanks to numerous tests by Froot and Rogoff in 1994, despite data from the fixed exchange rate regime attributing as the most powerful evidence. Similarly, purchasing power parity is generally concluded to be an effective theory for forex estimation over long-term horizons by Rosenberg in 1996. After that, in 2002, Taylor & Sarno argued for the theory, quoted “PPP might be viewed valid long-run international parity condition when applied to bilateral exchange rates obtaining among major industrialized countries, and that mean-reversion in real exchange rates displays significant non-linearities”.¹⁸ They also suggested further work on the impact of prices and the nominal exchange rates on the real forex rates.

3.4.2. The Monetary approach

Whilst the PPP approach concentrates on inflation rates, the monetary approach also emphasizes the importance of interest rates. It is explained that a currency with high interest rates is “suspect and should be sold”,¹⁹ therefore when possessing a suspicious currency people are immediately willing to sell it. This leads to the situation in which there are few lenders and many borrowers, which eventually leads to high interest rates. It is the fact that in the 1980s, monetarist economics valued the relation between money supply and productivity. However, the view of many contemporary governments that interest rates can significantly forecast the movement of future exchange rates was considered as

¹⁷ Rosenberg, M., *Currency forecasting: A Guide to Fundamental and Technical Models of Exchange Rate Determination*, pg. 14-21

¹⁸ Sarno, L., Taylor, M., *The economics of exchange rates*, pg. 87

¹⁹ Weisweiler, R., *Introduction to Foreign Exchange*, pg. 135-136

oversimplified; and movements of foreign exchange rates are far more crucial than interest rate differentials between currencies themselves, as assessed also by this researcher.

Various forms of the monetary approach were established and tested in the last four decades. In particular, the flexible-price version by Frenkel (1976) takes three fundamental determinants into account: monetary equilibrium of supply and demand, real income and expected inflation rates or expected monetary growth rates.²⁰ In order to remedy the invalid assumption of PPP hold in the short and medium run of Frenkel, Dornbusch's sticky-price model (1976) employs only the PPP's long-term assumption, as well as introduced the hypothesis of overshooting. Furthermore, official market intervention was an additional explanatory variable in the model of Roper and Girton (1976).²¹ In 1979, the real interest rate differential model termed by Frankel includes real exchange rate differentials to the flexible-price version whilst assuming validation of PPP only in the long-run.²² After that, Hooper and Morton alleviated the failure of the monetary approach caused by impacts of current account deficits and added "the effect of shifts in the current account balance plus official intervention on the risk premium" to the monetary function.²³

On the one hand, the monetary models were proved as flawed with generally unsatisfactory evidence to explain the path of exchange rates by Dornbusch (1980), Boughton (1988) and Rosenberg (1996).²⁴ On the other hand, some recent studies attempted to resurrect the monetary approach. For instance, a working paper of Bjørnland (2009) for Norway's Central Bank strongly supports Dornbusch's overshooting concept. Additionally, a version of this approach was backed by a statistical research by Azar

²⁰ Frankel, J.A., *Tests of Monetary and Portfolio Balance Models of Exchange Rate Determination*, pg. 240

²¹ Girton, L., Roper, D., *A monetary model of exchange market pressure applied to the post-war Canadian experience*, pg. 1-17

²² Frankel, J.A., *On the Mark: A Theory of Floating Exchange Rates Based on Real Interest Rate Differentials*, pg. 610-622

²³ Hooper, Peter and Morton, John. *Fluctuations in the Dollar: A Model of Nominal and Real Exchange Rate Determination*, pg. 1-19

²⁴ Rosenberg, Michael R. *Currency Forecasting: A Guide to Fundamental and Technical Models of Exchange Rate Determination*, pg. 157-162

(2012) for the case of the USD in the floating regime.²⁵ Nonetheless, this approach highlights the crucial impact of monetary policies on the exchange rate movements.

3.4.3. The Balance of Payment (BOP) approach

This approach bases on the most fundamental basis of exchange rate: it is the price of a national currency in the international forex market. Hence, the balance of exports and imports, or supply and demand, of the currency is expressed by the forex rate; i.e. when the balance moves the exchange rate changes correspondingly. A distinct characteristic

According to Sarno and Taylor, the assumption of “imperfect substitutability between domestic & foreign assets” is a distinct characteristic of the balance of payment approach. They believed that the level of foreign exchange depended on “supply of and demand for financial assets, at least in the short-run”; such that “surplus in current account balance is associated with a rise in net domestic holdings of foreign assets, which influences the level of wealth, and in turn the level of the demand for assets, which ultimately affects exchange rates”.

Indeed, the BOP model concerns the supply and demand of money and bonds, which are assets from both domestic and overseas nations. When the equilibrium level of domestic assets, that of foreign assets and that of money intersect, the equilibrium levels of interest rates and the exchange rates is achieved.²⁶

Nevertheless, this approach is still incomplete because the trade figures may not be the single valid indicator of exchange rate determination, because money inflows and outflows, investments inward and outward and other related issues may also contribute.

3.4.4. Other possible determinants

The sentiment of the major market operators in the forex market is believed by many researchers to be a possibly stronger than the force of the government. Their announcements and actions may extensively influence how the other market actors will behave. This psychological reality was once described as “collective emotions” or

²⁵ Azar, S., *Retesting the Monetary Approach to Foreign Exchange Rates: The Case of the US Dollar*, pg. 56

²⁶ Sarno, L., Taylor, M., *The economics of exchange rates*, pg. 115-117

“fashion”. To be precise, the researcher wrote: “for many years the dollar was unassailable, then the mark [...] then the yen [...], and [f]ashion is the ultimate motive.” It is suggested that learning both factual knowledge of the market and details of surrounding political-economic situation as well as possessing sensible intuitive responses are essential to win in the foreign exchange market.²⁷

4. Analytical part

4.1. The United States dollar

The U.S. dollar is the official currency of the United States of America, denoted as USD, \$ or US\$. According to the Federal Reserve, it is the most frequently used currency for cross-border transactions and accounts for more than 50% of other nations’ official foreign exchange reserves.²⁸ Its shares constituted just under 90% of the international currency market daily turnover from 1998 to 2013, nearly four times and seven times higher than the Japanese yen and the British pound, respectively (Table 4.1, see also Graph 4.3). Playing a central role in international trade as well as worldwide forex reserves, every change of the U.S. dollar is worth to be taken into consideration.

Table 4.1: Distribution of global currency market turnover
(Net-net basis, percentage share of average daily turnover in April) - Source: BIS²⁹

Currency	1998		2001		2004		2007		2010		2013	
	S	R	S	R	S	R	S	R	S	R	S	R
USD	86.8	1	89.9	1	88.0	1	85.6	1	84.9	1	87.0	1
EUR	...	32	37.9	2	37.4	2	37.0	2	39.1	2	33.4	2
JPY	21.7	2	23.5	3	20.8	3	17.2	3	19.0	3	23.0	3
GBP	11.0	3	13.0	4	16.5	4	14.9	4	12.9	4	11.8	4

S = Share; R = Rank

4.2. The euro

The euro is now the national currency of 18 member states of the European Union, including Latvia joining in on 1 January 2014. It has been managed and issued by the European Central Bank (ECB) and central banks of all countries involved. Together they

²⁷ Weisweiler, R., *Introduction to Foreign Exchange*, pg. 138-139

²⁸ Federal Reserve, *The Implementation of Monetary Policy – The Federal Reserve in the International Sphere*, pg. 51

²⁹ BIS, *Triennial Central Bank Survey Foreign exchange turnover in April 2013: preliminary global results*, pg. 10

formed the so-called “euro area”, or the “Eurozone”. It was first introduced in 11 member states on 1 January 1999, with three years being used only for accounting purposes before the launch of euro cash in 2002. This supranational currency is required to replace old national currencies at predetermined fixed rates of conversion.

Statistics of the Bank for International Settlements (BIS) assure that the euro involved in roughly a third of global daily average turnover in the forex market since its launch to date, maintaining its position of the second most common currency worldwide (Table 4.1, Graph 4.3). Behind the USD, the euro is the second most used and reserved currency. Nonetheless, unlike the monetary policy of U.S. Federal Reserve which promotes “maximum employment, stable prices and moderate long-term interest rates”³⁰, the most priority objective of the Eurosystem’s monetary policy is only ensuring price stability.

4.3. The EUR/USD currency pair

It is certainly true that both the euro and the USD are the most vital international currencies. The EUR/USD is therefore the most traded currency pair in the world. It is reported that the EUR/USD alone attributes to nearly a quarter of foreign exchange turnover every day, as can be seen in Graph 4.3:

Graph 4.3: Foreign exchange market turnover by currency and currency pairs (Net-net basis, daily averages in April 2013, in per cent) – Source: BIS³¹



Although the percentage of this pair’s volume decreased over the year from 30% in 2001 to 24.1% in 2013, the daily average turnover itself quadrupled.³² Thanks to high volatility, the laissez-faire floating regime and the active international market of the two economic entities, the exchange rates of the EUR/USD are recorded to change constantly.

³⁰ Federal Reserve, *Statement on Longer-Run Goals and Monetary Policy Strategy*, pg. 1

³¹ BIS, *Triennial Central Bank Survey Foreign exchange turnover in April 2013: preliminary global results*, pg. 5

³² BIS, *Triennial Central Bank Survey Foreign exchange turnover in April 2013: preliminary global results*, pg. 11

4.4. Trend analysis

Graph 4.4: EUR/USD daily spot rates, 04/01/1999-26/11/2013; Linear trendline – Source: ECB, author's computation



The line graph above demonstrates the development of the EUR/USD exchange rates during fourteen years from 4 January 1999 to 26 November 2013 (Graph 4.4). Overall, the pair follows an upward trend with three main phases with the lowest position in 2000 and the highest point in 2008.

Starting at US\$ 1.1789 per euro, in the first two years the pair plummeted and bottomed out at \$0.8252 on 26 October 2000. This was a steep decline of 3537 pips, about 28%. After that, it fluctuated around \$0.96 until the beginning of 2002.

In contrast, the periods from 2002 to mid-2008 experienced a phenomenal growth of the EUR/USD exchange rates in spite of a temporary appreciation of the USD in 2005. One euro cost \$0.8578 on 28 January 2002 and started going up to several periodic peaks on the way until the end of 2004, hitting approximately \$1.19 in May 2003, \$1.28 in February 2004 and \$1.36 on 28 December that year. This significant increase has a magnitude of more than 5000 pips, or around 60% of the opening rate in 2002. Similarly, a surge in the EUR/USD exchange rates was witnessed from 2006 to summer 2008. The pair reached a record high at the rate 1.5990 on 15 July 2008, a 37% growth in comparison with the figure in November 2005.

A side-way fluctuation has occurred since then. Three months after the highest peak, the rate plunged by a fifth to \$1.2460 a euro on 27 October 2008. Rapid decreases and soars continued while the pair hovered between 1.19 and 1.51, leading to the exchange rate prices at the same level as that in 2005-2006.

4.5. Technical analysis

4.5.1. Head & Shoulder formation

Graph 4.5.1: Head and Shoulder formation, EUR/USD, 2010-2013 – Source: ECB, author's identification of pattern



Head and Shoulder formation has long been considered to be beneficial to forecast peaks and reversed trends. From 2010 to 2012, a typical Head and Shoulder Top pattern was formed. Its left shoulder started its shape in August 2010, peaking in November at about 1.42 and hitting the higher low at approximately 1.29 in January 2011. The highest point of the head stood at around 1.49 after four months. The rates then dove close to 1.3181 in October 2011 before shooting up to reach the right shoulder top at 1.4160. The pattern was completed with a rapid dip, passing through the slightly upward sloping neckline and bottoming out at the breakout point of roughly 1.27. As the neckline being the support level, then turning into the resistance one, a clear sign of pullback was observed near level 1.32 for two months prior to the following depreciation of the euro against the United States dollar.

