Foreign Exchange Markets in the Digital Era

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Abstract: This thesis analyzes the foreign exchange markets in the new, fast and information-dense digital era. First the development of the Yen/Dollar and the Euro/Dollar will be discussed in the light of the monetary model. After that an analysis of the efficiency of the foreign exchange markets will be performed, which finds that the markets are still efficient, though no more efficient than in the early nineties. Of special interest is the role of 'news', which was frequently mentioned as a key factor affecting exchange rates, as we are currently flooded with news every second of the day via internet on our smartphones, televisions, laptops etcetera. It is shown 'news' still is a factor in the determination of the exchange rate. The conclusion states that the monetary approach to the exchange rate remains a useful and reasonably accurate framework in working with exchange rates.

Contents

I. Introduction

In the past, specifically for the nineteen-twenties and the seventies, much research had been done regarding the market efficiency of the foreign exchange market. Those periods have characteristics that differ greatly from one another and from more recent decades, especially the late nineties and the 00s. While the 20s were special because it was an inter-war period and the 70s because the world faced an oil crisis, both periods saw heavy and irregular inflation. Also both periods were preceded by a period of fixed exchange rate regimes, specifically a gold standard. In stark contrast, the last decades are characterized by low and constant inflation because of changes in monetary policy by authorities worldwide, and crises tended to be less severe and less common. The biggest difference of all though, is the, what some people like to call, third industrial revolution. With the arrival of the World Wide Web in the early nineties and the advancements in the following years towards the complete and standardized Internet, with possible communications through email, voip and videocalls, the effort and distance to information all over the world became negligible. As a result of these developments one can be almost certain that the information set of an agent acting in the foreign exchange market this day will be more complete than it was for an agent decades ago. The Rational Expectations and Efficient Market hypothesis are the theories I am referring to by talking about information sets and the foreign exchange market, and these theories, as aspects of the monetary approach to the exchange rate, will be the main focus of this thesis.

The main orientation of this thesis is empirical and the analysis is based on data involving two main exchange rates, the Yen/Dollar and the Euro/Dollar. This data is obtained from the Bloomberg Finance database, and consists of end-of-day values for the spot rate and 1-month forward rate.

In the conclusion, the answer will be given to the central question of the thesis:

Is the Monetary Model still a useful framework in working with exchange rates?

To answer this question, there are some hypothesis to be tested, particularly the Rational Expectations hypothesis and the Efficient Market hypothesis. This thesis consists of the following elements:

In section II, we will observe the exchange rates visually and we will look at the fundamentals underlying the movement of the Yen/Dollar and Euro/Dollar, and expectations will be evaluated against the actual movement of both rates. In the third section an analysis of the efficiency of the forward exchange market will be given by examining the relationship between the spot rate and forward rate. In the section after that the role of 'news' will be analyzed, and a theoretical comparison between these results and the results of earlier scholars will be given.

