The Foreign Exchange Risk Premium A Disaggregate Approach

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Abstract

This paper re-examines the issue of the existence of a time-varying risk premia in the three foreign exchange markets. By using the theoretical framework developed by Domowitz and Hakkio it relates the risk premium in the foreign exchange market with the heterogeneity across the market participants. The empirical research using a disaggregate survey data base support the importance is supportive of the existence of time-varying risk premia for the British Pound, German Mark and Japanese Yen exchange rates. In particular, we demonstrate that consensus measures of the risk premium mask the existence because of the importance of heterogenous expectations.

1. Introduction

The debate regarding the rationality of agents' expectations and the informational efficiency of foreign exchange markets continues to be an issue of central concern to academic and policy makers. We will test propositions relating to these hypotheses by analyzing survey data from some of the major currencies (German mark, Japan yen and British pound) relative to the United States dollar. The contribution of this work is that we implement statistical and econometric tests on an individual agent basis rather than adopting the pooling technique of previous researchers [Dominguez (1986), Frankel and Froot (1990), MacDonald and Torrance (1990)] who assess the statistical properties of the forecasting mean. For this reason we will use a data set which is generated by Consensus Forecasts of London.

Since October 1989 Consensus Forecasts have surveyed and published the exchange rate forecasts of economists, foreign exchange dealers and executives in over 150 companies and institutions in the G-7 nations. The companies surveyed are mainly commercial and investment banks, but industrial corporations and forecasting agencies are also polled. The responders return a fax on the first Monday of each month containing their point forecasts of dollar-sterling, Deutschmark-dollar and yen-dollar exchange rates three and twelve calendar months ahead. Since the response rate is less than perfect, in the work which follows we constrain our analyses to a subset of the total panel (in particular, a total panel of 60 individuals, approximately).

Additionally, we have estimated the properties of the mean for the three different groups of activities consisting our data set. MBANK stands for the mean of the banks MSEC and MINDUST, stand for the mean of securities companies, and industries, respectively. The mean across forecasters located in the same nation will be referred to as MUK, MGER, MFRA, MITA, MJAP, MUSA, and MCAN. In the rest of the paper we will refer to the mean across countries as a country mean, and the mean ranked with the criterion of the type of activities will be named as the group mean. At the end, it should be noted that in addition to the survey data we collected data on spot and forward exchange rates from Datastream International. The outline of this work is as follows.

A review of previous work is provided in section 2. We will derive the survey-based risk-premium in section 3. This model is a version of the cash-in-advance monetary model providing a foreign exchange risk

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premium which depends on the conditional variance of domestic and foreign money supply, augmented by the existing heterogeneity among the market participants. By using the disaggregate data set and an ARCH class of models we assess, in section 4, the performance ability of the previously developed model. Section 5 concludes and at the end, section 6 makes suggestions for future research.

2. Previous empirical and theoretical work

A large number of researchers [for a review see Engle (1995)] have tested the Efficient Market Hypothesis using a variety of currencies and time periods and report results which are unfavorable to the unbiasedness and orthogonality hypotheses. In the light of this research a number of researchers expand the investigation regarding the rationality of agents' expectations and the informational efficiency of the foreign exchange market using survey data. A number of papers using survey data include Dominguez (1986), Froot and Frankel (1989), Ito (1990), Allen and Taylor (1990), MacDonald and Torrance (1990), Chinn and Frankel (1994). This body of empirical work indicates that throughout the 1980's and 1990's we can reject the hypothesis of market efficiency for the foreign exchange markets. Another research element from this literature is that both irrationality and time-varying risk premia seem to be responsible for the rejection.

Another branch of the literature has examined the theoretical and empirical models which can derive the risk premium. There are a number of models that generate a time-varying risk premium. Between them, particular attention must be paid to the equilibrium, dynamic, optimizing models of asset pricing. Lucas (1978) presents such a model in an international context. The subsequent theoretical research has been motivated by the operationalising of the Euler conditions in the cash in advance model. Although the starting point remain the optimization of the first order condition there are three different approaches that have been developed. The CAPM/latent variable approach Hodrick (1987) and the risk free premium [*inter alia* Hodrick Srivastava (1986), Campell and Clarida (1987)] are included in the first two categories.

The most popular way of implementing the first order conditions has been the third category, the Autoregressive Conditional Heteroskedasticity (ARCH) framework, originally proposed by Engle (1982). A growing body of researchers have used the ARCH-M class of models suggested by Engle, Lilien and Robins (1987). According to this the conditional mean of the foreign exchange changes is an explicit function of the conditional variance of the forecast errors. In this model an increase in the conditional variance will be associated with an increase or an decrease in the conditional mean depending on the sign of the partial derivative of the function with respect to the variance. Domowitz and Hakkio (1985) were the first to apply this class to the forward exchange market. The basic idea in this model, as in many theories in financial economics, is the use of a measure of risk as an explanatory variable. To the extent that the conditional variance of an error term is a measure of risk it seems logical that the variance should enter the regression function as a measure of the risk premium. The authors use five currencies and report rather negative results. Kaminsky and Peruga (1990) reestimate the model of Domowitz and Hakkio in a multivariate context and they argue that the negative findings is a reflection of the failure to take into account properly exchange market interdependencies. In the same context several authors [McCurdy and Morgan (1987), (1988) Diebold and Pauly (1987), Lee (1988), Ballie and Bollerslev (1990)] suggest that the weak results might be due to the fact that the univariate ARCH-M's conditional variance being poor proxies for risk.