4.5.2. Exponential Moving Average and Relative Strength Index

With regards to the technical indicators, exponential moving average (EMA) and relative strength index are chosen over tens of existing technical tools. Firstly, EMA is powerfully effective for predicting future movements and indicating signals of trend shifting; and it is chosen instead of the simple moving average (SMA) because it places more weight on recent rates. Three chosen EMA periods are 400, 200 and 100 weeks since long-term trends are subject to be analysed. Whenever the EMA lines intersect each other, a new trend is believed to be set, such that the shortest moving average crosses longer ones showing a buying signal and vice versa. These meeting points are noted with red circles. Besides, so as to identify overbought and oversold levels, relative strength index (RSI) is employed. RSI, ranging from 1 to 100, measures the ratio of average price differences on up days to those on down days. An above 70 level warns an overbought situation and a below 30 level shows that the pair is oversold.

Graph 4.5.2: Weekly spot rates of the EUR/USD, 01/12/2003-09/12/2013 – Technical indicators: Exponential Moving Average and Relative Strength Index – Source: www.finance.yahoo.com



Graph 4.5.2 demonstrates the development of weekly spot rates of the EUR/USD pair from December 2003 to November 2013, with illustration of EMA and RSI charts drawn on the graph for further explanation. Eight trend-changing signals are circled on the exchange rate chart as a result of EMA lines, denoted from A to H. On the RSI line graph, the lines of level 70 (green) and level 30 (red) of the relative strength index are drawn, distinguishing overbought situations above the green line and oversold situations below the red line.

It is important to note that both indicators usually identify the signals in a fairly close period of time, which possibly reaffirms their validity. Moreover, the RS index tends to warn each short-term peak and trough several weeks in advance.

4.6. Fundamental analysis, psychological impressions, official intervention

4.6.1. Explanation of major trends

The previous section identifies three nominal trends of the EUR/USD in fourteen years: downward, upward and side-way developments, listed in the chronological order. To justify this, this section identifies the most influential fundamental and traders' psychological factors behind each drift; for instance, economic health, political situation and popular expectations of foreign exchange market participants, to name just a few.

To begin with, the downside trend in the first four years may be explained by the strength of the U.S. dollar, the relative weaknesses of the euro and an unavoidable impact of traders' expectations for the euro.³³ This astonishingly sharp drop was rationalized to be the consequences of the dynamics of learning about the euro and the lack of confidence in this new currency by Gomez and Melvin. They identified three decisive points: "policy uncertainty associated with the ECB, informed traders with prior knowledge of policy actions, and reduced hedging opportunities due to the elimination of the legacy-European currencies".³⁴ From a different point of view, a paper of Federal Reserve Bulletin points out noticeable risks prior to the launch of the euro which probably led to the early depreciation of the euro quoted against other currencies in general: (1) detrimental effects of the current financial crises in Latin America and Asia impacting European foreign trade beforehand, (2) slow growth of the United Kingdom, which was regarded as a soon-to-be member state of the Eurozone and (3) the lagged impacts of fiscal tightening in many European countries in 1997-1998. On the contrary, the economic environment in the USA

³³ De Grauwe, P., *Exchange Rates in Search of Fundamentals: The Case of the Euro-Dollar Rate*, pg. 6-7

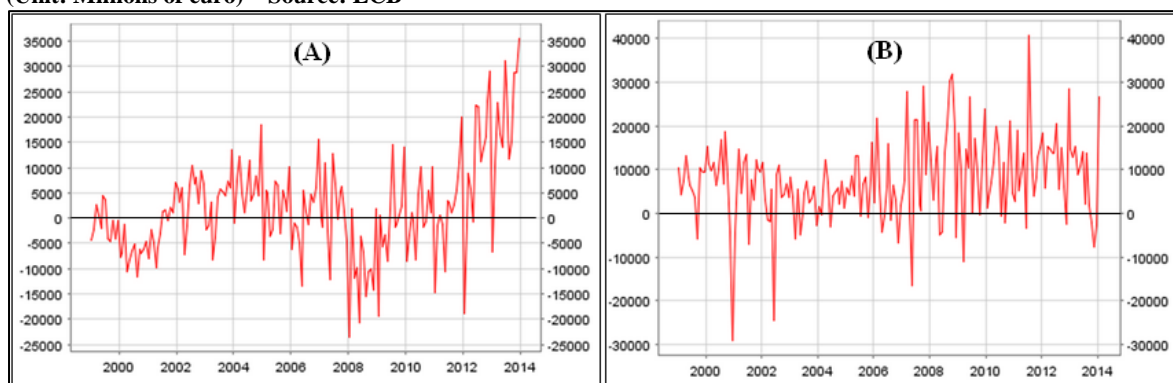
³⁴ Gomez, Manuel and Melvin, Michael. *Explaining the Early Years of the Euro Exchange Rate: an episode of learning about a new central bank*, pg. 27

during these years underwent a remarkable expansion which supported the dollar remarkably.³⁵

Second, the long-term upward trend of the pair might be due partly to the relatively good health of the euro area, reflected by surpluses in its current account balance, balance of payments (Graph 4.6.1 (A)) and long-term capital flows (Graph 4.6.1 (B)). Another ground for this movement can be the mistrust of the dollar owing to the United States' deteriorating trade deficits (Graph 4.6.1 (C)) and decreasing support for the USD by emerging and oil-exporting nations.

Specially, the foreseen economic downturn was expected to be massive, which was warned in December 2005 by the ECB. After that, a global financial crisis was triggered in 2008 and spread its effects all over the world, severely impacting the financial system in the USA. This was demonstrated clearly by interbank trading slowdown and freeze and consecutive bankruptcies of banking and mortgage giants such as the Lehman Brother and Goldman Sach. In these years, the EUR/USD exchange rate was so vulnerable that huge declines occurred overnight when the USD depreciated considerably against the euro constantly.³⁶

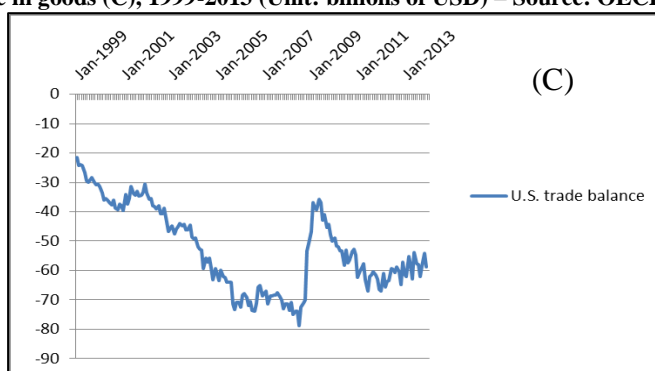
Graph 4.6.1: Balance of Payments (A) and Flows of financial transactions (B), monthly, Euro area, 1999-2013 (Unit: Millions of euro) – Source: ECB



³⁵ Federal Reserve. *The Launch of the Euro*, pg. 660

³⁶ Artus, Patrick. *When does the euro appreciate?*, pg. 1-6

Graph 4.6.1: U.S. net trade in goods (C), 1999-2013 (Unit: billions of USD) – Source: OECD



In the last term, the pair fluctuated dramatically, yet with a narrower span of deviation. The European debt crisis was triggered by the collapse of the Icelandic banking system and the recession in Ireland, which brought about a plunge in the EUR/USD rate to the level before crisis in America. Thanks to both regions’ efforts in regaining strength and stability from critical catastrophe, the pair was then in the process of steady recovery to the pre-crisis situation.

4.6.2. Explanation of major spikes and breaks; Official intervention

The table below filters political and economic events which are probably the most remarkable phenomena causing irregularities to the fluctuations of the EUR/USD in the recent ten years, based on eight signals identified by the EMA indicator in Graph 4.5.2, provided that some extent of lagged effects is taken into account. Official interventions and some strong psychological impacts are also listed. Most events relate directly to the two economic regions in question; while there are some other relevant factors contributed from overseas, for example, oil prices and traders’ belief.

Table 4.6.2: Major spikes and breaks in the EUR/USD movements – Causes and Effects - Source: IMF, U.S. Federal Reserve, ECB, European Commission; author’s selection

Signal (time)	Effects – Irregularities (time)	Causes – Events and official interventions (time)
A (mid-2005)	One-year appreciation of the USD (2005)	- USA: better improvements in unemployment than the Eurozone; strong GDP; decline in Balance of Payments; frequent raises of Federal funds interest rates (peak at 5.25%) to promote capital inflows (2004-2006) (Graph 4.6.2) - Eurozone: Political uncertainty, about 10 elections in the EU (2004-2006)
B (mid-	(A warning of) the soar of the	- USA: 9 times cutting interest rates down to 0.25% and less by 2008; clear evidence of serious economic downturn

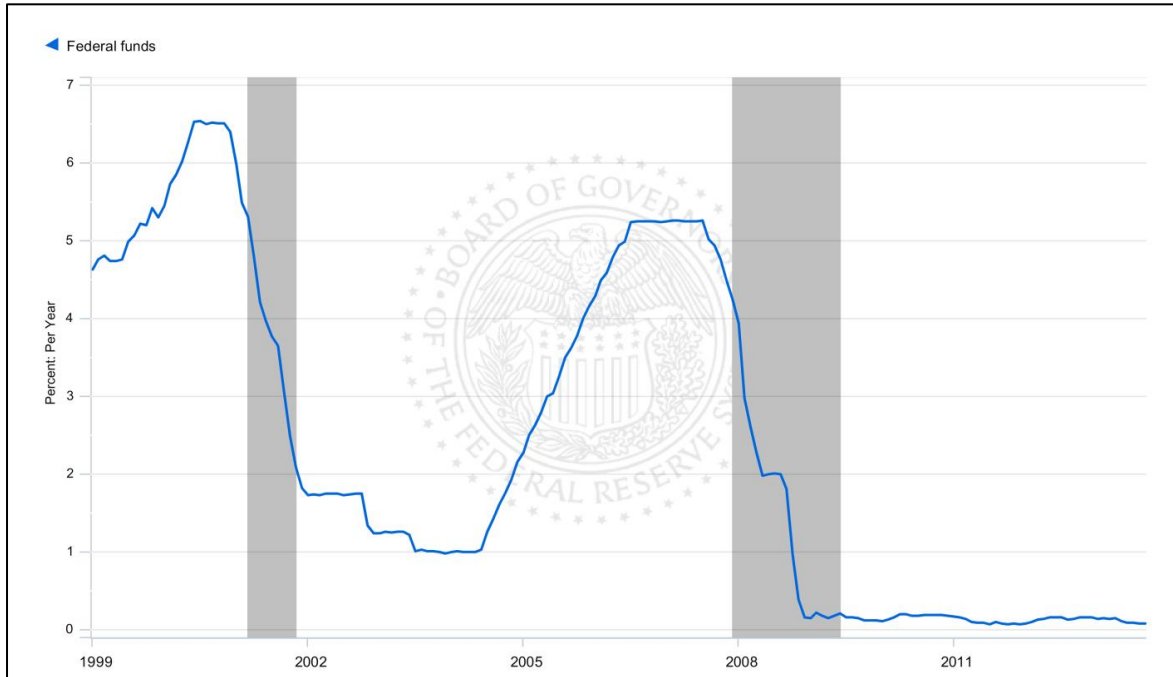
2006)	exchange rate to a record high (2006-2008)	(signals of credit squeeze) (Graph 4.6.2) - Eurozone: stable state of GDP growth; drop of unemployment rate - The rise in oil prices, which are closely correlated with the pair
C (mid-2008)	The pair's record high level (the first half of 2008)	- Widening of interest rate differentials between Eurozone and the USA - The popular belief that euro area would not undergo any crisis - USA: Federal regulators seize IndyMac Federal Bank after it becomes the largest regulated thrift to fail (11/07/2008)
	The pair's steep decline (mid-2008 – early 2009)	- USA: some signs of gradual crisis recovery ³⁷ - Eurozone: beginning of economic turmoil led by crisis in the U.S.; Iceland's banking system collapsed; Ireland fell into recession - "The ensuing reassessment of the outlook for growth and interest rates and precautionary flows into dollar assets" ³⁸
	A break in the series	- Many banks in the U.S. stopped trading and froze; no transaction is recorded from 31/07/2008 to 26/08/2008
	Sudden leap of the euro (late 2008)	- USA: Federal Reserve implemented zero-interest-rate policy (Graph 4.6.2)
D (mid-2009)	The euro appreciated against the USD	- USA: Federal Reserve reformed quantitative easing policy and bought government securities directly - Eurozone: 5 times cutting interest rates (November 2008-May 2009); G20 Summit in London was considered as the pivotal point in the crisis (2/4/2009)
E (early 2010)	A sharp fall of the EUR/USD (late 2009 – mid 2010)	- Eurozone: the truth of Greek accounting tricks was revealed; Eurozone's deteriorating debt crisis was spread further to Portugal, Ireland and other member states
F (early 2011)	The euro was strengthened (mid-2010 – mid 2011)	- Eurozone: economic reforms were implemented to support these weak economies; fiscal consolidation and significant progress were achieved
G (late 2011)	The pair's steady and continuous drop (March 2011 – mid-2012)	- Eurozone: increasing crisis; high budget deficits of member states; the high risk of Greece leaving the common currency system; low interest rates causing ample supply of the euro. After receiving aid packages from the ECB, Greece and Spain still needed more bailout; further announced austerity plans led to worse protests (mid-2011) - The USD became the safe haven amid European

