The Impact of Macro News on the Term Structure of Interest Rates

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The Thesis is dedicated to the memory of my mamá.

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Introduction

The evaluation of the impact of the news effects is one of the key questions in financial economics and a hot topic in recent studies of macroeconomic analysis. It may not be the act of releasing information to the market which is important, nor the (gross) information embodied in the estimate itself, rather, it is the extent to which the actual announcement differs from the expected which determines the response of the market to the new information (Kim et al. 2004). The aim of this thesis is to increase the knowledge of the impact of macro news, coming from scheduled macro announcements, on the US interest rates term structure. Chapter 1 reviews the definition and scope of the news concept and introduce a description of the data and its availability. Also, it presents the literature on the impact of news over stocks, foreign exchange markets and mainly interest rate term structure. The typical econometric weakness to address is that the literature usually starts the model selection from a limited General Unrestricted Model (GUM) that only considers a pre-selected pool of economic indicators. Given the myriad of economic announcements the researcher ends up dealing with a considerable model size that makes difficult the model selection procedure. Specially, the question on how to reduce the GUM to the Local Data Generation Process (DGP) raises naturally. In general, the amount of exogenous variables (announcements from the economic calendar) clearly points out to the impossibility to pick up easily a single model from the GUM. Moreover, the literature never studies the effects of all the possible economic announcements as the complexity of the models limited the analysis. This thesis adopts automatic selection devices such as PcGets to avoid pre-selection biases. The use of model selection techniques constitutes an important evolution in the way the literature handles the large number of economic indicators, without limiting the analysis to a subjective group of variables. Then, Chapter

1 formally justifies the use of an automatic algorithm based on general to specific models -which is used in the entire thesis.

The first case study is reported in Chapter 2. The objective of this piece is to explain the variation in the very short dated US term structure, Fed funds future contracts, using macroeconomic surprises. Fed funds interest rates and its expectations are the first link of transmission of Federal Reserve policy to other interest rates. This empirical approach helps to understand the underlying methodological problem and to discuss which model is appropriate. The chapter novelties, in relation with prior studies, are: a) it is the first study of the impact of macro news over the Fed funds future contracts' implicit rates; b) the study avoids preselection biases as it uses automatic General-to-Specific model selection procedure; c) thanks to b) the analysis covers all the US economic announcements available for that period; d) introduces an Error Correction Model (ECM)[1] that captures asymmetries in the response of the Fed funds movement to positive or negative surprises; and finally e) different authors' databases are built considering only expansionary years for the global economy, in this case the database frame cope with both expansionary and recessionary years (bull and bear markets). The chapter also compares the results using median survey and average survey as input of the surprises and addresses the fact that the model might suffer from collinearity and proposes a solution (reported in Appendix).

Is it enough with a single descriptive dimension to explain the effect of news? Is information being missed by only using the surprises? As described earlier, surprises are built using consensus data. Focusing on consensus ignores the fact that opinions usually differ among analysts. Ultimately, not only the degree of surprise is relevant, but also the disagreement in the expectations alters the effect of a piece of news. In a new approach the thesis builds an extra descriptive dimension from the survey of analyst to be used in the understanding of the influences of economic announcements. Chapter 3 shows that this disagreement is non neutral in the understanding of news surprises.

[1] In his Nobel lecture Granger (2003) afirms that in an ECM the change of one series is explained in terms of the lag of the difference between the series and lags of the differences of each series. Data generated by such a model is sure to be cointegrated. The ECM has been particularly important in making the idea of cointegration practically useful. It was invented by Dennis Sargan.

Six alternative measures of disagreement are considered. An ECM is introduced that captures the response of US interest rates to different level of disagreements and surprises asymmetries. The results show that disagreement at the time of the forecast is important on the conditional effect of the subsequent surprise reaction.

The literature so far limits the study of news to contemporaneous data ignoring past data. The consideration of news by the literature is expanded by taking into consideration past data. In order to do that, Chapter 4 defines two types of endogenous sentiment indicators: accumulated surprises and accumulated disagreement. Both indicators are defined as endogenous as they are derived from the analysts surveys conducted for each economic release. In the first case the key hypothesis is that surprises' effects depend on prior accumulated surprises. This is a different hypothesis from the one followed by the academic literature. So far, the effect of a surprise at time t depends on that current level. Practitioners handle previous data by constructing an index of accumulated surprises to gauge the market sentiment. Then, introducing an index of surprises in the academic literature builds a gap with practitioners applications, and deepen the knowledge boundaries. The closest topic in the academic literature are the regime-switching models, such as those developed by David (1997) and Veronesi (1999). The second type of endogenous sentiment uses the concept of disagreement discussed in Chapter 3. In this case, the disagreement is considered in an accumulative way, in a type of index, which ultimately condition the effect of economic news. As far as it is known, this issue has not been dealt by the academic literature nor by the practitioners. In a consistent modelling methodology context, Chapter 4 applies an ECM to US interest rates taking into consideration these endogenous sentiment indicators. This last chapter methodologies and models encompasses previous ones.

CHAPTER 1

Literature Review

1. Introduction

The evaluation of the impact of the news is one of the key questions in financial economics and a hot topic in recent studies of macroeconomic analysis. The issue has a broad range of potential users: Central Banks, Investment Banks' trading desks, Hedge Funds and Investment Managers in general. According to Flannery and Protopapadakis (2002) identifying macro variables that influence aggregate equity returns has two direct benefits. First, it may indicate hedging opportunities for investors. Second, if investors as a group are averse to fluctuations in these variables, they may constitute priced factors. Moreover, a further understanding of price movements (especially jumps in prices) and fundamentals could broaden the usage of Economic Derivatives (derivatives whose underlying are economic statistics[1]).

The reaction of financial prices to news should be determined by the extent to which the news changes market perceptions about the future payoff of the relevant security (Clare and Courtenay, 2001). Thus, as stated by Kim et al. (2004), it may not be the act of releasing information to the market which is important, nor the (gross) information embodied in the estimate itself, rather, it is the extent to which the actual announcement differs from the expected which determines the response of the market to the new information. The process in which traders constantly discount expectations of the future in their present decisions can explain the importance of unanticipated news that contradicts previous expectations of the foreign exchange market (Oberlechner and Hocking, 2004).

[1]Deutsche Bank and Goldman Sachs launched the first ever auction of economic derivatives in September 2002 (US Nonfarm payroll data).

According to Burrows and Wetherilt (2004), the response of market interest rates to macroeconomic announcements should be of particular interest to monetary policy makers as it may contain information about market perceptions of the policy maker's reaction function. Then, changes over time in the reaction of interest rates to macroeconomic announcements may be of further interest, as they may suggest that the market's understanding of monetary policy has changed. Clare and Courtenay (2001) and Lasaosa (2005) hypothesise that with increased transparency, market participants should pay more attention to macroeconomic announcements, thereby causing more pronounced reactions in asset prices. They argue that in a regime where market participants have a clear understanding of the central bank's objective function, they are also more capable of assessing which macroeconomic news is most likely to affect policy decisions. As a result, when macro data are released, market participants are likely to pay close attention to them and react strongly to information that they believe to be relevant (Burrows and Wetherilt, 2004).

The literature on announcement effects in the different asset classes is quite extensive. News in these studies are typically measured as surprises -that is, the difference between the forecast and the actual number released. Forecasts are either derived from surveys conducted a few days before announcements or repeating the prior value of the announcement (Fornari et al., 2002). The literature focus on news concerning economic activity (unemployment, industrial production, GDP growth, retail sales, business climate), inflation (CPI, PPI, wage developments), balance of payments (trade and current account) and changes in official interest rates. All these type of news can be considered scheduled macro announcements, while another research branch add also non-scheduled macro announcements (government officials' declarations, political crisis, etc.) (Ederington and Lee,1993 and Fornari et al., 2002).

The chapter is organised as follows. Section 2 reviews the definition and scope of the news concept and describes the data's availability. Section 3 briefly introduces the literature on the impact of news over stocks and foreign exchange markets, while Section 4 critically presents a detailed review on news effects over interest rates term structure.

Section 5 explains alternative econometric techniques which could be adopted to broaden the knowledge on the micro effect of macro news. Section 6 concludes.

2. Definition and Scope of the News Concept

In the literature of micro effect of macro news the definition of the news plays an important role. Specially, the survey or consensus of the economic indicator defines the way in which surprises are sketched. In all the thesis the term news and surprises will be used as synonyms.

The most straightforward characterization is used among others by McQueen and Roley (1993) and Lamont (1999) where news are innovations in expectations about a variable, lets say y_{t+k} is the relevant variable, and $\Delta E_t [y_{t+k}]$ is the surprise with notation:

$$\Delta E_t [y_{t+k}] = E_t [y_{t+k}] - E_{t-1} [y_{t+k}] \tag{1.1}$$

The expected value term $E_{t-1} [y_{t+k}]$ represents the survey or consensus data of the variable. In Fornari et al. (2002) the expected values are proxy by the last available value of the relevant series. In this case, the drawback is that the authors are assuming a static mechanism for the process according to which expectations are formed. Then, market expectations could differ from this restrictive assumption, and could undermine the analysis of the impact of the surprise. Fornari et al. (2002) also deals with non-scheduled macro announcements such as a declaration made by a treasury minister in a TV-interview on the tax treatment of bonds that is unexpected and will almost certainly affect assets' prices and volatility.

On the other side, Boyd et al. (2005) use their own time series model to forecast the expectations. In their case, they only focus on the study on the unemployment rate announcement and its unanticipated component. The rationale of the use of a time series model is that they do not follow the usual procedures commented above since they want to employ as much data as possible instead of being constrained by the length of the forecast surveys.

The simple calculation of the surprise as the difference between the actual announcement and its expectation has a problem as the units of measurement differ across the

economic variables. An alternative method, though much more popular used, consider news expressed in a standardised way dividing the surprise by its sample standard deviation:

$$Surprise_i \equiv \frac{(Actual_i - Forecast_i)}{\sigma_i} \tag{1.2}$$

The benefit of standardisation is that it allows comparing the size of the regression coefficients associated with surprises for all the different announcements (Chaudhry et al., 2005). As an example, Andersen et al. (2003) use this surprise definition as it facilitates interpretation and meaningful comparisons of responses of different exchange rates to different pieces of news. Nevertheless, the difficulty in obtaining the forecast remain, and then the above approaches in dealing with the expectation could be adopted in this method. Moreover, the method introduces the decision for the researcher of setting the relevant time frame of the standard deviation. A rolling standard deviation or the standard deviation of the whole sample could be alternatively used.

2.1. Actual Announcements and Surveys. The frequency of the databases used in the literature varies from low frequency (monthly) to high frequency (daily and intraday). The literature lacks analysis using transaction data, i.e. irregular spacing, as opposed to data which is aggregated into regular intervals or for which a representative value for some interval is chosen, i.e. regular spacing, such as daily, weekly, etc.

A key to the literature of the impact of news is the availability of data to express the surprise. Of course, this is the case if the researcher decides to denominate news using surveys to proxy the consensus numbers and not following the rest of the approaches (see Chapter 1, Section 2: Definition and scope of the news concept).

Most of the literature on news effect use Money Market Services International surveys (MMS, now a subsidiary of Standard and Poors') to gauge consensus estimates. MMS collects money-market economists' expectations for some of the series scheduled to be announced during the subsequent week. Among other authors, Flannery and Protopapadakis (2002) chose to use announcement surprises based on market participant surveys

rather than on econometric models, as in many previous studies. Boyd et al. (2005) justify the use of surveys as they more accurately capture contemporary market sentiment. At the same time, most econometric estimates of macro series innovations utilize revised data series, which are unavailable to market participants on the announcement date. The last point introduces another important issue: actual versus revised data. It is key to use actual announcement data series rather than its revised series. Many statistics are revised on later releases. The focus of the thesis is to understand the effect of surprises at the time of the announcement, that contain the values that were actually announced to the public at that moment (and not the ones later revised).

Bloomberg is the alternative to gather announcement surveys as it is the most used source by practitioners to check for economic announcements. Bloomberg allows building the surprises as it offers both the macroeconomic actual series and their surveys. Chapter 2, Section 3 Economic Announcements, describe the data set used in the thesis.

2.2. Index of Surprises. A practitioner approach to deal with economic surprises is to construct economic announcements surprise indexes. This section contains the description of JPMorgan surprise index called Economic Activity Surprise Index (EASI) used in currency markets. According to JPMorgan (2002) surprise indexes are needed to interpret fundamentals in a more systematic way. The key is to focus on investors perceptions of growth rather than trying to forecast growth per se, as shifts in growth perceptions are critical in financial markets expectations. For example, a series of positive surprises on activity data releases is likely to induce greater optimism on growth in investors, whereas a series of negative surprises is likely to induce greater pessimism. Consequently, JPMorgan (2002) affirms that tracking the recent history of activity data surprise is an attempt to capture investors perceptions of growth.

The methodology followed by JPMorgan (2002) in selecting the economic data releases to use follows a simple rule of only looking at the data that has a clear impact on the outlook on growth. Then, they discard inflation-related data (such as PPI and CPI), inventory data, and balance of payments data, ending with around 25 regular data releases.

JPMorgan (2002) found that stratifying the data by importance does not improve the accuracy of the final index.

Their treatment of the surprise is defined imposing a threshold of +/-0.5 standard deviations for all monthly and quarterly data and +/-1 standard deviations for the more frequent data (i.e. jobless claims) of the historic deviations of the actual number from consensus. Then, they draw on a balanced diffusion index to transform the surprises into an index by taking the net balance of activity surprises (positive minus negative) over a period and dividing it by the total number of releases over a 6 weeks period. According to them, this is less volatile than 4 weeks (i.e. less switches in signal a year), but still appears to capture changes in perception and turns out to give one of best trading performances. Then, a reading above zero, implies a positive balance of upside surprises over the past 6 weeks, and a reading below zero implies a negative balance.

JPMorgan (2002) use the index to extract buy or sell signals for the USD. But, in order to attain some leading indicator characteristics, they concentrate on the change in the pace of the index, rather than waiting for the index to cross from a positive balance to a negative one. Therefore, they compare the headline EASI to its 20-day moving average: a move below the moving average implies deteriorating perceptions (i.e. pessimism), while a move above implies improving perceptions (i.e. optimism). Finally, to avoid more unclear signals arising when the EASI is hugging the 20-day moving average, JPMorgan (2002) impose an additional 0.5 standard deviation threshold around the moving average to introduce a neutral zone (if the EASI lies between the 0.5 standard deviation band either side of the 20-day moving average).

Chapter 4, Section 3 Surprises' Accumulation, presents a more detailed description of the index of surprises.

3. Micro Effect of Macro News

Though the main research issues deal with the impact of macro news on the Term Structure of interest rates, this section contains a short presentation of the main papers on the impact of news on Stocks and Currencies. It is relevant to review the commented

literature as it has a strong connection with the literature concerning interest rates, while each research division has its influence over the other divisions.

3.1. Impact on Stocks. Numerous studies analyze the effect of new information about fundamentals on stock market prices. The theoretical effects of such announcements are often ambiguous for stocks as their prices depend on both cash flows and the discount rate, while for example bonds prices depend only on the discount rate. According to Flannery and Protopapadakis (2002) identifying macro variables that influence aggregate equity returns has two direct benefits. First, it may indicate hedging opportunities for investors. Second, if investors as a group are averse to fluctuations in these variables, these variables may constitute priced factors.

The work of McQueen and Roley (1993) differs from early works (Geske and Roll, 1983; Pearce and Roley, 1985; Chen et al., 1986 and Cutler et al., 1989) as it introduces the notion that business cycle matters on the effect of economic surprises. Prior studies neglected or simply avoided the changes in investors' response to news over different stages of the business cycle. McQueen and Roley (1993) argue that if the same type of news is considered good in some stages of the economy and bad in others, the response coefficient on the surprise in previous studies will be biased toward zero. Their business cycle variable is proxy using the index of industrial production. McQueen and Roley (1993) do not use the National the Bureau of Economic Research (NBER) business cycle turning points as a classification of different levels of economic activity. The authors argue that NBER classify the direction of economic activity (i.e. expansion or recession) rather than the level. This leave them with a much subjective definition of the cycle. At the same time, they only estimate how markets respond to news for the 932 days on which announcements are made, instead of dealing with the 3800 days of their sample. Their analysis is focused with the effect of surprises of only nine preselected economic announcements, which leave a limited General Unrestricted Model (GUM). The model used in their paper is the following:

$$\Delta P_t = a + H_t X_t^u b^H + M_t X_t^u b^M + L_t X_t^u b^L + d + e_t \tag{1.3}$$

where: ΔP_t is the percentage change in stock prices or change in interest rates (measured in basis points) from business day t-1 to business day t; X_t^u is the 1x9 vector of unanticipated components of economic announcements, calculated as $X_t^a - X_t^e$; X_t^a is the 1x9 vector of economic announcements; X_t^e is the 1x9 vector of expected economic announcements; d is a 1x4 vector of day of the week dummy variables for Monday through Thursday; e_t error term; a, b scalar and 9x1 vector of coefficients, respectively; $H_t = 1$ if economic activity is in the high state at time t, and zero otherwise; $M_t = 1$ if economic activity is in the medium state at time t, and zero otherwise; and $L_t = 1$ if economic activity is in the low state at time t, and zero otherwise. The results suggest that good news about economic activity in the high state is bad news for the stock market. Unanticipated increases in both the merchandise trade deficit and the PPI have significant negative effects on stock prices in the high output state. Money announcement surprises affect stock prices in both high and medium states, but the sign of the response is the same across all three states. Finally, CPI announcements produce mixed results, with a positive coefficient in the high state.

On an even more focused scope, Boyd et al. (2005) only investigate the unemployment rate announcement, employing much longer time series as their forecast are constructed with a time series model. This last approach is a risky one, as its expectation assumptions could differ from actual market ones, and ultimately distorting the conclusions. Instead, McQueen and Roley (1993) use forecasts made by Money Market Services International (MMS) to identify the surprise elements. Boyd et al. (2005) approach also introduce an asymmetry analysis of the announcements depending on the economic cycle. A different path of research, more based on the econometric modelisation versus a conditional approach, is introduced by Flannery and Protopapadakis (2002). The authors identify as a potential risk factor any macro announcement series that either affects returns or increases the market's conditional volatility. Their methodological approach differs from the simplest single factor case in which researchers regress the market's return (r_t) on a potential factor's (Z) "surprises", $Z_t = Z_t - E_{t-1}(Z_t)$:

$$r_t = E_{t-1}(r_t) + \beta Z_t + u_t \tag{1.4}$$

This methodology has been unsuccessful in detecting robust effects on aggregate equity market returns. This is due to the fact that estimated coefficients may therefore fail to identify a factor candidate whose effect switches sign and averages close to zero over time, or is occasionally important. Moreover, using a fixed-coefficient model to estimate time-varying coefficients on the announcement surprises causes the estimated residuals to be heteroscedastic. Then, they introduce a GARCH model for the conditional variance. The paper uses seventeen macro series' announcements over the 1980-1996 period. Their model adds lagged conditioning variables and a set of calendar dummy variables to a standard GARCH (1,1),

$$r_t = E_{t-1}(r_t) + \sum_{n=1}^{17} \beta_n \left[F_{nt} - E_{t-1}(F_{nt})\right] + u_t, \tag{1.5}$$

$$E_{t-1}(r_t) = r_0 + \Psi X_{t-1} + \sum_{w=1}^{4} \omega_w DW_{wt} + \sum_{k=1}^{6} \lambda_k DJ_{kt}, \tag{1.6}$$

$$u_t \equiv h_t \epsilon_t, \qquad \text{where } \epsilon_t \sim N(0,1) \text{ and i.i.d.,}$$

$$h_t^2 = \left\{ h_0^2 + \rho_1 \frac{h_{t-1}^2}{\Gamma_{t-1}} + \theta_1 u_{t-1}^2 + \gamma_p JPRE_{t-1}^2 + \gamma_t TB3M_{t-1}^2 \right\} * \Gamma_t \tag{1.7}$$

$$\Gamma_t = Exp\left\{ \sum_{w=1}^{4} \phi_w DW_{wt} + \phi_r PRE_t + \phi_S POST_t + \sum_{n=1}^{17} f_n DF_{nt} \right\}, \tag{1.8}$$

where: r_t = the realized market return on day t; $E_{t-1}(r_t)$ = the (possibly time-varying) expected return for day t; F_{nt}= the true value of the n^{th} risk factor, n=1, ...,N; β_n = the sensitivity of the market return to unanticipated changes in the n^{th} factor; r_0= a constant return; X_{t-1} = a vector of conditioning variables; h_t = the conditional standard deviation of the error term u_t.The following parameters are constrained to be non negative: $h_0, \rho_1, \theta_1, \gamma_p, \gamma_t$, while the others have unrestricted signs.

The return generating function (1.5) is a multifactor representation that equates factor surprises with the surprise components of seventeen macro announcement series. The market's expected return (1.6) depends on a standard set of predetermined variables: 1) Six financial variables (X_{t-1}) that previous research has shown to influence conditional expected returns: the 3-month Treasury bill rate (TB3M), the junk bond premium (JPRE), the Treasury term structure premium (TPRE), and the own stock return, the

dividend-price ratio (DIVPRI), and the log of the market portfolio's value (LMV); 2) Dummy variables (DW_{wt}) for four of the five weekdays (Wednesday is the excluded day); 3) The "January effect" is captured by six dummy variables (DJ_t), which identify the last 3 days in December, the last trading day of the year, and each of the first four weeks in January. For days with no macro announcements, the bracketed terms in (1.7) specify that the conditional variance depends on an ARMA(1,1) process and two lagged bond market variables. Coefficient restrictions guarantee that this part of the conditional variance is positive. This term is then multiplied by Γ_t, a function of dummy variables: PRE_t and $POST_t$ are equal to unity on trading days that immediately precede (PRE_t) and follow ($POST_t$) a holiday. DF_n are zero-one dummy variables that correspond to the announcement dates of each of the distinct macro series. At the same time, the authors assume that scheduled macro announcements have a multiplicative effect on conditional variance. The exponential form of Γ_t in equation (1.8) assures that the estimated conditional volatility will be positive, even though the signs of the dummy variable coefficients have no constraints. The paper finds that six of the seventeen macro variables are strong risk factor candidates: two inflation measures (CPI and the PPI) affecting only the level of the market portfolio's returns and three real factor candidates (Balance of Trade, Employment/Unemployment, and Housing Starts) affecting only the returns' conditional volatility. They subject the results to a series of robustness tests: (i) separating the sample into three economic "regimes" defined according to the level of economic activity, (ii) estimating simultaneously the model for three contiguous subperiods, and (iii) using six instruments, one at a time, to model directly nonlinearities in the coefficients. The six announcement variables significantly affect equity returns in all the model variations. The same factors also significantly increase stock market trading volume, while the other macro announcements do not.

3.2. Impact on Currencies. As with the rest of the markets, data watching has long been known to be an important part of the daily routine of foreign exchange traders (Galati and Ho, 2003). In general, the literature on the impact of news on foreign exchange assumes that markets are efficient, as all the relevant information is already discounted

in the prevailing exchange rates. Then, only the arrival of unanticipated information can cause market changes. Harris and Zabka (1995) study the behavior of the dollar/mark and dollar/yen rates in the 1980s and mid-1990s and found that news about non-farm payrolls in the United States has a positive and statistically significant, albeit economically very small, effect on the dollar. Tivegna and Chiofi (2004) investigate the effect of news on the daily data of dollar/mark and dollar/yen exchange rates in different trading zones during the period 1995-97. They distinguish news about macroeconomic data releases and about public statements by policymakers. They find evidence of a statistically significant average impact of public statements on both exchange rates. Recently, the literature has increasingly looked at intra day data. This data span allow a more precise determination of the timing of news arrivals. Almeida et al. (1998) analyze the effect of news about US and German fundamentals on the dollar/mark rate using data sampled at five-minute intervals over the period 1 January 1992 to 31 December 1994. As expected, positive news about the US cycle is found to be associated with a dollar appreciation. Another key result of the paper is that the effect of news was statistically significant only up to two hours after the announcement (Galati and Ho, 2003). Recently a series of papers by Evans and Lyons (2002, 2003 and 2004) relate news and foreign exchange market microstructure. Evans and Lyons (2003) use an intraday and a heteroscedasticity-based approach to argue that at least half of the effect of macro news on exchange rates are transmitted via the transactions process. Evans and Lyons (2004) develop a model that examines how information is aggregated in a dynamic general equilibrium (DGE) setting.

An example of a simple one factor model to study the impact of American and European news over the euro dollar exchange rate can be found in Galati and Ho (2003). The alternative models in this paper, though extremely simple and restricted, show the possibility of asymmetries and coefficient time variation via a rolling regressions over three-month windows. The authors could have added some conditional variable to check if the time variability is due to some specific variable. The specific equations in Galati and Ho (2003) are consistent with prior literature:

$$\Delta \ln S_t = \alpha + Z_t + \sum_{k=1}^{k} \sum_{j=0}^{5} \beta_{k,t-j} X_{k,t-j} + \epsilon_t \tag{1.9}$$

where S_t is the exchange rate, quoted in dollars per euro, on date t; $X_{k,t}$ is the surprise on the k^{th} macroeconomic announcement at date t; α is a constant and Z_t is a vector of additional explanatory variables, which include four lags of the dependent variable plus a fifth lag in levels, as well as weekday dummies (Monday to Thursday) capturing day-of-the-week effects. The authors also consider the possibility of a four-way asymmetry, i.e. good news versus bad news, in US versus in the euro area:

$$\begin{aligned} \Delta \ln S_t &= \alpha + Z_t + \sum_{j=0}^{5} \beta_{t-j}^{G} D_{t-j}^{US,G} + \sum_{j=0}^{5} \beta_{t-j}^{B} D_{t-j}^{US,B} + \\ &+ \sum_{j=0}^{5} \delta_{t-j}^{G} D_{t-j}^{EU,G} + + \sum_{j=0}^{5} \delta_{t-j}^{B} D_{t-j}^{EU,B} + \epsilon_t \end{aligned} \tag{1.10}$$

where the superscript G and B denote good (positive) news and bad (negative) news respectively.

Andersen et al. (2003) focus on the effect of news over conditional means of US dollar spot exchange rates for German Mark, British Pound, Japanese Yen, Swiss Franc and the Euro. The scope of the paper is based on the conditional mean due to its intrinsic interest, and because high-frequency discrete-time volatility can not be extracted accurately unless the conditional mean is modelled adequately. The returns estimated model is a linear function of I lagged values of itself, R_t and j lags of news on each of K fundamentals.

$$R_t = \beta_0 + \sum_{j=1}^{I} \beta_i R_{t-i} + \sum_{k=1}^{K} \sum_{j=0}^{J} \beta_{kj} S_{k,t-j} + \epsilon_t, \qquad t = 1, ..., T. \tag{1.11}$$

The estimation use a two-step weighted least squares (WLS) procedure. First, they estimate the conditional mean model (1.11) by ordinary least squares regression, and then estimate the time-varying volatility from the regression residuals, which they use to perform a weighted least squares estimation of (1.11). They approximate the disturbance

volatility using the model:

$$\begin{aligned} |\widehat{\epsilon}_t| &= C + \Psi \frac{\widehat{\sigma}_{dt}}{\sqrt{288}} + \sum_{k=1}^{K} \sum_{j\prime=0}^{J\prime} \beta_{kj\prime} |S_{k,t-j\prime}| + \\ &+ \left(\sum_{q=1}^{Q} \left(\delta_q \cos\left(\frac{q2\pi t}{288} \right) + \varphi_q \sin\left(\frac{q2\pi t}{288} \right) \right) + \sum_{r=1}^{R} \sum_{j\prime\prime=0}^{J\prime\prime} \gamma_{rj\prime\prime} D_{r,t-j\prime\prime} \right) \\ &+ u_t \end{aligned} \tag{1.12}$$

The left-hand-side variable is the absolute value of the residual of equation (1.11), which proxies for the $|\widehat{\epsilon}_t|$ volatility in the 5-minute interval t. As revealed by the right-hand side of equation (1.12), Andersen et al. (2003) model 5-minute volatility as driven partly by the volatility over the day containing the 5-minute interval in question, $\widehat{\sigma}_{dt}$, partly by news $S_{k,t}$, and partly by a calendar effect pattern consisting largely of intraday effects that capture the high-frequency rhythm of deviations of intraday volatility from the daily average. Only seven of the forty announcements (including German announcements) significantly impacted all the currency specifications. According to Andersen et al. (2003) the reason is that many of the announcements are to some extent redundant and the market then only reacts to those released earlier. The announcements released earliest tend to have the most statistically significant coefficients and the highest values. The authors show that announcement surprises produce conditional mean jumps, that occur quickly, in contrast to conditional variance adjustments, which are much more gradual. The announcement impact depends on its timing relative to other related announcements (earlier economic announcements have more effect than later ones).

An interesting issue of Andersen et al. (2003) is that they analyse whether the news effects vary with the sign of the surprise. Their central equation (ex-ante of the introduction of asymmetries) is:

$$R_t = \beta_k S_{kt} + \varepsilon_t \tag{1.13}$$

where R_t is the 5-minute return from time t to time t+1 and by S_{kt} is the standardised news corresponding to announcement k at the time t, and the model is based only on those observations such that an announcement was made at time t. To address the issue of asymmetries they generalise allowing the impact response coefficient to be a linear

function of the news surprise β_k, allowing for a different constant and slope on each side of the origin,

$$\beta_k = \left\{ \begin{array}{l} \beta_0 + \beta_1 S_{kt} \quad \text{if } S_t \leq 0 \\ \beta_2 + \beta_3 S_{kt} \quad \text{if } S_t > 0 \end{array} \right\} \tag{1.14}$$

Inserting these equations into (1) yields the impact response specification,

$$R_t = \left\{ \begin{array}{l} \beta_0 S_{kt} + \beta_1 S_{kt}^2 + \varepsilon_t \quad \text{if } S_t \leq 0 \\ \beta_2 S_{kt} + \beta_3 S_{kt}^2 + \varepsilon_t \quad \text{if } S_t > 0 \end{array} \right\} \tag{1.15}$$

Following Engle and Ng (1993), they call the union of $\beta_0 S_{kt} + \beta_1 S_{kt}^2$ to the left of the origin and $\beta_2 S_{kt} + \beta_3 S_{kt}^2$ to the right of the origin the "news impact curve.". Their study report that on average the effect of macroeconomic news often varies with its sign. In particular the Engle and Ng news impact curve tracks the variance of equity returns conditional upon the sign and size of past returns. Andersen et al. (2003) find that negative surprises often have greater impact than positive surprises. Nevertheless, Andersen et al. (2003) dataset is not well-suited for that purpose, as it contains only the expansionary 1990s.

The next section deals with a detailed literature review of term structure of interest rates and news.

4. Term Structure of Interest Rates and News

Sovereign bonds (specially default free instruments) differs from stocks and corporate bonds as there is almost no asset-specific or private information behind its pricing. Then, the valuation of government bonds rest on public information such as the economic fundamentals and its updates (economic announcements). As stated in Clare and Courtenay (2001), if the aims of monetary policy are clear, the interest rate decisions themselves will usually be less newsworthy and so will provoke little reaction in financial prices. Then, when the monetary policy process becomes more transparent, the reaction to these macroeconomic announcements could therefore increase while the reaction to interest rate decisions declines. Nevertheless, monetary policy will never be completely dependent on news as the process of converting raw, publicly available data into an interest rate decision is not mechanical. There is a growing body of theoretical and applied literature dealing

with the effect of surprises of macroeconomic announcements on the government fixed income markets. The following sections will critically pass review to several key papers of the literature.

4.1. Initial Studies. The study of the effect of news over sovereign bond prices initially was more concentrated on monetary variables due to the intrinsic importance of them in the time under study. A good example of this kind of papers are: Dwyer and Hafer (1989) and Cook and Korn (1991). Fleming and Remolona (1997) review the first approaches in the literature. Ederington and Lee (1993) use intraday data for T-bond, Eurodollar and dollar/Deutsche Mark futures contracts to identify the US macroeconomic news announcements that had the greatest impact. In their regression analysis the announcements are represented by dummy variables (D_{kt}) in Ordinary Least Squares (OLS) regressions. The dependent variable is the absolute value of the difference between the actual return R_{jt} for the five-minute interval on day t and the mean return $\overline{R}_j$ for interval j, then the model is:

$$\left|R_{jt} - \overline{R}_j\right| = a_{0j} + \sum_{k=1}^{k} a_{kj} D_{kt} + e_{jt} \tag{1.16}$$

Nine out of the sixteen announcements (k) show significant price effects. The biggest impacts reported come from PPI, CPI, employment and durable orders. The authors find that the majority of the price adjustment in their sample occurred within the first minute, with subsequent price movements seemingly independent of this first-minute change. The study lacks an analyses of the surprises and not only limiting it to the occurrence of an announcement. A later paper of the same authors, Ederington and Lee (1995), focuses on price behavior from the 2 minutes prior to the announcements to 10 minutes after. Krueger and Forston (2003), in a similar vein as Boyd et al. (2005) study the market rationality of bond price responses to labor market news. His focus is on market reaction to the availability of more reliable information, as the unemployment data were revised.

4.2. Surprises and Market Microstructure. Different authors started taking advantage of the use of market expectations and a growing interest on market microstructure. Fleming and Remolona (1997) use inter-dealer and intraday data for the U.S. T-bond market and focus on the possible implications that a particular market microstructure has

on the absorption of scheduled macroeconomic news announcements. The authors study the reactions of price changes and also trade volume to the announcements and surprises. Fleming and Remolona (1997) work with 21 different macroeconomic announcements. A limitation of their works is that it only analyses one year of data: August 23^{rd}, 1993, to August 19^{th}, 1994. The authors follow a common practice in the literature which is to first establish the importance of the various announcements by running regressions of price and trading activity on dummy variables representing each of the announcements, where D_{knt}=1 if announcement k is made on day n just before interval t and D_{knt}=0 otherwise. They measure price volatility by the absolute value of the change in log prices in the five minute interval following an announcement, with prices defined as the midpoints between bid and ask quotes. Trading activity is measured as the number of transactions during the one-hour interval following the announcement. Their results suggest that the bond market differentiates among the various types of announcements through the magnitude of its price movements. As expected, the announcements that matter for price also tend to matter for trading activity. Then, Fleming and Remolona (1997) regress five-year U.S. Treasury note price changes and trading activity on the surprise components of announcements. Surprises are defined as $S_{knt} = A_{knt} - F_{knt}$, where A_{knt} is the actual number released in announcement k on day n in interval t and F_{knt} is the corresponding forecast number (S_{knt}=0 on days and in intervals without a release of announcement k). Despite each announcement typically reveals several pieces of information, they restrain their analysis to surprises in the headline number. For example, in the case of the employment report they only include nonfarm payroll employment surprises. Surprises are scaled by the mean absolute surprise , $\overline{S}_k = \frac{1}{N_k} \sum_n |S_{knt}|$,where N_k is the number of releases of announcement k in our sample, and the regression equation for bond prices is given by:

$$Z_{nt}^P = a_0^P + \sum_{k=1}^{k} c_k^P \frac{S_{knt}}{\overline{S}_k} + u_{nt}^P \tag{1.17}$$

where Z_{nt}^P is the signed price change. In the case of trading activity, the equation is similar. This study finds twenty one out of twenty five significant variables. When they analyze the case of trading activity, it is much less clear that taking account of the magnitude of the surprise helps explain the bond market's response to announcements.

The authors also follow a similar approach to McQueen and Roley (1993) introducing state of the world variables to check the sensibility of the coefficients. Specially, they use a measure of implied volatility or the expected change in the Fed funds rate as a proxy for market conditions. The announcements surprise coefficients depend on uncertainty, $c_k^P = g_k^P + h_k^{Pi} V_n^i$ and $c_k^Q = g_k^Q + h_k^{Qi} V_n^i$, where V_n^i is one of the two measures of uncertainty and the coefficients h_k^{Pi} and h_k^{Qi} measure the influence of uncertainty on announcement effects. The regression equation for bond prices then becomes

$$Z_{nt}^P = a_0^P + \sum_{k=1}^{k} g_k^Q \frac{S_{knt}}{\overline{S}_k} + \sum_{k=1}^{k} h_K^{Pi} V_n^i \frac{S_{knt}}{\overline{S}_k} + u_{nt}^P \tag{1.18}$$

The results confirm that price responses are greater under conditions of increased uncertainty. In the case of trading activity, market uncertainty helps explain the trading surge that follows announcement surprises. According to Fleming and Remolona (1997) these results suggest that uncertain market conditions contribute to the divergence in traders' interpretations of announcement surprises. Taking account of the surprise component in a report's announced numbers extends their list of announcements that significantly affect bond prices from nine to thirteen, longer than any such list in previous studies. Greater market uncertainty also leads to a stronger market response, particularly in the form of increased trading activity.

A later study by Fleming and Remolona (1999) found that the reactions to macroeconomic announcements were the strongest for intermediate maturities (one to five years), creating a hump-shaped pattern in announcement effects. They attributed this result to the Federal Reserve's preference for interest rate smoothing, namely the practice to adjust interest rates in small steps towards a somewhat longer-term target.

Using 26 different economic news announcements (3 are monetary aggregates), Balduzzi et al. (2001) investigate the response on the three-month bill, the two and ten-year note, and a thirty-year bond intraday data. They find using data from the 90's that both positive real shocks and positive inflation shocks affect bond prices negatively and that the absolute size of news effects generally increases with the maturity of the instrument. Balduzzi et al. (2001) model regress price changes on the surprise in the economic variable

being studied and the surprises in variables announced simultaneously:

$$\frac{(P_{30it} - P_{5it})}{P_{5it}} = \beta_{0i} + \beta_{1i} S_{it} + \sum_{k=1}^{k} \beta_{k+1,i} S_{i_k t} + e_{it} \tag{1.19}$$

where P_{30it} is the price thirty minutes after announcement i at time t; P_{5it} is the price 5 minutes before the announcement at time t; β_{1i} is the sensitivity of the price to the announcement; k denotes the k-th announcement concurrent with announcement i, and K is the total number of concurrent announcements; $S_{i_k t}$ is the standardised surprise in the k-th announcement concurrent with announcement i at time t; $\beta_{k+1,i}$ is the sensitivity of the price to the k-th announcement concurrent with announcement i. A total of seventeen economic announcements have a significant impact on the price of at least one of the analysed instruments. Contrary to Fleming and Remolona (1997), Balduzzi et al. (2001) add some reports announced in the same day, tending to reduce the preselection bias as each announcement typically reveals several pieces of information. The paper has a microstructure approach as it also deals with the effect over trading volume. It concludes that there is a strong association between announcements and trading volume, while bid-ask spreads widen immediately after most economic announcements, but then return to normal levels within 5 to 15 minutes.

Another microstructure study is performed by Green (2004). The paper studies the impact of government bond trading on transaction prices surrounding the release of economic news. A significant increase in the adverse selection component of the bid-ask spread is reported, which suggests a rise in the level of information asymmetry and an increase in the informational role of trading.

The information content of releases and the structure of the announcement cycle is closely investigated by Hess (2001). The main hypothesis in Hess (2001) states that the value of the information contained in a release decreases with the number of previously released figures falling into the same content category. The study finds that the impact of surprises reveals that the sequence of releases within content categories is important. This result suggests that market participants consider various aspects of inflation and economic growth to be relevant in order to determine the equilibrium long-term interest rate. Moreover, it implies that the information value of an additional release for a given month

decreases with the number of already available figures providing a similar content. The work of Hess (2001) is based on 24 headline figures, that is, figures that summarise major parts of the information contained in a release. As opposed to Fleming and Remolona (1997), Hess (2001) uses an extended sample of intraday data investigating tick-by-tick T-bond futures prices from 1994 to 1999. The model is a simple one factor model where future prices variation is a function of surprises,

$$\Delta P_i = \sum_j \alpha_j (A_j - F_j) D_{j,i} + \varepsilon_i \tag{1.20}$$

where A_j denote the announced value of the j^{th} headline figure. $D_{j,i}$ is a dummy variable equal to one if A_j arrives during the time interval $(t_i, t_i+\Delta t)$; F_i market participants' forecasts of these figures. The input for the surprises are the median forecast of analysts surveyed by Standard & Poors, Global Markets Division (also known as MMS). The surprise is not scaled by any term which complicates intra-announcement comparisons. Hess (2001) argument for the use of this model is based on the fact that investigates price reactions in very narrow time windows around announcements, so then the impact of this error should be small and have zero expectations.

The microstructure approach also studies the effect of news over the conditional volatility. Jones et al. (1998) study the effects of announcements of employment and PPI on the conditional volatility of the excess returns of three different U.S. government bonds using daily data. The conditional variance is assumed to evolve according to a univariate Generalized Autoregressive Conditional Heteroscedasticity GARCH process, which is extended to include level as well as persistence differences on announcement and non-announcement days. Engle and Li (1998) study the volatility reaction of the Treasury futures market to the U.S. macroeconomic announcements. The paper presents strong asymmetric effects of scheduled announcements, as positive shocks depress volatility on consecutive days, while negative shocks increase it. The impact on the short run is big in comparison with the small persistence.

4.3. Maturity Reactions and International Studies. Another alternative study is the different effect of news over rates of different maturities. Theoretically, the term

structure should capture different aspects of monetary policy. Movements in the longer end of the yield curve capture immediate monetary policy expectations, as well as medium-term monetary policy and inflation expectations, while short term rates best denote expectations of immediate monetary policy. Burrows and Wetherilt (2004) look at the high-frequency reaction of the yield and trading volume of a short term interest rate futures contract (sterling) to the release of macroeconomic indicators. The Short Sterling future contract is a three-month interest rate, deliverable 0 to 3 months forward. The paper rejects the idea that increased transparency since the Bank of England was granted independence in June 1997 led to a larger change in price following macroeconomic news while confirms that increased transparency led to prices incorporating news more quickly.

Gürkaynak et al. (2003) reveals that long-term forward interest rates in the US often react considerably to surprises in macroeconomic data releases and monetary policy announcements. This contradicts the prediction of many macroeconomic models predicting that long-run properties of the economy are time-invariant and perfectly known by all economic agents. Then, the paper findings suggest that private agents adjust their expectations of the long-run inflation rate in response to macroeconomic and monetary policy surprises.

Burger (2004) finds empirical support for the policy anticipation hypothesis utilizing the Federal funds futures market to proxy for policy expectations. The policy anticipation hypothesis suggests that bond yields react to economic news due to its implication for future monetary policy decisions. The results indicate that once the Fed funds futures reaction is included in the model (three month Federal funds futures contract as a measure of policy expectations) the impact of many announcements on bond yields becomes statistically insignificant. Burger (2004) deals with 17 headline macroeconomic announcements while the surprises are built dividing the difference between the actual release and the survey data by the mean absolute surprise.

Among the studies that analyse international effects of news, Becker et al. (1995) examine the impact of 9 US and 9 UK news on futures prices of US, UK, German and Japanese government bonds. The usual highlight is that the US information has a significant influence on the rest of the countries while UK information has almost no effect on

foreign rates. On the same vein, but dealing with monthly data, Bruno et al. (2001) evaluate responses of US, Japan, and Euro-area yield curve to macroeconomic announcements, confirming the effects of those variables over the whole yield curve.

