DAY TRADING THE EURO-DOLLAR WITH A NEWS-BASED MODEL OF EXCHANGE RATES (*)

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ABSTRACT - The paper presents some first results on how to use a news-based model of the €-$ and $-¥ exchange rates with GARCH error terms to generate day-trading signals on the €-$. Conditional model forecasts and volatility values were used to draw three trading bands, Base, €-Strong, €-Weak to devise strategies for opening up trading positions according to where – inside or outside of them - the exchange rate falls in the morning in Central European Time. Trades were closed according to two procedures described in the paper. These trading rules generate a high number of profitable signals and the profit rates cluster between 10 and 20 percent, reaching 25%. Some profitable trading rules described in the paper may operate as unsupervised automatic day-trading machines. Positive Sharpe Ratios lay between 1.5 and 5.6. These results were obtained over a sample of 360 trading days in 2001 and 2002.

CONTENT

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1.) Introduction

Virtually all the literature on trading rules in the foreign exchange and stock markets is based on various forms of technical analysis and mechanical filter rules[1]. Making a quick and non-exhaustive reference to this literature, we have papers which describe straight [2] and bootsrapped [3] applications of various technical filters on some exchange rates and stock indexes, we have papers describing the use of various forms of genetic algorithms to select the best technical filter [4] and a more recent line of research suggests the so-called reality check approach [5].

With some exceptions [6] no public use is made of data-fitted linear or non linear models in order to generate buy and sell signals for trading activity[7]. After the random walk race generated by MEESE-ROGOFF(1983), no self respecting economist is willing to use formal macroeconomics-based models to offer buy and sell advice [8] .

After the Meese-Rogoff debacle, the macro based attempts to explain exchange rate dynamics have moved from the use of actual macroeconomic variables, as explanatory variables, to news on the same variables, i.e. the difference between the values expected by financial markets, just little before the time of the publication of these variables, and the actual values of them announced at generally fixed dates by the statistical agencies in charge of their estimation. They are called "scheduled news". The first papers on the news approach to exchange rate fluctuations were published about twenty years ago [9], but this line of research has produced papers quite regularly over the years both in the academic literature [10] and in the professional literature produced by the major financial institutions[11].

A more recent line of analysis in the foreign exchange literature uses also other unexpected events to explain the wild fluctuations of exchange rates, well over and above the fluctuations of the underlying macroeconomic variables. The papers and books describing the impact of central bank interventions belong to this strand[12]. The line of analysis carried out by the author of this paper also belongs to it.

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[1] For instance DOOLEY-SHAFER(1976,1983), SWEENEY(1986).

[2] For instance, see CURCIO-GOODHART(1993), HUDSON-DEMPSEY-KEASEY(1996), CURCIO-GOODHART-GUILLAUME-PAYNE(1997), NEELY(1997).

[3] See BROCK-LAKONISHOK-LEBARON(1992), LEVICH-THOMAS(1993), LEE-MATHUR(1996), MILLS(1997), CHANG-OSLER(1999).

[4] See NEELY-WELLER-DITMAR(1997), NEELY-WELLER(1997), ALLEN-KARJALAINEN(1999), DEMPSTER-JONES(2000), SKOURAS(2001).

[5] See SULLIVAN-TIMMERMANN-WHITE(1999), WHITE(2000).

[6] For instance TAYLOR(1992), GENCAY(1999).

[7] That does not rule out the possibility or even the likelihood that such instruments could be used internally by some market participants.

[8] We have a peculiar contrast here, whereby traders communicate in terms of "support", "resistance", "upper break" and so forth, whereas most market commentaries in the leading financial journals (e.g. Financial Times, Wall Street Journal, Bloomberg, etc.) make a heavy use of traditional open economy schemes - with frequent reference to macroeconomic quantities – to interpret what happens in the market.

[9] HOFFMAN-SCHLAGENHAUF(1985), EDWARDS(1982, 1983).

[10] See a recent survey on exchange rate research, FRANKEL-ROSE(1995). TIVEGNA(2002) has also an extensive list of references.

[11] The most recent example is a piece of research by JP Morgan on EASI, Economic Activity Surprise Index, which computes a linear combination of news. It seems to have a remarkable predicting power.

[12] See the most recent survey by SARNO-TAYLOR(2001).

According to this research strategy [13], the fluctuations of exchange rates can be best explained by adding a class of "unscheduled news" [14] to the "scheduled news" [15] already investigated extensively. Over the years (1994 – 2002) a taxonomy of unscheduled news has been developed using a large number of events collected in a relational data base called NEWSMETRICS [16]. A selection of these unscheduled news – together with the traditional scheduled news – has been used to estimate a multivariate GARCH models of the €-$ and $-¥ rates, on twice-daily data, together with some of their main financial determinants, ten-year bond rates and the Dow Jones Industrial Index , DJII [17]. Variations of these models have been used to identify model-based trading rules [18] .

There are several advantages in getting trading signals from a structural model – as opposed to a technical filter. A structural model – especially of the GARCH variety used in this research – explains endogenous variables (the exchange rates plus other variables in our approach) as function of exogenous variables (mainly news on macroeconomic variables and on market and policy events) under known statistical properties. This allows the user to statistically test model features (e.g. parameter stability) and trading propositions – not simply with respect to profitability - and to be fully aware of the reasons why he/she is earning or losing money. A technical trading scheme, typically, has no relational properties with nothing else but itself and can be tested almost exclusively for profitability[19].

On one critical factor – profitability – the first results discussed in this memorandum seem to suggest that using our news-based exchange rate model is more profitable than using a battery of technical analysis filters, as proposed in some of the papers quoted above.

News is almost tautologically unpredictable. For this very reason, no attempt is made, in our approach, to forecast the news, they are embodied in the parameters of the model. The model is then used to make forecasts of the €-$ conditional on the occurrence of a Euro-positive news or a Euro-negative news, or non news at all (the baseline simulation). This procedure has two implications. First, the production of trading signals relies only in part to straight exchange rate forecasting out of an estimated model. Second, our news-based model can be best used to produce very short-term trading signals. Even though we are in the first stages of testing this model for trading, its best use at the moment seems to be for day-trading. This memo presents some first results and outlines research strategies leading to a routine procedure to get profitable trading signals in foreign exchange trading.

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[13] TIVEGNA(2002) is the most recent paper. See also TIVEGNA(1996) and TIVEGNA-CHIOFI(2000).

[14] Unscheduled news consists of an economic or institutional event, a declaration or a disclosure, which can be either totally unexpected or - even though expected to occur - has an unknown timing, or an unknown content, or both. This news therefore is not likely to be fully embodied into observed prices. TIVEGNA(2002), pag.7.

[15] Scheduled news are built as the difference between the values of macroeconomic variables announced by the statistical authorities and their values as expected by financial markets. These latter values, called "market consensus" are estimated on data collected by various research organizations. One of them is Money Market Service, MMS, whose data are used in most of the literature.

[16] See TIVEGNA-CHIOFI(2000). All the events between 1994 and 1997 are collected in the book . The data bank is being updated regularly and has been used to estimate the equations of this paper, from 1998 till the end of 2000 and 2001.

[17] Details on the construction of this model are in TIVEGNA(2002).

[18] See BALBO-TIVEGNA(2002).

[19] All the papers quoted in the first four footnotes have this structure. Technical trading has been, on the other hand, the most popular tool for traders (ALLEN-TAYLOR(1990)), so no attempt will be made to argue on its faults.

This paper describes a particular typology of day-trading the €-$ exchange rate[20] for a Central-European-Time(CET)-based trader. The trader opens up a long or short position a little after 10 AM, after all the European macroeconomic data of interest [21] have been published. He/she longs or shorts the Euro in relation to the model baseline forecast or to the position – at that hour - of the exchange rate inside or outside three different bands generated by conditional (on positive or negative news) forecasts of the model and by its GARCH volatility. These bands are drawn in two ways: using either a fixed volatility (approximately equal to the long-run values of the GARCH volatility equation) or a day-changing volatility, using the GARCH equation. The trade is closed by 10 PM under two different procedures: at the reference rate published by the European Central Bank (ECB) a little after 2 PM, if a profit is recorded, or at any time afterwards, before 10 PM, either (1) at the best [22] rate, or (2) at take profit or stop loss signals before 10 PM, computed by using the historical or the time-varying GARCH volatility, or at 10 PM. Some care is taken to compute appropriate buying and selling quotes.

In the second section of the paper, the multivariate GARCH model, used to produce trading signals, is very synthetically described. In the third section we describe the issues involved in producing day-trading signals by taking into full account the forecasts of the model and the estimated parameters of the GARCH volatility. In the fourth section we describe the empirical results obtained by using the procedures analyzed in the previous section. The fifth section summarizes the results and, most of all, discusses the lines of future research activity that must be realized in order to have a thorough statistical testing of the trading signals and the trading profits produced by the model.

2.) The model

The main features of the model used in this paper to produce trading signals is briefly summarized here[23]. It is made up – in the mean part - of eight equations estimated on twice-daily observations (sampled at 2 PM and 10 PM, CET) on the €-$ and $-¥ exchange rates, whose error terms follow a GARCH scheme. The model parameters are estimated on stationary variables in maximum likelihood with a BEKK representations of the GARCH errors[24] . The timing of the twice-daily data allows to divide the global trading day into two time zones. The European Time Zone (ETZ), goes from 10 PM of the previous day – the informal closing of the East Coast North American financial markets, the most important in the continent – till the setting of the reference rate for the Euro by the European Central Bank (ECB), a little after 2 PM: it includes all Asian trading and the first part – and typically most active part – of European trading. The American Time Zone (ATZ) goes from 2:15 PM, a little before the publication of US macroeconomic data, to 10 PM, CET, and includes US trading and the afternoon part of European trading.

The model explains the variation of €-$ and $-¥ at the end of the two time zones with respect to the values at the end of the previous ones, together with interest rates on Euro, Dollar and Yen ten-year bonds plus the DJII, a very important explanatory variable of the exchange rates of the Dollar in

[20] The model has also a $-¥ part which will be described in the second paragraph but has not been used yet to test trading rules.

