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The Micro Dynamics of Macro Announcements*

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Abstract

We examine how regularly scheduled macroeconomic announcements for the U.S., Germany and the euro area affect the German stock market, using high–frequency, minute–by–minute DAX data. Our study extends the literature on high–frequency announcement effects in several ways. First, we account for endogenous return dynamics by assessing announcement impacts via response analysis. Second, we examine the announcements effects on market volatility in a more detailed fashion by distinguishing effects of positive and negative surprises. Finally, we adapt the standard weighted–least–squares approach to more adequately analyze both conditional mean and volatility effects.

JEL: F3, F4, G14, C58
Keywords: announcement effects; market efficiency; information spillover; impulse response analysis; volatility; weighted least squares

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1 Introduction

The question of how fundamental news affect asset prices has been the subject of numerous empirical studies. Earlier work came to the conclusion that asset prices and fundamentals are largely disconnected—especially, in the case of foreign–exchange markets (cf. Meese and Rogoff (1983)). More recent research, using high–frequency, intraday data, shows that—at least in the short–run—asset–price movements are linked to macroeconomic fundamentals. This evidence is largely based on event studies, on announcement regressions, or on time series analyses. All these efforts amount to evaluating the efficient–market hypothesis, which implies that asset prices should react virtually instantaneously to the surprise component in announcements.

The research on high–frequency responses to regularly scheduled macroeconomic announcements has covered a variety of asset classes, with exchange rates and bonds receiving most of the attention.[1] Also, most of the research has predominantly focused on U.S. announcements and the response in U.S. asset markets. Table 1 provides more detailed information about previous macro-announcement studies.[2]

In this paper, we investigate the impact of 64 types of announcements—comprised of 53 U.S., six German and five euro–area announcements—on the German blue–chip stock index DAX, using minute–by–minute returns over a ten–year period. The reasons for selecting the DAX are threefold.[3] First, the DAX covers a highly liquid and for global investors important market segment. Second, by considering the impact of U.S. announcements on the German stock market, we hope to provide insights into the international connectedness of economic activities and financial markets. Finally, and most importantly, in contrast to U.S. markets, German stock markets are open at the time when most of the U.S. announcements are released, which happens usually at 08:30 am (U.S. Eastern Standard Time). This timing issue explains the lack of high–frequency studies of announcement effects on U.S. stocks.[4]

Two types of announcement impacts are typically of interest, namely, asset price responses and volatility responses. The former involves shifts in asset prices as traders act on arriving news. As expectations have been formed before the release, trade only

[1]For exchange rates see, for example, Ehrmann and Fratzscher (2005a), Faust, Rogers, Wang, and Wright (2007), and Almeida, Goodhart, and Payne (1998); for interest rates, Faust, Rogers, Wang, and Wright (2007), and Coffinet and Gouteron (2010); for bonds, Balduzzi, Elton, and Green (2001), Fleming and Remolona (1997), Fleming and Remolona (1999), and Andersson, Overby, and Sebestyén (2009); for futures, Ederington and Lee (1993), and Andersen, Bollerslev, Diebold, and Vega (2007); and, for stock indices, Flannery and Protopapadakis (2002), Brenner, Pasquariello, and Subrahmanyam (2009), Savor and Wilson (2013).

[2]Table 1 also gives an overview of the data used in these studies and compares their findings with our results. We will return to the table in Sections 2 and 4.

[3]Intra–day announcement effects on the DAX have been examined in Entorf and Steiner (2007), Entorf, Gross, and Steiner (2012), and Harju and Hussain (2011). These studies are, however, limited to, at most, 13 announcements and data periods ranging from two to six years.

[4]Studies based on *daily* stock–market data are Li and Hu (1998), who use returns on the Dow Jones and the S&P500 index; Andersen, Bollerslev, Diebold, and Vega (2007), who analyze intraday S&P500 index futures, and Brenner, Pasquariello, and Subrahmanyam (2009), who studied excess returns based on portfolios made up of NYSE and AMEX stocks.

occurs if there is an unexpected surprise in the announcement, i.e., if the announcement deviates from prior market expectation. As a result, investors rebalance their portfolios according to their revised expectations and, thereby, affect prices and volatility.

To handle these two types of announcement effects, we adapt Andersen, Bollerslev, Diebold, and Vega (2003), who adopted weighted–least–squares methods for modeling highly heteroskedastic intraday return series. We modify their approach in several directions. For one, Andersen, Bollerslev, Diebold, and Vega (2003) derive the least–squares weights from a conditional–variance equation that captures both intra– and extra–day seasonalities in the return volatility. As their specification for the conditional–variance equation can give rise to negative weights, we employ an alternative specification that avoids this problem.[5] A second modification is that we allow positive and negative surprises to affect volatility asymmetrically. Furthermore, rather than using one–day–ahead GARCH forecasts as an "anchor" for *daily* volatility, we use implied volatility in form of the VIX index. The use of the VIX appears to be more appropriate as implied volatility represents a forward–looking, market–driven measure of market risk. In addition, for the German market, the VIX contains more recent risk information than a GARCH forecast based on daily close–to–close DAX returns or the previous day's closing level of the VDAX, i.e., the DAX equivalent to the VIX.

Apart from different model specifications, we also differ from the existing literature in the way we analyze our estimation results. The return–equation is commonly specified with lagged returns and lagged announcements as regressors, i.e., an autoregression with exogenous variables. Rather than interpreting the point estimates and significance of the coefficients associated with lagged announcements and, thereby, ignoring any autoregressive dynamics, we derive proper impulse response functions and assess their significance. By doing so, we obtain a more realistic quantification of announcement impacts than by simply interpreting regression coefficients.

To summarize our results, we find that in about two thirds of the cases announcement surprises have a significant impact on the DAX level. The volatility of the DAX also responds to announcement surprises. This is particulary the case for announcements related to investments, real–activity aggregates and surveys. Furthermore, it turns out that in majority of the cases where volatility responds significantly, we observe asymmetric reactions with respect to positive and negative announcement surprises.

The paper is organized as follows. Section 2 describes the announcement data and the high–frequency DAX data used. Section 3 details the modeling approach we adopt. Results are presented in Section 4. Section 5 concludes.

[5]This alternative specification has also been used in Ehrmann and Fratzscher (2005a,b), who focus is on daily data, however.

Table 1: Comparison of announcement effects across different studies

This table compares our results (Column 1) to those of existing announcement studies (Columns 2 to 11), reporting the announcements included and their significance. Rows "Asset" and "Frequency" report the specific assets under investigation and the data frequency employed in the studies. We report the immediate impact, i.e., one or five minutes or one day after the announcement was made, depending on the respective frequency employed. The symbols + (−) indicate "included in the regression and positively (negatively) significant at the 10% level." The circle (∘) indicates "included in the regression, but not significant." A blank indicates that this particular announcement was not included in the study. The announcement studies considered are: (1) this paper: Table 4; (2) Almeida, Goodhart, and Payne (1998): Tables 1 and 4; (3) Andersen and Bollerslev (1998): Table IV; (4) Li and Hu (1998): Table 2; (5) Flannery and Protopapadakis (2002): Table 3; (6) Andersen, Bollerslev, Diebold, and Vega (2003): Table 2; (7) Nikkinen and Sahlstróm (2004): Table 2; (8) Evans and Lyons (2005): Table 2; (9) Ehrmann and Fratzscher (2005a): Table 1; (10) Harju and Hussain (2011): Table 3; (11) Andersson, Overby, and Sebestyén (2009): Table 2.

	(1)	(2)	(3)	(4)		(5)	(6)		(7)	(8)	(9)	(10)				(11)
Asset	DAX	DEM/$	DEM/$	DJ	S&P500	NASDAQ	DEM/$	€/$	VDAX	€/$	€/$	CAC40	FT100	SMI	DAX	Bond
Frequency	1 Min.	5 Min.	5 Min.	Daily		Daily	5 Min.		Daily	Daily	Daily	5 Min.				5 Min.
U.S. Announcements																
Advance Retail Sales	+	+		∘	∘		+	+				+	+	+	+	
Average Hourly Earnings	−									∘						
Average Weekly Hours	+										−					
Building Permits	∘															
Business Inventories	−		∘	∘	∘		∘	∘								∘
Business Investment										∘						
Capacity Utilisation	∘	∘	∘	∘	∘		∘	∘		∘						
Car Sales			∘													
Chicago PMI	+															−
Construction Spending			∘				+	∘		∘						
Consumer Confidence	+	+					+	+		−	−					−
Consumer Credit						∘	∘	∘		∘						
Consumer Spending	∘					∘										
Continuing Claims	∘									+						
Core CPI	−															
Core PPI	−															−
CPI	∘	∘	∘	−	−	−	+	∘	∘	∘	+	∘	∘	∘	∘	
Current Account	∘		∘													
Discount Rate				−	−											
Durable Goods	∘	+	+	∘	∘		+	+		∘		+	+	+	+	−
Durable Goods e Transportation	+															
Earnings (Real)			∘													
Empire Manufacturing	+															
Employment Cost Index	−															
Employment			+						−							
Existing Home Sales	∘															
Factory Orders	+		+				∘	+		∘						−
Feds funds Rate							+	∘	−	∘	−					
GDP (Advance)	+		+			∘	+	+		∘	−	∘	∘	∘	∘	−
GDP (Final)	+						∘	∘		∘						∘
GDP (Preliminary)	+						∘	∘		∘						∘
GDP Price Deflator (Advance)	−															
GDP Price Deflator (Final)	∘															
GDP Price Deflator (Preliminary)	−															
Housing Starts	+		+	+	+	∘	∘	∘		∘	∘	∘	+	+	+	
Housing Completion			∘													
House Sales			∘	∘	∘											
Import Price Inde	−		∘													
Industrial Production	+	∘		∘	∘	∘	+	+		∘	∘	+	+	+	+	−
Initial Jobless Claims	−		+				−	−								+
ISM Manufacturing	+											+	+	+	+	−
ISM Non-manufacturing	+															−
ISM Prices Paid	−															
ISM Services												+	+	+	+	
Leading Indicator	+	∘	+	∘	∘	∘	∘	∘		∘		+	+	+	+	
Manufacturing Payrolls	∘															
Merchandise Trade			+													
Money Supply, M1				−	−	−	+	+		+						
Money Supply, M2			∘			∘	+	+		∘						
Money Supply, M3							∘	+		∘						
Monthly Budget Statement							∘	∘		∘						
NAPM		+	∘				+	+		−	−					
New Home Sales	∘					∘	∘	∘		−						
Non-farm Payrolls	−	+		∘	−	∘	+	+			−					−
Nonfarm Productivity (Final)	∘		∘													
Nonfarm Productivity (Preliminary)	+															
Personal Consumption (Advance)	+					∘										

Continued on next page.

