Fundamental and Nonfundamental Factors in the Euro/U.S. Dollar Market in 2002 and 2003

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The goal of this study is to identify factors which can explain the substantial appreciation of the EUR/USD exchange rate in the period from 2002 to 2003. Our analysis has shown that both fundamental and nonfundamental factors seem to have played a role. Regarding fundamental factors, an accommodating U.S. monetary policy in light of a weak labor market as well as the rising U.S. current account deficit contributed to weakening the U.S. dollar and thus strengthening the euro. The Bank of Japan's large intervention purchases of U.S. dollars, which have been widely considered important in the economic policy debate, do not appear to have had a significant impact on the EUR/USD exchange rate; however, they seem to have weakened the Japanese yen both vis-à-vis the U.S. dollar and the euro. In addition to these factors, the accounting scandals in the U.S. stock markets as well as fears of war and terrorism had a dampening effect on market sentiment, thus adding to the strain on the U.S. dollar. Measurement problems render it difficult to assess the role of euro area monetary policy and of European economic data. With a view to nonfundamental factors, we discuss the role of the trend-following behavior of agents in the foreign exchange market on the basis of a technical foreign exchange trading system used in practice. The buy and sell recommendations of such systems may also help explain the appreciation of the euro in the period in question. All in all, these fundamental and nonfundamental factors may explain the direction to which the EUR/USD exchange rate moved, but not the extent of this movement or the relative significance of these factors in determining the EUR/USD exchange rate in the period in question.

1 Introduction

The EUR/USD exchange rate is one of the most important relative prices in the global economy and in the global monetary system. Fluctuations of this rate have an effect on the competitiveness and purchasing power as well as on the value of accumulated assets of internationally diversified investors. Under the current regime of flexible exchange rates, the USD/EUR exchange rate fluctuates freely and is therefore determined by demand and supply in the foreign exchange market.

The EUR/USD exchange rate has been fluctuating considerably since the beginning of Economic and Monetary Union (EMU) in early 1999. Thus, the euro went down by around 26% against the U.S. dollar in the period up to the fourth quarter of 2000, which eventually led to coordinated interventions of the G-7 central banks and to unilateral interventions of the Eurosystem in the EUR/USD market.

This case study focuses on the period from early 2002 to end-2003, when the euro fully regained its losses vis-à-vis the U.S. dollar und appreciated up to a value of USD 1.26, which corresponds to a nominal appreciation of some 36%. By historical standards, this has been the second sharpest exchange rate increase over a two-year period since 1970.[1] This movement surprised many observers, since after the global downturn in 2001 the economy had been recovering notably faster in the U.S.A. than in the EU-12 and productivity growth in the U.S.A. continued to clearly surpass EU-12 figures.

This study aims to identify factors that influenced the EUR/USD market in 2002 and 2003 and which may therefore serve to explain at least the direction of these exchange rate movements. A differentiation is made between fundamental and nonfundamental factors that determine the exchange rate.

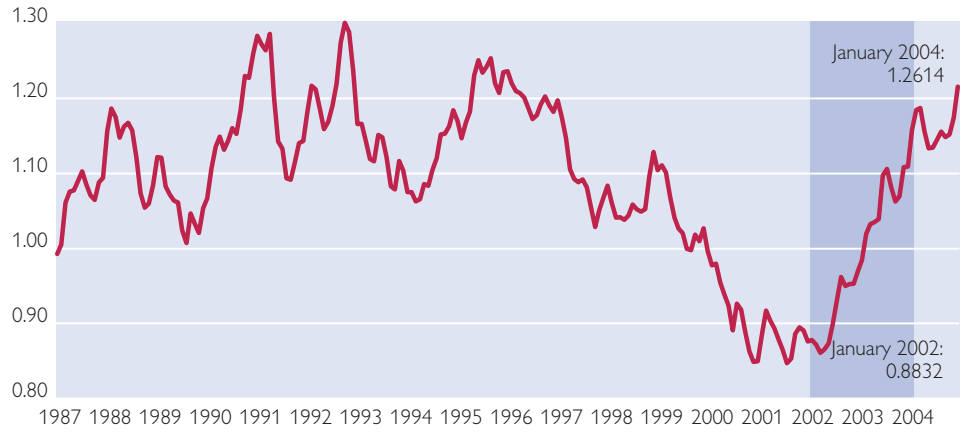
Refereed by
Michael Ehrmann, ECB.

[1] *The sharpest EUR/USD (synthetic) exchange rate increase occurred between 1985 and 1987.*

Chart 1

Historic Euro Exchange Rate

Development of the (synthetic) euro against the U.S. dollar since 1987



Source: Eurostat.

Chapter 2 examines the role of fundamentals such as the monetary policy of the Federal Reserve System (Fed), the Bank of Japan's interventions in the USD/JPY market as well as macroeconomic data in the U.S.A. and the EU-12. Furthermore, it provides an overview of important one-time events and other general factors market participants deemed significant in the period under review.

Chapter 3 examines nonfundamental factors, which exclusively result from market-inherent dynamics, using a concrete example of a technical foreign exchange trading system.

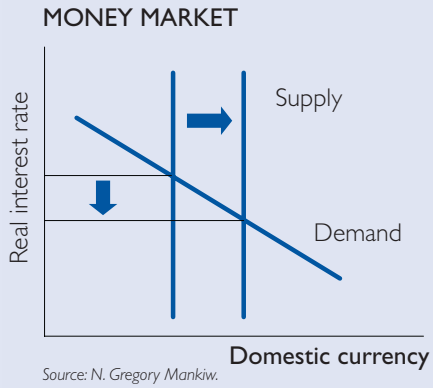
2 Fundamental Factors

It is a particular challenge to empirically illustrate the correlation between exchange rates and economic fundamentals such as economic growth, productivity, inflation rates, the current account or monetary and fiscal policy measures. In their frequently quoted paper, Meese and Rogoff (1983) find that fundamental variables, which are considered relevant by simple macroeconomic theories on exchange rate determination, usually cannot explain exchange rate movements. Another example that shows how difficult it is to explain exchange rate movements is the repeated rejection of the theory of uncovered interest parity in empirical studies (Froot and Thaler, 1990). Only fairly recent works, e.g. Chinn and Meridith (2002), find an empirical correlation between exchange rates and long-term interest rates which is consistent with uncovered interest parity.