[21] Variation of unemployed workers in Germany, the IFO index of business confidence in Germany, industrial production in Germany. The number of scheduled news tested for statistical significance was much larger. It is interesting to note that no Euro-area scheduled macroeconomic indicators turned out to be significant. Only the main German indicators. This is consistent, for instance, with ROTONDI-VACIAGO(2002).

[22] See footnote (..) later

[23] A much more detailed description is in TIVEGNA(2002).

[24] See ENGLE-KRONER(1995).

ATZ. Besides this latter variable, the main explanatory variables are scheduled and unscheduled news and the autoregressive exchange rate term, mentioned above. This argument picks up an empirically powerful regularity, probably generated by technically-based trading patterns.

European Time Zone (ETZ)

We make a simple list of equations with coefficients reported in Table 2.1. It must be remembered that all exchange and interest rates variables, plus the DJII, are log-differenced. Unscheduled news variables are built as vectors of +1, -1 and 0, with a €-positive, a €-negative or no-news. Scheduled news variables are described in footnote 3 and their vectors are built accordingly, with a zero when there is no-news. Everything is stationary.

Euro-Dollar (€-$)

$$r_t^{EU,ETZ} = F\left[D(L3)r_{t-1}^{EU}, D(L3)r_t^{US}, (SK)_t^{ETZ}\right] + \varepsilon^{1,ETZ}$$

$$r_t^{JA,ETZ} = F\left[D(L3)r_{t-1}^{JA}, D(L1)r_{t-1}^{US}, (UNSK)_t^{ETZ}\right] + \varepsilon^{2,ETZ}$$

$$(EUR-USD)_t^{ETZ} = F\left[(EUR-USD)_{t-1}^{ATZ}, r_t^{EU}, r_t^{US}, (SK)_t^{ETZ}, (UNSK)_t^{ETZ}\right] + \varepsilon^{3,ETZ}$$

$$(USD-JPY)_t^{ETZ} F\left[(USD-JPY)_{t-1}^{ATZ}, r_t^{\mathrm{JA}}, (UNSK)_t^{ETZ}\right] + \varepsilon^{4,ETZ}$$

The symbols have the following meaning:

r^{EU} : Euro-denominated ten-year bond yields.
r^{JA} : Yen-denominated ten-year bond yields.
r^{US} : Dollar-denominated ten-year bond yields.

D(LK) : Polynomial distributed lag operator for K lags ($1\pm k_1L\pm k_2L\pm\ldots$).

$(EUR\text{-}USD)^{ETZ}$: €-$ exchange rate at 2:15 PM, CET, published by ECB.
$(USD\text{-}JPY)^{ETZ}$: $-¥ exchange rate implied by the Euro rates published by ECB at 2:15 PM.

$(SK)^{ETZ}$: Scheduled news in ETZ (see list below).
$(UNSK)^{ETZ}$: Unscheduled news in ETZ (see list below).

$\varepsilon^{1,2,3,4\ ETZ}$: $N(0,\sigma_t^2)$ stochastic errors in the four equations.

The interest rate equations have a supporting role in this model: it consists of cleaning up the simultaneity bias in the exchange rate equations[25]. They have a dynamic structure and contain some scheduled and unscheduled news.

The scheduled news in ETZ which were found to be significant are:

- Variation of unemployed workers in Germany, seasonally adjusted, in the €-$ equation.
- The IFO index of business confidence in Germany, in the €-$ and ten-year interest rate equations.

[25] This bias seems to be quite strong according to TIVEGNA(2002).

- Industrial production in Germany, in the €-$ equation.

The unscheduled news relevant for €-$ are:

- Statements by European and US policy makers in ETZ.
- Markets news in ETZ (it includes also unexpected changes in official interest rates).
- Disclosed interventions in the foreign exchange market by ECB.

Dollar-Yen ($-¥)

The $-¥ is also a function of scheduled and unscheduled news. The scheduled news are collected with a different procedure, with respect to those of the €-$, given the more recent experience in collecting expected values for macroeconomic announcements in Japan. These news are not collected as difference between actual and expected values but according to the commentaries regarding them, which, only in more recent times, make a reference to market expectations. Overall, scheduled news in Japan do not have a long history.

The unscheduled news for this exchange rate are the following:

- Statements by Japanese policy makers regarding the Yen and the domestic economy.
- Yen-related market news (it includes also Japanese scheduled macroeconomic news and unexpected changes in official rates).
- Dollar-related market news.
- Disclosed interventions in the foreign exchange market by Bank of Japan (BoJ).

American Time Zone (ATZ)

Euro-Dollar (€-$)

We have the following equations (for parameters, see Table 2.1):

$$DJ_t^{US,ATZ} = F\left[D(L4)DJ_{t-1}^{US},(SK)_t^{ATZ}\right]+\varepsilon^{1,ATZ}$$

$$r_t^{US,ATZ} = F\left[D(L4)r_{t-1}^{US},(SK)_t^{ATZ}\right]+\varepsilon^{2,ATZ}$$

$$(EUR-USD)_t^{ATZ} = F\left[(EUR-USD)_t^{ETZ},r_t^{EU},r_t^{US},D(L2)DJ_t^{US},(SK)_t^{ATZ},(UNSK)_t^{ATZ}\right]+\varepsilon^{3,ATZ}$$

$$(USD-JPY)_t^{ATZ} = F\left[(USD-JPY)_t^{ETZ},r_t^{JA},r_t^{US},D(L2)DJ_t^{US},(SK)_t^{ATZ},(UNSK)_t^{ATZ}\right]+\varepsilon^{4,ATZ}$$

The new symbols, not previously described, are the following:

DJ^{US} : Dow Jones Industrial Index (DJII).

$\varepsilon^{1,2,3,4\,ATZ}$: $N(0,\sigma_t^2)$ Stochastic errors in the four equations.

The scheduled news are:

- Non-farm Payrolls, in the €-$ and DJII equations.
- Quarterly GDP estimates (flash, advance, final), in the $-¥ and DJII equations.

- Retail Sales, in the $-¥ and ten-year interest rate equations.
- ISM (formerly NAPM) Index, in the €-$ and ten-year interest rate equations.
- Consumer Confidence (Conference Board), all equations, except DJII.
- CPI index in the DJII equation and in the ten-year interest rate equation.
- Factory Orders, in the DJII equation.
- Wage rate, in the ten-year interest rate equation.

The unscheduled news are:

- Statements by European and US policy makers in ATZ.
- Markets news in ATZ (it includes also unexpected changes in official rates).
- Disclosed interventions in the foreign exchange market by ECB (the Fed was not active).

Dollar-Yen ($-¥)

No scheduled Japanese news are published in ATZ, so what we said for scheduled news in ETZ does not apply here.

The unscheduled news are here:

- Statements by Japanese and US policy makers regarding the Yen.
- Statements by Japanese and US policy makers regarding the Dollar.
- Yen-related market news (it includes also unexpected changes in official interest rates).
- Dollar-related market news (same).
- Disclosed interventions in the foreign exchange market by BoJ (Fed not active).

The model contains just a subset of scheduled and unscheduled news out of a much larger set. Many news variables were gradually eliminated in a specification search process described in TIVEGNA(2002). The GARCH part of the model is described in the following section.

Estimation and simulation sample

In the one-step-ahead simulations of the model we used parameters estimated between January 4, 1998 and January 21, 2001 [26] . The sample used for testing the trading rules went from January 22, 2001 to June 7, 2002.

3.) Day-trading in European Time

A news-based model, with GARCH-modelled errors, has various possibilities to be used as a trading-signal-producing device. A signalling effect could be attributed to the forecast by the linear part; or it could be attributed to the position of the exchange rate inside or outside trading bands produced by the GARCH part of the model; several of these bands could be produced in conjunction with the occurrence of various types of news[27]; on a longer term trading framework, a signal could be detected on the basis of how frequently the exchange rate, at various closing times (e.g. at 2 PM or at 10 PM, CET, etc.), falls within bands generated under different assumptions. And so on.

[26] For 1998, before the introduction of the Euro, a synthetic exchange rate has bee used.

[27] From the previous paragraph we know that there are various unscheduled news categories, having somewhat different coefficients. We opted for using the broader class of news in ETZ and ATZ, the so-called “Market news”.

All the experiments described in this paper are based on two trade-opening signals:

(a) a buy (or sell) signal centered at 10 AM, CET, is issued if the model forecasts an appreciation (or depreciation) of the Euro-Dollar rate, without any reference to unscheduled news, but keeping into due account the scheduled news;

(b) three GARCH bands are produced according to the occurrence of Euro-positive, or Euro-negative, or no news; a buy (or sell) signal centered at 10 AM, CET, is issued according to the position of the exchange rate within one of these bands, or outside all three, according to various criteria we will describe below.

As we mentioned before, the GARCH bands are drawn in two ways: by solving the GARCH volatility equation for its long-run value and this is a historical volatility; or by computing a new volatility each day, using the parameters of the GARCH part of the model, and this is the time-varying volatility.

The trading bands derived under the two procedures have different features. When using historical volatility, the bands maintain the same width in the whole trading sample. When using time-varying volatility, the bands change overtime according to the local turbulence of the Euro, as conveyed also by the forecast error of the model with lag one. This is an important consequence of these two procedures.