Table 1 – *cont. from previous page.*

	(1)	(2)	(3)	(4)		(5)	(6)		(7)	(8)	(9)	(10)				(11)
Personal Consumption (Final)	∘															
Personal Consumption (Preliminary)	∘															
Personal consumption expenditures							∘	∘		−						
Personal Income	−		∘			∘	∘	∘		∘		∘	∘	+	∘	
Personal Spending	+															
Philadelphia Fed Index																−
PPI	−	+	+	−	−	−	∘	+	∘	−	∘	∘	∘	∘	∘	−
Retail Sales Less Autos	+		+			∘	+	+			∘					−
Trade Balance	+	+		+	∘	∘	+	+		−	∘	+	+	+	+	
Unemployment Rate	∘	−		∘	∘	∘				+	+	−	−	−	∘	
Unit Labor Costs (Final)	−															
Unit Labor Costs (Preliminary)	−															
University of Michigan (Final)	+		∘													−
University of Michigan (Preliminary)	+															
Wholesale Inventories	−		∘													
German Announcements																
Bundesbank meeting			+								∘					
Business Insolvencies			∘													
Consumer price index		+	∘				∘	∘	∘		∘					∘
Current Account			∘				∘	∘								
Employment			∘				∘	∘	∘	∘						
GDP			∘				∘	∘		∘	∘					
IFO (Business)	+										+					−
IFO (Current)	∘															
IFO (Expectations)	∘															
Import Prices			∘				∘	∘		−						
Industrial Production	+	−					−	∘		∘	∘					∘
Industrial Orders			∘													
Manufacturing orders		∘					∘	∘			∘					
Manufacturing output			∘				∘	∘								
Money Stock M3		∘	+				−	−		∘	∘					
Producer price index		∘	∘				∘	∘	∘	+	∘					
Retail Sales		∘	∘				∘	−		∘	∘					
Trade Balance		∘					∘	∘		−	∘					
Unemployment		−					∘	∘			∘					∘
Wholesale Price Index		∘	∘				∘	∘		∘						
Wholesale Turnover			∘													
ZEW	+															−
ZEW (Current)	∘															
Euro–area Announcements																
Business Climate	∘															∘
Consumer Confidence	∘															
ECB Interest Rate	−								∘							+
HICP																∘
Flash HICP	∘															−
Industrial Production	+															−
Manufacturing PMI																∘
Unemployment																∘

2 The Data

2.1 Announcements, Expectations and News

The data on the altogether 64 regularly released announcements as well as the expectations for the announcements were taken from Bloomberg[6] and cover the period from 1997 to 2006. Table 2 lists all variables our announcement set covers and reports, in each case, the total number of releases, the number of zero surprises (i.e., exact matches between expectations and announcements), the sample period they cover, the announcement time (Central European Time, CET), and the release frequency. Out of the 64 announcements, 48 are published at monthly, 14 at quarterly and two at weekly frequencies. Most U.S. announcements are published at 14:30 CET.[7] All the German and euro–area announcements considered are published either in the morning or at noon.[8] The set of announcements considered is an expansion of that used in Andersson, Overby, and Sebestyén (2009).[9] Table 1, listing the announcement data used here and those in previous studies, reveals that present study employs the most extensive set thus far.

The *surprise* or *news* for announcement variable, i, at announcement date t, denoted by $S_{i,t}$, is defined as the difference between published value, $A_{i,t}$, and the analysts' median expectation, $E_{i,t}$. To allow for the different scaling of the underlying variables, surprises are expressed in terms of standard deviations, i.e.,

$$S_{i,t} = \frac{A_{i,t} - E_{i,t}}{\sigma_i}, \tag{1}$$

where σ_i denotes the standard deviation of the announcement forecast error, $A_{i,t} - E_{i,t}$. This standardization allows us to more directly compare the estimation results across announcements.

In line with Balduzzi, Elton, and Green (2001) and Andersson, Overby, and Sebestyén (2009), we conduct a simple test for unbiasedness of the survey expectations by estimating regression

$$A_{i,t} = \alpha_i + \beta_i E_{i,t} + \epsilon_{i,t}, \quad i = 1, \ldots, 64. \tag{2}$$

Under the null of unbiased market expectations, we have $\alpha = 0$ and $\beta = 1$, which we jointly test using an F–test. The results are reported in the last three columns in Table 2. For the majority of releases, the hypothesis of unbiasedness cannot be rejected at the

[6]Bloomberg asks economists at various banks about their expectations concerning upcoming announcements in the U.S. and Europe. In case of the U.S., data on expectations are collected up to the day before the announcement; in case of European announcements, the expectations are fixed on the Friday before the expected release. In all cases, the expected value of an announcement is defined by the median of the surveyed panelists' expectations.

[7]A few U.S. announcements are published at 16:00 CET. There are discrepancies in a small number of cases due to the non–synchronous adjustments in daylight–saving–time in the U.S. and Europe.

[8]Some announcements for Germany, such as GDP, are released at 08:30 (CET) in the morning, i.e., before stock markets open. We excluded those from the analysis.

[9]For a detailed description of the U.S. announcements see Neely and Dey (2010).

95%–level. Rejections occur for 16 U.S. announcements (among them CPI, PPI, non-farm payrolls, and the unemployment rate), two German announcements (Ifo business assessment and ZEW sentiment), and for the euro area Flash HICP.[10] In most cases, the rejections are due to the β–estimate deviating significantly from unity rather than the α–estimates deviating from zero, i.e., systematic over– or underpredictions.

2.2 High–frequency DAX Data

In order to analyze the impact of macroeconomic announcements on the German stock market, we employ intraday data of the DAX (Deutscher Aktienindex). The DAX is an aggregate of the Prime Standard's 30 largest German companies in terms of order–book volume and market capitalization. The sample consists of minute–by–minute index–level data from January 2, 1997 through December, 28 2006.[11] Index calculations start at 09:00 CET and end with documenting prices from the DAX closing auction at 17:30 CET. Altogether, the data set consists of a total of 2,509 trading days which amounts to 1,282,099 minute–by–minute return observations.[12]

The literature on high–frequency announcement–impact studies varies greatly with respect to the chosen frequencies. Almeida, Goodhart, and Payne (1998) note that some announcements may have a "discernable" impact on asset prices measured at high frequencies, but the effects may be masked at lower frequencies due to the increasing arrival of (other than macroeconomic announcement) news. Jain (1988), using hourly data, reports that responses of the S&P500 index to macroeconomic announcements more or less settle within one hour. Patell and Wolfson (1984) and Jennings and Starks (1985), using minute–by–minute data, show that stock prices capture most of the newly arriving information within 10 to 15 minutes. Ederington and Lee (1993, 1995), find that T-Bonds, and foreign–exchange rates absorb news effects within one minute after the announcement. Entorf and Steiner (2007) and Entorf, Gross, and Steiner (2012) report similar findings for the DAX.

Our choice of minute–by–minute returns should reasonably balance the trade-off between high resolution, i.e., the ability to attribute effects to a specific announcement, and possible biases due to microstructure noise. With respect to the latter, the choice of one–minute rather than, say, five–minute returns seems appropriate given the high informational efficiency of the German DAX market.

[10] These findings are in line with results found for the International Money Market Services (MMS) data set; see Balduzzi, Elton, and Green (2001) and Andersen, Bollerslev, Diebold, and Vega (2003). Every Friday the MMS asks about 40 money manages about their forecasts for all the indicators released in the subsequent week.

[11] The high–frequency DAX data were provided by the "Karlsruher Kapitalmarktdatenbank" at the University of Karlsruhe.

[12] The sample was obtained after excluding weekends, fixed holidays, such as Christmas (December 24-26), New Years (December 31 - January 1), German Unification Day (October 3), and Labor Day (May 1) as well as moving holidays, such as Good Friday, Easter Monday, Whitsun Monday, and Ascension Day. In the rare cases of missing quotes, we performed linear interpolation. Finally, days containing 75 consecutive minutes of zero or constant quotes were excluded.

Table 2: Summary of announcements under investigation

This table reports details of all announcements considered and sorted by region (USA, Germany and euro area). For each announcement, we state the number of observed surprises (S) and zero or non–surprise (NS), the sample–period's starting and ending dates (Period), and the announcement time (AT) in Central European Time. For some announcements, release times changed during the sample; specifically: [a]14:30 until the end of 2004 and 16:00 since 2005; [b]16:00 until the end of 2000, from 2001 on 14:30; [c]varies between 15:45 and 16:00; [d]15:00 until the end of 2002, from 2003 on 11:00; [e]12:00 until February 2002, from March 2002 on 11:00. Furthermore the table states the release frequency (F), where W = weekly, M = monthly, Q = quarterly, and 6W = every 6 weeks. Finally, we report the results of a test for rationality given by Equation (2). The p-values result from an F–test of the null hypothesis: $\alpha = 0$ and $\beta = 1$. Figures in bold indicate a rejection of the null, suggesting that the forecasts are biased.

