FOREIGN EXCHANGE RATE EXPECTATIONS: SURVEY AND SYNTHESIS

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Abstract. This paper reviews the empirical literature on foreign exchange rate expectations. Prominent issues are the forward premium puzzle, expectations formation in financial markets, heterogeneity of expectations, market microstructure, time-varying risk premiums and forecast performance. Although much has been learned in each field, this survey highlights the areas of research in which our understanding of the mechanism of exchange rate expectations is still incomplete. Our survey suggests that both irrational expectations and time-varying risk premiums account for the forward discount anomaly, that long-term expectations reverse towards their long-run equilibrium values and that heterogeneous behaviour of market participants has the potential of explaining some of the empirical regularities in the international finance literature.

Keywords. Exchange rates; Expectations; Heterogeneity; Risk premium; Survey data; Microstructure

1. Introduction

In the last decades we have seen an increase in the number of studies that attempt to explain various aspects of the foreign exchange market. The interest in this area does not come as a surprise, since the large amount of foreign exchange that is traded worldwide is far in excess of what is required for trade in goods and services. It therefore seems that the foreign exchange market is a market ‘on its own’ and that this market, because of its large volume, is highly liquid and efficient (Froot and Thaler, 1990). For this reason, market participants are said to have equal access to
information and form their expectations about future events in a uniform, rational manner.

However, with the arrival of several anomalies in the foreign exchange literature, such as the forward premium puzzle or the excess trade volume, the notion of rational expectations is losing more and more ground. Instead, the focus is shifting in the direction of bounded rationality, and the accompanying heterogeneity of agents’ expectations. New insight on how market participants form their expectations is therefore warranted.

Over the recent years, an interesting and promising new literature has emerged, relying on survey measures of exchange rate expectations. Instead of making assumptions about the way expectations are formed, or relying on some underlying model for the expectations, these studies try to measure expectations by use of a market panel. Pioneered by the work of, inter alia, Blake et al. (1986), Dominguez (1986) and Frankel and Froot (1987), many since have employed some form of survey measures of expectations in explaining some of the anomalies in the foreign exchange market.

In this paper, we will give an overview of the work on five issues in the foreign exchange literature that have received considerable attention over the past few decades, and where the emphasis is on the role of expectations in the foreign exchange market. First, we will discuss the failure of the forward rate as an unbiased estimate for future spot rates, and in particular look at whether the failure is attributable to the role of time-varying risk premiums or is due to the failure of the assumption of rational expectations. Second, we look at attempts to model the time variation in the term premium using either fundamentals-based models or time-series models. Third, we look at the performance of market participants when forecasting future spot exchange rates and try to ascertain whether individual agents can outperform a simple benchmark like a random walk forecast. Fourth, we look at a relatively new field within the foreign exchange literature: market microstructure and the role of heterogeneous expectations. Finally, we review some of the literature on the role of different agents and the interaction among these groups. In all five fields we take a survey-based point of view.

The use of survey data has not been uncommon in the international financial economics literature. For example, Friedman (1979, 1980), Froot (1989) and MacDonald and Macmillan (1994) have used interest survey data in tests for identifying term premiums and examining the rationality of expectations of future interest rates, and have concluded that predictions were biased and respondents did not efficiently exploit the information contained in past interest movements. Similarly, Dokko and Edelstein (1989) review the usefulness of the Livingston forecasts of stock market rates of return and find evidence of adaptive behaviour in the forecasts; Keane and Runkle (1990) use survey forecasts of the GNP deflator and find that expectations are rational and MacDonald and Torrance (1988a) use survey data on expected changes in money aggregates with UK data and find that these survey measures of expectations are extremely useful, for, unlike statistical methods for generating estimates, they are truly exogenous. It is thus surprising that
only towards the end of the 1980s was the use of survey data established in the foreign exchange literature.

On the other hand, the number of surveys on exchange rates expectations has grown considerably over the past 20 years. Most promising, these surveys increasingly encompass exotic exchange rates (i.e. not only the top five most actively traded rates); they have also included more cross-rates (instead of only currencies relative to the US dollar) and have reported expectations on disaggregate data, instead of only reporting a consensus measure such as the arithmetic mean. Not surprisingly, at the end of the 1980s the literature incorporating the expectations of such surveys had expanded rapidly and is still growing. This is intended to capture all of the main findings from these studies over the past 20 years.

This study is not the first to review this considerable, and growing, literature. In his review of the literature on forward market efficiency, Engel (1996) explicitly excludes the important areas of learning and peso problems, tests of rational expectations and time-varying risk premiums based on survey data.1 Takagi (1991), as well as Maddala (1991) and MacDonald (2000a), do summarize some of the main findings in the area of survey data on exchange rate expectations, and primarily focus on the forward premium puzzle. Therefore, we focus on aspects that were not covered in-depth in the previous studies. Specifically, our studies may be seen as a direct follow-up of MacDonald (2000a) in this journal.

The outline for the remainder of this study is as follows. Section 2 will introduce the forward discount puzzle and discusses the importance of time-varying risk premiums and irrational behaviour on the part of market participants in explaining this puzzle. Subsequently, in Section 3, we look at various attempts to model the time variation in these risk premiums. Section 4 will examine the performance of market participants in forecasting exchange rates. In Section 5, we examine the microstructure of the foreign exchange market and look at the role of heterogeneous agents. Section 6 will subsequently look at the role of different players in the foreign exchange market. Section 7 offers some concluding comments.

2. The Forward Premium Puzzle

One of the most challenging debates in the financial economics literature is the failure of the forward exchange rate as predictor of future spot exchange rates. This failure is often referred to as the forward premium puzzle. The use of forward rates to predict future spot exchange rates is not arbitrary, for the much-debated efficient market hypothesis claims that, if foreign exchange markets are efficient, then it should not be possible to generate exorbitantly high above-normal profits (where above-normal profits are defined relative to an expected equilibrium rate of return) through arbitrage in the forward market. In particular, the efficient market hypothesis encompasses the joint hypothesis that expectations are formed rationally and that market participants are risk neutral with respect to domestic or foreign assets. This section will review some of the work on the forward premium puzzle with an emphasis on the use of survey expectations.2
A formal and simple test of the unbiasedness assumption of forward rates can be introduced by regressing the actual depreciation on the forward discount, plus a constant, or

$$s_{t+k} - s_t = \alpha_1 + \beta_1(f_{t,t+k} - s_t) + \varepsilon_{t+k}$$

where $s_t$ is the logarithm of the current spot exchange rate and $f_{t,t+k}$ is the $k$-period-ahead forward rate. The null hypothesis of forward discount unbiasedness is presented as $H_0: \alpha = 0$ and $\beta = 1$, and $\varepsilon_{t+k}$ is a mean-zero white noise process, orthogonal to the information set on which agents base their expectations. A constant should be added to account for the convexity term arising from Jensen’s inequality. Under this null hypothesis, equation (1) in essence states that the future spot rate can be written as the weighted average of the current spot rate and the current forward rate for the delivery in period $t+k$, or $s_{t+k} = \alpha_2(f_{t,t+k}) + (1 - \alpha_2)s_t$. Finding that $\alpha_2 = 1$ would thus imply that the current spot rate has no explanatory power and the future spot exchange rate is solely predicted by the respective forward rate.

