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(Az MNB kommunikációjának hatása a pénzpiacokra)

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Contents

Abstract

Our paper aims to assess how the Magyar Nemzeti Bank's communication affects financial asset prices. We find that the central bank plays the most important role in influencing long-term yields. The effect on the exchange rate is less pronounced, while short-term yields are influenced only by the communication related to the exchange rate. Analysing the direction and channels of communication we observe two asymmetries. The central bank is more successful in signalling monetary policy tightening than easing and with the increase of time horizon the written communication gains in importance and dominates the verbal forms.

JEL: C22, E43, E52.
Keywords: communication, transmission mechanism.

Összefoglalás

Tanulmányunkban azt vizsgáltuk, hogy a Magyar Nemzeti Bank kommunikációja milyen mértékben gyakorolt hatást a pénzügyi eszközök áraira. Eredményeink alapján a jegybanki kommunikáció leginkább a hosszú hozamokra hatott. Az árfolyamra gyakorolt hatás már kevésbé egyértelmű, a rövid hozamokat pedig csak az árfolyammal kapcsolatos nyilatkozatok befolyásolták. A jegybanki kommunikáció hatása több szempontból is aszimmetrikus. Az MNB egyrészt sikeresebben közvetítette a szigorúbb, mint a lazább monetáris politikára irányuló törekvéseit, másrészt a rövid hozamokra a verbális, a hosszú hozamokra pedig az írásbeli kommunikáció hatott erősebben.

1. Introduction

The last decade brought about an important change in the relationship between central banks and the public and in central banks' communication strategies: aiming at transparency became general. The underlying economic motivation is the central bank's intention to make its decisions understandable and predictable for economic agents. Due to several factors, the information sets of central banks and market participants are not identical. On the one hand, in addition to published macroeconomic data, central banks may continue to have information not available to the public[1], and on the other hand, market participants do not have perfect information on the central bank's preferences and reaction function. By sharing (at least a part of) the additional information it has, the central bank can shift economic agents' expectations in the direction it considers appropriate, improving the efficiency of the monetary policy.[2]

Central bank communication plays a key role in creating transparency and thus in influencing expectations. For transparency to make monetary policy more efficient in practice, it is not enough to make many data public, but it is also important to make sure that market participants see and understand those frameworks within which the central bank processes information.[3] Economic agents' ability to absorb and process information has its limits, therefore they attach greater importance to pieces of information which are easier to understand.[4] Accordingly, appropriate communication – the decision maker's ability to make his intentions and decisions easy to understand but present at the same time the complexity of economic developments – is indispensable for the advantages of transparency to unfold.

Due to the increased importance of communication, central banks make increasing efforts to assess the efficiency of their communication. Measuring the efficiency of central bank communication is not a simple task, as central banks pursue several objectives at the same time when communicating with market participants. The medium- and long-term aim of their communication strategy is anchoring market expectations, while in the short run they often strive to change current market expectations. In the latter case it is relatively simple to measure the efficiency of communication by the immediate changes in prices, as the prices of financial assets reflect the effect of communication. Due to easier measurability, the empirical literature analysing the efficiency of central banks' communication focuses primarily on the analysis of short-term efficiency.

Following this path, in our analysis we try to assess the effect of the MNB's communication on short- and long-term yields and on the exchange rate in the period between August 2001 and September 2005. The effect is measured by the direct, daily price change following the communication. According to their content, we group communication into three categories. Communication can be related to the expected path of the central bank policy rate (interest rate communication), the exchange rate preferred by the central bank (exchange rate communication) or macroeconomic prospects. All three categories are further broken down on the basis of the direction of communication in order to be able to obtain a picture of the possible asymmetry of effects as well. In addition to the analysis and comparison of the effect of communication with various contents, written and verbal channels of communication are also distinguished, and their relative efficiency is also examined. Comparing our results to the literature we try to assess how efficient the MNB's communication is relative to other central banks.[5]

According to our findings, the role of the MNB's interest rate communication in short-term yield developments is moderate in international comparison; short-term yields are influenced only by the exchange rate communication. The

[1] Several empirical studies confirm the existence of information asymmetries between the central bank and market participants. For example, Romer and Romer (2000) confirm the existence of central banks' additional information by comparing the macroeconomic forecasts of the Fed and market analysts; Peek, Rosengren and Tootell (1999a, 1999b) show also in the case of the Fed that through the supervision of the banking sector the central bank obtains valuable additional information, which it utilises as well.

[2] Regarding the connection between transparency and expectations see e.g. Bernhardsen and Kloster (2002) and Poole (2001) and also Gjedrem (2001).

[3] This interpretation of transparency is based on the definition by Blinder at al. (2001). Both in literature and in central banks' communication, the similar, wider understanding of transparency tends to replace the earlier definition concentrating on openness and identifying transparency with the amount of information made public. Possible interpretations of transparency are analysed e.g. by Winkler (2000).

[4] Kahnemann (2003).