Before proposing another research path for modeling the risk premium in the ARCH context, however, we first of all conduct some empirical tests of our survey data set.

3. Time series properties and some empirical regularities

In this section we consider the time series properties of the forward premium and the survey based variables; i.e. the expected exchange rate changes and the survey forecast error. Although the scope of this work is the derivation of conclusions regarding the time series properties of individual participants in the foreign exchange market, for matter of convenience we present, in tables 1-7, the properties related to the means.

The Augmented Dickey Fuller tests applied to the spot rates are consistent with previous findings that the spot rate is a nonstationary process. Further, by applying the same test to the spot rate changes: $\Delta s^e_{t+k}=s_t-s^e_{t+k}$ where s^e_{t+k} is the survey based rate, corresponds to either the group/country means, or to the individual forecasts, we conclude that the spot rate is a difference stationary process in each case[1].

It should be noted that although the degree of integration of the forward premium is an issue that it is not yet settled in the literature in the present work, by applying the ADF we can reject the null of a unit root for the forward discount across the three currencies[2].

Table 1 panels A and B provide summary statistics for the expected exchange rate changes, the survey errors and the forward premium for the three currencies. The expected exchange rate changes and the survey errors are further decomposed taking the mean per country and the mean per activity. Before considering the time series properties of the financial series in question, we have to note that the literature using the assumption of rational expectations has concluded the following regularities: 1. Exchange rates are many times more variable than the forward premium. In fact $\sigma_k(\Delta s_{t+k}) > \sigma_f(fp_{t+k})$ and consequently the variance of $E_t(s_{t+1})-s_t$ is too large to be explained in the conventional models by the forward premium; 2. Forward premia and exchange rate changes exhibit marked positive serial dependence in their second moments and substantial leptokyrtosis.

Table 1
Time Series Properties Of The Aggregate Mean

PANEL A : DM

	Δs^e_{t+3}	fp_{t+3}	$s^e_{t+3}-s_{t+3}$
Mean	0.005	-0.002	0.0011
σ^2	8.7e-005	8.8e-006	0.0009
Ku	-0.48	-0.59	0.907
	(0.44)	(0.356)	(0.157)
Q_{16}	126	231	85.85
	(0.000)	(0.00)	(0.000)

PANEL B : JY

	Δs^e_{t+3}	fp_{t+3}	$s^e_{t+3}-s_{t+3}$
Mean	0.0004	-0.0006	0.0088
σ^2	7.7e-005	3.4e-006	0.0006
Ku	0.148	-0.78	0.930
	(0.817)	(0.223)	(0.046)
Q_{16}	173	94	71.6
	(0.000)	(0.000)	(0.000)

PANEL C : BP

	Δs^e_{t+3}	fp_{t+3}	$s^e_{t+3}-s_{t+3}$
Mean	-0.004	-0.004	0.001
σ^2	4.7e-005	9.5e-006	0.0009
Ku	-0.60	2.01	3.29
	(0.34)	(0.001)	(0.000)
Q_{16}	22.21	137	60.63
	(0.316)	(0.00)	(0.000)

** describes a test of the null hypothesis that the population kurtosis is zero. This is the population value if the series is i.i.d. Normal*

σ^2 indicates the variance

Q_{16} :indicates the Ljung-Box Q-Statistics for the 16 correlation coefficients into the parentheses are the level of significance

By examining the time series properties of the aggregate mean, several features deserve comment.

In accordance with the previous findings using the rational expectations literature the unconditional variance of the exchange rate change is many times more variable than the variance of the forward premium. This is cleaner in the cases of the group and country means. Further, both for the individual markets and for the means the unconditional variance of exchange rate changes is large relative to the unconditional variance of the average. The forward premium exhibits all the stylized properties; i.e. presents substantial serial correlation and heteroskedasticity. The fourth moments of both variables suggest that these distributions deviate from normality. In most cases we can reject the null hypothesis of a normal distribution. Similarly, an examination of the unconditional distribution of the survey error series indicates evidence of time variation in the conditional variances. The unusually high variance of the forward premium and the significant serial correlation are consistent with the large body of empirical work which indicates that throughout the late 1980's and early 90's nominal profits from speculation in forward contracts on the US dollar were highly volatile but also displayed a predictable component which was itself volatile and serially correlated.

Common phenomenon in the above series is the substantial serial correlation apparent in the expected profits and the survey errors. The very strong persistence, especially in the expected changes, can be partly attributed to the fact that the three months period exceeds the sampling frequency of our survey data and one should expect some serial correlation to appear even though the true series is not predictable using the time t information set[3].

Table 2
DM 3-Months Forecasts

PANEL A : Expected exchange rate changes, per country mean

	MUK	MCAN	MFRA	MGER	MITA	MJAP	MUSA
Mean	0.006	0.0008	0.007	0.006	0.004	0.003	0.004
σ^2	0.00012	0.0001	9.52e-005	0.0001	0.0001	0.0001	7.83e-005
Ku	-0.441	9.12	-0.616	-0.22	-0.377	0.527	-0.533
	(0.491)	(0.000)	(0.336)	(0.730)	(0.556)	(0.410)	(0.40)
Q_{16}	181	18.93	87	123	140	41.8	34.8
	(0.000)	(0.217)	(0.000)	(0.000)	(0.000)	(0.000)	(0.005)