						Test for Rationality		
Announcement	S	NS	Period	AT	F	α	β	p-value
			U.S. Announcements					
Real Activity Aggregates								
Capacity Utilization	119	9	01/17/97 - 12/15/06	15:15	M	0.00	1.00	0.99
GDP (Prel.)	40	5	02/27/97 - 11/29/06	14:30	Q	0.00	0.99	0.10
GDP (Advance)	40	0	01/31/97 - 10/27/06	14:30	Q	0.00	0.94	0.57
GDP (Final)	39	7	03/26/97 - 12/21/06	14:30	Q	0.00	1.03	0.42
Industrial Production	119	14	01/17/97 - 12/15/06	15:15	M	0.00	1.19	**0.03**
Personal Income	119	32	02/03/97 - 12/22/06	14:30	M	0.00	0.99	0.14
Consumption								
Advance Retail Sales	119	12	01/14/97 - 12/12/06	14:30	M	0.00	1.26	**0.01**
Consumer Spending	105	5	01/03/97 - 12/01/06	16:00	M	0.00	0.35	**0.05**
Personal Consumption (Preliminary)	15	1	02/28/03 - 11/29/06	14:30	Q	0.00	0.92	**0.08**
Personal Consumption (Advance)	15	3	01/30/03 - 10/27/06	14:30	Q	0.00	1.04	0.88
Personal Consumption (Final)	16	8	03/27/03 - 12/21/06	14:30	Q	0.00	1.03	0.63
Personal Spending	118	37	02/03/97 - 12/22/06	14:30	M	0.00	1.19	**0.00**
Retail Sales Less Autos	114	15	05/13/97 - 12/13/06	14:30	M	0.00	1.51	**0.01**
Housing								
Building Permits	53	0	08/16/02 - 12/19/06	14:30	M	-4.24	1.01	0.31
Existing Home Sales	107	4	08/26/97 - 12/28/06	16:00	M	0.08	1.00	**0.02**
Hoing Starts	109	1	03/17/98 - 12/19/06	14:30	M	110.25	0.95	0.15
New Home Sales	112	0	08/29/97 - 12/27/06	14:30	M	33.66	0.98	0.12
Investment								
Business Inventories	113	20	07/16/97 - 12/13/06	16:00 [a]	M	0.00	1.09	0.15
Durable Goods	109	2	11/26/97 - 12/22/06	14:30	M	0.00	1.69	**0.00**
Durable Goods ex Transportation	61	1	12/28/01 - 10/31/06	14:30	M	0.00	0.98	0.20
Empire Manufacturing	49	1	11/15/02 - 05/11/06	14:30	M	6.40	0.75	0.10
Factory Orders	119	09	01/07/97 - 12/05/06	16:00	M	0.00	1.04	0.22
Wholesale Inventories	113	8	01/09/97 - 12/11/06	16:00	M	0.00	1.07	0.12
Prices								
Core CPI	119	48	01/14/01 - 12/15/06	14:30	M	0.00	0.48	**0.02**
Core PPI	60	12	11/01/97 - 12/19/06	14:30	M	0.00	1.75	0.49
CPI	107	37	01/13/98 - 12/15/06	14:30	M	0.00	1.29	**0.00**
GDP Price Deflator (Preliminary)	35	14	05/28/98 - 11/29/06	14:30	Q	0.00	1.01	0.96
GDP Price Deflator (Advance)	35	1	04/30/98 - 10/27/06	14:30	Q	0.00	1.11	0.66
GDP Price Deflator (Final)	34	6	06/25/98 - 12/21/06	14:30	Q	0.01	0.49	**0.01**
Import Price Index	105	4	01/10/02 - 12/14/06	14:30	M	0.00	1.73	**0.00**
PPI	120	12	12/12/97 - 12/19/06	14:30	M	0.00	1.89	**0.00**
Surveys								
Chicago PMI	118	0	01/31/97 - 03/31/06	16:00	M	2.22	0.97	0.48
Consumer Confidence	119	0	02/25/97 - 12/28/06	16:00	M	0.01	1.00	0.75
ISM Manufacturing	119	3	02/03/97 - 12/01/06	16:00	M	0.11	1.00	0.99
ISM Non-manufacturing	95	1	01/06/99 - 12/05/06	16:00	M	7.19	0.88	**0.07**
ISM Prices Paid	77	2	07/03/00 - 12/01/06	16:00	M	1.92	0.97	0.75
Leading Indicator	116	47	03/04/97 - 12/21/06	16:00	M	0.00	1.23	**0.00**
University of Michigan (Final)	92	1	05/28/99 - 12/22/06	16:00 [c]	M	3.99	0.96	**0.03**
University of Michigan (Preliminary)	91	0	05/14/99 - 12/08/06	16:00 [c]	M	3.96	0.95	0.33

Continued on next page.

Table 2 – *cont. from previous page.*

Announcement	S	NS	Period	AT	F	Test for Rationality α	β	p-value
Labour								
Average Hourly Earnings	102	24	07/02/98 - 08/12/06	14:30	M	0.00	0.98	0.69
Average Weekly Hours	93	36	02/05/99 - 08/12/06	14:30	M	0.82	0.98	0.11
Continuing Claims	187	4	08/08/02 - 12/28/06	14:30	W	25.14	0.99	0.49
Employment Cost Index	40	9	01/28/97 - 10/31/06	14:30	M	0.01	0.37	**0.01**
Initial Jobless Claims	490	15	04/03/97 - 12/28/06	14:30	W	9.26	0.97	0.27
Manufacturing Payrolls	96	4	01/08/99 - 12/08/06	14:30	M	-9.04	1.26	**0.00**
Non-farm Payrolls	116	0	01/10/97 - 12/08/06	14:30	M	-28.57	1.06	**0.08**
Nonfarm Productivity (Final)	35	4	03/10/98 - 12/05/06	14:30	Q	0.00	1.04	0.16
Nonfarm Productivity (Preliminary)	36	1	02/10/98 - 11/02/06	14:30	Q	0.00	1.13	**0.04**
Unemployment Rate	117	36	01/10/97 - 12/08/06	14:30	M	0.00	0.96	**0.00**
Unit Labor Costs (Final)	30	1	06/08/99 - 12/05/06	14:30	Q	0.00	1.03	0.70
Unit Labor Costs (Preliminary)	29	1	08/05/99 - 11/02/06	14:30	Q	0.00	1.09	0.60
Others								
Current Account	36	0	03/12/98 - 12/18/06	16:00 [b]	Q	-0.67	0.99	0.93
Trade Balance	117	3	01/17/97 - 12/12/06	14:30	M	-0.32	1.00	0.61
German Announcements								
IFO (Business)	113	3	06/19/97 - 12/19/06	10:00	M	-2.54	1.03	0.35
IFO (Current)	53	0	06/25/06 - 12/19/06	10:00	M	-3.03	1.04	**0.01**
IFO (Expectations)	53	1	06/25/06 - 12/19/06	10:00	M	-2.81	1.03	0.15
Industrial Production	99	3	04/03/97 - 12/08/06	11:00	M	0.00	1.09	0.10
ZEW	58	0	03/19/02 - 12/12/06	11:00 [d]	M	-0.29	0.97	0.47
ZEW (Current)	45	0	02/17/04 - 12/12/06	11:00	M	4.11	1.07	**0.00**
Euro Area Announcements								
Business Climate	48	1	03/08/01 - 11/30/06	11:00	M	0.01	1.07	0.12
Consumer Confidence	63	25	03/04/01 - 11/30/06	11:00	M	0.26	1.01	0.71
Flash HICP	60	30	05/11/01 - 11/30/06	11:00[e]	M	0.00	1.14	**0.04**
Industrial Production	69	3	03/21/01 - 12/15/06	11:00[e]	M	0.00	0.81	0.11
ECB Interest Rate	113	94	04/03/99 - 12/07/06	13:45	6W	0.00	1.00	0.22

3 Empirical Analysis

3.1 The Model

There are two common empirical approaches in the macro–announcement literature. The first and most widely used method is the event–study approach, where observed returns around events are compared to hypothetical "normal" or "event–free" returns. The second strategy employs time series regressions, where return series are assumed to be driven by their own (autoregressive) past and by announcement surprises. The latter, in order to account for the heteroskedastic nature of return series, typically employ weighted–least–squares (WLS) estimation, with the weights derived from some GARCH–type model.

In a seminal article, Andersen and Bollerslev (1998)[13] show that the conditional variance of high–frequency exchange–rate returns is characterized by a strong intraday periodicity. From their study, it is evident that the estimation and extraction

[13] See also Andersen and Bollerslev (1997).

of the intraday periodic component is indispensable for meaningful analysis of intraday dynamics. Investigating high–frequency Deutsche Mark–U.S. Dollar returns, they demonstrate that the volatility process can be decomposed into three components: a deterministic periodic component (including day-of-the-week and calender effects), announcement effects, and ARCH effects. Andersen and Bollerslev (1998) and Andersen, Bollerslev, Diebold, and Vega (2003) capture the periodic intraday–volatility components using the Fourier flexible form introduced by Gallant (1981).

We follow this approach in specifying a mean and volatility equation to jointly examine the announcement effects on returns and volatility.[14] We model the conditional mean of the minute–by–minute DAX returns, R_t, via

$$R_t = \alpha_0 + \sum_{i=1}^{I} \alpha_i R_{t-i} + \sum_{k=1}^{K} \sum_{j=0}^{J} \beta_{kj} S_{k,t-j} + \alpha_{on} D_t^{on} + \alpha_{dg} D_t^{dg} + \epsilon_t, \quad t = 1, \ldots, T, \tag{3}$$

with $K = 64$ being the number of announcement variables, lag lengths $I = 10$, $J = 10$, and dummies D_t^{on} and D_t^{dg} capturing overnight and weekend/holiday breaks, respectively. Ordinary least–squares (OLS) estimation of (3) would yield consistent but inefficient estimates due to the heteroskedasticity of ϵ_t. To allow for this, we perform WLS estimation and fit the conditional volatility model

$$\begin{aligned} \log|\hat{\epsilon}_t| = a + b_1 X_t^{USM} + b_2 VIX_{d(t)-1} + \sum_{k=1}^{K} \sum_{j=0}^{P-1} \gamma_{k,j} \tau^j \left[1 - \left(\frac{\tau}{60} \right)^{P-j} \right] \qquad (4) \\ + \sum_{q=1}^{Q} \left[\phi_q \sin\left(\frac{2\pi q t'}{\sqrt{N}} \right) + \varphi_q \cos\left(\frac{2\pi q t'}{\sqrt{N}} \right) \right] + \sum_{k=1}^{K} \sum_{j=0}^{J} (\theta_{k,j} |S_{k,t-j}| + \delta_{k,j} S_{k,t-j}) + u_t \end{aligned}$$

to the OLS residuals, $\hat{\epsilon}_t$. In (4), X_t^{USM} is a dummy variables indicating the opening of the New York stock market; the trigonometric terms, representing the Fourier flexible form, model the intraday periodicity of volatility (with $Q = 3$); the polynomial in time τ, with τ (expressed in minutes) captures the volatility dynamics up to one hour after an announcement (with $P = 3$); and N represents the number of minutes per day.

