THE IMPACT OF NEWS ON FED FUNDS FUTURES' IMPLICIT INTEREST RATES

Daniel G. Braberman
(Cass Business School, London, U.K.)

Giovanni Urga[1]
(Cass Business Scholl, London, U.K.)

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Abstract

We analyse the daily variation of 8 FED funds future contracts implicit rates from end-1996 to mid-2003. As fundamentals are already priced in, we focus our analysis in surprises. The exogenous variables are series of surprises of 47 economic indicators. The main inputs of surprises are the actual economic release and the median estimate surveyed by Bloomberg News. The final model specification is selected using PcGets, an automated model selection embodying the general-to-specific (Gets) econometric modelling approach. PcGets is particularly suitable to deal with theory restrictions and problems posed by collinear data when a large number of variables are available for estimation. This calls for an appropriate formulation, estimation and evaluation of model specification. The main findings are that the significant economic surprises are those related to 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.

J.E.L. Classification Numbers: *E43, E44, G14, C10.*
Keywords: *Macro Announcements, Term Structure, General-to-Specific Modelling.*

[1] Corresponding author: Faculty of Finance, Cass Business School, 106 Bunhill Row, London EC1Y 8TZ (U.K.). e-mail: g.urga@city.ac.uk.

1. Introduction

A key question on financial economics is how news about fundamentals are incorporated into asset prices. The evaluation of the impact of the effects of 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 Management in general. Moreover, a further understanding of price movements (especially jumps in prices) and fundamentals could further broaden the usage of Economic Derivatives (derivatives whose underlying are economic statistics, Deutsche Bank and Goldman Sachs, 2002).

The purpose and contribution of this paper is to broaden the knowledge of the impact of news over Federal Reserve (Fed) funds' interest rate expectations, ie. Fed funds futures contracts' implicit rates. To our knowledge, far fewer 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.

We first evaluate 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, we focus our analysis in surprises. The election of the appropriate model is discussed and ultimately creates a methodological reason for the use of a new econometric tool: PcGets. Our research paths follow the building blocks of PcGets and enable us to handle the complexity of the models.

We want to highlight that a novelty in relation with prior studies is that different authors' databases are built considering only expansionary years for the global economy. Our database frame makes us available to cope both expansionary years and recessionary ones (bull and bear markets). This will ultimately add new insight into the effect of news on good and bad years, which has not been addressed by the literature.

The paper is organized as follows. In Section 2 we present a review of the literature on the micro effects of macro announcements. In Section 3 we introduce the definition and different features of the Fed funds future contracts, and in Section 4 a similar analysis is performed for the economic announcements and surprises. In Section 5 we discuss the appropriate econometric model and in Section 6 we draw on the necessity of the use of PcGets; a methodological description of the program and our intensive use of it are outlined. Last, Section 7 offers the conclusions including a summary of the results and policy analysis.

2. Literature on micro effect of macro announcements

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, Monticelli, Pericoli and Tivegna, 2002). The literature focuses 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) (Fornari, Monticelli, Pericoli and Tivegna, 2002).

The literature addresses the effects of news in two related directions: the first concentrates on the direction of first moments changes (conditional mean) and the second one, focus on second moments (volatility).

The effects of news arrivals on the bond market document a significant price impact from numerous macroeconomic announcements, including money supply, industrial production, PPI, CPI, unemployment rate, and non-farm payroll employment numbers (Fleming and Remolana, 1997 and references therein; Fleming and Remolana, 1999; Christiansen, 2000; Hardouvelis, 1988; Hedison, 1996; Kuttner, 2000; Rolley and Selon, 1998; Haldane and Read, 2000, Fornari, Monticelli, Pericoli and Tivegna, 2002, Bruno, Mancini, Resnati, Spinelli, Zorzoli and Urga, 2002,

Chaudhry, Ramchander and Simpson, 2003). A large number of such studies investigate the impact of macro news announcements on foreign exchange rates (Andersen and Bollerslev, 1998; Andersen, Bollerslev, Diebold and Vega, 2002, Hand, Holthausen and Leftwich, 1992; Gelati and Ho, 2001 and references therein, Evans and Lyons, 2003). 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, 2003). Andersen, Bollerslev, Diebold and Vega (2002) find that conditional mean adjustments occur rapid, effectively amounting to jumps, in contrast to conditional variance adjustments, which are much more gradual. In the same line, Andersen *et al*. and Bruno *et al* stress that earlier economic announcements have more effect than later ones. Though not entirely analyzed, this later study states that the adjustment response pattern is characterized by a sign effect: bad news has greater impact than good news.

Numerous studies analyze the effect of new information about fundamentals on stock market prices (Mc Queen and Roley, 1993, Hardouvelis 1987). 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 (Fleming and Remolana, 1997). Interestingly, McQueen *et al* (1996) and Nofsinger (2001) suggest that investors tend to react quickly to bad macroeconomic news in the trading of small and large firms, on the contrary react quickly in only large firms to good news.

3. 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), 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 (table 1).

Table 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

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.

Many literature (CBOT web page) 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.

The Fed fund futures contract data was collected from Bloomberg which uses data of the Chicago Board of Trade. The following contracts are used:

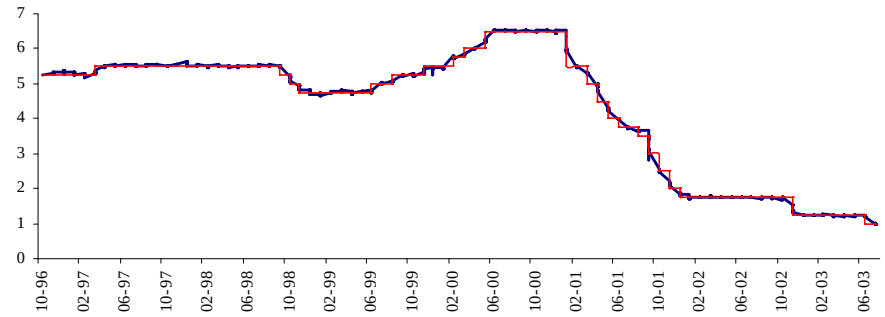
- Generic 1st Fed funds Future (FF1)
- Generic 2nd Fed funds Future (FF2)
- Generic 3rd Fed funds Future (FF3)
- Generic 4th Fed funds Future (FF4)
- Generic 5th Fed funds Future (FF5)
- Generic 6th Fed funds Future (FF6)

- Generic 7th Fed funds Future (FF7)
- Generic 8th 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 nth contract prices. Contract months are rolled on a given day. We also use the US Fed funds Effective rate and the Fed funds target rate.

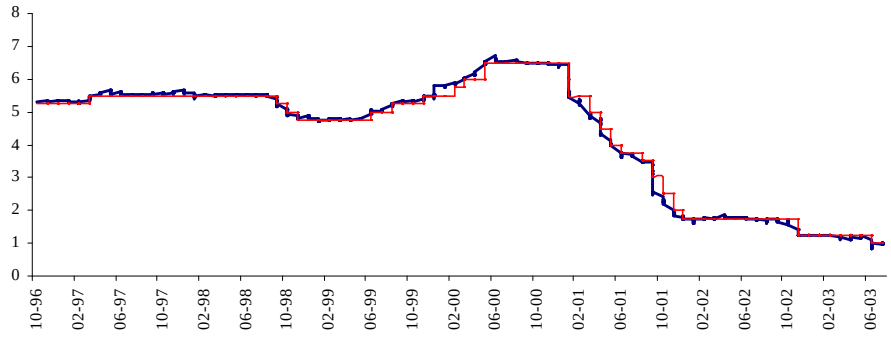
In general, the Fed funds contracts rates tend to follow the evolution of the Fed funds target rate. Specially, the longer the maturity of the contract the higher it granger cause the Fed fund target rate (Graphs 1-9).