In the past few years, however, a new kind of literature has emerged which makes use of a new, more market-based approach and has found a number of interesting empirical correlations between fundamentals and exchange rates. Before presenting this approach, we provide a simple macroeconomic theoretical model that explains the role demand and supply play in the foreign exchange market when it comes to exchange rate determination (see box "A Simple Model of Exchange Rate Determination").

A Simple Model of Exchange Rate Determination

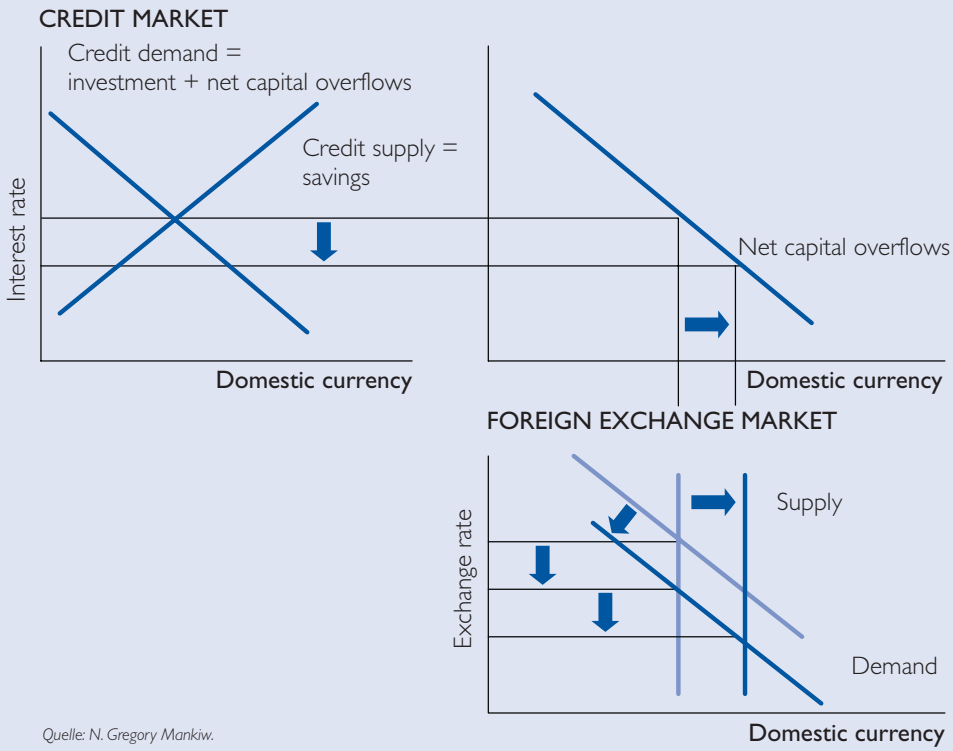
How do fundamental factors determine nominal exchange rates? Our rationale is based on a simple macroeconomic textbook model of an open economy according to Mankiw (2004). This model focuses on the money, credit and foreign exchange markets. Important macroeconomic factors influencing the nominal exchange rate are domestic and foreign interest rate and employment levels (reflecting differences in business cycles) in the short run and domestic and foreign price levels in the long run. In the short run, the central bank is capable of controlling the interest rate level vis-à-vis other countries by changing the money supply or the money market interest rate. The "Money Market" chart shows that, for example, an expansion of money supply creates a money supply surplus versus money demand. With interest rates still on a high level, this surplus reflects higher opportunity costs for holding money. In this situation, economic agents tend to shift their financial assets out of money balances to less liquid, higher-yielding financial instruments. Banks and security issuers respond to the higher demand for higher-yielding financial instruments by reducing interest rates. This, in turn, gives rise to an increased demand for holding money in the nonbank sector, because the holding of (non-interest bearing) money balances becomes less costly again. This process lasts until a new, lower equilibrium interest rate is established in the money market. The "Credit Market" chart, which explains how interest rate movements influence saving and investment decisions, shows that a decrease in interest rate causes a short-term increase in the employment level by pushing up consumption (which means savings go down) and investment. The higher employment level also corresponds to a business cycle acceleration vis-à-vis other countries, which triggers a virtuous circle of imports; as a result, net exports decline.[1] Depending on the starting point, this either causes a decline in the current account surplus or a rise in the current account deficit.



Source: N. Gregory Mankiw.

The following chart shows how the above-mentioned interest rate reduction directly affects credit market behavior and indirectly affects foreign exchange market behavior. Credit market: A lower interest rate first leads to a decline in savings deposits and thus in credit supply. Savings that were used to provide loans go down, as their yields fall. Given the higher interest rates abroad, savers rather opt for transfering part of their funds abroad; as a consequence, net capital outflows rise. Furthermore, the demand for loans to finance domestic investment goes up. The employment level rises, resulting in the above-mentioned virtuous circle of imports. Net exports decline.

[1] *In the short term, it is not relevant to differentiate between nominal and real interest and/or exchange rates, as price levels adjust only very slowly. In the long run, however, price levels developments do have an effect. Therefore, from a long-term perspective, the effect of monetary policy has to be assessed differently: The domestic price level rises in comparison to that of foreign countries. The money supply curve moves back to its original position. The impact on the interest rate level is neutralized, i.e. in the long run, monetary policy has no effect on interest rates.*



Quelle: N. Gregory Mankiw.

This brief illustration already defines the two principal determinants of the exchange rate. The supply of domestic currency in the foreign exchange market corresponds to the net capital outflow, which increases after a domestic interest rate cut. This capital outflow is part of the domestic currency savings used for foreign portfolio investment and direct investment and is thus supplied for exchange into foreign currency. At first this supply does not depend on the exchange rate but on the interest rate (i.e. on the interest rate differential vis-à-vis the foreign economy). If the net capital outflow increases, the exchange rate for the domestic currency will go down.

The second determinant for the exchange rate is the demand for domestic currency in the foreign exchange market, i.e. the domestic money foreign entities need to finance net exports. Net exports have to be financed in domestic currency. In exchange for domestic currency, foreign investors supply foreign currency; in other words: they demand the currency of the export country.

In this example, therefore, the exchange rate drops for two reasons: first, because higher net capital outflows raise the supply of domestic currency on the foreign exchange market (the supply curve shifts to the right) and second, because a stronger virtuous circle of imports causes a decline in net exports. This, in turn, corresponds to a lower demand for domestic currency on the foreign exchange market.