II. A closer look at the Yen/Dollar and Euro/Dollar exchange rates

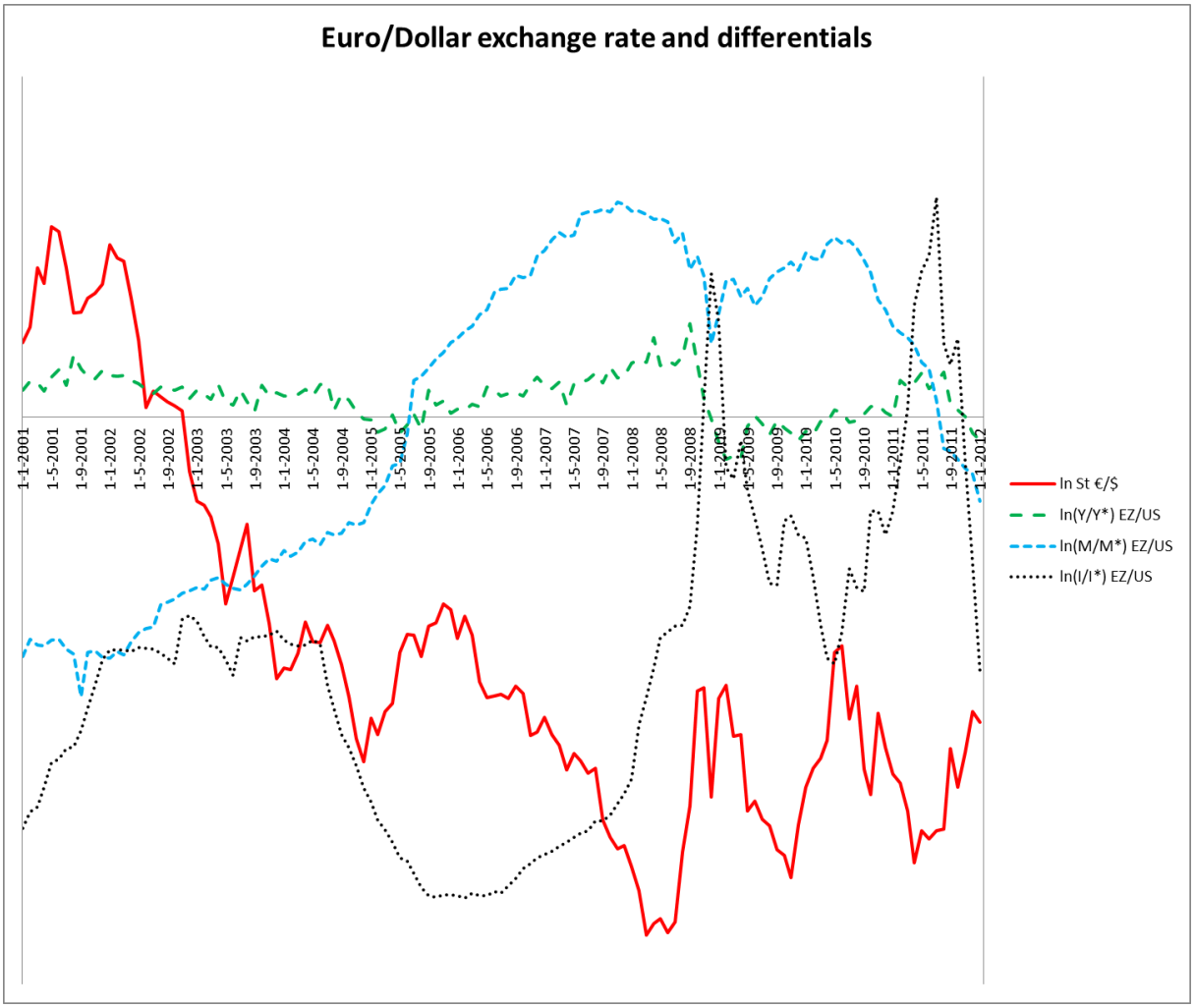


Figure 1

In this section we will examine figure 1 and 2, which display the Euro/Dollar and Yen/Dollar exchange rates together with some essential economic indicators[1], which are the sole variables influencing the exchange rate according to the monetary approach. The formal representations of this monetary model will follow in the succeeding sections of this paper.

Starting with figure 1, we see the Euro/Dollar in combination with the output differential, the money stock differential and the interest rate differential. The data for this differentials comes from the International Financial Statistics database of the International Monetary fund and the OECD.

[1] All except the interest rates are presented as their natural logarithm. The interest rate was scaled differently to accommodate comparison by view, this is also the case in figure 2.

In short, the basic monetary model expects a growing output differential to cause a declining spot rate, a growing money stock differential to cause a rising spot rate and a growing interest rate differential to cause a rising spot rate too. In summary:

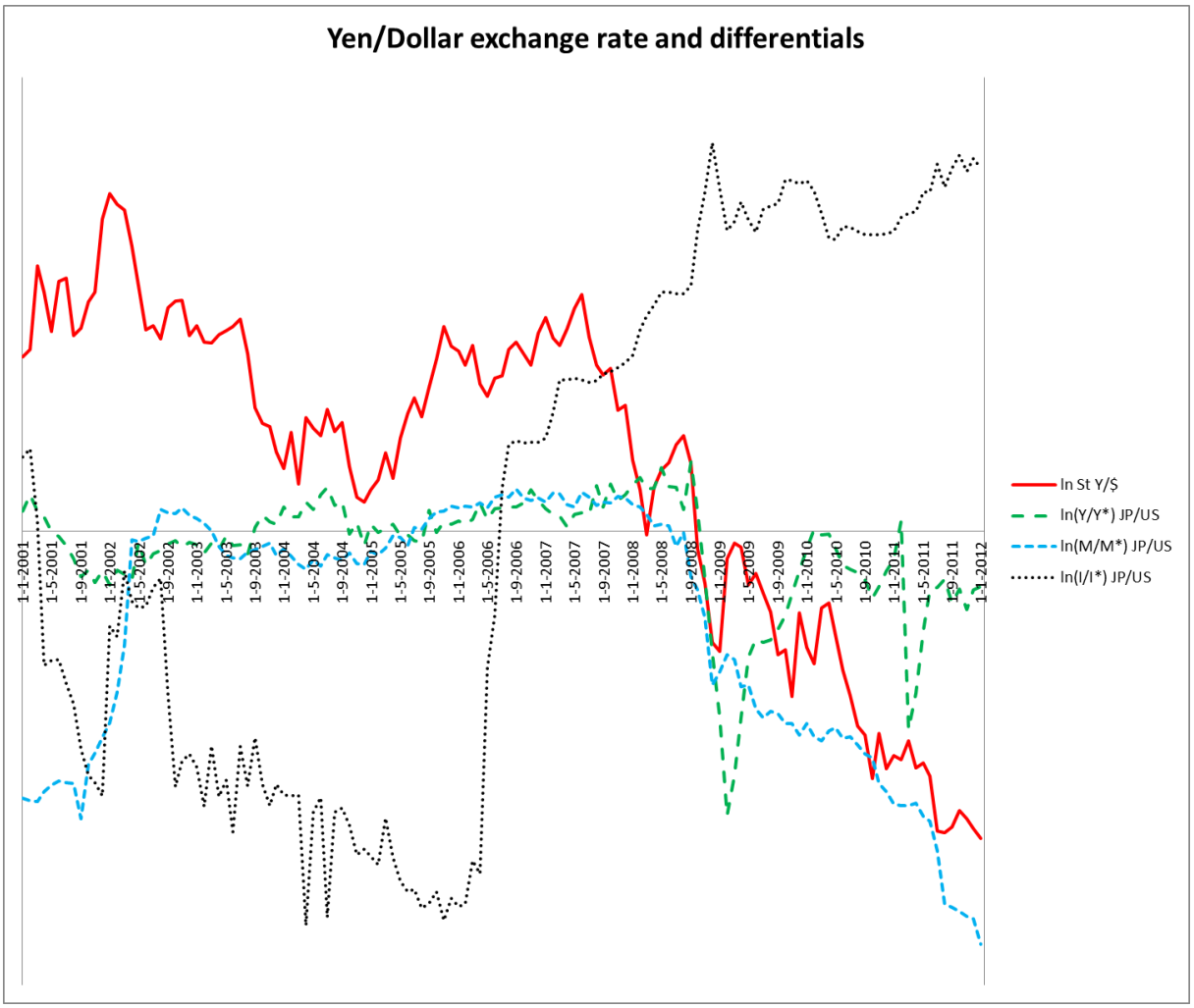
	S_t
(M/M*)	+
(Y/Y*)	-
(I/I*)	+

The first thing to notice about the Euro/Dollar exchange rate, is the fact that it generally fell over the full period, meaning an appreciation of the Euro. Remarkably, the Euro kept appreciating despite the fact that the money stock differential was growing. Also in contrast to the predictions of the model, is the slightly falling output ratio until roughly first quarter 2005, and the periods where the interest rate differential hit the bottom around January 2006 and May 2010. In this periods, the spot rate moves exactly in the opposite direction of the prediction. It is not all bad news. Q4 2004 to Q5 2005 show a period of monetary expansion in the Euro-zone, and the spot rate reacting accordingly with a rise. From 2005 on, the spot rate roughly moves in accordance with the prediction about the output differential, and with some imagination one can see the Euro/Dollar rate mimicking the movement of the money stock ratio after 2008.

In figure 2, the Yen/Dollar exchange rate is shown, also with the differentials mentioned before. In this case, the co-movement of the interest rate differential and the money stock differential, predicted by the monetary model is relatively clear. Also the movement of the output ratio meets the prediction for some periods. The most striking in this figure, is the great divergence between the movement of the exchange rate and the interest rate differential after the summer of 2007. While looking at the raw data however, this can be explained by the fact that the interest ratio is still below zero for that period[2],

[2] See note 1.