The unbiasedness hypothesis has been rejected by most studies, and most seem to agree on the direction of the bias. A review of this literature is available in Hodrick (1987) and more recently in Engel (1996). In fact, it has become a well-established regularity in the international finance literature that the forward discount is a biased estimator of future changes in exchange rates. Some researchers attribute the rejection of unbiasedness to irrational behaviour of exchange rate forecasters, while others, such as Fama (1984), Hsieh (1984) and Wolff (1987), claim that the rejection is caused by the risk preferences of market participants, i.e. by the existence of a time-varying risk premium. Since true market expectations are inherently unobservable, the first line of researchers assumed investors to be risk neutral with respect to investing in domestic or foreign assets, while the second line of researchers assumed expectations to be rational. Clearly, the inherently necessary use of joint tests of rationality and for the existence of a risk premium made it impossible to truly determine what caused the forward discount bias to exist.

To find explanations for the failure of the forward discount unbiasedness hypothesis we must examine the above equation in greater detail. If investors, for some reason, require a reward for the added risk of holding an open position in a foreign currency, those investors will demand a premium for this risk. When rates are quoted as units of foreign currency per unit of domestic currency, investors will require the future expected spot rate to be lower than the forward rate (a risk premium is required for holding an open position in a foreign currency and domestic and foreign assets are not considered perfect substitutes anymore), in that $f_{t,t+k} = E_t[s_{t+k}] + r_p f$, or more formally in terms of returns

$$f_{t,t+k} - s_t = (E_t[s_{t+k}] - s_t) + r_p f$$

where the risk premium can be defined as $r_p f = f_{t,t+k} - E_t[s_{t+k}]$. Studies employing the forward rate as a proxy for the expected future spot exchange rate will consequently not consider this risk premium. Hence, the risk premium should be isolated from the expected spot rate in unbiasedness tests, which creates a problem: the expected future spot rate is inherently unobservable. The rejection of forward rate
unbiasedness can therefore be attributed to biases in expectations or to the existence of a risk premium (or both). Algebraically, this implies a decomposition of the forward discount bias into an expectational bias and a risk premium component.

Following the above decomposition, the existence of a time-varying risk premium as the principal reason for rejection of the hypothesis that forward rates are unbiased predictors of future spot rates can be tested through a regression of the expected rate of depreciation (based on survey data) on the forward discount, or

\[ s_{t,t+k}^e - s = \alpha_2 + \beta_2(f_{t,t+k} - s_t) + \varepsilon_t \]  

(3)

where \( s_{t,t+k}^e \) presents the survey-based proxy for the (unknown) market expectation \( E_t[s_{t+k}] \). Overall, the null hypothesis of perfect substitutability (i.e. no constant, nor a time-varying risk premium) can be stated as \( H_0: \alpha_2 = 0 \) and \( \beta_2 = 1 \), where \( \varepsilon_t \) is a mean zero white noise process uncorrelated with the information set on which agents base their forecasts.

Frankel and Froot (1987, 1990b), Froot and Frankel (1989), MacDonald and Torrance (1989, 1990), Cavaglia and Wolff (1993), Cavaglia et al. (1993a, 1994), Frankel and Chinn (1993), Gan and Wong (1993), Madsen (1996) and Verschoor and Wolff (2001a, 2001b) find that in most instances the hypothesis of perfect substitutability is rejected. In fact, rejection more often than not occurs at significant levels exceeding the 1% level. Parameter estimates for \( \beta_2 \) are usually between zero and one.

Such a firm rejection of perfect substitutability comes as a surprise. Since the daily volume of foreign exchange that is traded worldwide is far in excess of the volume that is traded in other financial markets, the foreign exchange market is very liquid and efficient – a point made by Froot and Thaler (1990). In addition, transaction costs are comparably low and various currencies are commonly traded by the same financial institutions. For these reasons, assets denoted in the domestic or foreign currencies should be considered identical with respect to their degree of risk and it would appear that foreign-currency-denoted assets are perfect substitutes to domestic-currency assets.

The other main alternative hypothesis to forward discount unbiasedness is due to irrational expectations. Expectations are rational in the sense of Muth (1961, p. 316) when these ‘expectations, since they are informed predictions of future events, are . . . the same as the predictions of the relevant economic theory’. Pesaran (1987) specifies that for expectations to be rational, four conditions need to be met. First, forecasts should be unbiased, implying that the expected rate of depreciation is identical to the actual rate of depreciation, with the difference being a white noise error (distributed with a zero mean and constant variance). Second, survey-based forecast errors should be orthogonal to variables from the information set available to agents. Third, the forecast errors should be serially correlated only up to a moving average process of order \( k - 1 \), due to the presence of overlapping observations. Finally, expectations should be efficient, where efficiency is a special case of orthogonality in that the information set now only includes \( past \) values of the variables that are expected to form the expectations. We will focus on results from the first two conditions here.
Blake et al. (1986), Dominguez (1986), Avraham et al. (1987), MacDonald (1992), Cavaglia et al. (1993b), Chinn and Frankel (1994a), MacDonald and Marsh (1994), Sobiechowski (1996), Kim (1997), Marsh (1999), Verschoor and Wolff (2002) and Bénassy and Raymond (2003) test whether survey-based expectations are biased through the regression of the actual rate of depreciation on the survey-based expected rate of depreciation. Specifically,

$$s_{t+k} - s_t = \alpha_3 + \beta_3(s_{t,t+k} - s_t) + \varepsilon_{t+k}$$

where, under the null hypothesis of unbiasedness, $\alpha_3 = 0$ and $\beta_3 = 1$, and the forecast error is a white noise series with zero mean and constant variance and is orthogonal to the information set on which individuals form their forecasts. One should usually be careful to account for moving average errors, since the overlapping nature of the expectations is such that the error terms are usually serially correlated up to an order of $k - 1$.

It appears almost as an empirical regularity in the literature that the null hypothesis of survey unbiasedness is rejected, for nearly all currencies at all horizons, in that the expected rate of depreciation does not equal the actual rate of depreciation and even misses the direction of the actual depreciation in a great many cases. Although for European Monetary System (EMS) cross-currencies and for rates from high inflation countries the survey-expected rate of depreciation is usually in the same direction as the actual rate of depreciation, expectations are nevertheless biased. One might even ask whether the actual rate of depreciation is not better described by a random walk forecast. Indeed, for the majority of currencies, the correlation between the actual and expected rates of depreciation is close to zero, a finding which is consistent with the random walk hypothesis.

Nonetheless, it must be stressed that the finding of biases in expectations does not immediately imply that expectations are formed irrationally. Krasker (1980) shows that expectations, even when they are biased, are still formed rationally when a small probability of an event that would cause a large depreciation in an exchange rate exists. This is the so-called ‘peso problem’, after the consistent discount at which the Mexican peso sold prior to its massive depreciation in 1976. In addition, errors in expectations may arise when the market gradually and rationally learns about the true process that generates expectations or learns about new depreciation regimes – a point made by Lewis (1989). Finally, the assumption of homogeneous expectations, as made so far, may not hold. Indeed, it will be shown below that this assumption is empirically questionable – see also Section 5 below. Hence, finding that the expected rate of depreciation is a biased estimate of the actual rate of depreciation is no direct evidence of the failure of the rational expectations hypothesis.