A method which has increasingly been used – especially over the past few years – to empirically illustrate the correlation between fundamental data and financial market prices is the event study approach.[2] It investigates the response of the exchange rate to an event the market participants did not anticipate (the so-called surprise event). In this context, surveys among market participants or futures prices may be used as indicators for expectations regarding possible events. The following univariate

[2] *As alternatives to an empirical description of the correlation between exchange rates and economic fundamentals, structural macroeconomic models or structural VaR models can be used. VaR models are often used to describe the empirical correlation between monetary policy and exchange rates (Faust and Rogers, 2003).*

linear regression is then used to estimate the reaction of the exchange rate:

$$\Delta y_t = \alpha + \beta x_t + \varepsilon_t.$$

Δy_t indicates the percentage change of the EUR/USD exchange rate in a narrow observation window around the time market participants learn about the surprise event x_t. Many event studies estimate the correlation with daily data, which allow for a 24-hour observation interval. More recent works increasingly use intraday data with observation intervals of around 30 minutes. Depending on the type of event, this study uses both daily data and intraday data. The parameter β, estimated by applying the ordinary least squares (OLS) method, measures the reaction of the exchange rate.[3] The error term ε_t represents other factors which determine the price but do not correlate with the exogenous variables.

Furthermore, this equation is also estimated for interest rates in the money and capital markets, which enables the determination of the *simultaneous* reaction of interest and exchange rates to an event. By measuring these simultaneous reactions we arrive at a more accurate picture of the way in which financial market participants interpret an event and, consequently, which exchange rate determination model they use for orientation (Hardouvelis, 1988). Faust et al. (2003) also emphasize this role of interpretation and/or the subjective element contained in market reactions. Event studies measure not only the correlation between an event and the subsequent price changes, but also the way in which financial market agents interpret an event.

The selection of events for this analysis was based on the literature, which quotes a number of macroeconomic data releases as well as the monetary policy of the U.S. Fed as relevant factors for the EUR/USD exchange rate. With regard to macroeconomic data releases, this study focuses mainly on the role of employment figures (nonfarm payrolls) and the U.S. trade balance (as an indicator for the current account). The limited focus on these factors was chosen, among other things, because market participants deemed them particularly significant for the period under review. In addition, this study investigates the significance of a number of European data releases. Another factor which was considered relevant especially by European economic policy makers was the exchange rate policy of a number of Asian countries. Given the limited availability of intervention data, this study only analyzes interventions by the Bank of Japan (BoJ) on the USD/JPY market which may have had an indirect influence on the EUR/USD exchange rate in the period under observation. The table in the annex shows the events and the observation interval used to measure the exchange and interest rate changes.

2.1 The Monetary Policy of the Federal Reserve System

To investigate the market reaction to the Fed's interest rate moves we apply Kuttner's (2001) approach to measuring the surprise component of a change in the Fed's monetary instrument, the Fed funds target. This approach uses federal funds futures to determine the expectations of

[3] *If only the event is regressed on the exchange rate and its surprise component is not, this leads to an attenuation bias in estimating the coefficient and subsequently to an underestimation of the impact of the event.*

changes in the Fed funds target. It uses the unanticipated change or maintenance of the Fed funds target on days of Federal Open Market Committee (FOMC) meetings, computed by Gürkaynak et al. (2004), as an exogenous variable.[4] The estimate includes the reaction of both the EUR/USD exchange rate and the U.S. and euro area yield curves in the period after the start of Monetary Union in 1999. A Chow test is carried out to determine the structural stability of correlations for the period from 2002 to 2003, which is of particular interest for this study.

Table 1

Reaction of the EUR/USD Exchange Rate and U.S. and Euro Area Interest Rates to an Unanticipated 100 Basis-Point Change in the Fed Funds Target from 1999 to 2003

	Reaction		Standard deviation		R^2		Chow test	
	U.S.A.	EU-12	U.S.A.	EU-12	U.S.A.	EU-12	U.S.A.	EU-12
	Basis points							
3 months	94.1**	20.8**	6.5	5.2	0.82	0.26	0.84	0.53
2 years	41.2**	26.7**	10.7	11.5	0.20	0.12	0.78	0.33
10 years	18.7**	18.2	8.8	15.8	0.06	0.08	0.46	0.05
Real yield	18.2**	4.9	5.3	10.5	0.13	0.02	0.89	0.01
	%							
EUR/USD	−3.10**		0.84		0.13		0.92	

Source: OeNB.

*** indicates significance at the 5% level. R^2 indicates the coefficient of determination. The columns for the Chow test indicate the p-value of the null hypothesis of structural stability. The real yield is the yield on inflation-indexed government bonds with a residual maturity of 10 years.*

Table 1 shows that the Fed's interest rate moves have a significant simultaneous effect on the EUR/USD exchange rate and on interest rates in the U.S.A. and the euro area. In order to illustrate this assertion we discuss the relevant case of an interest rate cut in the period from 2002 to 2003.

If the Fed cuts interest rates by 100 basis points, the EUR/USD exchange rate goes up 3.1% according to this estimate, i.e. the euro appreciates. At 1.6%, Ehrmann and Frantzscher (2004) find a less strong reaction of the EUR/USD exchange rate.[5]

The Fed's interest rate cut causes U.S. interest rates to drop across the entire maturity spectrum, with the effect on the money market, where interest rates fall by 94 basis points, being clearly stronger than at the long end of the bond market, where rates decline by a mere 19 basis points. The response of yields of inflation-protected bonds suggests that in the U.S.A. both nominal and real interest rates reacted to the Fed's rate cut.

Furthermore, the effect spills over to interest rates in the euro area, causing them to drop as well. The extent to which euro area interest

[4] *The interest rate cut of January 3, 2001, which started the cycle of interest rate cuts in 2001, was removed from the sample because it is an observation atypical of the period in question, as U.S. bond markets responded to this key interest rate cut with rising nominal interest rates and real yields and inflation risk premiums. If this observation is taken into account, the effect on the exchange rate is weaker, but still significant.*

[5] *The result of Ehrmann and Fratzscher's (2004) estimate for the period from January 1993 to February 2003 falls within the 95% confidence interval of this estimate.*

rates react does not seem to depend on maturities; therefore, the yield curve reaction in the euro area may be described as a downward parallel shift. The effect at the long end (10 years), however, is significant neither for nominal nor for real interest rates.