Our specification of the conditional volatility equation (4) differs in several ways from common ones, such as in Andersen, Bollerslev, Diebold, and Vega (2003). For one, the functional form with which volatility evolves has been treated differently in the literature. Whereas Andersen, Bollerslev, Diebold, and Vega (2003, 2007), Harju and Hussain (2011) and Andersson, Overby, and Sebestyén (2009) take absolute values of the OLS residuals and Ehrmann and Fratzscher (2005a,b) the logarithm of the squared residuals, we use the logarithm of the absolute residuals, as done in Nowak, Andritzky, Jobst, and Tamirisa (2011). We prefer this specification, because absolute or squared residuals without taking logarithms give rise to negative weights for the WLS estimation. Also, for our data, the log–absolute specification provided a better

[14] The WLS approach was also employed in Andersson, Overby, and Sebestyén (2009), Ehrmann and Fratzscher (2005a,b), Harju and Hussain (2011), and Nowak, Andritzky, Jobst, and Tamirisa (2011).

Table 3: Comparing the goodness of fit for alternative specification of Equation (4)

This table reports the R^2–values for different specifications of the announcement surprises in the volatility Equation (4). $D_{k,t-j}$ stands for the inclusion of a dummy variable, assuming the value one for a nonzero announcement surprise; $|S_{k,t-j}|$ means that the absolute value of the surprise is specified; and inclusion of $|S_{k,t-j}|$ and $S_{k,t-j}$ allows for asymmetric impacts for positive and negative surprises.

Surprise specification	R^2
$D_{k,t-j}$	0.0725
$\|S_{k,t-j}\|$	0.0724
$\|S_{k,t-j}\|$ and $S_{k,t-j}$	0.0728

fit for the volatility dynamics than that in log–squares.

Secondly, as a proxy for daily volatility, we use the previous day's VIX closing level, i.e., the implied volatility of the S&P500, denoted by $VIX_{d(t)-1}$, instead of daily GARCH forecasts. The use of the VIX has two advantages. First, in contrast to sample standard deviation or GARCH–based proxies, the VIX is more of a forward–looking measure of uncertainty based on most current market information. Moreover, market uncertainty in the opening hours of DAX trading is, at least to some degree, determined by previous day's events on U.S. markets that occurred after market–closing in Europe. Therefore, it is more informative for DAX–stock traders to look at the previous day's VIX closing level rather than its German counterpart, the VDAX, as an up-to-date indicator of market uncertainty. For these reasons, the VIX–based WLS estimates are expected to better capture heteroskedasticity induced by overall market uncertainty.

Finally, we allow announcements to have asymmetric impacts on volatility. In the previous literature, the volatility impact has been either captured by the absolute value of the announcement surprise, $|S_{k,t-j}|$, as in Andersen, Bollerslev, Diebold, and Vega (2003) and Ehrmann and Fratzscher (2005a), or via dummy variables, $D_{k,t-j}$, as in Andersson, Overby, and Sebestyén (2009) and Nowak, Andritzky, Jobst, and Tamirisa (2011). Including $|S_{k,t-j}|$ and $S_{k,t-j}$ as regressors in (4) not only provides the best fit, as indicated by the R^2–values in Table 3, but also allows us to investigate both size and asymmetry effects of announcements on volatility.

3.2 Impact Assessment

Apart from the differences in model specification, we also adopt alternative strategies for evaluating the announcement impacts. So far, it has been ubiquitous to interpret, in (3), the beta–coefficients associated with lagged surprises, in order to assess the sign, size and significance of announcement impacts. This, however, ignores the dynamics arising from the autoregressive component in (3), which turns out to be highly significant for our sample. Abstracting from the deterministic components in (3), the relationship between the return, R_t, and the announcement surprise, S_{it}, is given by

$$\alpha(L)R_t = \sum_{k=1}^{K} \beta_k(L)S_{kt} + \epsilon_t,$$

where L denotes the lag operator, This amounts a linear dynamic system with "surprise" variables, see Baillie (1987), so that

$$R_t = \sum_{k=1}^{K} \frac{\beta_k(L)}{\alpha(L)} S_{kt} + \frac{\epsilon_t}{\alpha(L)} = \sum_{k=1}^{K} c_k(L)S_{kt} + \nu_t. \quad (5)$$

Therefore, it is the impulse response function $c_{kj}, j = 0, 1, 2 \ldots$, rather than the β_{kj}–coefficients that reflect the announcement impact implied by (3). Given the parameters α_j and β_{ij}, we follow Mittnik (1987) and compute the vector of impulse responses coefficients up to order N, $c_k = (c_{k0}, c_{k1}, \ldots, c_{kN})'$ via $c_k = (I - T_\alpha)^{-1}\beta_k$, where $\beta_k = (\beta_{0k}, \beta_{k1}, \ldots, \beta_{kN})'$ and T_α is an $(N+1) \times (N+1)$ lower–triangular Toeplitz matrix with the first column given by vector $(0, \alpha_1, \ldots, \alpha_N)'$. In addition to the impulse response, below, we also report estimates for the cumulative response function, $C_{kN} = \sum_{n=1}^{N} c_{kn}$ as well as the permanent effect, given by

$$C_{k,\infty} = \frac{\beta_k(1)}{\alpha(1)} = \frac{\sum_j \beta_{kj}}{1 - \sum_j \alpha_j}. \quad (6)$$

Although impulse or cumulative response estimates can be used to assess announcement effects, cumulative–response estimates probably best summarize the overall economic impact of announcement surprises.

4 Results

Reporting our results, we summarize general observations first and, then, take a closer look at some specific findings. The main results are given in Figures 1 and 2 and in Table 4. Figure 2 presents three graphs for each of the 64 announcement: the impulse (left) and the cumulative (center) response estimates together with their asymptotic 90% confidence bands,[15] and the symmetric component of the volatility response (right), captured by the coefficients $\theta_{k,j}$ in (4). Table 4 reports the first–minute and permanent return impacts (Columns 1 and 2, both measured in basis points)[16] and the first–minute volatility effects, namely, the symmetric response component, $\theta_{k,1}$, and the aggregate

[15] To derive the asymptotic confidence bands for the estimates of interest (i.e., impulse response functions, cumulative response functions and permanent effects), we follow Mittnik and Zadrozny (1993).

[16] Considering, for example, U.S. GDP (Advance), the entries in Table 4 are read as follows: a positive one–standard–deviation announcement–surprise leads, on average, to a DAX increase of 13.2 basis points within one minute and a permanent increase of 30.0 basis points.

volatility responses to negative, $\theta_{k,1} - \delta_{k,1}$, and positive, $\theta_{k,1} + \delta_{k,1}$, surprises. Finally, the boxplots of the p–values for (impulse and cumulative) return and volatility responses in Figure 1 compactly reveal the overall shifts in the significance of the responses around announcement releases.

4.1 Return Effects

The results of the response analysis, shown in Figure 2 and Table 4, give rise to four general conclusions. The first finding is that announcements generally matter. Considering the 90%–significance level, the German DAX shows in 42 out of the 64 announcements a significant one–minute response. The fact that 37 of the 53 U.S. announcement lead to significant responses reflects the importance of the U.S. economy for Germany's—heavily export–oriented—blue–chip stock companies. Of the six German announcements only three matter significantly, namely, German Industrial Production and two survey indicators for the German economy, the Ifo Business Climate Index and the ZEW indicator. Two of the five euro–area announcements (ECB interest rate and euro–area industrial production) turn out to be significant.

Second, news announcements not only matter but, as Figure 2 shows, their impact is rather immediate. For the 64 announcements, we observe for the subsequent minutes one through four 42, 11, 8, and 5 significant impulse responses, respectively. The responses of the pre–announcement returns, i.e., the returns during the minute preceding the announcement, are largely insignificant. This follows from the most left boxplot of the upper panel in Graph A in Figure 1.[17]

Third, the coefficients of the estimated first–minute impact have the expected sign. In Table 1 we compare our results (Column 1) with those of ten other studies in the literature (Columns 2 to 11). A blank entry indicates that this particular announcement was not included in that study. A "plus" ("minus') sign indicates a significant positive (negative) response at the 10% level; and a "circle" denotes an insignificant response.[18] Although most of the immediate responses have the expected sign, their statistical significance varies. The study most comparable to ours is Harju and Hussain (2011), who investigate the impact of 13 announcements on, among others, the DAX, using five–minute returns. Our conclusions differ in four of these 13 cases, namely: Durable Goods (insignificant in this study vs. significantly positive in Harju and Hussain (2011)), GDP Advance (significantly positive vs. insignificant), Personal Income (significantly negative vs. insignificant), and PPI (significantly negative vs. insignificant).

[17]However, eight of the 64 p-values fall below 0.1 indicating pre-release activities for Nonfarm Productivity (Preliminary), GDP Price Deflator (Advance), Unit Labor Costs (Preliminary), Durable Goods ex Transportation, Chicago PMI, Average Weekly Hours, University of Michigan (Preliminary), and ECB Interest Rate announcements.

[18]Note, however, that the data frequencies in these studies varies greatly. The comparisons in Table 1 are with respect the most immediate response–lag reported.

Table 4: DAX–level and –volatility responses to macroeconomic announcements

This table reports the impulse response after one minute ($c_{i,1}$) and the permanent response ($C_{i,\infty}$) of the DAX (measured in basis points) from the WLS estimation of Equation (3). Furthermore, it reports the one–minute volatility responses captured by Equation (4). The coefficients $\theta_{k,1}$ refer to the absolute impact of surprises on volatility ($|S_{k,t-j}|$). Also reported are the reactions to negative ($\theta_{k,1} - \delta_{k,1}$) and positive ($\theta_{k,1} + \delta_{k,1}$) announcements. Asterisks ***, **, and * indicate coefficients that are statistically significant at the 1%, 5% and 10% level, respectively. Asymptotic significance is assessed following Mittnik and Zadrozny (1993). The announcements are thematically ordered as in Table 2.