Graph 1: Fed funds Futures Contract FF1 vs. Fed funds Target



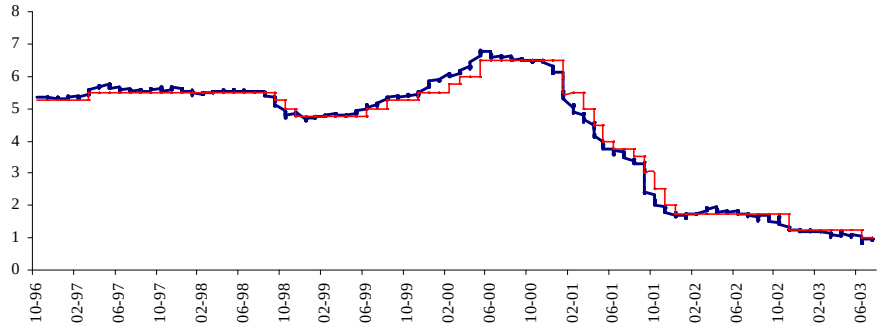
Source: Bloomberg

Graph 2: Fed funds Futures Contract FF2 vs. Fed funds Target



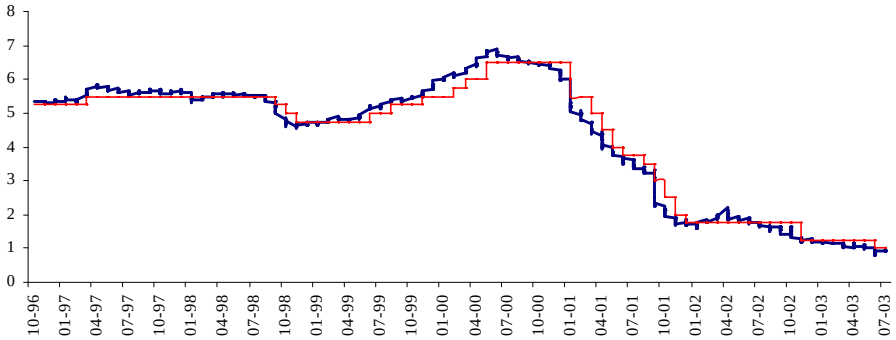
Source: Bloomberg

Graph 3: Fed funds Futures Contract FF3 vs. Fed funds Target



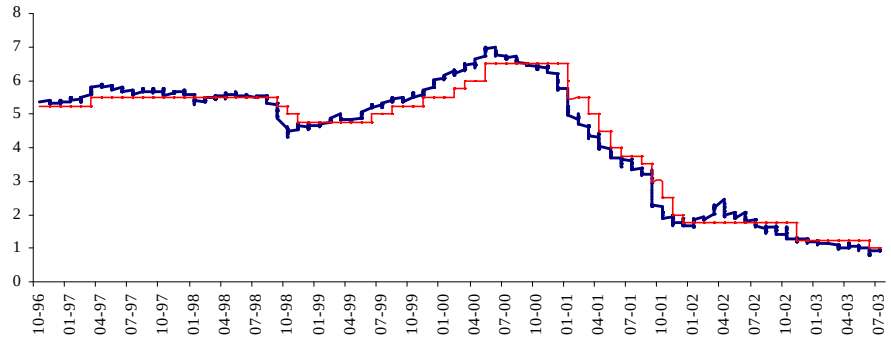
Source: Bloomberg

Graph 4: Fed funds Futures Contract FF4 vs. Fed funds Target



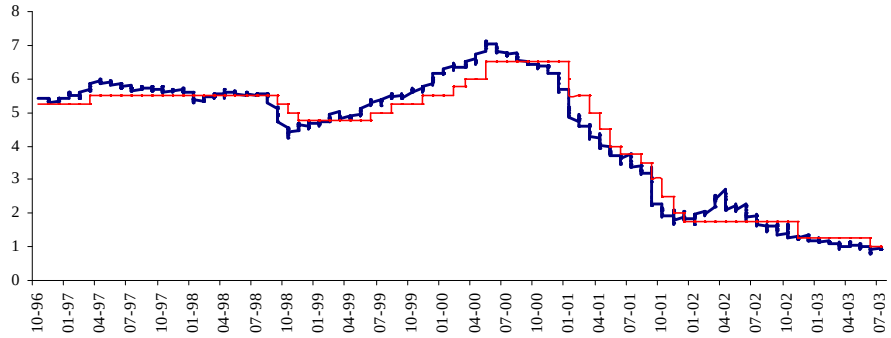
Source: Bloomberg

Graph 5: Fed funds Futures Contract FF5 vs. Fed funds Target



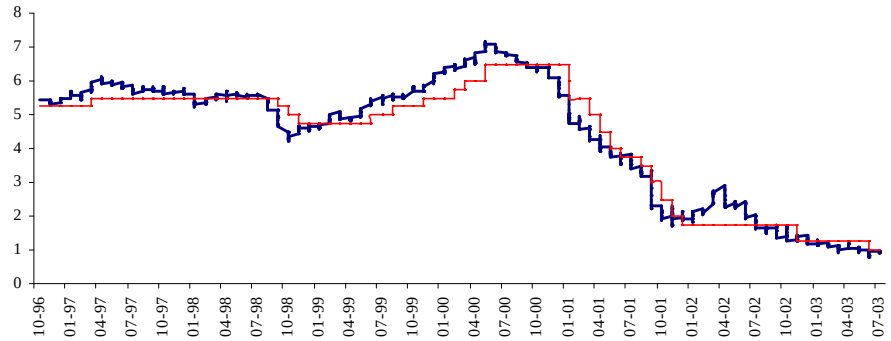
Source: Bloomberg

Graph 6: Fed funds Futures Contract FF6 vs. Fed funds Target



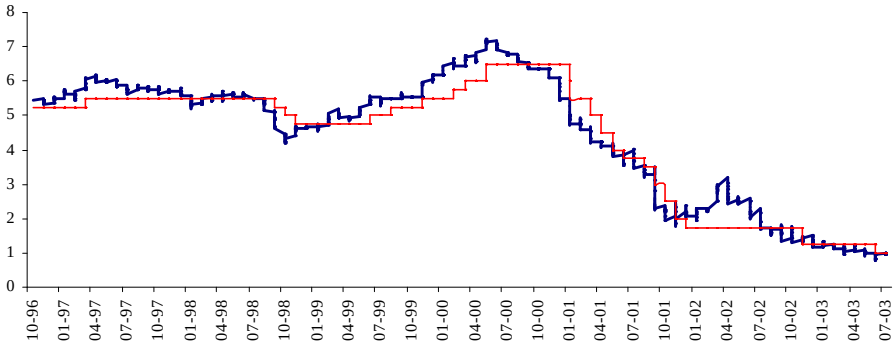
Source: Bloomberg

Graph 7: Fed funds Futures Contract FF7 vs. Fed funds Target



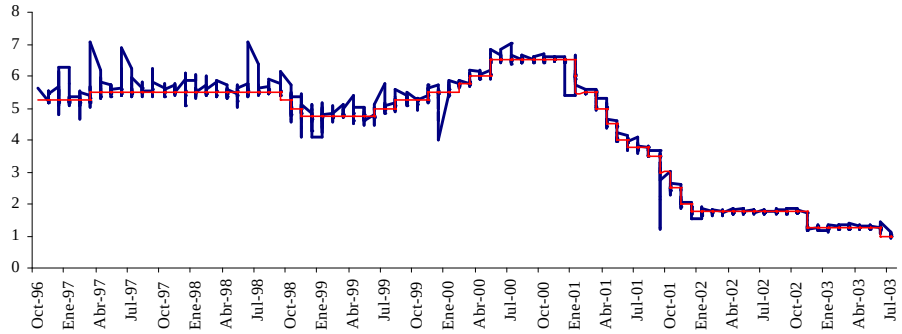
Source: Bloomberg

Graph 8: Fed funds Futures Contract FF8 vs. Fed funds Target



Source: Bloomberg

Graph 9: Fed funds effective rate vs. Fed funds Target



Source: Bloomberg

Table 2 shows the standard deviation and correlations of yield changes over daily intervals for Fed funds future contracts from January 1996 to July 2003. First, we find that volatility varies across different contracts. The standard deviation declines from 3.6bps of the first contract till 3.2 of the fourth one, and then increases to a high of 5.2bps for FF8. The volatility of the Fed funds Effective rate is much higher (21.4bps) as it moves in a discrete fashion as it is the Fed's control variable. In contrast, the Fed funds future contracts move in relation to market expectation on Fed's future moves.

Second, changes in yields on Fed funds contract implicit rates of different maturity sectors were imperfectly correlated. As expected, the correlations were highest for nearby contracts, such as FF5 and FF6, and lowest 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.

Table 2: Standard deviations and correlations of daily yield changes for Fed funds Future Contracts and Fed funds Effective Rate from 1996 to mid 2003

96-03	FF1	FF2	FF3	FF4	FF5	FF6	FF7	FF8	FED
Standard Deviation	3.6	3.4	3.2	3.6	4.0	4.4	4.9	5.2	21.4
Correlation with									
FF1	1								
FF2	0.66	1							
FF3	0.58	0.80	1						
FF4	0.42	0.78	0.87	1					
FF5	0.35	0.66	0.84	0.92	1				
FF6	0.24	0.58	0.77	0.88	0.94	1			
FF7	0.19	0.50	0.71	0.82	0.90	0.94	1		
FF8	0.09	0.38	0.59	0.71	0.80	0.85	0.90	1	
FED	0.06	0.02	0.10	0.06	0.10	0.07	0.07	0.07	1

Source: Bloomberg

If we consider the volatility per year (Tables 3-10) 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.

Table 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: Bloomberg

Table 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: Bloomberg

Table 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: Bloomberg

Table 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: Bloomberg

Table 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: Bloomberg

Table 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: Bloomberg

Table 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: Bloomberg

Table 10: Standard deviations and correlations of daily yield changes for Fed funds Future Contracts and Fed funds Effective Rate from January 2003 to July 2003

	FF1	FF2	FF3	FF4	FF5	FF6	FF7	FF8	FED
Standard Deviation	2.0	2.3	2.4	2.5	2.7	2.8	3.2	3.7	6.6
Correlation with									
FF1	1								
FF2	0.40	1							
FF3	0.34	0.84	1						
FF4	0.23	0.79	0.94	1					
FF5	0.16	0.69	0.90	0.94	1				
FF6	0.09	0.60	0.82	0.89	0.97	1			
FF7	0.02	0.53	0.74	0.82	0.92	0.97	1		
FF8	0.00	0.43	0.66	0.76	0.88	0.93	0.95	1	
FED	0.41	0.09	0.08	0.06	0.09	0.09	0.08	0.06	1

Source: Bloomberg

On October 15 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. We will follow Kuttner (2000) approach changing the Fed policy move to October 16 1998.

4. Economic Announcements

We used Bloomberg data source in order to report the US economic announces. At the same time, Bloomberg allows building the surprises, getting both the macroeconomic series and their surveys. Specially, 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. In table 11 we present 47 economic statistics, with its name, the reference that we will use in the econometric

analysis, the date when Bloomberg started doing either Median or Average surveys and the total number of observations in our sample.

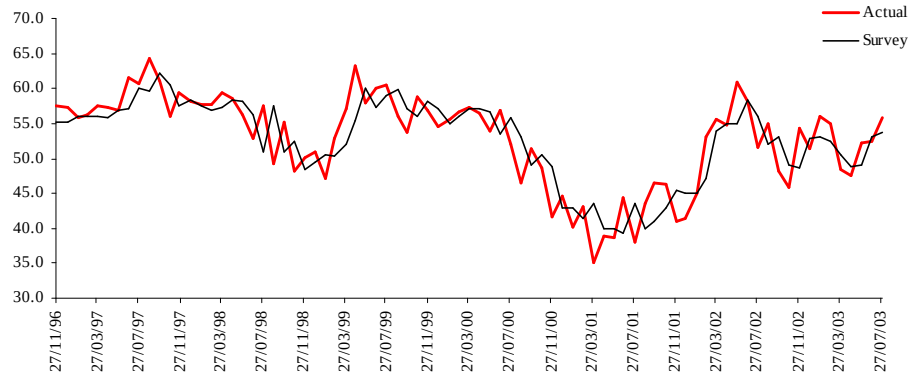
Table 11: Economic statistics surveys

Economic Announcement	Reference	Bn Avge Survey	Obs.	Bn Median survey	Obs.	Frequency
CHICAGO PURC. MANAGER	CPM M	30/06/1998	62	30/11/1996	81	monthly
CONSUMER CREDIT	CCred M	30/06/1998	62	30/09/1996	80	monthly
U OF MICHIGAN CONFIDENCE	UMCon S	31/05/1999	51	31/05/1999	51	monthly
UNIT LABOR COSTS	ULC M	31/03/1999	17	31/03/1999	17	quarterly
CPI MOM	CPI M	31/05/1998	61	30/11/1996	80	monthly
CAPACITY UTILIZATION	CU M	31/05/1998	60	31/12/1996	80	monthly
CPI EX FOOD & ENERGY	CPI ex M	31/05/1998	61	31/12/1996	78	monthly
DURABLE GOODS ORDERS	DGO M	31/05/1998	62	31/10/1997	69	monthly
DURABLE GOODS - TRANSP.	DGlt M	30/11/2001	20	30/11/2001	20	monthly
EMPLOYMENT COST INDEX	ECI M	30/06/1998	21	28/01/1997	27	quarterly
EXISTING HOME SALES	EHS M	30/04/1997	61	30/09/1996	70	monthly
EMPIRE MANUFACTURING	EM M	30/11/2002	8	30/11/2002	8	monthly
MONTHLY BUDG. STATE.	MBS M	31/05/1998	57	31/10/1996	80	monthly
GDP PRICE DEFLACTOR	GDP PD M	31/03/1997	23	31/03/1997	24	quarterly
GDP	GDP M	30/09/1997	25	31/12/1996	27	monthly
IMPORT PRICE INDEX MOM	IMI M	31/07/1998	57	31/07/1998	57	monthly
INITIAL JOBLESS CLAIMS	IJC M	29/05/1998	258	28/03/1997	306	weekly
INDUSTRIAL PRODUCTION	IP M	30/04/1998	62	31/10/1996	80	monthly
LEADING INDICATORS	LI M	30/04/1998	63	30/11/1996	78	monthly
BUSINESS INVENTORIES	BI M	31/05/1998	62	31/05/1997	73	monthly
WHOLESALE INVENTORIES	WI M	30/06/1998	60	30/09/1996	79	monthly
ISM NON MANUFACTURING	ISM NM M	31/12/1998	53	31/12/1998	54	monthly
ISM MANUFACTURING	ISM M	31/05/1998	62	31/10/1996	80	monthly
ISM PRICES PAID	ISM PP M	30/06/2000	37	30/06/2000	37	monthly
CHANGE NONF. PAYROLLS	CNFP M	31/05/1998	63	31/12/1996	78	monthly
NEW HOMES SALES	NHS M	30/09/1996	63	30/09/1996	74	monthly
BUILINDG PERMITS	BP M	31/07/2002	12	31/07/2002	12	monthly
HOUSING STARTS	HS M	31/05/1998	62	01/02/1998	65	monthly
PHILADELPHIA FED	PF M	30/06/1998	61	31/12/1996	75	monthly
PPI INDEX MOM	PPI M	31/05/1998	62	30/11/1997	68	monthly
ADVANCE RETAIL SALES	ARS M	31/05/2001	26	31/05/2001	26	monthly
RETAIL SALES LESS AUTOS	RS-A M	31/05/2001	26	31/05/2001	26	monthly
DOMESTIC VEHICLE SALES	DVS M	30/06/1999	47	30/06/1999	48	monthly
TOTAL VEHICLE SLES	TVS M	31/12/2002	7	31/12/2002	7	monthly
FACTORY ORDERS	FO M	30/04/1998	62	30/09/1996	81	monthly
AVERAGE HOURLY EARNINGS	AHE M	30/06/1998	61	30/06/1998	61	monthly
CHAN. MANUF. PAYROLLS	CMP M	31/9/1998	54	31/12/1998	55	31/9/1998
TRADE BALANCE	TB M	30/04/1998	62	31/10/1996	80	monthly
UNEMPLOYMENT RATE	U M	30/06/1998	62	30/11/1996	78	monthly
AVERAGE WEEKLY HOURS	AWH M	31/01/1999	53	31/01/1999	53	monthly
CONSTRUCTION SPENDING	CS M	31/08/1998	58	31/08/1998	58	monthly
CONSUMER CONFIDENCE	CC M	30/06/1998	61	28/02/1997	77	monthly
NON FARM PRODUCTIVITY	NFP M	31/03/1998	21	31/12/1997	22	quarterly
PPI EX FOOD & ENERGY	PPI-FE M	31/05/1998	62	30/11/1996	80	monthly
PERSONAL SPENDING	PS M	31/05/1998	62	31/12/1996	77	monthly
PERSONAL INCOME	PI M	31/05/1998	62	30/09/1996	81	monthly
FOMC RATE EXPECTED	FOMC M	22/12/1998	37	20/05/1997	49	-

Source: Bloomberg

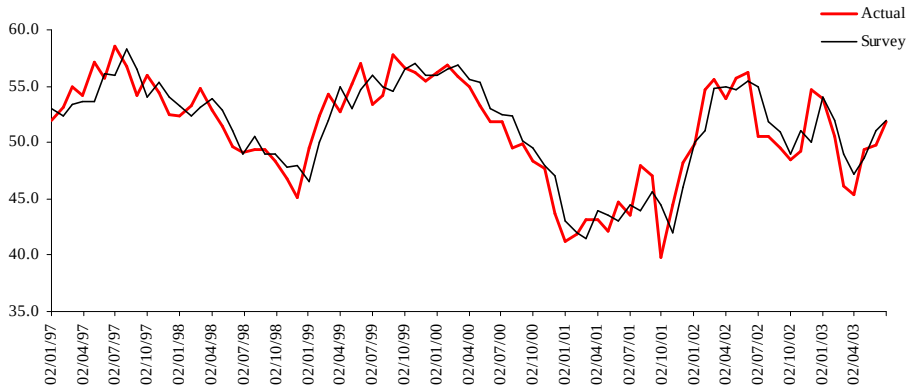
In order to allow a graphic representation of some of the economic announcements and their median survey we present the graphs of: Chicago Purchasing Manager, ISM Manufacturing, Industrial Production, Initial Jobless Claims, Durable Goods Orders, Change in Nonfarm Payrolls, Advanced Retail Sales, Domestic Vehicle Sales, Unemployment, Personal Spending and Personal Income (Graphs 10-20).