All in all, these estimates suggest that a relaxation of monetary policy in the U.S.A. ceteris paribus causes short- and long-term nominal and real interest rates in the U.S.A. to drop faster than those in the EU-12, with this effect being most obvious in the money market. The structural stability test of the correlation shows that the Fed's monetary policy affected the EUR/USD exchange rate and the interest rates in the years 2002 to 2003 as well.

Within the scope of our simple model, this effect of monetary policy can be interpreted as triggering a change in investment incentives for international investors, thus causing net capital flows, which in turn lead to a change in the exchange rate.

These estimates serve to prove the simultaneous effects of the Fed's monetary policy measures (i.e. decisions to change the Fed funds target or to keep it unchanged) on exchange rates and interest rates. Fatum and Scholnik (2003), however, have shown that revised expectations of *future* monetary policy measures also influence the EUR/USD exchange rate. Such revisions can be triggered by the release of certain new economic data informing the financial markets about the current state and the expected future developments of the U.S. economy. As the Fed reacts to economic developments in its monetary policy decisions, such data releases act as leading indicators for future monetary policy decisions. This, however, is not necessarily true for all economic data. Some economic data may have an effect on the exchange rate without at the same time causing a change in the expectations of future monetary policy decisions.

2.2 U.S. Macroeconomic Data: Labor Market and Current Account Deficit

From the literature on the correlation of unanticipated releases of U.S. macroeconomic indicators and on the EUR/USD exchange rate, a number of systematic correlations have been documented. In this context, the U.S. dollar is strengthened by better-than-expected economic data such as for industrial output, retail trade, orders for durable goods and consumer confidence but also by better-than-expected labor market statistics and U.S. trade balance data. Interestingly, unexpectedly high, or low, U.S. inflation rates often have no significant impact on the EUR/USD exchange rate (Faust et al., 2003, and Andersen et al., 2002).

In general, such estimates presuppose that the structural relationship between certain economic data and the exchange rate remain constant over time. This assumption, however, is not justified in all instances. In a survey among foreign exchange traders Cheung and Chin (1999) found that the relevance of specific economic data for the market may change considerably over time, i.e. that economic data that drive the market at one point may be irrelevant at a different point in time. As the markets' focus is continuously shifting between various aspects of the set of economic data, the obvious course of action is to narrow any detailed analysis down to the effect of those macroeconomic indicators that are considered particu-

larly important in the market debate in the period under observation. In 2003 in particular, these were new data on the U.S. labor market and current account.

In the following, we estimate the correlation between nonfarm payrolls (as the prime indicator for the U.S. labor market situation) and the U.S. balance of trade (as an indicator for the current account) on the one hand and the EUR/USD exchange rate and U.S. and euro area yield curves on the other hand (sample period: 2002 to 2003). Table 2 shows the results of this estimation:[6]

Table 2

Reaction of Prices in the Money, Bond and Foreign Exchange Markets to Unanticipated U.S. Employment and Trade Balance Data from 2002 to 2003

%

	Reaction		Standard deviation		R^2	
	U.S.A.	EU-12	U.S.A.	EU-12	U.S.A.	EU-12
Employment						
3 months	−0.0128**	−0.0034	0.0029	0.0021	0.24	0.09
2 years	−0.0487**	−0.0181**	0.0205	0.0078	0.30	0.21
5 years	−0.1190**	−0.0411**	0.0503	0.0200	0.30	0.18
EUR/USD	−0.132**		0.0553		0.34	
Trade balance						
3 months	−0.0011	0.0001	0.0017	0.0028	0.01	0.00
2 years	−0.0067	0.0065	0.0080	0.0077	0.03	0.03
5 years	−0.0268	0.0145	0.0201	0.0209	0.04	0.02
EUR/USD	−0.0786*		0.0441		0.12	

Source: OeNB.

** and ** indicate significance at the 10% and 5% level. R^2 indicates the coefficient of determination.*

To illustrate the results pertaining to the reaction to U.S. employment data we use the case of an unexpectedly low number of newly created jobs, or an unexpectedly strong decline in jobs, respectively, which was relevant in the observation period. It becomes evident that such negative news about the U.S. labor market weakens the U.S. dollar while at the same time driving up the price of money market papers and bonds, with the impact on the bond market being stronger. As there is an inverse relationship between prices and interest rates, this means that bad news from the U.S. labor market drives down interest rates in the U.S.A. Spillover effects then cause interest rates in the euro area to drop as well, but less than in the U.S.A. (the effect on the euro money market is insignificant). As a result, the relative prices of U.S. bonds, or money market papers, respectively, go up, thus causing U.S. interest rates to decline more sharply. These results are in line with those in Faust et al. (2003).

The reaction in U.S. money and bond markets can be interpreted as a "policy anticipation effect." The markets are aware of the Fed's monetary policy reaction function, where changes in the employment level play a prominent role because of their importance for price stability and sustainable economic growth. Consequently, a worse-than-expected labor

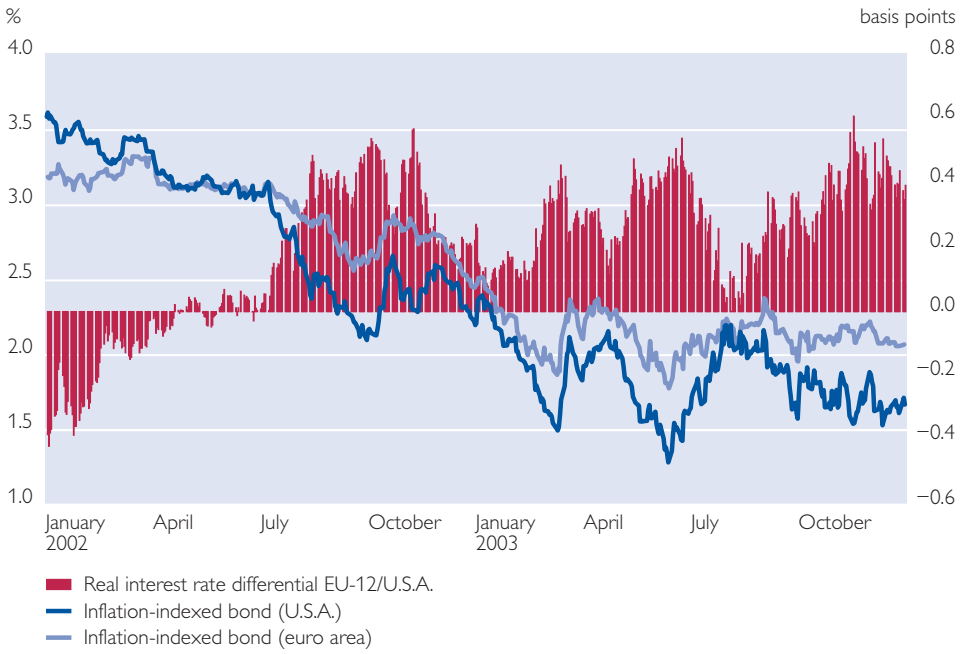
[6] *Other than in the sections dealing with the Fed's monetary policy, the euro area economic data and the Bank of Japan's exchange rate policy, in this section we use the price change of front-end foreign exchange or interest rate futures contracts as an endogenous variable. These data are available in intraday frequency, which allows for narrower observation intervals and thus more precise estimates.*

market report leads to a revision of expectations of future monetary policy; i.e. key interest rates are expected to fall or remain unchanged for longer than previously expected.