3.1) Drawing trading bands

In order to have a quick grasp of how to get trading signals according to the two systems outlined above, we can write in matrix form the single equations outlined in section 2 as follows. In European Time Zone (ETZ), we have:

$$Y_t^{ETZ} = INT + \sum_{j=0}^{4} \Theta_j Y_{t-j}^{ETZ} + \Phi Y_{t-1}^{ATZ} + D_S S_t^{ETZ} + D_U U_t^{ETZ} + \varepsilon_t^{ETZ} \quad (3.1)$$

where Y^{ETZ}_t is a 4x1 vector of stationary endogenous variables, including, respectively, the Ten-year Euro bond rate, the Ten-year Japanese bond rate, the €-$ (as quoted at the end of ETZ), and the $-¥ (as quoted at the end of ETZ). The 4x1 vector *INT* contains the intercept. The lagged dependent variable vector Y^{ETZ}_{t-j} picks up just the relevant Ten-year interest rates, as it can be seen from the ETZ model in section 2; Y^{ATZ}_{t-1} represents exchange rate variations observed in ATZ. S^{ETZ}_t and U^{ETZ}_t are vectors of scheduled and unscheduled news; Θ, Φ, K, D_S D_U are conformable matrices of parameters.

The American Time Zone (ATZ) model has a very similar structure:

$$Y_t^{ATZ} = INT + \sum_{j=0}^{5} \overline{\Theta}_j Y_{t-j}^{ATZ} + \overline{\Phi} Y_{t-1}^{ETZ} + \overline{D}_S S_t^{ATZ} + \overline{D}_U U_t^{ATZ} + \varepsilon_t^{ATZ} \quad (3.2)$$

where the symbols and parameters have similar interpretations. The vector of endogenous variables Y^{ATZ} includes now the Dow Jones Industrial Index, the Ten-year US bond rate, the €-$ (as quoted at the end of ATZ) and the $-¥ (as quoted at the end of ATZ). The bar over the parameters indicates of course that they are different in the two models.

The error terms ε^{ETZ} and ε^{ATZ} are distributed normally with zero mean and non-constant variance, σ^2_t, which follows the following GARCH scheme (in the case of ETZ):

$$(\sigma_t^2)^{ETZ} = \omega + \alpha(\varepsilon_{t-1}^2)^{ETZ} + \beta(\sigma_{t-1}^2)^{ETZ} \quad (3.3)$$

where ε^2_{t-1} is the squared error of the model.

Given the estimated values of parameters in (3.1), (3.2) and (3.3), we can compute one-step ahead simulations of the exchange rates (plus those of the DJII and the three long term interest rates, of lesser interest here) for given values of the news variables ($S^{ETZ,ATZ}$ and $U^{ETZ,ATZ}$). Besides that, we can build bands of various width around those rates, using a historical volatility or a time-varying volatility. This simulation is carried out jointly by stacking the code of the ATZ model beneath that of the ETZ model and using a Gauss-Seidel algorithm to take care of their simultaneity.

Even though the above models could be used to get trading signals both in ETZ and ATZ, in this paper we describe only trading experiments for a European based investor which begins trading in the morning, at 10 AM and closes the trade at 10 PM, at the very latest.

We can thus get three bands using the following methodology:

Baseline Band (which will be called **BASE**): we set S^{ETZ} at the observed value (the trade opens after all the ETZ scheduled news variables in our equations have been announced); U^{ETZ} has zero values all over, simulating a situation where no unscheduled news are present.

Strong Euro Band (**€-STRONG**): we set S^{ETZ} at the observed value, with U^{ETZ} having values indicating the presence of a Euro-positive unscheduled news (causing a strengthening of the Euro).

Weak Euro Band (**€-WEAK**): we set S^{ETZ} at the observed value, with U^{ETZ} having values indicating the presence of a Euro-negative unscheduled news (causing a weakening of the Euro).

So taking the expected value of the one-step ahead of the simulated values of the endogenous variables, with a particular attention to the €-$ (or EUR-USD), we would produce a baseline simulation (**BASE**):

$$E(Y_t^{ETZ}) = INT + \sum_{j=0}^{4} \Theta Y_{t-j}^{ETZ} + \Phi Y_{t-1}^{ATZ} + D_S S_t^{ETZ} = (EUR-USD)^{BASE} \quad (3.4)$$

A strong **(€-STRONG)** and a weak **(€-WEAK)** Euro simulated values would be obtained through the following expressions

$$E(Y_t^{ETZ}) = INT + \sum_{j=0}^{4} \Theta Y_{t-j}^{ETZ} + \Phi Y_{t-1}^{ATZ} + D_S S_t^{ETZ} + D_U U_t^{ETZ}(+) = (EUR-USD)^{STRONG} \quad (3.5)$$

$$E(Y_t^{ETZ}) = INT + \sum_{j=0}^{4} \Theta Y_{t-j}^{ETZ} + \Phi Y_{t-1}^{ATZ} + D_S S_t^{ETZ} + D_U U_t^{ETZ}(-) = (EUR-USD)^{WEAK} \quad (3.6)$$

having positive and negative values for the Euro-positive, (+), and the Euro-negative, (-), market news variables in U^{ETZ}.

The three bands would be built, using the GARCH equation (3.3) under the two different values of the GARCH volatility (historical or time-varying), in this way:

$$\begin{array}{lllll} \underline{\text{Baseline Band}}\ \textbf{(BASE)}: & (EUR\text{-}USD)^{BASE} & \pm \sigma_t^{ETZ} & = & (\text{UP})^{\text{BA}}\ ,(\text{LO})^{\text{BA}} \\ \underline{\text{Strong Euro Band}}\ \textbf{(€-STRONG)}: & (EUR\text{-}USD)^{STRONG} & \pm \sigma_t^{ETZ} & = & (\text{UP})^{\text{ST}}\ ,(\text{LO})^{\text{ST}} \\ \underline{\text{Weak Euro Band}}\ \textbf{(€-WEAK)}: & (EUR\text{-}USD)^{WEAK} & \pm \sigma_t^{ETZ} & = & (\text{UP})^{\text{WE}}\ ,(\text{LO})^{\text{WE}} \end{array} \qquad (3.7)$$

The symbols (UP) and (LO) indicates the upper and lower values of the band, whereas BA, ST and WE stand for **BASE**, **€-STRONG** and **€-WEAK**.

Given the estimated values of ω α and β in (3.3) and indicating (EUR-USD) as €, the above three bands have approximately the representation of Fig. 3.1, at each point in the testing period and under historical or time-varying volatility. It can be noticed from this chart that there is some moderate overlapping of the upper and lower edges of **BASE** and of the upper and lower edges of **€-WEAK** and **€-STRONG**. This is determined by the model parameters and is a standard feature of the model at different estimation samples and under the two different system for computing volatility. In this latter case, the position of the bands would be variable and sometimes very different from the one depicted in Fig. 3.1.

3.2) Opening a trade: the use of the bands

Having drawn these trading bands, it is possible to use them in various ways to get trading signals, according to where the exchange rate of the Euro falls at the beginning of trading. The exchange rate can fall inside one of these three bands or outside them. Given the two overlapping areas in the upper and lower parts of the **BASE**, it is possible to draw the bands as represented in Fig.3.2. The symbols in brackets are derived from (3.7) and $(€)^{BA}$, $(€)^{ST}$ and $(€)^{WE}$ are of course the point forecasts of the Euro in the three simulations. The regions where lower and upper outliers of the Euro could fall are defined as **(L.OUT)** and **(U.OUT)**.

We adopted three strategies to open-up a trade. The first consists of going long or short of €-$ according to model forecast. The other three make reference to the bands and issue trading signals according to the position of the exchange rate at 10 AM, CET.

News play an important role in the definition of our trading decisions. First, in order to compute upper and lower bounds around a point forecast, thus defining trading bands, as we saw above. Secondly, news variables are used also in the three trading strategies, to be described afterwards, to integrate the positioning argument - in order to go long or short the Euro – with the occurrence of an unscheduled news (or lack thereof) before or at the time of trading.

So let's indicate the four trading strategies as follows.

Strategy 1. The trader goes long or short €-$ if the model predicts an appreciation or a depreciation of the exchange rate, irrespective of any trading band. A second class of trading decisions, under this strategy, is examined where the trader looks also at the occurrence of unscheduled news.

Strategy 2. Figure 3.3 indicates this strategy. The trader looks for the model forecast only if the €-$ falls in the **(BASE)** area. He or she goes long if €-$ falls in **(WB)** or **(STRONG)** or goes short if it falls in **(SB)** or **(WEAK)**, but must make sure that no unscheduled news has occurred – or is likely to occur - at the time he or she begins trading. The trader keeps the same strategy in the case

of an outlier in **(U.OUT)** or **(L.OUT)**. In a news variant of this strategy, the trader looks at unscheduled news also in the **(BASE)** area.

Strategy 3. The trader decides now to go long or short according to model forecasts in the entire baseline area **(BASE)**. The **(WB)** and **(SB)** areas disappear and the trader goes long in the **(WEAK)** and **(L.OUT)** or short in the **(STRONG)** and **(U.OUT)** parts, but must look at the occurrence of news. See Fig. 3.4. As in Strategy 2, the trader looks at unscheduled news also in the **(BASE)** area, in the news variant of this strategy.

So we have a contrarian or "error correction" pattern underlying the last three trading strategies. When the €-$ rate falls in the **(BASE)** region in the European morning, this indicates a substantial uncertainty on how the rate will move for the rest of the day. The €-$ can be outside this region either by accident – and in this case it will correct and it can be a good idea to take advantage of it – or because there is a good reason for it, namely an unscheduled news has occurred.

3.3) Closing a trade: two procedures

We adopted two closing procedures. Both share the feature of opening the trade at 10 AM aiming at closing it at or about 2 PM, if the trade is profitable, or continuing on till 10 PM if a loss is recorded.

The first consists of closing the trade at the best rate [28] between 2 and 9 PM, or at the quote observed at 10. It is defined in this paper as **Closing Procedure 1**.

The second closing protocol, here defined as **Closing Procedure 2**, is more straightforward and closer to the actual trading practice: the trade is closed after 2 PM at the "take profit" or "stop loss" exchange rate values. The take profit signal is computed by adding (subtracting) the square root of the GARCH volatility to the opening rate for long (short) trades. The stop loss signal is obtained by subtracting (adding) the same quantity to the opening exchange rate for long (short) trades.