Andersen et al. (2005) typify the response of US, German and British stock, bond and foreign exchange markets to real-time US macroeconomic news using a high frequency futures returns data set. In their case, as in Andersen et al. (2003) news surprises produce conditional mean jumps and they verify contemporaneous linkages across all markets and countries over-and-above the direct news announcement effects. The research has it limits as it only deals with long term bonds and studies 25 economic announcements.

4.4. Equilibrium Framework. New approaches such as Chaudhry et al. (2005) investigate the impact of a broad set of unanticipated U.S. macroeconomic news on the daily yields of several debt instruments, as well as on term and quality spreads. The paper differs from prior literature as it applies an equilibrium framework using the cointegration methodology to study the joint behavior of long- and short-term rates and interest rate on default-prone and default-free securities. Then, their methodology rests on a Vector Error-Correction Estimation procedure (VECM) that captures the dynamic causal relationships and explicitly incorporates the role of macroeconomic surprises on yield spreads. The period covered is February 1991 to September 2000, using the Fed funds rate (FFR), the 3-year Treasury note rate (3YR), the 10-year Treasury note rate (10YR), the 30-year Treasury bond rate (30YR), the prime interest rate (PR) and the Moody's Baa corporate bond rate (Baa). Chaudhry et al. (2005) construct three daily measures of term spreads and two daily measures of quality spreads. The term spreads are computed as follows: 3YR minus FFR, 10YR minus FFR, and 30YR minus FFR. The quality spread indicators are PR minus 3YR and Baa minus 30YR. The consensus estimates source is Money Market Services (MMS) while the value of the surprise of 23 types of macroeconomic announcements follows the standardised or normalised definition. The essence of a cointegrating relationship is that the variables in the system share a common unit root process. The authors investigate the existence of a long-term equilibrium relationship

across the various interest rates employing the maximum-likelihood test procedure established by Johansen and Juselius (1990) and Johansen (1991). Then, VECM to estimate is the following:

$$\Delta Y_{1,t} = \mu_1 + \sum_{k=1}^{6}\sum_{j=1}^{m}\gamma_{1,k,j}\Delta Y_{k,t-j} + \sum_{i=1}^{23}\phi_{1,i}A_i + \sum_{l=1}^{h}\delta_{1,l}z_{l,t-1} + \varepsilon_{1,t} \tag{1.21}$$

$$\Delta Y_{2,t} = \mu_2 + \sum_{k=1}^{6}\sum_{j=1}^{m}\gamma_{2,k,j}\Delta Y_{k,t-j} + \sum_{i=1}^{23}\phi_{2,i}A_i + \sum_{l=1}^{h}\delta_{2,l}z_{l,t-1} + \varepsilon_{2,t}$$

$$\cdots$$

$$\cdots$$

$$\cdots$$

$$\Delta Y_{6,t} = \mu_6 + \sum_{k=1}^{6}\sum_{j=1}^{m}\gamma_{6,k,j}\Delta Y_{k,t-j} + \sum_{i=1}^{23}\phi_{6,i}A_i + \sum_{l=1}^{h}\delta_{6,l}z_{l,t-1} + \varepsilon_{6,t}$$

where Δ is the first-difference operator, $Y_{1,t,}.....Y_{6,t}$ represents the daily interest rates for the six debt instruments, A_i is a vector of exogenous variables that contains the surprise information associated with the ith macroeconomic variable (with i = 1,2,...,23), z_t is the error-correction term and $\varepsilon_{1,t}....\varepsilon_{6,t}$ are the residuals. The coefficients $\phi_{1,1}....\phi_{6,23}$ measure the impact of each of the announcements on interest rates. The error-correction term measures the deviations of the series from the long run equilibrium relation. This deviation affects the short-run behavior of ΔY with the error coefficients $\delta_{1,l}...\delta_{h,6}$ describing how quickly the interest rate variables respond to the deviations.

Following a similar VECM, Chaudhry et al. (2005) also examine the impact of the surprises on the spreads as themselves exhibit nonstationarity and cointegration. The evidence in Chaudhry et al. (2005) suggests that all of the interest rates are integrated of order one, I(1) while other tests show that results indicate the presence of a long-run, equilibrium relationship among the various yield spreads. Changes in the Fed funds rate significantly influences every other security in the system, with the exception of corporate bonds, but is itself largely insulated from the movement in yields of other securities. Chaudhry et al. (2005) report that 17 out of 23 of the macroeconomic news releases have a significant influence on the daily change in interest rates. The results of Chaudhry

et al. (2005) for the quality spread show more variability as the 3-year quality spread measure is seen to be more sensitive to macroeconomic news announcements than the corresponding 30-year quality spread measure. In general, there are more macroeconomic news impacting yield changes than impacting credit spreads.

Another interesting paper is the Kim et al. (2004) as it simultaneously test across financial markets when considering the impact of news announcements by adopting a unified methodology. The paper only deals with six economic announcements on the mean and volatility of returns in US equity, bond and foreign exchange markets in the period beginning January 2, 1986 to December 31, 1998. Also it introduces a GARCH model *a la* Flannery and Protopapadakis (2002). Nevertheless, the best approach to analyze simultaneous effects should be the use of a VAR model. The markets are represented by the daily returns data for the Dow Jones index, the JPY/USD and DEM/USD, and the daily continuously compounded excess return of the US 10-year bond over the 3-month Treasury bill. News are defined as the percent deviation of actual (released) figures from a market expectation estimate, which is the median survey expectations estimate provided by Money Market Services International (MMS). Following previous studies, Kim et al. (2004) modelisation approach is divided in two steps. The first one considers the impact of the act of releasing macroeconomic news on financial markets per se and ignores the role which market expectations play in determining the response of the market to such news releases. The returns are modelled as a GARCH process. The second step incorporates information about expectations into the estimation procedure, including a positive (D_j) and negative (D_K) news dummy variable in both the mean and variance equation. Higher than normal market volatility is expected in response to both positive and negative news announcements as the market readjusts itself to this new information irrespective as to the nature of that information. Then, the model is the following:

$$R_t = \mu_0 + \sum_{i=MON}^{THU} \mu_i D_i + \sum_{j=BOT}^{PPI} \mu_j D_j + \sum_{K=NBOT}^{NPPI} \mu_k D_k + \epsilon_t \tag{1.22}$$

$$h_t = \alpha_0 + \alpha_1 \epsilon_{t-1}^2 + \beta_1 h_{t-1} + \sum_{i=MON}^{THU} \alpha_i D_i + \sum_{j=BOT}^{PPI} \alpha_j D_j + \sum_{K=NBOT}^{NPPI} \alpha_K D_k$$

where R_t represents the returns of each market under consideration, D_i are dummy variables included to capture daily seasonalities, D_j represents dummy variables which takes the value of unity on those days in which a scheduled news announcement occurs. In the variance equation, the intercept term α_0 measures the time-invariant component of volatility associated with no-news Fridays. The rest of the α coefficients measure the average volatility increment for each designated case.

The authors find that the news content of the announcements cause the market to react. The balance of trade news is important in terms of the mean return for the foreign exchange market. For the bond market, information relating to the external economy was not found to be significant. Negative news relating to the internal economy was found to be important primarily for the mean. Only retail sales news had a role in volatility of bond yields – and then only for the negative news case. In terms of the stock market, information relating to prices, appears to be the primary source of news to which the mean market return responds. The stock market exhibits a much richer volatility response to news.

5. Econometric Issues

Having provided a critical review of the literature on the micro effects of macro news, the typical weakness to address is that the literature usually start the model selection from a limited General Unrestricted Model (GUM) that only considered a pre-selected pool of economic indicators. If the researcher aim is to deal with a huge number of economic announcements the size of the models makes difficult the model selection procedure. Specially, the question on how to reduce the GUM to the local data generation process (LDGP[2]) raises naturally. In general, the amount of exogenous variables (announcements from the economic calendar) clearly points out to the impossibility to pick up easily a single model from the GUM. Moreover, the literature never analysed the effects of all the possible economic announcements. In our opinion, this is the case as the complexity of

[2]The data generation process (DGP) is the statistical process by which the data are generated, comprising the actions of the agents and the measurement system. The most general unrestricted model considered to characterize that DGP is called the GUM.

the models limited the analysis, and an adoption of automatic selection devices such as PcGets and RETINA will avoid pre-selection biases. The use of model selection techniques constitutes an important evolution in the way the literature handles with the myriad of economic indicators, without limiting the analysis to a subjective group of variables. This section presents the methodological issues related to the selection of the model.

5.1. Empirical Applications, Related Econometric Issues and the Role of PcGets. Economies are so high dimensional, nonstationary, and complicated that pure theory can never precisely specify the underlying process, and there are simply too many variables to rely solely on data evidence. Thus, according to Hendry and Krolzig (2004a) model selection methods must be used and the methodology thereof deserves careful attention. The advances in computer automation of general-to-specific (Gets) methods have improved the success rates of the approach and allowed operational studies of alternative tactics (Campos et al., 2003).

The General-to-Specific (Gets) model selection is a central feature of what is often referred to as the LSE methodological approach to econometric modelling (Owen, 2003). The theory explains how the data generation process (DGP) characterizing and economy is reduced to the local DGP (LDGP) , which is the joint distribution of the subset of variables under analysis. Briefly, it involves the formulation of a general unrestricted model that is congruent[3] with the data and the application of a testing down process, eliminating variables with coefficients that are not statistically significant, leading to a simpler specific congruent model that encompasses rival models (Hendry, 1995 and Owen, 2003).

Hoover and Perez (1999) take the first important steps in automating the Gets process, using a Monte Carlo (MC) simulation study to show the possibility of automating some of the key steps in modelling. They also examine multiple search paths, thus avoiding path dependency, which can affect the properties of a simplification algorithm based on a single search path. The discussion of Hoover and Perez paper produced a revolution on automatic model selection procedures (Hendry and Krolzig, 1999).

[3]Congruent is an estimated model with no significant mis-specifications with the available evidence.

As a consequence of the above methodological problems, there are several benefits from the use of a new econometric program: PcGets, which works following the general-to-specific modelling. General-to-specific (Gets) modelling consists of a cycle of three steps: formulation (or re-formulation), estimation and evaluation, and model simplification, the last of which PcGets can simplify. Besides, automatic methods can eliminate what would otherwise be intolerable computational burdens (Hendry and Krolzig, 2004b).

In what follows, the PcGets methodology is introduced relying on Hendry and Krolzig (1999, 2001a, 2001b, 2005), Hendry (2000, 2004), Greene (2003) and Advance Information Nobel (2003).

5.1.1. *PcGets.* PcGets is an automatic econometric model selection program, designed for modelling economic data when the precise formulation of the equation under analysis is not known a priori. It is an empirical econometric modelling program, which interfaces with GiveWin. Thus, it offers an extensive range of data transformations, preliminary data analyses such as correlations (data means, standard deviations, 3rd and 4th moments), normality tests, unit root tests, graphing and the creation of lags.In Monte Carlo experiments, PcGets recovers the DGP with accuracy close to what one would expect if the DGP specification were known. In line with the GiveWin family, model formulation is straightforward, and earlier models can be recalled and revised (Urga, 2001).

An initial general model (that embed all relevant information) is formulated in place of the DGP, i.e. the GUM. The GUM must be congruent with the available evidence, thus the algorithm first tests the GUM against a range of potential mis-specifications to ensure data coherence. Next, statistically insignificant variables are eliminated by selection tests, both in block and individually. Many reduction paths are searched, to prevent the algorithm from becoming stuck in a sequence that inadvertently eliminates a variable that matters, and thereby retains other variables as proxies. If several models are selected, encompassing choice remains, model-selection criteria are the final arbiter. Last, sub-sample significance helps identify spuriously significant regressors. PcGets checks that each simplification step is acceptable by the user's criteria and that more of the diagnostic test reveal an invalid reduction. Then, the final choice encompasses the GUM and is undominated by any other model.

PcGets adopt a multipath search strategy to avoid biased conclusions. The final model is the one such that further reductions will lose information. If it ends with several models, it looks for the union, or the smallest one that nests all the contenders. Also this basic algorithm is augmented by pre and post selection checks. Pre-selection checks: with loose significance level eliminates highly irrelevant variables. Also checks in the opposite direction from most significant, retain the highly significant. Post-selection: use overlapping split-samples to mimic the application of recursive estimator to assess the reliability of retained coefficients. The empirical success of PcGets depends on the creativity of the researcher in specifying a feasible, congruent general model for the available data, but the program implements many tests to check for model mis-specification. The user can choose different strategies to analyze any data set. The strategies are based on the results of hundreds of MC experiments, and are designed to minimize the probabilities of omitting DGP variables or retaining nuisance variables. The formulation of the initial general model is specified by the user with the desired selection criteria, then PcGets do the model selection.

5.1.2. *Model Selection and the Theory Behind.* The analysis will focus on the Automatic model selection feature of the PcGets due to the necessity to simplify the models and end up with a specific and well defined model. The recommended general-to-specific approach to model construction is automatically adopted, the sequence of reductions is monitored, and F-tests, information criteria etc. are reported. The pre-selection screening tests quickly eliminate irrelevant variables, using loose significance levels. Multi-path searches check for hidden relations, and highlight the relevant explanatory variables, while ensuring that all reductions are acceptable, with diagnostic tests remaining insignificant (Hendry and Krolzig, 2001a).

When the prior specification of a possible relationship is not known for certain, data evidence is essential to delineate the relevant from the irrelevant variables. Thus, selection is inevitable in practice. Some economists insist on imposing a priori specifications: but such claims assume knowledge of the answer before the investigation starts, so deny empirical modelling any useful role (Hendry and Krolzig, 2003). Chapter 2 relies on the empirical modelling, leaving aside any prior specification of the relative importance of

the economic statistics in their influence on the Fed funds implicit rates. If the path of deciding a priori the relevant variables the research would have lost its appeal.

All tentatively-selected contending models from pre-selection and path searches are retained and evaluated against each other and the joint model by encompassing. The final selection utilizes all the search, encompassing and information criteria collected during the analysis.

Two pre-specified selection strategies, denoted liberal and conservative, make for simple yet powerful automated modelling, either to minimize the chances of omitting relevant variables, or to minimize the chances of including irrelevant variables. Liberal strategy aims to keep as many as possible of the GUM variables that matter in the DGP. The risk is that it will retain variables more often. Conservative strategy: its users must be concerned to avoid retaining irrelevant variables. The risk is omitting variables that really matter in the DGP. The expert strategy allows all the program parameters (namely, significance levels of all the selection criteria) to be designed at choice. Nevertheless, attention has to been placed in avoiding internal consistencies when values are fixed. Campos et al. (2003) establish the consistency of the Liberal and Conservative selection strategies embodied in PcGets, and compare their performance with other model selection criteria.

PcGets embodies all the principles discussed in Hendry (1995):

1. The initial general statistical model is tested for congruence, which is maintained throughout the selection process by diagnostic checks, thereby ensuring a congruent final model;

2. Statistically-insignificant variables are eliminated by selection tests, both in blocks and individually. Many reduction paths are searched, to prevent the algorithm from becoming stuck in a sequence that inadvertently eliminates a variable that matters, and thereby retains other variables as proxies;

3. If several models are selected, encompassing tests resolve the choice; and if more than one congruent, mutually-encompassing choice remains, model-selection criteria are the final arbiter. Lastly, sub-sample significance helps identify spuriously significant regressors.

A flexibility of the PcGets is that the user can fix one variable to stay in the final model. Automating the reduction process will enable researchers to concentrate their efforts on designing the GUM, which could significantly improve the empirical success of the algorithm.

The validity of a selected model depends primarily on that of the GUM as an approximation to the DGP, which in turn involves key considerations of the accuracy of the measurements of the data series; their conceptual adequacy for the underlying causal effects; the completeness of the information (both variables and observations); the homogeneity of the sample; the independence assumptions justifying regression; the weak exogeneity of the regressors (or instruments); and the constancy of the parameters across the observations (Hendry and Krolzig, 2004c).

Given the initial GUM PcGets conduct mis-specification tests, checking the following null hypothesis: 1) White noise errors; 2) Conditionally homoscedastic errors; 3) Normally distributed errors; 4) unconditionally homoscedastic errors and 5) Constant parameters. If the initial mis-specifications tests are significant at the pre-specified levels, the required significance level is lowered and continue till search is violated.

The empirical success of PcGets depends crucially on the creativity of each researcher in specifying the general model, and the feasibility of estimating it from the available data (Hendry and Krolzig, 2004b). Remember that PcGets can not perform well if the starting point is unsatisfactory.

In summary the main steps involved in PcGets are (Hendry and Krolzig, 2004b):

(1) Formulate the GUM based on theory, institutional knowledge, historical contingencies, measurement information, ensuring the GUM encompasses previous evidence, while seeking a relatively orthogonal parameterization;

(2) select the set of m mis-specification tests (e.g., residual autocorrelation) and their forms (e.g., of rth-order), and the desired information criterion (e.g., SIC);

(3) set the significance levels of all selection tests (generically denoted below) and mis-specification tests (generically denoted below) to ensure the desired null rejection frequencies, perhaps by selecting one of the pre-set Liberal or Conservative strategies;

(4) estimate the GUM appropriately (least squares—OLS—and instrumental variables—IV—are presently available), and check by the mis-specification tests that the GUM captures the essential characteristics of the data (denoted congruence), perhaps with outlier adjustments;

(5) undertake pre-search reductions at a loose significance level (these include lag-order pre-selection, F-tests on successively shorter lag groups, and cumulative F-tests based on t-tests ordered from the smallest up, and the largest down);

(6) eliminate the resulting insignificant variables to reduce the search complexity, then estimate the new GUM as the baseline for the remaining stages;

(7) multiple path reduction searches now commence from each feasible initial deletion (to avoid path dependent selections);

(8) the validity of each reduction is diagnostically checked to ensure the congruence of the final model;

(9) if all reductions and diagnostic tests are acceptable, and all remaining variables are significant (or further reductions induce mis-specifications), that model becomes a terminal selection, and the next path search commences (i.e. back to 7);

(10) when all paths have been explored and all distinct terminal models have been found, they are tested against their union to find an encompassing contender;

(11) rejected models are removed, and the union of the 'surviving' terminal models becomes the GUM of a repeated multi-path search iteration;

(12) the entire search process (i.e. from 7) continues till a unique choice of final model emerges, or the search converges to a set of mutually encompassing and undominated contenders;

(13) in that last case, all the selected models are reported, and a unique final choice made by the pre-selected information criterion;

(14) the significance of every variable in the final model is assessed in two over-lapping sub-samples to check the reliability of the selection.

The standard econometric model selection methods have some critics such as the latest from Hansen (2005). Hansen (2005) states that econometric model selection methods

should be based on a semiparametric vision, models should be viewed as approximations, models should be evaluated based on their purpose, and model uncertainty should be incorporated into inference methods. Instead, current model selection methods stand on four conceptual errors: parametric vision, the assumption of a true DGP, evaluation based on fit and ignoring the impact of model uncertainty of inference. The PcGets selection method make use of the Gaussian assumption in its choice of testable hypotheses, test statistics and sampling distributions, and all of these choices change in a semiparametric framework (Hansen, 2005).

Hendry and Krolzig (2004c) affirm that automatic model selection devices such as PcGets (or the many related alternatives now available, including, but not restricted to, Phillips (1994, 1995, 1996); White (2000); Perez-Amaral et al. (2003); Kurcewicz and Mycielski (2003); and Hoover and Perez, 2004) frees investigators to allocate much more of their time and effort to improving the theory, data measurement and econometric specification underpinning the GUM, which in turn should improve substantive inferences in all areas of econometrics. An additional bonus stated by the authors is that these procedures reduce the subjectivity of the selection.

5.1.3. *Gets Approach and Collinearity.* The own features of the GUM in the modelisation of the impact of news over different asset classes include a set of variables that by definition tend to be collinear. This could be the case for the economic series that are announced in the same day, for example: unemployment rate and change in nonfarm payrolls; CPI and CPI excluding Food and Energy; etc. In these series, surprises in one indicator could mean similar surprises in the other indicator which could raise collinearity problems. Also, by construction the variables tend to be collinear as all the series look like dummies, with a clear majority of zeros and only one non zero either if the surprise is negative or positive. The literature on the topic seem to be avoiding that problem by restricting the analysis to headline announcements. This add preselection biases.

Collinearity appears when the variables are highly correlated and so it becomes hard to isolate the response of them. From the classical linear regression model, the collinearity problem is a violation of the second assumption called identificability of the model parameters, or full rank (Greene. 2003).

Hendry and Krolzig (2004b) state that the General to Specific -Gets- model selection procedure is able to deal with what they call an intractable problem such as selecting from a set of perfectly collinear variables the subset that enters the DGP. The proposed solution is a subset selection across combinations of candidate variables that are non-collinear, each of these submodels lead to a terminal model. Then, this terminal models are combined. The assumption in the solution of this problem is that the DGP is identifiable and estimable from the available data, and the only challenge is to select the relevant regressors from the candidate variables. PcGets helps to extend the available technology and ease previously intractable situations (Hendry and Krolzig, 2004b).

The case of an exact linear relationship among the regressors is a serious failure of the assumptions of the model, not of the data (Greene, 2003). In the case that the variables are highly but not perfectly correlated, the following symptoms are typical:

- Small changes in the data produce swings in parameter estimates;
- Coefficients may have high standard errors and low significance levels, but they are jointly significant and the R^2 is quite high;
- Coefficients may have the wrong sign or implausible magnitudes.

Two usual solutions in the literature are: a) obtain more data and b) drop variables but this could produce specification problems. Other proposed techniques coming from statistics are: ridge regression, robust regression, and principal components regression (Judge et al., 1985).

It is worth to highlight that collinearity is not a problem if prediction is the intention of the regression analysis (though stability in the correlation should be addressed). On the contrary, it is a problem when the aim is to analyze predictors on an individual basis, and this is the case in this thesis.

Hendry and Krolzig (2004b) present an example of perfect collinearity where the researcher do not know which are the relevant lag transformations. So if the GUM is:

$$Y_t = \gamma_0 Z_t + \gamma_1 Z_{t-1} + \gamma_2 \overline{Z}_t + \gamma_3 \Delta Z_t + u_t \tag{1.23}$$

where, Z_t is the variable in levels; Z_{t-1} is the lag variable; $\overline{Z}_t$ is the moving average as $Z_t + Z_{t-1}$; ΔZ_t is the difference. The solution proposed by the authors is based on

multi-path searches. The sequence of search paths work by deleting variables until we have a non-collinear set for which a conventional search can be conducted and a terminal model selected. The final model is selected when the coefficients of the variables are sufficiently significant in the DGP, and will parsimoniously dominate the other selections. It is simply an automation of what many empirical modelers do in practice. Nevertheless, the size and power remain to be established when all paths are forcibly explored (Hendry and Krolzig, 2004b).

PcGets[4] is not yet programmed to follow all the feasible paths, but as a partial implementation, namely searching once a non-collinear set was imposed, gives the correct answers. Moreover, PcGets can work properly if it can find a unique orthogonal representation and not several orthogonal representations that compete with each other (Hendry 2004 at 2^{nd} Oxmetrics conference).

5.2. Alternative Model Selection Procedures: RETINA. The automatic procedure for model selection called RETINA has been developed by Perez-Amaral et al. (2003). RETINA stands for Relevant Transformation of the Inputs Network Approach. RETINA differs from PcGets in that the general-to-specific methodology is not its main principle. RETINA uses a specific-to-general approach whereby variables are added into

[4]In PcGets a collinearity analysis is available from the Test menu. The second-moment matrix are reported.

$$M_{xx} = \frac{X'X}{T}$$

as well as the matrix of correlations.

$$r_{ij} = \frac{m_{ij}}{(m_{ii}m_{jj})^{1/2}}$$

together with the eigenvalues of the former, which should all be real and positive. A large ratio of the biggest to the smallest eigenvalue can suggest possible problems, but it must be stressed that measures of collinearity are not invariant under linear transformations, whereas linear models are. A comparison of the eigenvalues before and after selection can be useful, as can large ratios of the biggest to the smallest eigenvalues. Eigenvalues of R close to zero indicate the presence of collinearity (Hendry and Krolzig 2001).

the model depending on a given criteria (Castle, 2005). PcGets is based on a general-to-specific search strategy, starting with a general model capturing the underlying characteristics of the data and testing downwards, ensuring validity of the reductions at each stage to result in a congruent parsimonious undominated model. RETINA is designed to identify a parsimonious set of regressors to predict out-of-sample. The method relies on a sub-sample cross validation scheme to ensure parsimony. The final model is the one such that further reductions will lose information. If it ends with several models, it looks for the union, or the smallest one that nests all the contenders.

The problem with selecting models for forecasting purposes is that forecasting models require entirely different characteristics to in-sample models.

PcGets performs an exhaustive search ensuring that all paths are checked whereas RETINA uses a selective search determined by correlations. Thus, RETINA could miss potentially relevant variables. The number of searched models is narrowed down by including variables sequentially in rank order.

RETINA does emphasize the problems of collinearity by controlling for the collinearity of variables. Obviously, an orthogonal specification of the GUM is preferable in PcGets but the program can handle collinearity, although there is a loss in power and the size grows. PcGets aims to find a congruent undominated representation of an overly general model. Collinearity is controlled by ensuring the R2 between the included variables and the additional variable lies below a specified threshold parameter λ.

PcGets specifies the GUM based on the econometrician's knowledge and experience, institutional knowledge, past evidence and economic theory. On the other hand, RETINA automates this decision, including all transformations that have been specified by the program. There are advantages to both procedures although a degree of economic interpretation is lost in RETINA. As the goal is out-of-sample prediction this property is not as fundamental as it is for PcGets. The selection algorithm and a comparison with PcGets is presented in detail in Castle (2005).

6. Conclusions

This chapter introduced the notion of economic surprises, its main definitions and uses. The literature review was divided in a brief section on the impact of news over stocks and foreign exchange markets, and a more detailed section on the news effects over interest rate term structure. Finally, alternative econometric techniques were critically discussed.

CHAPTER 2

The Impact of News on Fed Funds Futures

1. Introduction

A key question on financial economics is how news about fundamentals are incorporated into asset prices. The purpose and contribution of this chapter is to increase the knowledge of the news impact over Federal Reserve funds' interest rate expectations, i.e. Fed funds futures contracts' implicit rates. To our knowledge, very few researchers have investigated the responses of such short term interest rates to surprises in economic statistics. This is an important issue as Fed funds interest rates and its expectations are the first link of transmission of Federal Reserve policy to other interest rates. Fed funds future contracts are a natural market-based proxy for expectations of Fed policy actions. The market began in 1989 at the Chicago Board of Trade.

The chapter evaluates the impact of macro announcements surprises, defined as the difference between the actual values and the surveys, over the Fed funds futures contracts' implicit rates. As fundamentals are already priced in, surprises are the focus of analysis. The election of the appropriate model is discussed and ultimately creates a methodological reason for the use of a new econometric tool: PcGets. The research path presented in the chapter follows the building blocks of the PcGets that enables to handle the complexity of the models.

The novelties in relation with prior studies are: a) it is the first study of the impact of macro news over the Fed funds future contracts' implicit rates; b) the study avoids preselection biases as it uses the latest revolution of automatic General-to-Specific model selection; c) thanks to the point b, the analysis covers all the US economic announcements; d) introduces an Error Correction Model (ECM) that captures asymmetries in the response of the Fed funds movement to positive or negative surprises and e) different authors' databases are built considering only expansionary years for the global economy,

in this case the database frame cope with both expansionary and recessionary years (bull and bear markets). This will ultimately add new insight into the effect of news on good and bad years, which has not been entirely addressed by the literature.

The chapter is organised as follows. In Section 2 introduces the definition and different features of the Fed funds future contracts. Section 3 presents the economic announcements and the news concept. Then, Section 4 discusses the appropriate theoretical framework and the necessity of the use of model selection mechanism i.e. PcGets. Last, Section 5 offers the conclusion.

2. Fed Funds Future Contracts

The Fed funds rate is the interest rate that banks pay when they borrow Federal Reserve deposits, usually overnight, from other banks. It is the benchmark against which other short-term cash instruments are priced. Fed funds have historically displayed extremely close correlations with certificates of deposit (CDs), commercial paper (CP), repurchase agreements (repos), the London interbank offered rate (LIBOR), Eurodollar future contracts and a myriad of short-term instruments (CBOT web site).

Financial market participants watch the Fed funds rate closely, because the level of the funds rate can be directly and purposefully affected by Federal Reserve open market operations. The Federal Open Market Committee (FOMC), the main policymaking arm of the Federal Reserve, communicates an objective for the Fed funds rate in a directive to the Trading Desk at the Federal Reserve Bank of New York. Actions taken to modify an intended level of the Fed funds rate are driven by a desire to accomplish ultimate policy objectives, especially price stability. Permanent changes in the Fed funds rate level are thus the consequence of deliberate policy decisions.

Since any number of short-term interest rate instruments price in close correlation to the Fed funds rate, the Chicago Board of Trade launched futures contracts. The CBOT Fed Fund futures serve as a valuable hedging and trading tool for a variety of market users. The Fed funds contract, also known as 30-day Fed funds futures, calls for delivery of interest paid on a principal amount of $5 million in overnight Fed funds.

[Insert TABLE 2.1]

In practice, the total interest is not really paid but is cash-settled daily. This means payments are made whenever the futures contract settlement price varies. The futures settlement price is calculated as 100 minus the monthly arithmetic average of the daily effective Fed funds rate that the Trading Desk reports for each day of the contract month. Payments are made through margin accounts that sellers and holders have with their brokers. At the end of the trading day, sellers' and holders' accounts are debited or credited to facilitate payments.

The Fed funds futures are a suitable tool for hedging against future interest rate changes. Participants in the Fed funds futures market need not be banks that borrow in the Fed funds market. Anyone who can satisfy margin requirements may participate. Thus, traders who make their living as Fed-watchers may speculate with Fed funds futures. This would suggest that to the extent Fed policy is predictable, speculators would drive futures prices to embody expectations of future policy actions. As the level of the Fed funds rate is essentially determined by deliberative policy decisions, the Fed funds futures rate should have predictable value for the size and timing of future policy actions.

The FOMC could get a clear reading of what these market participants expect them to do, which may at times be helpful for FOMC members who place great weight on knowing if a policy choice would surprise the market.

The literature [1] states that if Fed funds rates are to be instructive for policymakers, they should have some predictive content. The predictive accuracy of futures rates historically improves over the two-month period leading up to the contract's expiration, providing some evidence that the market is efficient in incorporating new information into its pricing. The largest prediction errors have occurred around policy turning points. Nevertheless, there is a lot of evidence to suggest that the Fed funds futures markets are efficient processors of information concerning the future path of the Fed funds rate.

2.1. Data Description. The Fed funds futures contract data was collected from Bloomberg news which uses data of the Chicago Board of Trade (CBOT). The following generic contracts are used:

[1]See CBOT web page: http://www.cbot.com

- 1^{st} Fed funds Future (FF1)
- 2^{nd} Fed funds Future (FF2)
- 3^{rd} Fed funds Future (FF3)
- 4^{th} Fed funds Future (FF4)
- 5^{th} Fed funds Future (FF5)
- 6^{th} Fed funds Future (FF6)
- 7^{th} Fed funds Future (FF7)
- 8^{th} Fed funds Future (FF8)

The number approximately represents the month of the maturity of each contract. Bloomberg generic series are constructed by pasting together successive n^{th} contract prices. Contract months are rolled on a given day. US Fed funds Effective rate and the Fed funds target rate are also used.

In general, the Fed funds contracts rates tend to follow the evolution of the Fed funds target rate. Specially, the longer the maturity of the contract the higher it Granger causes the Fed fund target rate. All the contracts are presented in Figures 2.1 to 2.9. A simple observation of them helps to understand the bigger variability and predictability of longer contracts.

[Insert FIGURES 2.1 TO 2.9]

Table 2.2 shows the standard deviation and correlations of yield changes over daily intervals for Fed funds future contracts from January 1996 to July 2004. First, volatility varies across different contracts. The standard deviation declines from 3.4bps of the first contract till 3.1bps of the third one, and then increases to a high of 5.2bps for FF8. The volatility of the Fed funds Effective rate is much higher (20.2bps) as this rate is the Fed's control variable which it moves in a discrete fashion. In contrast, the Fed funds future contracts move daily in relation to market expectation on Fed's future moves. Second, Fed funds implicit rates' variation were imperfectly correlated across different maturities. As expected, the correlations were highest for nearby contracts, such as FF5 and FF6, and lowest and decreasing for the most distant pairings, such as the FF1 and FF8. Interestingly, the correlation of Fed funds effective rate and Fed funds futures is

lower than 0.1 in all the cases. The same analysis performed for each year yields the same conclusion. Tables 2.3 to 2.11 also show that in general the longer Fed funds future contracts are two times to three times higher than the volatilities of the shorter contracts. The exception in this period is 2001, as the sharp reduction in Fed fund target rate -from 6.5% to 2%- produced a similar volatility in almost all the contracts.

[Insert TABLES 2.2 TO 2.11]

3. Economic Announcements

The chapter uses Bloomberg data in order to report the US economic series and its surveys. Bloomberg's World Economic Calendar (WECO) contains a record of the economic statistics, including the actual announcements, a Bloomberg survey of economists' forecasts and the revised number. Some days prior to each announcement Bloomberg News surveys a broad range of economists and then report the median and average of the economic statistics. The macroeconomic indicators to be used in this case are the actual announcement and its survey and not its revised data as the difference between the actual data and the consensus (the median of the economists surveyed) leads the market surprise. Bloomberg News surveys begun in December 1996 for US, but in the first years did not cover every economic indicator. Table 2.12 presents 47 economic statistics, with its name, the reference used in the econometric analysis, the date when Bloomberg started doing either Median or Average surveys and the total number of observations in our sample.

[Insert TABLE 2.12]

Figures 2.10 to 2.20 report the graphs of the economic announcements and their median survey for the Chicago Purchasing Manager, ISM Manufacturing, Industrial Production, Initial Jobless Claims, Durable Goods Orders, Change in Nonfarm Payrolls, Advanced Retail Sales, Domestic Vehicle Sales, Unemployment, Personal Spending and Personal Income.

[Insert FIGURES 2.10 TO 2.20]

The entire thesis uses actual announcement data instead of revised data. The actual announcement data contains the values that were announced to the public at that moment, rather than the revised data that is announced in future releases of revised data. This difference is far from trivial as the conclusion could be distorted by the fact of not taking into account the actual releases at the time.

3.1. Measures of Surprises. Two measures of surprise are created based on the normalisation approach (alternatively called standardisation approach - see Chapter 1, Section 2 Definition and Scope of the News Concept, Equation 1.2) . One uses the Bloomberg average survey and the other takes the Bloomberg median survey. Anecdotal evidence points out that market participants tend to base their surprise beliefs on the median of analysts. A contrast analysis of the surprises using the survey average and the median is later presented.

Table 2.13 shows a summary of the descriptive statistics of the economic announcements. The descriptive statistics reported are: maximum, minimum, average and standard deviation of the actual economic release, the standard deviation of the Bloomberg average survey, the standard deviation of the surprise using the average, the standard deviation of the Bloomberg median survey and the standard deviation of the surprise using the median.

[Insert TABLE 2.13]

Figures 2.21 to 2.23 present three examples (Chicago Purchasing Manager, Domestic Vehicle Sales and Personal Income) of the surprise measure based on the Bloomberg median survey of economists.

[Insert FIGURES 2.21 TO 2.23]

4. Modelling the Fed Funds Futures' Term Structure

The chapter specifies and estimates a model of high-frequency Fed funds future contracts implicit rates dynamics that allows for the possibility of surprises affecting the conditional mean. The goal is to determine whether daily Fed funds rate movements are

linked to surprises in fundamentals, and if so how. The main motivation is the possibility of refining the understanding of the fundamental determinants of the short end of the yield curve, specially the Fed funds rates expectations. To understand how short yield expectations react to news is extremely important in a world of increase financial correlations as these rates are the most important transmission channel of monetary policy in the world economy. At the same time, the analysis is relevant as our database covers different policy periods from end 1996 to mid 2004 (tightening, easing, expansion and recession).

The daily variation of the Fed funds future contracts (FF) is modelled in absolute terms. Another alternative way to model the FF is using the spread between the FF and the Fed fund target. However, the results do not differ from our chosen research path. From now on, the daily variation of FF to be modelled is expressed as DFF. The number in the end of each DFF represents the generic FF contract, from 1 to 8.

On October 15^{th} 1998, the Fed surprised the markets by changing its Fed funds target between meetings. As the move was announced at 3:15pm ET, it was after the 3:00pm ET closing of the futures market in Chicago. As a consequence, the futures market registered the change in the target Fed funds rate on October 16^{th}. The chapter follows Kuttner (2001) in changing the Fed policy move to October 16^{th} 1998.

4.1. Modelling Strategies. As reported in Chapter 1, Section 5.1, the LSE approach argued for a close link of theory and model, and explicitly opposed running regressions on every variable on the database. Unfortunately, economic theory rarely provides a basis for specifying the lag lengths in empirical macro-models: even when a theoretical model is dynamic, a time period is usually not well defined (Hendry and Krolzig, 2001a). In practice, lags are chosen either for analytical convenience (e.g., first-order differential equation systems), or to allow for some desirable features (as in the choice of a linear, second-order difference equation to replicate cycles). Therefore, it seems sensible to start from an unrestricted autoregressive-distributed lag model with a maximal lag length set according to available evidence (e.g. as four or five lags for quarterly time series, to allow for seasonal dynamics).

There is a central role for economic theory in the modelling process in prior specification, prior simplification, and suggesting admissible data transforms. The first of these relates to the inclusion of potentially-relevant variables, the second to the exclusion of irrelevant effects, and the third to appropriate formulations in which the influences to be included are entered, such as log or ratio transforms etc., differences and cointegration vectors, and any likely linear transformations that might enhance orthogonality between regressors (Greene, 2003; Advance Information Nobel 2003 and Hendry, 2004).

This chapter avoids the GUM with a lag structure. The decision is based on the surprise variables intrinsic features. As the economic announcements do not have daily frequency they are similar to dummy variables given that the time frame is daily as the endogenous variables (Fed funds) are reported daily. Given the easiness of the PcGets tool, a regression including lags was run and as expected the model selected did not include the lags.

In order to select the model, the next sections compare three alternative experiments.

4.2. Modelling Fed Funds Futures 3^{rd}.

4.2.1. *First Experiment.* The variable to explain is the daily difference of the 3^{rd} Fed funds future contract. The PcGets procedure will be explained in detail using this contract. The 3^{rd} month contract is a good benchmark for short term rates and it is the most liquid one. Shorter contracts would not be very sensitive to economic announcements as the FED policy decision could already be a done deal (this is later shown in Section 4.3 Modelling the remaining contracts). On the contrary, longer dated contracts are influenced by other factors. Also, as commented in previous sections, the Fed funds implicit rates' variation are imperfectly correlated across different maturities, with higher correlation for nearby contracts. Then, the DFF3 will be the benchmark for short term contracts.

The model starts with a linear ECM unrestricted of DFF3 explained by one lagged values of DFF, news (S) without including their lags, and the lags of the Fed funds future contracts levels;

$$DFF_3 = \beta_0 + \sum_{i=1}^{I} \beta_i DFFi_{-1} + \sum_{k=1}^{K} \sum_{t=0}^{T} \beta_{ki} S_k + \sum_{i=1}^{I} \beta_i FFi_{it-1} + \epsilon_t \qquad (2.1)$$

where, K=47 and T=2016. The I represent the lags. At the same time, in order to capture the different effects of the Fed monetary policy bias three dummies were constructed: Symmetric, Tightening and Easing. Table 2.14 enumerate the Federal Reserve policy action from November 1996 to June 2004, with its target rate, the policy shift and the bias. Two of the Fed bias are introduced in the regressions to avoid collinearity. The dummies included are called Tighter and Symmetric, representing tighten and symmetric monetary policy stance respectively. In order to capture the effect of Fed Chairman Semi-annual Monetary Report to the Congress another dummy was added (called Greenspan[2] dummy). Then, K reaches 50 variables, while the number of daily data is 2015 as one day is lost due to the difference to construct the first variation in FF. For the definition of the economic announcements please refer to Table 2.12. The units are interest rates percentage points (i.e. 0.01 in ECI coefficient is 1 basis points).

[Insert TABLES 2.14 TO 2.16]

The reported results include coefficient estimates; standard errors; t -values; the residual sum of squares (RSS); the equation standard error (called sigma); the squared multiple correlation coefficient (denoted R2); and its value adjusted for degrees of freedom (T-p for T observations and p estimated parameters or regressors). The value of sigma is also the residual standard deviation. Table 2.15 presents the initial GUM. At this stage is not necessary to explain the results as it is the initial rough estimation (see the later comments in all the final selected models). PcGets conduct mis-specification tests as the next step (see Table 2.16). Thus, PcGets generally tests the following null hypotheses: white-noise errors; normally distributed errors; conditionally homoscedastic errors; unconditionally homoscedastic errors and constant parameters.

[2]During the period under consideration. Alan Greenspan was the Federal Reserve Chairman.

Hendry and Krolzig (2001a) state that if the initial mis-specification tests are significant at the pre-specified level, the required significance level is lowered, and search paths terminated only when that lower level is violated.

Once congruence of the GUM is established, groups of variables are tested in the order of their absolute t-values, commencing from the smallest and continuing up towards the pre-assigned selection criterion, when deletion must become inadmissible. A non-stringent significance level is used at this step, usually 90%, since the insignificant variables are deleted permanently. If no test is significant, the F-test on all variables in the GUM has been calculated, establishing that there is nothing to model.

All paths that commence with an insignificant t-deletion are explored. Blocks of variables constitute feasible search paths so these can be selected, in addition to individual-coefficient tests.

Encompassing tests select between the candidate congruent models at the end of path searches (see Table 2.17). Each contender is tested against their union, dropping those which are dominated by, and do not dominate, another contender. If a unique model results, it is selected; otherwise, if some are rejected, PcGets forms the union of the remaining models, and repeats this round till no encompassing reductions result. That union then constitutes a new starting point, and the complete path-search algorithm repeats until the union is unchanged between successive rounds.

When such a union coincides with the original GUM, or with a previous union, so no further feasible reductions can be found, PcGets selects a model by an information criterion. The preferred final-selection rule presently is the Schwarz criterion, or BIC (Hendry and Krolzig, 2001a, 2004, 2005).

[Insert TABLE 2.17]

For the finally-selected model, sub-sample reliability is evaluated. PcGets then concludes that some variables are definitely excluded; some definitely included; and some have an uncertain role.

[Insert TABLE 2.18]

The result of the regression (see Table 2.18, Columns 3 and 4) points to the significance and the following positive order of influence over DFF3 of the surprises in: Continuous Non Farm Payrolls (CNFP M), Institute for Supply Management Manufacturing Index (ISM M), Institute for Supply Management Non Manufacturing Index (ISM NM) and FOMC policy decision (FOMC M). The surprises with negative coefficient are: Trade Balance (TB M), Unemployment (U M) and Initial Jobless Claims (IJC M). All of the above variables with positive coefficients have the expected sign over DFF3: positive surprises tend to be followed by significant increases in DFF3. Among the negative sign variables, the sign of TB M can not be explained in a straight way. The ECM unrestricted model is not relevant as the lagged levels of FF variables (note that FF3 does not appear) sum is close to zero.