The second condition for rational expectations is orthogonality. When agents use all available information efficiently, any variable from their information should be orthogonal to the forecast error. Error orthogonality can be tested, for instance, by regressing the forecast error against its own lagged value:

$$s_{t+k} - s_{t,t+k} = \alpha_4 + \beta_4(s_t - s_{t-k,t}) + \varepsilon_{t+k}$$

where, under the null hypothesis of unbiasedness, $\alpha_4 = 0$ and $\beta_4 = 1$, and the forecast error is a white noise series with zero mean and constant variance and is orthogonal to the information set on which individuals form their forecasts. One should usually be careful to account for moving average errors, since the overlapping nature of the expectations is such that the error terms are usually serially correlated up to an order of $k - 1$.
Dominguez (1986), Frankel and Froot (1987), MacDonald and Torrance (1988b), MacDonald (1990, 1992), Gan and Wong (1993), Sobiechowski (1996), Lim and McKenzie (1998) and Bénassy and Raymond (2003) find that at shorter forecast horizons, specifically 1 week and 2 weeks ahead, rejection hardly ever occurs. At the somewhat longer 1-month horizon, rejection occurs more frequently, though the evidence is still not overwhelming. Rejection of the hypothesis of weak-form orthogonality is strongest when the forecast horizon lengthens beyond 3 months.

Since error orthogonality requires the forecast error to be orthogonal to all variables from the investor’s information set, a test can be performed by analysing the relation between the forecast error and, say, the forward discount:

\[ s_{t+k} - s^e_{t,t+k} = \alpha_5 + \beta_5(f_{t,t+k} - s_t) + \varepsilon_{t+k} \] (6)

Froot and Frankel (1989), Taylor (1989), Frankel and Froot (1990b), Cavaglia and Wolff (1993), Cavaglia et al. (1993a, 1993b, 1994), Gan and Wong (1993), Madsen (1996), Sobiechowski (1996) and Verschoor and Wolff (2001a) find that rejection of error orthogonality becomes more likely when the forecast horizon lengthens. At the longer end of the forecast horizons (12 months), rejection becomes almost an empirical regularity. Furthermore, it is also a virtual empirical regularity that estimates for \( \beta_5 \) are negative for nearly all currencies in most studies. Such a finding would indicate that agents could have reduced their forecast errors by betting against the forward rate and focus more on the contemporaneous spot rate instead.

The rejection of error orthogonality prompts for an understanding of the behaviour of the processes underlying the generation of expectations. A general framework for analysing the formation of market expectations is by seeing these expectations as the weighted average of the contemporaneous spot rate \( s_t \) and some other variable \( X_t \) from the investor’s information set. One common expectations formation process extrapolates the most recent trend in the spot rate into the future. That is, the expected future spot rate can be characterized as a weighted average of the contemporaneous spot rate and the \( l \)-period lagged spot rate. An empirically testable version of the above extrapolative expectations model can be presented as

\[ s^e_{t,t+k} - s_t = \alpha_6 + \beta_6(s_t - s_{t-l}) + \varepsilon_t \] (7)

Using this test, Frankel and Froot (1987, 1988, 1990b), MacDonald and Torrance (1988b), Cavaglia et al. (1993a, 1993b), Chinn and Frankel (1994a) and Ito (1994) find ample evidence of a twist in expectations. In particular, at horizons of up to 1 month nearly all estimates for \( \beta_6 \) are positive, thereby indicating that short-run expectations exhibit bandwagon effects in that the most recent depreciation is extrapolated into the future. On the other hand, at horizons of 3 months or longer, nearly all estimates for \( \beta_6 \) are negative and significantly different from zero, indicating that after the 3-month horizon expectations are stabilizing in that the most recent appreciation of a currency is expected to be followed by a future depreciation.

In a similar fashion can the expected future spot rate be formed adaptively, as the weighted average of the contemporaneous spot rate and the lagged expected value of the current spot rate. In a way, this model can be considered as a learning process
where forecasters try to learn the ‘true’ level of the variable, instead of its underlying process. An empirically testable version of the above adaptive expectations model can be introduced as

\[ s^e_{t+k} - s_t = \alpha_t + \beta_t (s_t - s^e_{t-1}) + \varepsilon_t \] (8)

At the short spectrum of the forecast horizon (1 week up to 1 month) expectations appear to be destabilizing in that slope estimates are positive, while at horizons exceeding the 3 months, expectations are stabilizing in that nearly all estimates are significantly negative. In contrast to the previous findings of statistically significant destabilizing bandwagon expectations at horizons of up to 1 month, empirical evidence of significant stabilizing expectations in the adaptive scheme at the same spectrum of the forecast horizon is only weak.

It is interesting to consider to what extent exchange rates are expected to appreciate or depreciate relative to their current deviation from long-run fundamentals. Indeed, Dornbusch (1976) posed that the expected future spot rate can be expressed as a weighted average of the contemporaneous spot rate and a long-run equilibrium, \( \bar{s}_t \), that is commonly based on economic fundamentals. A specification of the long-run equilibrium value is given by the purchasing power parity (PPP) assumption, where \( \bar{s}_t \) moves over time relative to the inflation rates of two countries. Using these tests, Frankel and Froot (1987), Chinn and Frankel (1994a) and Gan and Wong (1993) find that expectations are expected to regress towards their long-run equilibrium values.

When combining the empirical findings from the extrapolative, adaptive and regressive models of expectations formation, the evidence overwhelmingly indicates that for currencies relative to the US dollar expectations are stabilizing for horizons exceeding 1 month. On the other hand, for shorter horizons, expectations appear to be destabilizing and move away from equilibrium values.

Altogether, the consensus emanating from the literature on survey data is that the failure of the forward discount unbiasedness is attributable both to irrational expectations and to the existence of time-varying risk premiums. Furthermore, when the forecast horizon lengthens, rejection of the rational expectations hypothesis grows firmer and survey-based expectations show more evidence of stabilizing behaviour in that the most recent price trend is expected to be reversed in the future.

3. Modelling Risk Premiums

When the possibility of time-varying risk premiums as an explanation of the forward premium puzzle emerged in the foreign exchange literature, academics considered rationales for why this time variation makes sense from an economics point of view. Ever since, there has been an ongoing debate on the source of the time variation in the foreign exchange risk premium. Although some tentative explanations exist, such as the ‘safe-haven’ argument, most of the studies that looked into this issue still assume that expectations are formed in a rational way. Only a few studies have employed survey-based measures of expectations in attempts to model such time-varying risk premiums. In this section, we will examine some of the work on
modelling the time variation in risk premiums without the stringent assumption that expectations are formed rationally. The discussion will focus on fundamentals-based models and time-series models.

