The asymmetric impact of macroeconomic announcements on U.S. Government bond rate level and volatility

Tuysuz, Sukriye

15 September 2007

The asymmetric impact of macroeconomic announcements on U.S. Government bond rate level and volatility

Sukriye Tuysuz*

BETA-THEME

61 avenue de la forêt noire

67000 Strasbourg

Abstract

This paper investigates the impact of macroeconomic and monetary news on U.S. Government bond rate level and volatility. Specifically, it checks if these news affect differently interest rate level and volatility during *"stable"* and *"unstable"* periods. *"Unstable"* periods correspond to the periods marked by a great uncertainty on Government bond market. To do this, first we distinguish the *"stable"* and *"unstable"* periods by estimating interest rate dynamics with a markov swithing ARCH process, proposed by Hamilton and Susmel (1994). The results of this first estimation suggest that U.S. interest rate volatility is higher during periods of financial crises, war time periods and during periods marked by economic or policy instability. We use these results to eval-

*BETA-THEME, Université Louis Pasteur, Department of Economics, tuysuz@cournot.u-strasbg.fr

uate interest rate mean and volatility response to U.S. macroeconomic and monetary news with an EGARCH model, proposed by Nelson (1991). The results show that news announcements do not have important impact on interest rate volatility during *"stable"* periods. In contrast, they strongly affect market volatility during *"unstable"* periods. Finally, we check whether positive and negative news announcements influence differently bond rate volatility during *"unstable"* periods. The results suggest that negative news have important effects on the bond market volatility compared to the effects of positive news.

JEL Classification: E4; E5; G1

keywords: News announcements, Government bond rate, EGARCH, ARCH Markov Switching, Economic instability, Monetary policy instability, Financial crisis.

1 Introduction

Interest rate volatility has become an increasing concern to policymakers and financial market participants alike. Increased market volatility is associated with higher uncertainty about market outlooks, which also affects, among other things, the ability of market participants to discern the monetary policy stance. Long term interest rate volatility affects also the investment decisions and thus overall economic activity. In addition, financial market volatility plays an important role in understanding how financial instruments are priced.

Several authors have focused on the role of macroeconomic news as a source of financial market volatility and particularly Government bond market (Fleming and Remolona, 1997, 1999; Jones *et al.*, 1998; Li and Engle, 1998; Bollerslev, Cai and Song, 2000; Balduzzi, Elton and Green, 2001; Lee, 2002). For example, Ederington and Lee (1993), Becker, Finnerty and Kopecky (1996) and Balduzzi, Elton and Green (1996) document the importance of macroeconomic announcements as a major source of Bond market volatility. Most of the existing literature try to find out which macroeconomic releases have a significant impact on prices and volatility in financial markets (Jones *et al.*, 1998; Li and Engle, 1998; Christiansen, 2000; Goeij and Marquering, 2006). All these researchers suppose constant the financial market response to macroeconomic and monetary news. In contrast with the classical approach, some authors consider that the reaction of interest rate levels and volatility to macroeconomic and monetary news is unstable. A large part of these authors suppose that "*good*" and "*bad*" news have not the same impact on financial market volatility (Morgan, 1993; Thoma, 1994; Karras, 1996; Li and Engle, 1998; Christiansen, 2000; Kim *et al.*, 2004). As for Chadha and Nolan (2001), Clare and Courtenay (2001a,b), Lee (2002) and Tuysuz (2007a, b, c), they suppose that market interest rate reaction to news depends strongly to central bank transparency and credibility degrees. Moreover, some papers show that during periods of high uncertainty about economic situation, markets operators can react strongly to macroeconomic news (Banerjee, 1992; Bikchandani *et al.*, 1992; McQueen and Roley, 1993; Fleming and Remolona, 1997; Veronesi, 1999).

The previous empirical work considers either only the uncertainty related to monetary policy or to economic situation. In contrast to the existing literature this paper takes into account both sources of uncertainty which generate uncertainty on financial market. In addition, it considers other sources of market uncertainty, such as financial crises. Specifically, in contrast with the existing papers, this paper investigates whether the effects of macroeconomic and monetary news on interest rate level and volatility are different during *"stable"* and *"unstable"* periods. *"unstable"* periods correspond to the periods marked by a great uncertainty on Government bond market. These *"unstable"* periods correspond not only to periods marked by economic and monetary instability but also to periods marked by financial instability. For the present analysis, four daily U.S. Government bond interest rate series (3, 5, 7 and 10 year rate) and several macroeconomic news are used. Macroeconomic news include FED target variables and the official interest rate decisions about U.S. monetary policy. Interest rate dynamics are, first, evaluated with a markov-switching ARCH model, proposed by Hamilton and Susmel (1994), in order to determine *"stable"* and *"unstable"* periods. Using the results obtained in this first stage, interest rate dynamics are evaluated with an EGARCH model, proposed by Nelson (1991). This model enables to take into account the conditional heteroscedasticity effect, asymmetric effects and have the advantage of not having to impose positively restrictions on the coefficients in the conditional volatility equation. Moreover, we test whether financial operators react differently to positive (*"good"*) and negative (*"bad"*) macroeconomic news. Specifically, we test whether *"good"* and *"badd"* news affect differently market volatility.

The paper proceeds as follows. Section 2 presents the factors that influence the reaction of interest rate level and volatility to macroeconomic and monetary news. Section 3 gives information on the data used for the analysis. After presenting in detail the ARCH markov-switching model, section 4 discusses the results obtained. Section 5 uses the results of section 4 to evaluate interest rate level and volatility response to macroeconomic and monetary news using an EGARCH model. Section 6 analyzes the results, and finally, section 7 concludes.

2 Heterogeneity of interest rate response to economic news

The literature on herd behavior and informational cascades (Banerjee 1992, Bikchandani and al. 1992) emphasises that what drives financial market outcomes is not so much the occurrence of news per se, but how this new information is processed and interpreted by market participants. The same news can have a vastly different effect on markets depending on the conditions of markets and market participants. Market uncertainty can be implied by monetary policy uncertainty, economic uncertainty and/or financial uncertainty.

2.1 The importance of the central bank transparency and credibility

A widely researched area is the effect of announcements, and in particular of news on central bank target variables and of monetary policy rate changes, on the yield curve. Several authors argue that the impact of news related to central bank target variables on interest rate depends strongly on the credibility and transparency of central bank (Haldane and Read, 1999, 2000; Ellingsen and Söderström, 2001; Chadha and Nolan, 2001; Gravelle and Moessner, 2001; Parent, 2003; Connolly and Kohler, 2004; Tuysuz, 2007 b,c). If a central bank is fully transparent and credible, news on central bank target variables should alone suffice to anticipate future changes in monetary rate. In this situation, market interest rate level should only react to central bank target variables news. As market operators can accuratly anticipate central bank rate decisions, the diffusion of these decisions conveys any information to market participants. Thus, the diffusion of these decisions should not influence interest rate level and volatility. In contrast, if a central bank is not fully transparent and credible then announcements on central bank target variables influence interest rate level and volatility. In addition, in the last situation market operators cannot anticipate correctly central bank rate changes decisions. Thus, the unexpected part of central bank rate changes influences interest rate level and volatility. In sum, the reaction of interest rate level and volatility to macroeconomic and monetary news and to unexpected central bank rate changes strongly depends on the transparency and credibility of central bank. Consequently a greater transparency and/or credibility should affect interest rate response to central bank target variables news and to unexpected changes in policy rate (Sellon and Weiner, 1996; Muller and Zelmer, 1999; Haldane and Read, 2000; Clare and Courtenay, 2001; Gravelle and Moessner, 2001; Urich and Wachtel, 2001; Kuttner, 2001; Parent, 2003, Coppel and Connolly, 2003, Tuysuz, 2007b,c).

Furthermore, Demiralp and Jorda (2002) and Tuysuz (2007a) argue that uncertainty related to monetary policy is more greater around the turning point of monetary policy stance. For example, according to Demiralp and Jorda (2002), when market participant have no idea about the nature on the monetary policy stance around the turning point, announcements tend to have the largest effect on money markets. The authors provide evidence that market response to monetary policy decisions is markedly stronger when these decisions introduce a directional change in monetary policy. Tuysuz (2007a) confirms a similar result on the volatility of interest rate for US, UK, Germain and French data. Precisely, the author shows that interest rate volatility is greater during periods marked by high uncertainty about the future decisions of the central bank. These periods often correspond to the period when central bank change the direction of his monetary policy.

2.2 The role of the economic situation

Market response to macroeconomic news releases strongly depends upon the momentum of the business cycle (McQueen and Roley, 1993; Garcia and Schaller, 1995; Weise, Fleming and Remolona,1997; 1999; Veronesi, 1999; Balduzzi *et al.*, 2001; Andersen *et al.*, 2004; Veredas, 2005). For instance, by controlling the economic cycle[1], Fleming and Remolona find that durable goods orders, GDP, housing starts and unemployment announcements had a more significant impact upon Government bond prices and trading volumes once the economic cycle had been accounted for. In a similar vein, Veredas find that bad news do not have the same impact on the bonds prices during expansion and recession periods. Contrary

[1] Fleming and Remolona (1997) controlled for the economic cycle by using either a measure of implied volatility, or the expected change in the FED funds rate as a proxy for market conditions.

to the previous results, Andersen *et al.* 2004 find that the state of the economy does not influence the reaction bond and exchange markets to real-time U.S. macroeconomic news. However, the authors find that equity markets react differently to the same macroeconomic news depending on the state of the economy, with bad news having a positive impact during expansions and having negative impact during recessions. Similarly, McQueen and Roley find that by classifying economic activity as being either "high", "medium" or "low" relative to trend, it was easier to identify reactions to the U.S. stock market to US macroeconomic announcements. Finally, Veronesi show theoretically that when investors assign high probability to the good state of economy then the price reduction due to bad news is greater that the reduction in expected future dividends. Similarly, when investors assign high probability to the bad state of economy then the increase in the price, implied by a good news, is lower that the increase in expected future dividends.

On the volatility level, Chadha and Nolan (2001) show that English interest rate volatility seems to be lowest during the late 1980s boom in U.K. economy. In other world, the authors suggest that interest rate volatility is higher during recession. This coincidence suggests that higher volatility can be explained by uncertainty about economic situation. In the same way, Tuysuz (2007a) shows that interest rates are more volatile around business cycle turning points. More generally, investors tend to be more uncertain about the future growth rate of the economy during recessions[2] thereby these behaviors can partly justify higher volatility of financial market. Contrary to financial securities prices levels, few authors analyze the effects of news on market volatility by distinguishing economy state.

[2]Authors as Veronesi (1999) shows that economists' forecasts about future real output are more dispersed when the economy is contracting.