³⁷ For example, see Bram, J., Orr, J., Rich, R. et al, *Is the Worst Over? Economic Indexes and the Course of the Recession in New York and New Jersey*

³⁸ European Commission. *Annual Report on the Euro Area – 2009*, pg. 67

		sovereign debt crisis
H (mid-2013)	Sign of gradual rise (2013)	- Eurozone: the consequences of its debt crisis were considered to be alleviated; the viability of the financial sector in Cyprus was restored (25/03/2013); ECB kept lowering interest rates and enhanced risk control framework...

Graph 4.6.2: Federal funds interest rates, 1999-2013 – Source: Federal Reserve (Share bars demonstrate recessions)



4.6.3. Further remarks on official interventions in the EUR/USD

Independent floating is the *de facto* exchange rate regime backed by the U.S. governments and the Federal Reserve in recent decades.³⁹ Similarly, the ECB and central banks of the Eurozone member states also adopt market-determined regime in reality. It is confirmed by Marcel Fratzscher that oral interventions started replacing actual central bank interventions as the major instrument of foreign exchange management in both economic regions from 1995, as illustrated in Table 4.6.3 (A) and (B):

Table 4.6.3 (A): Actual foreign exchange intervention days 1990-2003 – Sources: Marcel Fratzscher⁴⁰

Period	US Federal Reserve (days)	Bundesbank / European Central Bank (days)
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³⁹ IMF staffs, *Classification of Exchange Rate Arrangements and Monetary Policy Frameworks*

⁴⁰ Fratzscher, M., *Exchange Rate Policy Strategies and Foreign Exchange Interventions in the Group of Three Economies*, pg. 261

	All	Buy FX	Sell FX	All	Buy FX	Sell FX
1990-1994	74	25	49	79	39	40
1995-1998	9	1	8	4	4	0
1999-2003	1	1	0	4	0	4

In 2000, the European Central Bank exercised an influence on the price by buying euros and selling U.S. dollars four times in order to boost the euro's appreciation.⁴¹

It is rated by Fratzscher that both economic areas were driven by strong-currency promotion. Most speeches and public remarks by their leaders were categorized to have a strengthening effect on the two currencies (period 1999-2003, Table 4.6.3 (B)).

Table 4.6.3 (B): Oral foreign exchange intervention days, 1990-2003 – Sources: Reuter News, Marcel Fratzscher⁴²

Period	U.S. Federal Reserve (days)			Bundesbank / European Central Bank (days)		
	S	W	A	S	W	A
1990-1994	18	1	14	13	0	4
1995-1998	31	0	5	3	11	4
1999-2003	76	1	9	61	3	15

S = Strengthen; W = Weaken; A = Ambiguous

In terms of effectiveness of official foreign exchange intervention, it is proved in some empirical work of Fatum and Hutchinson in 2002 and 2003 that such intervention “is effective when used selectively and directed to short-run objectives”.⁴³ Official intervention seemed to perform effectively in managing a degree of seriousness and easing the drawbacks of recent crises in both the USA and the euro area, as indicated in Table 4.6.2.

In an extensive research, Weisweiller emphasizes: “Political decisions or the absence of them can and often do override all economic indicators. The decisions of governments have considerable influence upon exchange rates, even though their power in this field is far from absolute.” He sums up all concerns about official intervention: “Economic policy holds the key to political success in the world of today. The level of the exchange rate is of paramount importance to the economic and social policy of any government”, regardless

⁴¹ Fatum, R., Hutchinson, M., *ECB Foreign Exchange Intervention and the EURO: Institutional Framework, News and Intervention*, pg. 1-23

⁴² Fratzscher, M., *Communication and exchange rate policy*, pg.13

⁴³ Hutchinson, M., *Is Official Foreign Exchange Intervention Effective?*

whether the government admits or believes it, whether they “believes in trying to put the exchange rate wherever it wants it or in accepting the level at which the forces of the free market have placed it.”⁴⁴

4.7. Major resistances and supports

Graph 4.7: Resistances and supports - Source: ECB, author’s identification of resistance and support levels



Graph 4.7 demonstrates levels of resistances and supports of the EUR/USD currency pair during the fourteen-year period from January 1999 to October 2013. Based on the line graph of exchange rate development (red), three levels of supports (purple) and five levels of resistances (green) are identified.

To explain in detail, support line S3 and resistance level R1 are determined to be valid throughout the whole period, at 0.82 and 1.56, respectively. They are the evidence of possible EUR/USD rates at extreme situations in both economic regions, which are the result of the exploration period of the euro and the peak of the global financial crisis.

A middle-term resistance, R5, was formed at around 1.18 between 1999 and 2003. It was then broken in late 2003 to become the second long-term support level, S2, from 2004 onwards due to an inevitable influence of the euro area’s strong emergence. Regarding

⁴⁴ Weisweiler, R., *Introduction to Foreign Exchange*, pg. 138

recent mid-term resistances, the process of crisis recovery in 2009-2011 helped to set level R2 at nearly 1.52 and R3 at about 1.49.

Meanwhile, the pre- and post-crisis periods seemingly determined long-term levels of resistance and support in a relatively more balanced and stable economic conditions of the two regions from 2004 to mid-2007 and from 2012 onwards, at 1.36 (R4) and 1.21 (S1) in turn.

Overall, it can be predicted that the EUR/USD will not break the strongest levels, R1 and S3, whilst the equilibrium level of the pair will probably fall in between levels R4 and S1.

4.8. Main data collected and discussion

The data for the regression analysis are collected from official websites of governments and authority bodies of the euro area and the United States. Their time frame is from January 1999 to September 2013 except for national government debts in the euro area, which is only available from January 2000. Moreover, all statistics are neither seasonally or working day adjusted with the exception of seasonally adjusted data for the percentages of total U.S. government debt to GDP. For the purpose of maximizing accuracy, every set of data concerning the Eurozone is retrieved and computed to achieve figures of changing composition. Additionally, due to the inflation factor being taken into account separately, the other data are calculated to be on a real basis.

Based on three approaches of forex determination discussed in Section 3.4, data on inflation rates, interest rates and trade figures are obtained. In addition, as leading indicators of economic health, announcement relating to purchasing manager index (PMI) and capital utilization in the United States may also affect traders' behaviour; these data are collected for the regression analysis. Details regarding collection of data are listed in Table 4.8 below.

Table 4.8: Description of the data collected

	Data name (region)	Acronym (unit)	Base period	Type	Source	Notes
1	EUR/USD exchange rates	R	n.a.	Average spot rates	Eurostat – ECB	
2	Urban consumer price index	CPI-U	1982 - 1984	Indices, U.S. city average	U.S. Bureau of Labor Statistics	

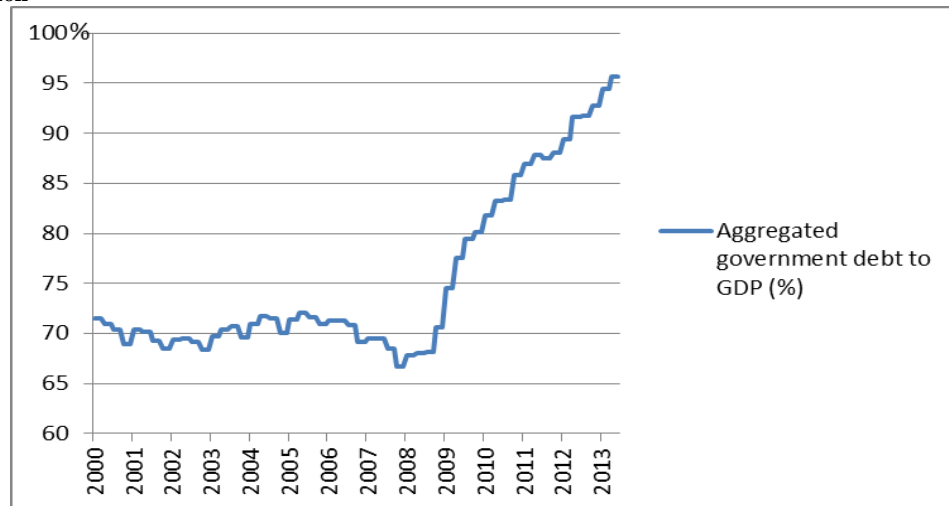
	(USA)					
3	Harmonised indices of consumer prices (EA)	HICP	2005	Aggregating indices for each country	Eurostat – ECB	
4	Federal funds interest rates (USA)	I _{US} (%)	n.a.	Rates	U.S. Federal Reserve	These rates are regarded as the base for all other interest rates in the USA.
5	Key ECB interest rates (EA)	I _{EA} (%)	n.a.	Rates	Eurostat – ECB	According to date of application**
6	Trade in goods from the euro area to the U.S.	EA-US (millions of USD)	1982 - 1984	Volume, on a real basis	Author's computation U.S. Census Bureau	Real values obtained by adjusting nominal values with CPI-U
7	Trade in goods from the U.S. to the euro area	US-EA (millions of USD)	1982 - 1984	Volume, on a real basis	Author's computation, U.S. Census Bureau	Real values obtained by adjusting nominal values with CPI-U
8	Purchasing Manager Index (USA)	PMI	n.a.	Indices	Institute for Supply Management	Economic expansion: > 50; contraction: < 50
9	Capital Utilization (USA)	CU (%)	n.a.	Rates (of used potential output)	Federal Reserve	Potential output levels being used
10	Consolidated government debt to GDP (EA)	GD _{EA} (%)	n.a.	Percentage	Author's computation, ECB	Original data: quarterly*, of individual nations.
11	Government debt to GDP (USA)	GD _{US} (%)	n.a.	Percentage	Financial Management Service	Original data: quarterly*, seasonally adjusted
<p><i>n.a. = not applicable; EA= Euro area</i> <i>* = Statistics are used for the whole respective quarter.</i> <i>** = When a month has more than one change in interest rate by the authority, author applies the one with a longer period of application as the rate for that month.</i></p>						

The graphs below show changes in the percentage of total public debt to GDP in the USA (Graph 4.8 (A)) and in the Eurozone (Graph 4.8 (B)) from 1999 to 2013. These figures seem to share a similar shape and trend to the development of the EUR/USD rates; therefore, it is suggested that there exists a relationship between these and the pair.