A traditional methodology for modelling risk premiums by using macroeconomic fundamentals is through the portfolio balance model (PBM) – see for example Frankel (1982). According to this approach, a portfolio of various foreign and domestic assets is composed through a mean–variance optimization process. When some assets are imperfect substitutes, an increase in the amount of a particular asset results in either an increase of the required return or an increase of the risk of that asset. Dominguez and Frankel (1993) were the first to apply a version of the PBM to model risk premiums by using survey-based measures of expected future spot rates. Their model is stated as

\[ f_{t,t+k} - E_t[s_{t+k}] = \gamma_0 + \gamma_1 V_t + \gamma_2 V_t \varphi_t + \epsilon_t \]  

(9)

where \( V_t \) is the variance of changes in exchange rates between two consecutive dates, which is a proxy for the volatility of the spot exchange rate, and \( \varphi_t \) is the value of domestic assets in an investor’s portfolio as a proportion of total wealth. A higher level of variability of the spot exchange rate will increase the uncertainty of the returns on assets that are denominated in the domestic currency, which in its turn will increase the risk premium. In addition, an increase in the proportion of domestic-currency-denominated assets relative to assets in the foreign currency (an increase in \( \varphi_t \)) will increase the risk premium.

Dominguez and Frankel (1993) implement this methodology for the risk premium of the Deutschemark versus the US dollar, using weekly 1-month-ahead and biweekly 1-month-ahead survey-based measures of the expected future spot rate for the period 1982–1988, taken from the Money Market Survey (MMS) data set. \( \varphi_t \) is approximated by the central bank intervention as a percentage of wealth, which is calculated as the total supply of US and German government debt. They find that over the period 1984–1988 the estimated coefficient of the variance of the spot rate, \( \hat{\gamma}_1 \), is statistically significant in all regressions, more often than not at the 1% level. For the period 1982–1984, no such significance is found.

Giorgianni (1997) proxies equation (9) for the Italian lira versus the US dollar (IL/US) and Deutschemark (IL/DM) exchange rates by regressing the survey-based risk premium on the expected future domestic and foreign ratios of government net borrowing to gross domestic product and finds that, for the 3- and 12-month-ahead IL/US rate, the Italian (domestic) net government borrowing requirement always enters significantly and positive of sign, indicating that a higher Italian government deficit is associated with higher risk premiums on assets denominated in Italian lira. For the IL/DM exchange rate, the results are similar, though less significant. Finally, MacDonald (2000b) uses a variation to the PBM approach by regressing the risk premium on the conditional standard deviations of the domestic stock price changes and the foreign (i.e. US) stock price changes, with survey data from the 1985–1991, 1-month-ahead MMS data set. He finds that the stock market volatility is statistically significantly related to the risk premium for the BP/US, DM/US, JY/US and BP/DM rates.
An alternative methodology that also relies on fundamentals for modelling risk premiums is the general equilibrium asset-pricing (GEAP) model, due to Lucas (1982), that relates the risk premium to several macroeconomic variables. A closed form, empirically testable specification of this model can be expressed as

\[ f_{t,t+k} - E_t[s_{t+k}] = \delta_0 + \delta_1(E_t[X_{t+k}]) + \delta_2 \text{var}(X_{t+k}) + \varepsilon_t \quad (10) \]

where \( X \) is a vector of fiscal and monetary variables and \( \text{var}(X) \) proxies the volatility of these variables through their variance and covariance terms.

Giorgianni (1997) implements a testable version of the GEAP model by regressing the risk premium on the variance and covariance terms of the domestic and foreign government expenditures, using survey-based measures of the risk premium for the IL/US and IL/DM rates. Interestingly, all regressors appear to be significantly different from zero and with the correct sign: a higher (lower) volatility of the future Italian (US) fiscal policy is associated with higher risk premiums on assets denominated in Italian lira. This makes sense, for a fiscal expansion in a country may increase the risk of assets that are denominated in that country’s currency, thereby depreciating the domestic currency. However, the model has little explanatory power overall. For the models that focus on the IL/DM rate, the evidence is even less convincing. The introduction of monetary variables to the model – the covariance of the foreign and domestic money growth with the government expenditures – does not substantially alter the earlier findings for either currency.

MacDonald (2000b) proxies the GEAP model by regressing the risk premium of the conditional standard deviation of autoregressive conditional heteroscedasticity (ARCH) and generalized autoregressive conditional heteroscedasticity (GARCH) based forecast errors and finds that for the JY/US, BP/DM and BP/US rates there is evidence that the conditional standard deviation calculated through both models for the error process is important in determining the risk premium. For the DM/US market, no such evidence is present.

A second strand of the literature tries to model the risk premiums using time-series models. Cavaglia et al. (1994) use survey-based measures of the risk premium for some 18 EMS and non-EMS exchange rates relative to the US dollar and Deutschemark from the 1986–1990 Business International Corporation (BIC) survey and model the risk premium using different time-series models of the autoregressive moving-average (ARMA) class. They find that the AR(1) model appears to be the best model for nearly all currency–horizon combinations. Apparently, low-order time-series models (especially when measuring the risk premium through survey data sets) appear to be reasonably capable of modelling the risk premium. Indeed, Peel and Pope (1989) find that for five out of nine currencies relative to the US dollar, with data from a monthly survey conducted by Euromoney over the period 1984–1988, the 3-month-ahead survey-based estimates of the risk premium are white noise, while the other rates follow an MA(2) process. Also Giorgianni (1997) tries to model the risk premium for the IL/US and IL/DM rates using low-order variations of the ARMA family, with or without a time trend. He finds that the 3- and 12-month-ahead IL/US risk premiums are best described by an AR(1) model without a time trend. For the 3-month IL/DM risk premium the mere sample mean seems the
best model specification, and for the 12-month premium an MA(1) model with a constant seems to offer the best fit. Yet, the explanatory power of these two models for the IL/DM rate is very low. A possible reason for this low fitness is the presence of many institutional arrangements in the EMS in an attempt to reduce volatility of EMS currencies. As a result, a time-series model for the IL/DM risk premium will probably not be a time-invariant model and stochastic properties are hence not guaranteed.

A final strand of the literature attempts to explain the time variation through direct application of ARCH or GARCH type models – initiated for the foreign exchange market by Domowitz and Hakkio (1985). Nieuwland et al. (1998, 2000) and Verschoor (1993) specify an ARCH-in-mean model (or ARCH-M), due to Engle et al. (1987), that extends the original ARCH model to allow the conditional variance to affect the conditional mean directly, by

\[ s_{t,t+k} - s_t = \alpha + \beta(f_{t,t+k} - s_t) + \theta \sigma_t + \varepsilon_t \]  

When assuming that the error term conditional on the information set at time \( t \) is normally distributed, the ARCH effect can be introduced as

\[ \sigma_t^2 = \gamma_0 + \gamma_1 \sum_{i=1}^{p} \omega_i \varepsilon_{t-i}^2 \]  

where \( p \) equals the number of lagged squared disturbances and \( \omega \) the weight attached hereto. Following Baillie and Bollerslev (1990), the above ARCH effect can be generalized as a GARCH effect by including one or several (\( q \)) lags of the conditional variance.

Nieuwland et al. (1998, 2000) and Verschoor (1993) show that over the period 1986–1991 using 3-, 6- and 12-month-ahead estimates for the BF/DM, DG/DM, FF/DM, IL/DM and SP/DM rates from the BIC data set, these models – and in particular the GARCH model – appear to be reasonably successful in modelling the risk premium in about half of the currency–horizon combinations. Berk and Knot (2001) use the same data set, as well as the Consensus data set, and find largely significant ARCH-M terms (\( \hat{\theta} \) significantly different from zero) for the four most actively traded rates plus the FF/US rate at the 3- and 12-month horizons. Taylor (1989), however, using monthly 12-month-ahead survey-expected measures of the risk premium for the BP/US rate from a survey conducted by Godwins, a firm of British management consultants, finds that over the period 1981–1985 his specification of an ARCH model fails to explain variation in the risk premium. Hence, the evidence of successfully modelling the risk premium through specifications of ARCH or GARCH models is mixed.