2.3 The role of financial crises

In the literature, generally authors analyze directly the dynamic of securities without considering macroeconomic and monetary news (Edwards, 1998, 2000; Park and Song, 1999; Edwards and Susmel, 2000; Bekaert et al., 2002; Baur, 2003; Alper and Yilmaz, 2004; Fernandez-Izquierdo and Lafuente, 2004; Hon et al., 2005; Tuysuz, 2007a). All the authors find that during financial crises periods financial operators uncertainty are very higher and markets volatility are also very important. A large part of this volatility can be explained by uncertainty about financial market evolution and then by financial transaction. By influencing financial markets, financial crises affect also domestic and foreign economic and monetary situation. The effects on economic activity rests mainly on the effects of financial crises on exchange market and then on trade. In addition, variations of Government bonds prices (rates) influence investment choice and thereby economic activity. Having conscience of these effects, the market operators revise their expectations about future evolution of the economic activity and about the future conduct of monetary policy. However, during periods of financial crises these revisions can be very heterogeneous and particularly if central bank is not fully transparent and/or credible. Thus, during financial crises the great uncertainty on financial market and the sudden and important revisions of agents' expectations can affect the influence of macroeconomic and monetary news on security dynamics. This change of the effects depends on the economic situation before the crisis and on the transparency and credibility of central bank.

3 Data Description and Preliminary Tests

This section presents the dataset and its statistical properties. The empirical part uses data series on interest rates, macroeconomic announcements and unexpected variations of key interest rates.

3.1 Interest rate series

Government bond rate corresponding to maturities of respectively 3, 5, 7 and 10 years are considered in this study. These series cover the period ranging from the first of July 1990 to July, 30^{th}, 2004. This data corresponds to the quotes at local time market closure: 17:30 Eastern Standard Time (EST).

In order to determine the order of integration of these series we carry out a series of unit-root tests. Three different kinds of unit-root tests are performed: the standard ADF test, the Zivot and Andrews (1992) test and finally the Seo (1999) test. According to the results of the ADF test, displayed in table 7, we cannot reject the null hypothesis of unit root for any of the four series. These results are confirmed for the Zivot and Andrews test as well as the Seo test. The Seo statistic allows to account for structural changes in the series while the former accounts for the presence of conditional heteroskedasticity. Indeed, using Box-Pierce, Ljung-Box and LM statistics (see Table 8), the null hypothesis of homoskedasticity is rejected at the 5% level for all assets considered in our study. Thus, all interest rate series present a unit root and interest rates differentials will be used in the empirical analysis. These interest rate series are also conditionally heteroscedastic.

3.2 Announcements and surprises

According to Balduzzi et al. (1997), it is not the announcement *per se* that is important, but rather the information it conveys to the market participants. Indeed, if announcements only comfort agents in their expectations they will not induce any behavioral changes. Since the aim of this paper is to study the effect of announcements on the dynamics of interest rates, series that reflect unanticipated variations for the relevant series are needed. These "surprises" are defined as the difference between the observed values for the variables and the values that were anticipated. As anticipations cannot be observed directly some approximation are needed. A solution suggests by Balduzzi et al. (1999) is to choose the surveys published by Money Market Service (MMS) for US macroeconomic announcements. This organization collects every Friday forecasts from a panel of market participants for the following week announcements. Median values for each variable were computed. Those values were retained as proxies of market participant expectations.

In more detail, these variables correspond to possible targets for central banks. That is, primarily, news concerning the inflation rate and the global health of the economies considered. The considered announcements concern unemployment (UE), consumer price index (CPI), production price index (PPI), gross domestic product (GDP), balance of payment (BP) and retail sales (RET). These variables are announced around 9:00 a.m. .

Two methods have been used in the literature for the computation of the unexpected part of monetary policy decisions. The first method uses surveys for macroeconomic announcements as previously discussed. The alternative approximates central bank decisions through carefully chosen asset quotations. More precisely, the methodology proposed by Kuttner (2001) suggests that FED future fund prices constitute a suitable proxy for FED expected actions. This latter solution is preferable to the surveys since, as pointed by Ehrmann and Fratzcher (2003), (2005a), the weekly frequency of surveys prevents from taking into account most recent expectations. On the other hand, asset prices used in this study are those from the day preceding central bank decisions. Prices of future contracts on FED funds are a reasonable choice as they meet the requirements put forward by Brooke et al. (2000), namely (i) its maturity is close to that of the key interest rate, (ii) it is a liquid asset and (iii) its maturity is shorter than the time interval between Federal Open Market Committee (FOMC) meetings. Moreover, as shown by Krueger and Kuttner (1996), future prices provide an efficient measure for the FED fund rate forecasts. Indeed, forecast errors are uncorrelated with the other variables observed at the contract's pricing time. Following Kuttner's methodology, we extract the unexpected part of monetary authorities' decisions, considering that this unexpected component is reflected by the difference between the future prices on the announcement day and the day before. More precisely, the relationship between the forecast error ($\Delta r_t^{*,na}$) and the future contract rates can be written as follows:

$$\Delta r_t^{*,na} = \frac{T}{T-\tau}(f_t - f_{t-1}), \tag{1}$$

where f denotes interest rate on the future contract, T is the number of days in the month under consideration and τ is the day of the month.

4 Evaluation of the *"stable"* and *"unstable"* periods

One of the most interesting aspects of Government bond rate variation is that those variations changes widely across time. More precisely, figures 5 through 8, in appendix, show that during some periods interest rate variations are very high and low during another periods. In addition, these interest rate variations tend to be persistent giving rise to the well documented volatility clustering and "GARCH-type" behavior of return[3]. In order to take into account the heteroscedasticity effect and the change of interest rate volatility dynamic, interest rate dynamics are evaluated with a markov-switching ARCH model proposed by Hamilton and Susmel (1994). This model enables to determine the periods of *"high"* (resp. *"slow"*) interest rate volatility and then periods marked by great uncertainty on bond market. After presenting the markov-switching ARCH model, we will present and discuss the results and then determine the sources of uncertainty which generate uncertainty on Government bond market.

[3]See Bollerslev et al. (1992) for an excellent survey of the literature.

4.1 Markov-Switching model

Hamilton and Susmel (1994) modify the ARCH processes proposed by Engle (1982) to account for several structural changes in data and propose a Switching ARCH (SWARCH) model. The AR-SWARCH model can be written as follows:

$$\begin{aligned}
\Delta r_t &= a + b\Delta r_{t-1} + \epsilon_t, \qquad (2)\\
\epsilon_t &= \sqrt{g_{s_t}}.u_t,\\
u_t &= \sqrt{h_t}.v_t,\\
h_t &= w + \sum_{j=1}^{J} \alpha_j u_{t-j}^2 \qquad j = 1, 2, ..., J \quad s_t = 1, 2, ..., K.
\end{aligned}$$

Where Δr_t represents the first-differenced interest rate. The innovations ϵ_t are composed by two elements, which are g_{s_t} and u_t. u_t is also composed by two components: h_t and v_t. The conditional volatility, h_t, is supposed drive by a ARCH model with j order. The innovations v_t follow a Gaussian or Student t distribution. As for g_{s_t}, they are scale parameters that capture the change in regime. One of the g's is unidentified and, hence, g_1 is set equal to 1. Thus, g_{s_2} is supposed $g_{s_2} > g_{s_1}$. s_t denotes an unobserved random variable that can values 1,2,...,k and is assumed to be governed by a first order Markov chain with transition probability, $p_{i,j}$. For example, $k = 2$, $p_{i,j}$, the transition probability from state i, at time $t-1$ to state j at time t is defined as:

$$\begin{aligned}
p(s_t = 1|s_{t-1} = 1) &= p_{11},\\
p(s_t = 2|s_{t-1} = 1) &= p_{12},\\
p(s_t = 1|s_{t-1} = 2) &= p_{21},\\
p(s_t = 2|s_{t-1} = 2) &= p_{22},
\end{aligned}$$

with $p_{11} + p_{12} = p_{21} + p_{22} = 1$.

Under this specification, the transition probabilities, the p_{ij}'s, are constant. For example, if interest rate was in a high volatility state last period ($s_{t-1} = 2$), the probability of changing to the low volatility state ($s_t = 1$) is a fixed constant p_{21}.

As a byproduct of the Maximum likelihood estimation, it is possible to make inferences about particular state of the security at any date. For this the "filter probabilities" or the "smooth probabilities" can be used. The "filter probabilities", $p(s_t, s_{t-1}|r_t, r_{t-1}, ..., r_1$, denote the conditional probability that the state at date t is s_t and that at date $t-1$ was s_{t-1}. These probabilities are conditional on the values of the observed interest rate through date t. As for "smooth probabilities", $p(s_t|r_T, r_{T-1}, ..., r_1$, are inferences about the state at date t based on data available through some future date T (end of sample).

Given the unit-root test in section 2, first-differenced interest rate dynamics are evaluated with the model described in equation 2. The evaluated "smooth probabilities" that the volatility is in the second state (high volatility state) are illustrated by the figures 1 through 4. A summary of our findings on the extent and the duration of *"high"* interest rate volatility during the period considered is given in the table 1.

[Insert Table 1 here]

[Insert Figure 1 here]

[Insert Figure 2 here]

[Insert Figure 3 here]

[Insert Figure 4 here]

4.2 Empirical results

The comparison of the periods of *"high"* volatility (see table 1) with the monetary and financial situation as well as the economic and political environment, we notice that these periods of *"high"* volatility coincide with the periods marked by uncertainty on the economic and/or monetary and/or financial instability.

The 1990s was marked by several financial crises such as the SME crisis (September 1992 and August 1993), the U.S. Government bond market crisis (January 1994), the Mexican crisis (December 1994), the Asian crisis (July 1997), the Russian crisis (August 1998), the Bresilian crisis (February 1999), the Argentine crisis (November 2001) and the bursting of the technology and internet bubble in 2002 in USA. Figures 1 through 4 and table 1 show that interest rate volatility was in the "high" state during periods corresponding to those periods covering the first SME crisis, the U.S. Government bond market crisis, the Russian crisis, the Argentina crisis and the bursting of the technology and internet bubble in 2002. These coincidences suggest that the increase in interest rate volatility during these periods can be explained by uncertainty implied by these crises. In addition, according to these results there was a fairly rapid transmission of respectively British, Mexican, Asian, Russian, Bresilian and Argentine financial instability to U.S. financial market.

As figures 1 thought 4 show U.S. interest rate volatility shifts to the *"high"* state in late September 2001. This date corresponds to the attack in USA on September 11*th* 2001. This event arose uncertainty on financial markets in various countries and in particular on U.S. markets. Figures 1 through 4 and table 1 suggest that U.S. interest rate volatility were on *"high"* state also during the Gulf War which began on August 2, 1990. The invasion of Kuwait by the Iraquian army provoked important reaction of all UN members and in particular USA. This reaction and the increase of oil prices have contributed to the uncertainty in the financial market which, in turn, increase the volatility. The uncertainty has fallen remarkably beginning from September 1990. This date coincides with the date when U.S. interest rate volatility shifts to *"low"* state (see figures 1 through 4 and table 1). This coincidence suggests that the high interest rate volatility observed between August and September 1990 can be explained by the uncertainty implied by the Gulf war and the increase of the oil price. The stability on the oil market and the relatively peaceful period lasted only until January 1991. The international intervention in January 1991 lead to the withdrawal of Iraqi forces from Kuwait which resulted in an important increase in oil prices during this period. These events generated uncertainty on the financial market. Our results suggest that this uncertainty was less important than the uncertainty observed during the August and September 1990. Indeed, only the 10 year interest rate volatility was on *"high"* state during January 1991.