The next line shows the log-likelihood value; and the three information criteria, AIC, HQ, SC; then T and p followed by the probability of observing an F value as large or larger for an F-test of R2 equaling zero, denoted FpNull, and a test against a constant denoted FpConst. This summary testing sequence on the residuals examines a range of null hypotheses of interest, including: autocorrelation, autoregressive conditional heteroscedasticity (ARCH), the normality of the distribution of the residuals, heteroscedasticity, and functional form mis-specification, as well as parameter constancy. Finally, the output reports the default mis-specification test statistics, which check whether the residuals are indeed consistent with the assumptions in, and that the parameters are constant. The evaluation statistics reported commence with tests of parameter constancy, based on Chow. These are both F-tests, and neither rejects. The normality test is a chi-squared statistic which again does not reject. The residual autocorrelation test (AR 1-4) rejects at 5%, so the first-order lag length in the model may not have been adequate to capture the dynamics. The ARCH 1–4 test is for fourth-order autoregressive conditional heteroscedasticity, and the hetero test is for unconditional heteroscedasticity: neither of these rejects.

The above results rest on the PcGets Liberal Strategy built-in focusing on minimizing the non-selection probability of relevant variables. In that sense, a liberal strategy

should have a higher probability of retaining relevant variables at the risk of also retaining irrelevant ones[3].

The Conservative Strategy focuses on minimizing the non-deletion probability of nuisance variables. In that sense, a conservative strategy should have a higher probability of eliminating irrelevant variables at the risk of also eliminating relevant ones. In our regression (see Table 2.18, Columns 5 and 6), U M variable has been deleted and no new variable has been included. FOMC A surprises still have the biggest impact in relative coefficient amounts while the rest of the variables maintain the same rankings.

The last strategy is the Experts User mode (see Table 2.18, Columns 7 and 8). This allows an expert user to specify their desired strategy. It refers to settings which are likely to be changed infrequently, and the choices are persistent between runs of PcGets (Hendry and Krolzig 2001a).

The options open to the expert user are presented in Table 2.19.

[Insert TABLE 2.19]

In this case the default levels were slightly modified by augmenting the significance level from 0.075 to 0.1 and setting the selection criteria for the final model from SC to AIC. The regression results do not change from the model reported in the liberal strategy.

Another feature of PcGets is the Outlier Correction. The outliers are detected using the size of the residuals in the GUM, and dummy variables are added to the model. The user determines the magnitude of departure, in terms of residual standard deviations, that defines an outlier. The default level of the size of the marginal outlier is 2.56 standard deviations. Using the expert mode, the standard deviation definition was increased for the outlier to 5 standard deviations. The specific model ends with 16 dummy variables and eight new variables, showing some trade off with the mis-specification test levels. The biggest positive impact still comes from FOMC A and CNFP M, while the biggest negative one is U M.

[3]The issue of collinearity among regressors of the overparametrised general model is addressed in the appendix. A solution is presented based on Hendry and Krolzig (2004b). The results confirm the robustness of the PcGets selection.

A comparison of the different strategies information criteria rank them in the following order: Outlier correction, Liberal strategy and Conservative strategy.

In the case of the restricted ECM model (i.e. above models replacing the lags of FF with the lagged residual of the cointegrating regression of FF3 and the remaining FF) the residuals do not appear in the specific model, i.e. they were non significant.

4.2.2. *Second Experiment.* The second experiment introduces the notion of asymmetries in the effect of positive and negative economic announcement news. It is worth noting that without PcGets this approach could be considered almost impossible due to the handing of so many variables. Then, the model is a linear ECM unrestricted of DFF3 explained by one lagged values of the daily difference of each Fed funds future contract (DFF), replacing each surprise with two dummies, D1 (ones where positive surprises and zeros otherwise) and D2 (ones where negative surprises and zero otherwise) and the lags of the Fed funds future contracts levels;

$$\begin{aligned} DFF_3 &= \beta_0 + \sum_{i=1}^{I} \beta_i DFFi_{-1} + \sum_{k=1}^{K}\sum_{j=0}^{J} \beta_{kj} DS^{+}_{k,t-j} + \\ &+ \sum_{k=1}^{K}\sum_{j=0}^{J} \beta_{kj} DS^{-}_{k,t-j} + \sum_{i=1}^{I} \beta_i FFi_{it-1} + \epsilon_t \end{aligned} \tag{2.2}$$

$$t = 1, ..., T$$

where, same notes of the experiment one applies and $DS^{+}_{k,t-j}$ and $DS^{-}_{k,t-j}$ represent the positive news dummies and the negative news dummies respectively. As in the first experiment the different strategies were run: liberal, conservative and expert user mode with outlier correction. The liberal strategy in the second experiment ended with three new variables (see Table 2.20, Columns 3 and 4): DISM PP (+ and -), DDVS and DCS, while U and ISM NM were dropped out. In the case of the conservative strategy two variables were left aside: DTB + and DISM M-. The analysis including outlier correction at 5 standard deviations found 13 outliers and 7 extra variables. All in all, the inclusion of asymmetry dummies proves to be relevant adding explanatory value. A way to see this, is that the coefficients differ between positive and negative dummies surprises. As in

the case of the first experiment, the information criteria rank the models in the following order: Outlier correction, Liberal strategy and Conservative strategy.

Meanwhile, in the case of the restricted ECM model the residuals do not appear in the specific model.

[Insert TABLE 2.20]

4.2.3. *Third Experiment.* In the third experiment the notion of asymmetries in the effect of positive and negative economic announcement news was expanded. In this case the dummies surprises of the second experiment were replaced with the surprises divided between positive and negative. Then, the linear ECM unrestricted of DFF3 will be explained by 1 lagged values of the daily difference of each Fed funds future contract (DFF), the positive and negative surprises and the lags of the Fed funds future contracts levels;

$$\begin{aligned} DFF_3 &= \beta_0 + \sum_{i=1}^{I} \beta_i DFF_{t-i} + \sum_{k=1}^{K}\sum_{j=0}^{J} \beta_{kj} S^{+}_{k,t-j} + \\ &+ \sum_{k=1}^{K}\sum_{j=0}^{J} \beta_{kj} S^{-}_{k,t-j} + \sum_{i=1}^{I} \beta_i FFi_{it-1} + \epsilon_t \end{aligned} \tag{2.3}$$

$$t = 1, ..., T$$

The liberal strategy specific model shows the relevance of adopting an asymmetry approach as the coefficients of the same variable depending on the positive surprise component or negative one have different magnitude and even sign. Some extra variables are also included (see Table 2.21). Meanwhile, the conservative strategy dropped ISM NM -and + and U -. As in the case of the first and second experiment, the ECM unrestricted model is not relevant as the lagged levels of FF variables (note that FF3 does not appear) sum is close to zero. Regarding the outlier correction mode with 5 standard deviations, 13 dummies to correct of outlier were included, while 12 new surprise variables appeared in the final specific model.

In the specific model of the restricted ECM model the residuals do not appear, and the model is dominated by the unrestricted ones, both in terms of information criteria and R^2.

[Insert TABLE 2.21]

The next step is to test the combination of asymmetries in the effect of positive and negative economic announcement news with also the two dummies, D1 (ones where positive surprises and zeros otherwise) and D2 (ones where negative surprises and zero otherwise). This case is a mix of the second experiment and the first part of the third one;

$$\begin{aligned} DFF_3 = {} & \beta_0 + \sum_{i=1}^{I} \beta_i DFF_{t-i} + \sum_{k=1}^{K}\sum_{j=0}^{J} \beta_{kj} DS^{+}_{k,t-j} + \\ & \sum_{k=1}^{K}\sum_{j=0}^{J} \beta_{kj} DS^{-}_{k,t-j} + \sum_{k=1}^{K}\sum_{j=0}^{J} \beta_{kj} S^{+}_{k,t-j} + \\ & \sum_{k=1}^{K}\sum_{j=0}^{J} \beta_{kj} S^{-}_{k,t-j} + \sum_{i=1}^{I} \beta_i FFi_{it-1} + \epsilon_t \\ & t = 1, ..., T \end{aligned} \tag{2.4}$$

The usual significant variables remained while some extra ones such as GDP PD appeared for the first time. Among the selected variables, positive and negative surprises outpaced the number of positive and negative dummies. When the conservative strategy was run, the selected model lost 6 variables. In the outlier correction mode with 5 standard deviations, 11 outliers were introduced.

[Insert TABLE 2.22]

In terms of Information Criteria, the addition of surprises asymmetry has added explanatory power (all the Information criteria are lower in Table 2.22 vs. previous ones).[4]

[4]A further experiment is to evaluate a linear ECM unrestricted of DFF3 that will be explained by 1 lagged values of the daily difference of each Fed funds future contract (DFF). the original surprises. the positive and negative surprises. the two dummies. D+ (ones where positive surprises and zeros otherwise)

4.3. Average survey vs. median average. In order to compare the results using the Bloomberg average survey as input of the surprises instead of the Bloomberg median survey, the steps for the experiment one were repeated but using the average survey. In the case of the Liberal strategy (see Table 2.23), Construction Spending (CS) has the biggest impact, while the rest of the variables maintain the same ranking. ECI is dropped from the specific model. The variables with negative impact also maintain the previous ranking using the median survey. In the case of the Construction Spending the relevance of the variable is quiet odd as the series starts in August 2003, covering just 12 months. The Conservative strategy does not differ from the Liberal one (see Table 2.23). Regarding the expert mode with 5 standard deviations outlier correction, the specific model ends with 16 dummy variables and eight new variables. In all the specific models, the dummies Tighter and Symmetric appear in the final model. Given the lack of further value added using average survey the analysis for the rest of the experiments was not repeated.

[Insert TABLE 2.23]

4.4. Modelling the remaining contracts. The same steps were performed for the analysis of the remaining Fed funds future contracts spectrum. For each of the contracts, the model was run in the liberal strategy and conservative strategy[5]. These analysis are presented in Table 2.24 and 2.25 respectively.

and D- (ones where negative surprises and zero otherwise) and the lags of the Fed funds future contracts levels. The results have all type of variables: single surprises, surprises with dummies positive and negative, and surprises negative and positive as well. The information criteria are equal to the last experiment (with positive and negative surprises), so does not make much sense to report it.

[5]The results using the experts mode combined with outlier detection with 5 standard deviations as the size of the marginal outlier are not presented in detail. The main findings are:

- DFF1: Found 18 outliers and 8 variables, while the bias dummies are not included and the mis-specification tests improved. The FOMC surprise remains with the highest impact over the DFF1.
- DFF2: Added 17 dummies and ends with five more significant variables.
- DFF4: Relevant 18 variables and the bias dummies (that is 2 more than DFF3 with outliers) and 10 outliers. This time Construction Spending has the biggest impact, while ECI surprise ranked second.

In the DFF1 case, only four variables are left in the model: FOMC surprise, Domestic Vehicle Sales (DVS), Construction Spending (CS) and Personal Income (PI). The dummies representing the Fed monetary policy bias remain significant.When the conservative strategy is run, CS drops from the specific model.

[Insert TABLES 2.24 AND 2.25]

The DFF2 case ends with seven variables in the model plus the two Fed bias dummies Besides FOMC surprise, ISM stays top in the positive factors, while TB takes the centre stage in the negative influences. The conservative strategy specific model maintains five economic surprises and the two Fed bias dummies. In this case, ISM NM and CNFP are not included.

The liberal strategy in DFF4 ended with 5 more variables than in DFF3. Among the variables, ISM achieves the biggest coefficient followed by ECI, while Total vehicle sales has the biggest negative effect. The conservative strategy in DFF4 entitled the same model as in the liberal one. According to market belief, ECI is among Alan Greenspan's (FED Chairman in the period under study) most favorite series to follow.

In the case of DFF5, the ISM, CNFP and ECI have the biggest positive effects among 14 variables, while TVS ranks first as biggest negative coefficient. CPI ex enters for first time in the final specific model. Nevertheless, it is then eliminated in the Conservative Strategy, as long as CCON which is also excluded.

- DFF5: Presented only 6 outliers as opposed to 18, 17, 17 and 10 for DFF1, 2, 3 and 4 respectively. Still 18 variables plus the bias dummies are significant.
- DFF6: The model includes 6 of them, with the 18 variables left. At the same time, the Fed bias dummies reappear in the final specification.
- DFF7: 18 variables are left, with only 4 outliers. Note that the number of outliers is reduced when longer maturity contracts are analysed. This could be due to the larger intrinsic volatility of the series.
- DFF8: The results signalled 6 outliers and 16 variables, maintaining as well the prior rankings of coefficient magnitude.

Fed bias dummies are dropped out from the specific model for the first time in DFF6. Moreover, for DFF7 and DFF8 the Fed policy bias dummies are not significant. This could be due to the longer time horizon of these contracts, where the stance of the Fed policy does not matter. The rest of the DFF6 model is similar to DFF5 specification following the liberal strategy except that there are two more variables. In the conservative strategy three variables are eliminated: FOMC, CCON and DGLT. The order of impact of variables remain the same.

As commented above, no Fed bias dummies are left in the DFF7 models; ISM tops the 15 variables. In this case, the Conservative strategy maintains all but two variables. The excluded variables are CCON and FOMC. The ranking is similar to the prior ones.

The last model is for DFF8. The liberal strategy encountered 13 variables in the specific model. The top variables in the rankings of relative absolute coefficient maintain the previous orders. The conservative strategy dropped 2 variables (PF M and CU M), while the usual rankings remained. The differences on which economic announcements are relevant in each contract would be expected on the base of the higher correlation among nearby contracts commented in Section 2. Also, the longer the contract the larger the number of significant announcements. This is related to the less volatile monetary policy in the very short term, but on the medium term, many pieces of information influence the next rate moves.

5. Conclusions

This chapter analysed the daily variation of the entire spectrum of the Fed Funds Futures contracts. The main aim was to evaluate how surprises affect the very short term interest rate structure. The surprises main input are the actual economic releases (not the revised data) and the median or the average estimates of the analysts surveyed by Bloomberg News. Further, in order to capture the specific effects of the Fed monetary policy bias, three dummies were constructed, plus another dummy was included to capture the Fed Chairman Semiannual Monetary Report to the US Congress. Asymmetries in the response of negative and positive surprises were also studied.

The final model was selected using PcGets, starting with a general model including n lagged values of the daily difference of each Fed funds future contract, and of the news. In order to appreciate the validity of using PcGets it is worth noticing that the general model contained 50 exogenous variables (47 surprises in median plus 2 Fed monetary policy bias and 1 Greenspan dummy). Any prior subjective specification of the relative importance of the economic statistics influencing the Fed funds implicit rates was left aside. Three different experiments were followed: an ECM unrestricted with other DFF and FF lagged variables and surprises; a second ECM unrestricted replacing the surprises by dummies, positive and negative when news are positive and negative respectively; and third and ECM unrestricted dividing the surprises in negative and positive groups.

The main findings can be summarised as follows: 1) in the specific models of the whole spectrum of the Fed future contracts there is evidence of significant impact of the activity surprises (primarily Institute of Supply Management Manufacturing and Non Manufacturing), with few labor (primarily Continuos Non Farm Payrolls, Unemployment and Initial Jobless Claims), inflation surprises (primarily Employment Cost Index) and monetary ones (FOMC surprise); 2) asymmetries play a key part in understanding the impact of news on Fed funds, it is not equivalent the effect of a positive surprise to a negative one; 3) the longer the contracts, the fewer the number of outliers (from 18 to 5); 4) the Federal Reserve bias on monetary policy does not play a role unless the ECM restricted is considered, where it influences the shorter contracts, while the bias relevance tends to disappear when longer contracts (DFF6 onwards) are evaluated (this could be due to the intrinsic features of the longer time horizon of these contracts, where the stance of the Fed policy does not matters); 5) the chapter also compares the results using Median survey and Average survey as measure of the surprises and it finds that the conclusions do not differ using either alternative of the measures.

Table 2.1: 30-Day Fed funds Futures Contract

Exchange: Chicago Board of Trade CBOT

Ticker Symbol: FF

Trading Unit: $5 million

Price Basis: 100 minus the monthly average overnight Fed funds rate for the delivery month: for example, a 7.25 percent rate equals 92.75

Tick Size: Increments of 1/2 of 1/100 of 1 percent of $5 million on a 30-day basis in the spot month only ($20.84) and 1/100 of 1 percent of $5 million on a 30-day basis in all other contract months ($41.67)

Daily Price Limit: 150 basis points (variable trading limits of 225 bps): no limit in the spot month

Contract Months: First 25 calendar months (and the next two months in the Mar, Jun, Sept, Dec cycle thereafter)

Settlement: The contract will be cash settled to the nearest half-basis point against the simple average overnight Fed funds rate for the delivery month. The overnight Fed funds rate is calculated and reported daily by the Federal Reserve Bank of New York.

Last Trading Day: Last business day of the delivery month

Trading Hours: 7:20 a.m. - 2:00 p.m. Chicago time, Mon - Fri. Project A Afternoon session hours are 2:30 - 4:30 p.m. Chicago time, Mon-Thu and the Project A Overnight* session hours are from 10:30 p.m. - 6:00 a.m., Sun-Thu. Trading in expiring contracts closes at 2:00 p.m. on the last trading day.

*Subject to change

Source: Chicago Board of Trade -CBOT

Table 2.2: Standard deviations and correlations of daily yield changes for Fed funds Future Contracts and Fed funds Effective Rate from 1996 to mid 2004

	FF1	FF2	FF3	FF4	FF5	FF6	FF7	FF8	FED
Standard Deviation	3.4	3.2	3.1	3.5	3.9	4.3	4.8	5.2	20.2
Correlation with									
FF1	1								
FF2	0.66	1							
FF3	0.57	0.81	1						
FF4	0.42	0.77	0.87	1					
FF5	0.35	0.65	0.84	0.92	1				
FF6	0.24	0.58	0.77	0.88	0.94	1			
FF7	0.18	0.49	0.70	0.82	0.90	0.94	1		
FF8	0.10	0.38	0.59	0.71	0.80	0.86	0.90	1	
FED	0.06	0.02	0.10	0.06	0.10	0.07	0.07	0.06	1

Source: Own elaborations, based on data from Bloomberg

Table 2.3: Standard deviations and correlations of daily yield changes for Fed funds Future Contracts and Fed funds Effective Rate in 1996

	FF1	FF2	FF3	FF4	FF5	FF6	FF7	FF8	FED
Standard Deviation	2.5	2.5	3.0	3.5	4.5	4.6	5.4	5.8	37.2
Correlation with									
FF1	1								
FF2	0.39	1							
FF3	0.51	0.80	1						
FF4	0.36	0.86	0.90	1					
FF5	0.35	0.74	0.85	0.93	1				
FF6	0.28	0.74	0.84	0.91	0.96	1			
FF7	0.23	0.67	0.77	0.88	0.94	0.97	1		
FF8	0.19	0.64	0.75	0.85	0.91	0.95	0.96	1	
FED	0.00	-0.02	0.12	0.08	0.14	0.08	0.08	0.07	1

Source: Own elaborations, based on data from Bloomberg

Table 2.4: Standard deviations and correlations of daily yield changes for Fed funds Future Contracts and Fed funds Effective Rate in 1997

	FF1	FF2	FF3	FF4	FF5	FF6	FF7	FF8	FED
Standard Deviation	1.6	1.7	1.9	2.3	2.6	3.0	3.5	3.6	24.2
Correlation with									
FF1	1								
FF2	0.58	1							
FF3	0.47	0.76	1						
FF4	0.50	0.75	0.88	1					
FF5	0.38	0.69	0.83	0.93	1				
FF6	0.35	0.60	0.82	0.88	0.94	1			
FF7	0.37	0.58	0.77	0.89	0.92	0.96	1		
FF8	0.30	0.55	0.73	0.81	0.89	0.93	0.95	1	
FED	-0.08	0.03	-0.07	-0.01	0.00	-0.05	-0.06	-0.06	1

Source: Own elaborations, based on data from Bloomberg

Table 2.5: Standard deviations and correlations of daily yield changes for Fed funds Future Contracts and Fed funds Effective Rate in 1998

	FF1	FF2	FF3	FF4	FF5	FF6	FF7	FF8	FED
Standard Deviation	2.4	2.6	3.2	3.5	3.9	4.0	4.2	4.2	22.7
Correlation with									
FF1	1								
FF2	0.58	1							
FF3	0.58	0.69	1						
FF4	0.60	0.84	0.73	1					
FF5	0.57	0.75	0.86	0.84	1				
FF6	0.39	0.73	0.77	0.80	0.92	1			
FF7	0.33	0.61	0.71	0.74	0.89	0.92	1		
FF8	0.30	0.59	0.65	0.70	0.84	0.87	0.93	1	
FED	0.12	0.12	0.13	0.07	0.09	0.03	0.01	0.02	1

Source: Own elaborations, based on data from Bloomberg

Table 2.6: Standard deviations and correlations of daily yield changes for Fed funds Future Contracts and Fed funds Effective Rate in 1999

	FF1	FF2	FF3	FF4	FF5	FF6	FF7	FF8	FED
Standard Deviation	2.8	3.0	2.1	2.6	3.0	3.6	3.8	3.9	19.2
Correlation with									
FF1	1								
FF2	0.59	1							
FF3	0.49	0.63	1						
FF4	0.48	0.74	0.83	1					
FF5	0.45	0.63	0.84	0.93	1				
FF6	0.47	0.66	0.81	0.91	0.92	1			
FF7	0.35	0.46	0.74	0.80	0.84	0.87	1		
FF8	0.08	0.18	0.43	0.48	0.53	0.54	0.73	1	
FED	0.10	-0.19	0.04	0.00	0.02	0.04	0.10	0.15	1

Source: Own elaborations, based on data from Bloomberg

Table 2.7: Standard deviations and correlations of daily yield changes for Fed funds Future Contracts and Fed funds Effective Rate in 2000

	FF1	FF2	FF3	FF4	FF5	FF6	FF7	FF8	FED
Standard Deviation	3.3	2.7	2.7	2.7	3.1	3.6	4.1	4.4	14.9
Correlation with									
FF1	1								
FF2	0.72	1							
FF3	0.62	0.77	1						
FF4	0.47	0.70	0.82	1					
FF5	0.37	0.59	0.78	0.91	1				
FF6	0.24	0.47	0.72	0.82	0.86	1			
FF7	0.17	0.40	0.61	0.74	0.80	0.90	1		
FF8	0.20	0.37	0.56	0.67	0.72	0.85	0.90	1	
FED	-0.03	0.04	0.10	0.08	0.10	0.09	0.11	0.08	1

Source: Own elaborations, based on data from Bloomberg

Table 2.8: Standard deviations and correlations of daily yield changes for Fed funds Future Contracts and Fed funds Effective Rate in 2001

	FF1	FF2	FF3	FF4	FF5	FF6	FF7	FF8	FED
Standard Deviation	7.6	6.5	5.7	5.9	5.9	6.3	6.8	7.4	18.1
Correlation with									
FF1	1								
FF2	0.70	1							
FF3	0.63	0.88	1						
FF4	0.41	0.81	0.92	1					
FF5	0.35	0.72	0.89	0.96	1				
FF6	0.20	0.60	0.80	0.91	0.95	1			
FF7	0.15	0.53	0.74	0.86	0.91	0.96	1		
FF8	0.00	0.34	0.54	0.68	0.73	0.82	0.85	1	
FED	0.16	0.07	0.19	0.10	0.17	0.14	0.13	0.12	1

Source: Own elaborations, based on data from Bloomberg

Table 2.9: Standard deviations and correlations of daily yield changes for Fed funds Future Contracts and Fed funds Effective Rate in 2002

	FF1	FF2	FF3	FF4	FF5	FF6	FF7	FF8	FED
Standard Deviation	1.9	2.3	2.4	3.4	4.4	5.3	5.9	6.5	6.8
Correlation with									
FF1	1								
FF2	0.69	1							
FF3	0.38	0.77	1						
FF4	0.22	0.65	0.87	1					
FF5	0.11	0.49	0.83	0.92	1				
FF6	0.05	0.43	0.75	0.91	0.97	1			
FF7	0.02	0.35	0.73	0.82	0.93	0.95	1		
FF8	-0.03	0.30	0.66	0.78	0.88	0.91	0.95	1	
FED	0.03	0.13	0.20	0.21	0.27	0.24	0.25	0.24	1

Source: Own elaborations, based on data from Bloomberg

Table 2.10: Standard deviations and correlations of daily yield changes for Fed funds Future Contracts and Fed funds Effective Rate in 2003

	FF1	FF2	FF3	FF4	FF5	FF6	FF7	FF8	FED
Standard Deviation	1.6	1.8	1.9	2.0	2.2	2.7	3.3	4.2	6.3
Correlation with									
FF1	1								
FF2	0.40	1							
FF3	0.34	0.83	1						
FF4	0.22	0.75	0.92	1					
FF5	0.14	0.63	0.86	0.94	1				
FF6	0.07	0.49	0.73	0.84	0.94	1			
FF7	0.00	0.39	0.61	0.72	0.85	0.93	1		
FF8	-0.01	0.30	0.54	0.68	0.81	0.91	0.91	1	
FED	0.30	0.06	0.05	0.04	0.05	0.06	0.04	0.04	1

Source: Own elaborations, based on data from Bloomberg

Table 2.11: Standard deviations and correlations of daily yield changes for Fed funds Future Contracts and Fed funds Effective Rate from January 2004 to July 2004

	FF1	FF2	FF3	FF4	FF5	FF6	FF7	FF8	FED
Standard Deviation	2.0	2.5	2.7	3.3	3.8	4.3	5.0	5.5	3.5
Correlation with									
FF1	1								
FF2	0.69	1							
FF3	0.54	0.90	1						
FF4	0.44	0.71	0.92	1					
FF5	0.40	0.64	0.85	0.95	1				
FF6	0.29	0.61	0.82	0.92	0.96	1			
FF7	0.12	0.42	0.67	0.83	0.92	0.95	1		
FF8	0.29	0.47	0.67	0.83	0.93	0.94	0.97	1	
FED	0.07	0.04	0.02	0.01	0.02	-0.01	0.02	0.04	1

Source: Own elaborations, based on data from Bloomberg

Table 2.12: Economic statistics surveys

Economic Announcement	Reference	Bn Avge Survey	Obs.	Bn Median survey	Obs.	Frequency
Inflation announcements						
UNIT LABOR COSTS	ULC M	05/08/1999	19	05/08/1999	19	quarterly
CPI MOM	CPI M	16/06/1998	74	12/12/1996	92	monthly
CPI EX FOOD & ENERGY	CPI ex M	16/06/1998	74	12/12/1996	92	monthly
EMPLOYMENT COST INDEX	ECI M	30/07/1998	24	28/01/1997	30	quarterly
GDP PRICE DEFLACTOR	GDP PD M	31/07/1998	24	31/07/1998	24	quarterly
IMPORT PRICE INDEX MOM	IMI M	13/08/1998	72	13/08/1998	72	monthly
ISM PRICES PAID	ISM PP M	01/08/2000	47	01/08/2000	47	monthly
PPI INDEX MOM	PPI M	12/06/1998	74	12/12/1997	80	monthly
PPI EX FOOD & ENERGY	PPI-FE M	12/06/1998	74	11/12/1996	92	monthly
Labor announcements						
INITIAL JOBLESS CLAIMS	IJC M	04/06/1998	320	26/06/1997	369	weekly
CHANGE NONF. PAYROLLS	CNFP M	05/06/1998	73	10/01/1997	91	monthly
AVERAGE HOURLY EARNINGS	AHE M	02/07/1998	73	02/07/1998	73	monthly
CHAN. MANUF. PAYROLLS	CMP M	08/01/1999	67	08/01/1999	67	31/9/1998
AVERAGE WEEKLY HOURS	AWH M	05/02/1999	66	05/02/1999	66	monthly
UNEMPLOYMENT RATE	U M	02/07/1998	72	06/12/1996	92	monthly
NON FARM PRODUCTIVITY	NFP M	04/06/1998	48	04/06/1998	48	quarterly
Demand announcements						
CONSUMER CREDIT	CCred M	05/06/1998	74	06/12/1996	92	monthly
U OF MICHIGAN CONFIDENCE	UMCon S	14/05/1999	63	14/05/1999	63	monthly
EXISTING HOME SALES	EHS M	25/06/1998	73	25/08/1997	83	monthly
CONSUMER CONFIDENCE	CC M	30/06/1998	72	25/02/1997	89	monthly
NEW HOMES SALES	NHS M	02/06/1998	74	02/06/1998	74	monthly
BUILINDG PERMITS	BP M	16/08/2002	24	16/08/2002	24	monthly
HOUSING STARTS	HS M	16/06/1998	74	16/06/1998	74	monthly
ADVANCE RETAIL SALES	ARS M	13/06/2001	38	13/06/2001	38	monthly
RETAIL SALES LESS AUTOS	RS-A M	13/06/2001	38	13/06/2001	38	monthly
DOMESTIC VEHICLE SALES	DVS M	02/07/1999	61	02/07/1999	61	monthly
TOTAL VEHICLE SLES	TVS M	03/01/2003	19	03/01/2003	19	monthly
PERSONAL SPENDING	PS M	26/06/1998	72	03/02/1997	90	monthly
PERSONAL INCOME	PI M	26/06/1998	73	23/12/1996	91	monthly
Activity announcements						
MONTHLY BUDG. STATE.	MBS M	22/09/1998	70	20/12/1996	94	monthly
GDP	GDP M	31/07/1998	24	31/07/1998	24	quarterly
INDUSTRIAL PRODUCTION	IP M	15/05/1998	74	15/11/1996	93	monthly
LEADING INDICATORS	LI M	02/06/1998	73	04/02/1997	90	monthly
BUSINESS INVENTORIES	BI M	15/07/1998	62	16/07/1997	84	monthly
WHOLESALE INVENTORIES	WI M	07/08/1998	71	09/01/1997	91	monthly
ISM NON MANUFACTURING	ISM NM M	06/01/1999	67	06/01/1999	67	monthly
ISM MANUFACTURING	ISM M	01/06/1998	73	01/11/1996	93	monthly
PHILADELPHIA FED	PF M	18/06/1998	74	19/12/1996	92	monthly
FACTORY ORDERS	FO M	04/06/1998	74	07/01/1997	91	monthly
CONSTRUCTION SPENDING	CS M	01/08/2003	12	01/08/2003	12	monthly
DURABLE GOODS ORDERS	DGO M	24/06/1998	73	26/11/1997	80	monthly
DURABLE GOODS - TRANSP.	DGlt M	28/12/2001	31	28/12/2001	31	monthly
CHICAGO PURC. MANAGER	CPM M	30/06/1998	73	27/11/1996	92	monthly
CAPACITY UTILIZATION	CU M	16/06/1998	74	17/01/1997	93	monthly
EMPIRE MANUFACTURING	EM M	15/11/2002	21	15/11/2002	21	monthly
Trade Bce announcement						
TRADE BALANCE	TB M	18/06/1998	74	19/12/1996	91	monthly
Monetary						
FOMC RATE EXPECTED	FOMC M	22/12/1998	47	20/05/1997	62	-
FED Monetary Bias	Tighter	Qualitative	-	Qualitative	-	-
FED Monetary Bias	Symetric	Qualitative	-	Qualitative	-	-
FED Monetary Bias	Easing	Qualitative	-	Qualitative	-	-
GREENSPAN SPEECH	GREEN	Qualitative	-	Qualitative	-	-

Source: Own elaborations, based on data from Bloomberg

Table 2.13: Economic announcements' descriptive statistics

Economic Announcement	Max.	Min.	Avge.	s Actual	s Bloomb. Survey Avge.	s Surprise Avge.	s Bloomb. Survey Median	s Surprise Median
CHICAGO PURC MANAGER	68.0	35.0	53.7	6.9	6.3	3.9	6.0	3.7
CONSUMER CREDIT	19.8	-5.1	6.7	5.1	3.4	5.3	2.3	5.1
U OF MICHIGAN CONFIDENCE	111.4	75.0	95.2	9.5	8.9	2.9	9.1	3.3
UNIT LABOR COSTS	5.2	-5.4	0.9	2.9	2.4	1.1	2.4	2.3
CPI MOM	0.7	-0.3	0.2	0.2	0.2	0.1	0.1	0.1
CAPACITY UTILIZATION	84.4	74.2	79.3	3.3	2.8	0.3	3.3	0.3
CPI EX FOOD & ENERGY	0.4	-0.1	0.2	0.1	0.1	0.1	0.0	0.1
DURABLE GOODS ORDERS	12.8	-12.4	0.2	3.8	1.6	3.1	1.6	3.0
DURABLE GOODS - TRANSP	3.9	-3.7	0.4	1.9	0.9	1.7	0.9	1.7
EMPLOYMENT COST INDEX	1.4	0.4	0.9	0.2	0.1	0.2	0.1	0.2
EXISTING HOME SALES	6.8	0.0	5.2	0.6	0.5	0.2	0.5	0.2
EMPIRE MANUFACTURING	42.1	-20.4	21.9	16.5	14.4	10.6	14.6	10.7
MONTHLY BUDG STATE	189.8	-96.7	-3.4	54.4	54.6	4.7	52.8	4.1
GDP PRICE DEFLACTOR	3.2	-0.3	1.6	0.8	0.5	0.5	0.5	0.6
GDP	7.2	-0.4	3.1	2.1	2.1	0.9	2.1	0.9
IMPORT PRICE INDEX MOM	1.6	-2.7	0.1	0.8	0.4	0.5	0.4	0.5
INITIAL JOBLESS CLAIMS	528.0	257.0	348.4	53.6	53.4	19.6	51.8	18.5
INDUSTRIAL PRODUCTION	1.7	-1.1	0.2	0.5	0.4	0.3	0.4	0.3
LEADING INDICATORS	1.2	-0.6	0.1	0.3	0.3	0.1	0.2	0.1
BUSINESS INVENTORIES	0.9	-1.4	0.2	0.4	0.3	0.2	0.3	0.2
WHOLESALE INVENTORIES	1.9	-1.1	0.3	0.6	0.3	0.4	0.3	0.5
ISM NON MANUFACTURING	68.4	40.6	56.8	5.9	5.4	3.5	5.4	3.5
ISM MANUFACTURING	66.2	39.8	52.3	5.4	5.3	2.0	4.9	2.0
ISM PRICES PAID	88	31.6	57.7	13.8	12.8	4.2	12.9	4.2
CHANGE NONF PAYROLLS	416	-415	105.6	179.7	135.8	101.3	131.1	108.3
NEW HOMES SALES	1369	811	967.9	107.6	90.3	62.9	90.6	63.6
BUILINDG PERMITS	2077	1669	1836.2	108.8	105.7	60.4	101.6	57.8
HOUSING STARTS	2088	1512	1698.0	136.6	122.1	81.1	122.7	82.3
PHILADELPHIA FED	36.1	-36.8	8.0	15.1	13.8	9.0	12.9	9.3
PPI INDEX MOM	1.6	-1.9	0.1	0.6	0.3	0.4	0.2	0.4
ADVANCE RETAIL SALES	7.1	-3.7	0.3	1.6	1.0	0.9	0.9	0.9
RETAIL SALES LESS AUTOS	1.7	-1.6	0.3	0.7	0.3	0.5	0.2	0.5
DOMESTIC VEHICLE SALES	17.7	12.2	13.9	1.1	0.7	0.7	0.7	0.7
TOTAL VEHICLE SLES	19	15.4	16.7	1.0	0.5	0.9	0.5	0.9
FACTORY ORDERS	7.1	-7.5	0.3	2.3	2.3	1.3	2.0	0.5
AVERAGE HOURLY EARNINGS	0.7	-0.1	0.3	0.2	0.0	0.1	0.1	0.1
CHAN MANUF PAYROLLS	46	-163	-41.5	44.6	28.5	29.0	28.5	29.4
TRADE BALANCE	-7.986	-48.3	-26.6	11.7	9.2	2.1	11.5	2.1
UNEMPLOYMENT RATE	6.4	3.9	4.9	0.7	0.8	0.1	0.8	0.1
AVERAGE WEEKLY HOURS	34.7	33.6	34.2	0.3	0.4	0.4	0.3	0.1
CONSTRUCTION SPENDING	1.5	-0.3	0.6	0.6	0.2	0.6	0.2	0.9
CONSUMER CONFIDENCE	144.7	62.5	114.3	22.4	22.8	4.9	21.7	4.9
NON FARM PRODUCTIVITY	8.6	-0.2	3.2	2.2	1.9	0.8	1.9	0.7
PPI EX FOOD & ENERGY	1	-0.9	0.1	0.3	0.1	0.3	0.1	0.2
PERSONAL SPENDING	2.9	-1.8	0.4	0.5	0.4	0.2	0.4	0.2
PERSONAL INCOME	1.3	-0.2	0.4	0.2	0.1	0.2	0.2	0.2

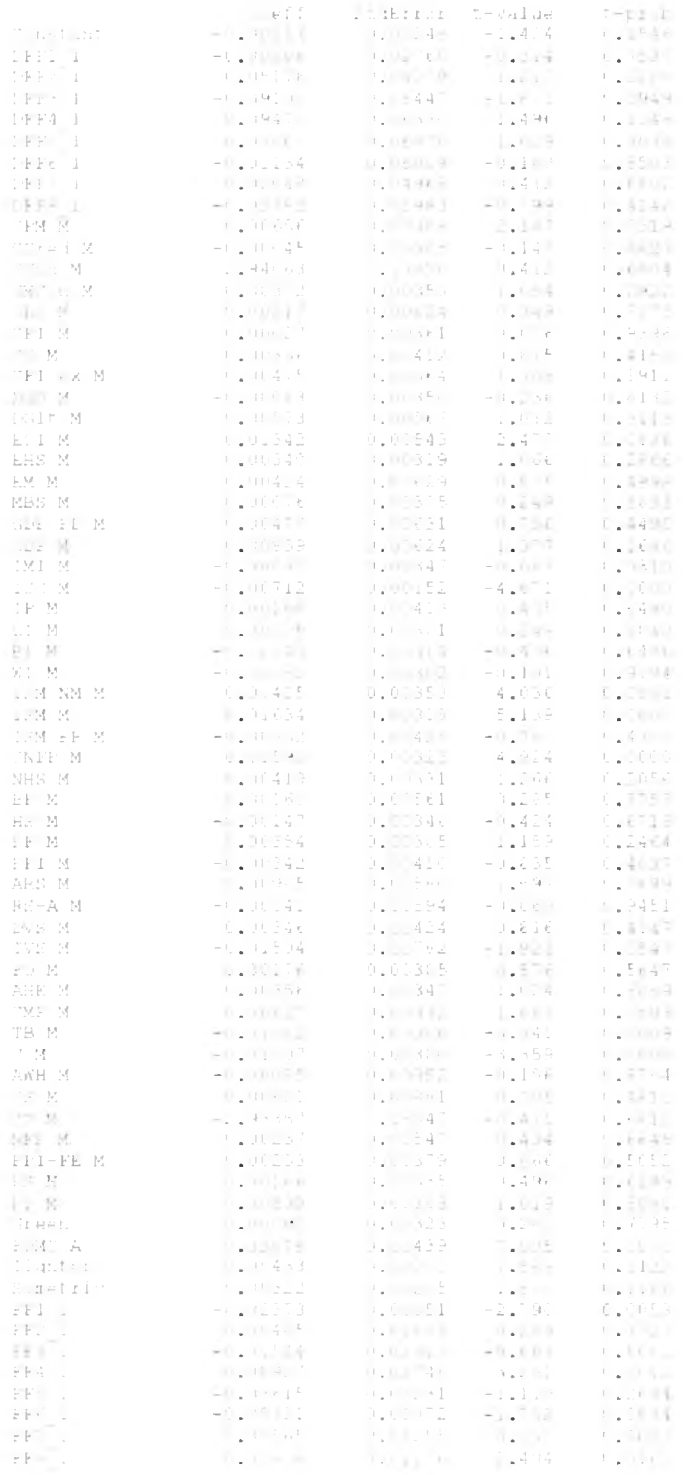
Source: own elaborations, based on data from Bloomberg

Table 2.14: Federal Reserve Policy Action

Date	Target Rate	Type of Policy shift	Bias
12/11/1996	5.25	Unchanged	Tighter
17/12/1996	5.25	Unchanged	Tighter
05/02/1997	5.25	Unchanged	Tighter
25/03/1997	5.5	Tightening	Symmetric
20/05/1997	5.5	Unchanged	Tighter
02/07/1997	5.5	Unchanged	Tighter
19/08/1997	5.5	Unchanged	Tighter
30/09/1997	5.5	Unchanged	Tighter
12/11/1997	5.5	Unchanged	Tighter
16/12/1997	5.5	Unchanged	Symmetric
04/02/1998	5.5	Unchanged	Symmetric
31/03/1998	5.5	Unchanged	Tighter
19/05/1998	5.5	Unchanged	Tighter
01/07/1998	5.5	Unchanged	Tighter
18/08/1998	5.5	Unchanged	Symmetric
29/09/1998	5.25	Easing	Easier
15/10/1998	5	Easing Full Pass Through (Conference call meeting)	Easier
17/11/1998	4.75	Easing Full Pass Through	Symmetric
22/12/1998	4.75	Unchanged	Symmetric
03/02/1999	4.75	Unchanged	Symmetric
30/03/1999	4.75	Unchanged	Symmetric
18/05/1999	4.75	Unchanged	Tighter
30/06/1999	5	Tightening	Symmetric
24/08/1999	5.25	Tightening Full Pass Through	Symmetric
05/10/1999	5.25	Unchanged	Tighter
16/11/1999	5.5	Tightening Full Pass Through	Symmetric
21/12/1999	5.5	Unchanged	Symmetric
02/02/2000	5.75	Tightening Full Pass Through	Risks weighted toward inflation
21/03/2000	6	Tightening Full Pass Through	Risks weighted toward inflation
16/05/2000	6.5	Tightening Full Pass Through	Risks weighted toward inflation
28/06/2000	6.5	Unchanged	Risks weighted toward inflation
22/08/2000	6.5	Unchanged	Risks weighted toward inflation
03/10/2000	6.5	Unchanged	Risks weighted toward inflation
15/11/2000	6.5	Unchanged	Risks weighted toward inflation
19/12/2000	6.5	Unchanged	Risks weighted toward inflation
03/01/2001	6	Easing Partial Pass Through	Risks w/t weakness
31/01/2001	5.5	Easing Full Pass Through	Risks w/t weakness
20/03/2001	5	Easing Full Pass Through	Risks w/t weakness
18/04/2001	4.5	Easing Full Pass Through	Risks w/t weakness
15/05/2001	4	Easing Full Pass Through	Risks w/t weakness
27/06/2001	3.75	Easing Full Pass Through	Risks w/t weakness
21/08/2001	3.5	Easing Full Pass Through	Risks w/t weakness
17/09/2001	3	Easing Full Pass Through (Conference call meeting)	Risks w/t weakness
02/10/2001	2.5	Easing Full Pass Through	Risks w/t weakness
06/11/2001	2	Easing Full Pass Through	Risks w/t weakness
11/12/2001	1.75	Easing Full Pass Through	Risks w/t weakness
30/01/2002	1.75	Unchanged	Risks w/t weakness
19/03/2002	1.75	Unchanged	Balanced risks
07/05/2002	1.75	Unchanged	Balanced risks
26/06/2002	1.75	Unchanged	Balanced risks
13/08/2002	1.75	Unchanged	Risks w/t weakness
24/09/2002	1.75	Unchanged	Risks w/t weakness
06/11/2002	1.25	Easing Full Pass Through	Balanced risks
10/12/2002	1.25	Unchanged	Balanced risks
29/01/2003	1.25	Unchanged	Balanced risks
18/03/2003	1.25	Unchanged	No risk assessment
06/05/2003	1.25	Unchanged	Risks w/t weakness
25/06/2003	1	Easing Full Pass Through	Growth balanced / Risk to lower inflation
12/08/2003	1	Unchanged	Growth balanced / Risk to lower inflation
16/09/2003	1	Unchanged	Growth balanced / Risk to lower inflation
28/10/2003	1	Unchanged	Growth balanced / Risk to lower inflation
09/12/2003	1	Unchanged	Growth balanced / Risk to lower inflation
28/01/2004	1	Unchanged	Balanced risks / Inflation risk almost equal
16/03/2004	1	Unchanged	Balanced risks / Inflation risk almost equal ("patient" wording)
04/05/2004	1	Unchanged	Balanced risks / Inflation risk has moved into balance
30/06/2004	1.25	Tightening Full Pass Through	Balanced risks / Removed at a pace that is likely to be measured

Source: Federal Reserve

Table 2.15: GUM (1) Modelling DFF3 by GETS, 4 – 2016



Source: Own elaborations, based on data from PcGets

Table 2.16: Mis-specification tests

RSS	1.58968	sigma	0.02858	R^2	0.17408
LogLik	7194.23081	AIC	-7.07669	HQ	-7.00720
T	2014	p	68	FpNull	0.00000

	Value	prob	alpha
Chow(1%)[1]	1.3071	0.0000	0.0100
Chow(1%)[2]	1.0044	1.9999	0.0100
Normality test	29[2] 2.2041	0.0000	0.0000
AR 1-4 test	1.2441	0.1187	0.0100
ARCH 1-4 test	10.2166	0.0000	0.0000
hetero test	5.4098	0.0000	0.0000

Source: Own elaborations, based on data from PcGets

Table 2.17: F pre-search testing (top-down and bottom up)

Stage-0 (Step 1): F presearch testing (lag-order preselection)
Check lag 2 F-prob =0.0211, Tests failed = 1, Invalid reduction

Stage-0 (Step 2): F presearch testing (top-down)
Remove 1 variable with t-prob > 0.9978 : F-prob =0.9978, Tests failed = 0;
Remove 2 variables with t-prob > 0.9347 : F-prob =0.9965, Tests failed = 0;
Remove 3 variables with t-prob > 0.9340 : F-prob =0.9996, Tests failed = 0;
Remove 4 variables with t-prob > 0.9331 : F-prob =0.2439, Tests failed = 1; Invalid reduction.