Overall, it can be stated that the literature on modelling the risk premium using survey-based measures of expected future spot rates produces somewhat mixed results. Although most models based on fundamentals have difficulties in finding the right variables to analyse, simple time-series models have been quite successful in modelling the risk premiums for most currencies. One of the future challenging avenues in this area is to use the information that is
available from individual market participants, instead of assuming a representative agent.

Chionis and MacDonald (2002) question whether aggregate-survey-based measures of expectations are of any use at all to derive a model of the risk premium. When comparing aggregate (mean), individual and sector-average measures of the risk premium for the BP/US, DM/US and JY/US rates from the 1989–1995 Consensus data set, using an ARCH-M strategy, they find that the disaggregate-survey-based risk premium for each individual is more volatile than the survey consensus measure. This finding would imply that aggregate measures of the risk premium ‘average out much of the heterogeneity and richness of the individual survey expectations’ (Chionis and MacDonald, 2002, p. 67). An interesting finding is that these findings are irrespective of whether the aggregate measures come from survey data or from realized spot rate data.

4. Foreign Exchange Forecast Performance

There has been an ongoing debate in the literature about whether foreign exchange rates can be forecasted. The general consensus thus far is that forecasting exchange rates in a consistent way is cumbersome. Meese (1990), Meese and Rogoff (1983) and Wolff (1987, 2000) show that most methods of exchange rate determination cannot outperform a simple random walk characterization. A natural extension to this debate is the question whether market participants themselves can better forecast future exchange rates, or perform worse.

There exists a range of competing approaches for calculating the accuracy of (individual) forecasts, for instance those from a statistical perspective (of which the root mean squared error (RMSE) methodology is most notable). MacDonald and Marsh (1994, 1996) determine the RMSEs for some 30 individual forecasters, the country averages and the total cross-sectional mean, as well as the RMSE for the forward rate and random-walk-based forecasts for 3-month-ahead BP/US, DM/US and JY/US rates for the period 1989–1991, yet only find two individual forecasters that succeed in outperforming a random walk (in terms of lower RMSE values). Using a larger set of individual forecasters for the same three rates, Marsh (1999) still finds only one individual forecaster for both the BP/US and DM/US rates whose RMSE was less than that of a random walk over the same period. Corroborating these findings for a disaggregate set of 1-, 3- and 6-month-ahead estimates of the future JY/US rate from the 1985–1996 Japan Center for International Finance (JCIF) survey in Elliott and Ito (1999) (in that nearly all of the individual forecasts have larger standard errors of the deviation of the forecast from the ex post spot rate than the benchmark of a random walk forecast), one may justly argue that the Meese and Rogoff (1983) claim remains upheld in that the vast majority of disaggregate-survey-based expectations appear to be statistically worse estimators of future spot rates than a simple random walk estimate.

At the same time, Elliott and Ito (1999) claim that finding such a below-benchmark statistical forecasting performance does not imply that disaggregate survey data are of poor quality; in fact, they may be more valuable in terms of generating profits
compared to a random walk specification. Consequently, they define a simple profit statement in which an agent takes a long (short) fixed position forward in the foreign currency if she believes that the forward rate undervalues (overvalues) the value of the domestic currency. With log profits for each individual agent given by \( \pi_{j,t+k} = (2I(s_{j,t,t+k} > f_{t,t+k}) - 1)(s_{t+k} - f_{t,t+k}) \), it appears that profits stemming from a random walk strategy (where \( s_{j,t,t+k} = s_t \)) only outperform survey-based forecasts for two out of 42 individual forecasts in terms of profitability at the 1- and 3-month horizon, and for none at the 6-month horizon.

One notable shortcoming of these simple profit-based trading rules is that no explicit measure of risk is incorporated in the transactions. Moreover, the inherently assumed fixed positions in size, as well as the fact that a single agent’s forecasts for individual currencies are analysed one at a time regardless of the probable dependence between forecasts for different currencies, render such methods rather implausible. In an attempt to address these shortcomings, Marsh and Power (1996) propose to construct portfolios of positions on the BP/US, DM/US and JY/US rates based on estimates from each of the 22 individual forecasters from the 1989–1992 Consensus survey. In particular, one portfolio minimizes the risk of this portfolio subject to a predefined minimal level of profit constraint, whereas a second portfolio uses a more orthodox approach in which a utility function of expected profits and risk is maximized. In contrast to the findings of Elliott and Ito, it appears that only one forecaster manages to generate returns in excess of those stemming from a simple random walk benchmark (and only in the first portfolio specification); thereby, again, questioning the ability of individual forecasters to forecast exchange rates.

Combining these findings, one may safely claim that the random walk model remains pre-eminent. Survey-based forecasts do not appear to produce statistically significantly smaller forecast errors than a random walk forecast. For the rare instance in which an individual forecaster does generate statistically more accurate forecasts, the information therein cannot be exploited to generate more accurate forecasts in the future.

5. Market Microstructure and Heterogeneity

In their survey on nominal exchange rates, Frankel and Rose (1995) note that there is little evidence that macroeconomic variables have a strong and consistent effect on floating exchange rates. In particular, the fluctuation in exchange rates is usually much larger than the fluctuation in the underlying fundamental exchange rate. Instead, attention has been directed towards a microstructure approach that analyses the interaction among information flows, price volatility, trading volume and the heterogeneity of agents’ expectations, and investigates the effect hereof on the movement of exchange rates. The investigation of various aspects of microeconomic theory, particularly the heterogeneity in agents’ expectations, appears useful in explaining some of the anomalies in the foreign exchange literature.

Yet, little is known about the microstructure of the foreign exchange market. This is surprising, since the daily amount of foreign exchange that is traded worldwide is vastly in excess of the amount that is required for trade in goods and services. Most
expectations’ studies assume a single representative agent, and thereby assume that market participants are homogeneous in their beliefs about the future avenue of the exchange rates. However, if all market participants have homogeneous beliefs and act according to these, the large excess volume of trade in the foreign exchange market cannot be explained. In this section, we review some of the work on heterogeneous beliefs in the foreign exchange market.

Heterogeneity is a concept that is used in a variety of ways in the foreign exchange literature. There are two commonly used explanations for the existence of heterogeneity of beliefs in financial markets. One strand of the literature argues that dispersion of beliefs arises because of the asymmetry in information. Different market participants are assumed to hold different sets of information, whereby part of the information is common for all participants and part is private. The asymmetry in information may be caused by the rigidity in the transmission of public information, so that the heterogeneity in agents’ beliefs is caused by an artificial informational assumption (Kurz and Motolese, 2001).

Another strand of the literature assumes that all market participants hold different beliefs about economic variables even when there is no difference in the information that is available to them. The difference in beliefs arises because agents disagree about the interpretation of this information. To argue why the difference in interpretation occurs, we can follow the rational beliefs theory of Kurz (1994) that assumes that heterogeneity of beliefs is caused by the fact that economic agents do not know the structural relations of the economy. Agents only have ‘information’ or ‘empirical knowledge’, which is readily observable from the economy, usually in the form of a large amount of data about the past performance of an asset or the economy in general. Agents form their opinions about the future by using the empirical distribution that is derived from the occurrence of events in the past.