In addition, during periods marked by economic and monetary policy uncertainty U.S interest rate volatility in all series was on the *"high"* state (see figures 1 through 4 and table 1). These periods cover the first quarter of 1992, the period from February to Mars 1993, the second and third quarter of 1995, the period between February and August 1996, first half of 1999 as well as the first and second quarter of 2000. All of these periods are marked with uncertainty about the future decisions of the central bank. For instance, during the first and the second quarter of 1995, economic and financial agents estimated that U.S. economy was going through a recession. Hence, they anticipated a change of the FED policy. Contrary to the expectations, FED did not change its rate during this period which, in turn, induced uncertainty on the financial market, particularly in the second quarter of 1995. The FED decided to decrease its rate only in July 1995. This decision eliminated the uncertainty about the monetary policy. In contrast with the previous situation, in 1996 the uncertainty was about the inflation rate and the FED decisions. More precisely, during the first quarter of 1996, the observed U.S. economic growth was greater than the expected level, which raised worries about the future inflation rate. Put differently, economic and financial agents anticipated an inflation risk hence a change in the Fed's monetary policy orientation. However, from January to summer 1996, FED did not change its rate. The fact that the expectations of an increase in FED's rate is not fulfilled lead to higher uncertainty on financial market. This situation persisted until summer 1996, the period during which the Governor of the FED affirmed his conviction about the absence of economic overheating in the United States. In addition, Alan Greenspan declared that the evolution of prices in USA was perfectly controlled and that in case of an inflation risk the FOMC would intervene quickly. These remarks helped reduce uncertainty about U.S. inflation and monetary policy decisions. In sum, inflationary risk and the uncertainty about the FED's future decision are the main factors which can explain the rise of U.S. interest rate volatility, observed in figures 1 through 4, between February to September 1996.

Finally, interest rate was relatively high during periods marked not only by uncertainty about the economic, monetary and financial situation but also by instability on the exchange rate market. For instance, during the first half of 2001 the dollar appreciated too much against the euro and the yen. This event affected negatively the U.S. economic competitiveness. In addition, the strong variations of the exchange rates influenced directly the portfolio returns and hence created uncertainty on financial markets. The instability on exchange rate market fell strongly on April 2001. This fall reduced the risk related to the U.S. economy and the uncertainty on financial markets. In sum, the strong appreciation of the dollar against the main currencies and the greater instability on the exchange rate market can explain uncertainty on financial market and the greater volatility of the interest rate during the first half of 2001, observed in the figures 1 through 4.

5 Evaluating interest rate response to news during *"stable"* and *"unstable"* periods.

In this section, we will check whether interest rate level and volatility respond differently to macroeconomic and monetary news during *"stable"* and *"unstable"* periods. For this, an AR-EGARCH model, proposed by Nelson (1991), is used.

5.1 Model

Given the unit-root test in section 2, the first-differenced interest rate response to macroeconomic and monetary news is modeled as follows:

$$\begin{aligned}\Delta R_t = a + b\Delta R_{t-1} \quad &+ \quad c\Delta r_t^* + \sum_{k=1}^{K} d_k D_{k,t}^a \\ &+ \quad c_1 \Delta r_t^* * Dum^R + \sum_{k=1}^{K} d_{k,1} D_{k,t}^a * Dum^R + \epsilon_t, \qquad (3)\end{aligned}$$

where R_t denotes interest rate differentials in period t. Δr_τ^* and $D_{k,t}^a, k = 1, \ldots, K$, correspond respectively to the unexpected part of the monetary policy rate changes and a set of macroeconomic news. c and d_k measure the effects of those news on interest rate level during *"stable"* periods. During *"unstable"* periods, these effects are measured by c_1 and $d_{k,1}$. The dummy variable (Dum^R) take the value 1 during *"unstable"* periods and 0 otherwise. As macroeconomic news are announced around 9:00 a.m. and monetary policy rate decisions are diffused around 2:30 p.m., Government bond rates in period t respond to macroeconomic news and monetary policy decisions immediately on the day of announcements (period t).

The term ϵ_t corresponds to the innovation series. Several authors estimate equation (3) supposing that the innovations are a Gaussian white noise (Balduzzi *et al.*, 1999; Bernhardsen, 2000; Ellingsen and Söderström, 2001; Favero, 2001; Kearney, 2001; Caporale and Williams, 2002; Parent, 2003). In the same line, equation (3) was estimated, first by supposing that the innovations are a Gaussian white noise and Engle Arch LM statistics was then applied to check whether the innovations ϵ_t are conditionally homoscedastic. Table 9, in the Appendix, enables to reject the null hypothesis and then accept the hypothesis that the interest rates volatility is conditionally heteroscedastic. Since Bollerslev proposed the GARCH models in 1986, numerous authors used such model to take into account the persistence in conditional variances of financial market. In a GARCH model, an unanticipated drop and an unanticipated rise in the same magnitude in an interest rate are assumed to generate the same impact on its future volatility. However, authors like Kim and Sheen (2000), Lee (2002) and Ehrmann and Fratzscher (2002, 2003, 2005)), argue that the size and the sign of the shocks influence differently the future financial market volatility. On the other hand, DeGoij and Marquering (2006) find that asymmetric volatility in the Treasury bond market can largely be explained by macroeconomic announcement news. This suggests that the asymmetric volatility find in government bond markets is likely due to misspecification of the volatility model. Indeed, after having included macroeconomic announcements into their model, they notice that the asymmetry disappears. In order to take into account the conditional heteroscedasticy effect and to check the asymmetric effect, the exponential GARCH (EGARCH) approach of Nelson (1991) was applied to estimate the effect of macroeconomic and monetary news on the conditional variances of the interest rates. One of the advantages of the EGARCH model is the non imposition of positively restrictions on the coefficients in the conditional variance equation. This model can be expressed as:

$$\begin{aligned} ln(h_t) &= w + \alpha\frac{\epsilon_{t-1}}{\sqrt{h_{t-1}}} + \beta ln(h_{t-1}) + \theta(|\frac{\epsilon_{t-1}}{\sqrt{h_{t-1}}}| - \sqrt{2/\pi}) \\ &+ \gamma Dum_{r^*_\tau} + \sum_{k=1}^{K}\varphi_k Dum^a_{k,t} \\ &+ \gamma_1 Dum_{r^*_\tau} * Dum^R + \sum_{k=1}^{K}\varphi_{k,1} Dum^a_{k,t} * Dum^R. \qquad (4) \end{aligned}$$

The term α reflects different impacts of positive and negative innovations on conditional variances. A positive (resp. negative) α estimate implies that a positive innovation increases volatility more (resp. less) than a negative (resp. positive) innovation of an equal magnitude. The term θ determines the size effect. As in the mean equation (3), we take into account the influence of macroeconomic and policy variables. Contrary to the level equation, dummies are used instead of actual news in order to avoid multicollinearity with the conditional mean regressors.

Assuming that $c_1 = d_{k,1} = \gamma_1 = \varphi_{k,1} = 0$, $k = K$ gives the classical benchmark model. In this classical model, interest rate level and volatility response to macroeconomic and monetary news is constant over the whole sample retained in the paper. In order to check if this response is different between *"stable"* and *"unstable"* periods interest rate dynamics are evaluated with the model described by the equations 3 and 4.

5.2 Empirical results

According to table 3, U.S. interest rates are mainly sensitive to the consumer price index (CPI) news and to the unexpected part of the FED decisions (d_{CPI} and c). These news have a positive impact on Government bonds rates. This is in accordance with theoretical expectancies. Indeed, the consumer price index can serve as a proxy for the inflation level. Thus, a positive surprise corresponds to an underestimation of the inflation level and market investors will revise their expectations about FED's monetary policy. As for FED decisions, our results show that an increase in unexpected central bank rate changes evokes an immediate increase in market interest rates and vice versa. This positive effect has already been shown by empirical studies such as Cook and Hahn (1989), Kuttner (2001), Kim and Sheen (2000) or Lee (2002). Cook and Hahn are the first to establish a positive empirical relationship between central bank rates and long term rates. They argue that their results support the expectations theory of the term structure[4].

Concerning the asymmetric response of interest rate, interest rates volatility respond differently to news during *"stable"* and *"unstable"* periods. Specifically, table 4 shows that during "normal" (*"stable"*) periods macroeconomic and monetary news announcements have nearly no influence on interest rates volatility. Note that only the balance of payment announcement days influence Government bond rate volatility (γ_{bp}). On the contrary, during *"unstable"* periods the effects of these news announcements on volatility is quite important. Indeed, during *"unstable"* periods bond rate volatility augment the day FED decisions, unemployment rate, gross domestic product and balance of payment news are announced ($\gamma_{r^*,1}$, $\gamma_{UE,1}$, $\gamma_{bp,1}$ and $\gamma_{gdp,1}$). In contrast, regarding the level, the results show that interest rate level response to macroeconomic and monetary news does not differ significantly across *"stable"* and *"unstable"* periods.

[Insert Table 2 here]

[Insert Table 3 here]

[Insert Table 4 here]

The fact that news announcements have little impact on interest rate volatility during the *stable"* periods can be explained mainly by two factors. First, when central bank is fully transparent and credible macroeconomic and monetary news announcements do not generate uncertainty on financial market and hence do not influence interest rate volatility, as pointed out by Chadha and Nolan (2001), Clare and Courtenay (2001a,b) and Tuysuz (2006, 2007a,b,c). Following their approach, our results suggest that FED is fully transparent and

[4]The expectations theory says that a long term interest rate should be equal to the average of the short term interest rates over the same period of time plus a term premium; thus, an increase in the first couple of short rate should drive up the long rate in a lesser extent.

credible. Actually, FED was considered as opaque prior to 1994. However, the transparency degree of FED increases since 1994. Indeed, beginning this date the U.S. Federal Reserve has started to publicly announce FOMC policy changes. In a similar vein, after 1999, press statements announcing policy decisions offer greater detail on all policy decisions, and occur after every meeting. In addition, since May 1999 the policy bias has been announced immediately after each FOMC meeting making it an effective forward-looking signal. In February 2000, Fed moved away from the policy bias terminology and instead inserted a formulaic "balance of risks" sentence in order to clarify its asymmetric directives regarding inflationary pressures and economic weaknesses. Finally, in March 2002, the FOMC started to publish a roll call of the votes on the Federal Funds target, including the preferred policy choice of any dissenters. Even all these transparency measures do not induce full transparency of FED. Indeed, Dincer and Eichengreen (2007) find that in 2005 FED transparency degree was about 61%.