Stage-0 (Step 3): F presearch testing (top-down)
Remove 1 variable with t-prob > 0.9286 : F-prob =0.9999, Tests failed = 0;
Remove 2 variables with t-prob > 0.9164 : F-prob =1.0000, Tests failed = 0;
Remove 3 variables with t-prob > 0.8153 : F-prob =1.0000, Tests failed = 0;
Remove 4 variables with t-prob > 0.7758 : F-prob =1.0000, Tests failed = 0;
Remove 5 variables with t-prob > 0.7561 : F-prob =1.0000, Tests failed = 0;
Remove 6 variables with t-prob > 0.7435 : F-prob =1.0000, Tests failed = 0;
Remove 7 variables with t-prob > 0.6695 : F-prob =1.0000, Tests failed = 0;
Remove 8 variables with t-prob > 0.6545 : F-prob =1.0000, Tests failed = 0;
Remove 9 variables with t-prob > 0.6352 : F-prob =1.0000, Tests failed = 0;
Remove 10 variables with t-prob > 0.6347 : F-prob =1.0000, Tests failed = 0;
Remove 11 variables with t-prob > 0.6151 : F-prob =1.0000, Tests failed = 0;
Remove 12 variables with t-prob > 0.6005 : F-prob =1.0000, Tests failed = 0;
Remove 13 variables with t-prob > 0.5924 : F-prob =1.0000, Tests failed = 0;
Remove 14 variables with t-prob > 0.5920 : F-prob =1.0000, Tests failed = 0;
Remove 15 variables with t-prob > 0.5749 : F-prob =1.0000, Tests failed = 0;
Remove 16 variables with t-prob > 0.5738 : F-prob =1.0000, Tests failed = 0;
Remove 17 variables with t-prob > 0.5730 : F-prob =1.0000, Tests failed = 0;
Remove 18 variables with t-prob > 0.5629 : F-prob =1.0000, Tests failed = 0;
Remove 19 variables with t-prob > 0.5509 : F-prob =1.0000, Tests failed = 0;
Remove 20 variables with t-prob > 0.4942 : F-prob =1.0000, Tests failed = 0;
Remove 21 variables with t-prob > 0.4710 : F-prob =1.0000, Tests failed = 0;
Remove 22 variables with t-prob > 0.4691 : F-prob =1.0000, Tests failed = 0;
Remove 23 variables with t-prob > 0.4176 : F-prob =1.0000, Tests failed = 0;
Remove 24 variables with t-prob > 0.4083 : F-prob =1.0000, Tests failed = 0;
Remove 25 variables with t-prob > 0.3690 : F-prob =1.0000, Tests failed = 0;
Remove 26 variables with t-prob > 0.2750 : F-prob =0.9999, Tests failed = 0;
Remove 27 variables with t-prob > 0.2693 : F-prob =0.9997, Tests failed = 0;
Remove 28 variables with t-prob > 0.2622 : F-prob =0.9995, Tests failed = 0;
Remove 29 variables with t-prob > 0.2057 : F-prob =0.9989, Tests failed = 0;
Remove 30 variables with t-prob > 0.1932 : F-prob =0.9815, Tests failed = 0;

Remove 31 variables with t-prob > 0.1807 : F-prob =0.9711, Tests failed = 0;
Remove 32 variables with t-prob > 0.1439 : F-prob =0.9298, Tests failed = 0;
Remove 33 variables with t-prob > 0.1257 : F-prob =0.9044, Tests failed = 0;
Remove 34 variables with t-prob > 0.0878 : F-prob =0.8412, Tests failed = 0;
Remove 35 variables with t-prob > 0.0790 : F-prob =0.7519, Tests failed = 0;
Remove 36 variables with t-prob > 0.0601 : F-prob =0.6422, Tests failed = 0;
Remove 37 variables with t-prob > 0.0316 : F-prob =0.4178, Tests failed = 0;
Remove 38 variables with t-prob > 0.0210 : F-prob =0.2497, Tests failed = 0;
Remove 39 variables with t-prob > 0.0196 : F-prob =0.1375, Tests failed = 0;
F presearch testing stopped: none remaining variable with t-prob > 0.0100.

Stage-0 (Step 4): F presearch testing (bottom-up)
Found 12 variables with t-prob < 0.0100.
Include 12 variables with t-prob < 0.0196 : F-prob =0.1375, Tests failed = 0; Valid reduction found

Stage-0 (Step 5): No additional restriction imposed by the bottom-up reduction.

Source: PcGets and Hendry and Krolzig 2001a

Table 2.18: DFF3 Specific models, First Exercise

Economic Announcement	Reference	Liberal Coeff.	Liberal T-Value	Conservative Coeff.	Conservative T-Value	Outlier Correction Coeff.	Outlier Correction T-Value
Constant						-0.00396	-3.47700
DFF1_1							
DFF2_1							
DFF3_1		0.10169	4.74500	0.10539	4.91600		
DFF4_1							
DFF5_1						0.07087	5.19500
DFF6_1							
DFF7_1							
DFF8_1							
Inflation announcements							
UNIT LABOR COSTS	ULC M						
CPI MOM	CPI M						
CPI EX FOOD & ENERGY	CPI ex M						
EMPLOYMENT COST INDEX	ECI M					0.01381	3.34100
GDP PRICE DEFLACTOR	GDP PD M						
IMPORT PRICE INDEX MOM	IMI M						
ISM PRICES PAID	ISM PP M					0.00955	2.81400
PPI INDEX MOM	PPI M						
PPI EX FOOD & ENERGY	PPI-FE M						
Labor announcements							
INITIAL JOBLESS CLAIMS	IJC M	-0.00708	-4.64790	-0.00710	-4.68400	-0.00439	-3.71500
CHANGE NONF PAYROLLS	CNFP M	0.01839	6.10600	0.01960	6.55200	0.01578	6.46000
AVERAGE HOURLY EARNINGS	AHE M						
CHAN. MANUF. PAYROLLS	CMP M					0.00815	3.26500
AVERAGE WEEKLY HOURS	AWH M						
UNEMPLOYMENT RATE	U M	-0.00886	-2.97200			-0.00872	-3.79400
NON FARM PRODUCTIVITY	NFP M						
Demand announcements							
CONSUMER CREDIT	CCred M						
U OF MICHIGAN CONFIDENCE	UMCon S						
EXISTING HOME SALES	EHS M						
CONSUMER CONFIDENCE	CC M					0.00739	3.10700
NEW HOMES SALES	NHS M						
BUILINDG PERMITS	BP M						
HOUSING STARTS	HS M						
ADVANCE RETAIL SALES	ARS M					0.00861	2.36800
RETAIL SALES LESS AUTOS	RS-A M						
DOMESTIC VEHICLE SALES	DVS M						
TOTAL VEHICLE SLES	TVS M						
PERSONAL SPENDING	PS M						
PERSONAL INCOME	PI M					0.00826	3.56700
Activity announcements							
MONTHLY BUDG. STATE	MBS M						
GDP	GDP M						
INDUSTRIAL PRODUCTION	IP M						
LEADING INDICATORS	LI M						
BUSINESS INVENTORIES	BI M						
WHOLESALE INVENTORIES	WI M						
ISM NON MANUFACTURING	ISM NM M	0.01389	3.94500	0.01342	3.80600	0.01194	4.34900
ISM MANUFACTURING	ISM M	0.01697	5.61600	0.01704	5.62900	0.01179	4.87900
PHILADELPHIA FED	PF M					0.00501	2.15300
FACTORY ORDERS	FO M						
CONSTRUCTION SPENDING	CS M						
DURABLE GOODS ORDERS	DGO M						
DURABLE GOODS - TRANSP	DGt M						
CHICAGO PURC. MANAGER	CPM M					0.00744	3.20300
CAPACITY UTILIZATION	CU M						
EMPIRE MANUFACTURING	EM M						
Trade Bce announcement							
TRADE BALANCE	TB M	-0.01017	-3.38100	-0.01017	-3.37300		
Monetary							
FOMC RATE EXPECTED	FOMC M	0.03144	7.17200	0.03142	7.17540	0.03084	9.12900
FED Monetary Bias	Tighter						
FED Monetary Bias	Symetric						
FED Monetary Bias	Easing						
GREENSPAN SPEECH	GREEN						
FF1_1		-0.03056	-8.02300	-0.03015	-7.90500	-0.00371	-3.20200
FF2_1							
FF3_1							
FF4_1		0.06856	4.96700	0.06750	4.88300		
FF5_1							
FF6_1		-0.06589	-3.72000	-0.06536	-3.68400		
FF7_1							
FF8_1		0.02742	3.43800	0.02755	3.44800	0.00410	3.52400
R2		0.14244		0.13866		0.49566	
R2 adj		0.13773		0.13436		0.48726	
AIC		-7.09472		-7.09131		-7.60371	
HQ		-7.08246		-7.08007		-7.56896	
SC		-7.06131		-7.06068		-7.50904	
CHOW (1815)		0.62780	1.00000	0.63020	1.00000	0.31800	1.00000
AR1-4 test		1.99200	0.09320	2.08400	0.08090	0.55000	0.69900
# Outliers						16	

Source: Own elaborations, based on data from PcGets

Table 2.19: Expert User Strategy options

1. Significance levels
t – tests: Sets the significance level of t-tests.
F – tests: Sets the significance level of F-tests.
F - test of the GUM: Sets the significance level of the F-test of the GUM.
Encompassing test: Sets the significance level of the encompassing tests.
Diagnostics (high): Sets the loosest significance level of diagnostic tests.
Diagnostics (low): Sets the most stringent significance level of diagnostic tests (implemented if the relevant test rejects at the looser level in the GUM).

2. F-pre-search tests
F - tests (lag pre-selection): Sets the significance level of the lag pre-selection.
F - tests (step 1): Sets the significance level of the top-down reduction pre-search (Step 1).
F - tests (step 2): Sets the significance level of the top-down reduction pre-search (Step 2).
F - tests (bottom-up): Sets the significance level of the bottom-up reduction pre-search.
Marginal t-prob (step 1): Sets the marginal t-probability of the top-down reduction pre-search: the reduction ceases when the smallest remaining t-value is smaller than this probability (Step 1).
Marginal t-prob (step 2): Sets the marginal t-probability of the top-down reduction pre-search (Step 2).
Marginal t-prob (bottom-up): Sets the marginal t-probability of the bottom-up reduction pre-search.
Two-step pre-search testing: If checked, the top-down reduction pre-search runs through two steps.

3. Block search
Check groups with t-probs > 0.90: If checked, a reduction path starts by removing a group of variables with t-probability > 0.90.
Check groups with t-probs > 0.70: If checked, a reduction path starts by removing a group of variables with t-probability > 0.70.
Check groups with t-probs > 0.50: If checked, a reduction path starts by removing a group of variables with t-probability > 0.50.
Check groups with t-probs > 0.25: If checked, a reduction path starts by removing a group of variables with t-probability > 0.25.
Check groups with t-probs > 0.10: If checked, a reduction path starts by removing a group of variables with t-probability > 0.10.
Check groups with t-probs > 0.05: If checked, a reduction path starts by removing a group of variables with t-probability > 0.05.
Check groups with t-probs > 0.01: If checked, a reduction path starts by removing a group of variables with t-probability > 0.01.
Check groups with t-probs > 0.001: If checked, a reduction path starts by removing a group of variables with t-probability > 0.001.

4. Selection criteria for final model
Four information criteria are calculated and reported, one of which can be set to select the final choice from mutually encompassing congruent terminal models.
AIC If checked, AIC is used in selecting the specific choice from the set of terminal models.
HQ If checked, HQ is used in selecting the specific choice from the set of terminal models.
SC If checked, SC is used in selecting the specific choice from the set of terminal models.
HK If checked, HK is used in selecting the specific choice from the set of terminal models.

5. Sample-split analysis
Significance level: Sets significance level for t-tests in sub-samples.
Size of the sub-sample (fraction): Sets size of the sub-sample as fraction of the full sample.
Penalty for failed t-test in full sample: Sets penalty for failed t-test in full sample.
Penalty for failed t-test in sub-sample 1: Sets penalty for failed t-test in sub-sample 1.
Penalty for failed t-test in sub-sample 2: Sets penalty for failed t-test in sub-sample 2.

6. Outlier detection
Size of marginal outlier (in std.dev.): Determines the size of a marginal outlier (as a multiple of std.dev.).

7. Diagnostic tests
Chow test 1: If checked, the first Chow test is included in the test battery.

Chow test 2: If checked, the second Chow test is included in the test battery.
Portmanteau: If checked, the portmanteau statistic is included in the test battery.
Normality: If checked, the normality test is included in the test battery.
AR test: If checked, the LM test for residual autocorrelation is included in the test battery.
ARCH test: If checked, the test for ARCH in the residuals is included in the test battery.
Hetero test: If checked, the LM test for heterosckedasticity is included in the test battery.

8. Test options
Chow test break-point 1: Sets first break-point as a fraction of the sample.
Chow rest break-point 2: Sets second break-point as a fraction of the sample.
Portmanteau max lag: Sets number of lags used in calculating the portmanteau statistic.
AR test min lag: Sets the minimal lag of the LM test for residual autocorrelation.
AR test max lag: Sets the maximal lag of the LM test for residual autocorrelation.
ARCH test min lag: Sets the minimal lag of the test for ARCH effects in the residuals.
ARCH test max lag: Sets the maximal lag of the test for ARCH effects in the residuals.

9. Reset default
Keep current settings: Leaves the expert settings unchanged when selected.
Liberal strategy: Resets the expert settings to the liberal strategy.
Conservative strategy: Resets the expert settings to the conservative strategy.

Source: Hendry and Krolzig 2001a

Table 2.20: DFF3 Specific models, Second Experiment

Economic Announcement	Reference	Liberal Coeff.	Liberal T-Value	Conservative Coeff.	Conservative T-Value	Outlier Correction Coeff.	Outlier Correction T-Value
Constant						-0.00396	-3.48
DFF4_1		0.12195	6.35	0.12335	6.40		
DFF6_1						0.05298	4.30
Inflation announcements							
CPI EX FOOD & ENERGY	DCPI ex M-					-0.00973	-2.38
ISM PRICES PAID	DISM PP M+	-0.05298	-7.02	-0.04218	-6.53	-0.04695	-7.39
ISM PRICES PAID	DISM PP M-	-0.04278	-5.54	-0.03244	-4.79	-0.04297	-6.64
PPI INDEX MOM	DPPI M+					-0.01192	-2.49
PPI EX FOOD & ENERGY	DPPI-FE M+					0.01731	3.33
Labor announcements							
INITIAL JOBLESS CLAIMS	DIJC M+	-0.00793	-3.60	-0.00830	-3.76	-0.00515	-2.89
CHANGE NONF. PAYROLLS	DCNFP M-	-0.02067	-5.02	-0.02042	-4.95	-0.02886	-7.93
UNEMPLOYMENT RATE	DU M-					0.01725	4.19
Demand announcements							
DOMESTIC VEHICLE SALES	DDVS M-	-0.02987	-4.23	-0.02903	-4.11		
PERSONAL SPENDING	DPS M-					-0.01137	-2.54
PERSONAL INCOME	DPI M-					-0.01788	-3.45
Activity announcements							
ISM NON MANUFACTURING	DISM NM-					-0.01058	-2.40
ISM MANUFACTURING	DISM M+	0.04325	7.91	0.03814	7.43	0.05367	11.89
ISM MANUFACTURING	DISM M-	0.01408	2.73			0.02221	5.00
CONSTRUCTION SPENDING	DCS M+	0.09161	6.21	0.08942	6.05	0.07322	6.21
CONSTRUCTION SPENDING	DCS M-	0.06210	5.59	0.06143	5.52	0.03914	4.46
CHICAGO PURC. MANAGER	DCPM M+					0.00797	2.42
Trade Bce announcement							
TRADE BALANCE	DTB M+	-0.01219	-2.66				
Monetary							
FOMC RATE EXPECTED	DFOMC +	0.02780	3.39	0.02778	3.37	0.02502	3.82
FOMC RATE EXPECTED	DFOMC -	-0.05171	-5.14	-0.05169	-5.12	-0.05767	-7.18
FF1_1		-0.01713	-7.00	-0.01740	-7.09	-0.00457	-3.90
FF4_1		0.01692	6.96	0.01722	7.06		
FF8_1						0.00419	3.68
R2		0.16437		0.15819		0.47264	
R2 adj.		0.15852		0.15315		0.46385	
AIC		-7.11765		-7.11226		-7.55907	
HQ		-7.10232		-7.09898		-7.52432	
SC		-7.07588		-7.07607		-7.46440	
CHOW (1815)		0.55980		0.53120		0.76900	
AR1-4 test		3.06930		3.11570		0.95120	
# Outliers						13	

Source: Own elaborations, based on data from PcGets

Table 2.21: DFF3 Specific models, Third Experiment

Economic Announcement	Reference	Liberal Coeff.	Liberal T-Value	Conservative Coeff.	Conservative T-Value	Outlier Correction Coeff.	Outlier Correction T-Value
Constant						-0.00283	-2.37
DFF4_1		0.12110	6.38000	0.12303	6.46000		
Inflation announcements							
CPI EX FOOD & ENERGY	CPI ex M-					0.00672	1.95
EMPLOYMENT COST INDEX	ECI M+					0.01697	3.02
ISM PRICES PAID	ISM PP M-	0.04590	5.46	0.04629	5.48	0.04868	6.81
ISM PRICES PAID	ISM PP M+	-0.03614	-7.03	-0.03603	-6.97	-0.02118	-4.37
PPI INDEX MOM	PPI M+					-0.01611	-2.70
PPI EX FOOD & ENERGY	PPI-FE M+					0.01796	3.15
Labor announcements							
INITIAL JOBLESS CLAIMS	IJC M+	-0.00849	-4.05	-0.00895	-4.26	-0.00338	-1.93
INITIAL JOBLESS CLAIMS	IJC M-					-0.00479	-2.65
CHANGE NONF. PAYROLLS	CNFP M-	0.02167	5.63	0.02472	6.77	0.02189	7.00
CHAN. MANUF. PAYROLLS	CMP M+					0.02319	2.98
UNEMPLOYMENT RATE	U M-	-0.01140	-3.23	-0.01170	-3.30	-0.00885	-3.05
UNEMPLOYMENT RATE	U M+	-0.01545	-2.75			-0.01855	-4.08
Demand announcements							
ADVANCE RETAIL SALES	ARS M+					0.01150	2.74
PERSONAL SPENDING	PS M-					0.01370	3.89
PERSONAL INCOME	PI M+					0.0066	2.27
Activity announcements							
ISM NON MANUFACTURING	ISM NM M-	0.01873	3.16			0.01275	2.57
ISM NON MANUFACTURING	ISM NM M+	0.01250	2.95			0.01198	3.48
ISM MANUFACTURING	ISM M+	0.02523	6.23	0.02536	6.22	0.02266	6.72
ISM MANUFACTURING	ISM M-					-0.01250	-2.68
PHILADELPHIA FED	PF M-					0.00674	2.03
CONSTRUCTION SPENDING	CS M-	-0.07318	-6.13	-0.07325	-6.10	-0.05837	-5.91
CONSTRUCTION SPENDING	CS M+	0.09044	6.86	0.09045	6.82	0.08971	8.37
CHICAGO PURC. MANAGER	CPM M-					0.00841	2.49
CHICAGO PURC. MANAGER	CPM M+					0.0068	1.99
Trade Bce announcement							
TRADE BALANCE	TB M+	-0.01993	-4.75	-0.01980	-4.69		
Monetary							
FOMC RATE EXPECTED	FOMC A +	0.03868	4.83	0.03879	4.81	0.03780	5.83
FOMC RATE EXPECTED	FOMC A -	0.02756	5.46	0.02750	5.42	0.02813	6.89
FF1_1		-0.01730	-7.17	-0.01756	-7.24	-0.00674	-4.78
FF4_1		0.01712	7.14	0.01735	7.20		
FF6_1						0.00690	4.96
R2		0.18886		0.17844		0.47649	
R2 adj.		0.18236		0.17309		0.46534	
AIC		-7.14540		-7.13561		-7.55747	
HQ		-7.12803		-7.12130		-7.51352	
SC		-7.09807		-7.09663		-7.43774	
CHOW (1815)		0.47320		0.45370		0.72330	
AR1-4 test		2.04980		2.00910		1.45660	
# Outliers						13	

Source: Own elaborations, based on data from PcGets

Table 2.22: DFF3 Specific models, Third Experiment

Economic Announcement	Reference	Liberal Coeff.	Liberal T-Value	Conservative Coeff.	Conservative T-Value	Outlier Correction Coeff.	Outlier Correction T-Value
Constant							
DFF4_1		0.12488	6.65	0.12306	6.52		
DFF5_1						0.08679	6.38
Inflation announcements							
CPI EX FOOD & ENERGY	CPI ex M+					0.02672	2.69
CPI EX FOOD & ENERGY	DCPI ex M+					-0.03493	-2.39
EMPLOYMENT COST INDEX	ECI M-					0.01533	2.38
ISM PRICES PAID	ISM PP M-	0.06261	6.78	0.05296	6.19		
ISM PRICES PAID	DISM PP M+	-0.05011	-7.11	-0.04286	-6.88	-0.05379	-8.61
ISM PRICES PAID	DISM PP M-					-0.05197	-8.02
GDP PRICE DEFLACTOR	GDP PD M+	0.02975	2.42			-0.06601	-2.44
GDP PRICE DEFLACTOR	DGDP PD M+					0.06716	3.64
PPI EX FOOD & ENERGY	DPPI-FE M-					-0.00704	-1.97
Labor announcements							
INITIAL JOBLESS CLAIMS	IJC M+	-0.00869	-4.21	-0.00837	-4.03		
INITIAL JOBLESS CLAIMS	IJC M-					-0.00386	-2.21
CHANGE NONF. PAYROLLS	CNFP M-	0.01918	5.15	0.01899	5.06	0.02076	6.80
CHAN. MANUF. PAYROLLS	CMP M+					0.02911	3.81
UNEMPLOYMENT RATE	U M+	-0.01674	-3.03	-0.01568	-2.82	-0.01866	-4.15
Demand announcements							
ADVANCE RETAIL SALES	ARS M+	0.01201	2.37			0.01037	2.51
DOMESTIC VEHICLE SALES	DDVS M-	-0.03496	-5.10	-0.03319	-4.82	-0.02899	-4.51
TOTAL VEHICLE SALES	TVS M-					-0.08624	-4.27
TOTAL VEHICLE SALES	DTVS M-					-0.04908	-3.68
PERSONAL SPENDING	PS M-					0.00988	2.93
PERSONAL SPENDING	PS M+					-0.01041	-2.70
Activity announcements							
ISM NON MANUFACTURING	ISM NM M-					0.02271	4.75
ISM NON MANUFACTURING	ISM NM M+	0.01272	3.04			0.01148	3.37
ISM MANUFACTURING	DISM M+	0.04317	8.17	0.04007	7.93	0.05693	12.08
ISM MANUFACTURING	DISM M-	0.01144	2.40			0.02481	5.56
CAPACITY UTILIZATION	CU M-					0.00792	2.15
DURABLE GOOD ORDERS	DGO M-					0.01565	2.33
DURABLE GOOD ORDERS	DDGO M-					0.01379	2.17
CONSTRUCTION SPENDING	CS M-	-0.06736	-5.89	-0.06890	-5.99	-0.04902	-4.70
CONSTRUCTION SPENDING	CS M+	0.19582	4.44	0.09803	7.26	0.18152	5.03
CONSTRUCTION SPENDING	DCS M+	-0.10794	-2.29			-0.10711	-2.79
EMPIRE MANUFACTURING	EM M-					-0.03222	-2.42
EMPIRE MANUFACTURING	DEM M-					-0.03722	-2.70
CHICAGO PURC. MANAGER	CPM M-					0.00962	2.88
CHICAGO PURC. MANAGER	DCPM M+					0.00683	2.09
Trade Bce announcement							
TRADE BALANCE	TB M+	-0.01978	-4.77	-0.01999	-4.78	0.01591	2.52
TRADE BALANCE	DTB M+					-0.01873	-3.01
Monetary							
FOMC RATE EXPECTED	FOMC A +	0.03869	4.89	0.03855	4.83	0.03484	5.41
FOMC RATE EXPECTED	FOMC A -	0.01800	2.79	0.02760	5.50	0.01667	3.16
FOMC RATE EXPECTED	DFOMC -	-0.02980	-2.34			-0.04254	-4.02
FF1_1		-0.01658	-6.94	-0.01685	-7.01	-0.00030	-2.40
FF4_1		0.01633	6.88	0.01668	6.98		
R2		0.20947		0.19499		0.48494	
R2 adj.		0.20154		0.18935		0.47209	
AIC		-7.16717		-7.15497		-7.56679	
HQ		-7.14571		-7.13964		-7.51569	
SC		-7.10870		-7.11321		-7.42757	
CHOW (1816)		0.43220		0.42810		0.52000	
AR1-4 test		2.59050		2.45360		2.63440	
# Outliers						11	

Source: Own elaborations, based on data from PcGets

Table 2.23: DFF 3 Specific models of DFF3, 4 – 2016, Average Survey

Economic Announcement	Reference	Liberal Coeff.	Liberal T-Value	Conservative Coeff.	Conservative T-Value	Outlier Correction Coeff.	Outlier Correction T-Value
Constant		-0.00709	-5.91	-0.00709	-5.91	-0.00428	-4.54
DFF_1		0.13421	6.36	0.13421	6.36	0.07854	4.62
DFF_2						0.04296	2.57
Inflation announcements							
EMPLOYMENT COST INDEX	ECI A					0.01119	2.38
ISM PRICES PAID	ISM PP A					0.00817	2.38
Labor announcements							
INITIAL JOBLESS CLAIMS	IJC A	-0.00772	-4.71	-0.00772	-4.71	-0.00497	-3.87
CHANGE NONF. PAYROLLS	CNFP A	0.02148	6.61	0.02148	6.61	0.01813	6.62
CHAN. MANUF. PAYROLLS	CMP A					0.00664	2.54
AVERAGE WEEKLY HOURS	AWH A					-0.00709	-2.49
UNEMPLOYMENT RATE	U A	-0.01127	-3.35	-0.01127	-3.35	-0.00938	-3.54
NON FARM PRODUCTIVITY	NFP A						
Demand announcements							
CONSUMER CONFIDENCE	CC A					0.00895	3.36
ADVANCE RETAIL SALES	ARS A					0.00848	2.31
Activity announcements							
ISM NON MANUFACTURING	ISM NM A	0.01561	4.36	0.01561	4.36	0.01187	4.23
ISM MANUFACTURING	ISM A	0.01947	5.71	0.01947	5.71	0.01472	5.38
PHILADELPHIA FED	PF A					0.00630	2.40
CONSTRUCTION SPENDING	CS A	0.03465	3.79	0.03465	3.79	0.04789	6.60
CHICAGO PURC. MANAGER	CPM A					0.00815	3.09
CAPACITY UTILIZATION	CU A					0.00808	3.07
Trade Bce announcement							
TRADE BALANCE	TB A	-0.01245	-3.69	-0.01245	-3.69		
Monetary							
FOMC RATE EXPECTED	FOMC A	0.03110	7.04	0.03110	7.04	0.03071	8.99
FED Monetary Bias	Tighter	0.00777	4.72	0.00777	4.72	0.00371	2.88
FED Monetary Bias	Symetric	0.00774	4.82	0.00774	4.82	0.00405	3.22
R2		0.12794		0.12794		0.48495	
R2 adj.		0.12315		0.12315		0.47583	
AIC		-7.07745		-7.07745		-7.58019	
HQ		-7.06518		-7.06518		-7.54338	
SC		-7.04402		-7.04402		-7.47991	
CHOW (1815)		0.56450		0.56450		0.51300	
AR1-4 test		1.83500		1.83500			
# Outliers						15	

Source: Own elaborations, based on data from PcGets

Table 2.24: DFF Specific models, 4 – 2016, Liberal Strategy

		DFF1		DFF2		DFF3		DFF4		DFF5		DFF6		DFF7		DFF8	
Economic Announcement	**Reference**	**Coeff.**	**T-Value**	**Coeff.**	**T-Value**	**Coeff.**	**T-Value**	**Coeff.**	**T-Value**	**Coeff.**	**T-Value**	**Coeff.**	**T-Value**	**Coeff.**	**T-Value**	**Coeff.**	**T-Value**
Constant		-0.00870	-6.20000	-0.00718	-5.50200	-0.00676	-5.57200	-0.00681	-5.21100	-0.00620	-4.30600	0.10217	4.91300				
Lag DFF				0.09684	4.47300	0.13883	6.49700	0.13002	6.23100	0.11781	5.67200	0.10217	4.91300	0.09115	4.37600	0.07359	3.58300
Inflation announcements																	
UNIT LABOR COSTS	ULC M																
CPI MOM	CPI M																
CPI EX FOOD & ENERGY	CPI ex M									0.00916	2.50900						
EMPLOYMENT COST INDEX	ECI M					0.01514	2.78000	0.02439	4.16200	0.02388	3.66900	0.03151	4.26100	0.03420	4.18100	0.03442	3.89500
GDP PRICE DEFLACTOR	GDP PD M																
IMPORT PRICE INDEX MOM	IMI M																
ISM PRICES PAID	ISM PP M							0.01314	2.93400	0.01405	2.83900	0.01857	3.33200	0.01953	3.16200	0.02404	3.56800
PPI INDEX MOM	PPI M																
PPI EX FOOD & ENERGY	PPI-FE M																
Labor announcements																	
INITIAL JOBLESS CLAIMS	IJC M			-0.00613	-3.71000	-0.00710	-4.59400	-0.00667	-4.01100	-0.00734	-3.99700	-0.00839	-4.03600	-0.00849	-3.69100	-0.00945	-3.76800
CHANGE NONF. PAYROLLS	CNFP M			0.00891	2.59200	0.01845	5.99300	0.02326	7.02700	0.03040	8.31400	0.03551	8.61700	0.03934	8.61600	0.03684	7.39600
AVERAGE HOURLY EARNINGS	AHE M																
CHAN. MANUF. PAYROLLS	CMP M			0.01081	3.05900												
AVERAGE WEEKLY HOURS	AWH M																
UNEMPLOYMENT RATE	U M					-0.00887	-2.91200	-0.01334	-4.07200	-0.01444	-3.98800	-0.01640	-4.02000	-0.01679	-3.71500	-0.01774	-3.59700
NON FARM PRODUCTIVITY	NFP M																
Demand announcements																	
CONSUMER CREDIT	CCred M																
U OF MICHIGAN CONFIDENCE	UMCon S																
EXISTING HOME SALES	EHS M																
CONSUMER CONFIDENCE	CC M									0.00912	2.43900	0.01137	2.69600	0.01274	2.72800	0.01496	2.99100
NEW HOMES SALES	NHS M																
BUILINDG PERMITS	BP M																
HOUSING STARTS	HS M																
ADVANCE RETAIL SALES	ARS M							0.01448	2.79700			0.02112	3.27000	0.02174	3.03800	0.02750	3.52300
RETAIL SALES LESS AUTOS	RS-A M																
DOMESTIC VEHICLE SALES	DVS M	-0.02478	-5.90500					0.01430	3.19100	0.02110	4.26000	0.01864	3.34400	0.02974	4.81400	0.03073	4.56000
TOTAL VEHICLE SLES	TVS M							-0.02874	-3.39900	-0.03559	-3.80700	-0.03103	-2.93700	-0.03213	-2.74800	-0.04368	-3.41700
PERSONAL SPENDING	PS M																
PERSONAL INCOME	PI M	0.01359	3.85200														
Activity announcements																	
MONTHLY BUDG. STATE.	MBS M																
GDP	GDP M											0.01945	2.39500	0.02344	2.60400		
INDUSTRIAL PRODUCTION	IP M																
LEADING INDICATORS	LI M																
BUSINESS INVENTORIES	BI M																
WHOLESALE INVENTORIES	WI M																
ISM NON MANUFACTURING	ISM NM M			0.01028	2.67400	0.00359	4.25400	0.01639	4.23700	0.01697	3.97100	0.02001	4.14900	0.02126	3.97700	0.01994	3.42000
ISM MANUFACTURING	ISM M			0.02059	6.24200	0.01804	5.85400	0.03349	9.89900	0.03809	10.19100	0.04067	9.64600	0.04458	9.54000	0.04846	9.50500
PHILADELPHIA FED	PF M											0.01122	2.72000	0.01277	2.79200	0.01568	3.14100
FACTORY ORDERS	FO M																
CONSTRUCTION SPENDING	CS M	-0.02681	-2.62800														
DURABLE GOODS ORDERS	DGO M																
DURABLE GOODS - TRANSP.	DGlt M											0.01537	2.15200				
CHICAGO PURC. MANAGER	CPM M							0.01013	3.06400	0.01173	3.21100	0.01375	3.31400	0.01526	3.32000	0.01946	3.90400
CAPACITY UTILIZATION	CU M																
EMPIRE MANUFACTURING	EM M																
Trade Bce announcement																	
TRADE BALANCE	TB M			-0.01303	-3.96400	-0.01079	-3.51200	-0.01027	-3.10700	-0.01122	-3.06800						
Monetary																	
FOMC RATE EXPECTED	FOMC M	0.02083	4.54000	0.02147	5.11800	0.01489	3.79600	0.01275	3.02300	0.01482	3.15900	0.01276	2.42700	0.01318	2.26100		
FED Monetary Bias	Tighter	0.00999	5.17000	0.00833	4.66600	0.00707	4.25400	0.00685	3.83100	0.00613	3.10600						
FED Monetary Bias	Symetric	0.00958	5.08000	0.00783	4.49500	0.00748	4.60100	0.00722	4.12500	0.00637	3.29500						
FED Monetary Bias	Easing																
GREENSPAN SPEECH	GREEN																
R2		0.05403		0.08484		0.10600		0.14703		0.15359		0.14578		0.14183		0.12790	
R2 adj.		0.05120		0.08027		0.10109		0.14019		0.14638		0.13893		0.13538		0.12223	
AIC		-6.74112		-6.91826		-7.05261		-6.90416		-6.70420		-6.46190		-6.25677		-6.08407	
HQ		-6.73396		-6.90701		-7.04034		-6.88678		-6.68579		-6.44452		-6.24041		-6.06975	
SC		-6.72162		-6.88761		-7.01918		-6.85681		-6.65405		-6.41455		-6.21221		-6.04507	
CHOW (1815)		0.15890		0.00000		0.62610		0.00000		0.00000		0.00000		0.00000		0.00000	
AR1-4 test		1.90840		0.74990		1.58570		0.88570		0.39340		0.51050		0.36630		0.36510	

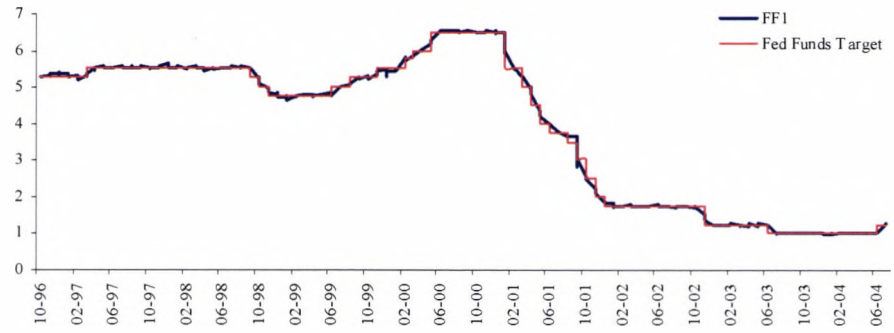
Source: Own elaborations, based on data from PcGets

Table 2.25: DFF Specific models, 4 – 2016, Conservative Strategy

Economic Announcement	Reference	DFF1 Coeff.	DFF1 T-Value	DFF2 Coeff.	DFF2 T-Value	DFF3 Coeff.	DFF3 T-Value	DFF4 Coeff.	DFF4 T-Value	DFF5 Coeff.	DFF5 T-Value	DFF6 Coeff.	DFF6 T-Value	DFF7 Coeff.	DFF7 T-Value	DFF8 Coeff.	DFF8 T-Value
Constant		-0.00869	-6.18500	-0.00717	-5.48000	-0.00657	-5.40800	-0.00681	-5.21100	-0.00647	-4.48600						
Lag DFF				0.09425	4.34800	0.14253	6.65800	0.13002	6.23100	0.12014	5.77300	0.10423	4.99700	0.09313	4.46100	0.07684	3.63800
Inflation announcements																	
UNIT LABOR COSTS	ULC M																
CPI MOM	CPI M																
CPI EX FOOD & ENERGY	CPI ex M																
EMPLOYMENT COST INDEX	ECI M							0.02439	4.16200	0.02549	3.92600	0.03246	4.40600	0.03647	4.47100	0.03440	3.87700
GDP PRICE DEFLACTOR	GDP PD M																
IMPORT PRICE INDEX MOM	IMI M																
ISM PRICES PAID	ISM PP M							0.01314	2.93400			0.01856	3.31700	0.01953	3.15300	0.02404	3.55300
PPI INDEX MOM	PPI M																
PPI EX FOOD & ENERGY	PPI-FE M																
Labor announcements																	
INITIAL JOBLESS CLAIMS	IJC M			-0.00622	-3.75300	-0.00700	-4.51400	-0.00667	-4.01100	-0.00744	-4.03900	-0.00817	-3.92100	-0.00851	-3.68900	-0.00933	-3.70400
CHANGE NONF. PAYROLLS	CNFP M					0.01967	6.42300	0.02326	7.02700	0.03037	8.28300	0.03552	8.58800	0.03934	8.59200	0.03684	7.36700
AVERAGE HOURLY EARNINGS	AHE M																
CHAN. MANUF. PAYROLLS	CMP M			0.01328	3.94900												
AVERAGE WEEKLY HOURS	AWH M																
UNEMPLOYMENT RATE	U M							-0.01334	-4.07200	-0.01445	-3.98100	-0.01639	-4.00200	-0.01678	-3.70300	-0.01773	-3.58200
NON FARM PRODUCTIVITY	NFP M																
Demand announcements																	
CONSUMER CREDIT	CCred M																
U OF MICHIGAN CONFIDENCE	UMCon S																
EXISTING HOME SALES	EHS M																
CONSUMER CONFIDENCE	CC M																
NEW HOMES SALES	NHS M																
BUILINDG PERMITS	BP M																
HOUSING STARTS	HS M																
ADVANCE RETAIL SALES	ARS M							0.01448	2.79700	0.01970	2.95800	0.02110	3.25500	0.02174	3.02900	0.02751	3.50900
RETAIL SALES LESS AUTOS	RS-A M																
DOMESTIC VEHICLE SALES	DVS M	-0.02499	-5.94600					0.01430	3.19100	0.02117	4.26300	0.01864	3.33200	0.02974	4.80100	0.03073	4.54200
TOTAL VEHICLE SLES	TVS M							-0.02874	-3.39900	-0.03571	-3.80900	-0.03107	-2.93200	-0.03221	-2.74800	-0.04375	-3.40900
PERSONAL SPENDING	PS M																
PERSONAL INCOME	PI M	0.01286	3.65000														
Activity announcements																	
MONTHLY BUDG. STATE.	MBS M																
GDP	GDP M											0.01952	2.39500	0.02372	2.62900		
INDUSTRIAL PRODUCTION	IP M																
LEADING INDICATORS	LI M																
BUSINESS INVENTORIES	BI M																
WHOLESALE INVENTORIES	WI M																
ISM NON MANUFACTURING	ISM NM M					0.01481	4.11100	0.01639	4.23700	0.01697	3.96000	0.02003	4.13800	0.02127	3.96800	0.01995	3.40800
ISM MANUFACTURING	ISM M			0.02081	6.29200	0.01812	5.86000	0.03349	9.89900	0.03812	10.17100	0.04066	9.61000	0.04457	9.51300	0.04845	9.46500
PHILADELPHIA FED	PF M											0.01121	2.70800	0.01277	2.78500		
FACTORY ORDERS	FO M																
CONSTRUCTION SPENDING	CS M																
DURABLE GOODS ORDERS	DGO M																
DURABLE GOODS - TRANSP.	DGlt M																
CHICAGO PURC. MANAGER	CPM M							0.01013	3.06400	0.01158	3.16100	0.01389	3.33900	0.01505	3.26700	0.01946	3.88700
CAPACITY UTILIZATION	CU M																
EMPIRE MANUFACTURING	EM M																
Trade Bce announcement																	
TRADE BALANCE	TB M			-0.01302	-3.95000	-0.01079	-3.49800	-0.01027	-3.10700								
Monetary																	
FOMC RATE EXPECTED	FOMC M	0.02084	4.53500	0.02148	5.10600	0.01490	3.78600	0.01275	3.02300	0.01475	3.15700						
FED Monetary Bias	Tighter	0.01004	5.19000	0.00826	4.61700	0.00697	4.17800	0.00685	3.83100	0.00640	3.24300						
FED Monetary Bias	Symetric	0.00962	5.09200	0.00794	4.54200	0.00735	4.50700	0.00722	4.12500	0.00688	3.55900						
FED Monetary Bias	Easing																
GREENSPAN SPEECH	GREEN																
R2		0.05078		0.07858		0.09876		0.14703		0.14840		0.13830		0.13644		0.11999	
R2 adj.		0.04841		0.07490		0.09471		0.14019		0.14200		0.13270		0.13082		0.11516	
AIC		-6.73868		-6.91342		-7.04652		-6.90416		-6.70001		-6.45617		-6.25250		-6.07703	
HQ		-6.73254		-6.90422		-7.03630		-6.88678		-6.68371		-6.44185		-6.23818		-6.06476	
SC		-6.72196		-6.88835		-7.01867		-6.85681		-6.65550		-6.41717		-6.21350		-6.04361	
CHOW (1815)		0.18490		0.00000		0.62490		0.00000		0.00000		0.00000		0.00000		0.00000	
AR1-4 test		1.83570		0.85190		1.79980		0.88570		0.63370		0.60630		0.26790		0.41200	