Graph 10: Chicago Purch. Manager (CPM M), Actual vs. Bn Median Survey



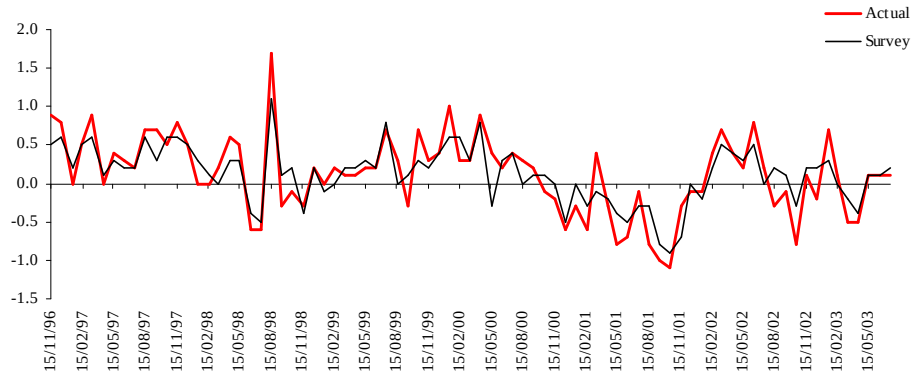
Source: Bloomberg

Graph 11: ISM Manufacturing (ISM M), Actual vs. Bloomberg Median Survey



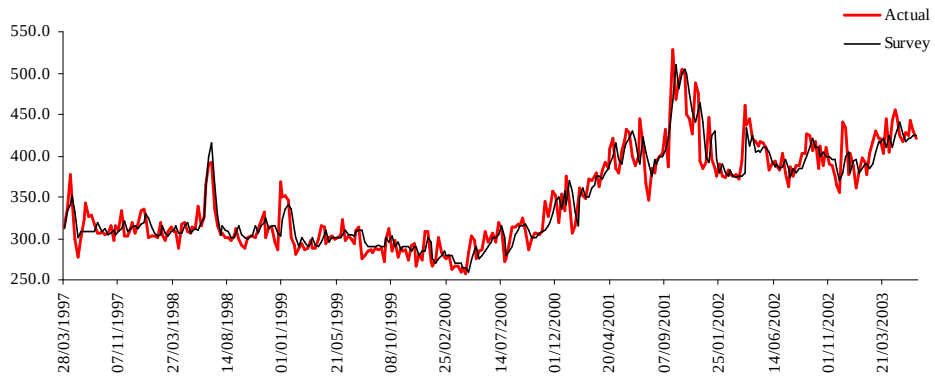
Source: Bloomberg

Graph 12: Industrial Production (IP M), Actual vs. Bloomberg Median Survey



Source: Bloomberg

Graph 13: Initial Jobless Claims (IJC M), Actual vs. Bloomberg Median Survey

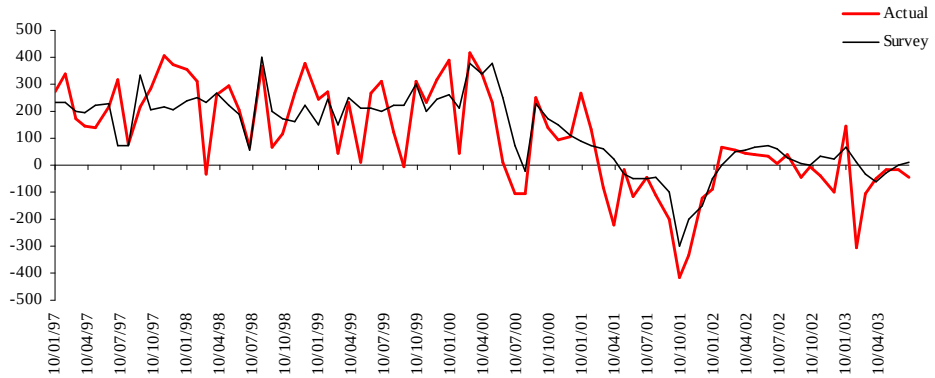


Source: Bloomberg

Graph 14: Durable Goods Orders (DGO M), Actual vs. Bn Median Survey

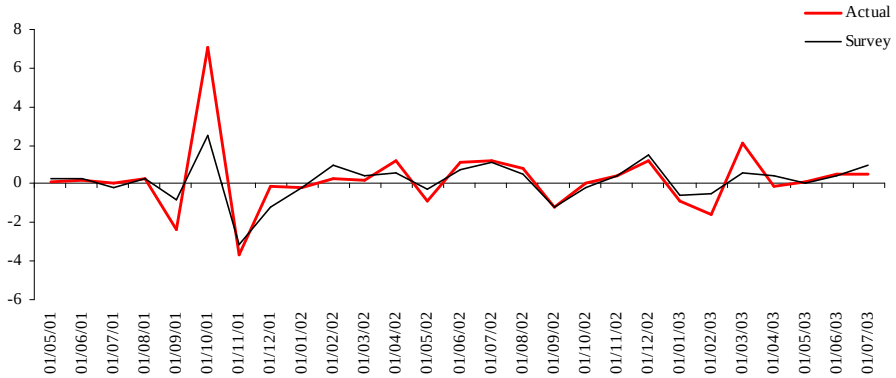
Source: Bloomberg

Graph 15: Change Nonfarm Payrolls (CNFP M), Actual vs. Bn Median Survey



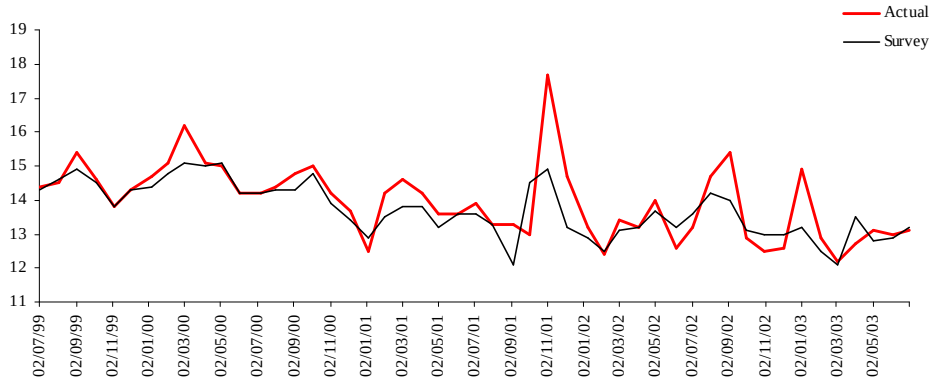
Source: Bloomberg

Graph 16: Advanced Retail Sales (ARS M), Actual vs. Bn Median Survey



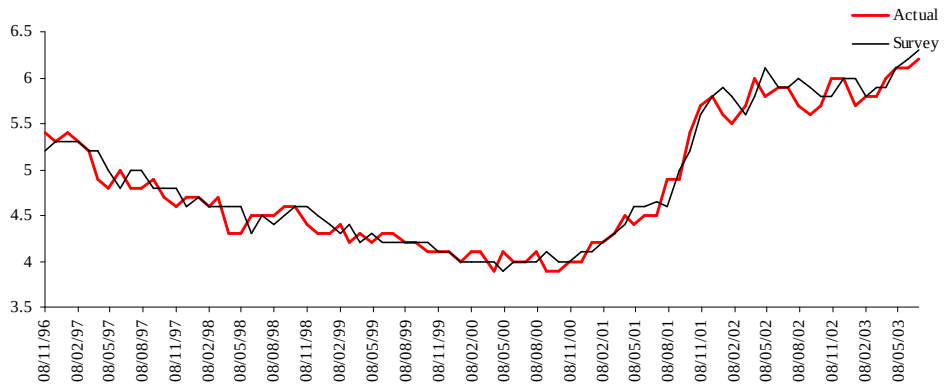
Source: Bloomberg

Graph 17: Domestic Vehicle Sales (DVS M), Actual vs. Bn Median Survey



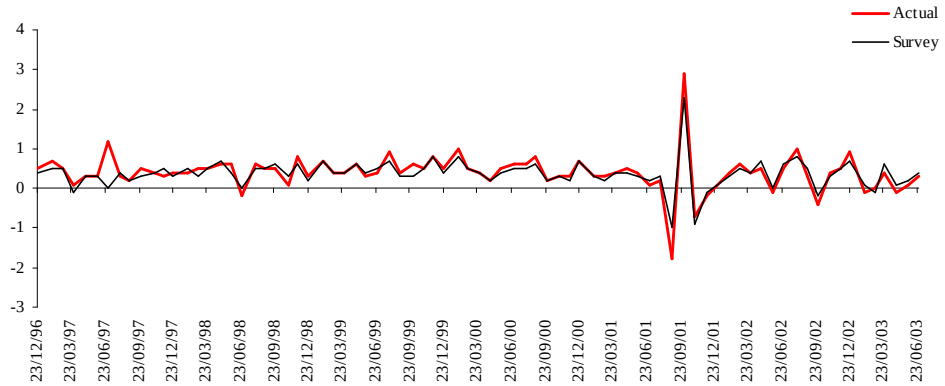
Source: Bloomberg

Graph 18: Unemployment (U M), Actual vs. Bloomberg Median Survey



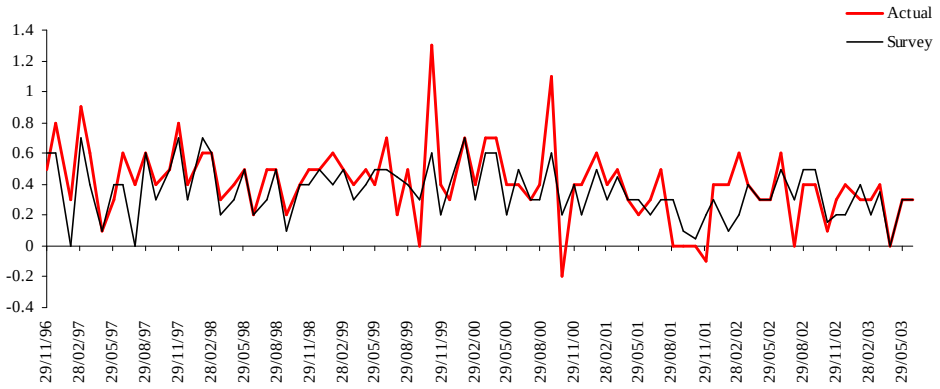
Source: Bloomberg

Graph 19: Personal Spending (PS M), Actual vs. Bloomberg Median Survey



Source: Bloomberg

Graph 20: Personal Income (PI M), Actual vs. Bloomberg Median Survey



Source: Bloomberg

5. The model

We will specify and estimate a model of high-frequency Fed funds future contracts implicit rates dynamics that allows for the possibility of surprises affecting the conditional mean. Our 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, as our database covers different policy periods (from the end of 1996 to mid-2003, tightening and easing, expansion and recession periods), it is interesting to proclaim an objective analysis of the economic statistics that significantly and regularly impact the Fed funds market.

Literature on impact news incorporate alternative econometric techniques, from heteroskedasticity-based identification (Fornari et al, 2002), GMM (Evans and Lyons 2003), a two-step weighted least squares (WLS) procedure (Andersen *et al.*, 2002), three step least square estimation (Bruno *et al.*, 2002). Ramchander *et al.* (2003) examine the impact of announcements on yields in the framework of the cointegration methodology. The essence of a cointegrating relationship is that the variables in the

system share a common unit root process. Nevertheless, in our case, we think that simple OLS analyses suffice our needs, while we devoted more attention to the final specification of the model using a new econometric tool: PcGets.

We decided to model the daily variation of the Fed funds future contracts (FF) in absolute terms. The decision was based on market convention of measuring interest rates changes in basis points. Another alternative way to model the FF is using the spread between the FF and the Fed fund target. However, the conclusions would not differ from our chosen research path. From now on, the daily variation of FF to be modeled is expressed as DFF. The number in the end of each DFF represents the generic FF contract, from 1 to 8.

As discussed above, we start with a linear function of n lagged values of the daily difference of each Fed funds future contract (DFF), and of the news (S) including their lags,

$$DFF_t = b_0 + \sum_{i=1}^{I} b_i DFF_{t-i} + \sum_{k=1}^{K} \sum_{j=0}^{J} b_{kj} S_{k,t-j} + e_t \qquad t = 1,...,T$$

As discussed earlier, K=47 and T=1758. The I and J represent the lags. As we will see later our final models will not include lags. At the same time, in order to capture the different effects of the Fed monetary policy bias three dummies were constructed (Table 12). 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. Then, K=49, while the number of daily data is 1757 as one day is lost due to the difference to construct the first variation in FF.

Table 12: 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

Source: Federal Reserve

As the economic variables have different units of measurement, we follow Andersen *et al* (2002) in using standardized news. That is each news series are constructed dividing the surprise by its sample standard deviation:

$$Surprise_{kt} = \frac{Actual_{kt} - Survey_{kt}}{s_{kt}}$$

The benefit of standardization is that it allows comparing the size of the regression coefficients associated with surprises for all the different announcements (Ramchander, Simpson and Chaudhry, 2003).

In our case, we decided to build two measures of surprise. One uses the Bloomberg average survey and the other takes the Bloomberg median survey. We believe that the variable using the median of the survey conducted by Bloomberg has more economic sense than using the average of the survey, due to the statistical properties of the median. Anecdotal evidence also points out that market participants tend to base their surprise beliefs on the median of analysts.

As a consequence, we will use the surprise using the median of the Bloomberg survey of analysts. We leave the contrast analysis of using the surprise using the survey average and median for future research.

In Table 13 we report 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.