PANEL B : Survey error per country mean

	MUK	MCAN	MFRA	MGER	MITA	MJAPAN	MUSA
Mean	0.0126	0.007	0.0141	0.010	0.010	0.009	0.011
σ^2	0.0009	0.0009	0.0009	0.001	0.001	0.0009	0.0009
ku	0.757	042	0.87	1.11	0.94	0.702	0.709
	(0.237)	(0.504)	(0.171)	(0.081)	(0.142)	(0.273)	(0.273)
Q_{16}	84	177.5	90.3	83.4	88.6	78.5	85.6
	(0.000)	(0.217)	(0.000)	(0.000)	(0.000)	(0.000)	(0.005)

Table 3
DM 3-Months Forecasts

PANEL A : Expected exchange rate changes, group mean

	MBANK	MINDUSTR	MSEC
Mean	0.005	0.005	0.054
σ^2	0.0001	0.0001	8.3e-005
Ku	-0.33	-0.07	-0.31
	(0.602)	(0.902)	(0.61)
Q_{16}	151	30.56	109
	(0.00)	(0.015)	(0.000)

***PANEL B : Survey errors, group mean* (Table 3 continued)**

	MBANKS	MINDUSTR	MSEC
Mean	0.011	0.012	0.011
σ^2	0.0009	0.0008	0.0009
ku	1.20	0.368	0.748
	(0.061)	(0.565)	(0.243)
Q_{16}	87.4	89	84.7
	(0.00)	(0.000)	(0.000)

Table 4
JY 3-Months Forecasts

PANEL A : Expected exchange rate changes, per country mean

	MUK	MCAN	MFRA	MGER	MITA	MJAP	MUSA
Mean	0.0007	-0.002	-0.001	0.002	0.0010	-0.0005	-0.09
σ^2	0.0001	6.8e-005	0.0001	0.0001	0.0001	6.2e005	0.17
ku	0.47	0.191	-0.148	-0.19	1.37	0.538	18.1
	(0.461)	(0.765)	(0.171)	(0.758)	(0.031)	(0.401)	(0.00)
Q_{16}	219	51.7	142	150	162	126	38.0
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)

PANEL B : Survey error per country mean

	MUK	MCAN	MFRA	MGER	MITA	MJAP	MUSA
Mean	0.009	0.005	0.006	0.01	0.010	0.007	0.009
σ^2	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.000609
ku	1.25	1.08	0.417	0.48	0.83	0.85	1.92
	(0.061)	(0.09)	(0.515)	(0.44)	(0.191)	(0.182)	(0.002)
Q_{16}	68	72	77	76	70.4	65.12	65
	(0.000)	(0.000	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Table 5
JY 3-Months Forecasts

PANEL A : Expected exchange rate changes, group mean

	MBANK	MINDUST	MSEC
Mean	0.005	0.001	-0.0003
σ^2	0.0003	0.0001	5.2e-005
ku	-0.737	96.7	0.49
	(0.274)	(0.08)	(0.44)
Q_{16}	56	96	98.16
	(0.00)	(0.000)	(0.000)

PANEL B : Survey errors, group mean

	MBANK	MINDUST	MSEC
Mean	O.O13	0.009	0.008
σ^2	0.0007	0.0006	0.0005
ku	-0.05	-0.7	1.15
	(0.937)	(0.219)	(0.071)
Q_{16}	56	66	68
	(0.00)	(0.015)	(0.000)

Table 6
BP 3-Months Forecasts

PANEL A : Expected exchange rate changes, per country mean

	MUK	MCAN	MFRA	MGER	MITA	MJAP	MUSA
Mean	-0.0047	-0.002	-0.006	-0.006	-0.218	-0.11	-0.007
σ^2	6.5e-005	5.7e-005	6.6e-005	6.2e-005	0.001	0.0001	8.6e-005
ku	-0.55	-0.28	-0.15	-0.55	-1.06	5.4	0.11
	(0.38)	(0.66)	(0.808)	(0.38)	(0.096)	(0.000)	(0.86)
Q_{16}	42.9	29.7	33.9	29.9	225	16.8	18.33
	(0.000)	(0.019)	(0.005)	(0.018)	(0.000)	(0.397)	(0.304)

PANEL B : Survey error per country mean

	MUK	MCAN	MFRA	MGER	MITA	MJAP	MUSA
Mean	-0.006	-0.0044	-0.008	-0.007	-0..007	-0.0005	-0.0088
σ^2	0.0009	0.001	0.0009	0.0009	0.001	0.001	0.0008
ku	2.23	2.77	2.00	2.00	-1.82	2.1	2.2
	(0.0004)	(0.00)	(0.001)	(0.01)	(0.004)	(0.000)	(0.0006)
Q_{16}	71.88	72.8	78.8	79.9	89.4	72.3	73.9
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Table 7
BP 3-Months Forecasts

PANEL A : Expected exchange rate changes, group mean

	MBANK	MINDUST	MSEC
Mean	0.003	-0.0029	-0.003
σ^2	0.0002	0.0001	5.0e-005
ku	2.52	1.16	-0.58
	(0.0001)	(0.068)	(0.365)
Q_{16}	31.8	35.3	18.90
	(0.010)	(0.003)	(0.273)

PANEL B : Survey errors, group mean

	MBANK	MINDUST	MSEC
Mean	-0.007	-0.004	-0.005
σ^2	0.0009	0.0009	0.0009
ku	2.26	1.4	2.35
	(0.0004)	(0.02)	(0.000)
Q_{16}	79.2	83	75.85
	(0.00)	(0.000)	(0.000)