	Level Effects		Volatility Effects		
	1^{st} Min.	Perm.	1^{st} Minute Impact		
	Impact	Impact	$\theta_{k,1}$	$\theta_{k,1} - \delta_{k,1}$	$\theta_{k,1} + \delta_{k,1}$
U.S. Announcements					
Real Activity Aggregates					
Capacity Utilisation	-1.6	-0.7	0.30	0.20	0.40
GDP (Preliminary)	6.2**	5.4	0.78**	0.80**	0.76*
GDP (Advance)	13.2***	30.0***	1.12***	0.79*	1.46***
GDP (Final)	3.3	1.3	0.71**	0.51	0.90**
Industrial Production	4.5***	4.7	0.57**	0.62**	0.53*
Personal Income	-2.0*	-2.2	0.57***	0.73***	0.40**
Consumption					
Advance Retail Sales	3.1*	6.3*	-0.05	-0.05	-0.05
Consumer Spending	0.0	5.6*	-0.02	0.10	-0.14
Personal Consumption (Preliminary)	3.1	16.1**	0.09	0.10	0.07
Personal Consumption (Advance)	13.4***	13.8*	0.08	0.18	-0.02
Personal Consumption (Final)	0.0	2.8	-0.49	-0.03	-0.95*
Personal Spending	1.9**	0.6	0.28*	0.28	0.28
Retail Sales Less Autos	2.9*	2.3	0.75***	0.72**	0.78***
Housing					
Building Permits	0.4	-2.2	0.08	0.29	-0.14
Existing Home Sales	3.1	-0.6	0.50***	0.51**	0.50**
Housing Starts	2.2*	6.0	0.60***	0.53**	0.67**
New Home Sales	1.2	0.4	0.24	0.21	0.27
Investment					
Business Inventories	-4.1***	-5.7	0.47***	0.41**	0.53**
Durable Goods	2.3	2.0	0.65***	0.87***	0.43*
Durable Goods ex Transportation	11.3***	14.5***	0.50**	0.10	0.91***
Empire Manufacturing	7.3***	7.1*	0.87***	0.80***	0.93***
Factory Orders	3.5***	5.6*	0.54***	0.45**	0.63***
Wholesale Inventories	-2.1**	-8.0***	0.09	0.05	0.14
Prices					
Core CPI	-9.0***	-12.1***	0.29	0.39*	0.19
Core PPI	-5.3***	-14.5***	0.05	0.02	0.07
CPI	-3.3	-3.8	0.48***	0.53**	0.42*
GDP Price Deflator (Preliminary)	-8.3***	-10.4	0.48	0.28	0.68*
GDP Price Deflator (Advance)	-3.1*	-5.3	0.41	0.07	0.75
GDP Price Deflator (Final)	-3.2	-5.5	0.13	0.10	0.17

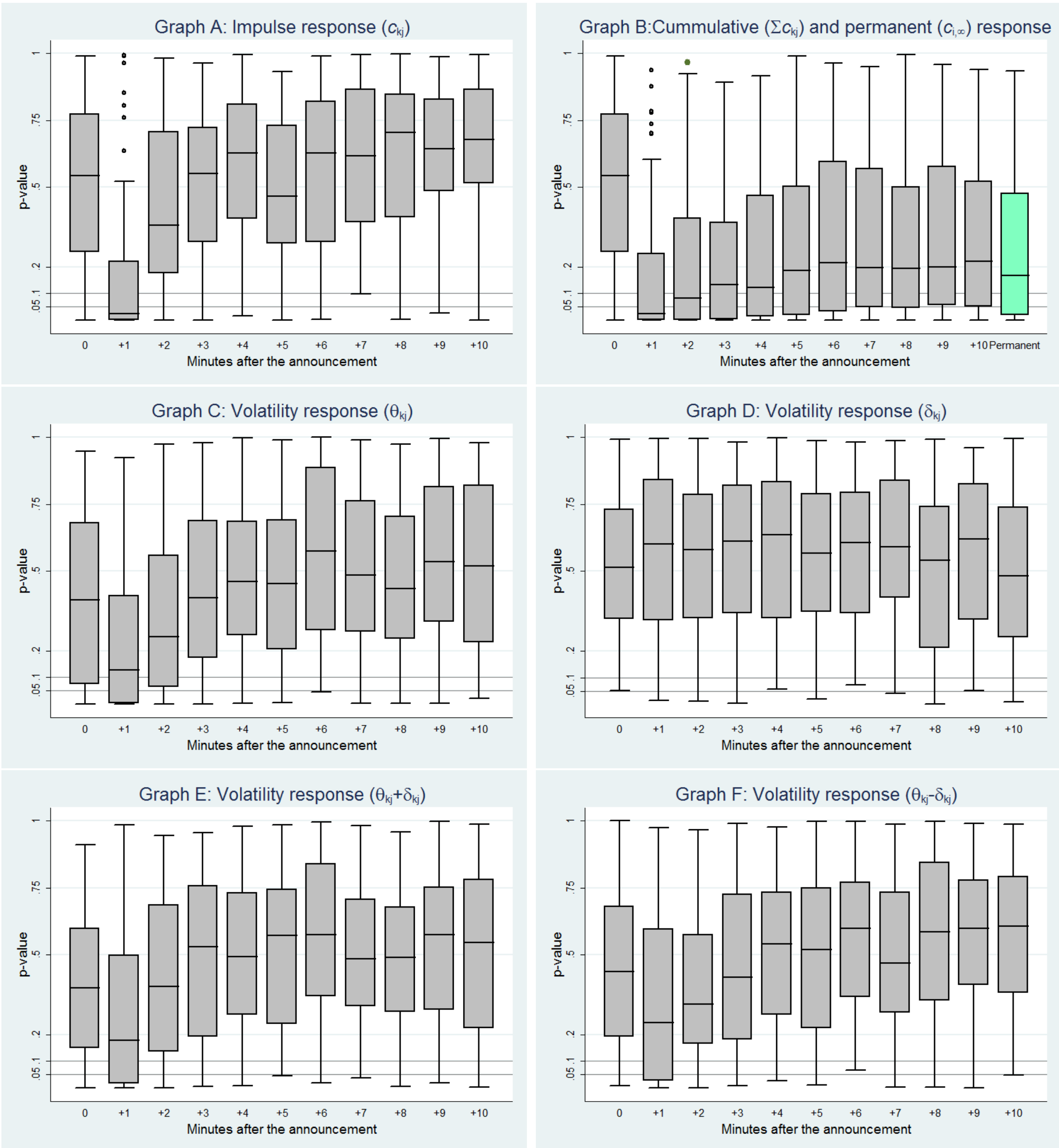
Continued on next page.

Table 4 – *cont. from previous page.*

	Level Effects		Volatility Effects		
	1^{st} Min.	Perm.	1^{st} Minute Impact		
	Impact	Impact	$\theta_{k,1}$	$\theta_{k,1} - \delta_{k,1}$	$\theta_{k,1} + \delta_{k,1}$
Import Price Index	-2.6**	-2.5	-0.03	-0.32	0.26
PPI	-11.0***	-4.3	0.66***	0.78***	0.55*
Surveys					
Chicago PMI	8.9***	11.7***	0.84***	0.66***	1.02***
Consumer Confidence	14.0***	15.2***	0.95***	0.96***	0.95***
ISM Manufacturing	3.5***	-0.6	0.24	0.14	0.34
ISM Non-manufacturing	8.1***	13.3***	0.48***	0.31	0.64***
ISM Prices Paid	-3.7***	-10.3***	-0.09	0.08	-0.26
Leading Indicator	4.2***	3.8	0.45***	0.42*	0.49***
University of Michigan (Final)	3.6***	6.5**	0.49***	0.49**	0.49**
University of Michigan (Preliminary)	4.5***	7.2***	0.44**	0.54**	0.34
Labor					
Average Hourly Earnings	-4.1***	-3.8	-0.32	-0.29	-0.36
Average Weekly Hours	7.1***	9.3**	0.35	0.55**	0.15
Continuing Claims	-1.7	-4.4	0.14	0.16	0.13
Employment Cost Index	-3.9**	-11.1***	0.39	0.51	0.27
Initial Jobless Claims	-3.8***	-4.6*	0.54***	0.55***	0.53***
Manufacturing Payrolls	-1.0	-2.3	0.15	-0.06	0.37
Non-farm Payrolls	-6.9***	8.4*	0.74***	0.86***	0.63***
Nonfarm Productivity (Final)	2.4	2.1	-0.17	-0.02	-0.32
Nonfarm Productivity (Preliminary)	10.1***	15.9***	0.37	0.24	0.49
Unemployment Rate	-1.8	4.4	0.55***	0.45*	0.66**
Unit Labor Costs (Final)	-5.5***	-9.3***	0.50	0.99	0.01
Unit Labor Costs (Preliminary)	-9.1***	-13.4***	0.25	0.28	0.23
Others					
Current Account	-0.9	3.3	0.34	0.36	0.32
Trade Balance	6.8***	9.1***	0.38**	0.24	0.51**
German Announcements					
IFO (Business)	5.8***	6.1	0.71***	0.25	1.16***
IFO (Current)	-0.9	2.7	-0.27	-0.07	-0.48
IFO (Expectations)	1.1	-2.1	0.49	0.74*	0.23
Industrial Production	1.8**	2.5	0.19	0.13	0.24
ZEW	11.6***	9.3**	0.36	0.26	0.46
ZEW (Current)	0.1	1.2	0.39	0.29	0.49
Euro–area Announcements					
Business Climate	0.4	-2.5	0.09	0.08	0.11
Consumer Confidence	-0.3	-0.3	0.05	0.27	-0.17
Flash HICP	-0.5	-0.9	0.24	0.32	0.17
Industrial Production	1.5*	3.1	0.22	0.34	0.11
ECB Interest Rate	-6.1***	-4.5	0.71***	0.78***	0.63***

Figure 1: Boxplots of p-values for return and volatility responses

This figure shows boxplots of the p-values for both the DAX–level (Graphs A and B) and DAX–volatility (Graphs C to F) responses. Each boxplot reflects the distribution of the p-values (for all the 64 announcements) for the returns in the minute preceding the release (0) up to 10 minutes after the announcement (+10). Graph A is based on the p-value for the impulse responses, c_{ik}, implied by Equation (5); Graph B relates to the corresponding cumulative responses up to minute 10, $\sum_i c_{ik}$, and the permanent effect, $C_{\infty k}$, given by Equation (6); Graphs C to F relate to the p–values of the symmetric (δ_{kj}) and asymmetric ($\theta_{kj} + \delta_{kj}$ and $\theta_{kj} - \delta_{kj}$) volatility responses based on Equation (4).