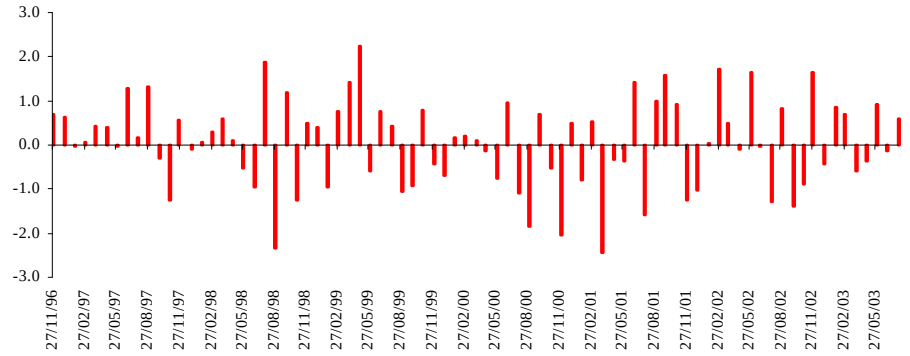
Table 13: Economic statistics' descriptive statistics

Economic Announcement	Max.	Min.	Avge.	s Actual	s Bloomb. Survey Avge.	s Surprise Avge.	s Bloomb. Survey Median	s Surprise Median
CHICAGO PURC. MANAGER	64.3	35.0	52.8	6.6	5.7	3.8	5.8	3.5
CONSUMER CREDIT	19.8	-5.1	6.5	5.4	2.6	5.5	2.4	5.3
U OF MICHIGAN CONFIDENCE	114.0	75.0	95.7	10.4	9.7	2.3	9.7	2.5
UNIT LABOR COSTS	6.3	-5.4	1.5	3.0	2.7	0.5	2.8	0.5
CPI MOM	0.7	-0.3	0.2	0.2	0.2	0.1	0.1	0.1
CAPACITY UTILIZATION	84.4	74.2	79.7	3.3	2.9	0.4	9.4	9.1
CPI EX FOOD & ENERGY	0.4	0.0	0.2	0.1	0.1	0.1	0.1	0.1
DURABLE GOODS ORDERS	12.8	-12.4	0.2	4.0	1.7	3.3	1.7	3.1
DURABLE GOODS - TRANSP.	3.9	-3.1	0.5	1.8	0.8	1.5	0.8	1.5
EMPLOYMENT COST INDEX	1.4	0.4	0.9	0.2	0.1	0.2	0.1	0.2
EXISTING HOME SALES	6.1	-1.5	4.5	1.0	0.3	0.2	1.4	0.3
EMPIRE MANUFACTURING	26.8	-20.4	8.8	14.6	9.6	13.3	10.0	13.4
MONTHLY BUDG. STATE.	189.8	-96.3	2.1	54.0	54.6	4.7	52.4	9.3
GDP PRICE DEFLACTOR	3.3	-0.3	1.6	0.8	0.8	0.2	0.8	0.2
GDP	7.3	-1.3	3.5	2.1	2.2	0.8	2.2	0.7
IMPORT PRICE INDEX MOM	1.5	-2.7	0.0	0.9	0.4	0.5	0.4	0.6
INITIAL JOBLESS CLAIMS	528.0	257.0	345.6	56.5	57.2	20.7	54.6	19.3
INDUSTRIAL PRODUCTION	1.7	-1.1	0.1	0.5	0.4	0.3	0.4	0.3
LEADING INDICATORS	1.2	-0.6	0.1	0.4	0.3	0.2	0.2	0.2
BUSINESS INVENTORIES	0.9	-1.4	0.2	0.4	0.3	0.2	0.3	0.2
WHOLESALE INVENTORIES	1.9	-1.1	0.2	0.6	0.3	0.4	0.3	0.5
ISM NON MANUFACTURING	65.1	40.6	55.5	5.4	4.9	3.5	4.8	3.5
ISM MANUFACTURING	58.6	39.8	51.2	4.5	4.4	1.9	4.2	1.9
ISM PRICES PAID	70	31.6	53.2	10.8	10.0	4.2	10.1	4.2
CHANGE NONF. PAYROLLS	416	-415	104.8	186.4	143.4	99.6	136.8	107.9
NEW HOMES SALES	1160	777	924.9	78.7	61.4	55.1	66.4	55.8
BUILINDG PERMITS	1880	1669	1757.2	61.6	45.7	55.1	45.1	56.6
HOUSING STARTS	2000	1512	1659.8	87.6	70.3	76.6	126.2	129.3
PHILADELPHIA FED	28.2	-36.8	5.1	13.9	12.1	9.3	11.8	9.5
PPI INDEX MOM	1.6	-1.9	0.1	0.6	0.3	0.4	0.3	0.4
ADVANCE RETAIL SALES	7.1	-3.7	0.2	1.8	1.1	1.0	1.0	1.1
RETAIL SALES LESS AUTOS	1.3	-1.6	0.2	0.7	0.2	0.5	0.2	0.5
DOMESTIC VEHICLE SALES	17.7	12.2	14.0	1.1	0.8	2.1	0.8	2.1
TOTAL VEHICLE SLES	18.3	15.4	16.6	0.9	0.5	0.8	0.5	0.9
FACTORY ORDERS	7.1	-7.5	0.2	2.3	2.5	1.4	2.1	0.5
AVERAGE HOURLY EARNINGS	0.7	0	0.3	0.1	0.0	0.1	0.0	0.1
CHAN. MANUF. PAYROLLS	46	-163	-45.9	44.5	28.1	29.7	28.0	30.0
TRADE BALANCE	-7.986	-44.2	-24.7	10.9	8.4	2.1	10.6	2.0
UNEMPLOYMENT RATE	6.2	3.9	4.8	0.7	0.8	0.1	0.7	0.1
AVERAGE WEEKLY HOURS	34.7	33.6	34.3	0.2	0.5	0.4	0.2	0.1
CONSTRUCTION SPENDING	2.7	-2.4	0.3	1.3	0.3	1.2	0.3	1.2
CONSUMER CONFIDENCE	144.7	62.5	118.4	21.2	22.1	4.9	20.4	5.1
NON FARM PRODUCTIVITY	8.6	-1.2	2.9	2.3	2.2	0.5	2.2	0.4
PPI EX FOOD & ENERGY	1	-0.9	0.1	0.3	0.1	0.3	0.1	0.3
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	0.2	0.2	0.2	0.2

Source: Bloomberg

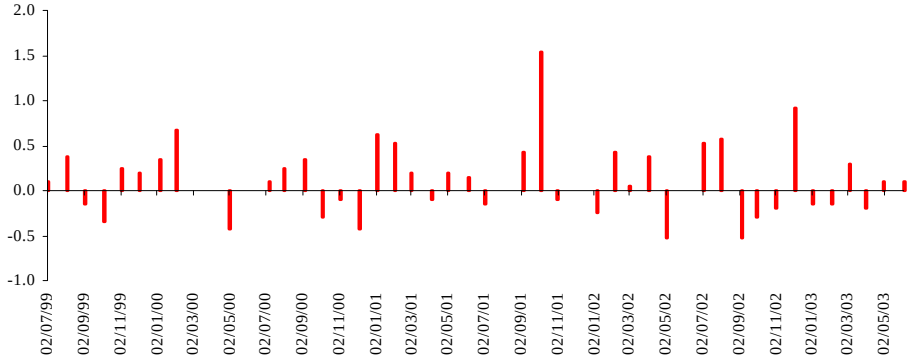
Graphs 21 to 23 present three examples (Chicago Purchasing Manager, Domestic Vehicle Sales and Personal Income) of the surprise variable based on the Bloomberg median survey of economists.

Graph 21: Chicago Purchasing Manager (CPM M), Surprises



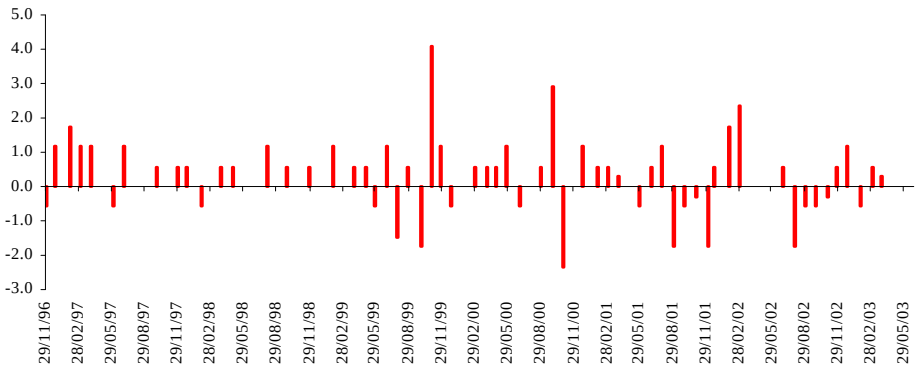
Source: Bloomberg

Graph 22: Domestic Vehicle Sales (DVS M), Surprises



Source: Bloomberg

Graph 23: Personal Income (PI M), Surprises



Source: Bloomberg

In the following section we will address the econometric problems that arise due to the size of the model.

6. Empirical applications and related econometric issues

In this section we will present the methodological issues related to the selection of the model. As commented above, our research task has its own complexities. The amount of endogenous variables (8 Fed funds contracts) and exogenous variables (47 economic announcements plus two Fed monetary policy bias) and 1758 daily values clearly points out to the impossibility to pick up easily a single model from the General Unrestricted Model (GUM).

As a consequence of the above methodological problems, we benefited 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.

In the following pages we will introduce the package relying on Hendry and Krolzig 2001a, Hendry and Krolzig 1999, Hendry 2000 and Hendry and Krolzig 2001b. At the same time we will discuss our own experience with this methodology and the different econometric steps we follow to finally end with the specific models.

6.1. PcGets: A useful tool

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, 3^{rd} and 4^{th} moments), normality tests, unit root tests, graphing and the creation of lags.

The current version is compatible for our underlying model as PcGets deals with models that are linear in variables.

The practical embodiment of the theory of reduction is general-to-specific (Gets) modelling. The former explains how the Data Generation Process (DGP) is reduced

to the local DGP (LDGP), namely the joint distribution of the subset of variables under analysis. The empirical analysis commences from the GUM, after testing for mis-specifications, and if none are apparent, it is simplified to a parsimonious, congruent model, each simplification step being checked by diagnostic testing. Simplification can be done in many ways: and although the goodness of a model is intrinsic to it, and not a property of the selection route, poor routes seem unlikely to deliver useful models. PcGets explores many simplification paths.

According to Hendry and Krolzig 2001a, PcGets is a revolutionary new approach to model building, based on recent advances in the understanding of model selection procedures. Experiments show that PcGets outperforms even the most experienced econometrician.

Extensive Monte Carlo simulations and theoretical analyses have demonstrated the remarkable properties of PcGets in model selection. In Monte Carlo experiments, PcGets recovers the data generation process (DGP) with accuracy close to what one would expect if the DGP specification were known, but nevertheless coefficient tests were conducted. PcGets selects models at least as good as those developed over several years by their authors.

In line with the GiveWin family, model formulation is straightforward, and earlier models can be recalled and revised (Urga 2001). Among the available estimators for linear models are Ordinary Least Squares, Instrumental Variables and their Gets generalizations. The program is strongly focused on graphical information. Output can be analysed graphically. Dynamic model analyses are provided including a calculation of the roots of the lag polynomials. A set of diagnostic tests is evaluated for determining model adequacy, including tests for autocorrelation, various forms of heteroscedasticity including auto-regressive conditional (ARCH) and non-normality. Encompassing tests of non-nested reductions are conducted and tests for omitted variables provided. The PcGets algorithm allows for the necessary flexibility by adjustments to the model settings. Finally, expert user's can define their personalized model selection strategies with help of the options dialog (Hendry and Krolzig 2001a).

6.2. Model Selection and the theory behind

Our analysis will focus on the Automatic model selection feature of the PcGets due to our necessity to simplify our 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. In our case, we decided to rely 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 we would have followed the path of deciding a priori the relevant variables our research would have lost its appeal (Hendry and Krolzig, 2003).

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. The expert strategy allows all the program parameters (namely, significance levels of all the selection criteria) to be designed at choice.

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.

6.3. Our General Unrestricted Model

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, 2001). 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.

In our case, we decided to avoid the GUM with a lag structure. We based our decision on our surprise variables intrinsic features. As the economic announcements do not have daily frequency they are similar to dummy variables as our time frame is daily as our endogenous variables (Fed funds) are reported daily. Due to the easiness of the PcGets tool we run a regression including lags and as expected the model selected did not include the lags. Table 14 shows our initial GUM for DFF1 using OLS.