From estimating the empirical properties we can derive some more useful conclusions for the forecasting behavior of the individuals. The largest average forecast errors were recorded by the banking sector and by the institutions located in the U.K. and Italy. The forecasting behavior for the DM and JY of the industrial sector present similarities with this of the banking sector while in the case of BP the similarities can be traced between the industry sector and the security industry. Common forecasting patterns as regard the direction of the spot changes turn out for DM and BP across countries. In the case of the JY the forecasts across countries seem to be differentiated. Close inspection of the individual series indicates the existence of heterogeneity among the market participants, confirming the results of the previous chapter. We further examine the degree of heterogeneity in the two different groups. Under the assumption that the degree of heterogeneity is expressed by the standard deviation among the market participants we estimate the cross correlation between the standard deviation of the banks and the security industry. For all currencies the estimated Q-stat seems to reject strongly the null hypothesis of statistically significant cross correlation.

At the end, it should be noted that the estimation of the survey-data properties indicate the seriousness of the answers. One of the common criticisms of the use of the survey expectation data is that respondents to the questionnaire may not be serious in answering questions. The consistency of the properties of expected exchange rate changes and the forecast errors with these of the rational expectation data is an additional indication for the usefulness of the survey data[4].

3. A Model of the Risk Premium with Heterogeneous Expectations

Typically, in writing models of the foreign exchange premium it is assumed that all agents are identical (representative agent models), and hence the equilibrium relationships are derived for a representative agent.[5] However, from the results derived by Ito (1990) and Chionis and MacDonald (1997) this does not seem to be an appropriate assumption for the foreign exchange market: in forecasting the exchange rate, agents seem to deviate systematically from each other due to both individual and idionsycratic effects. Therefore, in this section we derive a model of the risk premium which is consistent with using survey data to measure the premium and, in particular, captures the evident heterogeneity of such data. Our model yields an exchange rate equation with a time-varying risk premium that is not only a function of the conditional variance of domestic and foreign money, as in Domowitz and Hakkio, but also incorporates additional terms which arise from the forecasting process augmented by a term which indicates the deviation of an individual's forecasting of future money demand from the rational forecaster plus a term which accounts for the disturbances created by noise traders.

The general structure of the model consists of two countries *(U, E)* two goods *(x,y)* and two monies *(M, N)*. Consumers in country *U* receive an endowment ξ_t of good *x*, and nothing of good *y*; consumers in E receive nothing of good *x* and an endowment η_t of good *y*. Agents of each country demand both M and N, the demand being motivated by a cash-in-advance constraint.[6] The current period utility function, which is the same for all traders, is assumed to be of Cobb-Douglas form: $U(x,y)=Ax^a y^{1-b}$. Agents maximize an intertemporal utility function of the form $\sum_{t=0}^{\infty} \beta^t U(x_t,y_t)$, subject to a standard budget constraint. This constraint is of the form for the period t to t+1:

$$a_{t+1}=r_t\,(a_t + y_t - c_t)$$

where a_t denotes real wealth, y_t denotes labour income, $y_t - c_t$ denotes savings from labour income and r_t denotes one plus real interest rate.

The endowments are assumed to follow first-order Markov processes:

$ln\xi_t=\rho_1 ln\xi_{t-1} + u_{1t}$ and $ln\eta_t = \rho_2\, ln\eta_{t-1} + u_{2t}$ with $\mathbf{u} \sim N(\mathbf{O}, \mathbf{H}_t)$ $\mathbf{O}'=(0,0)$ and $\mathbf{H}_t=diag\,(h_{1t}, h_{2t})$

The nominal prices of the good *y* and *x* are $p_x=M/\xi$ and $p_y=N/\eta$ (also, p_y' denotes the price of *y* in *x*-units). In equilibrium the exchange rate is given by a purchasing power parity formula:

$$S_t= p_x\, p_y' / p_y= (M\ \eta\, p_y')/ \xi_t N \qquad (4)$$

If we equilibrate the relative price of y to the MRS we get:

$$p_y'=[(1-a)/a]\ \xi\ \eta^{-1}, \qquad (5)$$

and by making the substitution into the exchange rate equation we get:

$$S_t=[(1-a)/a](M_t/N_t) \qquad (6)$$

Without loss of generality we can assume that the equilibrium exchange rate in time t, S_t , is known to both the smart and noise traders[7]. Then the forward rate is given by

$$F_t=S_t \ E_t^M \ [\ Q_{t+1}^N] \Big/ \ E_t^M \ [Q_{t+1}^M] \tag{7}$$

where: $Q_{t+1}{}^N$, $Q_{t+1}{}^M$ are the intertemporal marginal rates of substitutions for two monies and E_t^M denotes the market's expectations of $Q^N{}_{t+1}$ and $Q^M{}_{t+1}$ which may contain both rational and non-rational elements, and

$$Q_{t+1}{}^N=\beta\,(\xi_{t+1}/\eta_{t+1})^a/(N_{t+1}/\ \eta_{t+1}) \Big/ (\xi_t/\eta_t)^a/(N_t/\ \eta_t),$$

$$Q_{t+1}{}^M=\beta\,(\eta_{t+1}/\xi_{\ t+1})^{1-a}/(M_{t+1}/\ \xi_{t+1}) \Big/ (\eta_t/\xi_t)^{1-a}/(M_t/\ \xi_t),$$