Fourth, 20 of 64 announcements have a significant longer–lasting impact on the DAX, as measured by the ten–minute cumulative response, and 26 in terms of the permanent response (see Column 2 in Table 4). Significant short– and long–run impacts are mostly observed for labor–market and investment announcements as well as for forward–looking indicators, such as Consumer Confidence, ISM Manufacturing and the University of Michigan Survey.

Regarding the size of the immediate response, we find the largest positive impacts for measures of U.S. economic activity, such as Consumer Confidence, Personal Consumption (Advance) and GDP Advance, and the largest negative impacts for U.S. price indicators such as PPI, Unit Labor Costs and Core CPI. With one exception, in all cases, where short– *and* long–run impacts are significant, they are of the same sign. The sole exception is U.S. Nonfarm Payrolls, where a positive surprise causes a significant drop in the DAX in the short run, but ultimately has a significant positive long–run effect.

4.2 Volatility Effects

In one way or another, DAX–volatility responds significantly to more than half of the announcements (see the last three columns in Table 4). We observe that—except one—all significant volatility responses are positive,[19] but they tend to dissipate quickly within a few minutes, as can bee seen from the volatility responses (i.e., $\theta_{k,j}$ in (4)) plotted in Figure 1. The rapid decay in the significance of the volatility responses is also evident from the boxplots of the p-values for the θ-estimates in Graph C in Figure 2. In those cases, where the one–minute responses to both positive *and* negative surprises are significant, we observe that the volatility of Personal Income, Durable Goods, CPI, PPI, Non-farm Payrolls, and ECB Interest Rate announcements respond more strongly to negative than to positive surprises,[20] i.e., $\delta_{k,1}$ is negative. The opposite holds for GDP (Advance), Housing Starts, Business Inventories, Empire Manufacturing, Factory Orders, Chicago PMI, and Unemployment Rate. For GDP (Final), Personal Consumption (Final), GDP Price Deflator (Preliminary), ISM Non-manufacturing, Trade Balance, and IFO (Business), only volatility responses to *positive* surprises matter significantly; whereas only *negative* surprises in Core CPI, University of Michigan (Preliminary), Average Weekly Hours, and IFO (Expectations) result in significant volatility responses.

Overall, most of the U.S. announcements belonging to the categories real–activity aggregates, investment and surveys have a significant impact on volatility. To a lesser extent, this also holds for announcements associated with consumption, labor and prices. In case of German and euro–area announcements, only the Ifo survey indicators and the ECB Interest Rate matter significantly for DAX volatility.

Looking at the pre–announcement volatility, as measured by $\theta_{i,0}$, it turns out that—with the exception of the ECB Interest Rate Announcement—all significant estimates are negative. This is in line with Jones, Lamont, and Lumsdaine (1998), who refer

[19] The sole exception is Personal Consumption (Final), where a positive surprise dampens volatility.
[20] With more than 0.1 points difference.

to this phenomenon as "the calm–before–the–storm," Entorf and Steiner (2007) and Brenner, Pasquariello, and Subrahmanyam (2009).

Finally, it should be noted that significant impacts on volatility do not necessarily coincide with significant impacts on the DAX level and vice versa. Significant impacts on level *and* volatility are mainly observed for announcements related to real–activity aggregates, investment and surveys. Positive surprises in price announcements have a negative effect on the DAX level, but virtually none on volatility. Only for CPI and PPI announcements we find significant volatility effects.

5 Conclusions

We have investigated the impact of a broad set of 53 U.S., six German and five euro–area macroeconomic announcements on the German DAX index, using minute–by-minute returns from 1997 to 2006. We have estimated a time series model for the returns employing weighted–least–squares methods, with weights obtained by estimating a conditional–volatility equation that extends those found in the literature. Specifically, we allow volatility to respond asymmetrically to positive and negative announcement surprises and use a forward–looking, market–driven measure, namely the previous day's VIX closing level, to incorporate overall market uncertainty.

Previous studies on announcement effects suffer from the shortcoming that effects are measured in terms of coefficient estimates associated with distributed lags of the announcement surprises. Doing so ignores the—at least in our sample—highly significant autoregressive dynamics, which are commonly included in model specifications. We overcome this deficit by estimating impulse response functions, together with their confidence bands, over a ten–minute horizon as well as permanent response effects.

Overall, we find that news announcements matter, and that they matter quickly. Approximately two thirds of the 64 announcement have a significant first–minute impact on the level of the German DAX; and in 40% of the cases we estimate a significant permanent impact. All of the significant responses have the expected sign with positive surprises in real activity having a positive impact on the DAX level, and positive surprises in price and labor–cost announcements having negative effects. DAX volatility is particulary affected by announcement surprises belonging to investments, real–activity aggregates and surveys. In about two thirds of the significant responses we identify asymmetric volatility reactions.