Expectations regarding the Fed's future monetary policy played an important role especially in the second half of 2003, as the Fed signaled during that period that, given the risk of an undesired further decline in inflation, it would keep its key interest rates low "for a considerable period." This move aimed to counter this risk and, at the same time, close the output gap more quickly. Anderson and Thornton (2004) assume that this "unconventional policy" was responsible for the decline in long-term real interest rates in this period (see chart 2).[7]

Chart 2

Long-Term Real Interest Rates and Real Interest Differential U.S.A./Euro Area



Source: Datastream.
A positive real interest rate differential means that real interest rates in the euro area are higher.

The estimates of the effects of negative labor market data and of the Fed's monetary policy suggest that these two factors together contributed to a decrease in short- and long-term real interest rates in the U.S.A. The simple model of exchange rate determination presented in this study showed that ceteris paribus this decline of interest rates leads to increased net capital outflows and subsequently to a weaker exchange rate.

The second factor we investigated more closely was the U.S. current account deficit. Market debates have regularly pointed out that the existing deficit reflects an imbalance that can only be evened out if U.S. imports go down or exports go up. This, in turn, requires a weaker U.S. dollar as a prerequisite. The estimates indi-

[7] *Measured by the break-even inflation rates computed from inflation-indexed bonds, inflation expectations in the U.S.A. also went up (more strongly than in the euro area), which generally also indicates a weaker U.S. dollar.*

Table 3

Bilateral Trade Balances of the EU-12, Japan and the U.S.A.

USD billion

U.S.A./EU-12		U.S.A./Japan		EU-12/Japan	
2002	2003	2002	2003	2002	2003
–13.1	–17.9	–35.4	–37.7	–12.9	–17.7

Source: Eurostat, IMF (Directions of trade).
Values for 2002 and 2003 are the total of Q4 01 and Q1 02 data, and of Q4 03 and Q1 04 data, respectively.

cate that in fact, in the period in question the U.S. dollar regularly reacted to unexpectedly high deficits in the U.S. trade balance by depreciating against the euro (see table 2). Table 3 shows the bilateral trade balances as the most important subaccount of the current account balance.

In the period from 2002 to 2003, the U.S. trade balance deteriorated both vis-à-vis the euro area and Japan (as well as against many other countries, including China), with the absolute increase of USD 9.6 billion and USD 4.6 billion, respectively, at an annualized basis being relatively small.[8] Based on the model described in the box "A Simple Model of Exchange Rate Determination," the change in the U.S. net trade balance can be interpreted as additional demand for foreign goods, which results in additional demand for foreign currency by U.S. residents. This, in turn, weakens the U.S. dollar. According to this model, in such a case there should be no simultaneous reaction of U.S. interest rates – an assumption which is in line with our estimates.

In this context, it is important to note that this study measures the market reaction to the release of new trade balance data rather than the reaction of the exchange rate to the trade balance and/or the subsequent demand for foreign currency. Using a theoretical model, Bachetta and Van Wincoop (2004) demonstrate that markets use fundamentals that are not directly observable and which show large imbalances as a "scapegoat" for exchange rate movements, which means that not only the effect of the fundamentals themselves, but also their subjective perception by the economic agents has an impact on the market.

By way of a summary, two fundamental factors are identified as being responsible for the weak U.S. dollar: the supportive U.S. monetary policy in conjunction with slow employment growth, and the high current account deficit, which triggers market concern. These two factors are complementary when explaining exchange rate developments by using fundamentals. Depending on the perspective, in the period under review the U.S. current account deficit was either too high or U.S. interest rates were too low for the U.S. dollar to be more stable. These results, however, do not allow for a relative or absolute weighting of these two factors when it comes to explaining the exchange rate changes in the period under observation.

[8] *The U.S. net investment position (foreign claims against the U.S.A. less U.S. claims against the rest of the world) came to USD –2,430 billion or some 24% of GDP at purchasing power parities in 2003.*

2.3 Monetary Policy and Macroeconomic Data Releases in the Euro Area

In sections 2.1 and 2.2 we used the event study approach to analyze specific fundamental factors in the U.S.A. which are relevant for price dynamics. The effects we found may help explain the direction of exchange rate changes and are consistent with those of the simple model of exchange rate determination we introduced. Basically, this empirical approach may also be used to measure market reactions to monetary policy measures and to the release of macroeconomic data in the euro area, which would also help demonstrate the significance of euro area factors in determining the EUR/USD exchange rate. However, a number of measurement problems exist in this context.

Up to now, relatively few empirical studies have been available for the euro area. Galati and Ho (2001) and Ehrmann and Fratzscher (2004) find that individual economic data from the euro area or from Germany (with the exception of the ifo business climate index) exert no significant influence on the EUR/USD exchange rate. These results are in line with the widely shared view in the foreign exchange market that the release of individual economic data from the U.S.A. plays a much more substantial role than that of euro area data. Table 4 shows the results of the estimates regarding the effects of certain macroeconomic data from the euro area (inflation rates of consumer and producer prices), from France (INSEE business climate) from Germany (ifo business climate index).

Table 4

Reaction of the EUR/USD Exchange Rate to Unanticipated Euro Area Economic Data from 2002 to 2003

%

	Reaction	Standard deviation	R^2
HICP (EU-12)	0.1371	0.0877	0.02
PPI (EU-12)	0.4509	0.4996	0.08
INSEE-BC	0.0424	0.0986	0.01
ifo index	−0.2857	0.1874	0.04

Source: OeNB.