Following the conceptual framework of noise trading proposed by DeLong *et al*. (1990) we allow for two categories of individuals. The first category utilizes a sophisticated forecasting method. Each investor in this group is assumed to use the same first-order Markov process to forecast money demand in the domestic and foreign country. That is:

$$ln\ M_t = \gamma_1 lnM_{t-1} + u_{3t}{}^s,\quad ln\ N_t = \gamma_2 lnN_{t-1} + u_{4t}{}^s,\qquad u^s{}_{3t} \sim (0,\ h_{33t}) \text{ and } u^s{}_{4t} \sim (0,\ h_{44t}), \tag{8}$$

The second category of trader exploits a noise trading process. In this case agent i in forecasting future money demand uses an idiosynchratic model, assigning a different coefficient in the Markov process. In this case the money demand takes the form:

$$ln\ M_{i,t} = \gamma_{1,i} lnM_{t-1} + u_{3,t,i}^n\ ,\ ln\ N_{i,t} = \gamma_{2,i} lnN_{t-1} + \ u_{4,t,i}^n\ ,\ \ u_{3,t,i}^n\ \sim(\boldsymbol{\mu}_{\,3,i,t},\ h_{\,33,t,i}) \text{ and } u_{4,t,i}^n\ \sim(\boldsymbol{\mu}_{\,\mathbf{4},i,t},\ h_{\,44,t,i}) \tag{9}$$

Since the process of logmoney is often thought of containing a unit root we can further assume that $\Sigma\gamma_{1i}>1$ and $\Sigma\gamma_{2i}>1$. With these assumptions it is not affected the long memory process of the logmoney.

In order to derive the market expectation we further assume that the expectation of the intertemporal marginal rates of substitution for the two currencies are derived by the market as a weighted average of the expectations of smart investors and noise traders. That is, the market assigns a proportion ω to the expectations derived by the smart investors and $(1-\omega)$ to the expectations derived by the noise traders. Then relation (7) becomes:

$$F_t=S_t \quad \frac{\omega E_t^S[Q_{t+1}^N]+(1-\omega)Z_t^N[Q_{i,t+1}^N]}{\omega E_t^S[Q_{t+1}^M]+(1-\omega)Z_t^N[Q_{i,t+1}^M]}, \tag{6′}$$

where E_t^s is the conditional expectations operator (i.e. $E_t^s = E[./I_t]$) of the smart money and Z_t^N is the subjective expectation of the noise traders. Alternatively (6′) may be expressed in logs as:

$$ln\ F_t = ln[(1-a)/a] + lnM_t + lnN_t + ln\{\ \omega E_t{}^S[Q^N{}_{t+1}]\ + (1-\omega)\ Z_t{}^N[Q^N{}_{i,t+1}]\} - ln\{\ \omega E_t{}^S[Q^M{}_{t+1}]\ -\ (1-\omega)\ Z_t{}^N[Q^M{}_{i,t+1}]\}.$$

where:

$$ln\ Q_{t+1}^N\ = ln\beta - (1-\alpha)(1-\rho_2) ln\eta_t\ - \alpha\,(1-\ \rho_1)\ ln\ \xi_t + (1-\ \gamma_2\ ) lnN_t + [(\alpha-1)^2/2]\ h_{22,t+1} + (\alpha^2/2) h_{11,t+1} + h_{44,\,t+1}$$

$$ln\ Q^M_{t+1} = ln\beta - \alpha(1-\rho_1)ln\xi_t - (1-\alpha)(1-\rho_2)ln\ \eta_t + (1-\gamma_1)lnM_t + [(\alpha)^2/2]\ h_{1,1t+1} + [(\alpha-1)^2/2)]h_{22,t+1}\ h_{33,t+1},$$

$$ln\ Q^N_{i,t+1} = ln\beta - (1-\alpha)(1-\rho_{2,i})ln\eta_t - \alpha(1-\rho_{1,i})\ ln\ \xi_t + (1-\gamma_{2,i})lnN_{i,t} + [(\alpha-1)^2/2]\ h_{22,i,t+1} + (\alpha^2/2)h_{11,i,t+1}\ h_{44,i,t+1} + \mu_{4,i,t+1},$$

$$ln\ Q^M_{i,t+1} = ln\beta - \alpha(1-\rho_{1,i})ln\xi_t - (1-\alpha)(1-\rho_{2,i})ln\ \eta_t + (1-\gamma_{1,i})lnM_{i,t} + [(\alpha)^2/2]\ h_{11,i,t+1} + [(\alpha-1)^2/2)]h_{22,i,t+1} + h_{33,i,t+1} + \mu_{3,i,t+1}.$$

On making the relevant substitutions, the market's forward rate may be expressed as:

$$lnF_t = lnS_t + ln[(1-a)/a] + lnM_t[1-\omega(1-\gamma_1)] - lnN_t[1-\omega(1-\gamma_2)] + \omega[-1/2h_{33,t+1} + 1/2\ h_{44,t+1}] + (1-\omega)\{(1-\gamma_{2,i})lnN_{i,t} - (1-\gamma_{1,i})lnM_{i,t} - 1/2h_{33,i,t+1} + 1/2\ h_{44,i,t+1} - \mu_{3,i,t+1} + \mu_{4,i,t+1}\}. \quad (10)$$

The future spot rate derived by the sophisticated trader is given by:

$$E^S_t\ lnS_{t+1} = ln[(1-a)/a] + E^S_t\ lnM_{t+1} - E^S_t\ lnN_{t+1} = ln[(1-a)/a] + \gamma_1\ lnM_{t+1} - \gamma_2\ lnN_{t+1} \quad (11)$$