Graph 4.8 (A): Total Public Debt as percentage of GDP in the USA, January 1999-September 2013 – Source: Federal Reserve Bank of St. Louis (Shade bars demonstrate recession periods)



Graph 4.8 (B): Aggregated government debt to GDP (%), Euro area, 2000-2013 – Source: ECB, author's computation



4.9. Regression analysis

4.9.1. Declaration of variables

Ten independent variables are listed in Table 4.9.1 as follows.

Table 4.9.1: Declaration of variables

Variable type	Notation	Description (Denote)	Unit
Dependent	y_t	EUR/USD exchange rates (R)	-
Independent	x_{1t}	Percentage change in Urban Consumer Price Index (% Δ CPI-U _{US})	-
	x_{2t}	Percentage change in Harmonized indices of consumer prices (% Δ HICP _{EA})	-
	x_{3t}	Federal funds interest rates (i_{US})	%
	x_{4t}	Key ECB interest rates (i_{EA})	%
	x_{5t}	Logarithm of trade volume in goods from the euro area to the U.S. (\log_{EA-US})	-
	x_{6t}	Logarithm of trade volume in goods from the U.S. to the euro area (\log_{US-EA})	-
	x_{7t}	Purchasing Manager Index (PMI _{US})	-
	x_{8t}	Capital Utilization (CU _{US})	%
	x_{9t}	Percentage of consolidated government debt to GDP (GD _{EA})	%
	x_{10t}	Percentage of U.S. Government debt to GDP (GD _{US})	%

While it can be true that the recent crises might impact traders' behaviour considerably, the effects of the crises can be reflected by other variables, such as the changes in interest rates adopted by the authorities and the changes in trade volume. That is the reasons, perhaps, for the collinearity problem when dummy variables regarding the economic downturns are included in the model in author's initial attempts.

4.9.2. Formulation of model and time series analysis

As discussed in Section 3.4 that numerous theories have been built yet need further improvement, it might be beneficial to investigate them simultaneously with a cross-sectional approach. The model evaluates the value of the EUR/USD exchange rates depending on 12 factors listed in Table 4.9.1.⁴⁵ Descriptive statistics for 176 samples of the model using observations from February 1999 to September 2013 is shown in the following Table 4.9.2.

As predicted and described in section 4.7 that the exchange rates of the pair may fluctuate between support level S1 (1.21) and resistance R4 (1.36) in a balanced economic environment. Table 4.9.2 below clearly indicates that both the mean and median of the

⁴⁵ The full table of data is in in Appendix 8.1 and 8.2

EUR/USD fall in between this range. In particular, the median is higher than the average, showing that more than half of rates are higher than the average value. This is also the case for other variables, except both regions' interest rates, export volume from the U.S. to euro area and the percentage of U.S. government debt to GDP.

Table 4.9.2: Descriptive statistics (sample size: 176, Appendix 8.1, 8.2) - Source: author's computation

Denote (Unit)	Mean	Median	Minimum	Maximum	Variance	Standard deviation
EUR/USD rates	1.2161	1.2689	0.8532	1.5770	0.0347	0.1861
CPI-U (%)	200.194	201.65	164.50	234.15	429.58	20.73
%ΔCPI_{US} (%)	0.20	0.20	-1.92	1.22	0.16	0.40
HICP	102.15	102.21	87.23	117.58	80.42	8.97
%ΔHICP_E A (%)	0.17	0.17	-0.44	0.71	0.03	0.17
i_{EA} (%)	2.43	2.25	0.50	4.75	1.53	1.24
i_{US} (%)	2.36	1.75	0.07	6.54	4.68	2.16
Trade volume US\rightarrowEA (real) (Millions of USD)	10,206.2	10,196.3	7,044.56	13,559.14	2,476,033	1,573.54
Trade volume EA\rightarrowUS (real) (Millions of USD)	15,225.1	15,309.0	9,905.84	22,610.15	5,387,921	2,321.19
log_{EA-US}	4.1774	4.1849	3.9959	4.3543	0.0045	0.0672
log_{US-EA}	4.0037	4.0084	3.8479	4.1322	0.0046	0.0675
PMI_{US}	51.94	52.40	33.10	61.40	28.89	5.37
CU_{US} (%)	77.32	77.76	66.93	82.31	11.83	3.44
GD_{EA} (%)	70.92	70.90	0.00	95.70	404.10	20.10
GD_{US} (%)	70.13	61.16	53.82	101.43	262.53	16.20

4.9.3. Hypotheses

It is assumed that the EUR/USD exchange rate has a positive direction of association with % Δ CPI_{US}, i_{EA}, log_{EA-US} and GD_{US} (\mathbf{x}_{1t} , \mathbf{x}_{4t} , \mathbf{x}_{5t} , \mathbf{x}_{10t}), and has a negative direction of association with the remaining variables.

4.9.4. Regression model

Function 1: General model

$$y_t = \beta_0 + \beta_1 x_{1t} + \beta_2 x_{2t} + \beta_3 x_{3t} + \beta_4 x_{4t} + \beta_5 x_{5t} + \beta_6 x_{6t} + \beta_7 x_{7t} + \beta_8 x_{8t} + \beta_9 x_{9t} + \beta_{10} x_{10t} + \varepsilon_t$$

where $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9, \beta_{10}$ are parameters of corresponding variables and ε_t is the error term at time t .

Using gretl software, ordinary least squares (OLS) method is applied. The interest rates are usually announced in advance; hence this variable is marked as lagged one period.

Function 2: Estimated model

$$\hat{y}_t = -10.0546 + 0.0636 x_{1t} - 0.0466 x_{4t} + 1.2819 x_{5t} + 1.9600 x_{6t} + 0.0045 x_{7t} - 0.0199 x_{8t} - 0.0024 x_{9t} - 0.0046 x_{10t}$$

Table 4.9.4: Result of OLS – Source: gretl software, author’s computation

OLS, using observations 1999:02-2013:09 (T = 176)				
Dependent variable: Forex_rate				
	coefficient	std. error	t-ratio	p-value
const	-10.0546	0.562152	-17.89	1.81e-040 ***
Change_CPI_U_per~	0.0635846	0.0236833	2.685	0.0080 ***
Change_HICP_perc~	-0.0495304	0.0552062	-0.8972	0.3709
i_US_1	-0.0104153	0.00693929	-1.501	0.1353
i_EA_1	-0.0465854	0.0141067	-3.302	0.0012 ***
Log_Trade_EA_US	1.28192	0.165114	7.764	8.23e-013 ***
Log_Trade_US_EA	1.95997	0.173566	11.29	2.85e-022 ***
PMI_US	0.00449306	0.00188424	2.385	0.0182 **
CU_US	-0.0198881	0.00354994	-5.602	8.68e-08 ***
GD_EA	-0.00237630	0.000459073	-5.176	6.51e-07 ***
GD_US	-0.00462382	0.00108095	-4.278	3.19e-05 ***
Mean dependent var	1.216081	S.D. dependent var	0.186679	
Sum squared resid	1.162306	S.E. of regression	0.083930	
R-squared	0.809414	Adjusted R-squared	0.797863	
F(10, 165)	70.07514	P-value(F)	3.82e-54	
Log-likelihood	192.0337	Akaike criterion	-362.0673	
Schwarz criterion	-327.1920	Hannan-Quinn	-347.9220	
rho	0.472525	Durbin-Watson	1.021782	

Excluding the constant, p-value was highest for variable 7 (Change_HICP_percent)

4.9.5. Interpretation of the results

- It is not necessary to interpret the result for the case when values of all independent values are equal to zero since it is unrealistic.
- If the percentage change in CPI-U increases by 1%, the EUR/USD rate will go up about 636 pips, ceteris paribus.
- If the key interest rates adopted by the ECB increases by 1%, the EUR/USD rate will go down about 466 pips, ceteris paribus.

- If the logarithm of trade volume in goods from the euro area to the U.S. increases by 1 unit, the EUR/USD rate will go up about 12819 pips, ceteris paribus.
- If the logarithm of trade volume in goods from the U.S. to the euro area increases by 1 unit, the EUR/USD rate will go up about 19600 pips, ceteris paribus.
- If the PMI in the U.S. increases by 1 unit, the EUR/USD rate will go up about 45 pips, ceteris paribus.
- If the capital utilization in the U.S. increases by 1%, the EUR/USD rate will go down about 199 pips, ceteris paribus.
- If the percentage of consolidated government debt to GDP in the Eurozone increases by 1%, the EUR/USD rate will go down about 24 pips, ceteris paribus.
- If the percentage of government debt to GDP in the U.S. increases by 1%, the EUR/USD rate will go down about 46 pips, ceteris paribus.

4.9.6. Statistical verification

The coefficient of determination, denoted as R^2 , is 0.809414, which is close to 1, indicating that the sample values y are close to the predicted theoretic values given by the regression model. The adjusted R^2 is also close to 1, amounting to 0.797863, showing the validity of R^2 in the long-run. With significance level $\alpha = 0.05$, the parameters of constant value, x_{1t} , x_{4t} , x_{5t} , x_{6t} , x_{7t} , x_{8t} , x_{9t} , x_{10t} are statistically significant although some are not at the expected sign.

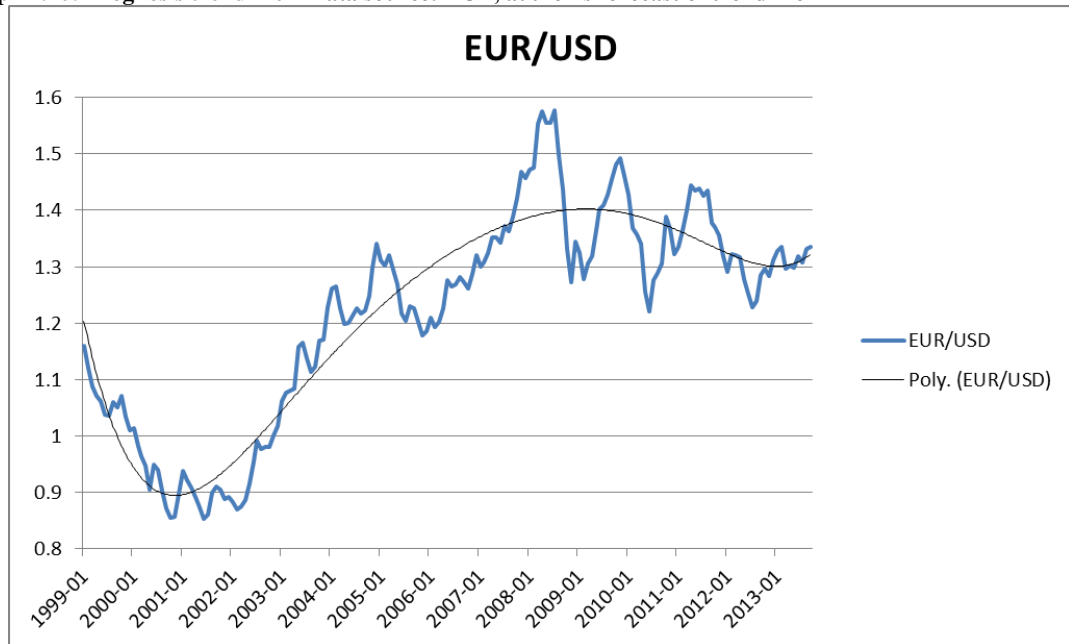
4.9.7. Confirmation of assumptions

Six out of ten hypotheses, which relate to x_{1t} , x_{2t} , x_{3t} , x_{5t} , x_{8t} and x_{9t} , are fulfilled with expected direction of association with y_t .

Based on the regression results, the exchange rate of the EUR/USD was proved to be insignificantly correlated with the percentage change in HICP and the Federal funds interest rates. In contrast, it had a strong association with the other eight factors, namely the percentage change in inflation rates of the USA, major interest rates of the ECB, logarithms of trade volume between two regions, America's PMI, the U.S. capital utilization and the government debt to GDP in both areas.