As to the latter procedure, there can be countless ways of computing take profit or stop loss rates. They could be fractions or multiples of the GARCH standard errors, they could be related to recent movements, technical values could play a role. Everything should be determined by market conditions and sentiment and by the risk profile of the trader.

As it is unrealistic to expect that a trader will always be able to close at the highest rate (on long positions) or at the lowest rate (on short positions), the closing rates are simple averages of the hourly high (or hourly low) quotes with the hourly closing quotes[29]. An ask-bid spread of 0.0002 was used throughout [30] .

[28] See further below for a discussion of "best" rates and bid-ask quotes.

[29] The performance of the trading rules was evaluated by computing trading results out of historic hourly time series of open, high, low, close exchange rates. The data used are mid-points between bid and ask quotes. Bid and ask quotes were obtained by subtracting or adding the bid and ask premia (see following footnote). The data were obtained from CQG Inc., a Denver, Colorado, headquartered company with offices throughout the world. See www.cqg.com.

[30] DACOROGNA et al (2001) indicate , at pag.170, that the relative ask-bid spread – meant as the log difference between the ask and bid quotes – is "usually below or around 0.1%". This relative spread for the observed quotes of €-$, since its inception, translates into a 0.0001 – or lower - absolute spread. Most retail-oriented FX trading platforms typically indicate an absolute spread of two basis points (0.0002). We opted for this latter quantity.

4.) Trading results

We combine **three strategies** to open up a trade – under two different methods of computing the GARCH volatility in order to draw trading bands, historical and time varying - with **two procedures** to close it. The type of trading experiments obtained by combining all the above cases is described in what follows. The results are summarized in Tables 4.1 and 4.2 and in Charts 4.2 – 4.6.

Strategy 1

Trading Experiment N. 1: Historical Volatility – **Closing Procedure 1**
Trading Experiment N. 2: Historical Volatility – **Closing Procedure 2**
Trading Experiment N. 3: Time Varying Volatility – **Closing Procedure 1**
Trading Experiment N. 4: Time Varying Volatility – **Closing Procedure 2**.

Strategy 1 With News

Trading Experiment N. 5: Historical Volatility – **Closing Procedure 1**
Trading Experiment N. 6: Historical Volatility – **Closing Procedure 2**
Trading Experiment N. 7: Time Varying Volatility – **Closing Procedure 1**
Trading Experiment N. 8: Time Varying Volatility – **Closing Procedure 2**

Strategy 2

Trading Experiment N. 9: Historical Volatility – **Closing Procedure 1**
Trading Experiment N. 10: Historical Volatility – **Closing Procedure 2**

Strategy 2 With News in BASE

Trading Experiment N. 11: Historical Volatility – **Closing Procedure 1**
Trading Experiment N. 12: Historical Volatility – **Closing Procedure 2**

Strategy 3

Trading Experiment N. 13: Historical Volatility – **Closing Procedure 1**
Trading Experiment N. 14: Historical Volatility – **Closing Procedure 2**
Trading Experiment N. 15: Time Varying Volatility – **Closing Procedure 1**
Trading Experiment N. 16: Time Varying Volatility – **Closing Procedure 2**

Strategy 3 With News in BASE

Trading Experiment N. 17: Historical Volatility – **Closing Procedure 1**
Trading Experiment N. 18: Historical Volatility – **Closing Procedure 2**
Trading Experiment N. 19: Time Varying Volatility – **Closing Procedure 1**
Trading Experiment N. 20: Time Varying Volatility – **Closing Procedure 2**

The main empirical results from Tables 4.1 and 4.2 are the following:

- The profit rates/signals and the Sharpe ratios of strategies with fixed historical volatility are always higher than those with time-varying volatility, with a couple of marginal exceptions.
- The use of news in **(BASE)** lead to much higher profits and Sharpe Ratios throughout all exercises, as the trader has a much wider information set.
- Profit rates and Sharpe Ratios in trades with **Closing Procedure 2** always outperform those with **Closing Procedure 1**.

- **Strategies 2** and **3** trades – using trading bands – have typically better profit rates and Sharpe Ratios than those of **Strategy 1**. This is to be expected as in the first two strategies the trader uses a wider information set.
- The overall profit and signalling performance is pretty high: with some exceptions, profits rates are never below 2.5% and reach 25%; they tend to cluster between 10 and 20 percent. The percentage of profit signals is always above 69.4% and, almost always, more than threes times the loss signals.
- The appreciation or depreciation trends of the Euro seems - from Charts 4.2 to 4.6 – to exert some noticeable influence only on cumulative profits in the first depreciation period (A zone) where profits tend to grow over a steeper trend in some trades. No clearly discernible influence is detectable in the other three time zones.
- The Sharpe Ratios[31] are pretty high. The best values are associated with fixed historical volatility and **Closing Procedure 2**. This is not surprising as historical volatility should perform better, given the length of the trading period (360 days) and the fixed GARCH volatility coefficients of the model. Besides, **Closing Procedure 2** can be implemented more swiftly as the trader con issue take profit and stop loss after 2 PM.
- The correct interpretation of incoming unscheduled news is quite important, as it is also confirmed by the much higher profits obtained when using unscheduled news in **(BASE)**.

5) Summary and open issues

This paper presents some descriptive results on how to use a news-based model of the €-$ and ¥-$ exchange rates with GARCH modelled error terms to generate day-trading signals on €-$. We use model simulations and the GARCH historical and time-varying volatility to draw three trading bands, **BASE**, **€-STRONG**, **€-WEAK** and propose three basic strategies to open trading positions. They consist of going long or short, if the model forecasts an appreciation or a depreciation (**Strategy 1**, see Section 3), or taking long-short positions according to where the €-$ falls in mid morning in Central European Time (**Strategies 2,3**).

Unscheduled news are used in drawing the above trading bands and in supporting a trade engagement decision in all three strategies. In particular, if we use unscheduled news in **(BASE)**, jointly with the appreciating or depreciating forecast of the model, we obtain much higher profits and Sharpe Ratios.

We then propose two closing protocols. According to the first, **Closing Procedure 1**, the trades are closed at or around 2 PM, CET, if they are profitable, or at the best quote afterwards if they are not profitable at that time, or at 10 PM, if neither of the above has occurred. According to **Closing Procedure 2**, the trade is closed at take profit or stop loss exchange rates, computed daily, using GARCH volatility. Best high or low quotes are derived as a simple average with the corresponding closing quotes in the eight hours after 2 PM. A bid–ask spread of 0.0002 is considered.

All these trading rules generate a high number of profitable signals and the profit rates (with no reinvestment) cluster between 10 and 20 percent and reach values between 20 and 25 percent, in some of the trading experiments (Table 4.1 and 4.2). These results were obtained over a sample of 360 trading days in 2001 and 2002.

As we mentioned at the end of Section 4, the correct interpretation of incoming unscheduled news is quite important whenever we use trade-opening strategies which require an evaluation of

[31] This is an indicative ratio computed with respect to a daily rate implicit in a risk-free interest rate of 4.5% over the 360 days trading period. The daily values are reported to the trading period following SHARPE(1994).

recently occurred or contemporaneous (i.e. happening at the moment of opening up a trade, or likely to happen immediately thereafter). They are **Strategies 2,3** and the news variants of all the strategies.

The collection of unscheduled news in NEWSMETRICS and the creation of news vectors is an ex-post process. In an actual trading situation, it can be difficult to figure out when a news has occurred or is, in fact, occurring when the trading decision takes place. This is an important issue but less so than it may appear. For two reasons: first, the amount of trading signals critically dependent on the occurrence of a news is not big; second, the main part of them occur before the trading decisions are made (most of them in Asian trading), and that a large number of them can be certainly detected by a skilled trader.

As to possible difficulties in news detection, the results of **Strategy 1** indicate that profits can be made even disregarding news. This strategy is purely model-based with no reference to any news and could be used – given a proper technology - as an unsupervised trading machine. Trading experiments 2 and 4 in Table 4.1 (belonging to this **Strategy 1** class) have good results in our simulated trades. They fully exploit the time-varying volatility and the take profit and stop loss features, which are the most realistic in an actual trading set-up.

The main purpose of this paper is to devise techniques to extract trading signals out of a news-based model built simply to explain exchange rate fluctuations in a world market characterized by a continuous bombardment of news of all kind (economic, financial, geopolitical, on monetary and fiscal policy, etc.).

As an aside, our approach shows that structural econometric modelling - using simultaneous estimation techniques (maximum likelihood here) and explaining dependent variables also with exogenous variables - can be very useful in model-building with daily data in order to get trading signals. Casual observation - but not fully tested here – indicates that our profit rates and Sharpe Ratios are higher than those obtained with technical analysis. And that has no mean relevance since by using structural econometrics, the trader can justify his/her results in terms of published data and widely known events.

We limited ourselves to compute descriptive trading signal and profit results out of simulated values. This means, in particular, that no attempt has been made, at this stage, to test the statistical significance of the differences between the various trading techniques, over Euro appreciating or depreciating periods. This could be done by taking into account the likely non-normal distribution of our exchange rates returns, through bootstrap and stochastic simulation techniques. Besides that, as we mentioned before, no serious attempt has been made here to compare our signal and profits results with those generated by the most popular technical filters, where bootstrapping would have also been necessary [32] . Some very casual and preliminary checks, though, indicate that our profit rates seem to be higher. All we wrote in this last section indicates quite clearly what is our immediate research agenda.