This is common for each individual included in the first category of forecasters. Subtracting relation (10) from (11) we may derive the risk premium which arises for the sophisticated process as:

$$lnF_t - E_t \ln S^S_{t+1} = lnS_t + ln[(1-a)/a] + lnM_t[1-\omega(1-\gamma_1)] - lnN_t[1-\omega(1-\gamma_2)] + \omega[1/2h_{33,t+1} + 1/2\ h_{44,t+1}] + (1-\omega)\{(1-\gamma_{2,i})lnN_{i,t} - (1-\gamma_{1,i})lnM_{i,t} - 1/2h_{33,i,t+1} + 1/2\ h_{44,i,t+1} - \mu_{3,i,t+1} + \mu_{4,i,t+1}\} - \{ln[(a-1)/a] + \gamma_1\ lnM_{t+1} - \gamma_2\ lnN_{t+1}\}$$

or

$$\lambda^{re}_t = lnF_t - E_t{}^s lnS_{t+1} = \omega\{[E^S_t\ lnM_{t+1} - E^S_t\ lnN_{t+1}] - [Z^N_t\ lnM_{i,t+1} - Z^N_t\ lnN_{i,t+1}]\} + \omega/2\ (h_{33,t+1} - h_{44,t+1}) \quad (12)$$

where Z^N_t denotes the subjective expectation operator of the noise trader and E_t denotes the conditional expectations operator of the smart investor.

According to (12), the risk premium of a smart investor depends upon the conditional variance, augmented by additional terms which take into account the deviation of the expectation of the noise trader from the rational trader weighted by the weight assigned by the market to the noise trader. It should be noted that in the case where the market deriving the ratio of intertemporal rate of substitution uses only the smart investors' expectation, then $\omega=1$ and (12) will degenerate to the risk premium derived by Domowitz and Hakkio.

For the noise trader, the derivation of the future spot rate differs from (11) because each individual assigns a different coefficient to the Markov process in the money market. Thus we have:

$$Z^N_t[S_{i,t+1}] = [(1-a)/a]\ (Z^N_t[M_{i,t+1}] / Z^N_t[N_{i,t+1}]) \quad (13)$$

Re-expressing (13) in logs we have:

$$Z^N_t\ lnS_{i,t+1} = ln[(a-1)/a] + Z^N_t\ lnM_{i,t+1} - Z^N_t\ ln\ N_{i,t+1},$$

and given the Markov structure (8)[8] we have

$$Z^N_t\ lnS_{i,t+1} = ln(1-a)/a] + \gamma_{1i}\ lnM_{i,t} - \mu_{3,i,t+1} - \gamma_{2i}lnN_{it} - \mu_{4,i,t+1}, \quad (14)$$

On subtracting (10) from (14) we obtain the risk premium for each individual using the noise process as:

$$lnF_t\text{-}ln\ Z_t^N lnS_{I,t+1} = \omega\,[(E_t^S\ lnN_{t+1} - E_t^S lnM_{t+1}\ )] + (1\text{-}\omega)(Z_t^N\ lnN_{i,t+1} - Z_t^N\ lnM_{it+1}\ ) + (\mu_{3,i,t+1} - \mu_{4,i,t+1}\ ) \qquad (15)$$

Hence, the risk premium of the noise traders depends upon the expectations of the market as a whole, augmented by a term which accounts for the disturbances due to their forecasting biases. Equations (12) and (15) define the risk premium for the two different categories of market participants. We note that a key feature of both these relationships is a term capturing the heterogeneity of the forecasting processes. Consensus, or average, measures of the risk premium may comprise both the smart and noise elements; however, access to disaggregate survey data should allow us to discover the importance of expectational differences. It is worth noting under what conditions this model reduces to that of Domowitz and Hakkio in which $E_t lnS_{t+1}\text{-}lnF_t=1/2[h_{33,t+1}\text{-}h_{44,t+1}]$. The conditions are that $\gamma_{11}=\gamma_{12}=.....=\gamma_1$, $\gamma_{21}=\gamma_{22}=.......=\gamma_2$, $\omega=1$ and that all agents hold rational expectations.

4. ARCH models and survey based risk premium

In this section we operationalise the model derived in section 3. In concern with Domowitz and Hakkio we generate the risk premium from the conditional variance of the forecast errors. Consistent with the previously developed model we allow heterogeneity to enter into the regression of conditional variance. The availability of the survey data allows us to examine not just a single strategy but instead the strategy of each of this firm for each currency. This research strategy allows us to gather much more evidence about the foreign exchange risk premium and the role of heterogeneity. In this case we define heterogeneity as the difference between the individual 's forecast and the average forecast. More specifically, we estimate an ARCH (1) -M multivariate model of the following form:

$s_{i,t+1}\text{-}s_t=\lambda_{i,t}+\beta_{i,0}(f_t\text{-}s_t)+\varepsilon_{i,t+1}$
$\lambda_{it} =\alpha_I+\beta_{i,1}+h_{i,t+1}$
$\varepsilon_{i,t+1}/\ I_t \quad \sim N\ (0,\ h^2_{t+1})$
$h^2_{t+1}= \gamma_{i,0}+ \gamma_{i,1}\varepsilon^2_{i,t+1}+ \gamma_{i,2}(Het)^2_{\ t+1}$
where the subscript ι denote the results of each firm.

Het stands for the heterogeneity and I_t is the information set available to the investors at time t.