** and ** indicate significance at the 10% and 5% level. R^2 indicates the coefficient of determination.*

These results confirm earlier studies, in part, as well as the market opinion, which says that European economic data, as a rule, have no significant influence on the exchange rate. The ifo business climate index, which other studies estimate as being significant, could not be estimated as being significant in the present study. A possible explanation for the minor significance of European economic data for the foreign exchange market may be the fact that they are released later than U.S. economic data. Since a lot of U.S. economic data act as leading indicators for European economic data, agents in the foreign exchange market might increasingly turn to U.S. figures for guidance, which would reduce the news value and thus the exchange rate relevance of European economic data.

Concerning the monetary policy of the European Central Bank (ECB), one option would be to proceed along the lines of the analysis presented in section 2.2, i.e. by measuring the effects of unanticipated interest rate moves on U.S. and euro area interest rates as well as on the EUR/USD

exchange rate. However, in the period from 2002 to 2003, markets for the most part anticipated the monetary policy decisions of the Governing Council of the ECB, i.e. they anticipated whether the Governing Council would change the main refinancing rate or leave it unchanged. Therefore, within the scope of this study it is not possible to determine unanticipated monetary policy events and to assign them to a specific point in time. Consequently, this analysis of the relatively short period from 2002 to 2003, which focuses on the event study approach, cannot make any statement on the effects of the ECB's monetary policy on the EUR/USD exchange rate.

Ehrmann and Fratzscher (2004) estimate the correlation between the USD/DEM exchange rate (and EUR/USD exchange rate, respectively) and interest rate moves of the Deutsche Bundesbank and the ECB in the period from 1993 to February 2003 and find that interest rate hikes have a nonsignificant, positive effect on the exchange rate, i.e. higher key interest rates of the Deutsche Bundesbank or the ECB strengthened the Deutsche mark (and the euro, respectively) against the U.S. dollar.

2.4 Interventions by the Bank of Japan

The large-scale purchases of U.S. dollars in the course of interventions on the foreign exchange market by a number of Asian central banks were another possible determinant for the external value of the euro that was discussed by in particular by European economic policy makers (see e.g. the interview with W. Duisenberg, Handelsblatt, September 22, 2003).

In this context, the unilateral interventions by the Bank of Japan (BoJ) stood out in particular. On behalf of the Japanese Ministry of Finance, the BoJ sold a total amount of around JPY 24,000 billion for U.S. dollars in the period under review.[9] Interventions on the foreign exchange market, inter alia, have been recommended as an effective instrument to combat deflation in Japan against the background of a zero-interest environment on the money market (Coenen and Wieland, 2004).[10] Given the availability of intervention data at a daily frequency, the effects of these interventions on the USD/JPY and the EUR/JPY exchange rates – and thus on the EUR/USD exchange rate – can be estimated using the event study approach (Ito, 2002). Table 5 presents the results of a regression of BoJ interventions on the three exchange rates as well as on bond yields in Japan and the U.S.A.

As table 5 shows, the sale of JPY 1,000 billion for U.S. dollars causes a depreciation of the Japanese yen against the U.S. dollar *and* the euro by 0.84% and 0.75%, respectively. The estimate of the effect on the USD/JPY exchange rate confirms Spiegel's (2003) assessment that the interventions successfully countered an appreciation of the Japanese yen

[9] *In the period from 2002 to 2003, neither the Eurosystem nor the Fed intervened on the foreign exchange market by purchasing or selling foreign exchange. However, there were a number of statements, most notably by individual members of the Governing Council of the ECB, that had an effect on the markets. Fratzscher (2004) provides an econometric analysis of such "verbal interventions."*

[10] *The accumulation of reserves by the Chinese central bank was also a relevant factor. A higher preference for U.S. dollar-denominated reserves, prompted by the Asian crisis, seems to have been one of the factors to play a role for the other Asian central banks (Aizenman and Marion, 2002).*

Table 5

Reaction of Exchange Rates and Bond Yields to U.S. Dollar Purchases within the Scope of BoJ Interventions to the Amount of JPY 1,000 Billion from 2002 to 2003

	Reaction		Standard deviation		R^2	
	%					
EUR/USD	−0.09		0.26		0.00	
EUR/JPY	0.75**		0.23		0.09	
USD/JPY	0.84**		0.15		0.25	
	U.S.A.	Japan	U.S.A.	Japan	U.S.A.	Japan
	Basis points					
2 years	0.1	−0.8	3.1	0.5	0.00	0.03
5 years	−0.1	−1.0	4.4	1.3	0.00	0.00
10 years	0.5	−1.9	3.5	1.7	0.00	0.01

Source: OeNB.

*** indicates significance at the 5% level. R^2 is the coefficient of determination.*

against the U.S. dollar ("leaning against the wind").[11] Bond yields in Japan did not react to the interventions.

A crucial finding with regard to the main focus of this study is the fact that the BoJ intervention purchases of U.S. dollars hardly supported the U.S. dollar against the euro, if at all. The measured effect has the right sign but is not significant, which means that the interventions do not seem to have had a substantial influence on the EUR/USD exchange rate. This fact may be attributable to the depth and/or elasticity of U.S. money and bond markets (Bernanke, 2004). The results for U.S. bond yields, which did not react to the interventions, suggest the same.

One-Time Events and Market Sentiment

Regardless of the factors analyzed so far, such as monetary policy decisions or the release of the latest economic indicators, there are other factors which are more difficult to quantify and less easily explicable in economic terms and which may also influence the foreign exchange market at least in the short term. These are one-time events that may drive the market. The political arena provides most of the examples for such events, which include elections or military conflicts. In addition, foreign exchange traders feel that the market is also driven by a wide range of general economic expectations and by less specific assessments and moods, the so-called market sentiment. These general assessments often create the backdrop for events analyzed in sections 2.1 and 2.4. To shed some light on these background characteristics as well as on certain relevant one-time events, we evaluated a number of sources which reflect the full spectrum of foreign exchange market activities in real time. For this purpose, reports of various investment banks were used which provide a comprehensive picture of those factors that were particularly important for the market in certain periods.