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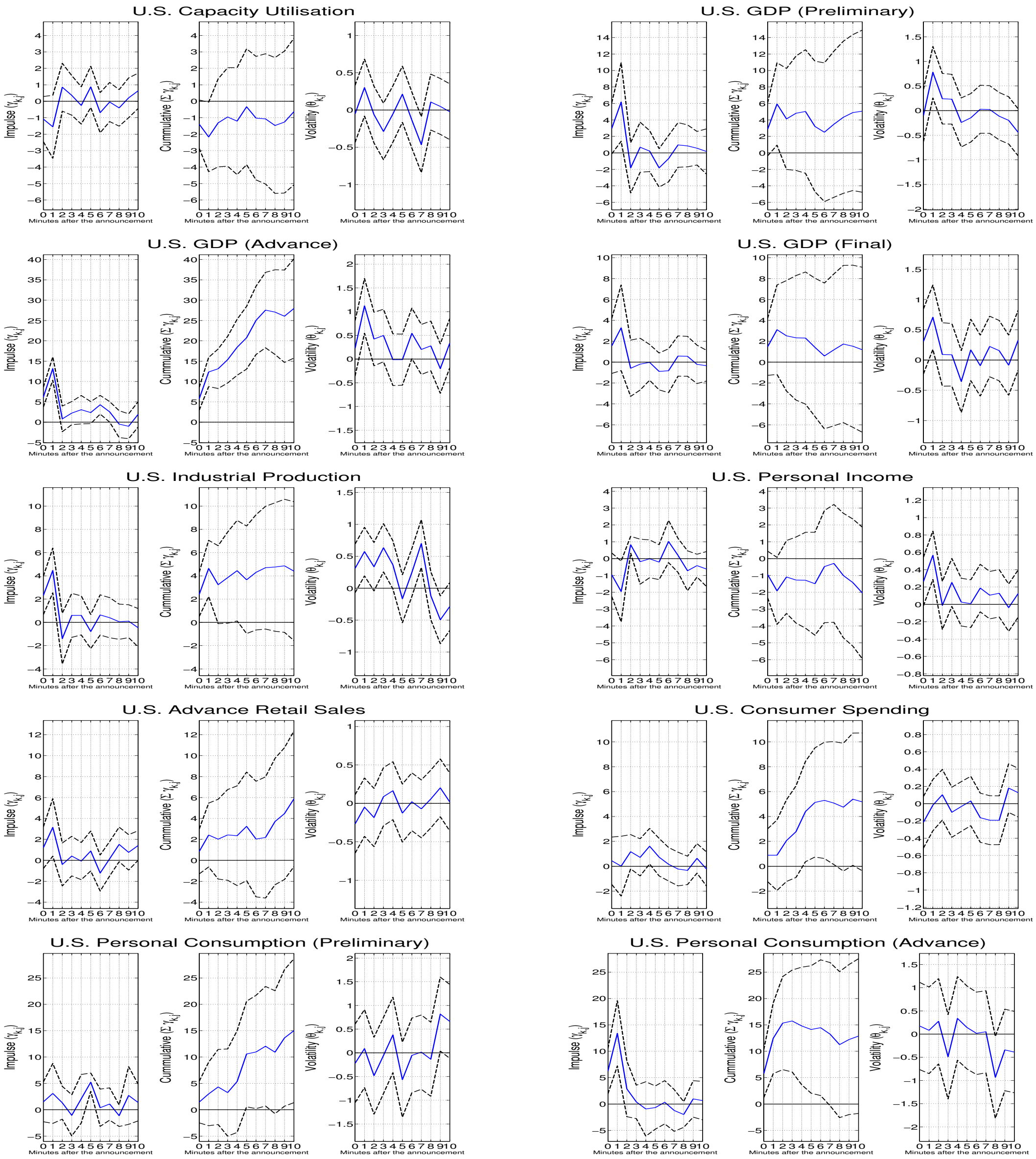
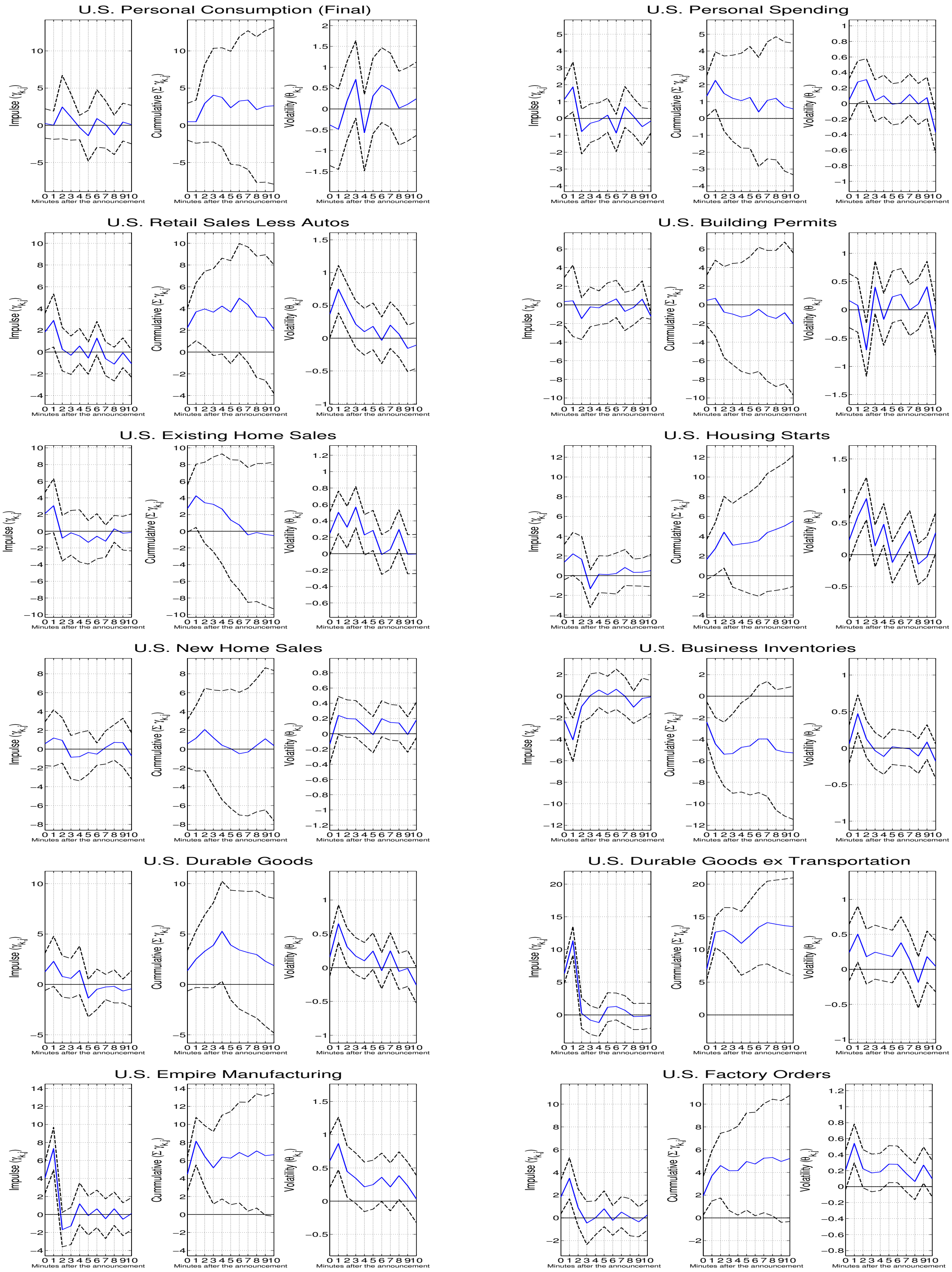
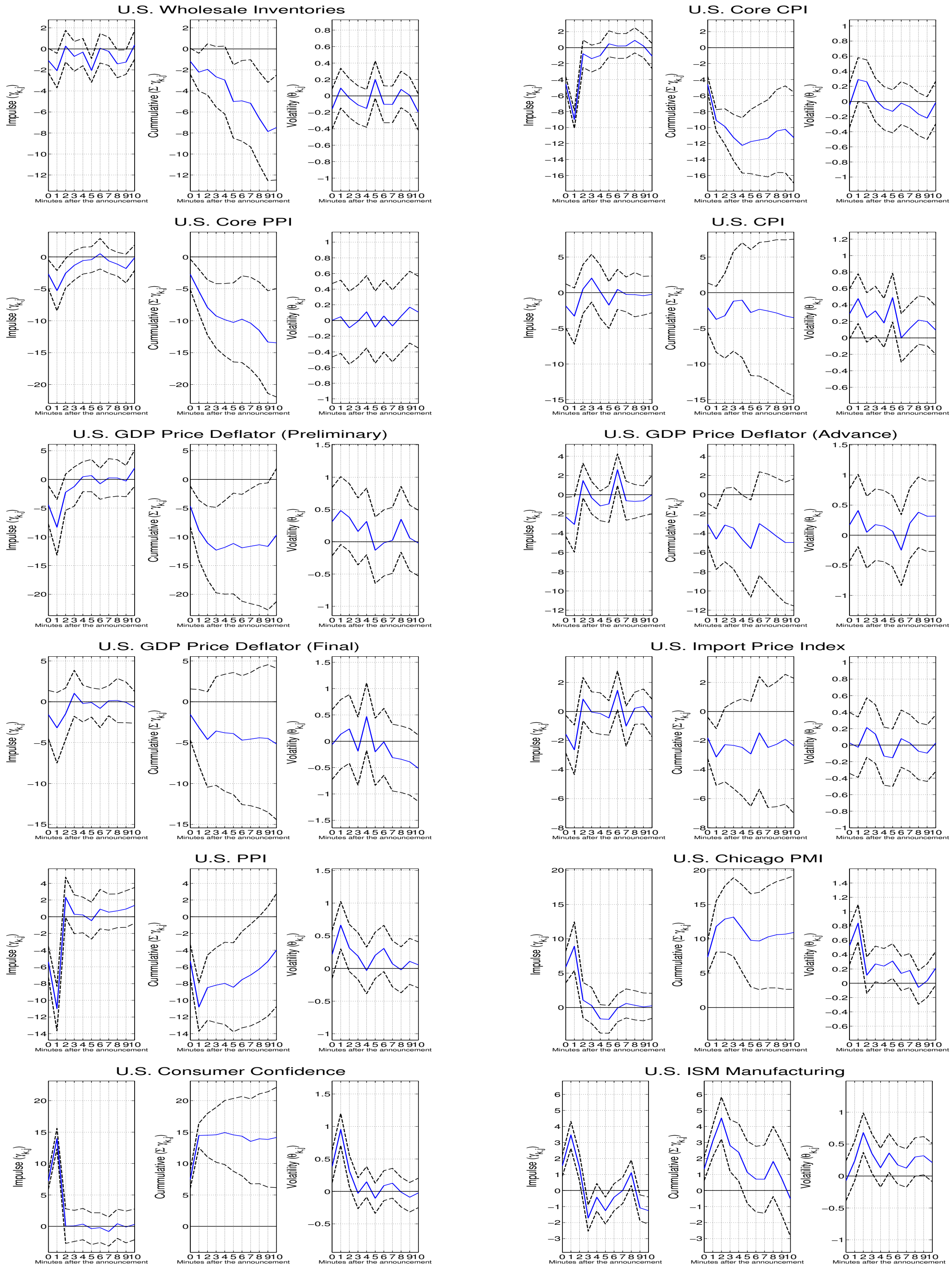
Figure 2: Impulse responses, cumulative responses and volatility impacts

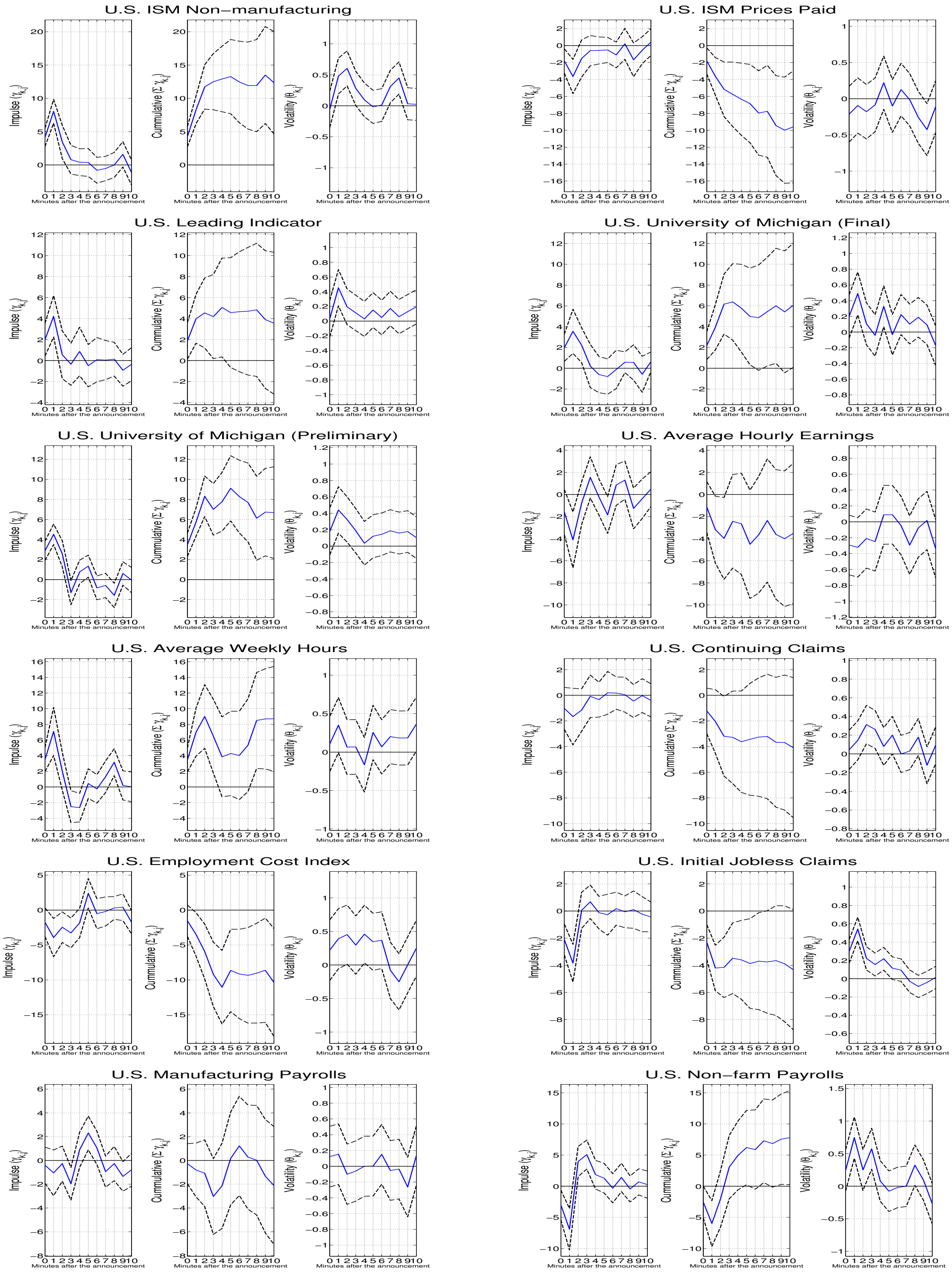
This figure plots, for each of the 64 announcements, three subplots: impulse responses, cumulative responses and volatility impacts. Each subplot displays the impact for the return of the minute preceding the announcement release (0) up to 10 minutes after the release (10). The left subplot shows the estimated impulse responses (c_{ik}), given by Equation (5). The subplot in the center displays the cumulative responses ($\sum c_{ik}$). The right subplot shows the (symmetric) volatility impacts, implied by θ_{kj} in Equation (4). All three subplots also display 90% confidence bands, which are derived following Mittnik and Zadrozny (1993).