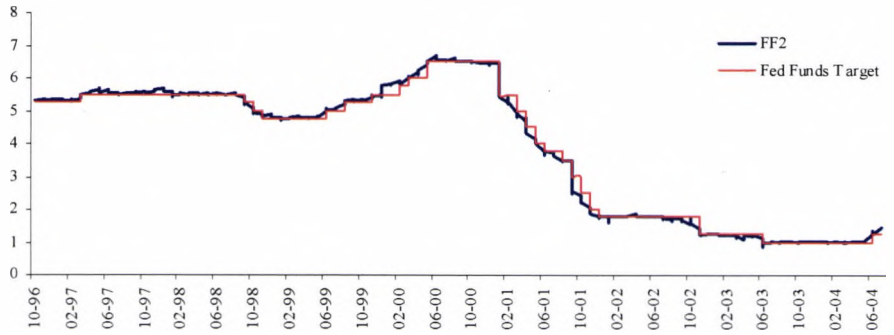
Source: Own elaborations, based on data from PcGets

Figure 2.1: Fed funds Futures Contract FF1 vs. Fed funds Target



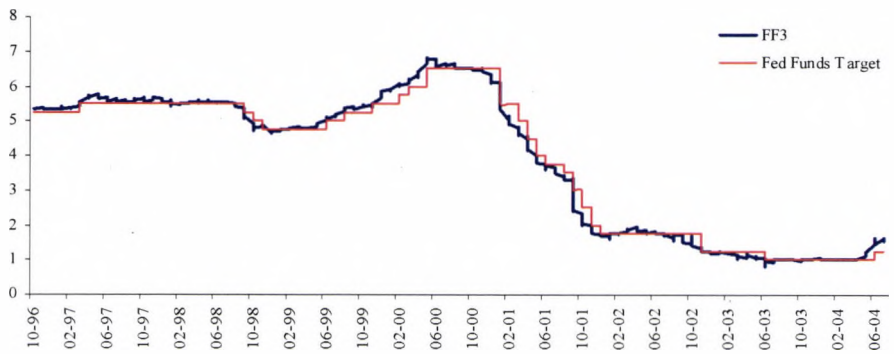
Source: Own elaborations, based on data from Bloomberg

Figure 2.2: Fed funds Futures Contract FF2 vs. Fed funds Target



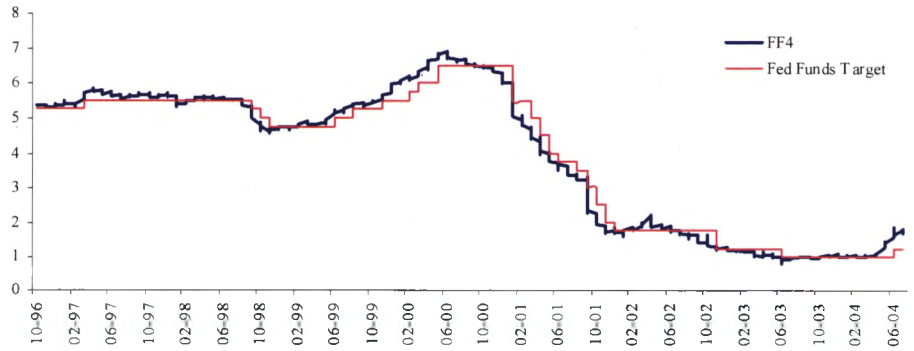
Source: Own elaborations, based on data from Bloomberg

Figure 2.3: Fed funds Futures Contract FF3 vs. Fed funds Target



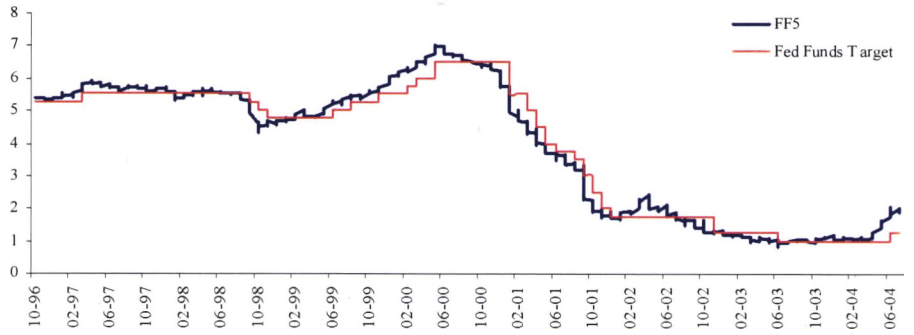
Source: Own elaborations, based on data from Bloomberg

Figure 2.4: Fed funds Futures Contract FF4 vs. Fed funds Target



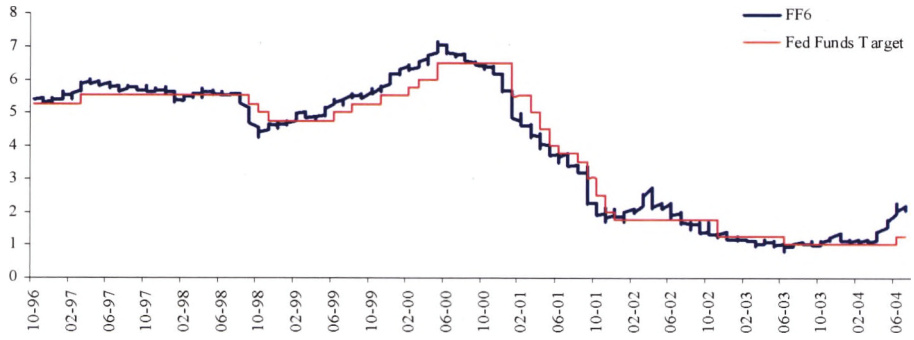
Source: Own elaborations, based on data from Bloomberg

Figure 2.5: Fed funds Futures Contract FF5 vs. Fed funds Target



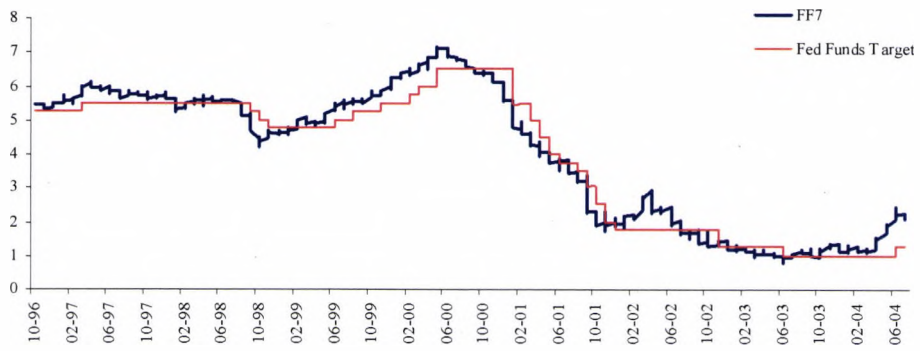
Source: Own elaborations, based on data from Bloomberg

Figure 2.6: Fed funds Futures Contract FF6 vs. Fed funds Target



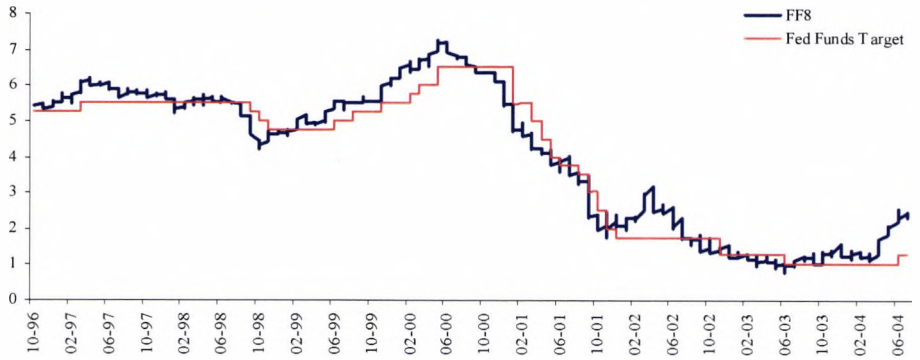
Source: Own elaborations, based on data from Bloomberg

Figure 2.7: Fed funds Futures Contract FF7 vs. Fed funds Target



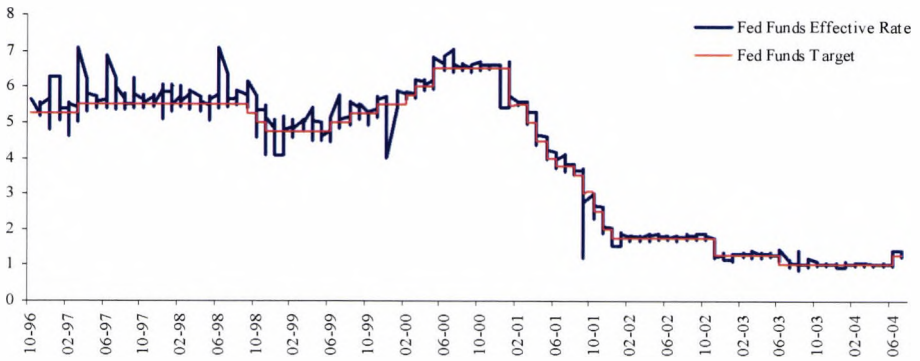
Source: Own elaborations, based on data from Bloomberg

Figure 2.8: Fed funds Futures Contract FF8 vs. Fed funds Target



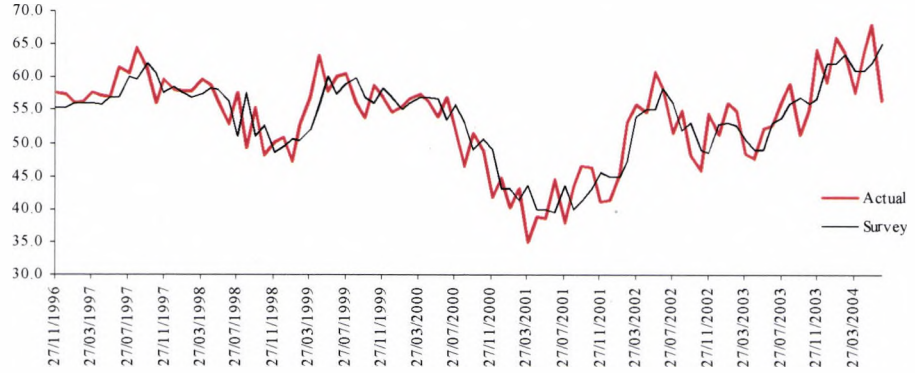
Source: Own elaborations, based on data from Bloomberg

Figure 2.9: Fed funds effective rate vs. Fed funds Target



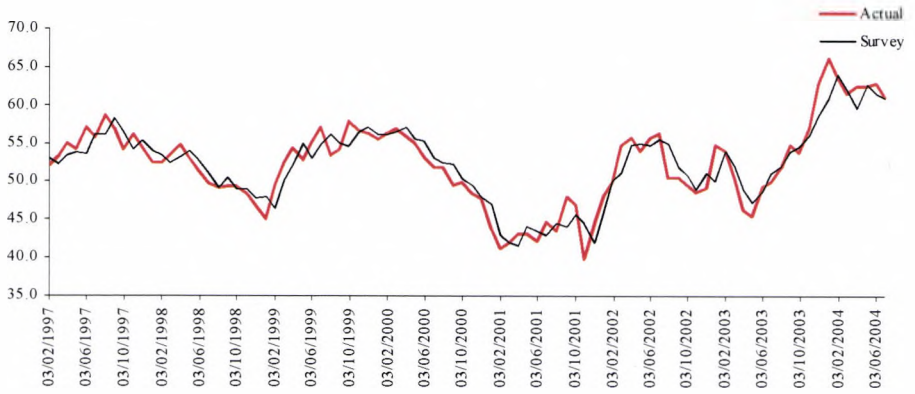
Source: Own elaborations, based on data from Bloomberg

Figure 2.10: Chicago Purch. Manager (CPM M), Actual vs. Bbg Median Survey



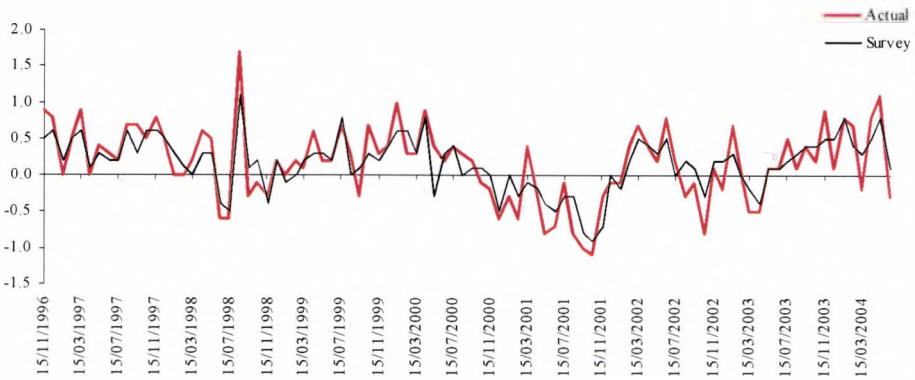
Source: Own elaborations, based on data from Bloomberg

Figure 2.11: ISM Manufacturing (ISM M), Actual vs. Bbg Median Survey



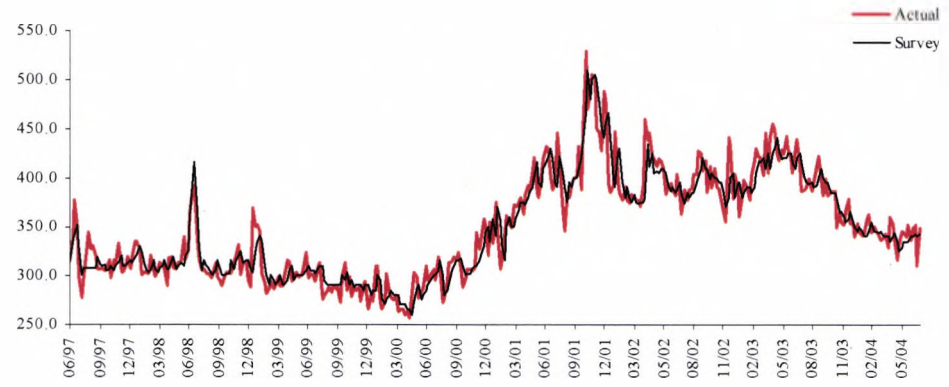
Source: Own elaborations, based on data from Bloomberg

Figure 2.12: Industrial Production (IP M), Actual vs. Bloomberg Median Survey



Source: Own elaborations, based on data from Bloomberg

Figure 2.13: Initial Jobless Claims (IJC M), Actual vs. Bbg Median Survey



Source: Own elaborations, based on data from Bloomberg

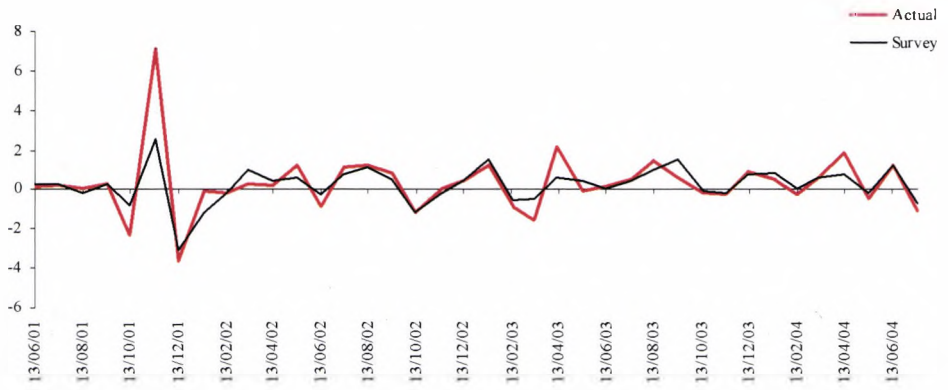
Figure 2.14: Durable Goods Orders (DGO M), Actual vs. Bbg Median Survey

Source: Own elaborations, based on data from Bloomberg

Figure 2.15: Change Nonfarm Payrolls (CNFFM) Actual vs. Bbg Median Survey

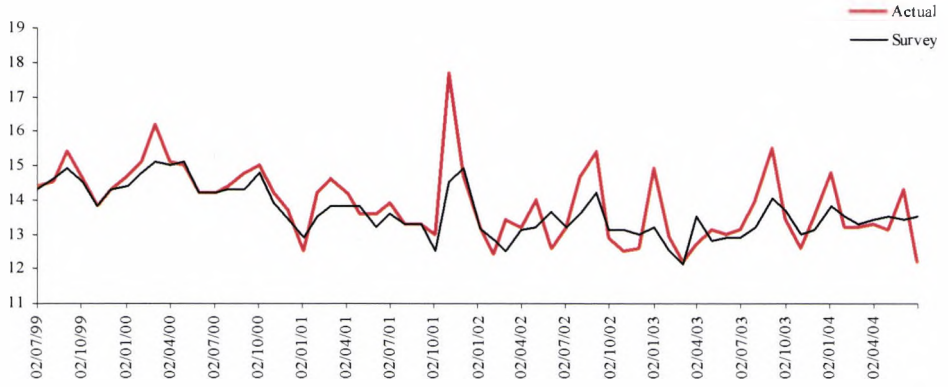
Source: Own elaborations, based on data from Bloomberg

Figure 2.16: Advanced Retail Sales (ARS M), Actual vs. Bbg Median Survey



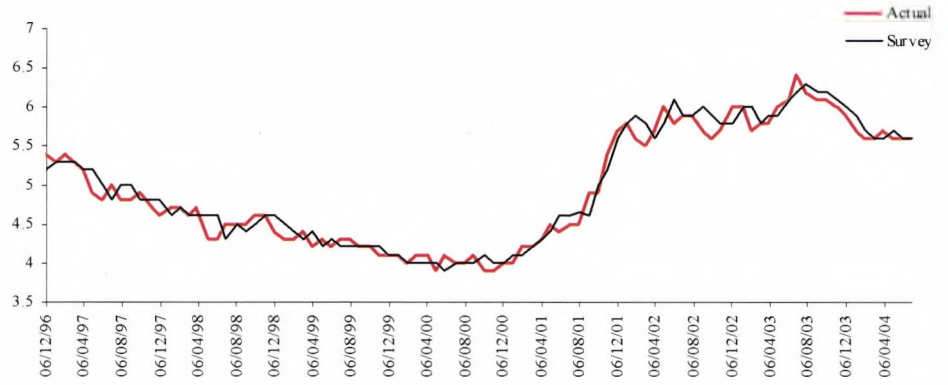
Source: Own elaborations, based on data from Bloomberg

Figure 2.17: Domestic Vehicle Sales (DVS M), Actual vs. Bbg Median Survey



Source: Own elaborations, based on data from Bloomberg

Figure 2.18: Unemployment (U M), Actual vs. Bloomberg Median Survey

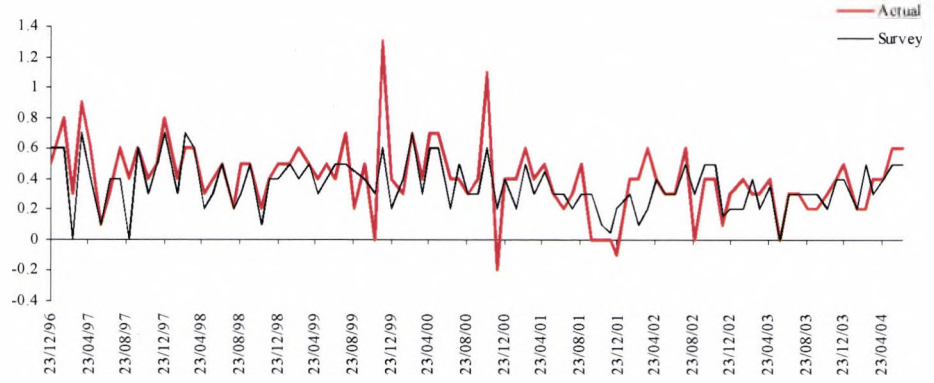


Source: Own elaborations, based on data from Bloomberg

Figure 2.19: Personal Spending (PS M), Actual vs. Bloomberg Median Survey

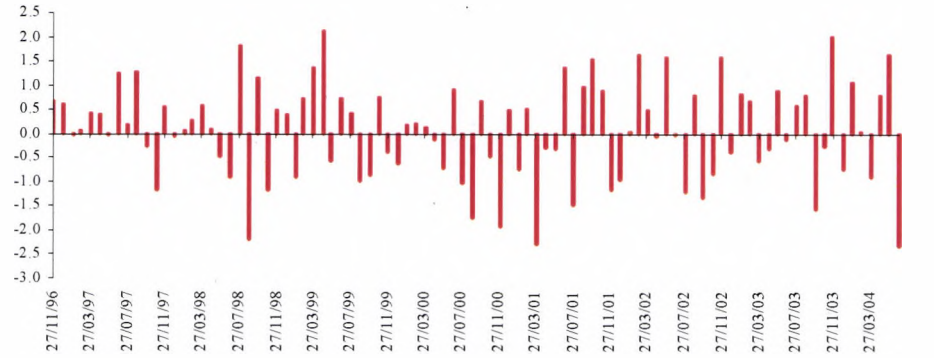
Source: Own elaborations, based on data from Bloomberg

Figure 2.20: Personal Income (PI M), Actual vs. Bloomberg Median Survey



Source: Own elaborations, based on data from Bloomberg

Figure 2.21: Chicago Purchasing Manager (CPM M), Surprises

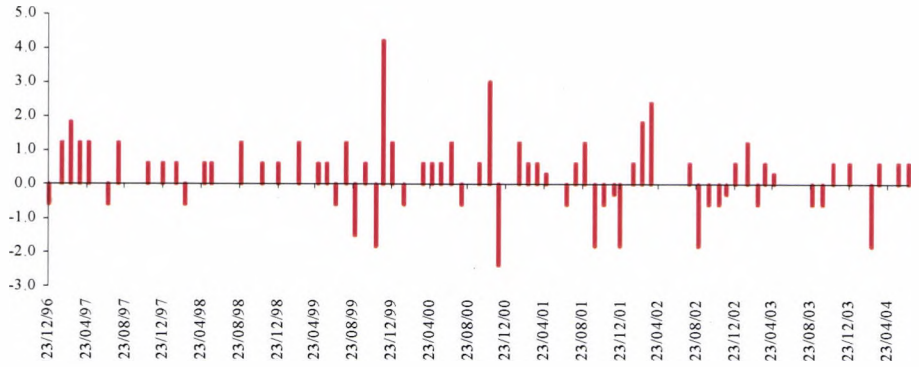


Source: Own elaborations, based on data from Bloomberg

Figure 2.22: Domestic Vehicle Sales (DVS M), Surprises

Source: Own elaborations, based on data from Bloomberg

Figure 2.23: Personal Income (PI M), Surprises



Source: Own elaborations, based on data from Bloomberg

CHAPTER 3

Macro News and Forecasters' Disagreement

1. Introduction

The literature of micro effect of macro news deals with the effect of surprises over different asset classes. In general surprise is defined as the difference between the actual release and the consensus of expectations (see Chapter 1, Section 2 Definition and Scope of the News Concept). The consensus usually is formed with the average or median estimate of economic analysts surveyed by a news agency [1]. The only statistical measure used from the survey is usually the consensus, and that is what in this chapter is called a single dimension representation of a survey of analysts. The utilisation of the consensus by the literature on the impact of macro-surprises tends to simplify and probably loses valuable information. This chapter aims to foster the understanding of the effect of economic announcements' surprises by adding extra descriptive dimensions from the analyst survey. Then, the chapter will extract other information from the survey apart from just the consensus.

From the survey, differences in estimates produce disagreement. In this case, the disagreement in the expectation means that market participants will interpret the surprise differently as their estimate differs.The fact that disagreement exist in the market suggest that expectations will be put under test once the announcement is released, so then prices would react according to the degree of difference in opinions.

The chapter novelties are: a) it is the first study of the impact of macro news that considers disagreement as a key explanatory variable; b) introduces an ECM that captures different level of disagreement to capture asymmetries in the response of the US interest rates to economic surprises; c) the study avoids preselection biases as it uses the latest

[1]The term consensus forecasts was made popular by J. Livingston (founder of the Livingston Survey in the US).

revolution of automatic General-to-Specific model selection; d) given point c, the analysis covers the entire spectrum of US economic announcements; and e) different authors' databases are built considering only expansionary years for the global economy, in this case the database frame cope with both expansionary and recessionary years (bull and bear markets).

The chapter is organised as follows. Section 2 reviews the definition of uncertainty and disagreement terms, which has been extensively discussed in the literature (but not in the way it is used in the chapter). Section 3 describes the data set. Section 4 critically presents the different measures of disagreement used in the literature and the new measures created for this chapter. Section 5 introduces the models to be estimated and Section 6 presents the main results. Finally, Section 7 concludes.

2. Uncertainty and Disagreement

The literature on micro effect of macro news ignores the disagreement behind the consensus forecast. The chapter deals with the use of survey data to estimate uncertainty. The disagreement in the analysts' survey is in this case interpreted as a proxy of the different opinions of the market at the time of the announcement. That difference in beliefs is also considered as heterogeneity in market positions. In other words, the asset allocations are influenced by the expectations on the economic variables. Then, once the innovation arrives to the market, i.e. the announcement is released, the market participants evaluate the news and rebalance their assets which ultimately has a market impact. It is not necessary in this chapter to assume a position in the debate of uncertainty vs. disagreement, although the chapter's approach resembles closer to disagreement. The understanding of this debate is still relevant to our study and a brief literature review is presented in this section.

Sepulveda -Umanzor (2004) defines two general approaches for uncertainty measures. The first one is the Model Based Approach. This one proxies uncertainty through econometric estimation of the variability of realized values of the variable under study, measuring volatility rather than uncertainty. As Sepulveda -Umanzor (2004) states volatility

is a characteristic of the data once uncertainty has been solved. The second path of uncertainty measures is the Survey Based Approach. As a general rule, the studies that follow this approach look at the standard deviation of the relevant variable calculated form the survey of forecasters. The assumption is that this measure of disagreement is a proxy of uncertainty. This opens several ongoing debates. Zarnowitz and Lambros (1987) define disagreement as the inverse of the consensus i.e. the dispersion of a sample of point forecasts. This is ultimately measured by their standard deviation. Then uncertainty is the diffuseness of the probability distributions attached by the same individuals to their predictions. Zarnowitz and Lambros (1987) affirm that to use disagreement as a proxy for uncertainty requires to assume that the interpersonal dispersion measure is a good approximation to the dispersion of intrapersonal predictive probabilities. That paper is able to calculate a direct measure of inflation uncertainty as they use the Survey of Professional Forecasters (SPF) which asks not only for point forecasts of inflation, but also requires forecasters to assign a probability per expected inflation interval. Then, statistical measures of uncertainty such as variance or standard deviation make explicit how uncertain is the forecaster around his point forecast. The measures in Zarnowitz and Lambros (1987) of consensus and uncertainty are positively correlated. But intrapersonal variation in expected inflation -uncertainty- is larger than interpersonal variation -disagreement.

Bomberger (1996, 1999) also examines the empirical validity of the relationship between current disagreement and current uncertainty about the future. Their tested hypothesis uses ARCH relationships stating that the conditional variance of forecast errors should be positively related to the disagreement among forecasters at the time of the forecast. The results show that the survey measures of disagreement provide a useful basis for assessing the effects of uncertainty. Giordani and Söderlind (2003) reach a similar conclusion affirming that disagreement is a fairly good proxy for other measures of uncertainty that are more theoretically appealing but less easily available.

Mankiw et al (2004) analyse the disagreement in inflation forecasts, and discover that inflation positively affects disagreement. The later is calculated using the interquartile range. The stylised facts reported are: disagreement about the future path of inflation

rise with inflation and when inflation changes sharply and it shows no clear relationship with measures of real activity. The authors present a simple sticky-information model that matches several stylised facts. The main feature of the sticky-information model is that agents only disagree in their forecast of future inflation due to updates in their information sets at different points in time.

Sepulveda -Umanzor (2004) also uses the concept of macroeconomic uncertainty based on expectations surveys. The paper finds a relationship between expected real activity and uncertainty. In this case, uncertainty is measured by the standard deviation of analysts surveys of output growth, unemployment and inflation. The main conclusion of this paper is that agents have more uncertainty in their expectations of the economic variables when the growth rate of output is expected to fall, and less uncertainty when the output is expected to rise. The survey disagreements are used in this case as proxies for macroeconomic uncertainty. Sepulveda -Umanzor (2004) affirms that the empirical estimation of uncertainty has been exclusively focused on measuring inflation uncertainty.

3. Data Set

Following Chapter 2, Section 3 Economic Announcement, Bloomberg News economic calendar is the source of US economic announcements used. Bloomberg's World Economic Calendar (WECO) contains a record of the economic statistics, including the actual announcements, the Bloomberg survey of economists' forecasts and the revised number. The surveys began in December 1996 for US, but in the first years it did not cover every economic indicator. The availability of the list of forecasts of each economist opens the possibility of the study of disagreement in the impact of economic news. Table 2.12 and 2.13 in Chapter 2 present 47 economic statistics, with its name, the reference that is used in the empirical analysis, the date when Bloomberg started the surveys, the total number of observations in our sample and the descriptive statistics of each of them.

The main input of this chapter are the particular analyst forecasts for each economic announcement. Then the database constructed has 47 indicators, for each statistic there are approximately 72 specific releases, and for each announcement there is a survey of analysts containing 30 to 60 economists' estimates (approximately 169,200 data points).

Table 3.1 presents an example of economic survey for Non Farm Payroll forecasts. The table shows the name of each analyst, the institution that represents and the forecast of each of the 61 analysts.

[Insert TABLE 3.1]

4. Measures of Disagreement

In order to be able to use the information contained in the survey of analysts, a proper measure of disagreement has to be found. The literature uses several measures to describe the disagreement in a survey. The most common is the simple standard deviation (SD). SD calculates the dispersion of data around its mean. But, in the case of this chapter, it will be necessary to have a measure that enables us to compare it along different points in time. This will enable us to see if different degrees of dispersion influences the impact of the surprises. In order to compare the relative dispersion of many sets of data, the SD needs to be based on the the same mean across them. For our analysis this drawback is key as the forecasters' means change over time, and also SD can not be compared across different type of economic announcements.

The natural alternative for SD is the Coefficient of Variation (CV) which relates dispersion and location. It is defined as the ratio of SD over mean. The higher the CV the more dispersed are the forecasts. This chapter considers several measures of CV. The first one is a slight variation to CV called CV+. This measure avoids the negative sign of CV that raises when the median is negative, therefore it just takes the mean absolute value. This is the usual measure followed in the stocks earnings forecast literature. In equity terms, the coefficient of variation of all earnings estimates is the standard deviation of all estimates that make up the consensus as a percentage of the absolute value of the mean value of all estimates for a company (Dische, 2002; Bond and Cunmins, 2004 and Johnson, 2004). CV has a clear drawback that appears when the mean is zero or close to zero. Diether et al. (2002) take notice of this issue and treat stocks with mean forecast of zero as of high dispersion (in their case they are assigned to the highest dispersion group). Moreover, in their study they show that the exclusion of observations with mean

earnings forecast of zero does not significantly affect the portfolio returns and the results achieved. A slight modification of the CV is the definition used by Thomas (2002) as the standard deviation of analysts' forecasts deflated by the stock price five days before the earnings announcement date. The second alternative measure that this chapter considers is CV2, where the median is replaced by the historic average median. A further variation is CV3 which replaces the median lower than a certain threshold by the historic average median, and keep the actual mean in the rest of the calculations (as opposed to CV2). While, CV3+ is a slight modification to CV3 taking the mean absolute values.

The interquartile range (IQR) is another measure of spread or dispersion applied in the literature. It is the difference between the 75^{th} percentile (often called Q3) and the 25^{th} percentile (Q1). The formula for interquartile range is therefore: Q3-Q1. It is sometimes called the H-spread. Mankiw et al (2003) use this measure. Giordani and Söderlind (2003) employ the quasi-standard deviation, denoted qStd(i), and is calculated as half the distance between the 84^{th} and 16^{th} percentiles of the point forecasts. As the authors above mentioned state, if these forecasts were normally distributed, then the quasi-standard deviation would coincide with the standard deviation, otherwise it is much more robust to outliers. The IQR and the qStd do not avoid the same drawbacks as SD. Then, an alternative could be to express them in mean terms as in CV. But, the disadvantages of CV remain as well. All in all, Chapter 3 does not use IQR as an alternative measure of disagreement as the same drawbacks of CV persist.

Alternatively to CV and its variations, a disagreement diffusion index is constructed that captures uncertainty. This index tracks the disagreement in each economic release by creating first an intra surprise indicator. It considers news expressed in a standardised way dividing the surprise by its sample standard deviation:

$$IntraSurprise_i = \frac{(Median_i - Analyst_A Forecast)}{\sigma_i} \tag{3.1}$$

Where i = analyst; σ_i = standard deviation of the median less analyst forecast survey at that time. Then, each analyst surprise with IntraSurprise>0.5 are assigned with a +1 and -1 in the case that surprises are lower than IntraSurprise <-0.5. The Intra Surprise Disagreement (ISD) diffusion index is then built performing this calculation:

$$ISD_t = \left(\frac{\sum_{t=1}^{N} (IS_t^+ + IS_t^-)}{N} \right) \tag{3.2}$$

Where N = Total Number of Analyst Surveyed for that specific announcement, IS = IntraSurprise; $IS_+ = 1$ when IS_i >0.5 and $IS_- = -1$ when IS_i<0.5 A reading above zero implies a positive balance of upside Intra Surprises on that specific release with respect to the median.

This last approach has a clear backdrop. If the number of analysts with positive and negative skewed disagreement is equal, then the ISD will be zero. Consequently, another way of calculating the disagreement is introduced. In this case, each analyst surprise with IS_i >0.5 and IS_i <-0.5 are assigned with a +1 respectively. Then, the Alternative Intra Surprise Disagreement (AISD) diffusion index is then built performing this calculation:

$$AISD_t = \left(\frac{\sum_{t=1}^{N} (IS_t)}{N} \right) \tag{3.3}$$

Where N =Total number of analyst surveyed for that specific announcement. A reading above zero implies that there is dispersion among analysts.

5. Forecasters' Disagreement and News

5.1. Base Model. The initial model starts with a linear Error Correction Model (ECM, following efficiency assumptions) unrestricted of the daily variation in interest rates (IR, initially a generic set of interest rates i=1,..., I) explained by 1 lagged values of the daily difference of each IR (DIR), and of the news (S) without including their lags, and the lags of the level IR contract levels;

$$DIR_{i,t} = \beta_0 + \sum_{i=1}^{I} \beta_i DIR_{i,t-1} + \sum_{k=1}^{K} \beta_k S_{k,t} + \sum_{i=1}^{I} \gamma_i IR_{i,t-1} + \epsilon_t \tag{3.4}$$

where, K=47 and T=2016. The I and J represent the lags. At the same time, in order to capture the different effects of the Fed monetary policy bias three dummies were constructed: Symmetric, Tightening and Easing (See Chapter 2, Table 2.14). As usual, two of them are introduced in the regressions to avoid collinearity. The dummies included are called Tighter and Symmetric, representing tighten and symmetric monetary policy

stance respectively. In order to capture the effect of Fed Chairman Semiannual Monetary Report to the Congress another dummy was added (called Greenspan dummy). Then, K reaches 50 variables, while the number of daily data is 2015 as one day is lost due to the difference to construct the first variation in FF.

5.2. Model I. The level of disagreement is a factor that has to be taken into account to explain the daily variation in IR. The model to estimate is a linear ECM including only disagreement (U_k) (no surprises). The idea is that the existence of differences in opinion (and behind that of different asset allocations) explain per se part of the impact of the economic announcement over IR.

$$\begin{aligned} DIR_{i,t} &= \beta_0 + \sum_{i=1}^{I} \beta_i DIR_{i,t-1} + \sum_{k=1}^{K} \beta_k U_{k,t} \\ &+ \sum_{k=1}^{K} \beta_k U_{k,t-1} + \sum_{i=1}^{I} \gamma_i IR_{i,t-1} + \epsilon_t \end{aligned} \tag{3.5}$$

5.3. Model II. The second model is a small variation to the alternative I. The model to estimate is a linear ECM including surprises and disagreement to analyse the daily variation in Interest Rates (IR). Then, not only the disagreement explains the variation in interest rates but also the surprises.

$$\begin{aligned} DIR_{i,t} &= \beta_0 + \sum_{i=1}^{I} \beta_i DIR_{i,t-1} + \sum_{k=1}^{K} \beta_k S_{k,t} + \sum_{k=1}^{K} \beta_k U_{k,t} + \\ &+ \sum_{k=1}^{K} \beta_k U_{k,t-1} + \sum_{i=1}^{I} \gamma_i IR_{i,t-1} + \epsilon_t \end{aligned} \tag{3.6}$$

5.4. Model III. Uncertainty dummies are calculated for each relevant economic announcement. Two stages are created: High (H) and Low Uncertainty (L). High Uncertainty (H) states a period when the uncertainty measure is higher than one standard deviation approximately. Then, the H stage is constructed using a percentile rank, and from there set the ones 84% higher and 16% lower with 1. The sample in between are low uncertainty (L) represented with 0's. Finally, two dummies are built that differentiate

between disagreement in a context of high and low uncertainty: HU (ones where H exist and zeros otherwise) and LU (ones where L exist and zeros otherwise). The model to estimate is a linear ECM with the dichotomy variables HU and LU and the lags of the IR levels.

$$\begin{aligned} DIR_{i,t} &= \beta_0 + \sum_{i=1}^{I} \beta_i DIR_{i,t-1} + \sum_{k=1}^{K} \beta_k HU_{k,t} + \\ &+ \sum_{k=1}^{K} \beta_k LU_{k,t} + \sum_{k=1}^{K} \beta_k HU_{k,t-1} \\ &+ \sum_{k=1}^{K} \beta_k LU_{k,t-1} + \sum_{i=1}^{I} \gamma_i IR_{i,t-1} + \epsilon_t \end{aligned} \tag{3.7}$$

5.5. Model IV. This alternative considers a linear ECM with dichotomy variables that differentiates between disagreement in a context of high and low uncertainty, and also the level of surprises (i.e. Model III plus surprises).

$$\begin{aligned} DIR_{i,t} &= \beta_0 + \sum_{i=1}^{I} \beta_i DIR_{i,t-1} + \sum_{k=1}^{K} \beta_k S_{k,t} + \\ &+ \sum_{k=1}^{K} \beta_k HU_{k,t} + \sum_{k=1}^{K} \beta_k LU_{k,t} + \\ &+ \sum_{k=1}^{K} \beta_k HU_{k,t-1} + \sum_{k=1}^{K} \beta_k LU_{k,t-1} \\ &+ \sum_{i=1}^{I} \gamma_i IR_{i,t-1} + \epsilon_t \end{aligned} \tag{3.8}$$

5.6. Model V. The last model introduces surprises conditioned to the level of disagreement (high and low uncertainty). Moreover, surprises are divided as positive and negative as explanatory variables to capture asymmetry in the response of news (see Chapter 2).

$$
\begin{aligned}
DIR_{i,t} \;=\; & \beta_0 + \sum_{i=1}^{I} \beta_i DIR_{i,t-1} + HU \sum_{k=1}^{K} \beta_k S^{+}_{k,t} + \\
& + HU \sum_{k=1}^{K} \beta_k S^{-}_{k,t} + LU \sum_{k=1}^{K} \beta_k S^{+}_{k,t} + \\
& + LU \sum_{k=1}^{K} \beta_k S^{-}_{k,t} + \sum_{k=1}^{K} \beta_{kj} S^{+}_{k,t} + \\
& + \sum_{k=1}^{K} \beta_{kj} S^{-}_{k,t} + \sum_{i=1}^{I} \gamma_i IR_{i,t-1} + \epsilon_t
\end{aligned}
\tag{3.9}
$$

6. Empirical Steps

The data selected in this chapter begins from January 8^{th} 1999 (or 572 in the data base) as the availability of Bloomberg analyst surveys starts later than the simple median or average survey. The usual first step is to test for cointegration in the set of interest rates used, which are the US 3 month, 6 month, 1 year, 2 year, 5 year and 10 year notes[2]. In all these exercises the main variable to explain is the variation in US 2 year interest rates. The 2 year interest rate is a good benchmark of short to medium term interest rates. At the same time, it is influenced by long term and short term factors. Following the modelling alternatives commented in the section 5.1 to 5.6, the first model to calculate is the ECM model including all the surprises, classified as positive and negative (no addition of disagreement measures so far). Table 3.2 presents the results applying PcGets liberal strategy to the ECM unrestricted and restricted model. The third and fourth columns

[2]All are constant maturities, i.e. yields on actively traded non-inflation-indexed issues adjusted to constant maturities. Yields on Treasury nominal securities at "constant maturity" are interpolated by the U.S. Treasury from the daily yield curve for non-inflation-indexed Treasury securities. This curve, which relates the yield on a security to its time to maturity, is based on the closing market bid yields on actively traded Treasury securities in the over-the-counter market. These market yields are calculated from composites of quotations obtained by the Federal Reserve Bank of New York. This method provides a yield for a 10-year maturity, for example, even if no outstanding security has exactly 10 years remaining to maturity.

in Table 3.2 present the results in the ECM unrestricted model. Columns fifth and sixth do the same with the ECM restricted estimation. For the definition of the economic announcements please refer to Chapter 2, Table 2.12. As in the previous chapters, the units are interest rates percentage points (i.e. 0.0239 in PPI M+ coefficient is 2.39 basis points).