Table 14: GUM (1) Modelling DFF1 by GETS, 2 - 1758

	Coeff	StdError	t-value	t-prob
Constant	-0.01177	0.00172	-6.852	0
CPM M	-0.0011	0.00411	-0.267	0.7894
CCred M	0.00334	0.00408	0.817	0.4139
UMCon S	-0.00221	0.0047	-0.469	0.6389
ULC M	-0.00287	0.00922	-0.311	0.7557
CPI M	-0.00438	0.00469	-0.934	0.3506
CU M	0.00094	0.00403	0.232	0.8165
CPI ex M	0.00441	0.0047	0.938	0.3482
DGO M	-0.00034	0.00464	-0.074	0.9414
DGlt M	0.00127	0.0087	0.146	0.8838
ECI M	0.00205	0.00751	0.274	0.7844
EHS M	0.00319	0.0046	0.693	0.4886
EM M	0.0036	0.01242	0.289	0.7723
MBS M	0.00102	0.0089	0.114	0.909
GDP PD M	0.00002	0.00784	0.003	0.9979
GDP M	0.00209	0.00749	0.279	0.7805
IMI M	-0.00072	0.00463	-0.156	0.8763
IJC M	0.00068	0.00214	0.315	0.7526
IP M	0.00072	0.00425	0.17	0.8648
LI M	0.00231	0.00404	0.571	0.5679
BI M	0.00075	0.00419	0.179	0.8579
WI M	-0.00064	0.00407	-0.158	0.8746
ISM NM M	0.00107	0.00492	0.218	0.8276
ISM M	0.01266	0.00411	3.079	0.0021
ISM PP M	-0.00369	0.00487	-0.756	0.4495
CNFP M	0.00051	0.00445	0.115	0.9088
NHS M	0.0011	0.00428	0.256	0.798
BP M	0.00157	0.00958	0.164	0.8696
HS M	-0.0005	0.0045	-0.111	0.9119
PF M	0.00187	0.00411	0.455	0.6494
PPI M	-0.00121	0.00612	-0.198	0.8429
ARS M	0.00192	0.00955	0.201	0.8405
RS-A M	-0.00067	0.00903	-0.074	0.941
DVS M	0.01691	0.00537	3.149	0.0017
TVS M	-0.01005	0.01293	-0.778	0.4369
FO M	-0.00024	0.00444	-0.053	0.9574
AHE M	0.0011	0.00484	0.226	0.8209
CMP M	0.00291	0.00441	0.66	0.5091
TB M	-0.00503	0.00407	-1.234	0.2174
U M	-0.00355	0.00409	-0.867	0.3861
AWH M	-0.00268	0.00483	-0.554	0.5796
CS M	-0.07799	0.01811	-4.307	0
CC M	-0.00275	0.00428	-0.643	0.5203
NFP M	0.00143	0.00813	0.175	0.8607
PPI-FE M	0.00239	0.00555	0.43	0.6672
PS M	-0.02467	0.00424	-5.816	0
PI M	0.01094	0.004	2.732	0.0064
FOMC M	0.02258	0.00524	4.31	0
Tighter	0.01301	0.00224	5.813	0
Symetric	0.01322	0.00225	5.876	0

Given the initial GUM, the next step is to conduct mis-specification tests. Thus, PcGets generally tests the following null hypotheses: white-noise errors; normally distributed errors; conditionally homoscedastic errors; unconditionally homoscedastic errors and constant parameters (table 15).

Table 15: Mis-specification tests

RSS	2.24518	**sigma**	0.03627	**R^2**	0.08128	**Radj^2**	0.0549
LogLik	5853.07477	**AIC**	-6.60566	**HQ**	-6.54812	**SC**	-6.44996
T	1757	**p**	50	**FpNull**	0	**FpConst**	0

	value	prob	alpha
Chow(880:1)	2.925	0	0
Chow(1583:1)	0.3161	1	0.01
Normality test	1977.5664	0	0
AR	1.6324	0.1635	0.01
ARCH 1 4 test	0.1091	0.9794	0.01
Hetero 1 4 test	5.5156	0	0

Significance levels (alpha) set for subsequent tests; 3 tests with alpha = 0 excluded.

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.

Table 16: F pre-search testing (top-down)

Stage-0 (**Step 1**): F presearch testing (lag-order preselection)
Stage-0 (**Step 2**): F presearch testing (top-down)
Remove 1 variable with t-prob > 0.9979 : F-prob =0.9979, Tests failed = 0;
Remove 2 variables with t-prob > 0.9574 : F-prob =0.9986, Tests failed = 0;
Remove 3 variables with t-prob > 0.9414 : F-prob =0.9998, Tests failed = 0;
Remove 4 variables with t-prob > 0.9410 : F-prob =1.0000, Tests failed = 0;
Remove 5 variables with t-prob > 0.9119 : F-prob =1.0000, Tests failed = 0;
Remove 6 variables with t-prob > 0.9090 : F-prob =1.0000, Tests failed = 0;
Remove 7 variables with t-prob > 0.9088 : F-prob =1.0000, Tests failed = 0;
Remove 8 variables with t-prob > 0.8838 : F-prob =1.0000, Tests failed = 0;
Remove 9 variables with t-prob > 0.8763 : F-prob =1.0000, Tests failed = 0;
Remove 10 variables with t-prob > 0.8746 : F-prob =1.0000, Tests failed = 0;
Remove 11 variables with t-prob > 0.8696 : F-prob =1.0000, Tests failed = 0;
Remove 12 variables with t-prob > 0.8648 : F-prob =1.0000, Tests failed = 0;
Remove 13 variables with t-prob > 0.8607 : F-prob =1.0000, Tests failed = 0;
Remove 14 variables with t-prob > 0.8579 : F-prob =1.0000, Tests failed = 0;
Remove 15 variables with t-prob > 0.8429 : F-prob =1.0000, Tests failed = 0;
Remove 16 variables with t-prob > 0.8405 : F-prob =1.0000, Tests failed = 0;
Remove 17 variables with t-prob > 0.8276 : F-prob =1.0000, Tests failed = 0;
Remove 18 variables with t-prob > 0.8209 : F-prob =1.0000, Tests failed = 0;
Remove 19 variables with t-prob > 0.8165 : F-prob =1.0000, Tests failed = 0;
Remove 20 variables with t-prob > 0.7980 : F-prob =1.0000, Tests failed = 0;
Remove 21 variables with t-prob > 0.7894 : F-prob =1.0000, Tests failed = 0;
Remove 22 variables with t-prob > 0.7844 : F-prob =1.0000, Tests failed = 0;
Remove 23 variables with t-prob > 0.7805 : F-prob =1.0000, Tests failed = 0;
Remove 24 variables with t-prob > 0.7723 : F-prob =1.0000, Tests failed = 0;
Remove 25 variables with t-prob > 0.7557 : F-prob =1.0000, Tests failed = 0;
Remove 26 variables with t-prob > 0.7526 : F-prob =1.0000, Tests failed = 0;
Remove 27 variables with t-prob > 0.6672 : F-prob =1.0000, Tests failed = 0;
Remove 28 variables with t-prob > 0.6494 : F-prob =1.0000, Tests failed = 0;
Remove 29 variables with t-prob > 0.6389 : F-prob =1.0000, Tests failed = 0;
Remove 30 variables with t-prob > 0.5796 : F-prob =1.0000, Tests failed = 0;
Remove 31 variables with t-prob > 0.5679 : F-prob =1.0000, Tests failed = 0;
Remove 32 variables with t-prob > 0.5203 : F-prob =1.0000, Tests failed = 0;
Remove 33 variables with t-prob > 0.5091 : F-prob =1.0000, Tests failed = 0;
Remove 34 variables with t-prob > 0.4886 : F-prob =1.0000, Tests failed = 0;
Remove 35 variables with t-prob > 0.4495 : F-prob =1.0000, Tests failed = 0;
Remove 36 variables with t-prob > 0.4369 : F-prob =1.0000, Tests failed = 0;
Remove 37 variables with t-prob > 0.4139 : F-prob =1.0000, Tests failed = 0;
Remove 38 variables with t-prob > 0.3861 : F-prob =1.0000, Tests failed = 0;
Remove 39 variables with t-prob > 0.3506 : F-prob =1.0000, Tests failed = 0;
Remove 40 variables with t-prob > 0.3482 : F-prob =1.0000, Tests failed = 0;
Remove 41 variables with t-prob > 0.2174 : F-prob =1.0000, Tests failed = 0;
F presearch testing stopped: none remaining variable with t-prob > 0.0250.

Source: Hendry and Krolzig (2001a)

Encompassing tests select between the candidate congruent models at the end of path searches (Tables 16 and 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, defined above (Hendry and Krolzig, 2001a).

Table 17: F pre-search testing bottom up

Stage-0 (**Step 3**): F presearch testing (top-down)
F presearch testing stopped: none remaining variable with t-prob > 0.0100.

Stage-0 (**Step 4**): F presearch testing (bottom-up)
Found 9 variables with t-prob < 0.0100. No further reduction possible.

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

Stage-1: Multiple-path encompassing search
All variables are significant: **General -> Specific.**

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, varying from a reliability of 0%.

Table 18: Specific model of DFF1, 2 – 1758, Liberal Strategy

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.01161	0.00166	-6.992	0	0	0	1
ISM M	0.01319	0.00404	3.265	0.0011	0.0002	0.002	1
DVS M	0.0175	0.00524	3.34	0.0009	0	0.0007	1
CS M	-0.0748	0.01723	-4.341	0	0.0137	0	1
PS M	-0.02443	0.00419	-5.837	0	0	0	1
PI M	0.01062	0.00394	2.691	0.0072	0.4624	0.082	0.2613
FOMC M	0.02259	0.00519	4.351	0	1	0	0.4
Tighter	0.01299	0.00218	5.967	0	0	0	1
Symetric	0.0131	0.00219	5.981	0	0	0	1

RSS	2.25714	**sigma**	0.03593	**R^2**	0.07638	**Radj^2**	0.07215
LogLik	5848.4062	**AIC**	-6.64702	**HQ**	-6.63666	**SC**	-6.61899
T	1757	**p**	9	**FpNull**	0	**FpGUM**	1

	value	prob
Chow(1583:1)	0.3032	1
AR 1 4 test	1.6737	0.1535
ARCH 1 4 test	0.1479	0.964

The reported results (Table 18) 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.

The result of the above regression (Table 18) points to the significance and the following positive order of influence over DFF1 of the surprises in: FOMC policy decision (FOMC M), Domestic Vehicle Sales (DVS M), Institute for Supply Management (ISM M), Personal Income (PI M). With a negative coefficient we have: Construction Spending (CS M) and Personal Spending (PS M). All of the above variables with positive coefficients have the expected sign over DFF1: positive surprises tend to be followed by significant increases in DFF1. The negative influence of CS M might be based on the countercyclical feature of construction in the US over the period under study. The sign of PS is hard to explain.

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.

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.

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.

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.

Tables 14, 15 and 18 present the results of 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.

We also perform the Conservative Strategy which 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, ISM M and PI M variables have been deleted and no new variable has been included FOMC surprises still have the biggest impact in relative coefficient amounts (Table 19).

Table 19: Specific model of DFF1, 2 – 1758, Conservative Strategy

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.01155	0.00167	-6.926	0	0	0	1
DVS M	0.01783	0.00526	3.389	0.0007	0	0.0006	1
CS M	-0.06916	0.01726	-4.007	0.0001	0.0035	0	0.7
PS M	-0.02402	0.00415	-5.781	0	0	0	1
FOMC M	0.0226	0.00522	4.334	0	1	0	0.4
Tighter	0.01299	0.00218	5.947	0	0	0	1
Symetric	0.01314	0.0022	5.975	0	0	0	1

RSS	2.28093	**sigma**	0.0361	**R^2**	0.06665	**Radj^2**	0.06345
LogLik	5839.1975	**AIC**	-6.63881	**HQ**	-6.63076	**SC**	-6.61702
T	1757	**p**	7	**FpNull**	0	**FpGUM**	0.97034

	value	prob
Chow(1583:1)	0.2829	1
AR 1 4 test	1.6963	0.1482
ARCH 1 4 test	0.159	0.959

The last strategy is the Experts User mode. 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 20.

Table 20: 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)

In our case we decided to modify slightly the default levels 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. In the case of our model, table 21, 40 dummy variables are added to correct the departures, while two new explanatory variables appear (ISM Price Paid (ISM PP) and Consumer Credit (CCred)) while prior ones are dropped (CS M, PS M, PI M, Tighter and Symmetric). The highest impact comes from Domestic Vehicle Sales (DVS M). The model mis-specification tests show better performances (table 20, higher R2 and information criterions).

Table 21: Specific model of DFF1, 2 – 1758 including Outliers

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.00229	0.00027	-8.492	0	0	0	1
CCred M	0.00356	0.00126	2.833	0.0047	0.0672	0.0005	0.7
ISM M	0.0155	0.00175	8.867	0	0	0	1
ISM PP M	0.00667	0.00218	3.056	0.0023	0.0491	0	0.7
DVS M	0.02782	0.00164	16.938	0	0.0126	0	1
FOMC M	0.02227	0.00163	13.655	0	1	0	0.4
I88:1	0.11263	0.01139	9.885	0	0	1	0.4
I109:1	0.14163	0.01131	12.525	0	0	1	0.4
I283:1	0.09799	0.01138	8.609	0	0	1	0.4
I328:1	-0.08664	0.01133	-7.647	0	0	1	0.4
I501:1	-0.27855	0.01132	-24.614	0	0	0	1
I523:1	-0.10569	0.01134	-9.321	0	0	0	1
I588:1	0.08109	0.01151	7.043	0	0	0	1
I696:1	0.27699	0.01155	23.983	0	0	0	1
I740:1	0.17373	0.0117	14.846	0	0	0	1
I762:1	0.0899	0.0113	7.957	0	0	0	1
I783:1	0.13227	0.01132	11.682	0	0	0	1
I825:1	-0.09928	0.0113	-8.787	0	0	0	1
I827:1	0.14572	0.0113	12.897	0	0	0	1
I849:1	0.36245	0.0113	32.062	0	0	0	1
I870:1	0.11013	0.01135	9.705	0	0	0	1
I893:1	0.16104	0.01131	14.233	0	0	0	1
I913:1	0.2029	0.01146	17.701	0	0	0	1
I936:1	0.30279	0.0157	19.284	0	0	0	1
I1089:1	-0.1401	0.0118	-11.873	0	0	0	1
I1090:1	-0.34428	0.0113	-30.471	0	0	0	1
I1111:1	-0.53362	0.01144	-46.627	0	0	0	1
I1131:1	-0.21934	0.01161	-18.894	0	0	0	1
I1153:1	-0.38273	0.01132	-33.804	0	0	0	1
I1165:1	-0.16928	0.0113	-14.982	0	0	0	1
I1174:1	-0.4622	0.01161	-39.821	0	0	0	1
I1197:1	-0.23972	0.01142	-20.984	0	0	0	1
I1218:1	-0.21377	0.0114	-18.759	0	0	0	1
I1240:1	-0.14575	0.01185	-12.297	0	0	0	1
I1264:1	-0.15671	0.01159	-13.515	0	0	0	1
I1273:1	-0.13928	0.0113	-12.327	0	0	0	1
I1274:1	-0.17928	0.0113	-15.868	0	0	0	1
I1275:1	-0.20928	0.0113	-18.523	0	0	0	1
I1276:1	0.12572	0.0113	11.127	0	0	0	1
I1277:1	0.08572	0.0113	7.587	0	0	0	1
I1278:1	0.09572	0.0113	8.472	0	0	0	1
I1283:1	-0.46269	0.01224	-37.8	0	0	0	1
I1306:1	-0.27906	0.01152	-24.215	0	0	0	1
I1328:1	-0.27073	0.01159	-23.366	0	1	0	0.4
I1567:1	-0.18676	0.01148	-16.27	0	1	0	0.4
I1588:1	-0.14914	0.01215	-12.27	0	1	0	0.4

RSS	0.21829	**sigma**	0.0113	**R^2**	0.91068	**Radj^2**	0.90833
LogLik	7900.6087	**AIC**	-8.94093	**HQ**	-8.88799	**SC**	-8.79769
T	1757	**p**	46	**FpNull**	0	**FpGUM**	0.34017

	value	prob
Chow(880:1)	0.742	1
Chow(1583:1)	0.9037	0.8038

Using the expert mode, we increased the standard deviation definition for the outlier, setting it to 5 standard deviations. The specific model ends with 16 dummy variables, showing some trade off with the mis-specification test levels. At the same time, the dummies Tighter and Symmetric reappear in the final model, while PS M is still missing (table 22).