Figure 2



and the fact that the monetary expansion in the US is way bigger than in Japan, causing, as is clearly visible, a fall in the money stock differential.

To summarize, the monetary approach to the exchange rates seems to be a better fit for the Yen/Dollar rate than it does for the Euro/Dollar rate. The cause of this observations is not easily revealed, but a possible factor in my opinion is the fact that the Euro is a very young currency constructed out of different currencies, and because of that the market still has to update its knowledge, expectations and technical aids used while acting. Obviously, this contradicts the Rational Expectations hypothesis which states that agents behave regarding a complete information set available at the time of trade. There may be other factors involved, like expectations that were never

met with actual outcomes because of speculative forces in the market (bubbles for example), in that case, the Rational Expectations hypothesis is not necessarily violated. In the next section, this hypothesis will be examined in the light of the foreign exchange market.

III. Efficiency of the forward exchange market

The monetary approach to the exchange rate, as already mentioned the framework for this thesis, is first and foremost characterized by the central assumption of rationality. This assumption regards agents in a market as 'homo economicus', with complete, consistent and transitive preferences. Despite the fact that other sciences falsified such a behavioral assumption a long time ago, neo-classical enthusiasts assume that on aggregate markets do behave in this fashion. The rationality assumption does imply that agents use every information available in their best interests, and their actions regarding the information must immediately clear the markets they act on, dissolving profit opportunities instantaneously. To formalize the assumption and specifying it for our topic, we can write:

$$S_{t+1}^{e} = E(S_{t+1}|I_t) = E_t S_{t+1}$$

It says that the market expectations of the future spot rate, $E_t S_{t+1}$, are formed regarding the information available at time 't'. One can ask themselves the question "Why don't we act on the available information right away?". Well, people do. And that is the next implication for our model: when the best possible prediction for the future spot rate, $E_t S_{t+1}$, is made with all the available information at time 't', the current spot rate, S_t, should be it. This is the Rational Expectations hypothesis. Formally this can be written as:

$$(1)\quad E_t S_{t+1} = S_t + \varepsilon$$

or one period back

$$(1a)\quad S_t = E_{t-1} S_t + \varepsilon$$

In which 'ε' represents no information or white noise, and will be normally distributed with zero mean. When we stretch this theorizing a little further, we can argue that the forward exchange rate also

should be set according to the information at a certain point in time. More specific, the forward rate would logically be the expected future spot rate. As a result, (1) can be rewritten as follows:

$$(2)\quad E_t S_{t+1} = F_t^{t+1} + \mu$$

or one period back

$$(2a)\quad S_t = F_{t-1}^{t} + \mu$$

Which states that the spot rate at time t will be equal to the (lagged) forward rate, set at time t-1 and maturing at time t. As 'ε' in (1), 'μ' is white noise. To lose the dimension of the variables, the data is represented by their natural logarithm, indicated by the lower-case letters:

$$(2b)\quad s_t = f_{t-1}^{t} + \mu$$

Or, as an Ordinary Least Squares test will be computed:

$$(2c)\quad s_t = \alpha + \beta_1 f_{t-1}^{t} + \mu$$

According to the Efficient Market hypothesis, 'α' should be zero, 'β_1' should be unity and 'μ' should be a white noise error with zero mean. The results of this OLS procedure is shown in Table 1. Also shown in this table is the addition of another lagged forward rate. The plus of adding this variable is derived from the fact that because the forward rate is set with all information available at a certain moment, information sets used in previous periods will not have additional value. Performing OLS with another lag included thus should tell us the additional lag is not significantly different from zero.

As is clear from the regression results, the efficient market hypothesis cannot be rejected, nor as a joint hypothesis, nor when looking at every independent variable in isolation. Overall the results seems to indicate that the Yen/Dollar market is somewhat more efficient than the Euro/Dollar market, but the difference in negligible. As expected by the Rational Expectations hypothesis, the extra lagged forward rate f_{t-2}^{t-1} does not have a significant influence on s_t, indicating that at least all available historical data

is comprised in the information set at time t. These results do not differ from most of the research done by other scholars for different time periods, like the 1920's (MacDonald 1983) and the 1970s (Frenkel 1981, Edwards 1982a, 1982b, 1983).