The second explanation rests on the speed of assimilation of the news by financial market and then by interest rate dynamic. Several authors find a significant increase in bond volatility as soon as the news are released (Ederington and Lee, 1993; Crain and Lee, 1995; Andersen and Bollerslev, 1997; Fleming and Remolona, 1997; Jones *et al.*, 1998). However, this increase does not persist, as the news are immediately incorporated in the prices. For instance, DeGoeij and Marquering (2006) find that bond market incorporates the implications of macroeconomic announcement news faster than any other information. As for Fleming and Remolona (1997), they find that U.S. Government bond rate volatility rise sharply as soon as U.S. macroeconomic news are released and remain relatively flat for the rest of the day. Precisely, these authors notice that U.S. interest rate volatility rise around 8.30 (time when certain U.S. macroeconomic news are released) and remain flat afterward. The results obtained by Ederington and Lee and Fleming and Remolona indicate that most of bond prices respond within one or 2 minutes to major macroeconomic announcements.

The third observation concerns interest rate volatility. Table 4 shows that both magnitude (or size) and sign effects of the conditional (or standardized) shocks on conditional variance are significant. Namely, the size effects on intermediate-term interest rate volatility are significant (θ). As for the sign effects, our results suggest that medium and long term interest rate volatility react differently to positive and negative standardized shocks (α). The effect of the absolute value of the standardized shocks on interest rate volatility is positive. In contrast, interest rate volatility react positively (negatively) to negative (positive) standardized shocks. The sign of these size and sign effects on interest rate volatility is in line with theoretical expectancies where as they contradict the results of De Goeij and Marquering (2006). These authors note that asymmetric volatility in the Treasury bond market can be largely explained by macroeconomic announcement shocks.

Finally, results obtained from the benchmark model (see table 2) to the model described in equations 3 and 4 (see tables 3 and 4) are compared. According to table 2, interest rate volatility is influenced by the announcements of unemployment, consumer price index, gross domestic product and retail sales as well as FED decisions news (γ_{r^*}, γ_{UE}, γ_{CPI}, γ_{GDP} and γ_{RET}). However, when we distinguish between *"stable"* and *"unstable"* periods, it can be seen that these news announcement days have an impact on bond market volatility only during *"unstable"* periods (see table 4).

6 Do positive and negative news affect interest rate differently?

Several authors find that positive and negative news do not have the same impact on the financial market (Morgan, 1993; Thoma, 1994; Karras, 1996; Li and Engle, 1998; Christiansen, 2000; Kim *et al.*, 2004). For instance, Li and Engle find that positive shocks depress futures market for Treasury bond volatility while negative shocks increase it. In contrast, Christiansen find no difference between positive and negative announcements shocks on interest rate volatility. As for Clare and Johnson ()**?**, they find that *"good"* news has a greater impact on the deviation of short term interest rate than *"bad"* news. Existing studies suppose that *"bad"* and *"good"* news have the same effect on securities market during the whole period retained. Contrary to these studies, this section investigates whether positive and negative news have the same effect on Government bond during *"unstable"* periods. The previous section showed that news announcement days influenced mainly interest rate volatility only during *"unstable"* periods without any significant effect during *"stable"* periods. A second result was that interest rates level response to macroeconomic and monetary news does not change across *"stable"* and *"unstable"* periods. Using these results, we test in this section whether positive and negative news announcements have the same impact on interest rate volatility during *"unstable"* periods.

6.1 Model

In order to check whether positive and negative news announcements affect differently interest rate volatility, we model the first-differenced interest rate with an AR-EGARCH approach, proposed by Nelson (1991). The model can be described as follows:

$$\Delta R_t = a + b\Delta R_{t-1} \quad + \quad c\Delta r_t^* + \sum_{k=1}^{K} d_k D_{k,t}^a + \epsilon_t. \tag{5}$$

$$
\begin{aligned}
ln(h_t) &= w + \alpha\frac{\epsilon_{t-1}}{\sqrt{h_{t-1}}} + \beta ln(h_{t-1}) + \theta(|\frac{\epsilon_{t-1}}{\sqrt{h_{t-1}}}| - \sqrt{2/\pi}) \\
&+ \gamma_1 \Delta r_\tau^{*+} * Dum^R + \sum_{k=1}^{K} \varphi_{k,1} D_{k,t}^{a+} * Dum^R \\
&+ \gamma_2 \Delta r_\tau^{*-} * Dum^R + \sum_{k=1}^{K} \varphi_{k,2} D_{k,t}^{a-} * Dum^R. \qquad (6)
\end{aligned}
$$

In contrast to the model described by the equations 3 and 4, in this model positive and negative macroeconomic and monetary news (Δr_τ^{*+}, $D_{k,t}^{a+}$, Δr_τ^{*-} and $D_{k,t}^{a-}$) can affect interest rate volatility differently during *"unstable"* periods (Dum^R).

Assuming that $\varphi_{k,2} = \gamma_2 = 0$ gives the model described by equations 3 and 4.

6.2 Empirical results

We estimate interest rate dynamics with the model described by the equations 5 and 6. The results are given in tables 5 and 6. In line with our previous results, U.S. interest rate level responds mainly to the unanticipated part of the FED rate changes and to the consumer price index news (c and d_{CPI}). Similarly, during *"unstable"* periods U.S. bond market volatility is mainly affected by FED decisions diffusion days and by the announcement days of unemployment and gross domestic product (γ_{r^*}, γ_{UE} and γ_{GDP}). Furthermore, negative news announcement days affect differently interest rate volatility compared to positive news announcement days. Negative news announcements amplify interest rate volatility more then positive news announcements. For instance, the size of the negative (resp. positive) unemployment news announcement days on the 10 years bond rate volatility is 4.187 (resp. 2.504) ($\gamma_{UE,1}$ and $\gamma_{UE,2}$). This result is in accordance with our expectations and with the results obtained by Morgan (1993), Thoma (1994), Karras (1996) and Kim *et al.* (2004). Indeed, negative news means that agents have under-anticipated the macroeconomic release.

For instance, a negative unemployment rate means that agents expectations are less that the announced value.

[Insert Table 5 here]

[Insert Table 6 here]

Conclusion

In this paper, we investigate whether U.S. interest rate level and volatility reacts differently to macroeconomic and monetary news during *"stable"* and *"unstable"* periods. For this, we determine, first, the *"stable"* and *"unstable"* periods by evaluating interest rate dynamics with an ARCH markov switching model proposed by Hamilton and Susmel (1994). In this first step, we find that U.S. interest rate volatility was on the "high" state during periods of financial crises, the periods marked by economic and monetary instability as well as war time periods. Then, we assume that interest rate level and volatility response to news during *"stable"* periods and *"unstable"* periods may differ. In this second step, we modelise interest rate dynamics with an EGARH (1,1) model proposed by Nelson (1991). The results obtained in this second stage show that U.S financial market volatility does not react to macroeconomic and monetary news announcement days during *"stable"* periods. In contrast, these days influence significantly interest rate volatility during *"unstable"* periods. When we do not make this distinction between *"stable"* and *"unstable"* periods and consider a classical approach we see that U.S. interest rate volatility reacts to announcement days. Finally, we check whether "positive" and "negative" news affect differently interest rate volatility. The results obtained suggest that the effect of negative macroeconomic and monetary news announcement days on the U.S. bond rate volatility is higher than positive news announcement days.

Appendix

[Insert Table 7 here]

[Insert Table 8 here]

[Insert Table 9 here]

[Insert Figure 5 here]

[Insert Figure 6 here]

[Insert Figure 7 here]

[Insert Figure 8 here]

References

Alper, C. E. and Yilmaz, K. (2004), 'Volatility and contagion: evidence from the istanbul stock exchange', *Economic Systems* **28**, 353–367.

Andersen, T. G. and Bollerslev, T. (1997), 'Intraday periodicity and volatility persistence in financial markets', *Journal of Empirical Finance* **4**, 115–158.

Balduzzi, P., Bertola, G. and Foresi, S. (1997), 'A model of target changes and the term structure of interest rates', *Journal of Monetary Economics* **39**(2), 223–249.

Balduzzi, P., Elton, E. and Green, T. (1999), 'Economic news and the yield curve: Evidence from the u.s. treasury market', *New York University, Leonard N. Stern School Working Paper* .

Banerjee, A. (1992), 'A simple model of herd behavior', *Quarterly Journal of Economics* **107**, 797–818.

Baur, D. (2003), 'Testing for contagion - mean and volatility contagion', *Journal of Multinational Financial Management* (13), 405–422.

Bernhardsen, T. (2000), 'The relationship between interest rate differentials and macroeconomic variables: a panel data study for european countries', *Journal of International Money and Finance* (19), 289–308.

Bikchandani, S., Hirshleifer, D. and Welch, I. (1992), 'A theory of fads, fashion, custom and cultural change as informational cascades', *Journal of Political Economy* **100**, 992–1026.

Bollerslev, T. (1986), 'Generalized autoregressive condional heteroskedasticity', *Journal of Econometrics* **31**, 307–327.

Brooke, M., Cooper, N. and Scholtes, C. (2000), 'Inferring market interest rate expectations from money market rates', *Bank of England Quarterly Bulletin* pp. 392–402.

Caporale and Williams (2002), 'Long-term nominal interest rates and domestic fundamentals', *Review of Financial Economics* (11), 119–130.

Chadha, J. and Nolan, C. (2001), 'Inflation targeting, transparency and interest rate volatility: Ditching 'monetary mystique' in the uk', *Journal of Macroeconomics* **23**(3), 349–366.

Christiansen, C. (2000), 'Macroeconomic announcement effects on the covariance structure of government bond returns', *Journal of Empirical Finance* (7), 479–507.

Clare, A. and Courtenay, R. (2001*a*), 'Assessing the impact of macroeconomics news annoncements on securities prices under different monetary policy regimes', *Bank of England Working Paper Nř 125* .

Clare, A. and Courtenay, R. (2001*b*), 'What can we learn about monetary policy transparency from financial market data?', *Deutsche Bundesbank Discussion Paper* (06/01).

Connolly, R. A. and Kohler (2004), 'News and interest rate expectations: a study of six central banks', *Research Discussion Paper* (2004-10).

Cook, T. and Hahn, T. (1989), 'The effect of changes in the federal funds target rate on market interest rates in the 1970s', *Journal of Monetary Economics* **24**, 331–351.

Coppel, J. and Connolly, E. (2003), 'What do financial market data tell us about monetary policy transparency', *Reserve Bank of Australia Research Discussion Paper* (2003-05).

Crain, S. and Lee, J. (1995), 'Intraday volatility in interest rate and foreign exchange spot and futures markets', *Journal of Futures Markets* **15**, 395–421.

de Goeij, P. and Marquering, W. (2006), 'Macroeconomic announcements and asymmetric volatility in bond returns', *Journal of Banking and Finance* **30**(2659-2680).

DeGoeij, P. and Marquering, W. (2006), 'Macroeconomic announcements and asymmetric volatility in bond returns', *Journal of Banking and Finance* **30**, 2659 – 2680.

Dincer, N. and Eichengreen, B. (2007), 'Central bank transparency: Where, why and with what effects?', *NBER Working Paper* **13003**.

Ederington and Lee (1993), 'How markets process information: news releases and volatility', *The Journal of Finance* (4), 1161–1191.