[Insert TABLE 3.2]

The only difference between the ECM restricted and unrestricted is that ISM NM M- remains in the restricted one. In summary, the 12 economic announcements relevant in influencing the variation of 2 year US yields are: PPI + (Inflation Announcement); IJC + and - (Labor Announcement); CNFP + and - (Labor Announcement); UMCon - (Demand Announcement); RS-A + (Demand Announcement); CPM - (Activity Announcement); GDP + (Activity Announcement); DGlT + (Activity Announcement); ISM NM + and - (Activity Announcement); ISM + (Activity Announcement) and PF + (Activity Announcement). Positive surprises in the inflation (PPI +) have a negative effect over interest rates (-0.02399 in the unrestricted and -0.02409 in the restricted). The coefficient does not have the expected sign (i.e positive inflation surprises lead to higher interest rate expectations). In order to check if the level of correlation influenced the selection of this variable and disturb the coefficients, the PPI was dropped in an alternative model. There was no change in the coefficients, one variable was excluded in the specific model (BI+) and two were added (UMCon + and ISM-).

In order to continue with the modelling steps described in the previous section, the complete set of alternative disagreement measures is calculated for each of the 12 economic announcements that remained in the Initial Model. Then, the Model I is introduced (ECM including only the disagreement measures -all of them) ending with no specific model, i.e. not a single variable was selected. The raw disagreement measures per se do not add any explanatory power to the variation of interest rates. In order to check the robustness, the sample was reduced starting at August 30^{th} 2000 (1000) instead of January 8^{th} 1999 (572). The same lack of selected variables was found. As an alternative to check the consistency of the previous analysis, a model including only ISD and AISD

definitions was run, achieving the same results. Also the same conclusion is reached with the different CV measures run on their own.

Model II is a linear ECM including surprises and disagreement. The only variables that are chosen in the final model are the same set of surprises as in the base case and none of the disagreement measures. To check this result, the model was run dropping ISD and AISD variables. As a sign of robustness of the model selection, the same specific model is achieved. On a similar note, adding ISD and AISD variables did not affect the results.

Model III considers a linear ECM with dichotomy variables that differentiates between disagreement in a context of high uncertainty and low uncertainty. Uncertainty dummies (HU and LU) are calculated for each relevant economic announcement (i.e. for the 12 that stay in the base model; avoiding the duplication for cv+, cv3 and cv3+ as they can be redundant). The model with uncertainty dummies only is presented in Table 3.3. As an example, the HU CV3 of NFP has a coefficient of -0.0286 (or 2.86 basis points). More CV than AISD and ISD variables are selected: 6 HU and 7 LU. Considering that the ratio of HU to LU is 1/3 in the sample this looks like a relevant result. The number of different economic variables in total is 7.

[Insert TABLE 3.3]

Model IV is a linear ECM with dichotomy variables that differentiates between disagreement in a context of high and low uncertainty, and also the level of surprises. The first set of estimations includes surprises and dummies as explanatory variables of the variation of US 2y interest rates (see Table 3.4). The specific model selected includes two disagreement measures (expressed as dummies): LU BI CV2 and HU DGlT CV. The information criteria does not improve vs. the base Model.

[Insert TABLE 3.4]

Model V introduces surprises but conditioned to the level of disagreement (high and low uncertainty). The model includes the surprises divided in positive and negative (see Table 3.5). The main variables HU and LU are constructed by multiplying the original

surprises by the dummies HU and LU. The results show a larger number of surprises interacting with disagreement than positive/negative surprises on their own. When it exists high uncertainty (HU) the effect tends to be higher. In terms of uncertainty interaction, AISD appears four times, CV2 twice and CV+ once. The economic announcements that do not remain in the specific model are: ISM NM, GDP, BI PPI and IJC. Table 3.6 presents the specific model considering only surprises interacting with HU / LU variables i.e. not including surprises on its own. The final variables are interactions with LU except two. The representation of announcements is 7 over a total of 12. There is no clear majority of disagreement measure. Next step in modelling is to exclude the other uncertainty measures, starting with only ISD and AISD: 9 disagreement variables over a total of 12 economic variables remain in the final model while more ISD variables remains and the HU variables have higher impact on D2y than LU. Considering only ISD, when there is more uncertainty (HU) it tends to have bigger effects (coefficients), also 9 disagreement measures over a total of 12 economic variables remain in the final model. In general the effect of HU is larger than LU. In other words, the higher the disagreement level, the higher the effect of surprises. In the case of only including AISD disagreement based measures, 10 disagreement variables out of 12 economic announcements remain in the final model. In terms of information criteria Model V has slightly higher AIC, HQ and SC than the base model (see Table 3.2). HU and LU interaction surprises seem more relevant than positive and negative ones (asymmetries). This is a total new finding in the literature.

[Insert TABLES 3.5 AND 3.6]

7. Conclusions

This chapter fosters the understanding of the effect of economic announcements' surprises by introducing disagreement as a conditional variable. In this case, two statistitcal measures are extracted from the survey: consensus and disagreement. Disagreement in the expectation means that market participants estimate differs and then economic announcements create different surprises and interpretations. The disagreement in the analysts'

survey is in this case interpreted as a proxy of the different opinions of the market at the time of the announcement. That difference in beliefs is also considered as heterogeneity in market positions. In other words, the asset allocations are influenced by the expectations on the economic variables. Then, once the innovation arrives to the market, i.e. the announcement is released, the market participants evaluate the news and rebalance their assets which ultimately has a market impact. The fact that disagreement exist in the market suggest that expectations are put under test once the announcement is released, so then prices react according to the degree of difference in opinions. The chapter is the first study that considers and shows that forecasters disagreement helps to understand the market response to economic news. Disagreement at the time of the forecast is far from neutral on the conditional effect of the subsequent surprise reaction.

The availability of the list of forecasts of each economist opens the possibility of the study of disagreement in the impact of economic news. The linear Error Correction Model (ECM) unrestricted of the daily variation in interest rates used captures asymmetries in the response of the US interest rates to economic surprises conditioned to different level of disagreement. It avoids preselection biases as it uses the latest revolution of automatic General-to-Specific model selection. The analysis covers the entire spectrum of US economic announcements between January 1999 and July 2004 including expansionary and recessionary years. This chapter considers 6 different measures of disagreement. The first group of measures derives from variations of the Coefficient of Variation (CV). The second group comes from a disagreement diffusion index. This index tracks the disagreement in each economic release by creating first an intra surprise indicator. It considers news expressed in a standardised way dividing the surprise by its sample standard deviation. The raw disagreement measures per se do not add any explanatory power. On the contrary, a linear ECM with dichotomy variables that differentiates between disagreement in a context of high uncertainty and low uncertainty results in a larger number of surprises interacting with disagreement than asymmetry (positive/negative) surprises on their own. In general the effect of high uncertainty (HU) is larger than low uncertainty (LU). This goes against the belief that in a low disagreement stage (i.e. more uniform asset allocations), the effect of surprises are higher.

Table 3.1: Non Farm Payroll Analyst Survey – January 2004

	Economist	Firm Name	Estimate
1)	David Sloan	4CAST Ltd.	100,000
2)	Steven Ricchiuto	ABN Amro Inc.	75,000
3)	Alessandro Truppia	Aletti Gestielle SGR	100,000
4)	Matthias Kreie	Ampega Asset Management	75,000
5)	Richard Yamarone	Argus Research Corp.	150,000
6)	Mickey Levy	Banc of America Securities	140,000
7)	Henry Willmore	Barclays Capital	170,000
8)	Andreas Speer	Bayerische Landesbank	120,000
9)	John Ryding	Bear, Stearns & Co.	160,000
10)	Timothy Rogers	Briefing.com	155,000
11)	Avery Shenfeld	CIBC World Markets	150,000
12)	John Herrmann	CantorViewpoint	144,000
13)	Brian Jones	Citigroup	200,000
14)	Brian Wesbury	Claymore Investments	200,000
15)	Ken Mayland	ClearView Economics	135,000
16)	Patrick Franke	Commerzbank AG	150,000
17)	Vincent Lahuec	Credit Agricole	115,000
18)	Michael Carey	Credit Lyonnais	125,000
19)	Neal Soss	Credit Suisse First Boston	200,000
20)	Carsten Valgreen	Danske Bank	160,000
21)	Widmann/Besch	DekaBank	100,000
22)	Joe LaVorgna	Deutsche Bank Securities	250,000
23)	Jean-Pierre Petit	Exane	140,000
24)	Christopher Low	FTN Financial	200,000
25)	Geoffrey Somes	Fleet National Bank	145,000
26)	Guy Verberne	Fortis Bank NV	150,000
27)	Edward McKelvey	Goldman, Sachs & Co.	150,000
28)	Adam Chester	HBOS Treasury Services	130,000
29)	Ian Morris	HSBC Markets	100,000
30)	Ian Shepherdson	High Frequency Economics	150,000
31)	Dirk Chlench	Hypothekenbank in Essen AG	200,000
32)	Wesley Beal	IDEAglobal	175,000
33)	James Knightley	ING Financial Markets	180,000
34)	Steven Wood	Insight Economics	150,000
35)	John Fauci	Int'l Insider Publishing	90,000
36)	Bill Sharp	J.P. Morgan Chase	150,000
37)	Anthony Chan	JPMorgan Asset Management	135,000
38)	Harris / Abate	Lehman Brothers	100,000
39)		MMS International	100,000
40)	Joshua Shapiro	Maria Fiorini Ramirez Inc.	125,000
41)	David Rosenberg	Merrill Lynch	150,000
42)	Bill Quan	Mizuho Securities USA Inc.	135,000
43)	Richard Grace	National Australia Bank Ltd.	130,000
44)	Richard DeKaser	National City Bank	134,000
45)	Sherry Cooper	Nesbitt Burns Inc.	200,000
46)	David Resler	Nomura Securities Intl.	150,000
47)	Jens Kramer	Nord/LB	130,000
48)	Poul Bendix Kristensen	Nykredit	175,000
49)	Stuart Hoffman	PNC Bank	115,000
50)	Lena Komileva	Prebon Marshall Yamane	155,000
51)	Jade Zelnik	RBS Greenwich Capital	150,000
52)		Ried, Thunberg & Co.	170,000
53)	Adrienne Warren	Scotiabank Group	125,000
54)	Stephen Gallagher	Societe Generale	200,000
55)	Stone & McCarthy	Stone & McCarthy Research	120,000
56)	Mat Johnson	ThinkEquity Partners	160,000
57)	O'Sullivan/Harris	UBS Securities LLC	100,000
58)	Aurelio Maccario	Unicredit Banca Mobiliare	164,000
59)	Sung Won Sohn	Wells Fargo & Co.	125,000
60)	James Shugg	Westpac Banking Co.	150,000
61)	Wrightson Associates	Wrightson Associates	150,000

Source: own elaborations, based on data from Bloomberg

Table 3.2: Base Model. (Specific model of US D2y, 573 – 2017)

Economic Announcement	Reference	Unrestricted Coeff.	T-Value	Restricted Coeff.	T-Value
Inflation announcements					
PPI INDEX MOM	PPI M+	-0.02399	-2.49	-0.02409	-2.51
Labor announcements					
INITIAL JOBLESS CLAIMS	IJC M+	-0.01899	-3.96	-0.01782	-3.70
INITIAL JOBLESS CLAIMS	IJC M-	-0.01221	-2.46	-0.01232	-2.49
CHANGE NONF. PAYROLLS	CNFP M-	0.04552	5.51	0.04515	5.47
CHAN. MANUF. PAYROLLS	CMP M+	0.09791	6.43	0.10515	6.42
Demand announcements					
U OF MICHIGAN CONFIDENCE	UMCon-	0.03152	3.80	0.03209	3.87
RETAIL SALES LESS AUTOS	RS-A M+	0.05565	3.82	0.05547	3.82
Activity announcements					
ISM NON MANUFACTURING	ISM NM M-			0.02923	2.30
ISM NON MANUFACTURING	ISM NM M+	0.02963	3.31	0.02946	3.29
ISM MANUFACTURING	ISM M+	0.05308	5.98	0.05300	5.98
BUSINESS INVENTORIES	BI M+	0.02005	2.30	0.02008	2.31
BUSINESS INVENTORIES	BI M-	-0.03843	-3.49	-0.03839	-3.50
PHILADELPHIA FED	PF M+	0.03895	3.23	0.03850	3.19
DURABLE GOODS - TRANSP.	DGlt M+	0.04678	2.43	0.04642	2.41
GDP	GDP M+	0.04748	2.90	0.04753	2.91
CHICAGO PURC. MANAGER	CPM M-	0.04845	4.93	0.04863	4.96
D1Y_1		0.24054	3.64	0.23445	3.55
D2Y_1		-0.13943	-2.83	-0.13473	-2.73
R2		0.14998		0.15280	
R2 adj.		0.14046		0.14271	
AIC		-5.63464		-5.63699	
HQ		-5.61147		-5.61245	
SC		-5.57257		-5.57123	
CHOW (1872)		0.80560	0.9512	0.81400	0.9426
AR1-4 test		1.77990	0.1303	1.61150	0.1689

Source: Own elaborations, based on data from PcGets

Table 3.3: Model III (Specific model of US D2y, 572 – 2017)

Economic Announcement		Reference	Coeff.	T-Value
Labor announcements				
NON FARM PRODUCTIVITY	NFP	HU CV3	-0.02860	-1.91
NON FARM PRODUCTIVITY		LU CV3	-0.03341	
NON FARM PRODUCTIVITY		LU CV3+	0.03543	-2.09
Demand announcements				
U OF MICHIGAN CONFIDENCE	UMCon	HU CV	-0.04128	-3.93
RETAIL SALES LESS AUTOS	RS-A	HU CV+	0.08687	-4.61
		HU ISD	-0.06091	-3.37
Activity announcements				
BUSINESS INVENTORIES	BI	HU CV2	0.04240	-2.79
BUSINESS INVENTORIES		LU CV+	0.02374	-2.00
BUSINESS INVENTORIES		LU ISD	-0.02222	-1.80
PHILADELPHIA FED	PF	HU CV3	0.02005	-1.56
DURABLE GOODS - TRANSP.	DGIT	HU CV	-0.03659	-1.94
GDP	GDP	LU CV2	-0.06017	-2.73
CHICAGO PURC. MANAGER	CPM	LU AISD	0.04510	-2.05
R2			0.05695	
R2 adj.			0.04772	
AIC			-5.53423	
HQ			-5.51380	
SC			-5.47949	
CHOW (1873)			0.99810	0.4928
AR1-4 test			1.36750	0.2430

Source: Own elaborations, based on data from PcGets

Table 3.4: Model IV. (Specific model of US D2y, 573 – 2017)

Economic Announcement	Reference	Coeff.	T-Value
Labor announcements			
INITIAL JOBLESS CLAIMS	IJC M+	-0.01814	-3.80
CHANGE NONF. PAYROLLS	CNFP M-	0.04556	-5.49
CHAN. MANUF. PAYROLLS	CMP M+	0.09775	-6.39
Demand announcements			
U OF MICHIGAN CONFIDENCE	UMCon-	0.03083	-3.69
Activity announcements			
ISM NON MANUFACTURING	ISM NM M+	0.02955	-3.28
ISM MANUFACTURING	ISM M+	0.05315	-5.96
BUSINESS INVENTORIES	BI M+	0.03648	-3.56
BUSINESS INVENTORIES	BI M-	-0.04792	-4.14
BUSINESS INVENTORIES	LU CV2	-0.03068	-2.72
PHILADELPHIA FED	PF M+	0.04468	-3.80
DURABLE GOODS - TRANSP.	DGIt M+	0.06844	-3.31
DURABLE GOODS - TRANSP.	HU CV	-0.05594	-2.90
CHICAGO PURC. MANAGER	CPM M-	0.04740	-4.81
D1Y_1		0.23689	-3.56
D2Y_1		-0.13631	-2.75
R2		0.13922	
R2 adj.		0.13079	
AIC		-5.62551	
HQ		-5.60508	
SC		-5.57077	
CHOW (1873)		0.79060	0.96
AR1-4 test		1.83810	0.12

Source: Own elaborations, based on data from PcGets

Table 3.5: Model V (Specific model of US D2y, 573 – 2017)

Economic Announcement	Reference	Coeff.	T-Value
Labor announcements			
NON FARM PRODUCTIVITY	NFP HU AISD	0.06786	-5.00
NON FARM PRODUCTIVITY	NFP LU AISD	0.05013	-5.79
Demand announcements			
RETAIL SALES LESS AUTOS	RS-A M+	0.05708	-3.93
U OF MICHIGAN CONFIDENCE	UMCon+	-0.06257	-3.99
U OF MICHIGAN CONFIDENCE	UMCon LU CV2	0.04828	-4.84
Activity announcements			
ISM MANUFACTURING	ISM M+	0.05149	-5.75
PHILADELPHIA FED	PF HU AISD	0.09242	-5.15
PHILADELPHIA FED	PF LU CV2	-0.05729	-3.11
PHILADELPHIA FED	PF LU AISD	0.06332	-3.65
DURABLE GOODS - TRANSP.	DGIT LU CV+	0.06009	-4.71
CHICAGO PURC. MANAGER	CPM M-	0.05050	-5.13
R2		0.12876	
R2 adj.		0.12269	
AIC		-5.61897	
HQ		-5.60399	
SC		-5.57883	
CHOW (1873)		0.78660	0.97
AR1-4 test		0.84280	0.50

Source: Own elaborations, based on data from PcGets

Table 3.6: Model V with only surprises interacting with HU/LU (Specific model of US D2y, 573 – 2017)

Economic Announcement	Reference	Coeff.	T-Value
Labor announcements			
NON FARM PRODUCTIVITY	NFP LU CV+	0.06864	-6.49
Demand announcements			
U OF MICHIGAN CONFIDENCE	UMCon HU CV	-0.05547	-3.18
U OF MICHIGAN CONFIDENCE	UMCon LU AISD	0.04335	-4.21
Activity announcements			
ISM MANUFACTURING	ISM LU AISD	0.05245	-5.94
ISM NON MANUFACTURING	ISM NM LU ISD	0.04427	-4.73
BUSINESS INVENTORIES	BI LU CV	0.04218	-3.57
BUSINESS INVENTORIES	BI LU AISD	-0.03288	-3.22
PHILADELPHIA FED	PF HU CV2	0.07660	-5.04
DURABLE GOODS - TRANSP.	DGIT LU CV+	0.06075	-4.74
R2		0.11968	
R2 adj.		0.11417	
AIC		-5.60998	
HQ		-5.59637	
SC		-5.57349	
CHOW (1873)		0.85330	0.89
AR1-4 test		2.10680	0.08

Source: Own elaborations, based on data from PcGets

CHAPTER 4

Macro News and Endogenous Sentiment

1. Introduction

This chapter relates the effect of macro-announcements with two types of sentiment indicators: accumulated surprises and accumulated disagreement. A common feature in markets is the swing in opinions of the investors, i.e. sentiment. As a consequence, the effect of economic surprises could ultimately depend on the current market sentiment. At the same time, the economic cycle and sentiment do not always coincide. Usually, sentiment indicators are more volatile showing the variations in expected future economic business cycle.

An endogenous idea of surprise sentiment is to work with an index of accumulated surprises to capture shifts in investor sentiment. The assumption is that changes in perception affect prices often and quickly. One of the key hypothesis is that surprises' effects depend on prior accumulated surprises. This is a different hypothesis from the one followed by the academic literature. So far, the effect of a surprise at time t depends on that current level. The chapter intends to condition the effect on previous surprise releases. Then, introducing an index of surprises in the academic literature will build a gap with practitioners applications, and will deepen the understanding of macro news.

This chapter also develops another notion of sentiment indicator: the accumulated disagreement. In this case the idea rests on conditioning the effect of economic surprises to the level of accumulated disagreement. As far as it is known, this issue has not been dealt by the academic literature nor by the practitioners. Disagreement captures the differences in economists opinion in the economic surveys (see Chapter 3, Section 4).

JPMorgan and Deutsche Bank, among other Investment Banks, construct an index of economic surprises, which is tracked on a daily basis. The index is a good tool to forecast the direction of currencies, mainly when the index is in positive territory (meaning a

significant accumulation of positive economic surprises). The closest topic in the academic literature are the regime-switching models, such as those developed by David (1997) and Veronesi (1999). Those models offer a rational explanation for why the aggregate equity market (although not necessarily individual stocks) can respond more strongly to bad news than good news in good times. Following a long period of good news, investors will become highly confident the market is in a good state. Under such circumstances, further good news have little impact on investor beliefs. Conrad et al. (2002) affirm that bad news make market prices to fall for two reasons. First, bad news causes investors to infer a lower probability that the market is in the good state. Second, as uncertainty in the state of the economy increases, risk-averse investors require a higher expected rate of return to hold stocks, and the market discount rate rises. The uncertainty about the state of the economy causes an asymmetry in the response to good news and bad news. That is, when investors believe that the economy is in a "bad" state and good news arrives, the inferred probability that the market is in a good state increases; thus, the positive impact on prices is offset by the rising discount rate generated by increased investor uncertainty.

In terms of data availability, the chapter rests on information collected in previous chapters: economic announcements, analysts surveys for each economic release, US 3 month, 6 month, 1 year, 2 year, 5 year and 10 year notes.

The usage of robust model selection techniques allows to increase the complexity of the models by adding variables that could be potentially relevant but that previous literature did not take into account to avoid selection problems. This chapter will encompass previous ones with the use of market sentiment in terms of accumulated surprises and disagreement.

The chapter is organised as follows. Section 2 reviews the relevant literature concerning behavioral finance and the treatment of news. Section 3 introduces surprises accumulation practitioners' approach, explaining the methodology of three major Investment Banks. Section 4 presents the methodology followed in this chapter on accumulated surprises indices. The modelling approach is explained and finally the empirical exercises commented. Section 5 deals with the second endogenous sentiment index: accumulated

disagreement. An index is constructed and several models are analised and applied. Section 6 concludes.

2. Behavioral Finance, Investor Sentiment and Treatment of News

This section briefly discusses the relevant papers here rather than in the literature review. Behavioral finance literature covers the effect of micro news on stock prices performances, capturing recurring cycles of over and under reaction. There is a lack of literature exclusively dealing with the effect of economic news over the behavior of economic agents. Nevertheless, it is worth considering behavioral finance literature, as it is a good theoretical framework to understand the theory behind price formation and it is possible that their propositions apply to the stock market as a whole (Knif et al., 2003).

Several studies have reported evidence that stock returns over or under react to market information, finding in general that extreme stock prices movements are followed by reversals in subsequent periods and that small, incremental stock price movements react slowly to significant new information. According to Knif et al. (2003) such price patterns are difficult to reconcile with traditional asset pricing theory based on efficient markets and rational expectations, then new theories based on investor psychology have emerged in an attempt to explain an extensive list of firm specific stock price anomalies.

Recent work in behavioral finance such as Barberis et al. (1998) and Daniel et al. (1998) argue that the value/glamour effect is the result of investor psychology. In particular, the model in Barberis et al. (1998) allows for investor underreaction (in the intermediate term) to single shocks and investor overreaction (in the longer term) to a series of shocks. This model also implies an asymmetry in the returns to value and glamour stocks following a news shock. Following a string of positive shocks observed in glamour stocks, the investor in this model expects another positive shock—that is, he expects the earnings to trend. If good news is announced, the market response is relatively small since the positive shock was anticipated (Conrad et al., 2002). A negative shock, on the other hand, generates a large negative return, since it is more of a surprise. In particular, they find that the response to news is asymmetric for value and glamour stocks; the market reacts more strongly to bad news for both types of firms, but the reaction to bad

news for glamour stocks over the subsequent 20 quarters is much larger. Their behavioral assumptions are representativeness and conservatism. Meanwhile, Daniel et al. (1998) psychological ideas are overconfidence and self-attribution that helps to explain the same market performances as in Barberis et al. (1998). According to Barberis et al. (1998) it is quite possible that both the phenomena that Daniel et al. (1998) describe, and those driving Barberis et al. (1998) model, play a role in generating the empirical evidence.

The notion that the market responds more strongly to bad news in good times does not necessarily require the assumption of irrationality or over-reaction on the part of investors that underlies much of the value/glamour literature. For example, regime-switching models, such as those developed by David (1997) and Veronesi (1999), offer a rational explanation for why the aggregate market (although not necessarily individual stocks) can respond more strongly to bad news than good news in good times. In these models, investors are uncertain about the overall state of the market. Because investors can not observe the current state of the market directly, they must infer it from past market performance. Following a long period of superior market performance, investors will become highly confident the market is in a good state. Under such circumstances, further good news has little impact on investor beliefs.

Baker and Wurgler (2006) present an equity valuation framework based on the notion that investor sentiment does not affect prices equally. They incorporate investor sentiment on a mainstream approach, and integrates the idea of characteristics with regime shifts in sentiment. They complement earlier work that suggests that sentiment helps to explain the time series of returns. Their work consider several measures of investor sentiment which in the overall affect extreme growth and distressed firms in similar ways.

The next subsections present a more detailed discussion on Barberis et al. (1998), Daniel et al. (1998) and Veronesi (1999) and their findings on underreaction and overreaction.

2.1. Underreaction and Overreaction. According to Barberis et al. (1998) the empirical research in finance has identified two families of regularities: underreaction and overreaction. The underreaction evidence shows that over horizons of perhaps 1–12

months, security prices underreact to news. As a consequence, news is incorporated only slowly into prices, which tend to exhibit positive autocorrelations over these horizons. A related way to make this point is to say that current good news has power in predicting positive returns in the future. The overreaction evidence shows that over longer horizons of perhaps 3–5 years, security prices overreact to consistent patterns of news pointing in the same direction. That is, securities that have had a long record of good news tend to become overpriced and have low average returns afterwards. The evidence presents a challenge to the efficient markets theory because it suggests that in a variety of markets, sophisticated investors can earn superior returns by taking advantage of underreaction and overreaction without bearing extra risk. Barberis et al. (1998) propose a parsimonious model of investor sentiment – of how investors form beliefs – that is consistent with the available statistical evidence. The model specification is consistent with the results of Kanheman and Tversky (1974) on the important behavioral heuristic known as representativeness, or the tendency of experimental subjects to view events as typical or representative of some specific class and to ignore the laws of probability in the process. In the stock market, for example, investors might classify some stocks as growth stocks based on a history of consistent earnings growth, ignoring the likelihood that there are very few companies that just keep growing. The idea here is simply that after a series of announcements of good news, the investor becomes overly optimistic that future news announcements will also be good and hence overreacts, sending the stock price to unduly high levels. Subsequent news announcements are likely to contradict his optimism, leading to lower returns. Barberis et al. (1998) model also relates to another phenomenon documented in psychology, namely conservatism, defined as the slow updating of models in the face of new evidence. The underreaction evidence in particular is consistent with conservatism. In particular, individuals tend to underweight useful statistical evidence relative to the less useful evidence used to form their priors. Alternatively, they might be characterized as being overconfident about their prior information. Barberis et al. (1998) model is that of one investor and one asset. This investor should be viewed as one whose beliefs reflect 'consensus forecasts' even when different investors hold different expectations. The earnings of the asset follow a random walk. However, the investor does not

know that. Rather, he believes that the behavior of a given firm's earnings moves between two 'states' or 'regimes'. In the first state, earnings are mean-reverting. In the second state, they trend, i.e., are likely to rise further after an increase. The transition probabilities between the two regimes, as well as the statistical properties of the earnings process in each one of them, are fixed in the investor's mind. In particular, in any given period, the firm's earnings are more likely to stay in a given regime than to switch. Each period, the investor observes earnings, and uses this information to update his beliefs about which state he is in. In his updating, the investor is Bayesian, although his model of the earnings process is inaccurate. Specifically, when a positive earnings surprise is followed by another positive surprise, the investor raises the likelihood that he is in the trending regime, whereas when a positive surprise is followed by a negative surprise, the investor raises the likelihood that he is in the mean-reverting regime. The key idea that generates underreaction is that investors typically believe that earnings are more stationary than they really are.

Daniel et al. (1998) also construct a model of investor sentiment aimed at reconciling the empirical findings of overreaction and underreaction. They, too, use concepts from psychology to support their framework, although the underpinnings of their model are overconfidence and self-attribution, which are not the same as the psychological ideas Barberis et al. (1998) use. The premise of overconfidence used by Daniel et al. (1998) is derived from a large body of evidence from cognitive psychological experiments and surveys which shows that individuals overestimate their own abilities in various contexts. According to Daniel et al. (1998) an overconfident investor is one who overestimates the precision of his private information signal, but not of information signals publicly received by all. In this case, investors view themselves as more able to value securities that they actually are, so that they underestimate their forecast error variance. Then, stock prices overreact to private information signals and underreact to public signals. This overreaction-correction pattern is consistent with long-run negative Autocorrelation in stock returns, with unconditional excess volatility. The biased self-atribution in Daniel et al. (1998) characterizes the growth in confidence of the investor when public information is in agreement with his information, but when public information contradicts his private

one, it does not fall commensurately. The psychological evidence indicates that people tend to credit themselves for past success and blame external factors for failure. In contrast with the common correspondence of positive (negative) return autocorrelations with underreaction (overreaction) to new information, Daniel et al. (1998) show that positive return autocorrelations can be a result of continuing overreaction. This is followed by long-run correction. Thus, short-run positive autocorrelations can be consistent with long-run negative autocorrelations. Finally, Daniel et al. (1998) model endogenously generates trading mistakes that are correlated with fundamentals.

Veronesi (1999) presents an explanation of stock market overreaction to bad news in good times. The key assumption is that economic fundamentals, such as the drift of dividend process, follow a process with unobservable regime shifts, which has been formalized by a two-state, continuous-time hidden Markov chain model. Investors formulate posterior probabilities on the two states, which depend on their observation of past dividends. Veronesi (1999) shows that investors rationally anticipate that during periods of high uncertainty their expectations of future cash flows tend to react more swiftly to news. This predictable higher sensitivity to news tend to increase the asset price volatility, against which risk averse investors are willing to hedge. As an extra discount is required by investors in anticipation of the higher volatility of returns that occur when they are more uncertain about the true state of the world, the equilibrium price function is increasing and convex in investors' posterior probability of the high state. Then, when times are good, a bad piece of news makes investors increase the discount over expected future dividends in order to bear the risk of higher uncertainty. As a consequence of this hedging behavior the price reduction due to a bad piece of news in good times is greater than the reduction in expected future dividends. Similarly, a good piece of news in bad times tends to increase the expected future dividends. Overall, the price function is increasing and convex in the posterior probability of the good state. This nonlinearity increases with the investors' degree of risk aversion. Other implications of the characterization of the Veronesi (1999) price function are: i) the reaction of prices to news tend to be high in good times and low in bad times (asymmetry); ii) the volatility of percentage returns tends to be higher in bad times than in good times and it is maximized during periods

of highest uncertainty; iii) expected returns change over time as the investors' level of uncertainty changes, as does return volatility.

3. Surprises' Accumulation

A practitioner approach to deal with economic surprises is to construct economic announcements surprise indexes. This section contains the description of the approaches followed by three investment banks: JPMorgan, Deutsche Bank and HSBC. Similarities and differences are highlighted.

JPMorgan surprise index is called Economic Activity Surprise Index (EASI) and was constructed with the aim to help forecasting changes in the currency markets. According to JPMorgan (2002) surprise indexes are needed to interpret fundamentals in a more systematic way. The key is to focus on investors perceptions of growth rather than trying to forecast growth as shifts in growth perceptions are critical in financial markets expectations. For example, a series of positive surprises on activity data releases is likely to induce greater optimism on growth in investors, whereas a series of negative surprises is likely to induce greater pessimism. Consequently, JPMorgan (2002) affirms that tracking the recent history of activity data surprise is an attempt to capture investors perceptions of growth. The methodology followed by JPMorgan (2002) in selecting the economic data releases to use follows a simple rule of only looking at the data that has a clear impact on the outlook on growth. Then, they discard inflation-related data (such as PPI and CPI), inventory data, and balance of payments data, ending with around 25 regular data releases. JPMorgan (2002) found that stratifying the data by importance does not improve the accuracy of the final index. JPMorgan used a diffusion index to reflect the accumulated surprises[1]. The EASI index starts defining surprises as in (Chapter 1, Section 2, Equation 1.2). Surprises are filtered imposing a threshold of +/-0.5 standard deviations

[1]Diffusion indexes measure the proportion of the components that are rising. The US Conference Board web site explains that the first step in computing the diffusion indexes is to calculate if a component increased, decreased, or had no change. In their example, components that rise more than 0.05 percent are given a value of 1, components that change less than 0.05 percent are given a value of 0.5, and components that fall more than 0.05 percent are given a value of 0. Next, sum the values of the components. Third, divide by the number of components, and finally multiply by 100.

for all monthly and quarterly data and +/-1 standard deviations for the more frequent data (i.e. jobless claims). Then, JPM builds a balanced diffusion index to transform the surprises into an index by taking the net balance of activity surprises (positive minus negative) over a period and dividing it by the total number of releases over a 6 weeks period.

$$EASI_t = \left(\frac{\sum_{t=1}^{30} (S_t^+ + S_t^-)}{\#S \text{ in t=1 to } 30} \right) \tag{4.1}$$

Where $S_+ = 1$ when sd(S_i) >0.5 or >1 in the case of more frequent data and $S_- = -1$ when sd(S_i)<0.5 or <1 for more frequent data. According to them, this is less volatile than 4 weeks (i.e. less switches in signal a year), but still appears to capture changes in perception and turns out to give one of best trading performances. Then, a reading above zero, implies a positive balance of upside surprises over the past 6 weeks, and a reading below zero implies a negative balance. In order to attain some leading indicator characteristics, they concentrate on the change in the pace of the index, rather than waiting for the index to cross from a positive balance to a negative one. Therefore, they compare the headline EASI to its 20-day moving average: a move below the moving average implies deteriorating perceptions (i.e. pessimism), while a move above implies improving perceptions (i.e. optimism). Finally, to avoid more unclear signals arising when the EASI is hugging the 20-day moving average, JPMorgan (2002) impose an additional 0.5 standard deviation threshold around the moving average to introduce a neutral zone (if the EASI lies between the 0.5 standard deviation band either side of the 20-day moving average).

Other investment banks such as HSBC (2005), Goldman Sachs (2005), Deutsche Bank (2005) and Dresdner Kleinwort (2005) use similar methodologies. Deutsche Bank (DB) index is called Macro Pulse Index (MPI). The DB MPI attempt is to obtain an overall picture of optimistic or pessimistic markets, by constructing an aggregate measure of data surprises. To calculate the Deutsche Bank Macro Pulse Index (DB MPI) they select the most important economic releases associated with a particular currency. In the case of the US dataset it consists of more than 30 individual economic releases. DB follows the usual definition of surprise by subtracting the consensus forecast from the actual release.

Then DB measure standardises the data surprise by finding its z-score (in other words the surprise formula, Chapter 1, Section 2, Equation 1.2). The DB MPI is subsequently calculated as the average of the last 30 z-scores of data surprises for each currency.

$$MPI_t = \left(\frac{\sum_{t=1}^{30} S_t}{30} \right) \tag{4.2}$$

The MPI differentiates from the EASI calculation as it considers all the surprises figures without excluding the ones contained between 0.5 and -0.5 standard deviations (or 1 and -1 for the more frequent data). A reading above (below) zero indicates that the data flow has been better (worse) than expected. DB use the MPI to read the market in two ways: a) by looking at the absolute levels of the index they obtain an overview of real economic developments relative to market expectations -market's optimism will be increased by releases coming above the consensus (positive MPI), negative surprises will cause disappointment (negative MPI); and b) MPI as a contrarian indicator based on the mean-reverting nature of it. In this latest case for example a stream of positive data surprises will cause an upward adjustment to expectations and economic forecasts. As forecasts start catching up with real economic data, the DB MPI should be interpreted as a contrarian signal: markets are more likely to be disappointed as they recover from their 'excessive' optimism. Similarly, in a situation of excessive disappointment, data releases are more likely to surprise positively.

HSBC has two categories of index: one considering economic activity surprises and the other inflation surprises. The index construction is similar to the MPI, but the main difference is the time frame considered. Three economic surprise indices are constructed. The first shows the surprise index for the last 5 trading days (one week). The second HSBC surprise index is very similar but measures the composite surprise inherent in the last 20 trading days worth of economic releases (one month). The third one is the cumulative surprise index and simply shows the sum of all economic surprises since inception and is depicted for the last year. Generally the last one does not mean-revert but it is useful in identifying longer term trends. HSBC suggests that the 5 day surprise index is most important since the market impact of surprises decays fairly rapidly.

4. Sentiment Indicators: Accumulated Surprises

This section examines whether the price response to bad and good economic news depends on past surprises. The relative level of past surprises is based on an accumulated surprise index. Intuitively, the idea is to test if the effect of the current surprise is conditioned to the average surprises over the prior x months. One hypothesis to evaluate is that when the accumulated surprise index is in positive territory (meaning a significant accumulation of positive economic surprises), a negative surprise could have a higher effect than a positive one. The fact that a new piece of information contradicts the previous trend has been a topic of study in behavioral finance literature (see Section 2). Due to the fact that the accumulated surprise is built using previous surprises, it is defined as an endogenous idea of surprise sentiment.

The index to be used is based on the practitioners approach that captures all the relevant economic indicators (including inflation, BoP, etc.). First, it considers news expressed in a standardised way (Chapter 1, Section 2, Equation 1.2). The diffusion index is built initially following an arbitrary 6 week rolling range (i.e. 30 trading days, based on JPMorgan, 2002). This index is called Accumulated Surprise Index (ASI) and follows this formula:

$$ASI_t = \left(\frac{\sum_{t=1}^{30} (S_t^+ + S_t^-)}{\#S_{\text{in t=1 to 30}}} \right) \tag{4.3}$$

Where $S_+ = 1$ when the surprises standard deviation (sd) is higher than 0.5, or expressed $\text{sd}(S_i) > 0.5$. While $S_- = -1$ when $\text{sd}(S_i) < 0.5$. An ASI reading above zero implies a positive balance of upside surprises over the past 6 weeks. The next step is to set three different stages:

(1) ASI+ when accumulated surprises are significantly positive (optimistic period);
(2) ASI- when accumulated surprises are significantly negative (pessimistic period) and
(3) No ASI when accumulated surprises are neutral (neutral period).

Using the ASI the three different stages are built in the following way:

- ASI+ (when the ASI is over its 20-day moving average plus 0.5 standard deviation of its historic moving average);

- ASI- (when the ASI is below its 20-day moving average less 0.5 standard deviation of its historic moving average) and
- No ASI (when its in between the previous boundaries).

An alternative to the definition of ASI and the stages is to modify the number of trading days for the rolling range, i.e. using 20 and 40 days instead of 30 and work with 10 days instead of 20 days moving averages. Given that the results do not change significantly, the chapter presents only the case with ASI30d and 20 day moving average to set the three different scenarios.

4.1. Base Model. The original model starts with a linear Error Correction Model (ECM) unrestricted of the daily variation in interest rates (IR, initially a generic set of interest rates i=1,..., I) explained by lagged values of the daily difference of each IR (DIR), news (S) without including their lags and the lags of the level IR contracts levels:

$$DIR_{i,t} = \beta_0 + \sum_{i=1}^{I} \beta_i DIR_{i,t-1} + \sum_{k=1}^{K} \beta_k S_{k,t-j} + \sum_{i=1}^{I} \gamma_i IR_{i,t-1} + \epsilon_t \tag{4.4}$$

where, K=47 and T=2016. The I and J represent the lags. At the same time, in order to capture the different effects of the Fed monetary policy bias three dummies were constructed: Symmetric, Tightening and Easing (see Chapter 2, Table 2.14). As usual, two of them are introduced in the regressions to avoid collinearity. The dummies included are called Tighter and Symmetric, representing tighten and symmetric monetary policy stance respectively. In order to capture the effect of Fed Chairman Semiannual Monetary Report to the Congress another dummy was added (called Greenspan dummy). Then, K reaches 50 variables, while the number of daily data is 2015 as one day is lost due to the difference to construct the first variation in FF.

4.2. Model I. The base model is enriched by adding the Accumulated Surprise Index (ASI) into the modelling framework. The level of ASI is taken into account to explain the daily variation in IR. The first modelling alternative enable the interaction of the

surprises with the three stages of accumulated surprises (ASI+, ASI- and Neutral ASI):

$$\begin{aligned} DIR_{i,t} &= \beta_0 + \sum_{i=1}^{I} \beta_i DIR_{i,t-1} + ASI^{+}_{k,t} \sum_{k=1}^{K} \beta_k S_{k,t} \\ &+ ASI^{-}_{k,t} \sum_{k=1}^{K} \zeta_k S_{k,t} + NoASI_{k,t} \sum_{k=1}^{K} \theta_k S_{k,t} \\ &+ \sum_{i=1}^{I} \gamma_i IR_{i,t-1} + \epsilon_t \end{aligned} \tag{4.5}$$

$$t = 1, ..., T$$

where, same notes of previous models applies.

4.3. Model II. In the second experiment the notion of asymmetries in news is introduced. Andersen et al. (2003) and Bruno et al. (2002) documented asymmetries in the announcement effects -responses vary with the sign of the news. In particular, they showed that negative surprises often have greater impact than positive ones. Though this issue has been studied, a well suited analysis is applied in this chapter, introducing a more refine definition of bad and good news (i.e. with respect to market trends, etc.) and econometric techniques designed to capture the effect. Chapter 2, Section 4.2.2 and 4.2.3 deal with the issue, but in this model the idea is to complete the analysis by relating the asymmetries with the sentiment (ASI).

Then, the model examines whether the price response to bad and good economic news changes as the relative level of past surprises changes. One of the hypothesis to test is the bigger effect of negative surprises when ASI index is in positive territory (ASI+). The first step is to use the dummies asymmetries ($DS^{+}_{k,t-j}$ and $DS^{-}_{k,t-j}$) and not the actual surprises divided in positive and negative. The model is a linear ECM unrestricted of IR replacing each surprise with two dummies, DS^{+} (ones where positive surprises and zeros otherwise) and DS^{-} (ones where negative surprises and zero otherwise). But in this case the asymmetries dummies interact with the level of accumulated surprises ASI+, ASI-

and neutral ASI.

$$\begin{aligned} DIR_{i,t} &= \beta_0 + \sum_{i=1}^{I} \beta_i DIR_{i,t-1} + ASI^{+}_{k,t} \sum_{k=1}^{K} \beta_k DS^{+}_{k,t-j} + \\ &+ ASI^{-}_{k,t} \sum_{k=1}^{K} \beta_k DS^{+}_{k,t-j} + ASI^{+}_{k,t} \sum_{j=0}^{J} \beta_{kj} DS^{-}_{k,t-j} + \\ &+ ASI^{-}_{k,t} \sum_{j=0}^{J} \beta_{kj} DS^{-}_{k,t-j} + NoASI_{k,t} \sum_{k=1}^{K} \phi_k DS^{+}_{k,t-j} + \\ &+ NoASI_{k,t} \sum_{j=0}^{J} \upsilon_{kj} DS^{-}_{k,t-j} + \sum_{i=1}^{I} \gamma_i IR_{i,t-1} + \epsilon_t \end{aligned} \tag{4.6}$$

$$t = 1, ..., T$$

where, same notes of previous models applies.