[32] See, for instance, BROK et al (1992) and LEVICH-THOMAS(1993)

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TABLES

AND

CHARTS

FIGURE 3.1

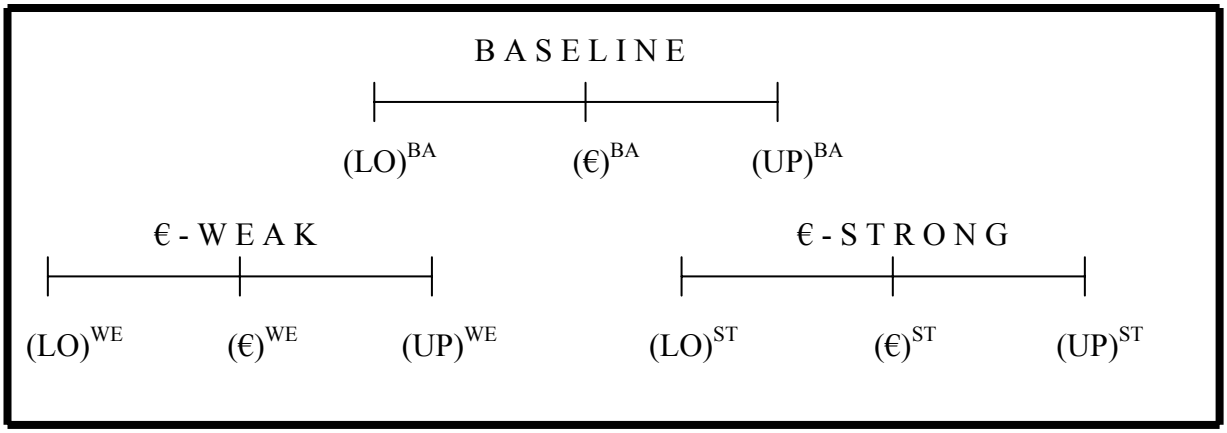
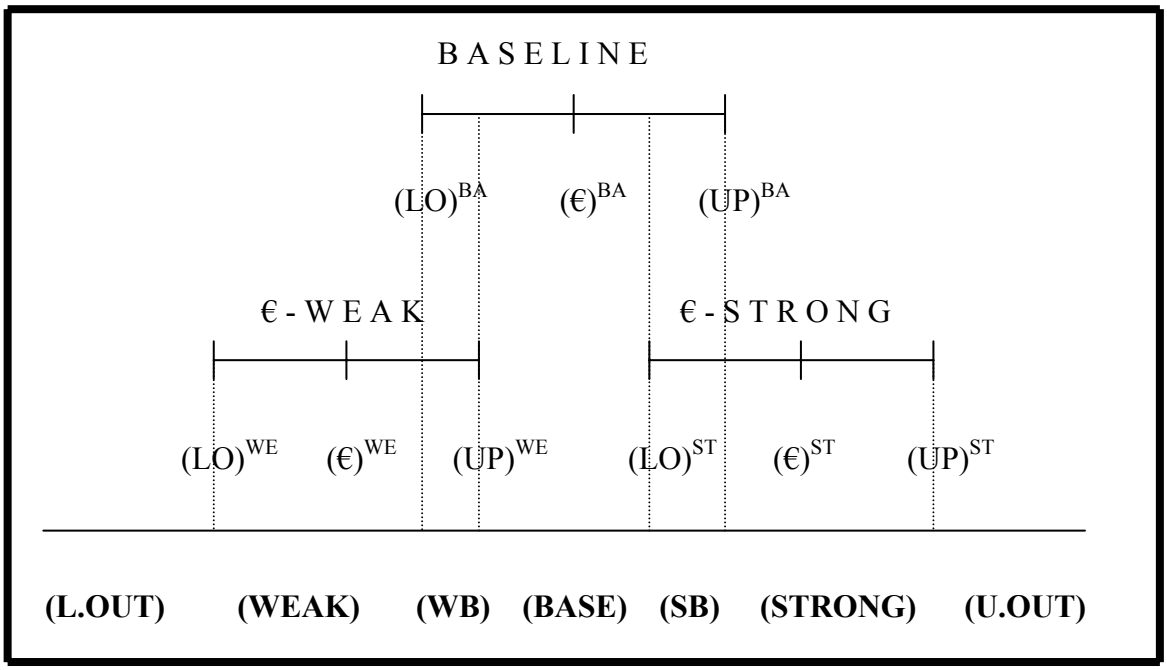


FIGURE 3.2



LIST OF SYMBOLS IN FIGURES 3.1 AND 3.2

$(€)^{BA}$	Forecast value of baseline simulation **(BASE)**
$(UP)^{BA}$	Upper value of baseline simulation **(BASE)**
$(LO)^{BA}$	Lower value of baseline simulation **(BASE)**
$(€)^{ST}$	Forecast value of €-Strong simulation **(€-STRONG)**
$(UP)^{ST}$	Upper value of €-Strong simulation **(€-STRONG)**
$(LO)^{ST}$	Lower value of €-Strong simulation **(€-STRONG)**
$(€)^{WE}$	Forecast value of €-Weak simulation **(€-WEAK)**
$(UP)^{WE}$	Upper value of €-Weak simulation **(€-WEAK)**
$(LO)^{WE}$	Lower value of €-Weak simulation **(€-WEAK)**