The availability of the survey data allows us to obtain a greater insight to each individual's forecasting behaviour. To the extent that we can detect regularities and common patterns among the individuals, in the following we provide a summary of these findings. The hope is that interesting information related to the forecasting behaviour can be identified. Before presenting the results of this analysis we should note that since the response rate is less than perfect, we constrain our ARCH analysis to a subset of the total panel examined in the first part of this work. Specifically, we fit an ARCH-M model in 51 for the DM, 46 for the BP, and 55 for the JY individuals consisting of banking sector and security industry.

The evidence seems to provide strong support for the theoretical model developed in the previous section. In particular for the DM there are 28 out of 34 cases in the banking sector and 13 out of 17 in the security industry in which the heterogeneity enters with a statistically significant coefficient. Similarly, for the case of BP the corresponding ratios are 22 out of 25 for banks and 19 out of 21 for the security industry, while for the JY 23 out of 28 for the bank 23 out of 27 for securities.

The high statistical significance of heterogeneity combined, in many cases, with the statistical insignificance of the other ARCH coefficients, suggest that the major part of the conditional volatility's momentum[9] is explained solely by the heterogeneity. It seems that the heterogeneity mainly affects the forecasters based in UK while in the institutions based in France and Canada the heterogeneity is not statistically significant. Not surprisingly, in all cases, the heterogeneity enters with a positive sign, indicating that an increase in heterogeneity fits the conditional volatility and subsequently the risk premium. Overall, we could argue that the heterogeneity seems to affect similarly the forecasting patterns of both sectors.

Table 8a
Results From The ARCH Model, Currency DM/Banks

V2	T2	T1	+V2	-T1
B13	B13		B13	B13
B25		B25	B25	B25
B35		B35	B35	B35
C1		C1	C1	C1
C12	C12	C12	C12	C12
C15	C15	C15	C15	C15
C2		C2	C2	C2
			F10	F10
F11			F11	F11
F16	F16	F16	F16	
	F4		F4	
F9	F9		F9	
G10	G10		G10	G10
G11		G11	G11	G11
G12	G12	G12	G12	G12
G13			G13	
	G15	G15		
G18		G18	G18	G18
	G19		G19	
G2		G2	G2	G2
G22	G22	G22	G22	
G23	G23	G23	G23	G23
G3			G3	G3
G4			G4	
G5	G5		G5	G5
G8		G8	G8	
	I1	I1	I1	I1
I5	I5		I5	
I6	I6		I6	
			J2	J2
J9			J9	J9
U15	U15	U15	U15	U15
U19	U19	U19	U19	U19
U18	U18	U18	U18	U18
82%	**56%**	**56%**	**97%**	**68%**

Total:34

Note: *Under the column head V2 we present the cases having statistical significant the coefficient of heterogeneity. Under the column head T2 we present the cases having statistical significant the coefficient of the forward premium. Under the header T1 we present the cases having statistical significant the coefficient of the risk premium. Under the column head +V2 we present the cases having positive sign in the heterogeneity. Under the column head - T1 we present the cases having negative sign in the forward premium.*

Table 8b
Currency: Dm / Sec

V2	T2	T1	+V2	-T1
B18	B18	B18	B18	B18
B27	B27	B27	B27	
B29	B29	B29	B29	
B30		B30	B30	
B4			B4	B4
B8	B8		B8	B8
B9	B9	B9	B9	
C3	C3	C3	C3	C3
	C4	C4	C4	
F12		F12	F12	
F2	F2		F2	
G5	G5		G5	G5
J20	J20	J20		
J3	J3		J3	
		U1	U1	
			U24	U24
88%	**65%**	**59%**	**88%**	**35%**

Total:17

Table 8c
Currency BP / Banks

V2	T2	T1	+V2	-T1
B25		B25	B25	
B13			B13	B13
C15		C15	C15	C15
C1		C1	C1	C1
F4			F4	F4
F12		F12	F12	
F10		F10	F10	
		C5	C5	C5
F5			F5	F5
F10		F10	F10	
G10	G10		G10	
G11		G11	G11	
G12		G12	G12	G12
G13			G13	G13
			G15	G15
G2		G2	G2	
G22		G22	G22	G22
G3			G3	G3
G4	G4	G4	G4	G4
C5			G5	
G8		G8	G8	G8
I1			I1	I1
I2		I2	I2	I2
I5			I5	I5
		J2	J2	J2
88%	**8%**	**60%**	**100%**	**68%**

Total: 25

Table 8d
Currency BP/Sec

V2	T2	T1	+V2	-T1
B30		B30	B30	B30
B27			B27	B27
B22			B22	
B2		B2	B2	
B18			B18	B18
B14		B14	B14	B14
B12			B12	
B9		B9	B9	B9
B8		B8	B8	B8
B4	B4		B4	B35
B35		B35	B35	
C18		C18	C18	
C12	C12	C12	C12	C12
C4	C4		C4	
	G19		G19	G19
G9		G9	G9	G9
I6		I6	I6	I6
J20		J20	J20	
U1	U1		U1	U1
			U24	U24
95%	**25%**	**52%**	**100%**	**70%**
Total: 21				

Table 8e
Currency: JY/Bank

V2	T2	T1	+V2	-T1
B13	B13		B13	B13
B25	B25		B25	
B27	B27	B27	B27	
B9			B9	
			C1	
F10			F10	
F16			F16	F16
F4			F4	
F5	F5	F5	F5	F5
			F9	F9
G8		G8	G8	G8
G5			G5	
G4		G4	G4	
G3			G3	G3
		G22	G22	
G20			G20	
G15			G15	
			G13	G13
G12	G12		G12	G12
G10	G10	G10	G10	
I1	I1		I1	I1
I5			I5	I5
J9	J9		J9	J9
J2				J2
				J18
J17		J17	J17	J17
J11			J11	
J13			J13	
82%	**28%**	**24%**	**93%**	**50%**
Total:28				