The number of methods to measure or quantify heterogeneity is small because of the relative scarcity of data on individual (survey) expectations. Ito (1990) develops a simple and robust test for detecting any differences in opinion among agents when forming expectations; i.e. whether expectations are heterogeneous. Suppose that an individual forecast $j$ made at time $t$ (where $j \in J$ total cross-section individual forecasts) consists of a collectively held function of all publicly available information, $f(I_t)$, and an individual effect, $g_j$, that may be based on private information. The expected future spot rate for this individual forecast can then be described algebraically as

$$s_{j,t,t+k}^e = f(I_t) + g_j + \varepsilon_{j,t} \quad \forall j = 1, \ldots, J$$

(13)

where $\varepsilon_{j,t}$ is an individual white noise disturbance term that may arise due to measurement errors. It should be noted that we make the explicit assumption that all individual forecasters attach the same weight to a particular variable from the common information set $I_t$: there are no idiosyncratic effects with respect to the publicly available information. The cross-sectional average of the individual forecasts, at time $t$, can be portrayed in a similar fashion as

$$\bar{s}_{t,t+k}^e = f(I_t) + \bar{g} + \bar{\varepsilon}_t$$

(14)
When $\bar{g}$ can be normalized to be zero, equation (14) can be subtracted from (13), yielding

$$s_i^{t,t+k} - \bar{s}_i^{t,t+k} = (g_j - \bar{g}) + (\varepsilon_{j,t} - \bar{\varepsilon}_t) = g_j + (\varepsilon_{j,t} - \bar{\varepsilon}_t)$$ (15)

Now, the individual effects can be determined by solving the above equation for $g_j$. Clearly, no knowledge whatsoever regarding the underlying information set is hence required when investigating heterogeneous behaviour.

In the above specification, the assumption of the identical use of the publicly available information set can be relaxed when allowing for idiosyncratic effects, i.e. beside individual biases ($g_j \neq 0$) each agent attaches a different weight to various elements from the publicly available information set. Suppose that on one variable in this information set, $X_t$, agents indeed attach different weights. One can then test for both individual biases and idiosyncratic effects ($\beta_j - \bar{\beta} \neq 0$) by estimating, for all $j$,

$$s_i^{t,t+k} - \bar{s}_i^{t,t+k} = (g_j - \bar{g}) + (\beta_j - \bar{\beta})X_t + (\varepsilon_{j,t} - \bar{\varepsilon}_t)$$ (16)

Ito (1990) executes regressions of both types (15) and (16) for a set of disaggregate expectations for the 1-, 3- and 6-month-ahead JY/US rate from the JCIF survey over the period 1985–1987 and finds that for some 44 companies industry effects enter significantly for the export industry, with an appreciation bias in that estimates for $g_j$ are significantly positive, and for trading companies, with a depreciation bias. When allowing for idiosyncratic group coefficients, and rendering the variable set $X_t$ equal to the two most recent lags in depreciation, none of the results changes markedly. Hence, it appears that heterogeneous behaviour of the various trading groups arises because of different individual effects, not because of idiosyncratic coefficients of the variables in the publicly available information set. The finding of such systematic heterogeneity in expectations remains upheld for an updated JCIF data set in Elliott and Ito (1999) and is confirmed by Bénassy-Quéré et al. (2003).

MacDonald and Marsh (1996) mimic the above tests for 3- and 12-month-ahead estimates of the BP/US, DM/US and JY/US rates from the 1989–1992 Consensus data set and find significant evidence of heterogeneous expectations in that significant individual effects exist, regardless of whether the overall average or country average is used as benchmark. The latter finding is of particular interest, for it would indicate that asymmetries in information between various countries are marginal. Furthermore, in contrast to the results of Elliott and Ito, there is significant evidence of idiosyncratic coefficients when using either the forward discount or the most recent lag in depreciation as explanatory variables in equation (16). Interestingly, the number of individuals for whom the joint null hypothesis of no individual or idiosyncratic effects cannot be rejected seems to decrease as the forecast horizon lengthens. This would indicate that in the longer run agents vary more in their use of information from the common information set, or attach less weight to the common information set and instead focus more on their own, private information $g_j$. Extending the Consensus data set to 1995, Chionis and MacDonald
Having established heterogeneous behaviour in expectations, Chionis and MacDonald (2002) question whether aggregate-survey-based measures of expectations are of any use at all in tests of unbiasedness, error orthogonality or perfect substitutability. When comparing aggregate (mean), individual and sector-average measures of the risk premium for the BP/US, DM/US and JY/US rates from the 1989–1995 Consensus data set, they find that the disaggregate-survey-based risk premium for each individual is more volatile than the survey consensus measure. This finding would imply that aggregate measures of the risk premium ‘average out much of the heterogeneity and richness of the individual survey expectations’ (Chionis and MacDonald, 2002, p. 67).

With the availability of disaggregate measures of expectations, and having established heterogeneous behaviour in such expectations, one can also directly test the market microstructure hypothesis that trading volume is related to dispersion in expectations by employing Granger causality tests. Frankel and Froot (1990b) investigate bivariate Granger causality relationships and estimate volume as the weekly number of futures contracts traded on the Chicago Mercantile Exchange (CME), exchange rate volatility as the average weekly squared percentage change in the exchange rate every 15 minutes, and dispersion as the standard deviation of individual forecasters’ 1-week and 1-month-ahead expectations from the 1984–1988 MMS survey for the individual BP/US, DM/US, JY/US and SF/US rates. It appears that dispersion Granger-causes both volume (at the 10% significance level, for all except the SF/US rate at both the 1-week and 1-month horizon) and volatility (for all of the four currencies at the 1-week horizon and for all except the JY/US rate at the 1-month horizon). Furthermore, there is some evidence that volatility Granger-causes dispersion at both the 1-week and 1-month horizon.

Chionis and MacDonald (1997) mimic these bivariate tests for 3- and 12-month-ahead estimates of the BP/US, DM/US and JY/US rates from the 1989–1995 Consensus data set, where measures of dispersion are calculated either as the standard deviation of the difference between the largest and smallest expectation of a particular currency or as the difference between an individual expectation and the cross-subsection mean. Both measures of dispersion appear to Granger-cause volatility at the 5% level (except for the 12-month-ahead DM/US rate), as well as Granger-cause volume at the 5% level – thereby corroborating the results of Frankel and Froot. In addition, there is lucid evidence of reverse Granger causality from volatility to dispersion.

Using the same survey data set, MacDonald and Marsh (1996) investigate the relationship between trading volume and heterogeneity in expectations through a mean–variance model of trading volume, by regressing turnover (defined as the daily average dollar value of trade on the CME) on the standard deviation of the actual and expected future spot rate, the latter of which is a measure of dispersion. For the DM/US and JY/US rates from the 1989–1992 Consensus data set, the dispersion of expectations enters positively and significantly. For the BP/US rate, no such evidence exists. Finally, Beine et al. (2006) investigate whether central bank intervention has
an impact on the dispersion of beliefs in exchange rate forecasts. They show that forecast heterogeneity increases as a result of interventions, regardless of whether these interventions are expected or unexpected. This finding is interesting, for it stresses the role of rumours in foreign exchange markets.