FIGURE 3.3

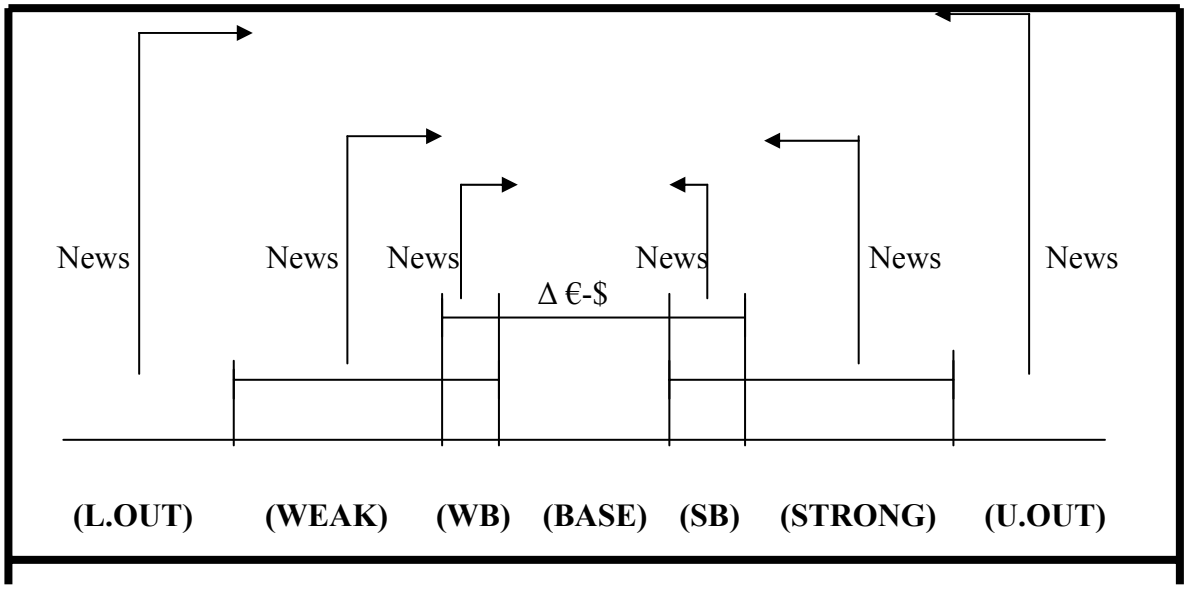


FIGURE 3.4

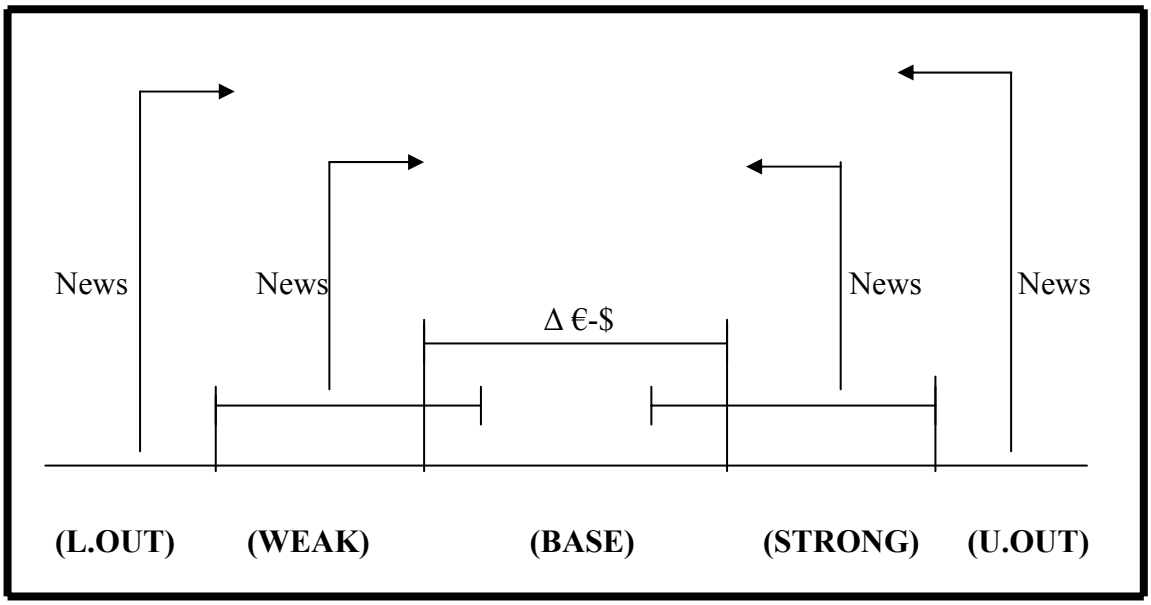


FIGURE 4.1 - EUR-USD in American Time Zone

From Jan. 22,2001 To June 7, 2002

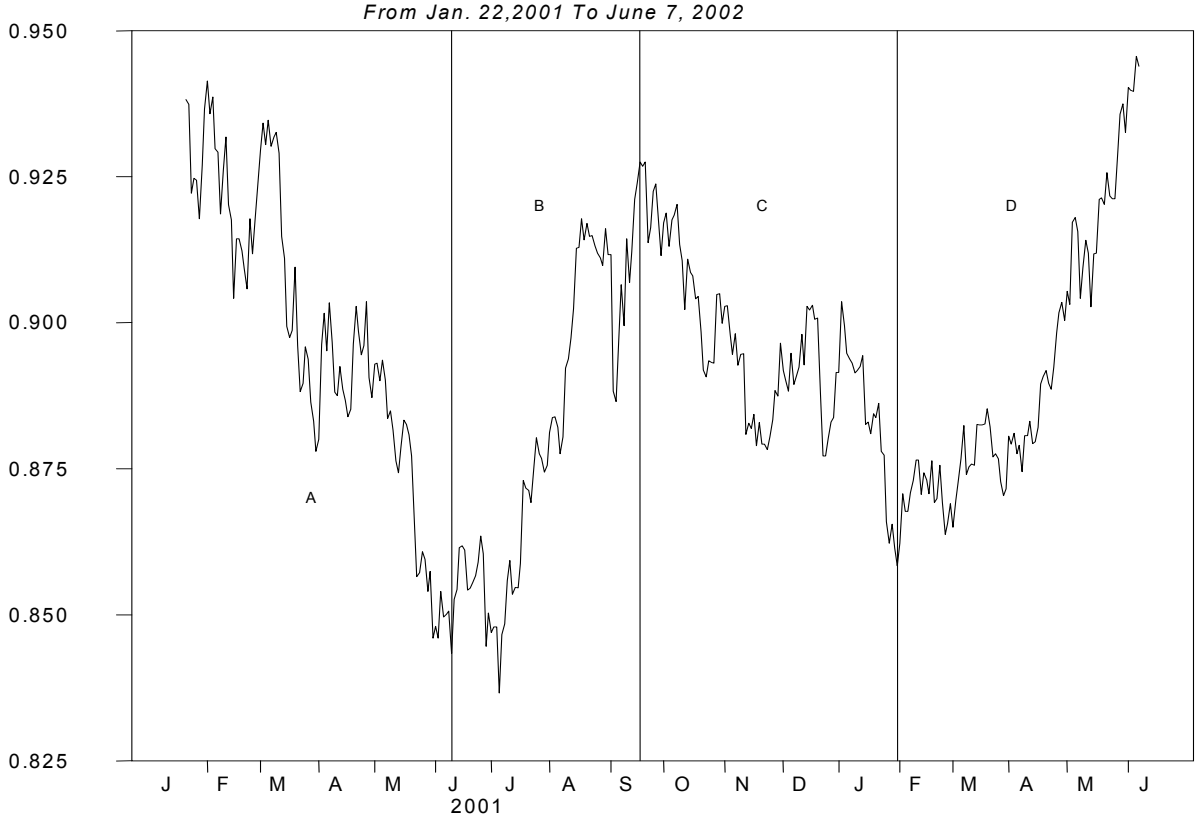


CHART 4.2 - Cumulative Profits in Strategy 1

From Jan. 22,2001 To June 7, 2002

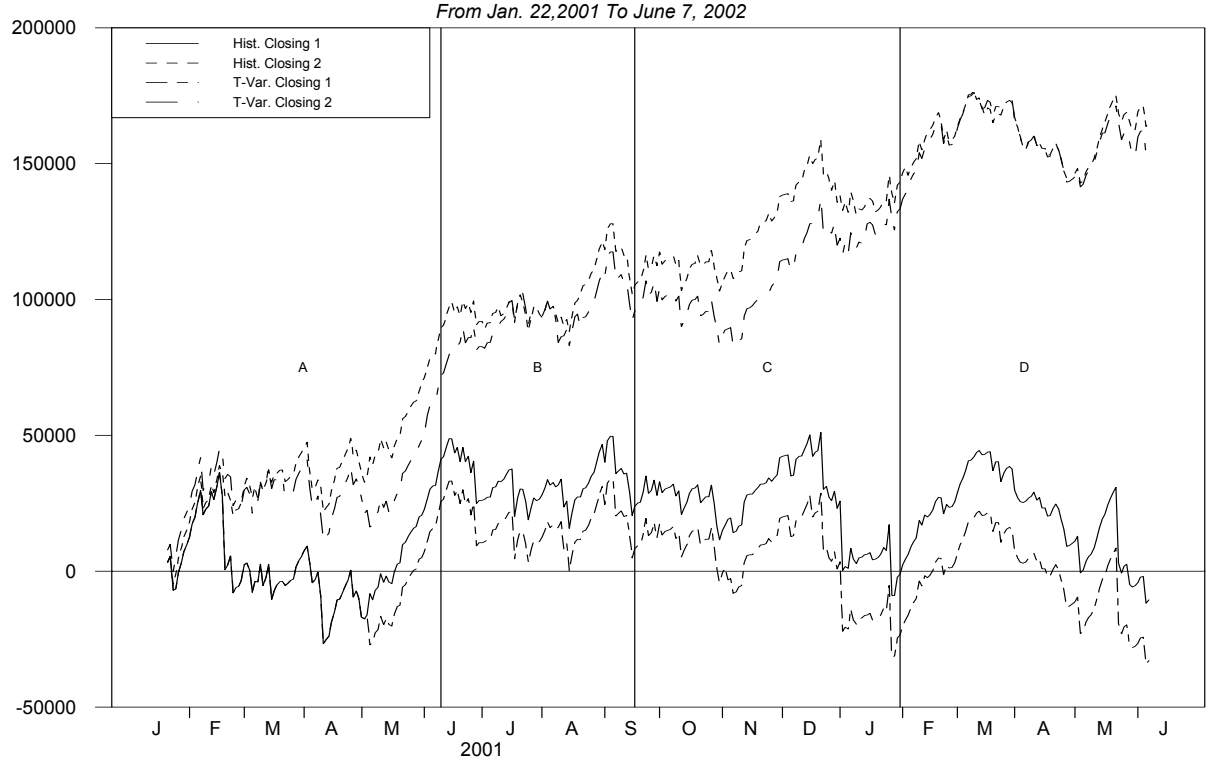


CHART 4.3 - Cumulative Profits in Strategy 1 With News

From Jan. 22,2001 To June 7, 2002

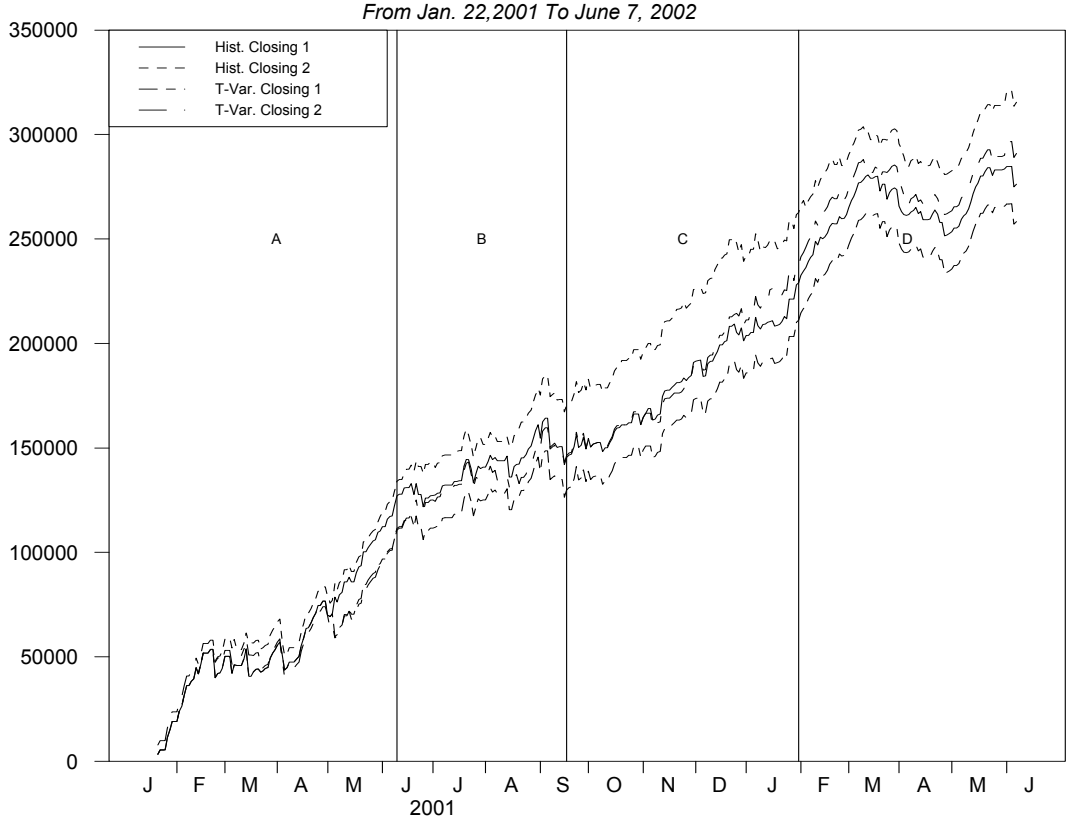


CHART 4.4 - Cumulative Profits in Strategy 2 With/out News

From Jan. 22,2001 To June 7, 2002

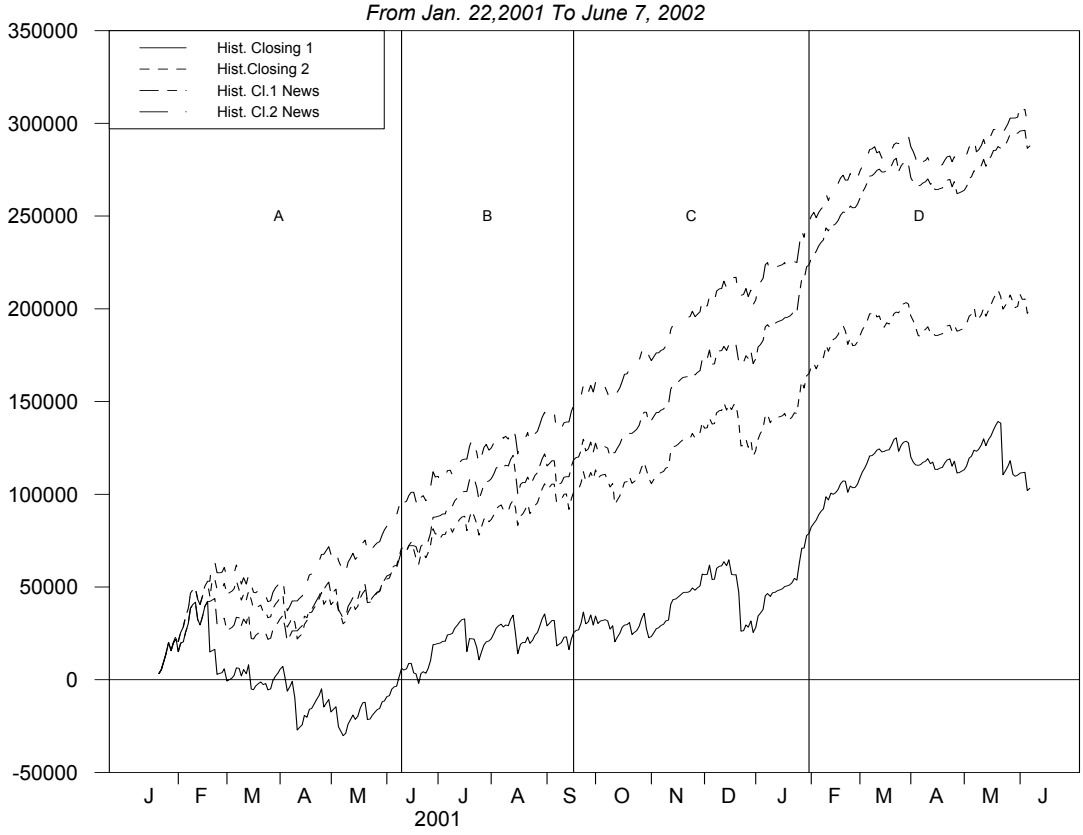


CHART 4.5 - Cumulative Profits in Strategy 3

From Jan. 22,2001 To June 7, 2002

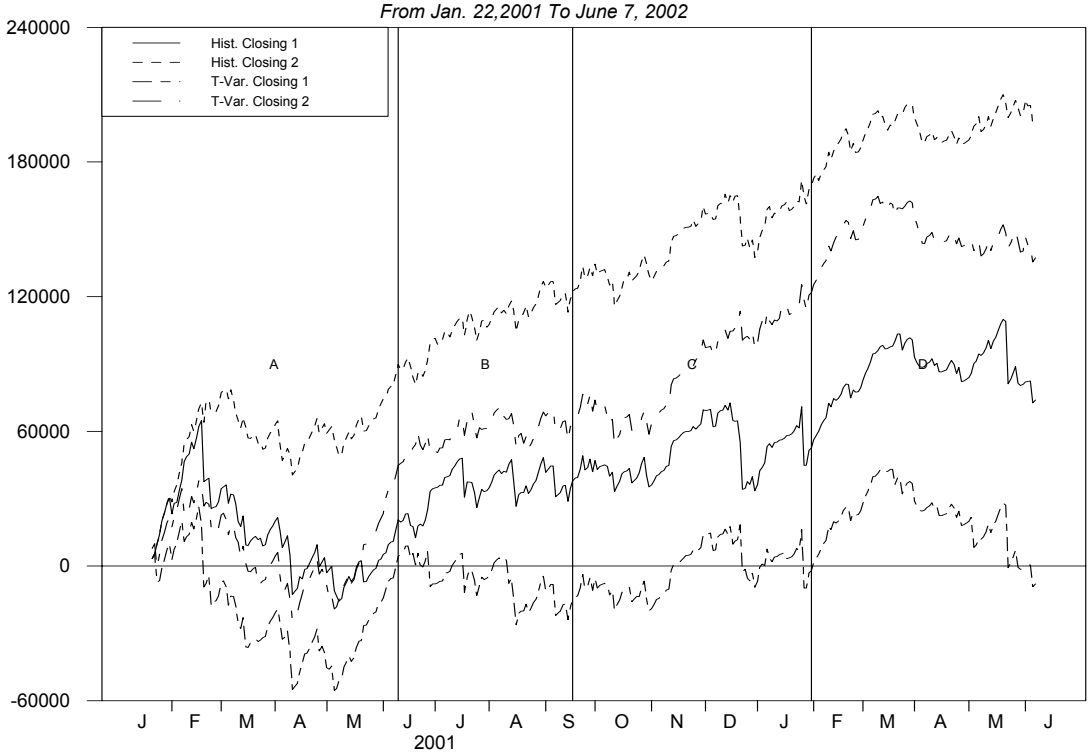


CHART 4.6 - Cumulative Profits in Strategy 3 With News

From Jan. 22,2001 To June 7, 2002

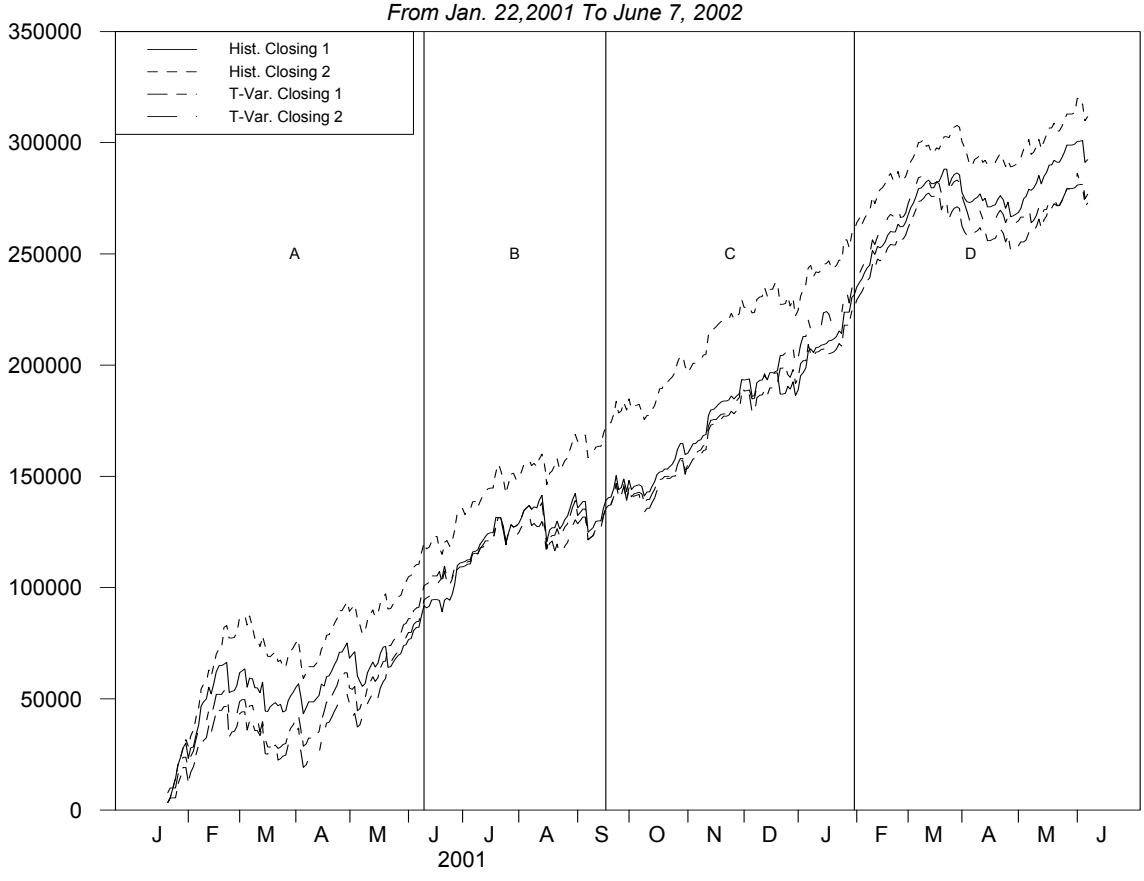


TABLE 2.1 - EUROPEAN TIME ZONE MODEL [1]

TEN-YEAR BOND INTEREST RATE IN EURO