4.10. Prognosis analysis

Graph 4.10: Prognosis trendline – Data source: ECB, author’s forecast of trendline



The best fitted prognosis trendline with the highest value of R^2 ($R^2 = 0.8801$), is the polynomial line to the power of 6.

Function 3: Prognosis trendline (where y_t is the exchange rates at time t)

$$y_t = 1e^{-1} y_{t-1} - 7e^{-10} y_{t-1} + 2e^{-07} y_{t-1} - 2e^{-05} y_{t-1} + 0.0014 y_{t-1}^2 - 0.0373 y_{t-1} + 1.2402$$

According to this trendline, it can be inferred that the EUR/USD exchange rate is going up in the short-run, probably in the following few months.

5. Evaluation of the result using statistical testing

The following tests are carried out by the same software used for the regression model, gretl.

5.1. Collinearity

It is noted in the test result that the minimum possible value for variance inflation factors (VIF) is 1.0 and all values which are greater than 10.0 may indicate a collinearity problem. Based on the result in Table 5.1, the estimated model has no such problem.

Table 5.1: Result of collinearity test for the estimated model – Source: gretl, author’s computation

Variance Inflation Factors	
Minimum possible value = 1.0	
Values > 10.0 may indicate a collinearity problem	
Change_CPI_U_percent	2.211
Change_HICP_percent	2.219
i_EA_1	7.531
i_US_1	5.627
Log_Trade_EA_US	3.074
Log_Trade_US_EA	3.429
PMI_US	2.562
CU_US	3.726
GD_EA	2.128
GD_US	7.664
VIF(j) = 1/(1 - R(j)^2), where R(j) is the multiple correlation coefficient between variable j and the other independent variables	
Properties of matrix X'X:	
1-norm = 3870725.2	
Determinant = 1.2328003e+023	
Reciprocal condition number = 4.457893e-009	

5.2. Durbin-Watson statistic

The Durbin-Watson statistic of this model is 1.0218 (Table 4.9.4) with p-value = $2.28597e^{-14}$, which is not close to 2 but closer to 0 than to 4. It detects positive autocorrelation which indicates that the regression model is spurious.

5.3. Autocorrelation

The LM test for autocorrelation up to order 12 also confirms the present of this problem when rejecting the null hypothesis (p-value = $8.6239e^{-016}$).

5.4. Other tests

Tests of heteroskedasticity, non-linearity, normality of residuals, structural break and parameter stability are also conducted. It is confirmed that the problems of heteroskedasticity and non-linearity are present in the model. There exist structural breaks and some changes in parameters as well. Besides these, fortunately, the error is normally distributed. Table 5.3 (A), (B) and Graph 5.3 below explain these issues in more detail.

Table 5.3 (A): Evaluation of other test statistics to the estimated model – Source: author’ evaluation

Test name	Null hypothesis (H ₀)	Reject H ₀	Help to prove model’s effectiveness	p-value
White's test for heteroskedasticity	Heteroskedasticity not present	Yes	No	= P (Chi-square (65) > 99.0857) = 0.00413033
Non-linearity test	Relationship is	Yes	No	= P (Chi-square (10)

(squares)	linear			$> 103.198) = 1.24577e^{-017}$
QLR test for structural break	No structural break	Yes	No	$= 1.19934e^{-105}$
CUSUM test for parameter stability	No change in parameters	Yes	No	$= P(t(164) > -4.05876) = 7.62016e^{-005}$
Normality of residual	Error is normally distributed	No	Yes	$= 0.454023$