In 2001, the market increasingly began to doubt in the sustainability of the New Economy in the U.S.A. The value of the U.S. dollar clearly dropped not only against the euro but also against a number of other important currencies. In the second half of the 1990s, high productivity growth and the expectations of higher profitability and better earnings prospects in the U.S.A. were considered

[11] *The effect on the USD/JPY exchange rate is very close to Ito's estimate for the period from 1995 to 2001 and slightly stronger than the effects Castren (2004) found for the period from 1999 to 2003 for the JPY/USD, JPY/EUR and USD/EUR exchange rates. As endogenous variables, Castren uses the first four moments of the risk-neutral density derived from foreign currency options. In general, the effects of interventions might tend to be stronger because the market reaction to interventions rather than to the surprise component of interventions is estimated.*

major pillars for the expansion of investment activities and the extraordinarily bullish stock markets. According to market estimates, this positive environment caused foreign capital inflows and thus raised the value of the U.S. dollar. In the course of 2001, the U.S. investment boom started to stagnate, corporate profits declined considerably and the economy slowed down. The terrorist attacks on the World Trade Center as well as the bankruptcy of the U.S. energy corporation Enron increased investors' risk aversion, causing them to resort to lower-risk assets.

In early 2002, markets were particularly focusing on the investigations of U.S. supervisory authorities into further cases of accounting irregularities in U.S. corporations. After the telecommunications company WorldCom had filed for bankruptcy and numerous other bankruptcies and accounting scandals had occurred in the U.S. telecom industry, many shareholders and investors suffered considerable losses. Investors increasingly lost confidence, uncertainty grew; and for the first time in two years the U.S. dollar tested parity with the euro, which markets considered an important barrier. In spite of sound economic prospects in the U.S.A., the U.S. dollar failed to recover.

Another political factor which increasingly became the center of market participants' attention was the ever clearer indication that a military conflict in Iraq was looming. In November 2002, the UN adopted a resolution to send weapon inspectors to Iraq, and in December it was reported that there was "solid" information that Iraq had weapons of mass destruction. In that period, the EUR/USD exchange rate climbed to 1.05.

In late 2002/early 2003, the war with Iraq became the markets' dominant issue. In the weeks prior to the release of the first preliminary report of the UN weapons inspectors on January 27, 2003, the value of the euro climbed by the day and reached a three-year high of 1.09, as the situation became more aggravated. U.S. military action influenced the mood in the financial markets throughout the period from March 20 to May 2, 2003.

Statements by U.S. Secretary of the Treasury John Snow, who succeeded Robert Rubin in January 2003, also stirred up the foreign exchange market. He had announced to the public that the market was to decide on the exchange rate level. A weak U.S. dollar was favorable for exports and thus also for the economy, he said. By the end of May 2003, the exchange rate of the U.S. dollar dropped to approximately 1.20 against the euro. Accordingly, the announced continuation of the strong dollar policy became less and less credible.

A factor that kept coming up in the discussion was the risk of new terrorist attacks in the wake of September 11, 2001. This risk was considered negative for the U.S. dollar, as negative repercussions on the U.S. economy were to be expected.

In the second half of 2003, the market focus shifted to international imbalances, and in particular to the U.S. current account deficit. In this context, markets considered the G-7 statement on the importance of exchange rate flexibility as a signal for a further decline of the U.S. dollar. Until the end of the fourth quarter 2003, the euro continued to strengthen and reached levels above 1.25.

When evaluating the various documents describing market opinion and market sentiment, it is remarkable that information about the euro area or about individual euro area countries was of very limited significance. For example, developments in connection with the Stability and Growth Pact hardly played a role in the markets in the period under observation. By contrast, the general perception was rather that the European economy was merely following the lead of the U.S. economy, and that therefore information on U.S. developments was more significant.

3 Nonfundamental Factors

In addition to the fundamental factors identified in chapter 2, evidence suggests that other factors which are related more closely to market dynamics may also influence the EUR/USD exchange rate. The majority of exchange rate changes, for example, occur at points in time when there are no observable market events. The coefficients of determination of the regressions presented in chapter 2 also suggest that, next to fundamentals, there are other factors that come into play. Ehrmann and Fratzscher (2004) find

that fundamentals may be used to explain the direction of a change of the EUR/USD exchange rate, but not its extent.

An alternative approach to explaining exchange rate fluctuations is to look at the role of market participants who use so-called technical trading and trend-following systems.[12] In the 1970s and 1980s, economics literature widely agreed (Fama, 1970) that financial markets (und thus also foreign exchange markets) were efficient and that price developments followed a random walk. Therefore, analyzing the history of a financial time series would not provide any useful information on future developments. For this reason, the use of technical trading systems – when taking transaction costs properly into account – would not able to generate profits and were therefore useless. In the early 1990s, however, empirical studies raised sustained doubts about this conclusion. Brock et al. (1992) found that trading strategies that followed relatively simple rules generated profits which exceeded those of a buy and hold strategy.

From the theoretical literature on nonfundamental exchange rate determinants, two approaches should be mentioned in particular, namely the microstructure approach (Lyons, 2001) and the dynamic equilibrium approach (Brock and Hommes, 1997) with heterogeneous foreign exchange market participants.

The first approach explains short-term exchange rate developments mainly by analyzing the way participants in the foreign exchange market aggregate information. Osler (2001) found that foreign exchange limit orders concentrated around certain points (points of support or points of resistance), which reinforced ongoing exchange rate movements. De Grauwe and Grimaldi's (2004) provide an example for the second approach. They define a dynamic equilibrium model with a group of foreign exchange traders acting on the basis of fundamentals and a second group acting on the basis of technical trading systems. Depending on their success (as measured by the generated risk-adjusted trading profits), the two groups' share in the foreign exchange market changes. The success of the technically oriented traders attracts more traders who work along the according to this pattern, which results in the reinforcement of existing trends in the foreign exchange markets. In this model, however, the "chartists" never completely dominate the exchange rate developments. Outside the tolerance band for the fundamental exchange rate, which depends on the transaction costs in the international commodity markets, "fundamentalists" prevail. Furthermore, the growing number of technically oriented traders leads to higher exchange rate volatility, which – via a risk-adjustment of trading profits – limits the number of new "chartists."

De Grauwe and Grimaldi's (2004) model arrives at a number of statements which seem to apply to the analyzed currency pair (EUR/USD) in the period from 2002 to 2003: First, the model presupposes that the volatility of the exchange rate increases as the volatility of the fundamentals declines. Although, as demonstrated above, the development of fundamentals may help explain a stronger euro,

[12] *This study examines the role of automated foreign exchange trading systems. The classic technical analysis (chart analysis) operates on the same principle: the price history is used to produce a forecast.*

a 36% change of the nominal EUR/USD exchange rate in the period under review seems very difficult to comprehend, given the high stability of the two economies (U.S.A. and EU-12) concerned.