Table 8f
Currency:JY/Sec

V2	T2	T1	+V2	-T1
B18	B18		B18	
B2	B2		B2	B2
B29		B29	B29	
B30		B30	B30	
B35			B35	
C12	C12		C12	C12
			C18	C18
C3			C3	
C4		C4	C4	
C5			C5	
F12	F12		F12	
G9		G9	G9	
G19			G19	
G11			G11	G11
I6			I6	
J6			J6	J6
J4	J4	J4	J4	
			J3	
J16	J16	J16	J16	
J15			J15	J15
J1			J1	
		U8		U8
U30			U30	
	U24		U24	
U19		U19	U19	U19
U15			U15	
U1	U1		U1	U1
85%	**30%**	**30%**	**96%**	**33%**

Total:27

Domowitz and Hakkio report rather weak results for the statistical significance of the risk premium in the unbiasedness equation. In our case the results present a rather mixed picture. In the case of DM and BP in a range 52-60 per cent of the cases the conditional variance is statistically significant. In contrast, the results are quite poor for JY in the sense that only 24 per cent in banks and 30 per cent in security industry produce conditional volatility different than zero. Evaluating the performance of sub-groups, it can be said that in the vast majority of the France-based institutions the risk premium is non different than zero, while the British-based institutions present weak results regarding the risk premium of the BP. Again, a notable indication arises from the almost identical influence of the risk premium in the forecasting patterns of the bank and security industry. The fluctuations between negative and positive values of the risk premium is in accordance with the findings of the Domowitz and Hakkio and the theoretical model proposed by Stockman (1978). The majority of the negative signs implies that the effect of the risk premium is to push estimates of the standard coefficient of β above 1. The positive indicates an overreaction to the information. The vast majority of positive signs is concentrated in the security industry 's forecasting patterns, especially for the DM and the JY. For 67 per cent of individuals the risk premium of JY and 65 DM enter with a positive sign, in the case of BP the ratio approaches 30 per cent.

5. Conclusions

In this paper we have examined some standard exchange rate expectational relationships using a disaggregate multicountry exchange rate survey database. The availability of survey data offers an independent measure of foreign exchange market participants' expectations of the exchange rate. The use of disaggregate data leads to conclusions which differ from the conclusion that would be drawn on the basis of the consensus forecasts.

The presence of heterogeneous behavior combined with the existence of conditional heteroskedasticity in the forward forecast error prompted this work to develop a model of individual's risk premium. In contrast to the existing work on this area, instead of working with the representative individual agent we focus on the behavior of each individual. Having as building block the model derived by Domowitz and Hakkio we found that individual's risk premium is a function of the variables defined by the authors augmented by the heterogeneity of the market. By testing the derived model using the available data sets. It seems that the standard deviation derived from the multivariate ARCH-M(1,1) provide, for the most of the cases, an adequate explanation for the risk premium.

6. Suggestions for Future Research

The risk premium is a variable which represent the assign risk from each individual to the foreign exchange rate. Since the risk play a role in explaining the failure of forward premium to provide unbiased predictions the risk premium is a factor that carries the individual's forecasts away from the equilibrium value. The investigation of the individual's risk premium under the view of microstructure analysis can further support the fact that the risk premium is an important signaling variable (together with volume, volatility, heterogeneity and bid-ask spreads) in the formation of exchange rate expectation.

From the results provided, it seems that heterogeneity plays an important role in explaining foreign exchange changes and enters significantly into the risk premia equation. These findings are suggestive of the direction for building models based on individual behavior. 🕮

We thank the participants in the 3rd annual conference of European Financial Management Association Conference held in Athens (28/6-1/7/2000) for many helpful discussions.

Endnotes

1. The results are available from the author upon request.
2. This is also confirmed by a visual examination of the first 17 autocorrelation coefficients which show a slow decay of the ACF and lead us to the conclusion that the forward premium is a stationary series but in a strange way.
3. Dealing with the serial correlation we have to take into account the fact that the serial correlation would be more significant if we were taken into consideration the hypothesis done by Chinn and Frankel (1994). The authors argues that forecasters are reluctant to issue predictions of future rates that are similar as today 's rates
4. From the other side Hodrick (1987) points out that many economists are 'justifiably suspicious' of using survey data. The author supports this idea by using the arguments of Frankel and Froot (1985 p. 70)'...a cornerstone of positive economics is that we learn more by observing what people do (in the market place) than what they say.' Hodrick gives an example of a trader who possesses private information that he has used to construct a portfolio of positions based on the deviations of his expectations from the current forward rates. The question that arises is related to the tension of the trader to reveal his information when questioned.
5. This is the case for the Lucas (1982) and Domowitz and Hakkio models.
6. This part of the model is therefore similar to the model of Canova and Marrinan's (1993)
7. Relaxing this assumption would only unnecessarily complicate the model without adding any extra insight.
8. We use the Markov process here, even in the presence of non-rational expectations, as it does not significantly affect our final result.
9. We test for the existence of conditional heteroscedastic structure in the forecasting residuals by applying a LM test statistic. In the 97 per cent of the cases we can reject the null of no-conditional heteroscedasticity.

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