Table 5.3 (B): Other test statistics for the estimated model – Source: gretl, author’s computation

```

White's test for heteroskedasticity -
Null hypothesis: heteroskedasticity not present
Test statistic: LM = 99.0857
with p-value = P(Chi-square(65) > 99.0857) = 0.00413033

Non-linearity test (squares) -
Null hypothesis: relationship is linear
Test statistic: LM = 103.198
with p-value = P(Chi-square(10) > 103.198) = 1.24577e-017

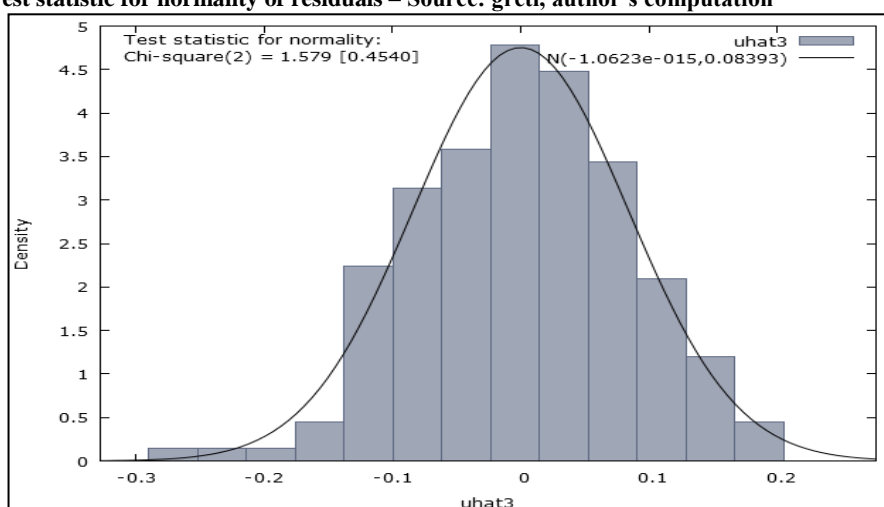
Test for normality of residual -
Null hypothesis: error is normally distributed
Test statistic: Chi-square(2) = 1.57921
with p-value = 0.454023

QLR test for structural break -
Null hypothesis: no structural break
Test statistic: chi-square(11) = 524.568 at observation 2008:08
with asymptotic p-value = 1.19934e-105

CUSUM test for parameter stability -
Null hypothesis: no change in parameters
Test statistic: Harvey-Collier t(164) = -4.05876
with p-value = P(t(164) > -4.05876) = 7.62016e-005

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Graph 5.3: Test statistic for normality of residuals – Source: gretl, author’s computation



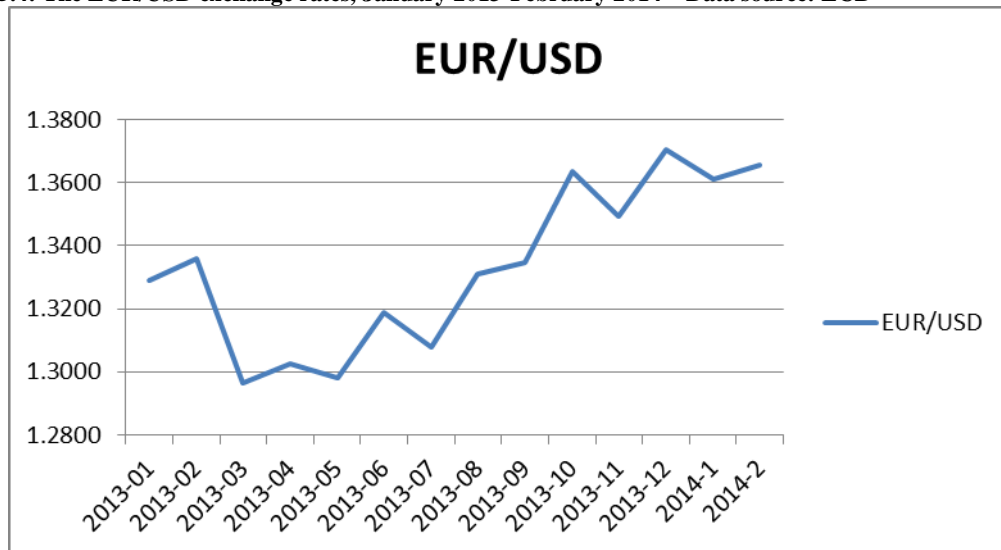
5.5. Verification of the short-term prognosis analysis

New data after September 2013 are retrieved from the official website of the ECB in order to verify the above forecast. It is true that the EUR/USD pair went up at the end of 2013 then decreased, yet still stood at a higher level than that the end of the examined period. The changes ranged from 260 to 360 pips compared to that end figure.

Table 5.4: The EUR/USD exchange rates, January 2013-February 2014 – Data source: ECB

Year-Month	EUR/USD	Year-Month	EUR/USD
2013-01	1.3288	2013-08	1.3310
2013-02	1.3359	2013-09	1.3348
2013-03	1.2964	2013-10	1.3635
2013-04	1.3026	2013-11	1.3493
2013-05	1.2982	2013-12	1.3704
2013-06	1.3189	2014-01	1.3610
2013-07	1.3080	2014-02	1.3658

Graph 5.4: The EUR/USD exchange rates, January 2013-February 2014 – Data source: ECB



When looking at the data more thoroughly, it is noticeable that from October 2013 onwards, the pair moved out of the expected range for balanced economic context. This is convincing because several elaborate measures and plans have been introduced to alleviate the crisis' aftereffects to Greece, Portugal and Spain recently, which helps strengthen the euro. It is noticeable from the chart above that the pair declined remarkably in November 2013 as a result of the ECB lowering the interest rates on the 7th that month, making the euro less attractive to traders so there would be fewer buyers and more sellers so the price of euro dropped in terms of the U.S. dollars.

6. Conclusion and recommendation

This section concludes five main issues and findings discussed in this thesis.

Firstly, it is undeniable that both the USD and the euro have been and continue to be the most vital financial instruments for international transactions and in the foreign exchange markets. The U.S. dollar is believed to maintain its first rank position, play a much more crucial role in the markets compared to other major currencies. About the euro, although concerns regarding the collapse of this common currency of 18 European Union member states have been raised, evidence of global currency market turnover and the euro's shares in foreign exchange reserves of other nations has proven that the euro is going to keep its second most important international currency as well. Similar expectation is held to the EUR/USD pair as its proportion in worldwide trade has shown no sign of potential replacement.

Secondly, the trend analysis in this study assures a clear upward sloping trend for the pair in question, being explained by the fundamental analysis. Three main trends are pointed out to be downward, upward and side-way, named in chronological order. The first one occurred from the launch of the euro to early 2002 as a result of the learning period about the effectiveness of the euro and the unfavourable economic condition of the euro currently. The second trend happened for the longest period of time, from then to the peak of the global financial crisis in 2008. It was attributed by the relatively stronger emergence of the Eurozone as a whole and the worldwide crisis triggered in the United States. After that, the pair has had a tendency to fluctuate remarkably towards the situation prior to the crisis and has continued its way up to now. The spread and severe effects of both regions' crises as well as their recovery towards the balance might contribute to this drift.

Thirdly, whilst fundamental analysis clarifies the underlying reasons of the trend, technical analysis, using exponential moving average and relative strength index, provides assistance to detect trend shifting signals, price forecasting reasoning and, perhaps, the shifts' magnitude. Eight noticeable signals are identified from 2004 to 2013: in mid-2005, mid-2006, mid-2008, mid-2009, early 2010, early 2011, late 2011 and mid-2013. Economic indicators, political conditions, official intervention and the effects of economic crises are the major causes for the spikes and breaks in the movement of the EUR/USD. Specially, clear evidence of official interventions is found and highlighted to be influential to the pair.

Additionally, a typical head and shoulder formation is analysed as a sample of another effective technical tool.

The fourth conclusion relates to major resistances and supports. Apparently, the resistance and support levels that probably hold for the longest time in extreme conditions are at 1.56 and 0.82, respectively. During the time of balanced and stable economic conditions in both the Eurozone and the U.S., it is expected that the pair fluctuates between 1.21 and 1.36.

After data being collected and computed to meet a certain requirements, ten independent variables are examined and used to establish a linear regression model of one time series set of data on a cross-sectional basis, for the period from February 1999 to September 2013. Statistical testing of the model indicates several problems that make it inconclusive: autocorrelation, heteroskedasticity, non-linearity, spurious regression, structural break(s) and potential changes in parameters. Prognosis analysis is carried out as well, being effective in forecasting near future trend, and is verified by newly retrieved data.

Overall, technical tools are generally effective to predict the foreign exchange rate of the EUR/USD whereas the regression model established in this study shows unsatisfactory performance. Certain statistical problems of regression analysis still exist that require more profound and accurate rectification. Furthermore, several researchers have worked on cointegration aspect for currency forecasting recently, it is recommended that further work on currency forecasting would focus on this approach, since this pair and the GBP/USD tend to have positive correlation.⁴⁶

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8. Appendices

8.1. Appendix 1

Table 8.1: Table of data 1 - Source: Eurostat, ECB, Federal Reserve, U.S. Bureau of Labor statistics, U.S Census Bureau, Institute for Supply Management, Financial Management Service

Time (yyyy-mm)	EUR/USD average spot rates (nominal)	Capital Utilization (USA)	CPI-U (USA)	HICP (euro area)	Key ECB interest rates	Federal funds interest rates	Trade volume EA-US (real)	Trade volume US-EA (real)
Unit	-	%	-	-	%	%	Millions of USD	
1999-01	1.1608	81.78	164.3	69.46	3.00	4.63	9,917.90	8,417.5
1999-02	1.1208	81.78	164.5	69.71	3.00	4.76	9,905.84	8,693.2
1999-03	1.0883	81.62	165.0	69.88	3.00	4.81	10,737.85	10,012.8
1999-04	1.0704	81.48	166.2	70.14	2.50	4.74	12,312.22	8,871.6
1999-05	1.0628	81.76	166.2	70.3	2.50	4.74	11,380.99	8,700.7
1999-06	1.0378	81.29	166.2	70.39	2.50	4.76	11,385.63	8,397.6
1999-07	1.0353	81.54	166.7	70.39	2.50	4.99	12,221.67	7,509.0
1999-08	1.0604	81.57	167.1	70.81	2.50	5.07	12,783.94	8,116.8
1999-09	1.0501	81.04	167.9	71.32	2.50	5.22	11,966.99	8,446.3
1999-10	1.0706	81.77	168.2	71.74	2.50	5.20	11,092.40	9,347.9
1999-11	1.0338	81.88	168.3	71.74	3.00	5.42	12,778.99	8,869.3
1999-12	1.0110	82.24	168.3	71.74	3.00	5.30	13,126.53	9,594.7
2000-01	1.0137	82.01	168.8	72.17	3.00	5.45	12,454.39	8,129.2
2000-02	0.9834	82.03	169.8	72.59	3.25	5.73	11,156.34	8,674.2
2000-03	0.9643	82.08	171.2	72.59	3.50	5.85	11,700.81	9,918.2
2000-04	0.9470	82.31	171.3	72.84	3.50	6.02	14,052.49	9,377.3
2000-05	0.9060	82.16	171.5	73.18	3.75	6.27	12,764.53	9,409.0
2000-06	0.9492	81.94	172.4	73.43	4.25	6.53	13,189.27	9,337.2

2000-07	0.9397	81.50	172.8	73.94	4.25	6.54	12,652.05	8,207.8
2000-08	0.9041	81.03	172.8	74.03	4.25	6.50	13,053.20	9,176.8
2000-09	0.8721	81.18	173.7	74.11	4.50	6.52	13,095.57	9,539.0
2000-10	0.8552	80.57	174.0	74.37	4.75	6.51	12,760.26	9,449.3
2000-11	0.8564	80.32	174.1	74.7	4.75	6.51	14,280.98	9,550.2
2000-12	0.8973	79.83	174.0	74.7	4.75	6.40	13,943.69	10,074.4
2001-01	0.9383	79.03	175.1	74.96	4.75	5.98	12,845.90	9,221.3
2001-02	0.9217	78.33	175.8	75.38	4.75	5.49	13,161.20	9,778.8
2001-03	0.9095	77.90	176.2	75.72	4.75	5.31	12,377.98	10,287.0
2001-04	0.8920	77.47	176.9	75.89	4.75	4.80	14,283.70	8,800.6