Because exchange rates are obviously interrelated, otherwise there would be arbitrage opportunities, all regressions were also jointly tested with the Seemingly Unrelated Regression method, to control for a possible joint distribution of the error terms (see Edwards 1982, MacDonald 1983). The differences with OLS were very little and thus not reported.

Table 1: Efficiency of Forward Exchange Market - Monthly data January 2001 - May 2012

Dependent Variable	Constant (α)	ln F_{t-1} (β_1)	ln F_{t-2} (β_2)	R^2	SE	D-W	F-statistic
Yen/Dollar							
ln S_t	-0,001[a]	1,002[b]		0,966	0,028	1,943	0,074
	(0,003)	(0,016)					
ln S_t	-0,001[a]	1,031[b]	-0,029[a]	0,966	0,028	2,001	0,087
	(0,003)	(0,086)	(0,088)				
Euro/Dollar							
ln S_t	-0,009[a]	0,968[b]		0,960	0,032	1,911	2,032
	(0,004)	(0,017)					
ln S_t	-0,009[a]	0,952[b]	0,015[a]	0,960	0,032	1,888	1,397
	(0,005)	(0,044)	(0,039)				

Note: [a] indicates no significant deviation from 0, [b] indicates no significant deviation from 1 (all at the 5% level). The F-statistic tests the joint restriction that constant=0, ln F_{t-1} = 1 and ln F_{t-2} = 0 (if included). It is distributed as F(3,134) when the extra lag in included, and the critical value at the 5% level is 2,67. Without extra lag the distribution is F(2,135) with a critical value of 3,06.

Efficiency in different times

As was mentioned in the introduction, a lot has changed in recent times, especially the introduction of Internet, which speeded up communications dramatically compared to telephony and telegraphy, had a big influence on markets and people worldwide . To test if this breakthroughs have contributed to a more efficient market, extra data on the Yen/Dollar and the Euro/Dollar exchange rate between January 1989 to December 2000 has been gathered. Because the Euro was not in circulation before 2001, the strongest and most important currency from the Eurozone, the Deutschmark, will serve as a

proxy for the Euro for this period. The same OLS procedure as before is run, and a dummy variable is introduced to separate two periods, February 1989-December 1995 (dummy = 0), and January 1996-May 2012 (dummy = 1). Adding dummies provides the possibility to recognize any differences between the two periods instantly. These periods are chosen because the biggest stock exchange in the world, the New York Stock Exchange, introduced real-time tickers in 1996, assuming they were the first major player to do this and others to follow suit. The results are shown in Table 2.

The results are very clear. There is hardly any difference between the two regressions, and for both exchange rates the dummy influences are far from significant. It seems the improved communication channels did not enhance the accuracy of decisions made by traders in the market, although it is difficult to say to which phenomenon this can be attributed. One can have second thoughts about the strict assumptions of rationality, the lack of change in forecasting behavior regarding the spot rate can be seen as evidence that agents are not that rational in the sense of making decisions with the full information set in mind. In fact ample evidence can be found that regular traders often rely on gut feelings.

Again in this case a SURE procedure was executed, but again this did not make very much difference.

Table 2: Efficiency of the Forward Exchange Market – Monthly data February 1989 – May 2012

Dependent	Constant (α)	ln F_{t-1} (β_1)	dummy * C	dummy * ln F_{t-1}	R^2	SE	D-W	F-statistic
Yen/Dollar								
ln S_t	0,002[a]	0,987[b]			0,958	0,032	1,928	0,555
	(0,002)	(0,012)						
ln S_t	0,002[a]	0,977[b]	-0,001[a]	0,018[a]	0,958	0,032	1,939	0,428
	(0,005)	(0,022)	(0,006)	(0,027)				
Euro*/Dollar								
ln S_t	-0,005[a]	0,974[b]			0,949	0,031	1,823	1,927
	(0,003)	(0,013)						
ln S_t	-0,019[c]	0,925[b]	0,016[a]	0,054[a]	0,950	0,031	1,828	1,982
	(0,008)	(0,039)	(0,009)	(0,042)				

Note: [a] indicates no significant deviation from 0, [b] indicates no significant deviation from 1, [c] does indicate significant deviation from 0 (all at the 5% level). The F-statistic tests the joint restriction that constant=0, ln F_{t-1} = 1, dummy*C=0 and dummy*ln F_{t-1} = 0 (if included). It is distributed as F(4,276) when the dummy is included, and the critical value at the 5% level is 2,4. Without the dummies the distribution is F(2,278) and the critical value is 3,03. * Before 2001 the Deutschmark (converted with the DM/Euro rate) is used as a proxy for the Euro.