A final question that naturally arises is whether one market participant’s action or beliefs influences the others in subsequent periods. If this were the case, then deviations of the exchange rate from their long-run fundamental value could be explained by herding behaviour of market participants. Beine et al. (2003) assess the extent of herding behaviour in foreign exchange markets by using individual survey expectations for two currencies versus the dollar. By using Granger causality tests they find that although forecasters are connected to each other through leader and imitation patterns, there is no evidence of sequential herding. Interestingly, leaders do not appear to be selected based on their past forecast performance.

Altogether, the albeit limited microstructure literature of the foreign exchange market and the associated heterogeneity of beliefs on behalf of market participants presents a challenging opportunity for future research in explaining some of the anomalies in this market. The debate thus far shows that expectations are heterogeneous to such an extent that we cannot simply assume models based on one representative agent. This would imply in practice that aggregate expectations, for instance from a survey panel, average out much of the heterogeneity of individual expectations and therefore tests that use these aggregate measures may not be capable of explaining the anomalies in the foreign exchange market.

6. Noise Trading, Chartism and the Role of Fundamentals

An alternative explanation for why market participants hold different beliefs about the future may be related to the existence of fundamentally different types of market participants. In the financial economics literature, there have been several attempts to present models with different types of investors who in essence all have the same information. For instance, De Long et al. (1990) present a model where noise traders, with no access to inside information, act irrationally on noise as if it were information that would give them an advantage over rational arbitrageurs. These noise traders can earn higher expected returns, because of their own destabilizing influence and not because they bear more of the fundamental risk.

The establishment of heterogeneous beliefs among currency forecasters may furthermore alleviate some of the debate regarding the formation of expectations. Specifically, such heterogeneous behaviour can contribute to the explanation of the before-mentioned twist in expectations at approximately the 1- to 3-month horizon, as well as shed new light on how agents form expectations. To this end, Frankel and Froot (1986, 1988) establish a model that assumes the foreign exchange market to consist of three classes of actors, i.e. fundamentalists, chartists and portfolio managers, all of whom have their own, heterogeneous beliefs towards the future value of an exchange rate, and behave rationally in that each uses all information available.

When defining the expectations of portfolio managers (i.e. \( m \), those who actually participate in market transactions) as a weighted average of the expectations of
fundamentalists \((f)\), who base expectations on some structural model of exchange rate determination, and chartists \((c)\), who use non-fundamentals-based techniques like autoregressive models,

\[
s_{m,t,t+k}^e - s_t = \omega_t \left( s_{f,t,t+k}^e - s_t \right) + (1 - \omega_t) \left( s_{c,t,t+k}^e - s_t \right)
\]  \(17\)

and for the moment assuming that the chartists expected rate of depreciation is zero \((s_{c,t,t+k}^e - s_t = 0)\), we can analyse the weight attached to the fundamentalists’ expectations, \(\omega_t\), at time \(t\) as

\[
s_{m,t,t+k}^e - s_t = \omega_t \left( s_{f,t,t+k}^e - s_t \right) \iff \omega_t = \Delta s_{m,t,t+k}^e / \Delta s_{f,t,t+k}^e
\]  \(18\)

where the expected rate of depreciation of fundamentalists is approximated by the survey-based expectations and the expected depreciation of portfolio managers by the forward discount. Using pooled survey-based expectations for the four most actively traded rates from the AMEX and Economist surveys, Frankel and Froot (1986, 1988) find that the weight \(\omega_t\) has been decreasing since the early 1980s – a phenomenon indicating that gradually less weight is attached to the expectations of fundamentalists. Instead, chartists’ methods of forming expectations have become the primary tools for establishing expectations in the above four markets.

In a companion paper, Frankel and Froot (1990a) analyse a 1978–1985 Euromoney survey that investigates the extent to which a selection of forecasting companies use various specifications of chartist or fundamentalist forecasting techniques, and conclude that the number of companies using the latter techniques as the primary tools for estimating future spot rates has been decimated over the years, to the benefit of technical, or chartist, analysis. In two auxiliary studies, Allen and Taylor (1990) and Taylor and Allen (1992) attempt to ascertain the influence of chartist methods used in the London foreign exchange market and uncover that at the short-run spectrum of the forecast horizon up to 90% of all survey respondents use some chartist input when forming expectations regarding future exchange rates. When the forecast horizon lengthens (3 months up to 12 months), weight given to fundamental variables increases.

Interestingly, these findings also have the potential of explaining some of the above-mentioned anomalies in the foreign exchange market. Most prominent, the earlier discovered shift in expectations can now be attributed to an alteration in the use of forecasting methodologies, shifting towards chartist techniques as the forecast horizon shortens. In the same line, a somewhat different and carefully advocated alternative explanation, provided by Frankel and Froot (1986), states that chartists are simply people who think only in terms of the short-run horizon, whereas fundamentalists think long term. Thus, both groups (which inherently hold heterogeneous beliefs regarding the future value of a spot rate) are taking direct positions in the market. The latter view is challenging and provides grounds for future research.

Second, the model of chartists and fundamentalists has the potential of explaining the microstructure anomaly of excessive trading volume. When considering the finding that currency forecasters have increasingly relied on chartist methods of forecasting, and when maintaining that noise traders encompass those traders who
employ such chartist analysis, the noise trader model of De Long et al. (1990) then explains that an increase in the number of trades based on noise (which inherently rely on diverse, and often conflicting, sources of information) will make the foreign exchange rate more volatile. In addition, a shift towards more noise trading will imply an increase in the number of trades based on heterogeneous information, which in its turn may Granger-cause an increase in trading volume (although this reasoning has so far not been verified empirically).

7. Discussion and Conclusions

This study has attempted to shed new light on some anomalies in the foreign exchange market by analysing over 20 years of empirical work that employs survey-based measures of expected future spot rates. Five topics that gained considerable attention in the past years, or will play an increasing role in future research, are covered. First, we have attempted to determine the relative importance of both irrationality in the behaviour of market participants and the existence of time-varying risk premiums in explaining the forward discount puzzle, and to see how market participants form their expectations about future spot exchange rates. Second, we analysed the rationales behind the existence of time-varying term premiums and how these premiums can be modelled best. Third, we looked at the relative performance of market participants in forecasting future spot exchange rates, relative to a simple random walk forecast, using a range of performance criteria. Fourth, we touch upon a relatively new topic in the foreign exchange literature: market microstructure and the role of heterogeneity in beliefs, and see how microstructure theory has the capacity to explain some of the anomalies in the foreign exchange market. Finally, we look at the role of different players in the foreign exchange market.

Survey-based measures of expectations have allowed a direct measure of biases in expectations and risk premiums, and consequently allow a decomposition of the forward premium into a part attributable to irrationality on behalf of market participants and a part attributable to the existence of time-varying risk premiums. The consensus emanating from the literature is that the failure of the forward premium unbiasedness is attributable both to irrational expectations and to the existence of time-varying risk premiums. In particular, the survey-based expected future spot rates are biased estimates of the true level of the future spot rate.