Edwards, S. (1998), 'Interest rate volatility, capital controls and contagion', *NBER Working Paper* (6756).

Edwards, S. (2000), 'Contagion', *NBER* .

Edwards, S. and Susmel, R. (2000), 'Interest rate volatility and contagion in emerging markets', *NBER* .

Ehrmann, M. and Fratzcher, M. (2003), 'Monetary policy announcements and money markets: A transatlantic perspective', *International Finance* (63), 309–328.

Ehrmann, M. and Fratzcher, M. (2005a), 'Equal size, equal role? interest rate independence between the euro area and the united states', *Economic Journal* **115**, 930–950.

Ellingsen, T. and Söderström, U. (2001), 'Monetary policy and market interest rates', *American Economic Review* **91**(5), 1594–1607.

Engle, R. F. (1982), 'Autoregressive conditional heteroscedasticity with estimates of the variance of united kingdom inflation', *Econometrica* **50**, 987–1006.

Erhmann, M. and Fratzscher, M. (2002), 'Interdependence between the euro area and the us: What role for the emu?', *European Central Bank Working Paper* (200.).

Favero (2001), 'Does macroeconomics help us to understand the term structure of interest rates?', *CEPR discussion paper series* (2749).

Fernandez-Izquierdo, A. and Lafuente, J. (2004), 'International transmission of stock exchange volatility: Empirical evidence from the asian crisis', *Global Finance Journal* **15**(2), 125–137.

Fleming, M. and Remolona, E. (1997), 'Price formation and liquidity in the u.s. treasury market: Evidence from intraday patterns around announcements', *Reserve Bank of New York* (27).

Fleming, M. and Remolona, E. (1999), 'The term structure of announcement effects', *BIS Working Paper* (71).

Garcia, R. and Schaller, H. (1995), 'Are the effects of monetary policy asymmetric?', *Montréal University Working Paper* **0595**.

Gravelle, T. and Moessner, R. (2001), 'Reactions of canadian interest rates to macroeconomics announcements: Implications for monetary policy transparency', *Bank of Canada Working Paper* **2001-5**.

Haldane, A. and Read, V. (1999), 'Monetary policy and the yield curve', *Bank of England Quarterly Bulletin* pp. 171–176.

Haldane, A. and Read, V. (2000), 'Monetary policy surprises and the yield curve', *Bank of England Working Paper* (106), 1–41.

Hamilton, J. and Susmel, R. (1994), 'Autoregressive conditionnal heteroskedasticity and changes in regime', *Journanl of Econometrics* pp. 307–333.

Hon, M. T., Strauss, J. K. and Yong, S.-K. (2005), 'Deconstructing the nasdaq bubble: A look at contagion across international stock markets', *Journal of International Financial Markets, Institutions and Money* .

Jones, C., Lamont, O. and Lumsdaine, R. (1998), 'Macroeconomic news and bond markets volatility', *Journal of Financial Economics* **47**, 315–337.

Karras, G. (1996), 'Are the output effects of monetary policy asymmetric? evidence from a sample of european countries', *Oxford Bulletin of Economics and Statistics* **58**, 267–278.

Kearney (2001), 'A note on modeling the impact of economic announcements on interest rates', *Economic letters* (71), 83–89.

Kim, S.-J. and Sheen, J. (2000), 'International linkages and macroeconomic news effects in interest rate volatility - autralia and the us', *Pacific-Basin Finance Journal* **8**(1), 85–113.

Krueger, J. and Kuttner, K. (1996), 'The fed funds futures rate as a predictor of federal reserve policy', *Journal of Futures Markets* **16**, 865–879.

Kuttner, K. (2001), 'Monetary policy surprises and interest rates: Evidence from the fed funds futures market', *Journal of Monetary Economics* **47**(3), 523–544.

Lee, J. (2002), 'Federal funds target changes and interest rate volatility', *Journal of Economics and Business* **54**(2), 159–191.

Li, L. and Engle, R. F. (1998), 'Macroeconomic announcements and volatility of treasury futures', *University of California, San Diego Discussion Paper* (98-27).

McQueen, G. and Roley, V. (1993), 'Stock prices, news, and business conditions', *Review of Financial Studies* **6**(3), 683–707.

Morgan, D. P. (1993), 'Asymetric effects of monetary policy', *Federal Reserve Bank of Kansas City Economic Review* (78), 21–33.

Muller, P. and Zelmer, M. (1999), 'Greater transparency in monetary policy: Impact on financial markets', *rapport technique, Banque du Canada.* (86).

Nelson, D. (1991), 'Conditional heteroskedasticity in asset returns', *Econometric* **59**, 347–370.

P. Balduzzi, E. J. E. and Green, T. C. (2001), 'Economic news and bond prices: Evidence from the u.s. treasury market', *Journal of Financial and Quantitative Analysis* **36**(4), 523–43.

Parent, N. (2003), 'Transparence et réactin des taux d'intérêt à la publication périodique des données macroéconomiques', *Revue de la Banque du Canada* **Hiver 2002-2003**, 31–37.

Park, Y. and Song, C. Y. (1999), 'Financial contagion in the east asian crisis with special reference to the republic of korea', *Worldbank Working Paper* .

Sellon, G. H. and Weiner, S. E. (1996), 'Monetary policy without reserve requirements: Analytical issues', *Federal Reserve Bank of Kansas City. Economic Review* pp. 5–24.

Seo, B. (1999), 'Distribution theory for unit root tests with conditional heteroskedasticity', *Journal of Econometrics* **91**(1), 113–144.

T. Bollerslev, J. C. J. and Song, F. (2000), 'Intraday periodicity, long memory volatility and macroeconomic announcement effects in the us treasury bond market', *Journal of Empirical Finance* **7**, 37–55.

T. G. Andersen, T. Bollerslev, F. X. D. and Vegad, C. (2004), 'Real-time price discovery in stock, bond and foreign exchange markets', *The Journal of Finance* .

Thoma, M. A. (1994), 'Subsample instability and asymetries in money-income causality.', *Journal of Econometrics* (64), 279–306.

Tuysuz, S. (2006), 'Effets de la transparence et de la crédibilité sur le mécanisme de transmission de la politique monétaire sur les taux d'intérêt: le cas des etats-unis et du royaume-uni', *mimeo* .

Tuysuz, S. (2007*a*), 'Central bank transparency and the u.s. interest rates level and volatility response to u.s. news', *MPRA Paper* (5217).

Tuysuz, S. (2007*b*), 'The effects of a greater central bank credibility on interest rates level and volatility response to news in the u.k', *MPRA Paper* (5263).

Tuysuz, S. (2007*c*), 'Evaluation de la dynamique des taux d'intérêt à l'aune des bouleversements du système économique, monétaire et financier', *Thèse Univesité Louis Pasteur* .

Urich, T. and Wachtel, P. (2001), 'Financial market responses to monetary policy change in the 1990s', *Contemporary Economic Policy* **19**(3), 254–267.

Veredas, D. (2005), 'Macroeconomic surprises and short term behavior in bond futures', *Empirical Economics* **30**.

Veronesi, P. (1999), 'Stock market overreaction to bad news in good times: A rational expectations equilibrium model', *Review of Financial Studies* **12**(5), 975–1007.

Weise, C. L. (1999), 'The asymetric effects of monetary policy: A nonlinear vector autoregression approach', *Journal of Money, Credit and Banking* **31**(1).

Zivot, E. and Andrews, D. (1992), 'Further evidence on the great crash, the oil-price shock, and unit-root hypothesis', *Journal of Business and Economic Statistics* **10**(3), 251–270.

Table 1: Periods of *"high"* volatility

3-year bond	5-year bond	7-year bond	10-year bond
08/01/1990-31/08/1990	08/01/1990-11/09/1990	08/01/1990-26/03/1990	08/01/1990-17/05/1990
		27/07/1990-03/09/1990	19/07/1990-21/01/1991
06/01/1992-07/04/1993	23/12/1991-08/04/1993	01/01/1992-25/03/1992	23/12/1991-27/03/1992
		31/07/1992-26/11/1992	11/08/1992-23/11/1992
		04/02/1993-05/04/1993	10/02/1993-07/04/1993
24/02/1994-23/09/1994	28/01/1994-23/09/1994	08/02/1994-01/09/1994	31/01/1994-14/09/1994
21/10/1994-05/09/1995	21/10/1994-20/09/1995	02/05/1995-15/08/1995	04/05/1995-17/08/1995
13/02/1996-24/09/1996	14/02/1996-14/10/1996	15/02/1996-15/08/1996	12/02/1996-20/09/1996
26/08/1998-20/08/1999	31/08/1998-12/10/1999	10/09/1998-12/10/1999	08/09/1998-12/10/1999
	03/01/2000-08/06/2000	04/01/2000-02/06/2000	31/12/1999-09/06/2000
01/12/2000-	05/12/2000-	12/12/2000-18/05/2001	06/12/2000-25/05/2001
		28/08/2001-20/03/2002	10/08/2001-22/03/2002
		10/05/2002-	10/05/2002-

Table 2: Results of the model benchmark

	3-year bond	5-year bond	7-year bond	10-year bond
a	0,000	0,000	0,000	0,000
	(−0,28)	(−0,27)	(−0,41)	(−0,44)
b	**0,057***	**0,059***	**0,063***	**0,056***
	(3,50)	(3,61)	(3,76)	(3,41)
c	**0,244***	**0,166***	**0,117****	0,073
	(3,64)	(2,31)	(1,73)	(1,03)
d_{UE}	**-0,120***	**-0,100****	-0,082	-0,076
	(−2,16)	(−1,80)	(−1,52)	(−1,48)
d_{cpi}	**0,131***	**0,132***	**0,118***	**0,104***
	(2,91)	(2,76)	(2,49)	(2,24)
d_{ppi}	-0,021	-0,021	-0,020	-0,015
	(−1,24)	(−1,22)	(−1,18)	(−0,89)
d_{gdp}	0,011	0,011	0,007	0,006
	(0,95)	(0,94)	(0,67)	(0,60)
d_{ret}	**0,030***	**0,025****	0,022	0,021
	(2,04)	(1,71)	(1,56)	(1,56)
d_{bp}	-0,002	-0,002	-0,001	-0,001
	(−0,66)	(−0,81)	(−0,41)	(−0,57)
w	**-5,437***	**-5,364***	**-5,107***	**-5,140***
	(−5,50)	(−5,53)	(−4,66)	(−4,42)
θ	0,075	**0,092****	**0,109****	0,033
	(1,32)	(1,67)	(1,83)	(0,58)
α	0,009	0,022	0,040	**0,059****
	(0,28)	(0,75)	(1,23)	(1,87)
β	0,058	0,072	0,124	0,121
	(0,34)	(0,43)	(0,65)	(0,61)
γ_{r*}	**0,703***	**0,774***	**0,733***	**0,787***
	(3,84)	(3,67)	(3,45)	(3,22)
γ_{UE}	**1,134***	**1,124***	**1,037***	**0,994***
	(8,89)	(8,83)	(8,33)	(7,37)
γ_{cpi}	**0,276****	**0,258***	**0,228****	**0,251***
	(1,91)	(2,00)	(1,89)	(2,14)
γ_{ppi}	-0,038	-0,008	0,035	0,095
	(−0,27)	(−0,07)	(0,25)	(0,66)
γ_{gdp}	**0,445***	**0,466***	**0,459***	**0,437***
	(3,90)	(4,21)	(4,08)	(3,78)
γ_{ret}	**0,461***	**0,463***	**0,406***	**0,297***
	(3,14)	(3,36)	(2,89)	(2,09)
γ_{bp}	-0,187	-0,139	-0,135	-0,133
	(−1,41)	(−1,04)	(−1,00)	(−1,06)

* and ** indicate that the corresponding coefficient is statistically significant at the 5% and 10 %, respectively.