IV. The role of 'news'

In the previous section we saw that the forward exchange rate is a good unbiased predictor of the spot rate on t+1. The only problem facing decision makers on time t, the reason why forward rates are never met with spot rates, is the fact that they don't know anything beyond time t with certainty. In the previous section this meant that everything that happened between the forward rate established on t-1 and the spot rate on time t was assigned to the error term, μ, in (2). In this section we will expand this analysis of the movement of exchange rates by adding 'news':

$$(3)\quad s_t = f_{t-1}^{t} + 'news' + \omega$$

or

$$(3a)\quad s_t - f_{t-1}^{t} = 'news' + \omega$$

The framework used in this thesis, the basic monetary model of flexible exchange rates consists of the following equations, showing us what to incorporate as 'news':

(m1) Goods market

$s = p - p^*$

(m2) Money market

$m - p = \alpha y - \varphi i$

$m^* - p^* = \alpha y^* - \varphi i^*$

(m3) Asset market

$E(\dot{s}) = i - i^*$ or $i - i^* = E_t(s_{t+1} - s_t)$

All variables except the interest rate are written down as their natural logarithm, and the stars above the variables indicate the foreign country. By combining (1), (2) and (3) and with a little rearranging the model states that the exchange rate is determined as follows[3]:

$$s_t = (m_t - m_t^*) - \alpha(y_t - y_t^*) + \varphi(i_t - i_t^*) \quad \text{or} \quad s_t = (m_t - m_t^*) - \alpha(y_t - y_t^*) + \varphi(E_t(s_{t+1} - s_t))$$

[3] Notice this is the formal representation mentioned in section I.

The exchange rate thus moves with respect to the money stock differential, the output differential and the expected change in value of itself, implied by the interest rate differential.

As the Rational Expectations hypothesis of section III and (3) and (3a) indicate, most information about the goods market, money market and asset market is already incorporated in f_{t-1}^{t}. What is not included however, is 'news' about these fundamentals, the difference between what was expected about the money stock at home and abroad, and what was expected of the output at home and abroad. This allows us to rewrite (3) as follows, in regression form:

$$(4)\ s_t = a + \beta_1 f_{t-1}^{t} + \beta_2[(\tilde{m})_t - E_{t-1}(\tilde{m})_t] + \beta_3[(\tilde{y})_t - E_{t-1}(\tilde{y})_t] + \beta_4[(\tilde{\imath})_t - E_{t-1}(\tilde{\imath})_t] + \omega$$

The tilde above variables tell us it is a ratio, for example $(\tilde{m})_t$ is $(m - m^*)_t$ and so on. The terms between square brackets represent the difference between the expected value of a variable at time t-1 and the revealed value at time t, thus, the 'news'. The errors still present after this extension are captured by ω.

The reason for incorporating the interest rate differential in (4) instead of $E_t(s_{t+1} - s_t)$, the expected appreciation (depreciation) of the exchange rate, is that it cannot be told without testing the interest rate parity if that relationship holds, and the test will not be performed in this thesis. If it does hold, there should hardly be any difference between using the two. If it does not, it is probably for the better to estimate the equation with the interest differential. For the analysis, again data extracted from the International Financial Statistics database of the IMF will be used. Industrial Production will function as a proxy for output, y, and the interest rate data consists of monthly money market rates. Only the money stock, M1, will be from the OECD database.

To generate news, three-month auto-regressions were performed for the three fundamentals, which results were subtracted from the actual data (Edwards, 1982a). The regression of (4) will be performed using both OLS and SURE, and the results are shown in Table 3.

Table 3: Exchange rates and news, single and multi-currency tests.