Second, technically oriented traders play a major role in this model if the exchange rate fluctuates around a fundamentally justified value within a tolerance band determined by transaction costs in commodity markets. Conversely, the importance of fundamentally oriented traders increases if the exchange rate is outside the limits of the tolerance band: The trend of the EUR/USD exchange rate reversed in 2001–02, when the exchange rate clearly deviated from the purchasing power parity (PPP) of 1.11[13] computed by the OECD (2004), and when the G-7 central banks (and the Eurosystem, respectively) – in view of an exchange rate level of around 0.85 EUR/USD in 2001 – signaled that the euro was undervalued by performing coordinated and unilateral foreign exchange market interventions. Accordingly, the ensuing exchange rate development in 2002 could be interpreted as the euro approaching its equilibrium exchange rate, where, according to De Grauwe and Grimaldi's (2004) model, the technically oriented traders were supposed to play a major role. The results of this analysis do not clearly say whether, at a rate of 1.26, the valuation of the euro exceeded the transaction cost band at the end of 2003. If we assume, however, that the exchange rate is based on purchasing power parity as a fundamentally justified value, it should be noted that the upward deviation of the EUR/USD exchange rate from the PPP exchange rate at 13.5% was significantly lower than the downward deviation of 23% in early 2002. Accordingly, starting from a significantly undervalued position, the EUR/USD exchange rate in 2002–03 may have fluctuated within a band determined by the transaction costs in the commodity markets.

A technical foreign exchange trading system that is used in practice exemplifies the functioning of such a system in the period analyzed (Capital Invest, 2004). The present trading system is a trend-following system, which uses certain indicators (e.g. moving averages, price break-outs out of trading ranges, etc.) to identify upward and downward trends of the underlying exchange rate time series. In addition to price history, the system also takes exchange rate volatility into account. For example, if a price persistently lingers above or below a moving average, the system generates a buy or sell signal. Usually, several technical indicators are used after their profitability and reliability has been backtested for long price histories.

Chart 3 shows that the system presented in this study was very successful in the observation period from 2002 to 2003. Almost all positions closed with a profit (which becomes apparent when comparing buy and sell signals).[14]

[13] *The PPP rates determined by the OECD (2004) for the relation between euro and U.S. dollar are USD 1.12 per euro for 2002 and USD 1.11 per euro for 2003.*

[14] *For an exact analysis, transaction costs and the interest rate differential would have to be taken into account. The EUR/USD market is a very liquid market and therefore the transaction costs are very low. Even if the interest rate differential is taken into account, the quality of the result will not change. In part, U.S. dollar interest rates were even below euro interest rates, which would have increased profits given the fact that the U.S. dollar was falling most of the time.*

Chart 3

EUR/USD Exchange Rate

Source: Investkredit/Datastream.

A large number of other market participants might have applied these or similar strategies. Based on this assumption, the behavior of market agents who rely solely on the history of the EUR/USD time series may have become a major factor in the market, which means that consequently, this nonfundamental factor may also have contributed to the appreciation of the euro.

4 Summary

This study examines the significance of fundamental and nonfundamental factors for the determination of the EUR/USD exchange rate in the period from 2002 to 2003 – a period in which the euro appreciated by some 36%. Using an event study approach, we examine the significance of specific U.S.-specific factors such as the Fed's monetary policy, data on newly created jobs in the U.S.A. and the U.S. balance of trade as well as the interventions by the BoJ on the USD/JPY market. As regards U.S.-specific factors, negative employment and trade balance data as well as the Fed's monetary decisions had a weakening effect on the U.S. dollar. The analyzed economic data on the EU-12 had no significant influence on the EUR/USD exchange rate. The BoJ's interventions on the foreign exchange market in favor of the U.S. dollar had no significant impact on the EUR/USD exchange rate, either, but they did serve to strengthen the euro against the Japanese yen. Important one-time events, which market participants estimated to be extremely significant for the decline of the U.S. dollar, are the war in Iraq and the U.S. accounting scandals, which influenced market sentiment to the disadvantage of the U.S. dollar.

With respect to nonfundamental factors, which solely originate from market dynamics, this study presents an example of a technical foreign exchange trading system which provided mostly accurate short-term exchange rate forecasts – and thus trading profits – in the period under review. If such profitable trading strategies were employed by a large enough number of market participants, this might ex-

plain the weaker U.S. dollar and the stronger euro.

Altogether, both fundamental and nonfundamental factors can be used to explain the direction of the EUR/USD exchange rate movement. This analysis, however, does not allow for a weighing of the relative significance of these factors.

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Annex: Data Used for the Event Study

Overview of Times of Events and Observation Intervals (GMT)

Event	Source	Usual time of event	Observation interval		Observations	Instrument	Source/Market
			From	To			
FOMC meeting	Gürkaynak et al. (2004)	19:00	23:00(t-1)	23:00	41	Bonds	Bloomberg
			17:00	10:30(t+1)		EUR/USD	BIS, Fed h10
			10:30	10:30(t+1)		Money market portfolios	BIS
Nonfarm payrolls	Bloomberg	13:30	13:20	13:40	24	EUR/USD – future	Tickdata/CME
						EURIBOR, treasury, BOBL – futures	Tickdata/EUX, LIF
						Eurodollar, TRN 2-year, 5-year – futures	Tickdata/CME, CBT
Trade balance	Bloomberg	13:30	13:20	13:40	24	EUR/USD – future	Tickdata/CME
						EURIBOR, treasury, BOBL – futures	Tickdata/EUX, LIF
						Eurodollar, TRN 2-year, 5-year – futures	Tickdata/CME, CBT
HICP (EU-12)	Bloomberg	10:00	23:00(t-1)	10:30	24	EUR/USD	BIS, Bloomberg
PPI (EU-12)	Bloomberg	10:00	23:00(t-1)	10:30	22	EUR/USD	BIS, Bloomberg
Insee index	Bloomberg	06:45	23:00(t-1)	10:30	20	EUR/USD	BIS, Bloomberg
ifo index	Bloomberg	08:00	23:00(t-1)	10:30	23	EUR/USD	BIS, Bloomberg
BoJ intervention	www.mof.go.jp	23:00–23:00	23:00(t-1)	23:00	88	USD/JPY, EUR/USD, bonds	Bloomberg

Source: OeNB.