The numbers in (.) are the t-statistics.

$\Delta R_t = a + b\Delta R_{t-1} + c\Delta r_t^* + \sum_{k=1}^{K} d_k D_{k,t}^a + \epsilon_t,$

$ln(h_t) = w + \alpha \frac{\epsilon_{t-1}}{\sqrt{h_{t-1}}} + \beta ln(h_{t-1}) + \theta(|\frac{\epsilon_{t-1}}{\sqrt{h_{t-1}}}| - \sqrt{2/\pi}) + \gamma Dum_{r*} + \sum_{k=1}^{K} \varphi_k Dum_{k,t}^a.$

Table 3: Results of the model with *"stable"* and *"unstable"* periods distinction (mean)

	3-year bond	5-year bond	7-year bond	10-year bond
a	-0,001	-0,001	-0,001	-0,001
	$(-0,96)$	$(-1,08)$	$(-1,31)$	$(-1,01)$
b	**0,062***	**0,067***	**0,075***	**0,065***
	(3,92)	(4,18)	(4,63)	(4,16)
***stable* periods**				
c	**0,284***	**0,246***	**0,226***	**0,234***
	(2,96)	(2,65)	(3,01)	(3,41)
d_{UE}	-0,038	-0,041	-0,079	-0,035
	$(-0,54)$	$(-0,56)$	$(-1,21)$	$(-0,56)$
d_{cpi}	**0,160***	**0,274***	**0,185***	**0,164***
	(2,68)	(4,49)	(3,55)	(2,71)
d_{ppi}	0,020	0,020	0,019	0,026
	(1,09)	(0,91)	(0,90)	(1,26)
d_{gdp}	-0,001	0,003	-0,006	-0,008
	$(-0,07)$	(0,27)	$(-0,58)$	$(-0,75)$
d_{ret}	0,009	0,004	**0,031****	0,014
	(0,54)	(0,27)	(1,91)	(0,96)
d_{bp}	-0,004	-0,001	-0,001	0,001
	$(-1,23)$	$(-0,24)$	$(-0,19)$	(0,40)
***unstable* periods**				
c_1	0,019	-0,081	-0,228	**-0,261****
	(0,13)	$(-0,48)$	$(-1,21)$	$(-1,68)$
$d_{UE,1}$	-0,119	-0,091	-0,029	-0,100
	$(-1,17)$	$(-0,89)$	$(-0,27)$	$(-0,99)$
$d_{cpi,1}$	-0,029	**-0,182***	-0,111	-0,105
	$(-0,34)$	$(-2,09)$	$(-1,21)$	$(-1,19)$
$d_{ppi,1}$	**-0,091***	**-0,079***	**-0,083***	**-0,075***
	$(-2,93)$	$(-2,45)$	$(-2,36)$	$(-2,27)$
$d_{gdp,1}$	0,025	0,013	0,032	0,029
	(1,23)	(0,67)	(1,57)	(1,49)
$d_{ret,1}$	**0,051**	0,042	0,001	0,024
	(1,93)	(1,62)	(0,03)	(0,87)
$d_{bp,1}$	0,003	-0,002	0,000	-0,003
	(0,62)	$(-0,44)$	$(-0,04)$	$(-0,71)$

* and ** indicate that the corresponding coefficient is statistically significant at the 5% and 10 %, respectively.

The numbers in (.) are the t-statistics.

$\Delta R_t = a + b\Delta R_{t-1} + c\Delta r_t^* + \sum_{k=1}^{K} d_k D_{k,t}^a + c_1 \Delta r_t^* * Dum^R + \sum_{k=1}^{K} d_{k,1} D_{k,t}^a * Dum^R + \epsilon_t$

r^*: FED rate; UE: unemployment; CPI: consumer price index; PPI: producer price index;

GDP: gross domestic product; BP: balance of payment ; RET: retail sales

Table 4: Results of the model with *"stable"* and *"unstable"* periods distinction (volatility)

w	**-1,039***	**-1,234***	**-1,106***	**-1,211***
	$(-4,20)$	$(-5,53)$	$(-6,25)$	$(-5,97)$
θ	**0,047****	**0,050****	0,009	0,003
	(1,84)	(1,85)	(0,38)	(0,13)
α	-0,019	**-0,035****	**-0,042***	**-0,048***
	$(-0,97)$	$(-1,73)$	$(-2,26)$	$(-2,51)$
β	**0,828***	**0,794***	**0,812***	**0,796***
	(19,57)	(20,71)	(25,69)	(22,27)
***stable* periods**				
γ_{r^*}	0,234	-0,006	0,112	-0,039
	(1,06)	$(-0,03)$	(0,58)	$(-0,17)$
γ_{UE}	0,024	0,182	0,174	0,182
	(0,12)	(0,88)	(1,08)	(1,05)
γ_{cpi}	-0,256	-0,168	-0,185	-0,173
	$(-1,31)$	$(-0,78)$	$(-1,12)$	$(-0,93)$
γ_{ppi}	-0,264	-0,210	-0,195	-0,207
	$(-1,29)$	$(-0,95)$	$(-1,09)$	$(-1,12)$
γ_{gdp}	-0,056	-0,228	-0,203	-0,226
	$(-0,28)$	$(-1,10)$	$(-1,22)$	$(-1,25)$
γ_{ret}	-0,062	-0,167	-0,002	-0,056
	$(-0,27)$	$(-0,71)$	$(-0,01)$	$(-0,31)$
γ_{bp}	**-0,394***	**-0,628***	**-0,359***	**-0,328****
	$(-2,27)$	$(-2,89)$	$(-2,20)$	$(-1,88)$
***unstable* periods**				
$\gamma_{r^*,1}$	0,216	**0,611****	**0,565***	**0,660***
	(0,75)	(1,86)	(2,07)	(2,27)
$\gamma_{UE,1}$	**0,743***	**0,630***	**0,654***	**0,618***
	(3,05)	(2,60)	(3,15)	(2,80)
$\gamma_{cpi,1}$	0,403	0,300	0,343	**0,393****
	(1,61)	(1,17)	(1,54)	(1,66)
$\gamma_{ppi,1}$	0,121	-0,013	0,018	0,137
	(0,42)	$(-0,05)$	(0,06)	(0,49)
$\gamma_{gdp,1}$	**0,765***	**0,774***	**0,862***	**0,812***
	(3,31)	(3,53)	(4,62)	(4,17)
$\gamma_{ret,1}$	0,318	**0,509****	0,299	0,271
	(1,03)	(1,68)	(1,00)	(0,96)
$\gamma_{bp,1}$	**0,422****	**0,738***	**0,489***	**0,379****
	(1,86)	(2,94)	(2,36)	(1,74)

* and ** indicate that the corresponding coefficient is statistically significant at the 5% and 10 %, respectively.

The numbers in (.) are the t-statistics.

$ln(h_t) = w + \alpha \frac{\epsilon_{t-1}}{\sqrt{h_{t-1}}} + \beta ln(h_{t-1}) + \theta(|\frac{\epsilon_{t-1}}{\sqrt{h_{t-1}}}| - \sqrt{2/\pi}) + \gamma Dum_{r^*_\tau} + \sum_{k=1}^{K} \varphi_k Dum^a_{k,t}$

$+\gamma_1 Dum_{r^*_\tau} * Dum^R + \sum_{k=1}^{K} \varphi_{k,1} Dum^a_{k,t} * Dum^R$.

r^*: FED rate; UE: unemployment; CPI: consumer price index; PPI: producer price index;

GDP: gross domestic product; BP: Balance of payment; RET: retail sales

Table 5: Results of the model with positive and negative news (Mean)

	3-year bond	5-year bond	7-year bond	10-year bond
a	-0,001	-0,001	**-0,002***	-0,001
	$(-1{,}54)$	$(-0{,}68)$	$(-1{,}96)$	$(-1{,}52)$
b	**0,062***	**0,064***	**0,072***	**0,064***
	(3,83)	(3,88)	(4,25)	(4,01)
c	**0,318***	**0,227***	**0,208***	**0,162***
	(4,26)	(3,10)	(2,85)	(2,41)
d_{UE}	-0,078	-0,030	-0,086	-0,068
	$(-1{,}53)$	$(-0{,}55)$	$(-1{,}61)$	$(-1{,}37)$
d_{cpi}	**0,156***	**0,185***	**0,144***	**0,126***
	(3,66)	(4,32)	(3,29)	(2,83)
d_{PPI}	-0,013	-0,026	-0,016	-0,008
	$(-0{,}79)$	$(-1{,}53)$	$(-0{,}98)$	$(-0{,}52)$
d_{GDP}	0,006	0,001	0,001	0,000
	(0,62)	(0,09)	(0,11)	$(-0{,}05)$
d_{RET}	**0,028***	0,018	**0,026***	0,018
	(2,05)	(1,37)	(1,94)	(1,43)
d_{bp}	-0,002	-0,002	-0,001	-0,001
	$(-1{,}05)$	$(-1{,}03)$	$(-0{,}50)$	$(-0{,}44)$

* and ** indicate that the corresponding coefficient is statistically significant at the 5% and 10 %, respectively.

The number in (.) are the t-statistics.

$\Delta R_t = a + b\Delta R_{t-1} + c\Delta r_t^* + \sum_{k=1}^{K} d_k D_{k,t}^a + \epsilon_t,$

$ln(h_t) = w + \alpha \frac{\epsilon_{t-1}}{\sqrt{h_{t-1}}} + \beta ln(h_{t-1}) + \theta(|\frac{\epsilon_{t-1}}{\sqrt{h_{t-1}}}| - \sqrt{2/\pi})$

$+\gamma_1 Dum_{r_\tau^*}^{+} * Dum^R + \sum_{k=1}^{K} \varphi_{k,1} Dum_{k,t}^{a+} * Dum^R + \gamma_2 Dum_{r_\tau^*}^{-} * Dum^R + \sum_{k=1}^{K} \varphi_{k,2} Dum_{k,t}^{a-} * Dum^R.$

r^*: central bank rate , UE: unemployment; CPI: consumer price index; PPI: producer price index;

GDP: gross domestic product; BP: Balance of payment; RET: retail sales.