4.4. Model III. In the third experiment the notion of asymmetries is developed further by introducing the actual surprises divided in positive and negative (S^+ and S^-) replacing the dummies DS^+ and DS^-:

$$\begin{aligned} DIR_{i,t} &= \beta_0 + \sum_{i=1}^{I} \beta_i DIR_{i,t-1} + ASI^{+}_{k,t} \sum_{k=1}^{K} \beta_k S^{+}_{k,t-j} + \\ &+ ASI^{-}_{k,t} \sum_{k=1}^{K} \beta_k S^{+}_{k,t-j} + ASI^{+}_{k,t} \sum_{j=0}^{J} \beta_{kj} S^{-}_{k,t-j} + \\ &+ ASI^{-}_{k,t} \sum_{j=0}^{J} \beta_{kj} S^{-}_{k,t-j} + NoASI_{k,t} \sum_{k=1}^{K} \phi_k S^{+}_{k,t-j} \\ &+ NoASI_{k,t} \sum_{j=0}^{J} \upsilon_{kj} S^{-}_{k,t-j} + \sum_{i=1}^{I} \gamma_i IR_{i,t-1} + \epsilon_t \end{aligned} \tag{4.7}$$

$$t = 1, ..., T$$

where, same notes of previous models applies and $S^{+}_{k,t-j}$ and $S^{-}_{k,t-j}$ represent the positive and negative news respectively.

4.5. The Interaction of Surprises and ASI. As in the previous chapters the first step is to test for cointegration in the set of interest rates used, which are the US 3 month, 6 month, 1 year, 2 year, 5 year and 10 year notes. In all this exercises the variation in US 2 year interest rates is the main variable to explain. The 2 year interest rate is a good benchmark of short to medium term interest rates, influenced by long and short term factors. The second step is to introduce the initial base model i.e. the ECM model including all the surprises. Table 4.1 presents the specific models applying PcGets liberal strategy to the ECM unrestricted and restricted model (base model).

[Insert TABLE 4.1]

The number of variables that remained in the specific models are 12 economic announcements in the unrestricted model and 13 in the restricted one. For the definition of the economic announcements please refer to Chapter 2, Table 2.12. As in the previous chapters, the units are interest rates percentage points (i.e. 0.04 in ECI coefficients is 4 basis points). The economic announcements relevant in influencing the level variation of 2 year US yields can be aggregated in: one Inflation Announcement (ECI), two Labor Announcements (IJC and CNFP), three Demand Announcements (BP, HS and ARS), and six Activity Announcements (CPM, DGLT, GDP, ISM NM, ISM and PF).

The Model I introduces the accumulated surprises as a conditional variable to the actual surprises. In this case, the model explains the effect of surprises looking for differences in the effects in an environment of positive, negative or neutral accumulated surprises. The model has 156 variables (the lagged variation of IR, the lagged IR levels, surprises interacting with ASI+, ASI- and neutral ASI). Table 4.2 presents the selected model of this alternative.

[Insert TABLE 4.2]

The specific model has 20 variables, of which 5 are surprises interacting with ASI+, 7 with ASI- and 8 surprises in neutral ASI periods. CPM, IJC, ISM NM, CNFP are selected interacting with ASI+ and with neutral ASI. The coefficients of all these variables in a period of positive accumulated surprises are bigger than in the neutral ASI scenario.

ISM is the only variable that appears selected both interacting with ASI- and neutral ASI, showing a bigger coefficient within a neutral scenario. Announcement's coefficients conditioned by ASI+ tend to be bigger than conditioned by Neutral ASI. In comparison with the base model, there are 5 new announcements included (1 Labor, 3 Demand, and 1 Activity). All the information criteria but one (SC) are lower in the Model I than in the base model.

Model II introduces asymmetry, dividing between positive and negative surprises. Each of these news interacts with positive, negative and neutral accumulated surprises. In this case as well, the number of variables involved goes beyond the limits of excel and Pc Give (47 economic announcements divided in positive and negative surprises gets to 94 variables, and each of those variables interacts with three different scenarios: ASI+, ASI- and neutral ASI, then the explanatory variables are 282). This limitation is avoided by dropping 16 surprises -dummies in this case-, that are not included in any specific model commented so far in all the chapters (CCRED, CCON, ULC, EM, MBS, IMI, LI, WI, NHS, TVS, FO, AHE, CS, CC, PS and PI). Then, the model has 203 explanatory variables (of which 32 are economic announcements).

[Insert TABLE 4.3]

The total number of selected variables is 17; 2 are Inflation announcements, 5 Labor, 3 Demand and 7 Activity announcements. Dummy surprises in Neutral ASI periods are 9 and 4 dummy surprises in each of +ASI and -ASI periods. There are no cases of announcements conditioned by more than one accumulated surprise periods.

In Model III the surprises are divided in positive and negative, but this time they are not replaced by dummy variables. In this case as well, the number of variables involved goes beyond the limits of excel and Pc Give (47 economic announcements divided in positive and negative surprises gets to 94 variables, and each of those variables interacts with three different scenarios: ASI+, ASI- and neutral ASI, then the explanatory variables are 282). The same steps as in Model II were followed, dropping 16 surprises that are not included in any specific model commented so far in all the chapters (CCRED, CCON, ULC, EM, MBS, IMI, LI, WI, NHS, TVS, FO, AHE, CS, CC, PS and PI). Then, the

model has 203 explanatory variables (of which 32 are economic announcements). The final model (see Table 4.4) has 31 selected variables, of which 9, 7 and 15 surprises interact with ASI+, ASI- and Neutral ASI respectively. Of the 9 surprises that are significant in an optimistic scenario (ASI+), 6 are positive surprises and 3 are negative ones. In the case of the pessimistic scenario (ASI-), 2 are positive surprises and 5 negative ones. While in neutral scenarios, there are 7 positive surprises and 8 negative ones. IJC has a bigger effect when its a positive surprise rather than negative in an optimistic scenario. Note that for the calculation of the ASI the sign of IJC was changed to be consistent with an optimistic or pessimistic scenario. In this case a positive IJC has a negative interpretation as it means that the economy is destroying jobs. The same happens with ISM NM, when there is a positive surprise in an optimistic environment the effect is bigger than when a neutral scenario prevails. In the case of CNFP-, a negative surprise in a pessimistic scenario (negative surprise in this case will mean the economy is destroying employment) has bigger effect than in a neutral one. Negative surprises in the ECI have bigger effects in a negative surprise environment than in a neutral one.

In summary, the introduction of asymmetries interacting with accumulated surprises (Model III) adds explanatory power. In the last case, the Information criteria is lower in all the tests vs. the other models.

[Insert TABLE 4.4]

4.6. ASI with Exponentially Weighted Moving Average. In general economic surprise accumulation indices use an equal weighting irrespective of the relevance of the indicator, and also assume an equal weighting along the days considered in the index (i.e. along time). This section introduces an exponential weighting in the diffusion indexes. In other words, the idea is to modify the Equation 4.3, based on the hypothesis that a recent positive/negative surprise should have a bigger weighting than an older one. The exponentially weighted moving average (EWMA) applies weighting factors that decrease exponentially. The weighting for each day are reduced exponentially, giving much more importance to recent observations while still not discarding older observations entirely. The weighting chosen is 0.12, or 4 times bigger than a simple moving average (i.e. 1/30

in ASI, Equation 4.3). Once the ASI corrected with the EWMA is calculated, the three stages of accumulated surprises is built (ASI+, ASI- and No ASI).

The next step is to start with the calculation of the models. At first, PcGets was not able to perform the estimation procedure. Then a two stage estimation procedure was followed. The first stage included surprises interacting with positive exponentially weighted accumulated surprises and negative ones. In the second stage, a new estimation is performed including those selected variables in the first stage plus the surprises interacting with neutral exponentially weighted accumulated surprises. Then, the selected model in this last stage is the final model.

The same models as before were followed. Model I shows the exponentially weighted moving average surprises conditioning the surprises. Table 4.5 presents the selected model.

[Insert TABLE 4.5]

The specific model has 18 variables: one is D1y_1, 8 are surprises interact with ASI+, 4 with ASI- and 5 surprises in neutral ASI periods. CNFP and ISM are selected interacting with ASI+and neutral ASI, showing similar coefficients in the two periods. UMCon is the only variable that appears selected in the ASI- and neutral period. In this case the coefficients are similar but with opposed signs. The differences with the base model are: 4 new announcements included (1 Inflation, 2 Demand, and 1 Activity), but 2 Activity variables are not included. Only one information criteria is lower than in the base model.

In the case of Model II asymmetry is introduced. The same procedure was followed and 16 surprises were dropped (see comments in Section 4.6, Model II).

[Insert TABLE 4.6]

The total number of selected variables is 10; one is D1y_1, 1 Labor, 3 Demand and 5 Activity announcements. Dummy surprises in ASI+ periods are 4, 3 dummy surprises in -ASI and 2 in neutral ASI periods. There are no cases of announcements conditioned by more than one accumulated surprise periods.

Model III chose as explanatory variables positive and negative surprises (no dummies). As in the previous model, the same procedure of dropping 16 variables was followed. The

selected model (see Table 4.7) has 37 variables; 17, 9 and 8 surprises interact with ASI+, ASI- and Neutral ASI respectively. Of the 17 surprises that are selected in an optimistic scenario (ASI+), 10 are positive surprises and 7 are negative ones. In the 9 selected variables in the pessimistic scenario (ASI-), 3 are positive surprises and 4 negative. In the neutral scenario 5 out of 8 are positive surprises. In 4 selected variables of the neutral scenario the coefficients are higher than in the rest of the stages (ECI -, CNFP +,ISM +, GDP +). The information criteria is lower in 2 out of 3 tests vs. the other models (see tables commented in Section 4.5).

[Insert TABLE 4.7]

5. Sentiment Indicators: Accumulated Disagreement

This section analyses the effect of analysts accumulated disagreement over interest rates variations. This is another notion of sentiment indicator, and it has not been dealt by the academic literature nor by the practitioners. In this case the idea rests on conditioning the economic surprises to the level of accumulated disagreement. A higher level of disagreement relative to the accumulated past disagreement could influence the impact of a surprise. As used in Chapter 3, the notion of disagreement captures the differences in economists opinion in the economic surveys. Price movements can be particularly strong when the disagreement surrounding a data release is high. Then, the effect of economic surprises could tend to increase when the consensus had become less certain or in other terms there is more disagreement. It is worth highlighting that this index is extremely data intensive, it uses each economist estimation for every economic indicator to build a measure of disagreement, and then an index of accumulated disagreement (See definition of disagreement in Chapter 3, Section 4).

The first step is to build an index of accumulated disagreement. In this case, a similar approach to the ASI is followed. The Index of disagreement uses 12 economic announcements (following same steps as in Chapter 3 Section 5.4 and Section 6, these variables are the selected ones in the base model of asymmetry surprises). A key input for the index are the disagreement dichotomy variables High Uncertainty (HU) and Low

Uncertainty (LU). HU uncertainty dummy measures take the value 1 when exists a high uncertainty environment defined as a period when the uncertainty measure is higher than one standard deviation approximately (i.e. built using a percentile rank, and from there set the ones 84% higher with 1 and 16% lower with 1 too, the sample in between are low uncertainty represented with 0's in the sample). Low uncertainty periods are defined as stages when the uncertainty measures are lower than one standard deviation. Then, the index calculates the Accumulated Intra Surprise Disagreement (ASD) as the share of total disagreements that are considered HU in the last 30 days divided by the total disagreements of the last 30 days (or equivalently all the data releases):

$$ASD_t = \left(\frac{\sum_{t=1}^{30}(HU_t)}{\sum_{t=1}^{30}(HU_t + LU_t)} \right) \tag{4.8}$$

Two different scenarios are set using the ASD:

(1) High Accumulated Uncertainty (HAU) when accumulated disagreements are significantly high (period of high uncertainty);

(2) Low Accumulated Uncertainty (LAU) when accumulated disagreements are significantly low (period of low uncertainty).

The HAU is defined as the period when ASD is over its 20-day moving average plus 0.5 standard deviation of its historic moving average. The LAU is defined as the period when the ASD is below its 20-day moving average plus 0.5 standard deviation of its historic moving average, or alternatively the period when the surprises are not in HAU.

The ASD is applied to two of the definitions of disagreement considered in Chapter 3: CV and AISD (see Chapter 3, Section 4).

5.1. Model I. The model completes previous modelling frameworks by considering the accumulated disagreement indices. The first step is to calculate the interaction of surprises with the two types of uncertainty levels: HAU and LAU.

$$\begin{aligned} DIR_{i,t} &= \beta_0 + \sum_{i=1}^{I} \beta_i DIR_{i,t-1} + HAU_{k,t} \sum_{k=1}^{K} \beta_k S_{k,t} \\ &+ LAU_{k,t} \sum_{k=1}^{K} \zeta_k S_{k,t} + \sum_{i=1}^{I} \gamma_i IR_{i,t-1} + \epsilon_t \end{aligned} \tag{4.9}$$

where, HAU and LAU defined above, and the rest of the variables are defined in previous chapters.

5.2. Model II. The second approach is to apply the above method to asymmetry surprises, that is positive and negative surprises. This model is richer, as it allows to understand the interaction between the positive/negative surprises in high/low uncertainty periods. Then, this model encompass previous ones.

$$\begin{aligned} DIR_{i,t} &= \beta_0 + \sum_{i=1}^{I} \beta_i DIR_{i,t-1} + HAU_{k,t} \sum_{k=1}^{K} \beta_k S^{+}_{k,t-j} \\ &+ HAU_{k,t} \sum_{k=1}^{K} \beta_k S^{-}_{k,t-j} + LAU_{k,t} \sum_{k=1}^{K} \beta_k S^{+}_{k,t-j} + \\ &+ LAU_{k,t} \sum_{k=1}^{K} \beta_k S^{-}_{k,t-j} + \sum_{i=1}^{I} \gamma_i IR_{i,t-1} + \epsilon_t \end{aligned} \tag{4.10}$$

where, HAU and LAU were defined above, and the rest of the variables are defined in previous chapters.

5.3. Empirical Analysis. The data selected in this chapter covers the period starting from March 30^{th}, 1999 (632 in the data base) as the availability of analysts surveys starts later than the simple median or average survey, and also more data is needed to calculate the initial averages. In all these simulations the variation in US 2 year interest rates is the main variable to explain. Following the different models commented in the previous section, the first model to calculate is the ECM model including all the surprises, interacting with HAU and LAU. The Accumulated Intra Surprise Disagreement (ASD, Equation 4.8) is first applied to CV (see definition in Chapter 3, Section 4). For the definition of the economic announcements please refer to Chapter 2, Table 2.12.

[Insert TABLE 4.8]

Only 2 out of 11 economic surprises belong to a period of HAU, while 9 are part of LAU (see Table 4.8). ISM is the only variable that is selected with HAU and LAU. No clear conclusion can be obtained from comparing the coefficients. All the variables but ECI are part in the build up of the disagreement measures (13 variables are selected to

analyse the disagreement, see Chapter 3, Section 5 for further details). Comparing the model with the total surprises without any uncertainty interaction (vs. the base model - see Section 4.2 and 4.6 and Table 4.1), only UMCon is added, while BP, ARS and HS do not appear in the uncertainty interaction set. All the information criteria are bigger in the uncertainty model, while the coefficients are very similar. The same analysis is performed using AISD as a base of the calculation of HAU and LAU.

[Insert TABLE 4.9]

The model ends up with 6 surprises interacting with HAU and 7 with LAU. IJC, ISM NM and CNFP interact with both HAU and LAU (see Table 4.9). The first one has a bigger coefficient in the HAU stage, while the other ones have similar. ECI and ARS are the only variables that are not part of the 13 variables used in the disagreement index. UMCon is the only variable that is added when the selected variables are compared with the model without uncertainty interaction. GDP is missed in Table 4.9 vs. Table 4.8, while BP and HS are not included vs. the base model (see Table 4.1). Only SC information criteria is higher than in the case of the model without uncertainty interaction.

The second approach is to model the variation of interest rates explained with surprises classified as positive and negative interacting with the accumulated disagreement measures HAU and LAU. As a consequence, the model will have 206 variables. Case 1 (see Table 4.10) base its accumulation disagreement measures on the Coefficient of Variation (CV3).

[Insert TABLE 4.10]

The specific model selects 21 surprises, 9 interacting with HAU and 12 with LAU. There are 2 cases when the same variable remains selected in both periods: CNFP+ and ISM+. The coefficient is bigger when it interacts with HAU than with LAU. Also in the case of CNFP, the positive news in a LAU period is bigger than with negative news in a LAU period.

The next step is to introduce another indicator to base the ASD. The AISD is used to build another set of variables that differentiate disagreement in a context of high uncertainty HAU (ones where high survey uncertainty exits and zeros otherwise) and

low uncertainty LAU (ones where low survey uncertainty exist and zeros otherwise). The specific model ends with 29 surprises, of which 16 interacts with HAU (10 positive surprises in a HAU period, and 6 negative surprises in a HAU period) and 13 with LAU (6 negative surprises and 7 positive surprises in a LAU period). In general the effect of economic surprises is bigger when the consensus had become less certain or in other terms there is more disagreement.

[Insert TABLE 4.11]

6. Conclusions

This chapter relates the effect of macro-announcements with two types of sentiment indicators: accumulated surprises and accumulated disagreement. Both indicators are defined as endogenous as they are derived from the analysts surveys conducted for each economic release. In the first case the key hypothesis is that surprises' effects depend on prior accumulated surprises. This is a different hypothesis from the one followed by the academic literature. Practitioners construct index of economic surprises to gauge the market sentiment. The specific models show that introducing accumulated surprises as a conditional variable to the actual surprises adds explanatory power. The same happens with the interaction of asymmetry surprises (divided in positive and negative) with accumulated surprises. Another novelty tested in this chapter is the use of accumulated surprises built with an exponentially weighted moving averages. Similar conclusions to the simple version were reached. The second notion of sentiment indicator developed in the chapter rests on conditioning the effect of economic surprises to the level of accumulated disagreement in a similar modelling methodology (ECM) applied to US interest rates. In general the effect of economic surprises is bigger when the consensus had became less certain or in other terms there is more disagreement. This last approach enrichs as well the understanding of the impact of news.

Table 4.1: Interaction of Surprises and Accumulated Surprise Index (ASI). Base Model. (Specific model of US D2y, 51 – 2017)

Economic Announcement	Reference	Unrestricted Coeff.	T-Value	Restricted Coeff.	T-Value
Inflation announcements					
EMPLOYMENT COST INDEX	ECI	0.04443	4.11	0.04516	4.18
Labor announcements					
INITIAL JOBLESS CLAIMS	IJC	0.01479	4.85	0.01481	4.86
CHANGE NONF. PAYROLLS	CNFP	0.04736	7.90	0.04736	7.90
Demand announcements					
BUILINDG PERMITS	BP	0.02473	2.22	0.02473	2.22
ADVANCED RETAIL SALES	ARS	0.03094	3.26	0.03094	3.27
HOUSING STARTS	HS	-0.01940	-2.81	-0.01940	-2.82
Activity announcements					
ISM NON MANUFACTURING	ISM NM	0.02956	4.18	0.02955	4.18
ISM MANUFACTURING	ISM	0.03653	6.00	0.03653	6.00
GDP	GDP	0.04030	3.38	0.03995	3.35
PHILADELPHIA FED	PF	0.02110	3.45	0.02110	3.45
CHICAGO PURC. MANAGER	CPM	0.02369	3.87	0.02362	3.87
DURABLE GOODS - TRANSP.	DGIT	0.03571	3.41	0.03369	3.20
D1Y_1		0.09067	3.28	0.09011	3.26
R2		0.10905		0.11086	
R2 adj.		0.10357		0.10494	
AIC		-5.69653		-5.69717	
HQ		-5.68256		-5.68297	
SC		-5.65741		-5.65962	
CHOW (1821)		0.99500	0.5073	0.99080	0.5233
AR1-4 test		2.34760	0.0524	2.37720	0.0499

Source: Own elaborations, based on data from PcGets

Table 4.2: Interaction of Surprises and Accumulated Surprise Index (ASI). Model I (Specific model of US D2y, 51 – 2017)

Economic Announcement	Reference	ASI+ Coeff.	T-Value	ASI- Coeff.	T-Value	Neutral ASI Coeff.	T-Value
Inflation announcements							
EMPLOYMENT COST INDEX	ECI			0.07642	-4.00		
Labor announcements							
INITIAL JOBLESS CLAIMS	IJC	0.02093	-3.37			0.01563	-3.87
CHAN. MANUF. PAYROLLS	CMP			0.04527	-3.43		
CHANGE NONF. PAYROLLS	CNFP	0.07935	-4.24			0.04631	-6.38
Demand announcements							
DOMESTIC VEHICLE SALES	DVS					0.02170	-2.68
U OF MICHIGAN CONFIDENCE	UMCon			0.06703	-5.60		
RETAIL SALES LESS AUTOS	RS-A					0.04718	-3.81
HOUSING STARTS	HS			-0.05729	-3.44		
Activity announcements							
ISM NON MANUFACTURING	ISM NM	0.04515	-3.40			0.02704	-2.72
ISM MANUFACTURING	ISM			0.03410	-2.93	0.04851	-5.58
INDUSTRIAL PRODUCTION	IP			0.04192	-2.87		
GDP	GDP			0.07753	-3.21		
PHILADELPHIA FED	PF	0.03121	-2.79				
CHICAGO PURC. MANAGER	CPM	0.03679	-3.50			0.02463	-2.74
DURABLE GOODS - TRANSP.	DGIT					0.04719	-3.77
R2		0.12656					
R2 adj.		0.11803					
AIC		-5.70888					
HQ		-5.68801					
SC		-5.65208					
CHOW (1821)		1.01260	0.4419				
AR1-4 test		1.38950	0.2351				

Source: Own elaborations, based on data from PcGets

Table 4.3: Interaction of Surprises and Accumulated Surprise Index (ASI). Model II. (Specific model of US D2y, 51 – 2017)

Economic Announcement	Reference	ASI+ Coeff.	T-Value	ASI- Coeff.	T-Value	Neutral ASI Coeff.	T-Value
Inflation announcements							
GDP PRICE DEFLACTOR	D GDP PD +			0.23303	3.46		
CPI MOM	D CPI +					-0.05301	-2.87
Labor announcements							
INITIAL JOBLESS CLAIMS	D IJC +	-0.02997	-2.81				
AVERAGE WEEKLY HOURS	D AWH -	0.24541	4.21				
UNEMPLOYMENT RATE	D U +					0.06063	3.71
UNEMPLOYMENT RATE	D U -					0.04804	3.47
CHANGE NONF. PAYROLLS	D CNFP -					-0.0835	-6.27
Demand announcements							
U OF MICHIGAN CONFIDENCE	D UMCon -			-0.10391	-5.32		
RETAIL SALES LESS AUTOS	D RS-A +					0.08616	4.44
HOUSING STARTS	D HS -			0.05868	3.17		
Activity announcements							
ISM NON MANUFACTURING	D ISM NM +	0.06001	2.72				
ISM MANUFACTURING	D ISM +					0.04010	3.29
BUSINESS INVENTORIES	D BI +	0.04071	2.61				
BUSINESS INVENTORIES	D BI -					0.04189	2.87
GDP	D GDP -			-0.10394	-3.09		
CHICAGO PURC. MANAGER	D CPM -					-0.03903	-3.14
DURABLE GOODS - TRANSP.	D DGIT -					-0.06462	-3.51
DIY_1		0.09174	3.28				
R2		0.09572					
R2 adj.		0.08783					
AIC		-5.67622					
HQ		-5.65743					
SC		-5.62510					
CHOW (1821)		1.00400	0.4739				
AR1-4 test		1.84200	0.1181				

Source: Own elaborations, based on data from PcGets

Table 4.4: Interaction of Surprises and Accumulated Surprise Index (ASI). Model III. (Specific model of US D2y, 51 – 2017)

Economic Announcement	Reference	ASI+ Coeff.	T-Value	ASI- Coeff.	T-Value	Neutral ASI Coeff.	T-Value
Inflation announcements							
EMPLOYMENT COST INDEX	ECI -			0.08056	2.72	0.05026	2.61
PPI INDEX MOM	PPI +					-0.06144	-2.45
PPI EX FOOD & ENERGY	PPI-FE +					0.04479	1.94
CPI MOM	CPI -					0.03083	2.62
Labor announcements							
INITIAL JOBLESS CLAIMS	IJC +	-0.02624	-3.12				
INITIAL JOBLESS CLAIMS	IJC -	-0.01818	-1.92			-0.02022	-3.71
AVERAGE WEEKLY HOURS	AWH -	-0.22373	-3.07				
CHAN. MANUF. PAYROLLS	CMP -			0.50748	3.69		
CHANGE NONF. PAYROLLS	CNFP +	0.05542	2.76			0.05906	4.38
CHANGE NONF. PAYROLLS	CNFP -			0.04309	3.12	0.04057	4.86
Demand announcements							
U OF MICHIGAN CONFIDENCE	UMCon +					-0.06625	-3.28
U OF MICHIGAN CONFIDENCE	UMCon -			0.11166	6.72		
RETAIL SALES LESS AUTOS	RS-A +					0.12112	5.46
HOUSING STARTS	HS -			-0.05948	-3.54		
Activity announcements							
ISM NON MANUFACTURING	ISM NM +	0.05882	3.49			0.02480	2.07
ISM MANUFACTURING	ISM +			0.05169	3.40	0.05643	4.84
ISM MANUFACTURING	ISM -					0.02946	2.53
BUSINESS INVENTORIES	BI +	0.03611	2.99				
BUSINESS INVENTORIES	BI -					-0.06811	-3.81
GDP	GDP +	0.04028	2.18				
PHILADELPHIA FED	PF -	0.04213	2.52				
CHICAGO PURC. MANAGER	CPM +	0.03196	2.65				
CHICAGO PURC. MANAGER	CPM -			0.03537	2.32	0.03662	3.30
DURABLE GOODS - TRANSP.	DGIT -					0.05611	3.86
DIY_1		0.09607	3.57				
R2		0.15909					
R2 adj.		0.14593					
AIC		-5.75032					
HQ		-5.71761					
SC		-5.66122					
CHOW (1821)		1.02150	0.4087				
AR1-4 test		1.43090	0.2212				

Source: Own elaborations, based on data from PcGets

Table 4.5: Interaction of Surprises and ASI with exponentially weighted moving average (EWMA). Model I (Specific model of US D2y, 51 – 2017)

		ASI+		ASI-		Neutral ASI	
Economic Announcement	**Reference**	**Coeff.**	**T-Value**	**Coeff.**	**T-Value**	**Coeff.**	**T-Value**
Inflation announcements							
CPI EX FOOD AND ENERGY	CPI ex	0.03447	3.32				
EMPLOYMENT COST INDEX	ECI					0.05465	2.77
Labor announcements							
INITIAL JOBLESS CLAIMS	IJC	0.02158	3.89				
CHANGE NONF. PAYROLLS	CNFP	0.05188	4.81			0.04949	3.49
Demand announcements							
U OF MICHIGAN CONFIDENCE	UMCon			0.04377	4.94	-0.04041	-3.05
ADVANCED RETAIL SALES	ARS	0.03860	3.71				
HOUSING STARTS	HS			-0.03865	-2.79		
PERSONAL SPENDING	PS					-0.02767	-2.91
Activity announcements							
ISM NON MANUFACTURING	ISM NM	0.04080	3.77				
ISM MANUFACTURING	ISM	0.04109	4.13			0.04509	4.60
INDUSTRIAL PRODUCTION	IP			0.04230	3.83		
PHILADELPHIA FED	PF	0.03367	3.66				
CHICAGO PURC. MANAGER	CPM	0.03572	3.72				
D1y_1		0.08314	3.00				
R2		0.11586					
R2 adj.		0.10814					
AIC		-5.69874					
HQ		-5.67995					
SC		-5.64761					
CHOW (1821)		1.03870	0.3494				
AR1-4 test		2.23280	0.0632				

Source: Own elaborations, based on data from PcGets

Table 4.6: Interaction of Surprises and ASI with exponentially weighted moving average (EWMA). Model II (Specific model of US D2y, 51 – 2017)

		ASI+		ASI-		Neutral ASI	
Economic Announcement	**Reference**	**Coeff.**	**T-Value**	**Coeff.**	**T-Value**	**Coeff.**	**T-Value**
Labor announcements							
CHANGE NONF. PAYROLLS	D CNFP -			-0.05749	-5.21		
Demand announcements							
U OF MICHIGAN CONFIDENCE	D UMCon -			-0.04785	-3.32		
U OF MICHIGAN CONFIDENCE	D UMCon +					-0.13775	-4.03
RETAIL SALES LESS AUTOS	D RS-A +	0.08283	3.43				
Activity announcements							
ISM NON MANUFACTURING	D ISM NM +	0.04145	2.97				
ISM MANUFACTURING	D ISM +	0.04069	2.92				
BUSINESS INVENTORIES	D BI -	0.12384	4.18				
CHICAGO PURC. MANAGER	D CPM -			-0.05084	-3.33		
DURABLE GOODS - TRANSP.	D DGlT -					-0.06963	-2.88
D1Y_1		0.08141	2.87				
R2		0.06348					
R2 adj.		0.05917					
AIC		-5.64932					
HQ		-5.63888					
SC		-5.62092					
CHOW (1821)		1.07200	0.25				
AR1-4 test		2.27130	0.06				

Source: Own elaborations, based on data from PcGets

Table 4.7: Interaction of Surprises and ASI with exponentially weighted moving average (EWMA). Model III (Specific model of US D2y, 51 – 2017)

		ASI+		ASI-		Neutral ASI	
Economic Announcement	**Reference**	**Coeff.**	**T-Value**	**Coeff.**	**T-Value**	**Coeff.**	**T-Value**
Inflation announcements							
EMPLOYMENT COST INDEX	ECI -	0.04818	1.94			0.06321	2.64
ISM PRICES PAID	ISM PP +	-0.07784	-2.82				
GDP PRICE DEFLACTOR	GDP PD +			0.44269	3.50		
GDP PRICE DEFLACTOR	GDP PD -			-0.33018	-2.26		
Labor announcements							
INITIAL JOBLESS CLAIMS	IJC +						
INITIAL JOBLESS CLAIMS	IJC -	-0.02475	-3.42				
AVERAGE WEEKLY HOURS	AWH -						
CHAN. MANUF. PAYROLLS	CMP -						
CHANGE NONF. PAYROLLS	CNFP +	0.05841	4.53			0.08855	3.62
CHANGE NONF. PAYROLLS	CNFP -			0.04721	5.38		
Demand announcements							
U OF MICHIGAN CONFIDENCE	UMCon +					-0.13582	-4.69
U OF MICHIGAN CONFIDENCE	UMCon -			0.04383	4.54		
BUILDING PERMITS	BP +	0.05392	2.78				
ADVANCED RETAIL SALES	ARS -	0.58731	2.98				
RETAIL SALES LESS AUTOS	RS-A +	0.07100	4.01				
RETAIL SALES LESS AUTOS	RS-A -	-0.42848	-2.72				
HOUSING STARTS	HS +	-0.05303	-2.78				
HOUSING STARTS	HS -			-0.03581	-2.56		
Activity announcements							
ISM NON MANUFACTURING	ISM NM +	0.04025	3.77				
ISM NON MANUFACTURING	ISM NM -					0.05306	2.91
ISM MANUFACTURING	ISM +	0.04469	3.93	0.10585	2.11	0.05162	4.46
ISM MANUFACTURING	ISM -						
BUSINESS INVENTORIES	BI +					0.03432	2.46
BUSINESS INVENTORIES	BI -	-0.14743	-4.56				
GDP	GDP +			-1.28786	-2.53	0.04152	1.89
GDP	GDP -			0.16540	3.06		
PHILADELPHIA FED	PF -	0.02914	2.19				
CHICAGO PURC. MANAGER	CPM +	0.02766	2.46				
CHICAGO PURC. MANAGER	CPM -	0.04607	2.49	0.03422	2.70	0.03172	2.08
DURABLE GOODS ORDERS	DGO +	-0.03054	-2.99				
DURABLE GOODS - TRANSP.	DGT +	0.07689	3.09				
Monetary							
FOMC Rate expected	FOMC	-0.02508	-2.11				
D1Y_1		0.14244	3.66				
D10Y_1		-0.06242	-2.03				
R2		0.15250					
R2 adj.		0.13623					
AIC		-5.72071					
HQ		-5.68105					
SC		-5.61279					
CHOW (1821)		0.98550	0.5430				
AR1-4 test		2.39640	0.0484				

Source: Own elaborations, based on data from PcGets

Table 4.8: Interaction of Surprises and Accumulated Surprise Disagreement (ASD). Model I ASD using CV (Specific model of US D2y, 636 – 2017)

Economic Announcement	Reference	HAU Coeff.	HAU T-Value	LAU Coeff.	LAU T-Value
Inflation announcements					
EMPLOYMENT COST INDEX	ECI			0.03546	2.62
Labor announcements					
INITIAL JOBLESS CLAIMS	IJC			0.01419	3.87
CHANGE NONF. PAYROLLS	CNFP			0.07001	7.73
Demand announcements					
U OF MICHIGAN CONFIDENCE	UMCon	0.05983	3.72		
Activity announcements					
ISM NON MANUFACTURING	ISM NM			0.03675	4.39
ISM MANUFACTURING	ISM	0.04022	3.02	0.04176	4.84
GDP	GDP			0.04158	2.85
PHILADELPHIA FED	PF			0.03408	4.10
CHICAGO PURC. MANAGER	CPM			0.03582	4.60
DURABLE GOODS - TRANSP.	DGIT			0.03300	2.93
D1Y_1		0.23426	3.46		
D1Y_2		-0.13402	-2.64		
R2		0.13838			
R2 adj.		0.13083			
AIC		-5.60796			
HQ		-5.58956			
SC		-5.55878			
CHOW (1879)		0.87630	0.8383		
AR1-4 test		1.92650	0.1036		

Source: Own elaborations, based on data from PcGets

Table 4.9: Interaction of Surprises and Accumulated Surprise Disagreement (ASD). Model I ASD using AISD. (Specific model of US D2y, 636 – 2017)

		HAU		LAU	
Economic Announcement	**Reference**	**Coeff.**	**T-Value**	**Coeff.**	**T-Value**
Inflation announcements					
EMPLOYMENT COST INDEX	ECI	0.08042	2.87		
Labor announcements					
INITIAL JOBLESS CLAIMS	IJC	0.03040	3.72	0.01263	3.30
CHANGE NONF. PAYROLLS	CNFP	0.05349	4.14	0.05845	6.29
Demand announcements					
U OF MICHIGAN CONFIDENCE	UMCon	0.04945	4.40		
ADVANCED RETAIL SALES	ARS			0.03680	3.56
Activity announcements					
ISM NON MANUFACTURING	ISM NM	0.02989	2.72	0.03217	3.10
ISM MANUFACTURING	ISM			0.05027	6.21
PHILADELPHIA FED	PF			0.03601	4.19
CHICAGO PURC. MANAGER	CPM			0.03783	4.34
DURABLE GOODS - TRANSP.	DGIT	0.10204	3.53		
D1Y_1		0.24022	3.55		
D1Y_2		-0.13918	-2.75		
R2		0.14578			
R2 adj.		0.13703			
AIC		-5.61310			
HQ		-5.59186			
SC		-5.55632			
CHOW (1879)		0.99620	0.4985		
AR1-4 test		2.72080	0.0283		

Source: Own elaborations, based on data from PcGets

Table 4.10: Interaction of Surprises and Accumulated Surprise Disagreement (ASD). Model II ASD using CV3. (Specific model of US D2y, 636 – 2017)

		HAU		LAU	
Economic Announcement	**Reference**	**Coeff.**	**T-Value**	**Coeff.**	**T-Value**
Inflation announcements					
CPI EX FOOD & ENERGY	CPI ex +	0.04052	1.85		
Labor announcements					
CHANGE NONF. PAYROLLS	CNFP +	0.27983	6.49	0.12454	6.50
CHANGE NONF. PAYROLLS	CNFP -			0.05629	5.68
Demand announcements					
RETAIL SALES LESS AUTOS	RS-A +			0.05024	3.57
CONSUMER CONFIDENCE	CC -	0.03218	2.13		
CONSUMER CREDIT	CCred +	-0.04249	-2.42		
U OF MICHIGAN CONFIDENCE	UMCon -	0.20279	8.61		
Activity announcements					
MONTHLY BUDG. STATE.	MBS +	-0.05472	-1.46		
ISM NON MANUFACTURING	ISM NM -			0.04644	3.18
ISM NON MANUFACTURING	ISM NM +			0.03219	3.28
ISM MANUFACTURING	ISM +	0.07589	4.21	0.04707	4.34
PHILADELPHIA FED	PF +			0.05619	4.31
DURABLE GOODS ORDERS	DGO +			-0.03339	-3.18
DURABLE GOODS ORDERS	DGO -	-0.07333	-1.48		
DURABLE GOODS - TRANSP.	DGlt -	0.11139	1.52		
	DGlt +			0.06596	3.06
GDP	GDP +			0.05403	3.08
BUSINESS INVENTORIES	BI -			-0.03764	-3.43
CHICAGO PURC. MANAGER	CPM -			0.05233	5.16
D3m_1		0.07502	1.69		
D1y_1		0.19553	2.70		
D2Y_1		-0.13229	-2.65		
R2		0.19583			
R2 adj.		0.18222			
AIC		-5.66106			
HQ		-5.62710			
SC		-5.57027			
CHOW (1879)		0.79330	0.9584		
AR1-4 test		2.10620	0.0778		

Source: Own elaborations, based on data from PcGets

Table 4.11: Interaction of Surprises and Accumulated Surprise Disagreement (ASD). Model II ASD using AISD. (Specific model of US D2y, 636 – 2017)

		HAU		LAU	
Economic Announcement	**Reference**	**Coeff.**	**T-Value**	**Coeff.**	**T-Value**
Inflation announcements					
IMPORT PRICE INDEX	IMI +	0.06262	2.76		
Labor announcements					
UNEMPLOYMENT RATE	U -	-0.05204	-2.88		
CHANGE NONF. PAYROLLS	CNFP +	0.12815	4.69	0.09132	4.38
CHANGE NONF. PAYROLLS	CNFP -			0.04907	4.93
CHAN. MANUF. PAYROLLS	CMP -	0.03971	3.27		
Demand announcements					
ADVANCE RETAIL SALES	ARS +	0.47575	3.85	0.04160	3.87
PERSONAL INCOME	PI -	-0.06972	-2.12		
HOUSING STARTS	HS -			-0.03094	-2.39
CONSUMER CREDIT	CCred -			0.03852	2.17
U OF MICHIGAN CONFIDENCE	UMCon +			-0.08137	-3.77
U OF MICHIGAN CONFIDENCE	UMCon -	0.13471	8.05		
Activity announcements					
MONTHLY BUDG. STATE.	MBS +	-0.10169	-2.20		
INDUSTRIAL PRODUCTION	IP +	0.08809	2.37		
ISM NON MANUFACTURING	ISM NM -			0.04173	2.91
ISM NON MANUFACTURING	ISM NM +	0.03205	2.72		
ISM MANUFACTURING	ISM +			0.05559	5.57
ISM MANUFACTURING	ISM -			0.04130	3.33
PHILADELPHIA FED	PF +			0.05884	4.28
DURABLE GOODS ORDERS	DGO +	-0.06952	-4.47		
DURABLE GOODS - TRANSP.	DGIt +	0.22829	2.85		
GDP	GDP +	0.14315	2.44	0.04164	2.34
BUSINESS INVENTORIES	BI +	0.03665	2.33		
BUSINESS INVENTORIES	BI -			-0.03830	-3.52
CHICAGO PURC. MANAGER	CPM -	0.04081	2.85	0.05748	4.44
CAPACITY UTILIZATION	CU -				
Trade Bce Announcement					
TRADE BALANCE	TB -	-0.05344	-2.09		
Monetary					
FOMC Rate Expected	FOMC	-0.02693	-2.23		
D3M_1		0.12189	3.32		
R2		0.21837			
R2 adj.		0.20043			
AIC		-5.67791			
HQ		-5.63263			
SC		-5.55686			
CHOW (1879)		1.07330	0.28		
AR1-4 test		3.56970	0.01		

Source: Own elaborations, based on data from PcGets

CHAPTER 5

Conclusions and Future Research

The impact of news effects is one of the key questions in financial economics and an intense topic of interest in recent studies of macroeconomic analysis. The thesis adopts the automatic algorithm based on general to specific models to handle the large number of economic indicators without limiting the analysis to a subjective group of variables. The thesis discusses these problems first in a theoretical context before moving on to applied examples. The variation in the very short dated US term structure, Fed funds rate contracts, is analysed using macroeconomic surprises (including asymmetries) coming from scheduled macroeconomic announcements. Fed funds interest rates and its expectations are the first link of transmission of Federal Reserve policy to other interest rates. This empirical approach helps to understand the underlying methodological problem and to discuss which model is appropriate. In general there are more significant economic surprises related with production indexes and far less employment and inflation surprises. Fed monetary policy bias has an influence over the shorter contracts, while for the longer ones they do not appear as relevant. This has it rationale on the time frame and time volatility of the bias. The next step in the thesis introduces another dimension in news: disagreement. Opinions of analysts usually differ, and this is what the thesis considers as disagreement. It is showed then that disagreement is non neutral in the understanding of news surprises. The empirical application provides significant evidence that forecasters disagreement helps to understand the market response to economic news. Finally, the thesis measures the impact of two types of endogenous sentiment indicators (accumulated surprises and accumulated disagreement), derived from the analysts surveys conducted for each economic release. Both endogenous indicators add explanatory power. To sum up, the usage of robust model selection techniques allowed to increase the complexity of

the models and theory, adding variables that are relevant but that previous literature do not take into account to avoid selection problems.

The future research agenda could be enriched by analysing the following points:

- Alternative selection techniques such as RETINA could be used as well and compared given the different methodological approaches on which it is based. The effect of macro surprises could be an appropriate field of comparison of the different techniques due to the intrinsic features of the topic.
- Another further step to deepen the knowledge of micro effects of macro announcements would be to discuss the relevance of *structural breaks* in the models. As academics and practitioners usually point out, market causalities change abruptly in short time. For example, the same news surprise could raise different market movements depending on the causalities predominant (in FX, interest rate discrepancies -carry trades- against growth differentials). In the case of US short-term interest rate markets, it would be interesting to check the effect of news surprises evaluating structural breaks depending on the monetary stance of the Federal Reserve. Though the literature linking asset prices and news is well-developed, issues relating the estimation method and the evaluation of breaks with high frequency data have not been done properly so far. Then, the introduction of structural breaks and time variation would increase the general knowledge of asset pricing determination and fundamentals. Clearly, a suitable analysis will be necessary to relate model selection procedures with structural breaks.
- An interesting addition to the existing literature will be to set a methodology to deal with the revisions of economic statistics. Sometimes (quiet often) the revised data announcement have more effect than the actual releases.
- The natural next step to disagreement effect will be to evaluate if analysts' disagreement dominates business cycle and other investor sentiment measures in a model of surprises effects (including asymmetry effects).
- The extension of the analysis to Emerging Markets (EM) will be a natural step on the literature. In this case, it will be interesting to evaluate both the effect

of G7 and EM news over EM assets, and check if the outcome depends on the transparency and credibility of the Central Bank.