Table 22: Specific model of DFF1, 2 – 1758 including Outliers

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.005	0.00089	-5.608	0	0	0	1
ISM M	0.01174	0.00239	4.92	0	0	0	1
DVS M	0.02872	0.00278	10.334	0	0.2589	0	0.7
PI M	0.00445	0.00215	2.073	0.0383	0.18	0.6596	0.2021
FOMC M	0.02237	0.00277	8.073	0	1	0	0.4
Tighter	0.00385	0.00117	3.289	0.001	0.0001	0.0014	1
Symetric	0.00343	0.00118	2.908	0.0037	0.0002	0.0045	1
I501:1	-0.27725	0.01923	-14.419	0	0	0	1
I696:1	0.2711	0.01948	13.915	0	0	0	1
I849:1	0.36251	0.01921	18.873	0	0	0	1
I913:1	0.19757	0.01938	10.195	0	0	0	1
I936:1	0.26699	0.01926	13.864	0	0	0	1
I1090:1	-0.34159	0.01921	-17.784	0	0	0	1
I1111:1	-0.53878	0.01931	-27.906	0	0	0	1
I1131:1	-0.22411	0.01935	-11.583	0	0	0	1
I1153:1	-0.38163	0.01923	-19.841	0	0	0	1
I1174:1	-0.46844	0.0193	-24.274	0	0	0	1
I1197:1	-0.23712	0.01933	-12.27	0	0	0	1
I1218:1	-0.21862	0.01928	-11.336	0	0	0	1
I1275:1	-0.20659	0.01921	-10.755	0	0	0	1
I1283:1	-0.46985	0.02013	-23.341	0	0	0	1
I1306:1	-0.27301	0.01948	-14.016	0	0	0	1
I1328:1	-0.25239	0.01979	-12.754	0	1	0	0.4

RSS	0.63834	**sigma**	0.01919	**R^2**	0.73879	**Radj^2**	0.73548
LogLik	6957.9309	**AIC**	-7.89406	**HQ**	-7.86759	**SC**	-7.82244
T	1757	**p**	23	**FpNull**	0	**FpGUM**	0.97647

	value	prob
Chow(1583:1)	0.6097	0.8038

We performed the same steps for the analysis of the remaining Fed funds future contracts 2 to 8. For each of the contracts, we run the model in the liberal strategy mode, then we performed the same analysis with the conservative strategy and last we did a regression using the experts mode combined with outlier detection with 5 standard deviations as the size of the marginal outlier.

Table 23: Specific model of DFF2, 2 – 1758, Liberal Strategy

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.01085	0.00156	-6.959	0	0	0	1
PS M	-0.01012	0.00388	-2.609	0.0092	0.0069	0.0092	1
FOMC M	0.02319	0.00488	4.751	0	1	0	0.4
Tighter	0.01174	0.00204	5.741	0	0	0	1
Symetric	0.01154	0.00206	5.607	0	0	0	1

RSS	2.00116	**sigma**	0.0338	**R^2**	0.03761	**Radj^2**	0.03541
LogLik	5954.1525	**AIC**	-6.77194	**HQ**	-6.76619	**SC**	-6.75637
T	1757	**p**	5	**FpNull**	0	**FpGUM**	0.37382

	value	prob
Chow(1583:1)	0.3939	1

In the DFF2 case, only two variables are left in the model: FOMC surprise and Personal Spending (Table 23). The dummy variables representing the Fed monetary policy bias remain as significant.

Table 24: Specific model of DFF2, 2 – 1758, Conservative Strategy

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.01079	0.00156	-6.908	0	0	0	1
FOMC M	0.02318	0.00489	4.74	0	1	0	0.4
Tighter	0.01162	0.00205	5.675	0	0	0	1
Symetric	0.01139	0.00206	5.525	0	0	0	1

RSS	2.00894	**sigma**	0.03385	**R^2**	0.03387	**Radj^2**	0.03222
LogLik	5950.746	**AIC**	-6.7692	**HQ**	-6.7646	**SC**	-6.75675
T	1757	**p**	4	**FpNull**	0	**FpGUM**	0.02914

	value	prob
Chow(1583:1)	0.391	1

From the conservative strategy (Table 24) only FOMC surprise remain, while PS M dropped. The analysis including outlier (Table 25) determination at 5 standard deviations found 15 outliers and 11 variables including the bias dummies, while the mis-specification tests improved. The FOMC surprise remains with the highest impact over the DFF2.

Table 25: Specific model of DFF2, 2 – 1758, including Outliers at 5 sd

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.00616	0.00108	-5.718	0	0	0	1
UMCon S	-0.00819	0.00313	-2.616	0.009	0.0028	0.0052	1
ISM M	0.00562	0.00275	2.047	0.0408	0.1059	0.1931	0.4
ISM PP M	-0.01309	0.00313	-4.177	0	0	0	1
CMP M	0.0072	0.00264	2.733	0.0063	0.0087	0.0036	1
TB M	-0.00599	0.00258	-2.324	0.0202	0.0034	0.0051	1
CC M	0.00527	0.00268	1.969	0.0491	0.0749	0.0217	1
PS M	-0.00754	0.00268	-2.81	0.005	0.0007	0.0082	1
PI M	0.00561	0.00254	2.21	0.0273	0.2496	0.0573	0.7
FOMC M	0.02309	0.00332	6.955	0	1	0	0.4
Tighter	0.00549	0.00141	3.896	0.0001	0	0.0002	1
Symetric	0.00479	0.00142	3.379	0.0007	0	0.0011	1
I512:1	-0.19519	0.02301	-8.483	0	0	0	1
I827:1	0.35502	0.023	15.434	0	0	0	1
I870:1	0.17772	0.02306	7.707	0	0	0	1
I913:1	0.22554	0.0232	9.722	0	0	0	1
I1089:1	-0.39466	0.02364	-16.692	0	0	0	1
I1090:1	-0.28519	0.02301	-12.394	0	0	0	1
I1091:1	-0.18519	0.02301	-8.049	0	0	0	1
I1111:1	-0.19214	0.02317	-8.293	0	0	0	1
I1131:1	-0.36958	0.02352	-15.715	0	0	0	1
I1153:1	-0.22282	0.02304	-9.672	0	0	0	1
I1165:1	-0.41872	0.02306	-18.156	0	0	0	1
I1174:1	-0.20778	0.02329	-8.923	0	0	0	1
I1197:1	-0.20791	0.02341	-8.879	0	0	0	1
I1240:1	-0.17741	0.0238	-7.455	0	0	0	1
I1271:1	-0.27478	0.02484	-11.063	0	0	0	1

RSS	0.91392	**sigma**	0.02298	**R^2**	0.56048	**Radj^2**	0.55387
LogLik	6642.6656	**AIC**	-7.53064	**HQ**	-7.49956	**SC**	-7.44656
T	1757	**p**	27	**FpNull**	0	**FpGUM**	0.88344

	value	prob
Chow(1583:1)	0.8564	0.9059
AR 1-4 test	1.9923	0.0932

The liberal strategy in DFF3 ended with 3 variables and the bias dummies (Table 26). Among the variables, FOMC M achieves the biggest coefficient followed by ISM M, while Construction Spending (CS M) has the same negative sign as in DFF1 liberal and conservative strategies.

Table 26: Specific model of DFF3, 2 – 1758, Liberal Strategy

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.00966	0.00146	-6.605	0	0	0	1
ISM M	0.0138	0.00355	3.89	0.0001	0.0022	0.0006	1
CS M	-0.07289	0.01499	-4.863	0	0	0	1
FOMC M	0.01598	0.00457	3.495	0.0005	1	0.0003	0.4
Tighter	0.01022	0.00192	5.332	0	0	0	1
Symetric	0.01038	0.00193	5.385	0	0	0	1

RSS	1.7548	**sigma**	0.03166	**R^2**	0.04588	**Radj^2**	0.04316
LogLik	6069.5655	**AIC**	-6.90218	**HQ**	-6.89527	**SC**	-6.8835
T	1757	**p**	6	**FpNull**	0	**FpGUM**	0.30308

	value	prob
Chow(1583:1)	0.4987	1

The conservative strategy in DFF3 entitled the same model as in the liberal one (Table 27).

Table 27: Specific model of DFF3, 2 – 1758, Conservative Strategy

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.00966	0.00146	-6.605	0	0	0	1
ISM M	0.0138	0.00355	3.89	0.0001	0.0022	0.0006	1
CS M	-0.07289	0.01499	-4.863	0	0	0	1
FOMC M	0.01598	0.00457	3.495	0.0005	1	0.0003	0.4
Tighter	0.01022	0.00192	5.332	0	0	0	1
Symetric	0.01038	0.00193	5.385	0	0	0	1

RSS	1.7548	**sigma**	0.03166	**R^2**	0.04588	**Radj^2**	0.04316
LogLik	6069.5655	**AIC**	-6.90218	**HQ**	-6.89527	**SC**	-6.8835
T	1757	**p**	6	**FpNull**	0	**FpGUM**	0.30308

	value	prob
Chow(1583:1)	0.4987	1

Meanwhile, the DFF3 outlier correction mode with 5 standard deviations found as relevant 9 variables and the bias dummies, that is 6 more than DFF1 with outliers (Table 28). This time Construction Spending has positive sign and the biggest impact, while FOMC surprise ranked third. This regression has 3 new variables entering as significant. ISM Price Paid and Employment Cost Index are two of them ranking as second and fourth respectively. According to market belief, these two variables are among Alan Greenspan's (FED Chairman) most favourite series to follow.

Table 28: Specific model of DFF3, 2 – 1758, including Outliers at 5 sd

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.00642	0.00116	-5.515	0	0	0	1
CPM M	0.00798	0.00279	2.855	0.0044	0.0135	0.0025	1
ECI M	0.01418	0.00492	2.882	0.004	0.0001	0.0371	1
ISM M	0.00855	0.0029	2.949	0.0032	0.0026	0.0324	1
ISM PP M	0.0184	0.00344	5.357	0	0.001	0	1
CMP M	0.00776	0.00279	2.784	0.0054	0.012	0.0027	1
CS M	0.03658	0.01334	2.742	0.0062	0	0.0024	1
CC M	0.00931	0.00292	3.187	0.0015	0.0001	0.0003	1
PI M	0.00548	0.00272	2.012	0.0443	0.8135	0.1767	0.1559
FOMC M	0.01592	0.0036	4.42	0	1	0	0.4
Tighter	0.0052	0.00152	3.411	0.0007	0	0.0025	1
Symetric	0.00561	0.00153	3.664	0.0003	0	0.0003	1
I501:1	-0.21624	0.02557	-8.457	0	0	0	1
I512:1	-0.21465	0.02496	-8.601	0	0	0	1
I544:1	-0.23532	0.02623	-8.973	0	0	0	1
I805:1	0.16904	0.02499	6.765	0	0	0	1
I893:1	0.15808	0.02497	6.332	0	0	0	1
I913:1	0.21052	0.02522	8.348	0	0	0	1
I1089:1	-0.21581	0.02564	-8.416	0	0	0	1
I1090:1	-0.2694	0.02553	-10.554	0	0	0	1
I1091:1	-0.23465	0.02496	-9.403	0	0	0	1
I1111:1	-0.26868	0.02524	-10.643	0	0	0	1
I1153:1	-0.18899	0.02501	-7.555	0	0	0	1
I1165:1	-0.34465	0.02496	-13.81	0	0	0	1
I1271:1	-0.23965	0.02496	-9.603	0	0	0	1

RSS	1.07636	**sigma**	0.02493	**R^2**	0.41476	**Radj^2**	0.40665
LogLik	6498.9502	**AIC**	-7.36932	**HQ**	-7.34055	**SC**	-7.29147
T	1757	**p**	25	**FpNull**	0	**FpGUM**	0.74512

	value	prob
Chow(1583:1)	0.8516	0.9137

In the case of DFF4, the Employment Cost Index (ECI M) is the first time it appears as the biggest coefficient, while FOMC ranks second (table 29). In neither DFF1, 2 and 3 ECI M enters in the liberal and conservative strategy models. The same happens with Consumer Confidence (CC M).