Table 6: Results of the model with positive and negative news (Volatility)

	3-year bond	5-year bond	7-year bond	10-year bond
w	**-0,452***	**-5,175***	**-0,516***	**-0,616***
	$(-4,75)$	$(-11,54)$	$(-4,93)$	$(-4,85)$
θ	**0,059***	0,075	**0,050***	**0,047***
	(3,22)	(1,44)	(2,55)	(2,29)
α	0,004	0,027	0,015	0,024
	(0,26)	(0,94)	(0,92)	(1,40)
β	**0,932***	0,096	**0,919***	**0,903***
	(60,27)	(1,19)	(52,69)	(43,69)
$\gamma_{r^*,+}$	0,463	**4,566***	1,734	1,889
	(0,45)	(3,27)	(1,10)	(1,33)
$\gamma_{r^*,-}$	**-3,610****	**-13,397***	**-5,479***	**-6,337***
	$(-1,92)$	$(-5,04)$	$(-2,57)$	$(-2,82)$
γ_{UE+}	**2,071***	**7,673***	**2,436***	**2,504***
	(2,52)	(6,45)	(2,85)	(2,42)
γ_{UE-}	**-3,156***	**-7,006***	**-4,110***	**-4,187***
	(2,09)	(4,78)	(3,23)	(3,37)
γ_{CPI+}	0,112	**3,169***	0,357	0,943
	(0,09)	(2,04)	(0,32)	(0,87)
γ_{CPI-}	-0,501	**-3,512***	-0,922	**-1,768****
	$(-0,68)$	$(-2,82)$	$(-0,94)$	$(-1,93)$
γ_{PPI+}	0,530	-0,151	0,238	0,442
	(1,51)	$(-0,21)$	(0,55)	(1,06)
γ_{PPI-}	-0,371	-0,164	-0,354	-0,173
	$(-0,72)$	$(-0,27)$	$(-0,80)$	$(-0,39)$
γ_{GDP+}	**1,438***	**1,261***	**1,082***	**1,123***
	(4,35)	(3,62)	(3,51)	(3,80)
γ_{GDP-}	**-0,626***	**-1,170***	**-0,570***	**-0,555***
	$(-2,75)$	$(-6,05)$	$(-3,43)$	$(-2,98)$
γ_{RET+}	0,072	**1,664***	0,363	0,060
	(0,25)	(2,77)	(1,00)	(0,19)
γ_{RET-}	-0,267	-0,007	-0,514	-0,465
	$(-0,60)$	$(-0,01)$	$(-1,23)$	$(-1,13)$
γ_{BP+}	-0,074	0,060	-0,096	**-0,126****
	$(-1,19)$	(0,86)	$(-1,41)$	$(-1,87)$
γ_{BP-}	-0,019	0,054	-0,054	-0,041
	$(-0,32)$	$(-0,56)$	$(-0,86)$	$(-0,67)$

* and ** indicate that the corresponding coefficient is statistically significant at the 5% and 10 %, respectively.

The number in (.) are the t-statistics.

$\Delta R_t = a + b\Delta R_{t-1} + c\Delta r_t^* + \sum_{k=1}^{K} d_k D_{k,t}^a + \epsilon_t$,

$ln(h_t) = w + \alpha \frac{\epsilon_{t-1}}{\sqrt{h_{t-1}}} + \beta ln(h_{t-1}) + \theta(|\frac{\epsilon_{t-1}}{\sqrt{h_{t-1}}}| - \sqrt{2/\pi})$

$+\gamma_1 Dum_{r_\tau^*}^{+} * Dum^R + \sum_{k=1}^{K} \varphi_{k,1} Dum_{k,t}^{a+} * Dum^R + \gamma_2 Dum_{r_\tau^*}^{-} * Dum^R + \sum_{k=1}^{K} \varphi_{k,2} Dum_{k,t}^{a-} * Dum^R$.

r^*: central bank rate , UE: unemployment; CPI: consumer price index; PPI: producer price index;

GDP: gross domestic product; BP: Balance of payment; RET: retail sales.