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APPENDIX A

Indices and Formulas

Surprises

Surprises are expressed in a standardised way dividing the surprise by its sample standard deviation (σ_i):

$$Surprise_i \equiv \frac{(Actual_i - Forecast_i)}{\sigma_i} \tag{A.1}$$

Coefficient of Variation

The most common measure of dispersion is the simple standard deviation (SD). SD calculates the dispersion of data around its mean. In order to compare the relative dispersion of many sets of data, the SD needs to be based on the the same mean across them. The natural alternative for SD is the Coefficient of Variation (CV) which relates dispersion and location. It is defined as the ratio of SD over mean.

Coefficient of Variation +

The thesis considers several measures of CV. The first one is a slight variation to CV called CV+. This measure avoids the negative sign of CV that raises when the median is negative, therefore it just takes the mean absolute value. This is the usual measure followed in the stocks earnings forecast literature. In equity terms, the coefficient of variation of all earnings estimates is the standard deviation of all estimates that make up the consensus as a percentage of the absolute value of the mean value of all estimates for a company (Dische, 2002; Bond and Cummins, 2004 and Johnson, 2004). CV has a clear drawback that appears when the mean is zero or close to zero. Diether et al. (2002) take notice of this issue and treat stocks with mean forecast of zero as of high dispersion (in their case they are assigned to the highest dispersion group). Moreover, in their study they show that the exclusion of observations with mean earnings forecast of zero does not significantly affect the portfolio returns and the results achieved. A slight modification

of the CV is the definition used by Thomas (2002) as the standard deviation of analysts' forecasts deflated by the stock price five days before the earnings announcement date.

Coefficient of Variation 2

The second alternative measure that this chapter considers is CV2, where the median is replaced by the historic average median.

Coefficient of Variation 3

A further variation is CV3 which replaces the median lower than a certain threshold by the historic average median, and keep the actual mean in the rest of the calculations (as opposed to CV2).

Coefficient of Variation 3+

CV3+ is a slight modification to CV3 taking the mean absolute values.

Intra Surprise Disagreement Index

Alternatively to CV and its variations, a disagreement diffusion index is constructed that captures uncertainty. This index tracks the disagreement in each economic release by creating first an intra surprise indicator. It considers news expressed in a standardised way dividing the surprise by its sample standard deviation:

$$IntraSurprise_i = \frac{(Median_i - Analyst_A Forecast)}{\sigma_i} \tag{A.2}$$

Where i = analyst; σ_i = standard deviation of the median less analyst forecast survey at that time. Then, each analyst surprise with IntraSurprise>0.5 are assigned with a +1 and -1 in the case that surprises are lower than IntraSurprise <-0.5. The Intra Surprise Disagreement (ISD) diffusion index is then built performing this calculation:

$$ISD_t = \left(\frac{\sum_{t=1}^{N} (IS_t^+ + IS_t^-)}{N} \right) \tag{A.3}$$

Where N = Total Number of Analyst Surveyed for that specific announcement, IS = IntraSurprise; $IS_+ = 1$ when IS_i >0.5 and $IS_- = -1$ when IS_i<0.5 A reading above zero implies a positive balance of upside Intra Surprises on that specific release with respect to the median.

This last approach has a clear backdrop. If the number of analysts with positive and negative skewed disagreement is equal, then the ISD will be zero. Consequently, another way of calculating the disagreement is introduced. In this case, each analyst surprise with IS_i >0.5 and IS_i <-0.5 are assigned with a +1 respectively.

Alternative Intra Surprise Disagreement (AISD)

The Alternative Intra Surprise Disagreement (AISD) diffusion index is built performing this calculation:

$$AISD_t = \left(\frac{\sum_{t=1}^{N} (IS_t)}{N} \right) \tag{A.4}$$

Where N =Total number of analyst surveyed for that specific announcement. A reading above zero implies that there is dispersion among analysts.

Accumulated Surprise Index (ASI)

The diffusion index is built initially following an arbitrary 6 week rolling range (i.e. 30 trading days, based on JPMorgan, 2002). This index is called Accumulated Surprise Index (ASI) and follows this formula:

$$ASI_t = \left(\frac{\sum_{t=1}^{30} (S_t^+ + S_t^-)}{\#S_{\text{in t=1 to 30}}} \right) \tag{A.5}$$

Where $S_+ = 1$ when the surprises standard deviation (sd) is higher than 0.5, or expressed sd(S_i) >0.5. While $S_- = -1$ when sd(S_i)<0.5. An ASI reading above zero implies a positive balance of upside surprises over the past 6 weeks. The next step is to set three different stages:

(1) ASI+ when accumulated surprises are significantly positive (optimistic period);
(2) ASI- when accumulated surprises are significantly negative (pessimistic period) and
(3) No ASI when accumulated surprises are neutral (neutral period).

Using the ASI the three different stages are built in the following way:

- ASI+ (when the ASI is over its 20-day moving average plus 0.5 standard deviation of its historic moving average);

- ASI- (when the ASI is below its 20-day moving average less 0.5 standard deviation of its historic moving average) and
- No ASI (when its in between the previous boundaries).

Accumulated Intra Surprise Disagreement Index

A similar approach to the ASI is followed. The Index of disagreement uses 12 economic announcements (following same steps as in Chapter 3 Section 5.4 and Section 6, these variables are the selected ones in the base model of asymmetry surprises). A key input for the index are the disagreement dichotomy variables High Uncertainty (HU) and Low Uncertainty (LU). HU uncertainty dummy measures take the value 1 when exists a high uncertainty environment defined as a period when the uncertainty measure is higher than one standard deviation approximately (i.e. built using a percentile rank, and from there set the ones 84% higher with 1 and 16% lower with 1 too, the sample in between are low uncertainty represented with 0's in the sample). Low uncertainty periods are defined as stages when the uncertainty measures are lower than one standard deviation. Then, the index calculates the Accumulated Intra Surprise Disagreement (ASD) as the share of total disagreements that are considered HU in the last 30 days divided by the total disagreements of the last 30 days (or equivalently all the data releases):

$$ASD_t = \left(\frac{\sum_{t=1}^{30}(HU_t)}{\sum_{t=1}^{30}(HU_t + LU_t)} \right) \tag{A.6}$$

Two different scenarios are set using the ASD:

(1) High Accumulated Uncertainty (HAU) when accumulated disagreements are significantly high (period of high uncertainty);

(2) Low Accumulated Uncertainty (LAU) when accumulated disagreements are significantly low (period of low uncertainty).

The HAU is defined as the period when ASD is over its 20-day moving average plus 0.5 standard deviation of its historic moving average. The LAU is defined as the period when the ASD is below its 20-day moving average plus 0.5 standard deviation of its historic moving average, or alternatively the period when the surprises are not in HAU.

APPENDIX B

Greenspan Speeches

1996

July 26, 1996

Chairman Alan Greenspan

Recent reports on Federal Reserve operations

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

July 18, 1996 Humphrey Hawkins

Chairman Alan Greenspan

The Federal Reserve's semiannual monetary report

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

1997

January 21, 1997

Chairman Alan Greenspan

Performance of the U.S. economy

Before the Committee on the Budget, U.S. Senate

January 30, 1997

Chairman Alan Greenspan

The comsumer price index

Before the Committee on Finance, U.S. Senate

February 13, 1997

Chairman Alan Greenspan

Modernization of the financial system

Before the Subcommittee on Financial Institutions and Consumer Credit of the Committee on Banking and Financial Services, U.S. House of Representatives

February 26, 1997 Humphrey Hawkins

Chairman Alan Greenspan

The Federal Reserve's semiannual monetary policy report

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

March 4, 1997

Chairman Alan Greenspan

Bias in the consumer price index

Before the Committee on the Budget, U.S. House of Representatives

March 19, 1997

Chairman Alan Greenspan

Supervision of banking organizations

Before the Subcommittee on Capital Markets, Securities and Government-Sponsored Enterprises of the Committee on Banking and Financial Services, U.S. House of Representatives

March 20, 1997

Chairman Alan Greenspan

Performance of the U.S. economy

Before the Joint Economic Committee, U.S. Congress

May 22, 1997

Chairman Alan Greenspan

H.R. 10, the Financial Services Competitiveness Act of 1997

Before the Committee on Banking and Financial Services, U.S. House of Representatives

July 17, 1997

Chairman Alan Greenspan

The Financial Services Competition Act of 1997

Before the Subcommittee on Finance and Hazardous Materials of the Committee on Commerce, U.S. House of Representatives

July 22, 1997 Humphrey Hawkins

Chairman Alan Greenspan

The Federal Reserve's semiannual monetary policy report

Before the Subcommittee on Domestic and International Monetary Policy of the Committee on Banking and Financial Services, U.S. House of Representatives

October 8, 1997

Chairman Alan Greenspan

Economic and budgetary outlook

Before the Committee on the Budget, U.S. House of Representatives

October 29, 1997

Chairman Alan Greenspan

Turbulence in world financial markets

Before the Joint Economic Committee, U.S. Congress

November 13, 1997

Chairman Alan Greenspan

The growing international financial system

Before the Committee on Banking and Financial Services, U.S. House of Representatives

November 20, 1997

Chairman Alan Greenspan

Social security

Before the Task Force on Social Security of the Committee on the Budget, U.S. Senate

1998

January 29, 1998

Chairman Alan Greenspan

The current fiscal situation

Before the Committee on the Budget, U.S. Senate

January 30, 1998

Chairman Alan Greenspan

The current Asia crisis and the dynamics of international finance

Before the Committee on Banking and Financial Services, U.S. House of Representatives

February 12, 1998

Chairman Alan Greenspan

The current Asian crisis and the dynamics of international finance

Before the Committee on Foreign Relations, U.S. Senate

February 24, 1998 Humphrey Hawkins

Chairman Alan Greenspan

The Federal Reserve's semiannual report on economic conditions and the conduct of monetary policy

Before the Subcommittee on Domestic and International Monetary Policy of the Committee on Banking and Financial Services, U.S. House of Representatives

March 3, 1998

Chairman Alan Greenspan

The current Asian crisis

Before the Subcommittee on Foreign Operations of the Committee on Appropriations, U.S. Senate

March 4, 1998

Chairman Alan Greenspan

Coming budgetary challenges

Before the Committee on the Budget, U.S. House of Representatives

April 20, 1998

Chairman Alan Greenspan

The allocation of the economy's resources between Medicare and competing needs

Before the National Bipartisan Commission on the Future of Medicare

May 21, 1998

Chairman Alan Greenspan

The current Asian crisis and the financial resources of the IMF

Before the Committee on Agriculture, U.S. House of Representatives

June 10, 1998

Chairman Alan Greenspan

An update on economic conditions in the United States

Before the Joint Economic Committee, U.S. Congress

June 16, 1998

Chairman Alan Greenspan

The effects of mergers

Before the Committee on the Judiciary, U.S. Senate

June 17, 1998

Chairman Alan Greenspan

H.R. 10, the Financial Services Act of 1998

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

July 21, 1998

Chairman Alan Greenspan

The Federal Reserve's midyear report on monetary policy

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

Chairman Greenspan presented identical testimony before the Subcommittee on Domestic and International Monetary Policy of the Committee on Banking and Financial Services, U.S. House of Representatives, July 22, 1998

July 24, 1998

Chairman Alan Greenspan

The regulation of OTC derivatives

Before the Committee on Banking and Financial Services, U.S. House of Representatives

July 30, 1998

Chairman Alan Greenspan

The Commodity Exchange Act and OTC derivatives

Before the Committee on Agriculture, Nutrition, and Forestry, U.S. Senate

September 16, 1998

Chairman Alan Greenspan

International economic and financial system

Before the Committee on Banking and Financial Services, U.S. House of Representatives

September 23, 1998

Chairman Alan Greenspan

The crisis in emerging market economies

Before the Committee on the Budget, U.S. Senate

October 1, 1998

Chairman Alan Greenspan

Private-sector refinancing of the large hedge fund, Long-Term Capital Management

Before the Committee on Banking and Financial Services, U.S. House of Representatives

1999

January 20, 1999

Chairman Alan Greenspan

State of the economy

Before the Committee on Ways and Means, U.S. House of Representatives

January 28, 1999

Chairman Alan Greenspan

Social security

Before the Committee on the Budget, U.S. Senate

February 11, 1999

Chairman Alan Greenspan

H.R. 10 and the need for financial reform

Before the Committee on Banking and Financial Services, U.S. House of Representatives

February 23, 1999

Chairman Alan Greenspan

The Federal Reserve's semiannual report on monetary policy

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

Chairman Greenspan presented identical testimony before the Committee on Banking and Financial Services, U.S. House of Representatives

March 3, 1999

Chairman Alan Greenspan

On investing the social security trust fund in equities

Before the Subcommittee on Finance and Hazardous Materials, Committee on Commerce, U.S. House of Representatives

April 28, 1999

Chairman Alan Greenspan

H.R. 10 and financial modernization

Before the Subcommittee on Finance and Hazardous Materials, Committee on Commerce, U.S. House of Representatives

May 20, 1999

Chairman Alan Greenspan

Efforts to improve the "architecture" of the international financial system

Before the Committee on Banking and Financial Services, U.S. House of Representatives

June 14, 1999

Chairman Alan Greenspan

High-tech industry in the U.S. economy

Before the Joint Economic Committee, U.S. Congress

June 17, 1999

Chairman Alan Greenspan

Monetary policy and the economic outlook

Before the Joint Economic Committee, U.S. Congress

July 22, 1999

Chairman Alan Greenspan Humphrey Hawkins

The Federal Reserve's semiannual report on monetary policy

Before the Committee on Banking and Financial Services, U.S. House of Representatives

Chairman Greenspan presented identical testimony before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate, on July 28, 1999

2000

January 26, 2000

Chairman Alan Greenspan

On nomination to fourth term as Chairman

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

February 10, 2000

Chairman Alan Greenspan

Over-the-counter derivatives

Before the Committee on Agriculture, Nutrition, and Forestry, U.S. Senate

February 17, 2000

Chairman Alan Greenspan

The Federal Reserve's semiannual report on the economy and monetary policy

Before the Committee on Banking and Financial Services, U.S. House of Representatives

Chairman Greenspan presented identical testimony before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate on February 23, 2000

March 27, 2000

Chairman Alan Greenspan

General revenue transfers for social security and Medicare

Before the Special Committee on Aging, U.S. Senate

April 13, 2000

Chairman Alan Greenspan

Evolution of our equity markets

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

June 21, 2000

Chairman Alan Greenspan

S. 2697, the Commodity Futures Modernization Act of 2000

Before the Committee on Agriculture, Nutrition, and Forestry and the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

July 20, 2000

Chairman Alan Greenspan

The Federal Reserve's report on monetary policy

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

Chairman Greenspan presented identical testimony before the Committee on Banking and Financial Services, U.S. House of Representatives, on September 21, 2000

2001

January 25, 2001

Chairman Alan Greenspan

Outlook for the federal budget and implications for fiscal policy

Before the Committee on the Budget, U.S. Senate

February 13, 2001

Chairman Alan Greenspan

Federal Reserve Board's semiannual monetary policy report to the Congress

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

February 28, 2001

Chairman Alan Greenspan

Federal Reserve Board's semiannual monetary policy report to the Congress

Before the Committee on Financial Services, U.S. House of Representatives

This presentation updates the testimony given by Chairman Greenspan before the Committee on Banking, Housing, and Urban Affairs, U.S.

Senate, on February 13, 2001

March 2, 2001

Chairman Alan Greenspan

Current fiscal issues

Before the Committee on the Budget, U.S. House of Representatives

April 4, 2001

Chairman Alan Greenspan

Trade policy

Before the Committee on Finance, U.S. Senate

June 20, 2001

Chairman Alan Greenspan

Condition of the U.S. banking system

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

July 18, 2001

Chairman Alan Greenspan

Federal Reserve Board's semiannual monetary policy report to the Congress

Before the Committee on Financial Services, U.S. House of Representatives

July 24, 2001

Chairman Greenspan presented identical testimony before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

September 20, 2001

Chairman Alan Greenspan

The condition of the financial markets

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

October 17, 2001

Chairman Alan Greenspan

Monetary policy and economic outlook

Before the Joint Economic Committee, U.S. Congress

2002

January 24, 2002

Chairman Alan Greenspan

The state of the economy

Before the Committee on the Budget, U.S. Senate

February 5, 2002

Chairman Alan Greenspan

Financial literacy

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

February 27, 2002

Chairman Alan Greenspan

Federal Reserve Board's semiannual monetary policy report to the Congress

Before the Committee on Financial Services, U.S. House of Representatives

March 7, 2002

Chairman Alan Greenspan

Federal Reserve Board's semiannual monetary policy report to the Congress

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

This presentation updates the testimony given by Chairman Greenspan before the Committee on Financial Services, U.S. House of Representatives, on February 27, 2002

April 17, 2002

Chairman Alan Greenspan

Monetary policy and the economic outlook

Before the Joint Economic Committee, U.S. Congress

April 23, 2002

Chairman Alan Greenspan

Federal deposit insurance reform

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

July 16, 2002

Chairman Alan Greenspan

Federal Reserve Board's semiannual monetary policy report to the Congress

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

Chairman Greenspan presented identical testimony before the Committee on Financial Services, U.S. House of Representatives, on July 17, 2002

September 12, 2002

Chairman Alan Greenspan

Current fiscal issues

Before the Committee on the Budget, U.S. House of Representatives

November 13, 2002

Chairman Alan Greenspan

The economic outlook

Before the Joint Economic Committee, U.S. Congress

February 11, 2003

Chairman Alan Greenspan

Federal Reserve Board's semiannual monetary policy report to the Congress

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

Chairman Greenspan presented identical testimony before the Committee on Financial Services, U.S. House of Representatives, on February 12

February 26, 2003

Chairman Alan Greenspan

Deposit insurance

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

February 27, 2003

Chairman Alan Greenspan

Aging global population

Before the Special Committee on Aging, U.S. Senate

April 30, 2003

Chairman Alan Greenspan

Follow-up to the semiannual monetary policy report to the Congress

Before the Committee on Financial Services, U.S. House of Representatives

May 21, 2003

Chairman Alan Greenspan

The economic outlook

Before the Joint Economic Committee, U.S. Congress

June 10, 2003

Chairman Alan Greenspan

Natural gas and supply issues

Before the Committee on Energy and Commerce, U.S. House of Representatives

July 10, 2003

Chairman Alan Greenspan

Natural gas supply

Before the Committee on Energy and Natural Resources, U.S. Senate

July 15, 2003

Chairman Alan Greenspan

Federal Reserve Board's semiannual monetary policy report to the Congress

Before the Committee on Financial Services, U.S. House of Representatives

Chairman Greenspan presented identical testimony before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate, on July 16, 2003

2004

February 11, 2004

Chairman Alan Greenspan

Federal Reserve Board's semiannual Monetary Policy Report to the Congress

Before the Committee on Financial Services, U.S. House of Representatives

Chairman Greenspan presented identical testimony before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate, on February 12

February 24, 2004

Chairman Alan Greenspan

Government-sponsored enterprises

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

February 25, 2004

Chairman Alan Greenspan

Economic outlook and current fiscal issues

Before the Committee on the Budget, U.S. House of Representatives

March 11, 2004

Chairman Alan Greenspan

Education

Before the Committee on Education and the Workforce, U.S. House of Representatives

April 20, 2004

Chairman Alan Greenspan

The state of the banking industry

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

April 21, 2004

Chairman Alan Greenspan

The economic outlook

Before the Joint Economic Committee, U.S. Senate

June 15, 2004

Chairman Alan Greenspan

Nomination hearing

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

July 20, 2004

Chairman Alan Greenspan

Federal Reserve Board's semiannual Monetary Policy Report to the Congress

Before the Committee on Banking, Housing, and Urban Affairs, U.S. Senate

Chairman Greenspan presented identical testimony before the Committee on Financial Services, U.S. House of Representatives, on July 21, 2004

APPENDIX C

US Economy Stylized Facts

In 1996, solid advances in the real expenditures of households and businesses led to sizable gains in output[1]. With the economy strengthening, intermediate- and long-term interest rates rose on net, but credit continued to be amply available to businesses and most households, and equity prices soared. Reflecting the surprising strength in economic activity last year, longer-term Treasury rates rose on balance on the order of 0.5 percentage point over the year and intermediate rates were up somewhat more.

In 1997 growth was strong, the unemployment rate declined to its lowest level in nearly a quarter-century, and inflation slowed further. Impressive gains were also made in other important respects: The federal budget moved toward balance much more quickly than almost anyone had anticipated. Intermediate- and long-term interest rates began moving up in December 1996, effectively anticipating Federal Reserve action. When the FOMC firmed policy slightly at its March meeting by raising the intended federal funds rate from 5.25 percent to 5.5 percent, the market response was small. The economy slowed a bit during the second and third quarters and inflation moderated further. In the latter part of the year, developments in other parts of the world began to alter the perceived risks attending the U.S. economic outlook. In light of the ongoing difficulties in Asia and the possible effects on the US, the FOMC not only left interest rates unchanged in December, but shifted its stance to symmetry between ease and tightening in the near term. On balance, between the end of 1996 and the end of 1997, the yields on ten-year and thirty-year Treasury bonds fell about 70 basis points. With real interest rates remaining low and corporate profits growing strongly, equities had another good year in 1997, and major stock indexes rose 20 percent to 30 percent.

[1]This section is based on the Semianual Monetary Policy Reports of the Federal Reserve.

In 1998, US output expanded rapidly, the unemployment rate fell to the lowest level since 1970, and inflation remained subdued. Nevertheless, economic troubles abroad posed a significant threat to the performance of the economy. The recession in Japan deepened, and several emerging market economies in Asia, which had started to weaken in the wake of the financial crises of 1997, contracted sharply. A worsening economic situation in Russia in the summer led to a devaluation of the ruble and a moratorium by that country on a substantial portion of its debt payments. Conditions in Latin America also weakened. To cushion the U.S. economy from the effects of these financial strains, and potentially to help reduce the strains as well (including the LTCM collapse), the Federal Reserve eased monetary policy on three occasions in the fall, bringing the total reduction during the autumn to 0.75 percentage point.

The resulting shift of demand toward safety and liquidity led to declines of 40 to 75 basis points in Treasury coupon yields between mid-August and mid-September. In contrast, yields on higher-quality private securities fell much less, and those on issues of lower-rated firms increased sharply. As a result, spreads of private rates over Treasury rates rose substantially and issuance of corporate securities dropped sharply.

By the middle of 1999, with financial markets resuming normal functioning, foreign economies recovering, and domestic demand continuing to outpace increases in productive potential, the Committee began to reverse the 1998 easing. Short-term interest rates moved up with monetary policy tightenings in June, August, and November of 25 basis point each. Bond and note yields moved sharply higher from early November 1999 to mid-January 2000, as Y2K fears diminished. Nearly all major stock indexes ended 1999 in record territory. The NASDAQ composite index paced the advance by soaring 86 percent over the year, and the S&P 500 and Dow Jones Industrial Average posted still-impressive gains of 20 percent and 25 percent. The year 1999 was the fifth consecutive year that all three indexes posted double-digit returns.

The FOMC also decided on some modifications to its disclosure procedures at the December meeting. These modifications, announced in January 2000, consisted primarily of a plan to issue a statement after every FOMC meeting that not only would

convey the current stance of policy but also would categorize risks to the outlook as either weighted mainly toward conditions that may generate heightened inflation pressures, weighted mainly toward conditions that may generate economic weakness, or balanced with respect to the goals of maximum employment and stable prices over the foreseeable future. The changes eliminated uncertainty about the circumstances under which an announcement would be made; they clarified that the Committee's statement about future prospects extended beyond the intermeeting period; and they characterized the Committee's views about future developments in a way that reflected policy discussions and that members hoped would be more helpful to the public and to financial markets.

Financial markets in 2000 were influenced by the changing outlook for the U.S. economy and monetary policy and by shifts in investors' perceptions of and attitudes toward risk. The economy continued to expand at an exceptionally strong and unsustainable pace in the early part of 2000, prompting the Federal Reserve to tighten its policy stance in several steps ending at its May meeting. Private interest rates and shorter-term Treasury yields rose considerably over that period, reaching a peak just after the May FOMC meeting. Long-term Treasury yields, in contrast, remained below their levels from earlier in the year, as market participants became increasingly convinced that the supply of those securities would shrink considerably in coming years and incorporated a "scarcity premium" into their prices. By mid-May, with the rapid expansion of economic activity showing few signs of letting up, rates on federal funds and Eurodollar futures, which can be used as a rough gauge of policy expectations, were indicating that market participants expected additional policy tightening going forward. Signs of a slowdown in the growth of aggregate demand began to appear in the incoming data soon after the May FOMC meeting and continued to gradually accumulate over subsequent months. In response, market participants became increasingly convinced that the FOMC would not have to tighten its policy stance further, which was reflected in a flattening of the term structure of rates on federal funds and Eurodollar futures. Later in the year, participants began to incorporate expectations of significant policy easing into asset prices, and most interest rates fell sharply over the last several months of 2000 and into 2001. The two-year Treasury yield dropped more than a full percentage point from mid-November to early January, moving

below the thirty-year yield for the first time since early 2000. Stock markets had another volatile year in 2000. After touching record highs in March, stock prices turned lower, declining considerably over the last four months of the year. On balance, the broadest stock indexes fell more than 10 percent last year, and the tech-heavy NASDAQ was down nearly 40 percent.

In 2001, the economy turned in its weakest performance in a decade. With few indications that economic conditions were about to improve, with underlying inflation moderate and edging lower, and with inflation expectations well contained, the Federal Reserve continued its efforts to counter the ongoing weakness by cutting the federal funds rate, bringing the cumulative reduction in that rate to 3 percentage points by August. The devastating events of September 11 further set back an already fragile economy. The economic fallout of the events of September 11 led the Federal Open Market Committee (FOMC) to cut the target federal funds rate after a conference call early the following week and again at each meeting through the end of the year. In total, the number of Fed rate cuts reached 11.

Short-term market interest rates moved down with the FOMC's cumulative cut in the target federal funds rate of 4.75 percentage points, and yields on intermediate-term Treasury securities declined almost 2 percentage points. Longer-term interest rates had already fallen in the latter part of 2000, when investors began to anticipate significant policy easing in response to weakening economic growth. The exceptional volatility of equity prices in 2001 likely reflected the dramatic fluctuations in investors' assessment of the outlook for the economy and corporate earnings.

In 2002, the US economy extended the upturn in activity that began in late 2001. The recovery was supported by accommodative monetary and fiscal policies. Although economic performance appeared to be gradually improving, the tentative nature of this improvement warranted the continuation of a highly accommodative stance of monetary policy. Accordingly, the FOMC held the federal funds rate at 1.75 percent through the first part of the year. In March, however, the FOMC shifted from an assessment that the risks over the foreseeable future to its goals of maximum sustainable growth and price stability were tilted toward economic weakness to an assessment that the risks were balanced. In

August, the FOMC adjusted its weighting of risks toward economic weakness, and in November, it reduced the targeted federal funds rate 50 basis points, to 1.25 percent. The policy easing allowed the Committee to return to an assessment that the risks to its goals were balanced.

Developments in financial markets in 2002 were shaped importantly by sharp declines, on net, in equity prices and most long-term interest rates and by periods of heightened market volatility. Over the spring and summer, accounting scandals, widespread warnings about near-term corporate profitability, and heightened geopolitical tensions intensified the slide in stock prices.

Reflecting an unchanged stance of monetary policy over most of last year, short-term market interest rates moved little until early November. Yields on intermediate- and long-term Treasury securities, by contrast, declined as much as 1.5 percentage points, on net, in 2002.

The economic expansion in the US gathered strength during 2003 while price inflation remained quite low. Interest rates fell for most of the first half of 2003, primarily in response to continuing weak economic data and an associated marking down of expectations for the federal funds rate. Global uncertainty ran high, particularly surrounding the timing of military intervention in Iraq, which elevated safe-haven demands and depressed yields on Treasury securities.

At its June meeting, the FOMC provided additional policy accommodation, given that, as yet, it had seen no clear evidence of an acceleration of U.S. economic activity and faced the possibility that inflation might fall further from an already low level. Some investors were reportedly disappointed for the timid reduction and for the statement following this meeting included no mention of "unconventional" monetary policy actions that would be aimed at lowering longer-term yields more directly than through changes in the federal funds rate target alone. As a result, market interest rates backed up, with the move probably amplified by the unwinding of mortgage-related hedging activity. The Chairman's monetary policy testimony in July, and the FOMC's statements at subsequent meetings that noted that policy could remain accommodative for "a considerable period," apparently provided an anchor for the front end of the yield curve.

Equity prices marched up after the first quarter of the year in response to the initiation and swift conclusion of major combat operations in Iraq, positive earnings reports, and -in the second half of the year- a stronger pace of economic growth. Broad equity price indexes ended the year 25 percent to 30 percent higher.

The economic expansion in the United States became increasingly well established in the first half of 2004, but the pace of inflation picked up from its very low rate in 2003. Over the first half of this year, energy prices soared; moreover, inflation in core consumer prices-as measured by the price index for personal consumption expenditures excluding the direct effects of movements in food and energy prices-increased from an exceptionally low rate of 1 percent over the four quarters of 2003 to an annual rate of a little more than 2 percent. With subsequent labor market reports suggesting that hiring was on a stronger track, growth in output continuing at a solid pace, and core consumer price inflation possibly running higher, the FOMC announced in May that it saw the risks to the goal of price stability as having moved into balance. Even so, the Committee stated that it believed that the monetary policy accommodation then in place could be "removed at a pace that is likely to be measured". Given these considerations, the Committee modified the language of its policy statement to gain greater flexibility to firm policy should circumstances warrant. The Committee achieved this added flexibility by removing its assessment that monetary policy would be accommodative for "a considerable period" and instead saying that the Committee could be "patient" in removing its policy accommodation.

Indeed, at its June meeting, the FOMC decided that sufficient evidence was in hand to begin moving the federal funds rate back toward a more neutral setting and raised the federal funds rate 0.25 percentage point to 1.25 percent, a decision that was widely anticipated by market participants. Equity prices changed little, and interest rates rose on balance in response to positive economic news and expectations of a tightening of monetary policy.

APPENDIX D

Gets Approach and Collinearity

This appendix address the fact that the model might suffer from Collinearity. The DGP under analysis includes a set of variables that by definition tend to be collinear. These could be the case for the economic series that are announced in the same day, for example: unemployment rate and change in nonfarm payrolls; CPI and CPI excluding Food and Energy; etc. In these series, surprises in one indicator could mean similar surprises in the other indicator which could raise collinearity problems. Also, by construction the variables tend to be collinear as all the series look like dummies, with a clear majority of zeros and only one non zero either if the surprise is negative or positive.

The proposed solution based on Hendry and Krolzig (2004b) is a subset selection across combinations of candidate variables that are non-collinear, each of these submodels lead to a terminal model. PcGets is not yet programmed to follow all the feasible paths, but as a partial implementation, namely searching once a non-collinear set was imposed, gives the correct answers. Then, the steps to follow are:

(1) introduce subset selection and model selection dividing the surprise series announced in the same day in two groups;
(2) then, run usual regressions, obtain the specific model for both of them;
(3) compare the selected models; e) mix the significant variables in a final model and obtain the nested specific model;
(4) finally, evaluate the nested specific model with the specific model without the procedure.

The above is applied to the analysis of DFF3. First, the economic announcements are divided in two sets to avoid collinearity, according to the date of announcements, isolating variables that are announced on the same day such as for example CPI and CPI ex, U and CNFP, etc. The model selection mechanism are adopted for each subgroup (Table

Appendix 1 and Appendix 3) Then, the terminal models for each subgroup are found (Table Appendix 2 and Appendix 4).

[Insert TABLES APPENDIX 1 TO 4]

For the first and second group 5 economic variables are significant plus the two Fed bias dummies. Then, these terminal models are combined (see Table Appendix 5). The specific model for the nested procedure ends with 9 significant variables (see Table Appendix 6), one more variable (CCON) than in the case of the specific model without subdividing the announcements while the coefficients and the mispecification tests are similar as well.

[Insert TABLES APPENDIX 5 AND 6]

Table Appendix 1: General model of DFF3, 4 – 2016, dividing data set to avoid collinearity. First Group

	Coeff	StdError	t-value	t-prob
Constant	-0.00638	0.00126	-5.064	0
DFF3_1	0.11958	0.02212	5.405	0
DFF3_2	0.05645	0.02204	2.562	0.0105
CPM M	0.00643	0.00315	2.042	0.0413
CCred M	-0.00111	0.00316	-0.353	0.724
UMCon M	0.00248	0.00363	0.684	0.4943
ULC M	0.00351	0.00648	0.541	0.5885
CPI ex M	0.00485	0.00312	1.553	0.1205
DGlt M	0.00345	0.00543	0.636	0.5247
ECI M	0.01647	0.00556	2.961	0.0031
EHS M	0.0033	0.00329	1.005	0.315
EM M	0.00629	0.00651	0.966	0.3339
MBS M	0.00098	0.00316	0.311	0.7555
GDP M	0.00864	0.00614	1.407	0.1595
IMI M	-0.00075	0.00358	-0.21	0.8334
IJC M	-0.00703	0.00158	-4.443	0
IP M	0.00609	0.00315	1.935	0.0531
LI M	0.00084	0.0031	0.272	0.7855
BI M	-0.00138	0.00324	-0.427	0.6698
WI M	0.0008	0.00313	0.254	0.7993
ISM M	0.01758	0.00314	5.599	0
HS M	-0.00129	0.00344	-0.373	0.7088
PF M	0.00515	0.00315	1.635	0.1022
RS-A M	0.00485	0.00499	0.971	0.3318
TVS M	-0.01255	0.00699	-1.797	0.0724
FO M	0.00244	0.00315	0.776	0.4377
AHE M	0.00048	0.00353	0.137	0.8909
CMP M	0.0103	0.00325	3.173	0.0015
U M	-0.01072	0.00308	-3.478	0.0005
AWH M	-0.0011	0.00362	-0.304	0.761
CS M	0.00784	0.00886	0.885	0.3765
NFP M	0.00134	0.00568	0.235	0.814
PPI-FE M	0.00233	0.00316	0.738	0.4605
PI M	0.00411	0.00307	1.339	0.1808
Green	0.00409	0.00708	0.578	0.5636
Tighter	0.00645	0.00171	3.778	0.0002
Symetric	0.00723	0.00167	4.328	0

RSS	1.74786	**sigma**	0.02974	**R^2**	0.092	**Radj^2**	0.07546
LogLik	7094.808	**AIC**	-7.01223	**HQ**	-6.9744	**SC**	-6.90916
T	2013	**p**	37	**FpNull**	0	**FpConst**	0

	value	prob	alpha
Chow(1010:1)	1.9419	0	0
Chow(1815:1)	0.6037	1	0.01
normality test	2807.4643	0	0
AR 1-4 test	1.049	0.3804	0.01
ARCH 1-4 test	8.0904	0	0
hetero test	2.7099	0	0

Source: Own elaborations, based on data from PcGets

Table Appendix 2: Specific model of DFF3, 4 – 2016, dividing data set to avoid collinearity First Group

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.00635	0.00124	-5.102	0	0	0	1
DFF3_1	0.12016	0.02194	5.476	0	0	0	1
DFF3_2	0.0589	0.02188	2.692	0.0072	0.0112	0.0002	1
ECI M	0.01533	0.00553	2.773	0.0056	0.0012	0.0202	1
IJC M	-0.00691	0.00157	-4.404	0	0	0	1
ISM M	0.01816	0.00313	5.807	0	0	0	1
CMP M	0.01066	0.00319	3.342	0.0008	0.0003	0.0004	1
U M	-0.01066	0.00306	-3.483	0.0005	0.002	0.0003	1
Tighter	0.00655	0.0017	3.863	0.0001	0	0 0005	1
Symetric	0.00732	0.00166	4.421	0	0	0	1

RSS	1.77337	**sigma**	0.02975	**R^2**	0.07875	**Radj^2**	0.07461
LogLik	7080.2249	**AIC**	-7.02457	**HQ**	-7 01434	**SC**	-6.99671
T	2013	**p**	10	**FpNull**	0	**FpGUM**	0.37014

	value	prob
Chow(1815:1)	0.6016	1
AR 1-4 test	0.8408	0.4992

Source: Own elaborations, based on data from PcGets

Table Appendix 3: General model of DFF3, 4 – 2016, dividing data set to avoid collinearity. Second Group

	Coeff	StdError	t-value	t-prob
Constant	-0.00569	0.00124	-4.575	0
DFF3_1	0.13443	0.02187	6.148	0
DFF3_2	0.0562	0.02192	2.564	0.0104
Ccon M	0.00786	0.00317	2.479	0.0133
CPI M	0.00215	0.00311	0.692	0.4889
CU M	0.00714	0.00313	2.282	0.0226
DGO M	-0.00084	0.00334	-0.253	0.8004
GDP PD M	0.00169	0.00614	0.274	0.7837
ISM NM M	0.01424	0.00365	3.902	0.0001
ISM M	-0.00627	0.00419	-1.495	0.1352
CNFP M	0.02056	0.00309	6.664	0
NHS M	0.00359	0.0034	1.056	0.2912
BP M	0.00284	0.00556	0.51	0.6099
PPI M	-0.00263	0.00336	-0.782	0.4345
ARS M	0.00871	0.00488	1.785	0.0743
DVS M	-0.00345	0.00377	-0.916	0.3597
TB M	-0.01109	0.00312	-3.555	0.0004
PS	0.00557	0.00328	1.696	0.09
Green	0.00451	0.00708	0.638	0.5238
FOMC M	0.0149	0.00397	3.754	0.0002
Tighter	0.00579	0.0017	3.415	0.0006
Symetric	0.00627	0.00166	3.781	0.0002

RSS	1.75467	**sigma**	0.02969	**R^2**	0.08847	**Radj^2**	0.07885
LogLik	7090.8947	**AIC**	-7.02324	**HQ**	-7.00075	**SC**	-6.96196
T	2013	**p**	22	**FpNull**	0	**FpConst**	0

	value	prob	alpha
Chow(1010:1)	1.9602	0	0
Chow(1815:1)	0.6475	0.9999	0.01
normality test	2570.1094	0	0
AR 1-4 test	0.2044	0.936	0.01
ARCH 1-4 test	9.1793	0	0
hetero test	8.0983	0	0

Source: Own elaborations, based on data from PcGets

Table Appendix 4: Specific model of DFF3, 4 – 2016, dividing data set to avoid collinearity. Second Group

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.0057	0.00124	-4.61	0	0	0	1
DFF3_1	0.13675	0.02184	6.261	0	0	0	1
DFF3_2	0.05483	0.02192	2.501	0.0125	0.0275	0.0004	0.3
Ccon M	0.00799	0.00317	2.519	0.0119	0.0138	0.0023	0.6
ISM NM M	0.01414	0.00365	3.87	0.0001	0	0	1
CNFP M	0.02062	0.00309	6.671	0	0	0	1
TB M	-0.01071	0.00312	-3.436	0.0006	0	0.0003	1
FOMC M	0.01491	0.00398	3.748	0.0002	1	0.0001	0.4
Tighter	0.0059	0.00169	3.483	0.0005	0	0.0016	1
Symetric	0.00629	0.00166	3.798	0.0002	0	0.0002	1

RSS	1.77111	**sigma**	0.02974	**R^2**	0.07993	**Radj^2**	0.07579
LogLik	7081.5075	**AIC**	-7.02584	**HQ**	-7.01561	**SC**	-6.99798
T	2013	**p**	10	**FpNull**	0	**FpGUM**	0.09823

	value	prob
Chow(1815:1)	0.625	1
AR 1-4 test	0.3043	0.8752

Source: Own elaborations, based on data from PcGets

Table Appendix 5: General model of DFF3, 4 – 2016, dividing data set to avoid collinearity. Specific models 1 and 2 nested

	Coeff	StdError	t-value	t-prob
Constant	-0.00611	0.00123	-4.984	0
DFF3_1	0.12744	0.02163	5.893	0
DFF3_2	0.05099	0.0216	2.361	0.0183
Ccon M	0.00716	0.00314	2.282	0.0226
ISM NM M	0.01477	0.0036	4.101	0
ISM M	0.01774	0.00308	5.768	0
IJC M	-0.00687	0.00154	-4.452	0
ECI M	0.01405	0.00546	2.573	0.0102
CNFP M	0.01668	0.00323	5.157	0
TB M	-0.01088	0.00306	-3.549	0.0004
U M	-0.00912	0.00304	-3.001	0.0027
CMP M	0.00593	0.00331	1.793	0.0732
FOMC M	0.01491	0.00391	3.812	0.0001
Tighter	0.00638	0.00167	3.821	0.0001
Symetric	0.00678	0.00163	4.15	0

RSS	1.70877	**sigma**	0.02924	**R^2**	0.11231	**Radj^2**	0.10609
LogLik	7117.5754	**AIC**	-7.05671	**HQ**	-7.04137	**SC**	-7.01492
T	2013	**p**	15	**FpNull**	0	**FpConst**	0

	value	prob	alpha
Chow(1010:1)	1.8777	0	0
Chow(1815:1)	0.6161	1	0.01
normality test	2990.6991	0	0
AR 1-4 test	0.2233	0.9255	0.01
ARCH 1-4 test	7.8807	0	0
hetero test	10.704	0	0

Source: Own elaborations, based on data from PcGets

Table Appendix 6: Nested Specific model of DFF3, 4 – 2016, dividing data set to avoid collinearity.

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.00631	0.00122	-5.168	0	0	0	1
DFF3_1	0.13124	0.02153	6.094	0	0	0	1
DFF3_2	0.05094	0.02161	2.357	0.0185	0.0448	0.0009	0.3
Ccon M	0.00714	0.00314	2.274	0.023	0.0121	0.0046	0.6
ISM NM M	0.01452	0.0036	4.034	0.0001	0	0	1
ISM M	0.01797	0.00307	5.846	0	0	0	1
IJC M	-0.00688	0.00154	-4.458	0	0	0	1
ECI M	0.01405	0.00546	2.571	0.0102	0.001	0.0455	0.3
CNFP M	0.0185	0.00307	6.021	0	0	0	1
TB M	-0.01085	0.00307	-3.54	0.0004	0	0.0002	1
U M	-0.00903	0.00304	-2.972	0.003	0.022	0.0004	1
FOMC M	0.0149	0.00391	3.809	0.0001	1	0	0.4
Tighter	0.00653	0.00167	3.917	0.0001	0	0.0001	1
Symetric	0.00693	0.00163	4.249	0	0	0	1

RSS	1.71151	**sigma**	0.02926	**R^2**	0.11088	**Radj^2**	0.1051
LogLik	7115.9576	**AIC**	-7.05609	**HQ**	-7.04178	**SC**	-7.01709
T	2013	**p**	14	**FpNull**	0	**FpGUM**	0.07315

	value	prob
Chow(1815:1)	0.6212	1
AR 1-4 test	0.1505	0.9628

Source: Own elaborations, based on data from PcGets