Table 29: Specific model of DFF4, 2 – 1758, Liberal Strategy

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.00924	0.0016	-5.764	0	0	0	1
ECI M	0.02377	0.00685	3.468	0.0005	0	0.0103	1
ISM M	0.01331	0.00388	3.427	0.0006	0.0122	0.0001	1
CC M	0.01077	0.00407	2.646	0.0082	0.0005	0.0027	1
FOMC M	0.01374	0.00502	2.738	0.0062	1	0.0041	0.4
Tighter	0.00919	0.0021	4.368	0	0	0.0001	1
Symetric	0.00944	0.00212	4.457	0	0	0	1

RSS	2.11244	**sigma**	0.03474	**R^2**	0.03644	**Radj^2**	0.03314
LogLik	5906.6107	**AIC**	-6.71555	**HQ**	-6.70749	**SC**	-6.69375
T	1757	**p**	7	**FpNull**	0	**FpGUM**	0.23063

	value	prob
Chow(1583:1)	0.4444	1

In the conservative strategy (table 30), FOMC and CC dropped, while ECI M and ISM M remain.

Table 30: Specific model of DFF4, 2 – 1758, Conservative Strategy

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.0094	0.00161	-5.847	0	0	0	1
ECI M	0.02577	0.00684	3.77	0.0002	0	0.0028	0.7
ISM M	0.01332	0.0039	3.417	0.0006	0.0125	0.0001	0.6962
Tighter	0.00941	0.00211	4.459	0	0	0.0001	1
Symetric	0.00956	0.00212	4.505	0	0	0	1

RSS	2.12996	**sigma**	0.03487	**R^2**	0.02845	**Radj^2**	0.02623
LogLik	5899.3552	**AIC**	-6.70957	**HQ**	-6.70381	**SC**	-6.694
T	1757	**p**	5	**FpNull**	0	**FpGUM**	0.03406

	value	prob
Chow(1583:1)	0.4293	1

The regression including outliers presents 9 outliers as opposed to 16, 15 and 13 for DFF1, 2 and 3 respectively. Still 9 variables plus the dummy bias are significant. Construction spending ranks first with positive sign, while ECI stands second in terms of positive impact. Philadelphia Fed (PF M) and University of Michigan Consumer Confidence (UMCon S) enter the model (Table 31).

Table 31: Specific model of DFF4, 2 – 1758, including Outliers at 5 sd

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.00634	0.00137	-4.642	0	0	0	1
CPM M	0.00979	0.00328	2.99	0.0028	0.0112	0.002	1
UMCon S	-0.01101	0.00398	-2.767	0.0057	0.0039	0.0031	1
ECI M	0.02372	0.00577	4.113	0	0	0.002	1
ISM M	0.00865	0.00332	2.605	0.0093	0.6627	0.0031	0.5012
ISM PP M	0.01222	0.00413	2.96	0.0031	0.9604	0.0013	0.4119
PF M	0.00897	0.00328	2.732	0.0064	0.0018	0.0027	1
CMP M	0.01294	0.00332	3.899	0.0001	0.0007	0	1
CS M	0.03795	0.0153	2.481	0.0132	0.3998	0.0088	0.5801
CC M	0.01154	0.00343	3.365	0.0008	0	0.0001	1
FOMC M	0.01365	0.00422	3.231	0.0013	1	0.0005	0.4
Tighter	0.00569	0.00179	3.19	0.0014	0	0.0016	1
Symetric	0.00485	0.00179	2.704	0.0069	0	0.0089	1
I501:1	-0.20681	0.02995	-6.904	0	0	0	1
I512:1	-0.2547	0.02927	-8.702	0	0	0	1
I523:1	-0.21521	0.02999	-7.175	0	0	0	1
I1089:1	-0.36649	0.03011	-12.172	0	0	0	1
I1090:1	-0.225	0.02991	-7.523	0	0	0	1
I1091:1	-0.2047	0.02927	-6.994	0	0	0	1
I1165:1	-0.3097	0.02927	-10.581	0	0	0	1
I1271:1	-0.30775	0.03159	-9.741	0	0	0	1
I1413:1	0.26104	0.0302	8.645	0	1	0	0.4

RSS	1.48311	**sigma**	0.02924	**R^2**	0.3235	**Radj^2**	0.31531
LogLik	6217.3372	**AIC**	-7.05218	**HQ**	-7.02686	**SC**	-6.98367
T	1757	**p**	22	**FpNull**	0	**FpGUM**	0.9366

	value	prob
Chow(1583:1)	0.6331	0.9999
AR 1-4 test	3.4432	0.0082

The DFF5 model is very similar to DFF4 model following the liberal strategy except that ISM Price Paid entered ranking second while FOMC M ranked fourth (Table 32).

Table 32: Specific model of DFF5, 2 – 1758, Liberal Strategy

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.00845	0.00176	-4.804	0	0	0	1
ECI M	0.02655	0.00747	3.552	0.0004	0	0.0045	1
ISM M	0.01584	0.00428	3.698	0.0002	0.0002	0	1
ISM PP M	0.0237	0.00493	4.804	0	0.1169	0	0.6649
FOMC M	0.01583	0.00551	2.875	0.0041	1	0.0024	0.4
Tighter	0.00833	0.00231	3.611	0.0003	0	0.002	1
Symetric	0.00814	0.00232	3.506	0.0005	0	0.0005	1

RSS	2.5429	**sigma**	0.03812	**R^2**	0.03858	**Radj^2**	0.03528
LogLik	5743.6835	**AIC**	-6.53009	**HQ**	-6.52203	**SC**	-6.50829
T	1757	**p**	7	**FpNull**	0	**FpGUM**	0.16357

	value	prob
Chow(1583:1)	0.4279	1

In the conservative strategy the same variables and coefficient remains but the Fed policy bias dummies slightly change (Table 33).

Table 33: Specific model of DFF5, 2 – 1758, Conservative Strategy

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.00845	0.00176	-4.794	0	0	0	1
ECI M	0.02655	0.00749	3.545	0.0004	0	0.0046	0.7
ISM M	0.01585	0.00429	3.692	0.0002	0.0002	0	1
ISM PP M	0.02372	0.00494	4.797	0	0.1168	0	0.6649
Tighter	0.00833	0.00231	3.604	0.0003	0	0.002	0.7
Symetric	0.00797	0.00233	3.425	0.0006	0	0.0007	1

RSS	2.55491	**sigma**	0.0382	**R^2**	0.03404	**Radj^2**	0.03128
LogLik	5739.543	**AIC**	-6.52651	**HQ**	-6.51961	**SC**	-6.50783
T	1757	**p**	6	**FpNull**	0	**FpGUM**	0.05303

	value	prob
Chow(1583:1)	0.4258	1

Using the outlier correction (Table 34), we reach to 7 outlier detections, with the highest level of variables left. Change in Non Farm Payrolls (CNFP M) enters as number 10 variable. Average Hourly Earnings is also a new variable for our models. ECI M remains top of the variables. Note that the Fed policy bias variables reach a very low level in comparison to our DFF models. In the following models, DFF6, 7 and 8 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 do not matters.

Table 34: Specific model of DFF5, 2 – 1758, including Outliers at 5 sd

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.00591	0.00159	-3.726	0.0002	0	0.0001	1
CPM M	0.01093	0.00383	2.851	0.0044	0.0139	0.0045	1
ECI M	0.02442	0.00675	3.618	0.0003	0	0.0058	1
ISM M	0.01333	0.00387	3.444	0.0006	0.0054	0.0001	1
ISM PP M	0.0229	0.00465	4.926	0	0.7957	0	0.4613
CNFP M	0.00873	0.00386	2.263	0.0237	0.0323	0.002	1
PF M	0.01011	0.00384	2.629	0.0086	0.0021	0.0061	1
AHE M	0.0109	0.00445	2.449	0.0144	0.0012	0.0042	1
CC M	0.01162	0.00401	2.897	0.0038	0	0.0016	1
FOMC M	0.01578	0.00494	3.192	0.0014	1	0.0006	0.4
Tighter	0.00528	0.00208	2.536	0.0113	0	0.0131	1
Symetric	0.00447	0.00209	2.132	0.0331	0	0.0412	1
I501:1	-0.29994	0.03429	-8.748	0	0	0	1
I512:1	-0.29487	0.03426	-8.607	0	0	0	1
I1089:1	-0.23868	0.03516	-6.788	0	0	0	1
I1091:1	-0.20487	0.03426	-5.98	0	0	0	1
I1165:1	-0.32987	0.03426	-9.629	0	0	0	1
I1271:1	-0.20987	0.03426	-6.126	0	0	0	1
I1413:1	0.21626	0.03533	6.122	0	1	0	0.4

RSS	2.03525	**sigma**	0.03422	**R^2**	0.23051	**Radj^2**	0.22254
LogLik	5939.3147	**AIC**	-6.73912	**HQ**	-6.71725	**SC**	-6.67995
T	1757	**p**	19	**FpNull**	0	**FpGUM**	0.76039

	value	prob
Chow(1583:1)	0.5235	1

As commented above, no dummies are left in the DFF6 models (table 35); ECI M is still top of the variables. Chicago Purchasing Manager (CPM M) surprises occupy the lowest level in relative size of the coefficient.

Table 35: Specific model of DFF6, 2 – 1758, Liberal Strategy

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
CPM M	0.01411	0.00479	2.944	0.0033	0.0149	0.0037	1
ECI M	0.02909	0.00844	3.447	0.0006	0	0.0116	1
ISM M	0.01538	0.0048	3.201	0.0014	0.0125	0.001	1
ISM PP M	0.02508	0.00553	4.533	0	0.3137	0	0.6059
CC M	0.0142	0.00501	2.834	0.0046	0	0.0026	1

RSS	3.20558	**sigma**	0.04277	**R^2**	0.02911	**Radj^2**	0.02689
LogLik	5540.2343	**AIC**	-6.30078	**HQ**	-6.29502	**SC**	-6.28521
T	1757	**p**	5	**FpNull**	0	**FpGUM**	0.04839

	value	prob
Chow(1583:1)	0.426	1

In this case, the Conservative strategy maintains the same model structure (Table 36).

Table 36: Specific model of DFF6, 2 – 1758, Conservative Strategy

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
CPM M	0.01411	0.00479	2.944	0.0033	0.0149	0.0037	0
ECI M	0.02909	0.00844	3.447	0.0006	0	0.0116	0.6965
ISM M	0.01538	0.0048	3.201	0.0014	0.0125	0.001	0.2962
ISM PP M	0.02508	0.00553	4.533	0	0.3137	0	0.6059
CC M	0.0142	0.00501	2.834	0.0046	0	0.0026	0.2981
RSS	3.20558	**sigma**	0.04277	**R^2**	0.02911	**Radj^2**	0.02689
LogLik	5540.2343	**AIC**	-6.30078	**HQ**	-6.29502	**SC**	-6.28521
T	1757	**p**	5	**FpNull**	0	**FpGUM**	0.04839
	value	**prob**					
Chow(1583:1)	0.426	1					

Using the expert mode with outliers detection, 9 variables are left, with only 5 outliers. Note how the number of outliers is reduced when we analyse contracts with longer maturity. This could be due to the larger intrinsic volatility of the series. The ranking is similar to the prior ones (Table 37).

Table 37: Specific model of DFF6, 2 – 1758, including Outliers at 5 sd

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.0024	0.00096	-2.505	0.0123	0.012	0.0039	1
CPM M	0.01414	0.00446	3.173	0.0015	0.0094	0.0017	1
UMCon S	-0.01248	0.00541	-2.305	0.0213	0.0041	0.0127	1
ECI M	0.02917	0.00785	3.717	0.0002	0	0.0053	1
ISM M	0.01443	0.00451	3.201	0.0014	0.0552	0.0006	1
ISM PP M	0.02452	0.00541	4.535	0	0.3054	0	0.6084
PF M	0.0122	0.00447	2.73	0.0064	0.0016	0.0063	1
CMP M	0.01421	0.0045	3.159	0.0016	0.002	0.0009	1
CC M	0.01415	0.00466	3.038	0.0024	0	0.0013	1
PS M	0.01199	0.00459	2.614	0.009	0.0105	0.0013	1
FOMC M	0.01344	0.00574	2.34	0.0194	1	0.0129	0.4
I512:1	-0.30811	0.03979	-7.743	0	0	0	1
I1089:1	-0.28816	0.04086	-7.053	0	0	0	1
I1165:1	-0.28811	0.03979	-7.24	0	0	0	1
I1271:1	-0.27055	0.04296	-6.298	0	0	0	1
I1413:1	0.27015	0.04105	6.58	0	1	0	0.4
RSS	2.75519	**sigma**	0.03978	**R^2**	0.16552	**Radj^2**	0.15833
LogLik	5673.245	**AIC**	-6.43966	**HQ**	-6.42125	**SC**	-6.38984
T	1757	**p**	16	**FpNull**	0	**FpGUM**	0.80932
	value	**prob**					
Chow(1583:1)	0.5003	1					

Only four variables remain in the liberal strategy for DFF7. ECI M still ranks first, followed by ISM PP M, CC M and CPM M (table 38).