2001-05	0.8742	76.71	177.7	76.14	4.50	4.21	13,413.98	8,946.2
2001-06	0.8532	76.00	178.0	76.31	4.50	3.97	13,320.39	8,757.3
2001-07	0.8607	75.49	177.5	76.4	4.50	3.77	12,481.34	7,309.2
2001-08	0.9005	75.12	177.5	76.48	4.50	3.65	13,769.82	8,306.2
2001-09	0.9111	74.71	178.3	76.57	4.25	3.07	12,435.66	7,838.0
2001-10	0.9059	74.19	177.7	76.73	3.75	2.49	10,682.09	8,773.9
2001-11	0.8883	73.65	177.4	76.99	3.25	2.09	13,957.63	8,196.5
2001-12	0.8924	73.54	176.7	77.07	3.25	1.82	12,575.23	8,579.0
2002-01	0.8833	73.87	177.1	77.5	3.25	1.73	11,776.91	7,652.3
2002-02	0.8700	73.74	177.8	77.92	3.25	1.74	11,255.01	8,300.8
2002-03	0.8758	74.20	178.8	78.17	3.25	1.73	11,831.71	9,043.5
2002-04	0.8858	74.44	179.8	78.34	3.25	1.75	13,199.38	8,002.8
2002-05	0.9170	74.77	179.8	78.51	3.25	1.75	12,966.08	8,067.9

2002-06	0.9554	75.46	179.9	78.68	3.25	1.75	12,994.77	7,834.2
2002-07	0.9922	75.19	180.1	78.93	3.25	1.73	12,632.95	7,044.6
2002-08	0.9778	75.29	180.7	79.02	3.25	1.74	14,623.97	7,691.9
2002-09	0.9808	75.33	181.0	79.1	3.25	1.75	12,746.87	7,734.3
2002-10	0.9811	75.10	181.3	79.27	3.25	1.75	12,211.76	8,833.6
2002-11	1.0014	75.53	181.3	79.44	3.25	1.34	14,528.72	8,582.5
2002-12	1.0183	75.22	180.9	79.53	2.75	1.24	13,675.95	7,882.9
2003-01	1.0622	75.78	181.7	79.78	2.75	1.24	14,572.79	7,965.2
2003-02	1.0773	76.10	183.1	80.2	2.75	1.26	12,823.91	8,018.1
2003-03	1.0807	75.98	184.2	80.37	2.50	1.25	12,117.27	8,994.8
2003-04	1.0848	75.40	183.8	80.46	2.50	1.26	14,484.29	8,781.0
2003-05	1.1582	75.42	183.5	80.71	2.50	1.26	14,108.25	8,396.0
2003-06	1.1663	75.46	183.7	80.8	2.00	1.22	13,663.59	8,370.8
2003-07	1.1372	75.76	183.9	80.96	2.00	1.01	14,018.92	7,651.6
2003-08	1.1139	75.69	184.6	81.13	2.00	1.03	14,847.48	7,794.3
2003-09	1.1222	76.17	185.2	81.22	2.00	1.01	12,884.37	8,152.8
2003-10	1.1692	76.16	185.0	81.3	2.00	1.01	13,080.43	9,173.0
2003-11	1.1702	76.76	184.5	81.39	2.00	1.00	14,889.43	9,242.3
2003-12	1.2286	76.72	184.3	81.56	2.00	0.98	14,449.13	8,491.2
2004-01	1.2613	76.96	185.2	81.73	2.00	1.00	15,558.13	8,189.4
2004-02	1.2646	77.42	186.2	82.15	2.00	1.01	12,358.07	8,935.4
2004-03	1.2262	77.02	187.4	82.4	2.00	1.00	14,187.62	10,228.4
2004-04	1.1985	77.35	188.0	82.57	2.00	1.00	16,532.96	9,393.8

2004-05	1.2007	77.93	189.1	82.66	2.00	1.00	15,514.05	9,408.8
2004-06	1.2138	77.33	189.7	82.91	2.00	1.03	14,906.72	8,927.1
2004-07	1.2266	77.94	189.4	82.91	2.00	1.26	15,512.28	8,214.0
2004-08	1.2176	78.08	189.5	82.99	2.00	1.43	15,274.37	8,522.2
2004-09	1.2218	78.10	189.9	83.16	2.00	1.61	15,231.17	9,053.8
2004-10	1.2490	78.83	190.9	83.25	2.00	1.76	14,044.28	9,751.3
2004-11	1.2991	78.95	191.0	83.33	2.00	1.93	15,841.69	9,061.3
2004-12	1.3408	79.44	190.3	83.5	2.00	2.16	16,134.15	9,800.9
2005-01	1.3119	79.70	190.7	83.67	2.00	2.28	16,290.62	8,957.3
2005-02	1.3014	80.13	191.8	84.09	2.00	2.50	14,144.54	9,394.4
2005-03	1.3201	79.99	193.3	84.35	2.00	2.63	15,083.94	10,527.9
2005-04	1.2938	79.97	194.6	84.52	2.00	2.79	16,409.17	9,990.3
2005-05	1.2694	80.01	194.4	84.69	2.00	3.00	15,986.31	9,744.8
2005-06	1.2165	80.23	194.5	84.69	2.00	3.04	16,678.68	9,659.0
2005-07	1.2037	80.01	195.4	84.69	2.00	3.26	16,547.17	8,800.3
2005-08	1.2292	79.99	196.4	84.69	2.00	3.50	15,989.80	8,799.5
2005-09	1.2256	78.32	198.8	84.86	2.00	3.62	15,785.44	8,961.0
2005-10	1.2015	79.18	199.2	84.94	2.00	3.78	14,996.26	9,544.1
2005-11	1.1786	79.84	197.6	84.94	2.00	4.00	16,865.03	10,013.3
2005-12	1.1856	80.18	196.8	85.11	2.25	4.16	16,978.14	10,232.4
2006-01	1.2103	80.15	198.3	85.36	2.25	4.29	16,432.40	9,143.6
2006-02	1.1938	80.12	198.7	85.62	2.25	4.49	15,430.81	9,670.6
2006-03	1.2020	80.21	199.8	85.7	2.50	4.59	14,858.01	11,025.2

2006-04	1.2271	80.42	201.5	85.62	2.50	4.79	17,819.25	10,246.7
2006-05	1.2770	80.22	202.5	85.87	2.50	4.94	16,151.62	10,518.3
2006-06	1.2650	80.41	202.9	85.87	2.50	4.99	17,560.98	10,962.4
2006-07	1.2684	80.32	203.5	85.96	2.75	5.24	17,229.34	9,174.9
2006-08	1.2811	80.35	203.9	86.13	3.00	5.25	17,450.18	10,217.9
2006-09	1.2727	80.09	202.9	86.21	3.00	5.25	17,374.76	10,819.0
2006-10	1.2611	79.86	201.8	86.21	3.25	5.25	15,265.93	11,292.3
2006-11	1.2881	79.60	201.5	86.29	3.25	5.25	17,130.94	11,109.3
2006-12	1.3213	80.24	201.8	86.38	3.50	5.24	17,346.97	11,112.2
2007-01	1.2999	79.69	202.416	86.29	3.50	5.25	17,021.50	11,666.9
2007-02	1.3074	80.40	203.499	86.55	3.50	5.26	15,896.45	11,027.9
2007-03	1.3242	80.29	205.352	86.63	3.75	5.26	15,343.64	12,991.1
2007-04	1.3516	80.71	206.686	86.8	3.75	5.25	18,868.52	11,260.3
2007-05	1.3511	80.61	207.949	86.97	3.75	5.25	17,430.90	11,618.7
2007-06	1.3419	80.47	208.352	87.06	4.00	5.25	17,388.30	11,733.2
2007-07	1.3716	80.39	208.299	87.06	4.00	5.26	17,981.48	10,726.4
2007-08	1.3622	80.40	207.917	87.06	4.00	5.02	18,697.29	11,811.9
2007-09	1.3896	80.70	208.490	87.06	4.00	4.94	18,138.94	11,935.4
2007-10	1.4227	80.28	208.936	86.97	4.00	4.76	15,816.18	12,468.0
2007-11	1.4684	80.74	210.177	86.97	4.00	4.49	19,830.55	11,716.6
2007-12	1.4570	80.76	210.036	87.06	4.00	4.24	18,268.39	12,033.8
2008-01	1.4718	80.53	211.080	86.97	4.00	3.94	16,764.80	11,902.4
2008-02	1.4748	80.41	211.693	87.23	4.00	2.98	16,195.17	13,189.1

2008-03	1.5527	80.22	213.528	87.48	4.00	2.61	17,753.67	13,476.8
2008-04	1.5751	79.64	214.823	87.73	4.00	2.28	18,513.02	13,100.2
2008-05	1.5557	79.30	216.632	87.82	4.00	1.98	18,983.80	13,235.8
2008-06	1.5553	79.16	218.815	87.82	4.00	2.00	18,245.99	13,559.1
2008-07	1.5770	78.81	219.964	87.99	4.25	2.01	18,919.20	13,061.3
2008-08	1.4975	77.52	219.086	88.07	4.25	2.00	19,716.37	13,056.6
2008-09	1.4369	74.21	218.783	88.07	4.25	1.81	16,633.93	11,614.9
2008-10	1.3322	74.78	216.573	88.16	3.75	0.97	16,377.78	12,763.1
2008-11	1.2732	73.86	212.425	88.24	3.25	0.39	18,698.03	12,091.7
2008-12	1.3449	71.72	210.228	88.58	2.50	0.16	15,875.88	11,510.1
2009-01	1.3239	70.05	211.143	88.58	2.50	0.15	15,823.75	10,061.1
2009-02	1.2785	69.56	212.193	88.92	2.00	0.22	12,691.59	10,754.5
2009-03	1.3050	68.46	212.709	89.17	1.50	0.18	12,537.15	10,987.1
2009-04	1.3190	67.86	213.240	89.26	1.25	0.15	14,317.15	10,174.7
2009-05	1.3650	67.16	213.856	89.34	1.00	0.18	13,422.15	10,468.9
2009-06	1.4016	66.93	215.693	89.68	1.00	0.21	11,940.49	10,223.6
2009-07	1.4088	67.55	215.351	89.76	1.00	0.16	13,372.15	9,358.2
2009-08	1.4268	68.33	215.834	89.85	1.00	0.16	14,521.15	9,169.7
2009-09	1.4562	68.89	215.969	90.27	1.00	0.15	12,616.70	10,112.2
2009-10	1.4816	69.22	216.177	90.27	1.00	0.12	13,234.38	11,578.0
2009-11	1.4914	69.68	216.330	90.44	1.00	0.12	14,533.20	10,522.3
2009-12	1.4614	70.15	215.949	90.78	1.00	0.12	14,475.07	10,661.6
2010-01	1.4272	71.05	216.687	90.36	1.00	0.11	14,744.22	10,361.4

2010-02	1.3686	71.48	216.741	90.61	1.00	0.13	12,531.80	9,680.2
2010-03	1.3569	72.19	217.631	91.12	1.00	0.16	12,846.25	11,213.3
2010-04	1.3406	72.59	218.009	91.71	1.00	0.20	16,498.44	10,522.0
2010-05	1.2565	73.90	218.178	92.13	1.00	0.20	14,162.57	10,877.7
2010-06	1.2209	74.22	217.965	92.22	1.00	0.18	14,917.83	11,315.1
2010-07	1.2770	74.79	218.011	92.05	1.00	0.18	15,675.37	10,301.8
2010-08	1.2894	75.10	218.312	91.96	1.00	0.19	16,246.57	10,774.2
2010-09	1.3067	75.39	218.439	92.22	1.00	0.19	15,626.04	11,339.5
2010-10	1.3898	75.20	218.711	92.3	1.00	0.19	15,013.20	12,167.0
2010-11	1.3661	75.45	218.803	92.22	1.00	0.19	16,553.22	11,882.1
2010-12	1.3220	76.22	219.179	92.64	1.00	0.18	16,061.79	12,575.0
2011-01	1.3360	76.13	220.223	92.72	1.00	0.17	16,110.19	11,045.3
2011-02	1.3649	75.75	221.309	92.89	1.00	0.16	14,818.79	11,127.5
2011-03	1.3999	76.47	223.467	93.4	1.00	0.14	15,591.53	12,927.5
2011-04	1.4442	75.96	224.906	93.82	1.25	0.10	18,855.44	12,503.0
2011-05	1.4349	76.15	225.964	93.99	1.25	0.09	17,652.15	11,903.0
2011-06	1.4388	76.18	225.722	93.99	1.25	0.09	17,558.65	11,953.4
2011-07	1.4264	76.49	225.922	93.91	1.50	0.07	18,280.24	11,303.9
2011-08	1.4343	76.77	226.545	93.91	1.50	0.10	16,841.37	11,896.0
2011-09	1.3770	76.70	226.889	94.16	1.50	0.08	17,544.55	11,978.7
2011-10	1.3706	76.97	226.421	94.42	1.50	0.07	16,617.76	12,608.7
2011-11	1.3556	76.99	226.230	94.33	1.25	0.08	17,793.85	11,836.7
2011-12	1.3179	77.29	225.672	94.75	1.00	0.07	17,880.42	11,961.1

2012-01	1.2905	77.67	226.665	94.67	1.00	0.08	18,200.18	10,994.2
2012-02	1.3224	77.90	227.663	95.09	1.00	0.10	16,421.01	11,537.3
2012-03	1.3201	77.32	229.392	95.69	1.00	0.13	15,626.30	13,029.9
2012-04	1.3162	77.75	230.085	95.77	1.00	0.14	19,228.52	11,651.6
2012-05	1.2789	77.81	229.815	95.69	1.00	0.16	17,250.24	12,143.6
2012-06	1.2526	77.69	229.478	95.77	1.00	0.16	18,369.05	12,442.7
2012-07	1.2288	77.90	229.104	95.69	0.75	0.16	17,409.84	10,723.8
2012-08	1.2400	77.16	230.379	95.85	0.75	0.13	18,364.87	11,370.8
2012-09	1.2856	77.18	231.407	96.19	0.75	0.14	17,996.34	10,980.4
2012-10	1.2974	76.97	231.317	96.28	0.75	0.16	16,042.90	11,276.2
2012-11	1.2828	77.86	230.221	96.36	0.75	0.16	17,754.84	11,163.1
2012-12	1.3119	77.78	229.601	96.62	0.75	0.16	18,757.28	11,476.5
2013-01	1.3288	77.69	230.280	96.45	0.75	0.14	16,848.79	10,590.9
2013-02	1.3359	78.10	232.166	96.62	0.75	0.15	15,929.70	10,274.3
2013-03	1.2964	78.19	232.773	97.29	0.75	0.14	15,960.61	12,165.5
2013-04	1.3026	77.86	232.531	97.72	0.75	0.15	18,059.21	11,616.3
2013-05	1.2982	77.86	232.945	98.05	0.50	0.11	18,660.46	11,987.0
2013-06	1.3189	77.91	233.504	98.05	0.50	0.09	18,220.63	11,804.7
2013-07	1.3080	77.74	233.596	97.88	0.50	0.09	16,120.18	11,430.3