Dependent Variable	Constant	f_{t-1}^{t} β_1	$(\tilde{m})_t - E_{t-1}(\tilde{m})_t$ β_2	$(\tilde{m})_{t-1} - E_{t-2}(\tilde{m})_{t-1}$ π_1	$(\tilde{y})_t - E_{t-1}(\tilde{y})_t$ β_3	$(\tilde{y})_{t-1} - E_{t-2}(\tilde{y})_{t-1}$ π_2	$(\tilde{\imath})_t - E_{t-1}(\tilde{\imath})_t$ β_4	$(\tilde{\imath})_{t-1} - E_{t-2}(\tilde{\imath})_{t-1}$ π_3	R^2	SE	D-W
Yen/Dollar											
(OLS) s_t	-0,002[a]	1,001[b]	0,176[a]		0,002[a]		-0,031[a]		0,968	0,027	2,126
	(0,003)	(0,016)	(0,170)		(0,093)		(0,017)				
(SURE) s_t	-0,002[a]	1,003[b]	0,188[a]		-0,011[a]		-0,048[c]		0,968	0,027	2,189
	(0,002)	(0,015)	(0,163)		(0,087)		(0,016)				
(OLS) s_t	-0,002[a]	1,001[b]	0,172[a]	0,043[a]	-0,022[a]	-0,006[a]	-0,030[a]	-0,042[c]	0,970	0,027	2,122
	(0,002)	(0,016)	(0,169)	(0,173)	(0,095)	(0,094)	(0,018)	(0,017)			
(SURE) s_t	-0,002[a]	1,002[b]	0,186[a]	0,001[a]	-0,019[a]	-0,024[a]	-0,044[c]	-0,044[c]	0,969	0,027	2,15
	(0,002)	(0,015)	(0,160)	(0,164)	(0,088)	(0,086)	(0,016)	(0,016)			
Euro/Dollar											
(OLS) s_t	-0,011[c]	0,965[d]	0,571[c]		-0,054[a]		-0,012[a]		0,962	0,031	1,939
	(0,004)	(0,017)	(0,222)		(0,222)		(0,019)				
(SURE) s_t	-0,011[c]	0,964[d]	0,542[c]		-0,106[a]		-0,021[a]		0,962	0,031	1,957
	(0,004)	(0,016)	(0,213)		(0,207)		(0,018)				
(OLS) s_t	-0,011[c]	0,964[d]	0,549[c]	-0,384[a]	0,118[a]	0,385[a]	-0,018[a]	-0,024[a]	0,963	0,030	1,904
	(0,005)	(0,017)	(0,221)	(0,221)	(0,234)	(0,233)	(0,020)	(0,020)			
(SURE) s_t	-0,011[c]	0,961[d]	0,517[c]	-0,464[c]	0,046[a]	0,289[a]	-0,023[a]	-0,017[a]	0,962	0,031	1,925
	(0,004)	(0,016)	(0,209)	(0,210)	(0,216)	(0,215)	(0,019)	(0,019)			

Note: [a] No significant deviation from 0. [b] No significant deviation from 1. [c] Significant deviation from 0. [d] Significant deviation from 1. All at the 5% level. The F-statistic is not reported in this table, but the joint hypothesis that the constant term is zero and β_1 equals unity could not be rejected for any of the exchange rates, in any of the procedures.

The 'news' items should show that an unexpected rise in the money stock differential has a positive contribution to the spot rate because more supply of money ceteris paribus leads to a depreciation. On the other hand, the unexpectedly rising output differential should show an appreciation of the currency, so a negative relationship in (4). A higher interest rate than abroad, again unexpected, should lead to a depreciation. To explain this, let us take a look at the money market equation again:

$$(m2)\quad m - p = \alpha y - \varphi i \quad \text{or} \quad m - \alpha y + \varphi i = p$$

Particularly the second form makes it easy to see that, holding foreign variables constant, a rise in the interest rate i leads to a rise in price p. Through the goods market equation, (m1), a price rise causes a rising exchange rate, or a depreciation. It is the other way around for output. Growing output causes decreasing price and a falling exchange rate, an appreciation.

First we take a look at the results from the regression of (4). In the case of the Yen/Dollar exchange rate, the efficient market hypothesis is again confirmed in both the ordinary least squares and seemingly unrelated regression procedures. In both procedures the news regarding money supply has the right sign, but these are not significant. In OLS, both the output variable and the interest variable have the wrong sign, but especially the output variable is highly insignificant, so this is not very startling. The interest 'news' actually is significant at the 10% level, so the sign raises questions. Looking at the SURE results the output differential shows the right sign, but the interest rate differential still got the wrong sign. Now the interest variable is significant at the 5% level too.