It furthermore appears that expectations are irrational in that agents do not use all available information efficiently. The survey-based forecast error is not orthogonal to the most important elements from agents’ information sets, at least at horizons exceeding 1 month. Agents could have reduced their forecast errors by betting against the various elements from the information set and instead focus more on the contemporaneous spot rate. In addition, the farther agents predict into the future, the less they use various elements from their information set. When analysing in greater depth the process of expectations formation, it appears that at horizons up to approximately 1 month agents extrapolate the most recent trend in the behaviour of exchange rates and do not sufficiently adapt to the most recent survey-based forecast error. This destabilizing character of the survey-based measures of expectations is
corroborated by the fact that expectations appear to diverge from their hypothesized long-run equilibrium values. At horizons exceeding 1 month, expectations appear to stabilize, in that expectations regress towards their equilibrium values.

Also, the existence of time-varying risk premiums at horizons that extend beyond 1 month has led to several attempts to model these premiums. There is some support for the claim that survey-based risk premiums can be modelled by simple, low-order time-series models (in particular of the ARMA class), and that exchange rate risk premiums are not invariant over time, in that they systematically vary with agents’ perception of underlying uncertainty in the behaviour of the exchange rate. Models using a combination of macroeconomic or fiscal variables occasionally contain significant explanatory variables, although most fundamentals-based models have little explanatory power overall.

Yet, most of these studies are hampered by the fact that they use aggregate measures of expectations in models of the risk premiums. Since risk premiums are associated with the attitude towards risk and uncertainty of market participants, using aggregate measures of risk premiums averages out much of the heterogeneity and richness of the individual survey expectations. Indeed, risk premiums based on disaggregated market expectations have been shown to be more volatile than the survey consensus measure. One of the challenges in modelling risk premiums is to use the information that is available from individual market participants, instead of relying on a single representative-agent model.

Also the debate about whether market participants can forecast exchange rates in a consistent way has led to several interesting results. The literature has shown earlier that most macroeconomic or time-series models cannot outperform a simple random walk forecast. Evidence from survey data now shows that actual market participants (irrespective of which techniques they use) do not seem to outperform a simple random walk forecast in terms of lower errors. Although studies that use a profit-based criterion to assess the forecast performance of individual market participants show that most forecasters are successful in forecasting the directional change, these simple profit-based rules often have the shortcoming that no explicit measure of risk is incorporated in the transactions. The random walk model therefore remains preeminent.

This does not mean that the study on the behaviour of individual market participants is futile. There is relatively little known about the microstructure of the foreign exchange market, which is surprising, since the daily volume of foreign exchange that is traded worldwide is far in excess of the amount that is required for trade in goods and services. The examination of disaggregate measures of expectations has shed new light on the efficiency of the foreign exchange market and the preceding tests of rational expectations and perfect substitutability. Not only has the presence of heterogeneously held expectations been revealed, aggregate measures of various variables have furthermore been shown to average out much of the heterogeneity and richness of the individual survey expectations. The analysis of individual market expectations has also provided new insights on some of the anomalies in this market, for instance that the volume of foreign exchange traded weekly is related to the dispersion in beliefs and uncertainty in the foreign exchange market.
Finally, the claim that the foreign exchange market consists of players that hold essentially different views of the behaviour of the exchange rate is shown to have considerable empirical ground. Categorizing market participants as pursuing either a chartist forecast strategy or a fundamentalist strategy has revealed new insights into how market participants form their forecasts. It seems that over the years the role of macroeconomic fundamentals in forecasting has declined and is only used for longer-term forecasts. Still, most market participants use a combination of these two techniques. The increased use of chartist techniques and the presence of noise traders in the foreign exchange market can, to some extent, explain the large trading volume in the foreign exchange market.

These findings have significant implications for future research on several topics in international finance. First, one can conclude that investors’ exchange rate expectations do not conform to the rational expectations hypothesis. Although the rational expectations hypothesis has considerable appeal as a theoretical model, it does not appear to provide an adequate explanation of exchange rate expectations in most survey-based studies. It is therefore important to consider alternatives to rational expectations or other models of expectations formation. Clearly, there is considerable scope for further research in this area. The finding of systematic exchange rate forecast errors can plausibly stem from a variety of sources, including – but certainly not limited to – investors’ irrationality.

Furthermore, the possibility of influential yet uncommon events should be considered. Most notably, peso problems may lead to repetitive exchange rate forecast errors in small samples and consequently invalidate standard statistical inference. While this argument applies with equal force to virtually all empirical analyses, it may be that the type of government policies and other exogenous processes that determine exchange rates make this problem particularly strikingly manifest in most studies. Such a possibility probably deserves more study than it has received so far. Especially within the EMS where such peso problems may result from expectations of periodic realignments of central parities will further research not be misplaced.

As a second alternative explanation to the failure of the rational expectations hypothesis, one might investigate whether investors learn as they go. Explicit examples of the failure of the rational expectations assumption because of learning by economic agents have also started to be produced. If investors are in the process of learning about floating exchange rates or other regime changes, then exchange rate changes will be affected by the learning. Periods of history in the foreign exchange market may well be consistent with the same type of learning mechanism in the formation of expectations that gradually converges to rationality in the same sense.

In future work, considerable attention should furthermore be paid to the heterogeneity in exchange rate expectations among investors. Although homogeneity has been assumed by a great many investigators of foreign exchange market efficiency (heterogeneity among market participants was aggregated out), the diverse patchwork on heterogeneous behaviour suggests conclusively that homogeneity is not a reasonable assumption. It may well be that a great many studies employing some form of aggregate expectations report understated degrees of time-varying risk.
premiums and biases in expectations. Heterogeneous expectations and their role in determining foreign exchange market dynamics may hence be important areas for future research.

Finally, the role of survey-based measures of expected future spot rates in the process of modelling risk premiums is only at its preliminary phase. The ‘true’ observation of risk premiums only now allows a ‘true’ modelling hereof. Beyond doubt, the future course of empirical studies on the modelling of risk premiums employing some form of survey-based expectations of future spot rates is likely to produce interesting and successful methodologies, which might be capable of withstanding the ultimate test of consistently outperforming a simple random walk forecast.

Notes
1. Note that the survey of Engel (1996) is limited only to those studies which have assumed rational expectations and attempted to attribute the forward rate bias to a foreign exchange risk premium.
2. We would like to refer to MacDonald (2002a) for an earlier and in-depth overview of this literature and focus in this section on updating his work.
3. Since from most studies it appeared that both the current spot rate and the forward rate series follow a unit root process, the correct way to estimate forward rate unbiasedness is through tests in which the variables are transformed into returns. A seminal work on unit root behaviour in the empirical modelling of exchange rates is provided by Meese and Singleton (1982) and Liu and Maddala (1992a, 1992b). Dutt and Ghosh (1997) approach the issue of unit root behaviour differently by adjusting the tests for unit roots, instead of the variables. Fischer (1989) furthermore provides an excellent work on the application of cointegration tests in examining the rationality of expectations.
4. Here, \( I(\cdot) \) is an indicator function yielding 1 if the statement between the parentheses is true and 0 otherwise.
5. Liu (1996) uses a somewhat different approach by considering the weight \( \omega \) to be fixed over the sample period and assuming that fundamentalists adopt a random walk model (of no change) for the depreciation of the BP/US, DM/US, JY/US and SF/US exchange rates, and shows that the percentage weight assigned to fundamentalists’ views over the period from 1984 to 1989 never exceeds 40%.

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