U.S. Announcements

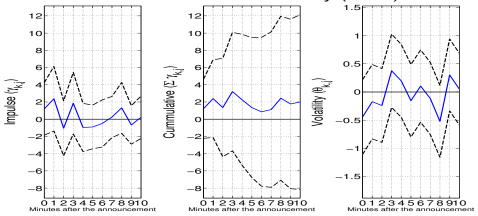



U.S. Personal Consumption (Final)
U.S. Personal Spending
U.S. Retail Sales Less Autos
U.S. Building Permits
U.S. Existing Home Sales
U.S. Housing Starts
U.S. New Home Sales
U.S. Business Inventories
U.S. Durable Goods
U.S. Durable Goods ex Transportation
U.S. Empire Manufacturing
U.S. Factory Orders
Impulse ($\gamma_{k,j}$)
Cummulative ($\Sigma\ \gamma_{k,j}$)
Volatility ($\theta_{k,j}$)
Minutes after the announcement

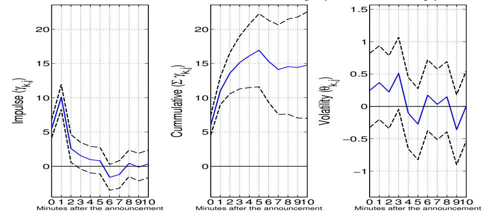

U.S. Wholesale Inventories
U.S. Core CPI
U.S. Core PPI
U.S. CPI
U.S. GDP Price Deflator (Preliminary)
U.S. GDP Price Deflator (Advance)
U.S. GDP Price Deflator (Final)
U.S. Import Price Index
U.S. PPI
U.S. Chicago PMI
U.S. Consumer Confidence
U.S. ISM Manufacturing
Impulse ($\gamma_{k,j}$)
Cummulative ($\Sigma\ \gamma_{k,j}$)
Volatility ($\theta_{k,j}$)
Minutes after the announcement


U.S. ISM Non−manufacturing
U.S. ISM Prices Paid
U.S. Leading Indicator
U.S. University of Michigan (Final)
U.S. University of Michigan (Preliminary)
U.S. Average Hourly Earnings
U.S. Average Weekly Hours
U.S. Continuing Claims
U.S. Employment Cost Index
U.S. Initial Jobless Claims
U.S. Manufacturing Payrolls
U.S. Non−farm Payrolls
Minutes after the announcement

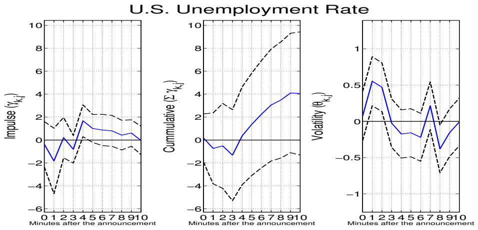
U.S. Nonfarm Productivity (Final)



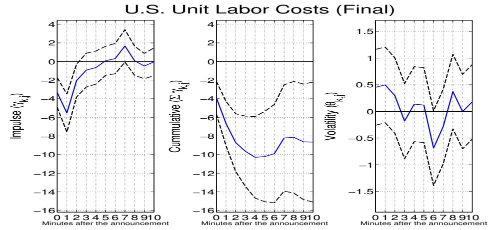
U.S. Nonfarm Productivity (Preliminary)



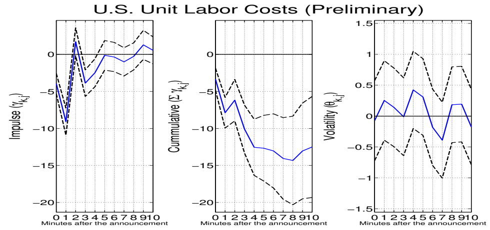
U.S. Unemployment Rate



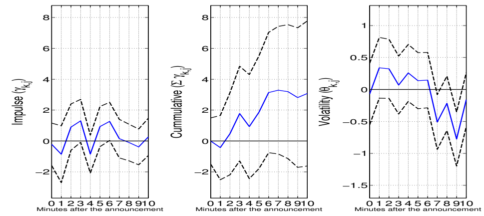
U.S. Unit Labor Costs (Final)



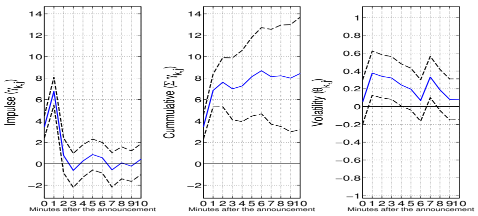
U.S. Unit Labor Costs (Preliminary)



U.S. Current Account

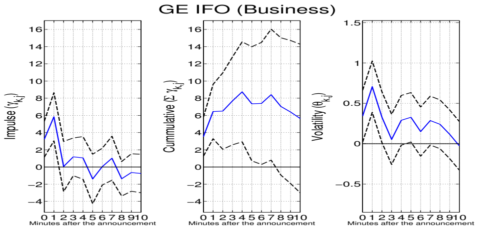


U.S. Trade Balance

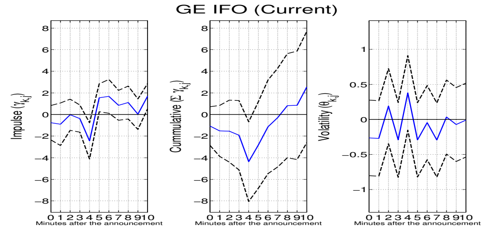


German Announcements

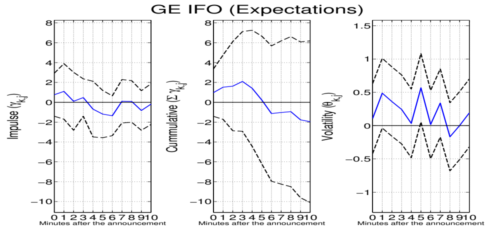
GE IFO (Business)



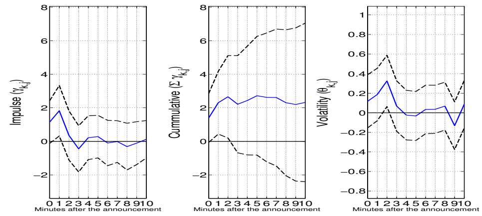
GE IFO (Current)



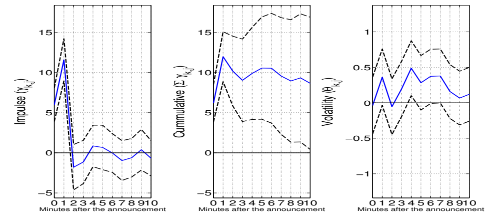
GE IFO (Expectations)



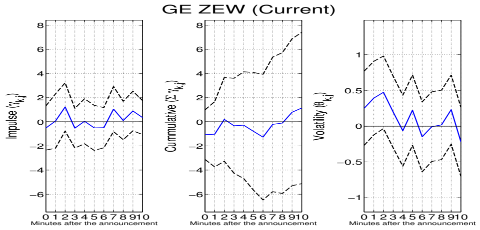
GE Industrial Production



GE ZEW

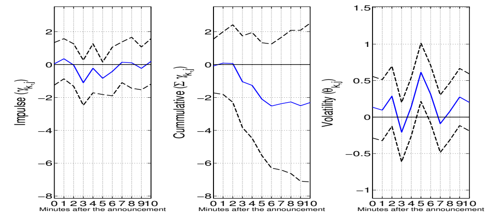


GE ZEW (Current)

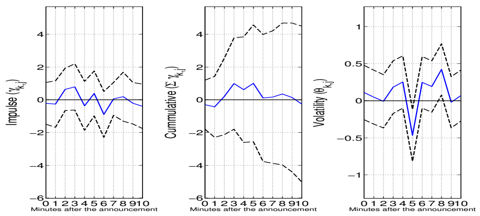


Euro–area Announcements

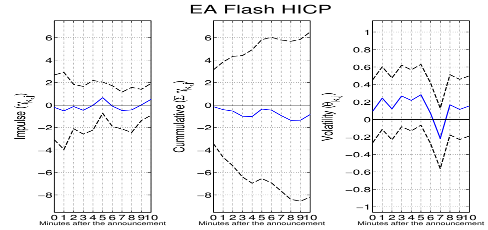
EA Business Climate



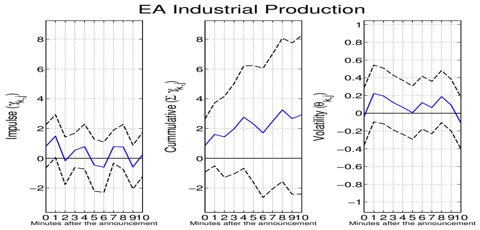
EA Consumer Confidence



EA Flash HICP



EA Industrial Production



ECB Interest Rate