1 Interc.	-0,0216	0,2759	14 Interc.	-0,0136	0,5626
2 Dep. Variab.(T-1)	0,5369	0,0000	15 Dep. Variab.(T-1)	0,6547	0,0000
3 Dep. Variab.(T-2)	-0,0136	0,6139	16 Dep. Variab.(T-2)	-0,1344	0,0000
4 Dep. Variab.(T-3)	-0,1428	0,0000	17 Dep. Variab.(T-3)	-0,1395	0,0000
5 Dep. Variab.(T-4)	0,0902	0,0000	18 Dep. Variab.(T-4)	0,1182	0,0000
6 IFO Germany	0,0243	0,2830	19 Policy Stat. Yen	-0,0448	0,0968
7 $ 10-Y Bond Yield	0,2140	0,0000	20 Market News Yen	-0,0579	0,0061
8 $ 10-Y Bond Yield(T-1)	0,5706	0,0000	21 $ 10-Y Bond Yield(T-1)	0,1878	0,0000
9 $ 10-Y Bond Yiel(T-2)	-0,3951	0,0000	22 $ 10-Y Bond Yield(T-2)	-0,1675	0,0000
10 $ 10-Y Bond Yiel(T-3)	0,1262	0,0000			

€-$ EXCHANGE RATE

26 Interc.	-0,0352	0,1488
27 E-$ ATZ(T-1)	-0,2121	0,0000
28 € 10-Y Bond Yield	0,0154	0,4899
29 $ 10-Y Bond Yield	-0,0626	0,0082
30 Unempl.Germany	-0,0889	0,0000
31 IFO Germany	0,0471	0,0262
32 Ind.Prod. Germany	0,0405	0,0314
33 Policy Stat.	-0,1851	0,0000
34 Market News	-0,4099	0,0000
35 Interv. ECB	-0,3019	0,0000