Figure 1: Smooth probability - state 2 - 3-year

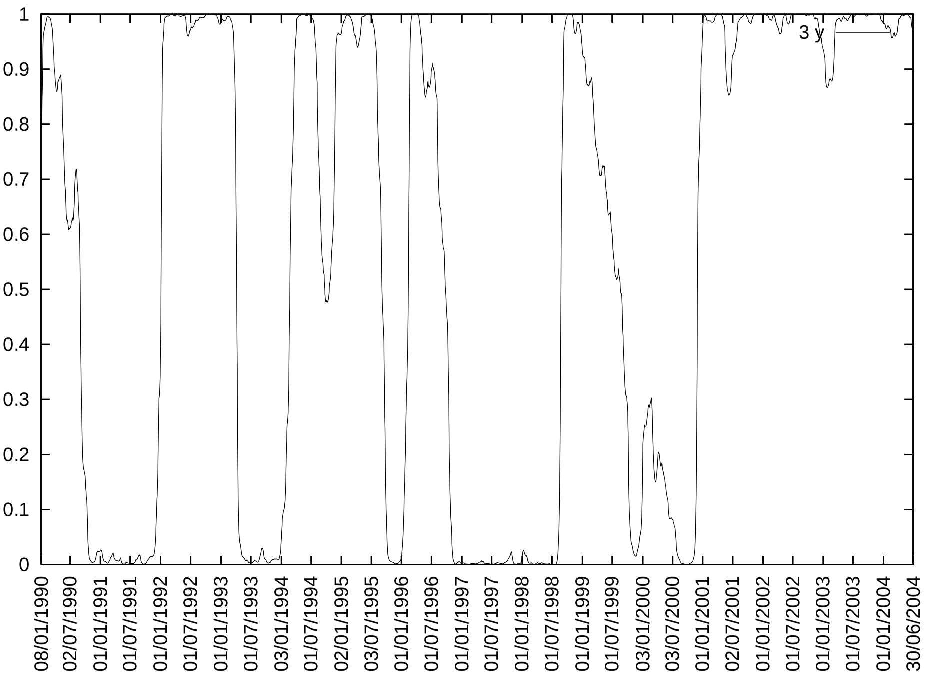

Figure 2: Smooth probability - state 2 - 5-year

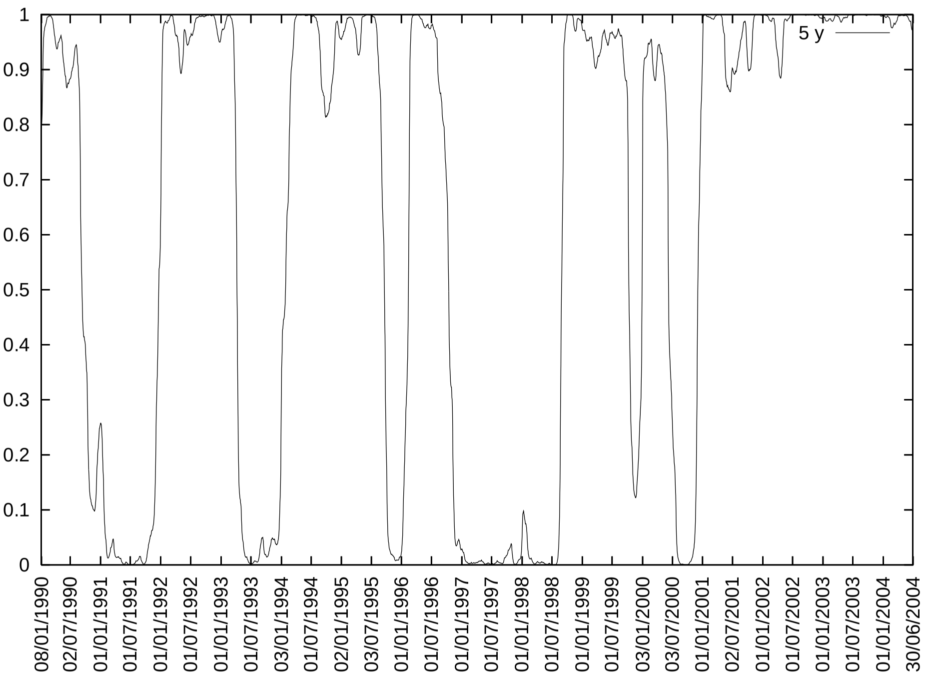

Figure 3: Smooth probability - state 2 - 7-year

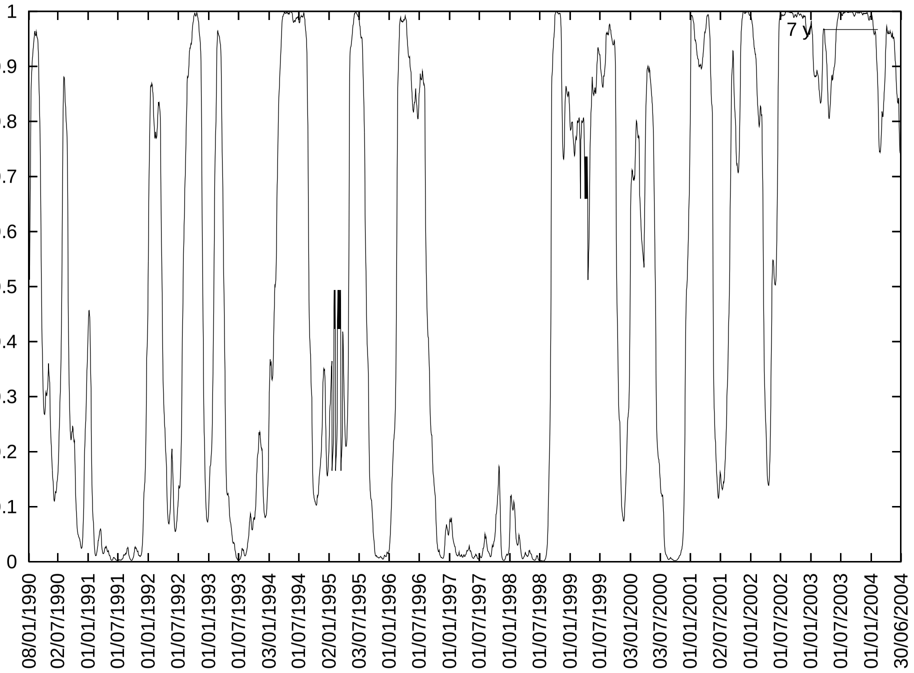

Figure 4: Smooth probability - state 2 - 10-year

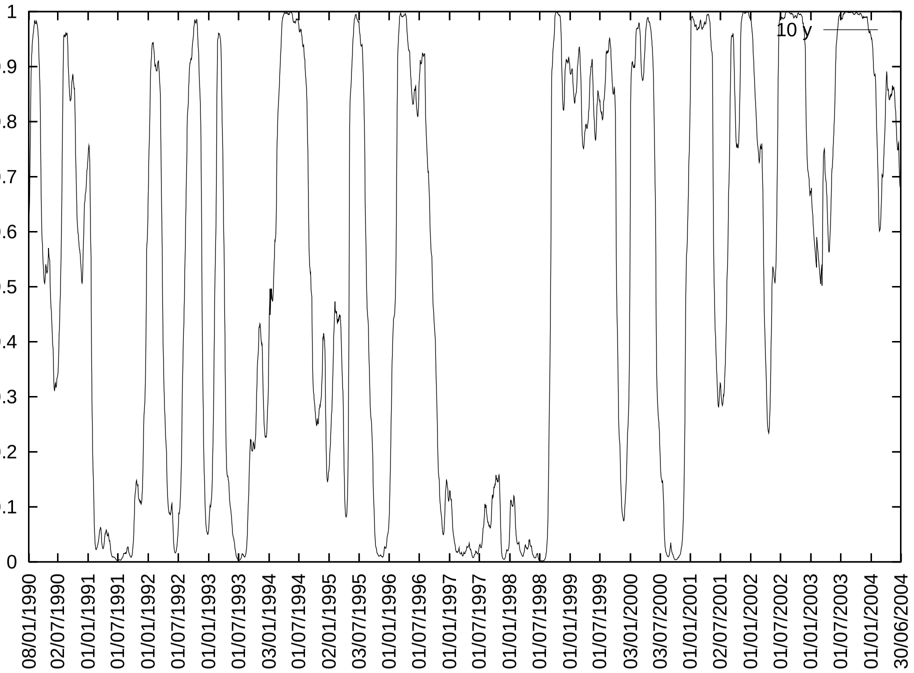

Table 7: Test of unit root

	ADF					Zivot and Andrews			SEO		
	C		B		A	C	B	A	**Model 2**	**Model 1**	**Model 0**
	$\widehat{\rho}$	$\widehat{\beta}$	$\widehat{\rho}$	$\widehat{\mu}$	$\widehat{\rho}$						
3-year bond	-1.82	-1.17	-1.41	0.99	-1.52	-3.76	-2.26	-3.34	-1.52	-1.73	-2.18
									[0.55]	[0.54]	[0.54]
5-year bond	-2.33	-1.79	-1.50	1.20	-1.33	-4.26	-2.55	-3.42	-2.08	-1.43	-1.86
									[0.57]	[0.57]	[0.57]
7-year bond	-2.61	2.45	-1.57	1.32	-1.26	-4.65	-2.95	-3.48	-2.05	-1.36	-2.27
									[0.59]	[0.59]	[0.59]
10-year bond	-2.97	-2.50	-1.61	1.40	-1.17	-4.80	-3.45	-3.52	-2.45	-1.14	-2.16
									[0.61]	[0.61]	[0.56]

* and ** indicate that the corresponding coefficient is statistically significant at the 5% and 10 % level, respectively.

The values [./.] in the central part of the table correspond to the month and the year of the change.

The value [.] in the right hand of the table corresponds to the value of ρ.

Figure 5: 3-year bond rate variation

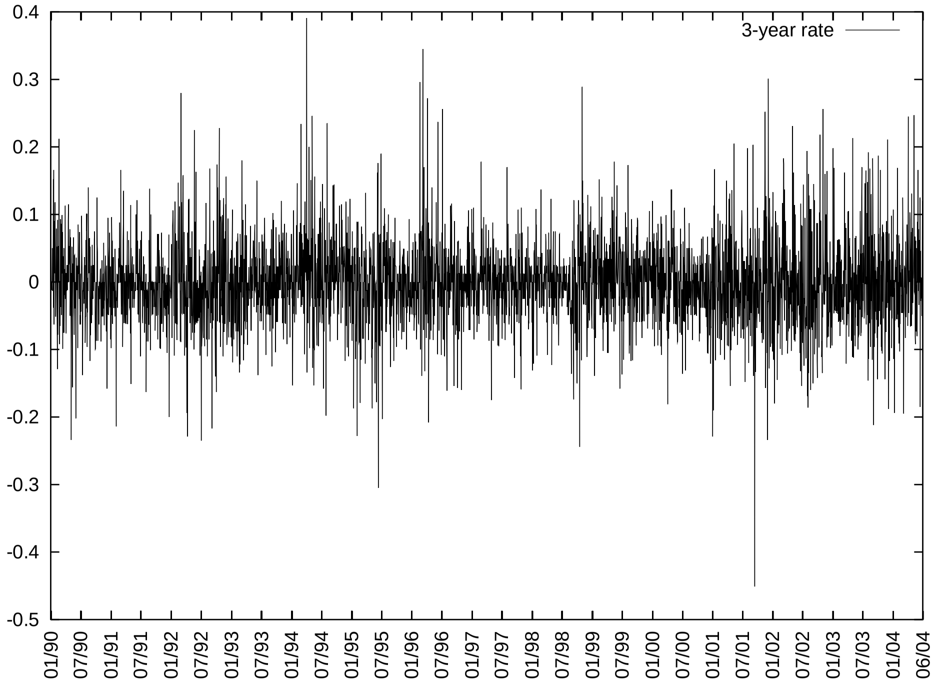

Figure 6: 5-year bond rate variation

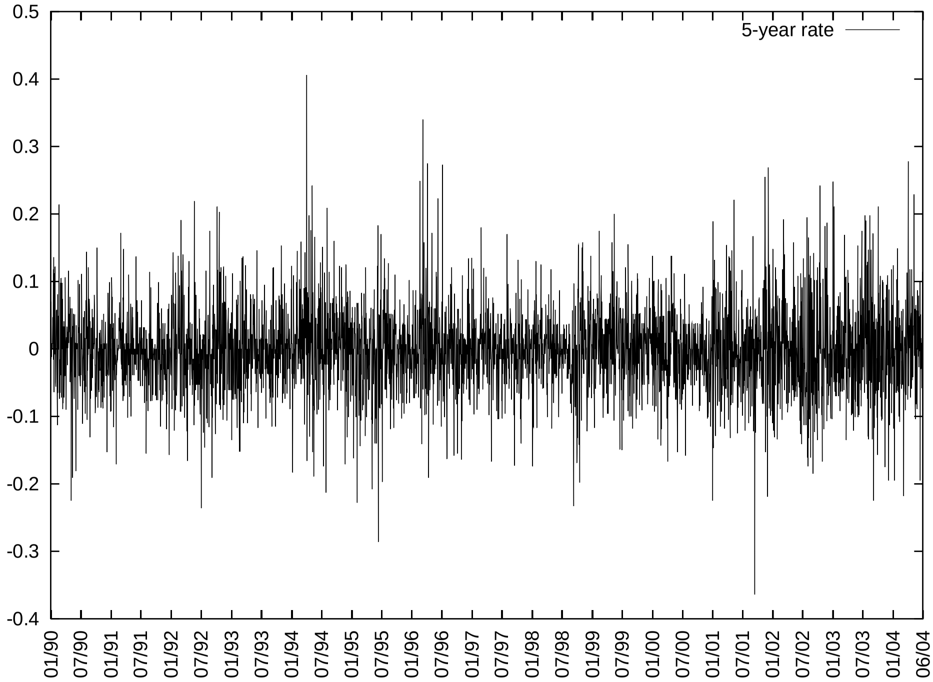

Table 8: Statistical properties of the daily U.S. interest rate

	3-year bond	5-year bond	7-year bond	10-year bond
Lyung-Box (LB) test on the squared residuals				
$LB(1)$	3.592*	7.512*	18.264*	7.101*
$LB(5)$	40.893*	48.647*	55.437*	47.970*
$LB(10)$	63.716*	79.554*	92.816*	85.052*
Box-Pierce (BP) test on the squared residuals				
$BP(1)$	3.591*	7.504*	18.244*	7.093*
$BP(5)$	40.816*	48.558*	55.345*	47.884*
$BP(10)$	63.572*	79.370*	92.611*	84.852*
LM test for ARCH effect (Engle (1982))				
$LM-ARCH(1)$	3.591*	7.505*	18.483*	7.094*
$LM-ARCH(5)$	38.207*	44.478*	50.226*	43.474*
$LM-ARCH(10)$	52.665*	63.356*	72.962*	65.301*

* and ** indicate that the corresponding coefficient is statistically significant at the 5% and 10 % level, respectively.

Table 9: Statistical properties of the innovations (ϵ_t) in the Eq. 3.

	3-year bond	5-year bond	7-year bond	10-year bond
Ljung-Box des autocorrélations				
	0.006*	0.001*	0.002*	0.001*
	(0.00)	(0.00)	(0.00)	(0.00)
	8.043*	6.327	8.746*	9.655*
	(0.05)	(0.10)	(0.03)	(0.02)
	14.701**	13.547**	14.720**	16.799*
	(0.07)	(0.09)	(0.06)	(0.03)
LM pour l'effet ARCH				
	3.297**	12.704*	23.042*	9.109*
	(0.07)	(0.00)	(0.00)	(0.00)
	49.927*	56.993*	57.820*	50.075*
	(0.00)	(0.00)	(0.00)	(0.00)
	71.586*	77.162*	79.297*	72.141*
	(0.00)	(0.00)	(0.00)	(0.00)

* and ** indicate that the corresponding coefficient is statistically significant at the 5% and 10 % level, respectively.

Figure 7: 7-year bond rate variation

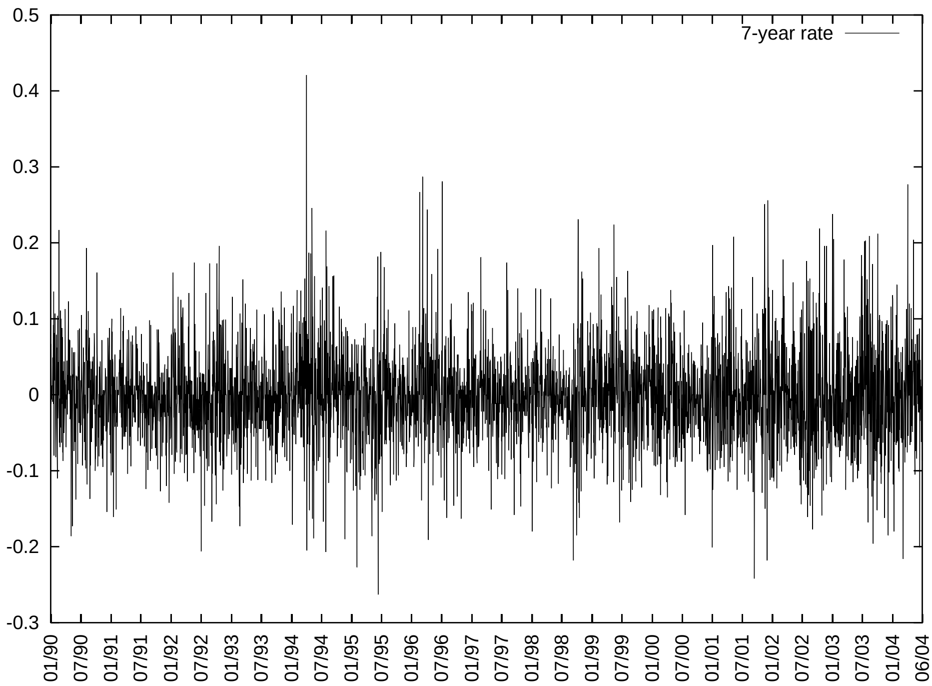

Figure 8: 10-year bond rate variation