Table 38: Specific model of DFF7, 2 – 1758, Liberal Strategy

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
CPM M	0.01472	0.00525	2.807	0.0051	0.0565	0.005	0.7
ECI M	0.03319	0.00924	3.592	0.0003	0	0.0123	1
ISM PP M	0.02442	0.00602	4.053	0.0001	0.2837	0	0.6149
CC M	0.01636	0.00548	2.984	0.0029	0	0.001	1

RSS	3.84403	**sigma**	0.04683	**R^2**	0.02408	**Radj^2**	0.02241
LogLik	5380.6724	**AIC**	-6.12029	**HQ**	-6.11568	**SC**	-6.10783
T	1757	**p**	4	**FpNull**	0	**FpGUM**	0.03577

	value	prob
Chow(1583:1)	0.4643	1

The conservative strategy ends with only the two variables with biggest coefficients in the liberal case (Table 39).

Table 39: Specific model of DFF7, 2 – 1758, Conservative Strategy

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
ECI M	0.03643	0.00922	3.952	0.0001	0	0.0028	0.7
ISM PP M	0.02442	0.00605	4.037	0.0001	0.2865	0	0.6141

RSS	3.87962	**sigma**	0.04702	**R^2**	0.01504	**Radj^2**	0.01448
LogLik	5372.5765	**AIC**	-6.11335	**HQ**	-6.11105	**SC**	-6.10712
T	1757	**p**	2	**FpNull**	0	**FpGUM**	0.00219

	value	prob
Chow(1583:1)	0.4494	1

The DFF7 model with outlier detection found 4 outliers and 8 variables. ISM Prices Paid (ISM PP) stands for the first time as the biggest coefficient, while ECI M gains the second position (Table 40).

Table 40: Specific model of DFF7, 2 – 1758, including Outliers at 5 sd

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.00252	0.00106	-2.372	0.0178	0.0194	0.0062	1
CPM M	0.01476	0.00499	2.956	0.0032	0.0452	0.0031	1
ECI M	0.03328	0.00879	3.785	0.0002	0	0.007	1
ISM M	0.01141	0.00504	2.262	0.0238	0.0267	0.0047	1
ISM PP M	0.03393	0.00588	5.766	0	0.4342	0	0.5698
PF M	0.0129	0.00501	2.577	0.0101	0.0036	0.0119	1
CC M	0.01631	0.00522	3.124	0.0018	0	0.0006	1
PS M	0.01295	0.00514	2.52	0.0118	0.0141	0.001	1
FOMC M	0.01416	0.00644	2.201	0.0279	1	0.0184	0.4
I512:1	-0.26812	0.04459	-6.013	0	0	0	1
I1065:1	-0.27812	0.04459	-6.237	0	0	0	1
I1089:1	-0.2909	0.04571	-6.364	0	0	0	1
I1165:1	-0.29812	0.04459	-6.686	0	0	0	1

RSS	3.46541	**sigma**	0.04458	**R^2**	0.1202	**Radj^2**	0.11415
LogLik	5471.7652	**AIC**	-6.21373	**HQ**	-6.19877	**SC**	-6.17325
T	1757	**p**	13	**FpNull**	0	**FpGUM**	0.54634

	value	prob
Chow(1583:1)	0.5185	1

In the last model, DFF8, the liberal strategy encountered 5 variables in the specific model. No bigger surprises appear in the rankings of relative absolute coefficient (Table 41).

Table 41: Specific model of DFF8, 2 – 1758, Liberal Strategy

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
CPM M	0.01748	0.0056	3.122	0.0018	0.0316	0.0012	0.7
ECI M	0.03352	0.00986	3.4	0.0007	0	0.0214	1
ISM PP M	0.02364	0.00643	3.677	0.0002	0.0163	0.0001	1
PF M	0.01521	0.00561	2.71	0.0068	0.0033	0.0059	1
CC M	0.01824	0.00585	3.117	0.0019	0	0.0008	1

RSS	4.37553	**sigma**	0.04997	**R^2**	0.02753	**Radj^2**	0.02531
LogLik	5266.9023	**AIC**	-5.98964	**HQ**	-5.98389	**SC**	-5.97407
T	1757	**p**	5	**FpNull**	0	**FpGUM**	0.10904

	value	prob
Chow(1583:1)	0.5799	1

The conservative strategy dropped 2 variables (PF M and CC M), while the usual rankings remained (Table 42).

Table 42: Specific model of DFF8, 2 – 1758, Conservative Strategy

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
CPM M	0.01688	0.00562	3.004	0.0027	0.0359	0.0018	0.2892
ECI M	0.03693	0.00984	3.754	0.0002	0	0.0057	0.7
ISM PP M	0.02364	0.00646	3.661	0.0003	0.0171	0.0001	0.6949
RSS	4.41814	**sigma**	0.05019	**R^2**	0.01806	**Radj^2**	0.01694
LogLik	5258.3882	**AIC**	-5.98223	**HQ**	-5.97878	**SC**	-5.97289
T	1757	**p**	3	**FpNull**	0	**FpGUM**	0.00762
	value	**prob**					
Chow(1583:1)	0.5528	1					

Last, the expert mode with including outliers at a 5 standard deviation margin signalled 4 outliers and 9 variables, maintaining the prior ranking of coefficient magnitude (Table 43).

Table 43: Specific model of DFF8, 2 – 1758, including Outliers at 5 sd

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	-0.00244	0.00115	-2.122	0.034	0.0249	0.0138	1
CPM M	0.01738	0.00535	3.245	0.0012	0.0214	0.0006	1
ECI M	0.03375	0.00943	3.579	0.0004	0	0.0131	1
IMI M	-0.01313	0.00609	-2.155	0.0313	0.0088	0.0197	1
ISM PP M	0.02294	0.00615	3.728	0.0002	0.0074	0.0001	1
PF M	0.01508	0.00537	2.808	0.005	0.0019	0.0046	1
CMP M	0.0118	0.00532	2.217	0.0267	0.0677	0.0206	1
CC M	0.01843	0.0056	3.292	0.001	0	0.0004	1
PI M	0.01038	0.0052	1.996	0.0461	0.5545	0.0318	0.5336
FOMC M	0.01412	0.0069	2.046	0.0409	1	0.0289	0.4
I798:1	0.34217	0.04781	7.157	0	0	0	1
I1065:1	-0.26283	0.04781	-5.498	0	0	0	1
I1070:1	-0.25783	0.04781	-5.393	0	0	0	1
I1269:1	-0.29783	0.04781	-6.23	0	0	0	1
RSS	3.9816	**sigma**	0.04779	**R^2**	0.11508	**Radj^2**	0.10848
LogLik	5349.7835	**AIC**	-6.07374	**HQ**	-6.05763	**SC**	-6.03015
T	1757	**p**	14	**FpNull**	0	**FpGUM**	0.53195
	value	**prob**					
Chow(1583:1)	0.6254	0.9999					

7. Conclusions

Fed funds interest rates and its expectations are the first link of transmission of Federal Reserve policy to other interest rates. In this paper we broaden the knowledge of the impact of news on the Federal Reserve funds' interest rate expectations, ie. Fed funds futures contracts' implicit rates. To our knowledge, few researchers have investigated the responses of such short term interest rates to surprises in economic statistics. As fundamentals are already priced in, our analysis is centered on surprises, defined as the difference between the actual values and the surveys. We analyse the daily variation of the 8 generic Fed funds future contracts implicit rates from end 1996 till mid 2003. The exogenous variables are series of surprises of 47 economic statistics. The surprises main input are the actual economic release and the median estimate surveyed by Bloomberg News. At the same time, in order to capture the different effects of the Fed monetary policy bias three dummies were constructed.

The selection of the final specification of the model was done via an extensive use of PcGets.

We started with a linear function of n lagged values of the daily difference of each Fed funds future contract (DFF), and of the news (S) including their lags. The amount of endogenous variables (8 Fed Fund contracts) and exogenous variables (47 surprises in median plus 2 Fed monetary policy bias) and 1758 daily values clearly points out to the impossibility to pick up easily a single model from the GUM. As a consequence of the methodological problems, we benefited from the use of a new econometric program: PcGets. This econometric package works following the general-to-specific modelling. General-to-specific modelling consists of a cycle of three steps: formulation, estimation and evaluation, and model simplification. We introduce the underlying theory used in PcGets discussing our own experience with this methodology and the different econometric steps we follow to finally end with 24 specific models.

In our case, we decided to avoid the GUM with a lag structure. We based our decision on our surprise variables intrinsic features. As the economic announcements do not have daily frequency they are similar to dummy variables as our time frame is daily as our endogenous variables (Fed funds) are reported daily. Due to the easiness of the

PcGets tool we run a regression including lags and as expected the model selected did not include the lags.

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 (Hendry and Krolzig 2001a). 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. In our case, we decided to rely 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.

Table 44 summaries the results of the PcGets Liberal Strategy –focusing on minimizing the non-selection probability of relevant variables-; Conservative Strategy -focusing on minimizing the non-deletion probability of nuisance variables and the Experts User mode with an Outlier Correction level of 5 standard deviations. The table shows the ranking in terms of absolute coefficient size of each of the significant surprises for each model.

In general there are more significant economic surprises related with production indexes and far less employment and prices surprises.

Surprises in Employment Cost Index materialize 16 times in all our models, and in 13 of them it ranked first in terms of the absolute size of the coefficient. The surprise in the median of FOMC expectations appear in 17 models out of 24, ranking in the first three positions 12 times. The third most significant variable is the Institute of Supply Management (ISM M) statistics. The ISM M stays as significant variable in 16 models, standing on the second and third importance role 3 and 9 times respectively. The ISM Prices Paid is survived the filters in 14 models. Consumer Confidence (CC M) and Chicago Purchasing Manager (CPM M) are found in 12 and 11 models respectively. Construction spending is the negative coefficient with more appearances (4). Its negative coefficient could be explained by its countercyclical performance in the US economy.

A stylized fact from the summary is that the 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.

Table 44: Summary of specific models and coefficients absolute ranking

Surprise	Reference	DFF1			DFF2			DFF3			DFF4			DFF5			DFF6			DFF7			DFF8		
		L	C	OC	L	C	OC	L	C	OC	L	C	OC	L	C	OC	L	C	OC	L	C	OC	L	C	OC
CHICAGO PURC. MANAGER	CPM M									8			7			7	5	5	6	4		4	4	3	4
CONSUMER CREDIT	CCred M																								
U OF MICHIGAN CONFIDENCE	UMCon S												(1)						(1)						
UNIT LABOR COSTS	ULC M																								
CPI MOM	CPI M																								
CAPACITY UTILIZATION	CU M																								
CPI EX FOOD & ENERGY	CPI ex M																								
DURABLE GOODS ORDERS	DGO M																								
DURABLE GOODS - TRANSP.	DGlt M																								
EMPLOYMENT COST INDEX	ECI M									4	1	1	2	1	1	1	1	1	1	1	1	2	1	1	1
EXISTING HOME SALES	EHS M																								
EMPIRE MANUFACTURING	EM M																								
MONTHLY BUDG. STATE.	MBS M																								
GDP PRICE DEFLACTOR	GDP PD M																								
GDP	GDP M																								
IMPORT PRICE INDEX MOM	IMI M																								(1)
INITIAL JOBLESS CLAIMS	IJC M																								
INDUSTRIAL PRODUCTION	IP M																								
LEADING INDICATORS	LI M																								
BUSINESS INVENTORIES	BI M																								
WHOLESALE INVENTORIES	WI M																								
ISM NON MANUFACTURING	ISM NM M																								
ISM MANUFACTURING	ISM M	3		3			3	2	2	6	3	2	9	3	3	6	3	3	3			8			
ISM PRICES PAID	ISM PP M									2			5	2	2	2	2	2	2	2	2	1	2	2	2
CHANGE NONF. PAYROLLS	CNFP M															10									
NEW HOMES SALES	NHS M																								
BUILINDG PERMITS	BP M																								
HOUSING STARTS	HS M																								
PHILADELPHIA FED	PF M												8			9			8			7	5		5
PPI INDEX MOM	PPI M																								
ADVANCE RETAIL SALES	ARS M																								
RETAIL SALES LESS AUTOS	RS-A M																								
DOMESTIC VEHICLE SALES	DVS M	2	2	1																					
TOTAL VEHICLE SLES	TVS M																								
FACTORY ORDERS	FO M																								
AVERAGE HOURLY EARNINGS	AHE M															8									
CHAN. MANUF. PAYROLLS	CMP M						2			9			4						4						7
TRADE BALANCE	TB M						(2)																		
UNEMPLOYMENT RATE	U M																								
AVERAGE WEEKLY HOURS	AWH M																								
CONSTRUCTION SPENDING	CS M	(1)	(1)					(1)	(1)	1			1												
CONSUMER CONFIDENCE	CC M						5			5	4		6			5	4	4	5	3		3	3		3
NON FARM PRODUCTIVITY	NFP M																								
PPI EX FOOD & ENERGY	PPI-FE M																								
PERSONAL SPENDING	PS M	(2)	(2)		(1)		(1)												9			6			
PERSONAL INCOME	PI M	4		4			4			7															8
FOMC RATE EXPECTED	FOMC M	1	1	2	1	1	1	1	1	3	2		3	4	4	3			7			5			6
Tighter	Tighter																								
Symetric	Symetric																								
# Outliers	# Outliers			16			15			13			9			7			5			4			4

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