$-YEN EXCHANGE RATE

39 Interc.	-0,0412	0,0772
40 $-Yen ATZ(T-1)	-0,2178	0,0000
41 Yen 10-Y Bond Yield	0,0026	0,9442
42 Interv.BoJ	0,2108	0,0000
43 Policy Stat. Yen	0,2858	0,0000
44 Market News Yen	0,4578	0,0000
45 Market News $	0,1738	0,0000

MULTIVARIATE GARCH VOLATILITIES AND CORRELATIONS [2]

TEN-YEAR BOND INTEREST RATE IN EURO

Interc.	0,0292	0,0000	Interc.	0,0163	0,0000
e(T-1)	0,1087	0,0000	e(T-1)	0,0590	0,0000
h(T-1)	0,8442	0,0000	h(T-1)	0,9241	0,0000

EURO-DOLLAR EXCHANGE RATE

Interc.	0,0703	0,0000
e(T-1)	0,2233	0,0000
h(T-1)	0,7858	0,0000

DOLLAR-YEN EXCHANGE RATE

Interc.	0,1433	0,0000
e(t-1)	0,3776	0,0000
h(T-1)	0,4887	0,0000

CORRELATIONS [3]

Correl.of Variables 1-2	0,0211	0,5195
Correl.of Variables 3-2	0,0335	0,2739
Correl.of Variables 3-1	-0,1145	0,0000
Correl.of Variables 4-1	-0,1101	0,0000
Correl.of Variables 4-2	-0,0312	0,5609
Correl.of Variables 4-3	-0,2076	0,0000

[1] The first column represents the estimated coefficients, the second the level of significance.
[2] The e(T-1) represents the lagged squared error of the GARCH term, h(T-1) is the lag variance.
[3] Var. 1 is the Euro Ten-year yield, var. 2 is the Yen Ten-year yield, var. 3 is €-$, var. 4 is $-Yen.

TABLE 2.2 - AMERICAN TIME ZONE MODEL [1]

DOW JONES INDUSTRIAL INDEX			TEN-YEAR BOND INTEREST RATE IN $		
1 Interc.	0,0340	0,2439	12 Interc.	-0,0115	0,6387
2 Dep. Var.(T-1)	0,7252	0,0000	13 Dep. Var.(T-1)	0,7974	0,0000
3 Dep. Var.(T-2)	-0,1588	0,0000	14 Dep. Var.(T-2)	-0,1861	0,0000
4 Dep. Var.(T-3)	-0,1496	0,0048	15 Dep. Var.(T-3)	-0,2032	0,0000
5 Dep. Var.(T-4)	0,1289	0,0075	16 Dep. Var.(T-4)	0,1976	0,0000
6 Dep. Var.(T-5)	-0,0734	0,0124	17 Dep. Var.(T-5)	-0,0855	0,0019
7 US Payrolls	-0,0779	0,0016	18 US Wage Rate	0,1331	0,0000
8 US GDP Deflator	-0,0502	0,0811	19 US GDP Deflator	0,0574	0,0072
9 US CPI	-0,0620	0,0007	20 US CPI	0,0306	0,1706
10 US ISM	-0,0332	0,3803	21 US ISM	0,0841	0,0123
11 US Fact.Ord.	-0,0399	0,0411	22 US Retail Sales	0,0783	0,0773
			23 US Cons.Confid.	0,1016	0,2319
EURO-DOLLAR EXCHANGE RATE			**DOLLAR-YEN EXCHANGE RATE**		
24 Interc.	0,0345	0,1814	37 Interc.	-0,0139	0,6421
25 E-$ ETZ	-0,2752	0,0000	38 $-Yen ETZ	-0,2368	0,0000
26 Int.Rate US	-0,1457	0,0029	39 Int.Rate US	0,1274	0,0046
27 Int.Rate Euro	0,0763	0,0004	40 Int.Rate Yen	-0,0398	0,0894
28 Dow Jones	-0,7662	0,0002	41 Dow Jones	0,6340	0,0001
29 Dow Jones(T-1)	0,6934	0,0000	42 Dow Jones(T-1)	-0,5173	0,0000
30 Dow Jones(T-2)	-0,2378	0,0000	43 Dow Jones(T-2)	0,1626	0,0015
31 US Payrolls	-0,1135	0,0001	44 US GDP	0,0690	0,0186
32 US GDP	-0,0599	0,0140	45 US Retail Sales	-0,0539	0,2692
33 US ISM	-0,1234	0,0000	46 US Cons.Confid.	0,1099	0,3892
34 US Cons.Confid.	-0,0398	0,6050	47 Market News Yen	0,3811	0,0000
35 Market News	-0,4098	0,0000	48 Market News $	0,2920	0,0000
36 Policy Stat.	-0,1600	0,0000	49 Policy Stat. Yen	0,1704	0,0000
			50 Policy Stat. $	0,0356	0,0000
			51 Interv. BoJ	0,1959	0,0000

MULTIVARIATE GARCH VOLATILITIES AND CORRELATIONS [2]

DOW JONES INDUSTRIAL INDEX			TEN-YEAR BOND INTEREST RATE IN $		
Interc.	0,1440	0,0001	Interc.	0,0277	0,0000
E(T-1)	0,1283	0,0000	e(T-1)	0,0813	0,0000
H(T-1)	0,6558	0,0000	h(T-1)	0,8591	0,0000
EURO-DOLLAR EXCHANGE RATE			**DOLLAR-YEN EXCHANGE RATE**		
Interc.	0,1030	0,0000	Interc.	0,1016	0,0000
E(T-1)	0,1697	0,0020	e(T-1)	0,1053	0,0000
H(T-1)	0,7493	0,0000	h(T-1)	0,7921	0,0000
CORRELATIONS [3]					
Corr.Var.1 and 2	0,1203	0,0003	Corr.Var.4 and 1	-0,3068	0,0215
Corr.Var.3 and 2	0,1805	0,0000	Corr.Var.4 and 2	-0,2334	0,0000
Corr.Var.3 and 1	0,3584	0,0187	Corr.Var.4 and 3	-0,2878	0,0000

[1] The first column represents the estimated coefficients, the second the level of significance.
[2] The e(T-1) represents the lagged squared error of the GARCH term, h(T-1) is the lag variance.
[3] Variable 1 is the DJII, variable 2 is the $ Ten-year yield, variable 3 is €-$, variable 4 is $-Yen.

TABLE 4.1 - PART A	PROFIT SIGNALS IN PERC. [1]	LOSS SIGNALS IN PERC. [2]	TOTAL PROFITS IN EURO [3]	PROFIT RATE IN 2001 [4]	PROFIT RATE IN 2002 [5]	SHARPE RATIO IN TRADING SAMPLE [6]
STRATEGY 1						
TRADING EXPER. 1	72,8	26,1	-10.528	2,5	-7,6	-0,55
TRADING EXPER. 2	69,4	29,4	165.576	14,3	6,8	1,75
TRADING EXPER. 3	72,5	26,4	-32.873	0,1	-7,7	-0,70
TRADING EXPER. 4	71,6	27,2	156.311	12,7	8,3	1,54
STRATEGY 1 WITH NEWS IN (BASE)						
TRADING EXPER. 5	78,6	20,1	276.266	21,3	17,1	4,41
TRADING EXPER. 6	75,9	22,7	315.451	25,3	17,3	5,60
TRADING EXPER. 7	78,5	20,1	258.382	19,4	17,1	4,00
TRADING EXPER. 8	77,2	21,5	290.939	22,1	18,7	4,80
STRATEGY 2						
TRADING EXPER.9	75,0	24,4	103.259	2,7	17,7	0,68
TRADING EXPER.10	71,7	27,5	199.522	12,8	17,9	2,20

[1] [2] Percentage of profitable (loss-making) trading signals over the total number of signal issued. They do not add to 100 as there are zero profit trades
[3] Profits generated over the relevant period of trading
[4] Profit rates on annual basis. Between Jan.22,2001 and Jan.31, 2002.
[5] Profit rates on annual basis between Feb.2,2002 and June 7,2002.
[6] As described in footnote 28. The ratio is computed over the 360 trading days.

TABLE 4.1 - PART B	PROFIT SIGNALS IN PERC. [1]	LOSS SIGNALS IN PERC. [2]	TOTAL PROFITS IN EURO [3]	PROFIT RATE IN 2001 [4]	PROFIT RATE IN 2002 [5]	SHARPE RATIO IN TRADING SAMPLE [6]
STRATEGY 2 WITH NEWS IN (BASE)						
TRADING EXPER. 11	78,3	21,1	287.751	18,0	26,7	3,96
TRADING EXPER.12	75,0	24,0	301.742	21,4	22,7	4,33
STRATEGY 3						
TRADING EXPER. 13	74,2	25,0	73.954	3,5	9,2	0,33
TRADING EXPER. 14	71,4	27,5	199.525	14,5	14,1	2,26
TRADING EXPER. 15	72,5	26,4	-7.981	-1,0	0,3	-0,55
TRADING EXPER.16	71,1	27,8	137.397	10,2	9,3	1,28
STRATEGY 3 WITH NEWS IN (BASE)						
TRADING EXPER.17	77,9	21,2	292.372	19,7	24,2	4,12
TRADING EXPER.18	75,2	23,6	311.728	23,5	20,4	4,59
TRADING EXPER.19	77,7	21,0	272.812	20,3	18,5	4,03
TRADING EXPER.20	75,9	22,9	276.783	21,2	17,4	4,13

[1] [2] Percentage of profitable (loss-making) trading signals over the total number of signal issued. They do not add to 100 as there are zero profit trades
[3] Profits generated over the relevant period of trading
[4] Profit rates on annual basis. Between Jan.22,2001 and Jan.31, 2002.
[5] Profit rates on annual basis between Feb.2,2002 and June 7,2002.
[6] As described in footnote 28. The ratio is computed over the 360 trading days.