When we observe the results for the Euro/Dollar exchange rate, the first thing we notice is that for both procedures the news regarding money supply is highly significant at the 5% level. Another interesting observation is the fact that both the constant term and the lagged forward rate differ from their hypothesized values of zero and one. The tension was already noticeable in the tests performed in section three, but the hypothesis did hold in that situation. Testing the joint hypothesis that the

constant is zero and β_1 equals unity does not reject the efficient market hypothesis however. Next thing to see is that for both procedures the news regarding output shows the correct sign, and the interest rate news the incorrect one. However, both coefficients were highly insignificant, so we don't have to put much thought on these observations.

For both exchange rates, the SURE procedure does not seem to enhance the results very much. When looking at the correlation and covariance matrices of the procedure, the values stated in them also were not as high as reported by Edwards in his paper 'Exchange Rates and 'News': A Multi-Currency Approach' (1982a).

Despite the fact that the rational expectations hypothesis is proved many times in history, and also in this thesis, some scholars discovered that 'lagged news', which should be incorporated in the exchange rate already according to the hypothesis , in some cases proved to be of significant influence (Edwards 1982a, MacDonald 1983). Because 'news' was shown hardly to be of any influence for the Yen/Dollar exchange rate in the regression just discussed, a regression, again using both procedures, was performed including 1-period lags for every 'news' variable.

In the case of Japan, not much happens. The money stock and output differentials and their lags still possess the right sign but remain highly insignificant, especially, as expected, the lagged variables. Interesting however, is the fact that for both procedures the lagged interest differential is highly significant but shows the wrong sign according to the basic monetary approach. It is interesting to note that Frenkel (1981) argues that the interest/inflation relation just mentioned, varies with the state of the economy. He specifically tells that the positive relation between interest rates and inflation proves to be true in inflationary environments, and not in steady environments. As we know, Japan has hardly known inflation in the last two decades. In combination with the very low interest rate that persists in Japan, this may be the reason the interest differential shows a negative relationship in this case.

For the Euro/Dollar exchange rate, seemingly abnormal things happen. The output-news switches sign and is relatively large and positive for both tests, although it is still insignificant. In contrast, the lagged news about the money stocks is quite large and wrongly signed negative, and in the case of SURE even significant. This phenomenon disappears when the output-news lag is not included, and is possibly caused by the nature of the relation between the two variables.

To conclude, the tests regarding 'news' show mixed results, especially regarding significance. Looking at the sign of the variables, the tests suggest the monetary model works fairly well.

Conclusion

In this thesis, an analysis of the Euro/Dollar and Yen/Dollar exchange rate was given, performed with the hypothesis and tools the monetary approach to the exchange rate provided us and many researchers before.

The model was used to test if in this fast changed world, both in economic science and technology, the conclusions reached by other scholars decades ago were still going strong. After a quick look at the exchange rates and their fundamental determinants, reality seems to indicate the monetary model is still useful to describe the macroeconomic forces depicting exchange rates. However, it was already noticeable the model has some issues with the Euro/Dollar exchange rate, while the Yen/Dollar exchange rate seemed to behave as predicted.

In the third section, the hypotheses about rational expectations and market efficiency were tested performing both an ordinary least squares regression and a seemingly unrelated regression, which tests two regressions simultaneously while keeping in mind the covariance structure of the errors of both regressions. For both exchange rates, the results show that the forward rate is a good unbiased predictor of the spot rate, confirming rational expectations and market efficiency. In addition is was tested if a difference existed in the accuracy of predicting the spot rate in two periods, one period before the universal breakthrough of the Internet, and one thereafter. The reason for this test was the assumption that the information set in the second period, would be more complete than in the first. The accuracy did not improve. Differences, or the lack of differences over the last decades, remain subject for further research.

Section IV provides an analysis of the role of 'news', the difference between what agents in the foreign exchange market expected and the reality it faced a moment later. The role of news was proven with mixed success in earlier times, and again it was partly proven to be of significant influence on the

forecasting errors observed in the market. With the inclusion of 'news', the efficient market hypothesis again was not rejected, fortifying the conclusion of section III.

The main question of this thesis, as stated in the introduction, can be positively answered. The evidence provided cannot show that the Monetary Model has become useless in analyzing the market for foreign exchange.

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