2013-08	1.3310	77.93	233.877	98.05	0.50	0.08	19,131.59	11,540.5
2013-09	1.3348	78.26	234.149	98.22	0.50	0.08	17,237.90	0.0

8.2. Appendix 2

Table 8.2: Table of data 2 - Source: Eurostat, ECB, Federal Reserve, U.S. Bureau of Labor statistics, U.S Census Bureau, Institute for Supply Management, Financial Management Service

Time (yyyy-mm)	Logarithm of trade volume EA→US	Logarithm of trade volume US→EA	Government debt to GDP (EA)	Government debt to GDP (US)	PMI _{US}	Percentage Change HICP (euro area)	Percentage change CPI-U (USA)
Unit	-	-	%	%	-	%	%
1999-01	3.9964	3.9252	0.0	59.80	50.6	0.00	0.00
1999-02	3.9959	3.9392	0.0	59.80	51.7	0.05	0.12
1999-03	4.0309	4.0006	0.0	59.80	52.4	0.15	0.30
1999-04	4.0903	3.9480	0.0	58.97	52.3	0.24	0.73
1999-05	4.0562	3.9396	0.0	58.97	54.3	0.03	0.00
1999-06	4.0564	3.9242	0.0	58.97	55.8	0.05	0.00
1999-07	4.0871	3.8756	0.0	58.20	53.6	0.22	0.30
1999-08	4.1067	3.9094	0.0	58.20	54.8	0.14	0.24
1999-09	4.0780	3.9267	0.0	58.20	57.0	0.11	0.48
1999-10	4.0450	3.9707	0.0	58.15	57.2	0.11	0.18
1999-11	4.1065	3.9479	0.0	58.15	58.1	0.17	0.06
1999-12	4.1181	3.9820	0.0	58.15	57.8	0.17	0.00
2000-01	4.0953	3.9101	71.5	57.53	56.7	0.22	0.30
2000-02	4.0475	3.9382	71.5	57.53	55.8	0.12	0.59
2000-03	4.0682	3.9964	71.5	57.53	54.9	0.15	0.82
2000-04	4.1478	3.9721	70.9	55.29	54.7	-0.01	0.06
2000-05	4.1060	3.9735	70.9	55.29	53.2	0.10	0.12
2000-06	4.1202	3.9702	70.9	55.29	51.4	0.35	0.52
2000-	4.1022	3.9142	70.4	54.75	52.5	0.22	0.23

07							
2000-08	4.1157	3.9627	70.4	54.75	49.9	0.13	0.00
2000-09	4.1171	3.9795	70.4	54.75	49.7	0.40	0.52
2000-10	4.1059	3.9754	68.9	54.05	48.7	0.04	0.17
2000-11	4.1548	3.9800	68.9	54.05	48.5	0.24	0.06
2000-12	4.1444	4.0032	68.9	54.05	43.9	0.19	-0.06
2001-01	4.1088	3.9648	70.4	54.92	42.3	-0.14	0.63
2001-02	4.1193	3.9903	70.4	54.92	42.1	0.16	0.40
2001-03	4.0926	4.0123	70.4	54.92	43.1	0.28	0.23
2001-04	4.1548	3.9445	70.2	53.82	42.7	0.41	0.40
2001-05	4.1276	3.9516	70.2	53.82	41.3	0.42	0.45
2001-06	4.1245	3.9424	70.2	53.82	43.2	0.17	0.17
2001-07	4.0963	3.8639	69.3	54.56	43.5	-0.01	-0.28
2001-08	4.1389	3.9194	69.3	54.56	46.3	-0.02	0.00
2001-09	4.0947	3.8942	69.3	54.56	46.2	0.27	0.45
2001-10	4.0287	3.9432	68.5	55.53	40.8	0.06	-0.34
2001-11	4.1448	3.9136	68.5	55.53	44.1	0.00	-0.17
2001-12	4.0995	3.9334	68.5	55.53	45.3	0.24	-0.39
2002-01	4.0710	3.8838	69.4	55.42	47.5	0.47	0.23
2002-02	4.0513	3.9191	69.4	55.42	50.7	0.04	0.40
2002-03	4.0730	3.9563	69.4	55.42	52.4	0.26	0.56
2002-04	4.1206	3.9032	69.5	56.01	52.4	0.23	0.56
2002-05	4.1128	3.9068	69.5	56.01	53.1	0.17	0.00
2002-	4.1138	3.8940	69.5	56.01	53.6	0.01	0.06

06							
2002-07	4.1015	3.8479	69.2	56.42	50.2	0.15	0.11
2002-08	4.1651	3.8860	69.2	56.42	50.3	0.16	0.33
2002-09	4.1054	3.8884	69.2	56.42	50.5	0.20	0.17
2002-10	4.0868	3.9461	68.4	57.68	49.0	0.17	0.17
2002-11	4.1622	3.9336	68.4	57.68	48.5	0.01	0.00
2002-12	4.1360	3.8967	68.4	57.68	51.6	0.23	-0.22
2003-01	4.1635	3.9012	69.7	57.53	51.3	0.37	0.44
2003-02	4.1080	3.9041	69.7	57.53	48.8	0.29	0.77
2003-03	4.0834	3.9540	69.7	57.53	46.3	0.25	0.60
2003-04	4.1609	3.9435	70.4	58.66	46.1	-0.10	-0.22
2003-05	4.1495	3.9241	70.4	58.66	49.0	-0.05	-0.16
2003-06	4.1356	3.9228	70.4	58.66	49.0	0.17	0.11
2003-07	4.1467	3.8837	70.7	58.33	51.0	0.14	0.11
2003-08	4.1717	3.8918	70.7	58.33	53.2	0.26	0.38
2003-09	4.1101	3.9113	70.7	58.33	52.4	0.26	0.33
2003-10	4.1166	3.9625	69.6	59.21	55.2	0.07	-0.11
2003-11	4.1729	3.9658	69.6	59.21	58.4	0.12	-0.27
2003-12	4.1598	3.9290	69.6	59.21	60.1	0.07	-0.11
2004-01	4.1920	3.9133	71.0	59.47	60.8	0.28	0.49
2004-02	4.0920	3.9511	71.0	59.47	59.9	0.14	0.54
2004-03	4.1519	4.0098	71.0	59.47	60.6	0.27	0.64
2004-04	4.2184	3.9728	71.7	59.71	60.6	0.22	0.32
2004-	4.1907	3.9735	71.7	59.71	61.4	0.32	0.59

05							
2004-06	4.1734	3.9507	71.7	59.71	60.5	0.12	0.32
2004-07	4.1907	3.9146	71.5	59.66	59.9	0.11	-0.16
2004-08	4.1840	3.9306	71.5	59.66	58.5	0.26	0.05
2004-09	4.1827	3.9568	71.5	59.66	57.4	0.05	0.21
2004-10	4.1475	3.9891	70.1	60.46	56.3	0.30	0.53
2004-11	4.1998	3.9572	70.1	60.46	56.2	0.00	0.05
2004-12	4.2077	3.9913	70.1	60.46	57.2	0.11	-0.37
2005-01	4.2119	3.9522	71.4	60.68	56.8	0.02	0.21
2005-02	4.1506	3.9729	71.4	60.68	55.5	0.24	0.58
2005-03	4.1785	4.0223	71.4	60.68	55.2	0.37	0.78
2005-04	4.2151	3.9996	72.1	60.39	52.2	0.13	0.67
2005-05	4.2037	3.9888	72.1	60.39	50.8	0.21	-0.10
2005-06	4.2222	3.9849	72.1	60.39	52.4	0.17	0.05
2005-07	4.2187	3.9445	71.6	60.07	52.8	0.29	0.46
2005-08	4.2038	3.9445	71.6	60.07	52.4	0.27	0.51
2005-09	4.1983	3.9524	71.6	60.07	56.8	0.44	1.22
2005-10	4.1760	3.9797	71.0	61.05	57.2	0.13	0.20
2005-11	4.2270	4.0006	71.0	61.05	56.7	-0.16	-0.80
2005-12	4.2299	4.0100	71.0	61.05	55.1	0.09	-0.40
2006-01	4.2157	3.9611	71.3	61.33	55.0	0.24	0.76
2006-02	4.1884	3.9855	71.3	61.33	55.8	0.17	0.20
2006-03	4.1720	4.0424	71.3	61.33	54.3	0.16	0.55
2006-	4.2509	4.0106	71.3	61.00	55.2	0.39	0.85

04							
2006-05	4.2082	4.0219	71.3	61.00	53.7	0.28	0.50
2006-06	4.2445	4.0399	71.3	61.00	52.0	0.15	0.20
2006-07	4.2363	3.9626	70.8	61.16	53.0	0.30	0.30
2006-08	4.2418	4.0094	70.8	61.16	53.7	0.12	0.20
2006-09	4.2399	4.0342	70.8	61.16	52.2	-0.10	-0.49
2006-10	4.1837	4.0528	69.2	61.70	51.4	-0.04	-0.54
2006-11	4.2338	4.0457	69.2	61.70	50.3	0.09	-0.15
2006-12	4.2392	4.0458	69.2	61.70	51.4	0.13	0.15
2007-01	4.2310	4.0670	69.5	62.17	49.5	0.23	0.31
2007-02	4.2013	4.0425	69.5	62.17	51.9	0.16	0.54
2007-03	4.1859	4.1136	69.5	62.17	50.7	0.22	0.91
2007-04	4.2757	4.0516	69.5	61.48	52.6	0.39	0.65
2007-05	4.2413	4.0652	69.5	61.48	52.5	0.26	0.61
2007-06	4.2403	4.0694	69.5	61.48	52.6	0.18	0.19
2007-07	4.2548	4.0305	68.5	61.82	52.4	0.21	-0.03
2007-08	4.2718	4.0723	68.5	61.82	50.9	0.06	-0.18
2007-09	4.2586	4.0768	68.5	61.82	51.0	0.28	0.28
2007-10	4.1991	4.0958	66.7	62.83	51.1	0.36	0.21
2007-11	4.2973	4.0688	66.7	62.83	50.5	0.63	0.59
2007-12	4.2617	4.0804	66.7	62.83	49.0	0.15	-0.07
2008-01	4.2244	4.0756	67.8	64.32	50.3	0.45	0.50
2008-02	4.2094	4.1202	67.8	64.32	47.6	0.17	0.29
2008-	4.2493	4.1296	67.8	64.32	48.3	0.53	0.87

03							
2008-04	4.2675	4.1173	68.1	64.06	48.8	0.09	0.61
2008-05	4.2784	4.1217	68.1	64.06	48.8	0.71	0.84
2008-06	4.2612	4.1322	68.1	64.06	49.8	0.50	1.01
2008-07	4.2769	4.1160	68.2	67.53	50.0	0.34	0.53
2008-08	4.2948	4.1158	68.2	67.53	49.2	-0.22	-0.40
2008-09	4.2210	4.0650	68.2	67.53	44.8	0.10	-0.14
2008-10	4.2143	4.1060	70.6	73.55	38.9	-0.15	-1.01
2008-11	4.2718	4.0825	70.6	73.55	36.5	-0.44	-1.92
2008-12	4.2007	4.0611	70.6	73.55	33.1	-0.42	-1.03
2009-01	4.1993	4.0026	74.5	77.37	34.9	0.11	0.44
2009-02	4.1035	4.0316	74.5	77.37	35.5	0.18	0.50
2009-03	4.0982	4.0409	74.5	77.37	36.0	-0.22	0.24
2009-04	4.1559	4.0075	77.6	80.50	39.5	0.16	0.25
2009-05	4.1278	4.0199	77.6	80.50	41.7	0.11	0.29
2009-06	4.0770	4.0096	77.6	80.50	45.8	0.30	0.86
2009-07	4.1262	3.9712	79.4	82.80	49.9	-0.16	-0.16
2009-08	4.1620	3.9624	79.4	82.80	53.5	0.27	0.22
2009-09	4.1009	4.0048	79.4	82.80	54.4	-0.13	0.06
2009-10	4.1217	4.0636	80.1	84.53	56.0	0.07	0.10
2009-11	4.1624	4.0221	80.1	84.53	54.4	0.24	0.07
2009-12	4.1606	4.0278	80.1	84.53	55.3	0.05	-0.18
2010-01	4.1686	4.0154	81.8	87.05	56.6	0.25	0.34
2010-	4.0980	3.9859	81.8	87.05	55.7	0.09	0.02

02							
2010-03	4.1088	4.0497	81.8	87.05	59.3	0.40	0.41
2010-04	4.2174	4.0221	83.3	88.73	58.9	0.23	0.17
2010-05	4.1511	4.0365	83.3	88.73	57.8	0.19	0.08
2010-06	4.1737	4.0537	83.3	88.73	56.1	0.09	-0.10
2010-07	4.1952	4.0129	83.4	90.11	56.4	0.14	0.02
2010-08	4.2108	4.0324	83.4	90.11	57.8	0.14	0.14
2010-09	4.1938	4.0546	83.4	90.11	56.5	0.06	0.06
2010-10	4.1765	4.0852	85.8	92.08	57.3	0.17	0.12
2010-11	4.2189	4.0749	85.8	92.08	58.2	0.23	0.04
2010-12	4.2058	4.0995	85.8	92.08	57.3	0.38	0.17
2011-01	4.2071	4.0432	86.9	93.62	59.2	0.48	0.48
2011-02	4.1708	4.0464	86.9	93.62	59.6	0.24	0.49
2011-03	4.1929	4.1115	86.9	93.62	59.3	0.50	0.98
2011-04	4.2754	4.0970	87.8	92.76	59.4	0.43	0.64
2011-05	4.2468	4.0757	87.8	92.76	53.5	0.08	0.47
2011-06	4.2445	4.0775	87.8	92.76	55.8	0.07	-0.11
2011-07	4.2620	4.0532	87.5	94.74	52.3	0.06	0.09
2011-08	4.2264	4.0754	87.5	94.74	53.2	0.19	0.28
2011-09	4.2441	4.0784	87.5	94.74	53.2	0.38	0.15
2011-10	4.2206	4.1007	88.0	96.23	51.5	0.25	-0.21
2011-11	4.2503	4.0732	88.0	96.23	52.3	0.24	-0.08
2011-12	4.2524	4.0778	88.0	96.23	52.9	0.11	-0.25
2012-	4.2601	4.0412	89.4	97.29	53.7	0.45	0.44

01							
2012-02	4.2154	4.0621	89.4	97.29	51.9	0.36	0.44
2012-03	4.1939	4.1149	89.4	97.29	53.3	0.32	0.76
2012-04	4.2839	4.0664	91.6	98.11	54.1	0.33	0.30
2012-05	4.2368	4.0843	91.6	98.11	52.5	-0.08	-0.12
2012-06	4.2641	4.0949	91.6	98.11	50.2	-0.01	-0.15
2012-07	4.2408	4.0303	91.7	98.23	50.5	0.21	-0.16
2012-08	4.2640	4.0558	91.7	98.23	50.7	0.46	0.56
2012-09	4.2552	4.0406	91.7	98.23	51.6	0.27	0.45
2012-10	4.2053	4.0522	92.7	100.08	51.7	0.14	-0.04
2012-11	4.2493	4.0478	92.7	100.08	49.9	-0.09	-0.47
2012-12	4.2732	4.0598	92.7	100.08	50.2	0.13	-0.27
2013-01	4.2266	4.0249	94.4	101.43	53.1	0.22	0.30
2013-02	4.2022	4.0118	94.4	101.43	54.2	0.21	0.82
2013-03	4.2030	4.0851	94.4	101.43	51.3	0.16	0.26
2013-04	4.2567	4.0651	95.7	100.46	50.7	-0.29	-0.10
2013-05	4.2709	4.0787	95.7	100.46	49.0	0.20	0.18
2013-06	4.2606	4.0721	95.7	100.46	50.9	0.19	0.24
2013-07	4.2074	4.0581	90.0	98.97	55.4	0.23	0.04
2013-08	4.2818	4.0622	90.0	98.97	55.7	0.18	0.12
2013-09	4.3543	4.1179	90.0	98.97	56.2	0.01	0.12