[5] The studies used for the comparison analysed the ECB and the central banks of the following countries: Australia, Canada, New Zealand, USA, United Kingdom, Sweden, Poland and the Czech Republic.

role of the exchange rate communication can be explained by the fact that in a small and open economy, exchange rate and interest rate policies and their communications cannot be independent. Therefore, both the interest rate and exchange rate communication can influence the expectations regarding the short-term path of the central bank's policy rate. However, this alone does not provide an explanation to the relatively small effect of interest rate communication; in addition to the high volatility of the risk premium, different opinions in the Monetary Council and the occasional inconsistencies of interest rate decisions and communication may also play a role. Central bank communication has a moderate effect on the exchange rate, it usually can not turn the trend of the exchange rate change, only reduces its magnitude. As opposed to the above, analysing the changes in long-term yields we find that over the longer horizon communication co-ordinates market participants' expectations to a greater extent. The written communication on macroeconomic outlook has a relatively strong effect on long-term yields, which shows that according to economic agents central bank analyses carry useful information and can lead to a revision of market expectations. An asymmetry can be observed in the efficiency of interest rate and exchange rate communication. Statements about a stricter interest rate policy or stronger exchange rate are usually more effective than statements suggesting a looser interest rate policy or weaker exchange rate. A probable explanation for this finding is that market participants assume that the central bank has an asymmetric reaction function, it reacts quicker if the monetary conditions have to be tightened and slower if it considers the monetary conditions to be too strict. Our findings suggest that central bank statements usually reduce the volatility of asset prices and market uncertainty. Exchange rate weakening statements are an exception; in the short run they add to the uncertainty surrounding the expected exchange rate developments.

The outline of our paper is as follows. In Chapter 2 we briefly present through what kind of mechanisms central bank communication can have an effect on market yields and on the exchange rate, Chapter 3 provides an overview of empirical studies on the efficiency of communication. Chapter 4 describes the data used for our analysis and the methodology applied. Chapter 5 contains the quantitative analysis of the effect of communication on the exchange rate and short- and long-term yields. In Chapter 6 we attempt to explain the differences in the effects of communication of the MNB and other central banks. Chapter 7 concludes.

2. How can communication affect financial markets?

In this chapter we give a brief overview of the possible effect of central bank communication on the yield curve and the exchange rate. We do not aim at a formal modelling of possible mechanisms, but simply summarize what market participants can infer from the central bank's messages.

Although each central bank strives to share all or part of the information it has, the role of communication, its topics and its effect on asset prices depend on the monetary policy strategy and the economic environment. Therefore, first we present the possible effects of communication in large, closed economies, then the further aspects arising with relation to smaller, open economies, and finally we also review how the MNB's communication is influenced by the institutional and economic environment of the Hungarian monetary policy.

In a large, closed economy the role of the interest rate and expectation channels are decisive in the transmission mechanism, thus interest rate communication and the communication on economic outlook play a pronounced role in communication. Over a very short horizon, the expected interest rate decisions by the central bank determine market participants' interest rate expectations, and everything that contains new pieces of information in this regard may have an effect on short-term yields. As the central bank is aware of its own preferences and reaction function, it can be assumed that it uses the communication to signal its additional information about the next decisions.

Interest rate communication conveys direct information about the next interest rate decision, so it should have a strong effect on short-term yields. Statements regarding macroeconomic outlook may also indicate the future path of the policy rate. In this case the information on the next decision is indirect, so the effect on short-term yields may be weaker.

In case of long-term yields, mainly the communication related to macroeconomic outlook can carry information, although the direction of the effect is ambiguous. For example, statements emphasizing negative growth prospects may, on the one hand, increase market participants' uncertainty, and raise long-term yields, and on the other hand, they may result in interest rate cut expectations in the long run, and lead to a decline in long-term yields. Furthermore, if the central bank's information on long-term economic developments is the same as that of the market participants', then the effect of the communication on the economic outlook can be negligible.

Over the long run, a credible central bank is able to anchor expectations, and in this case the interest rate communication is not expected to have a significant effect on long-term yields. However, if the central bank is not fully credible, statements can become tools to create or restore credibility. In this case, communication may have an effect on longer-term expectations and thus on longer-term yields as well. If this effect is dominant, one can expect that the statements suggesting a raise of the interest rate indicate the commitment of the central bank, therefore they result in a decline in long-term yields.

Exchange rate communication provides direct information for market participants regarding the central bank's exchange rate preferences. Communication related to macroeconomic outlook can transmit information to market participants on the fundamentals which determine the exchange rate in the longer run. The effect of these types of communication on the exchange rate depends on to what extent market participants think that the central bank has additional information on the factors which determine the exchange rate, and how they judge the weight and role of the exchange rate in the central bank's reaction function.

In case of a small, open economy it is obvious also for economic agents that the exchange rate and interest rate policies cannot be independent of each other. Therefore, if the central bank discloses new information with relation to the interest rate policy (exchange rate policy), market participants can draw conclusions regarding the exchange rate policy (interest rate policy) as well. If the central bank's exchange rate and interest rate communication is inconsistent, it causes uncertainty and reduces the credibility of the central bank. To avoid a possible inconsistency the central bank can opt

to disclose its exchange rate and yield preferences only partly. Although less clear communication can co-ordinate market participants only to a smaller extent, it reduces the risk of losing the credibility of the central bank.

The central bank can reduce the possible inconsistency of communication, if it puts the emphasis only on either the interest rate or the exchange rate communication. Interest rate communication can be more credible, as the short-term interest rate is the variable directly controlled by the central bank. However, if communication concentrates only on the interest rate, it only has an indirect effect on the exchange rate, which may mean a weaker-than-optimum relationship. Therefore, central banks of open economies usually try to influence market expectations with regard to the exchange rate as well.

Exchange rate developments and shocks to the exchange rate can also play an important role in determining interest rate policy, therefore the central bank's statements regarding the exchange rate may also contain information with regard to upcoming interest rate decisions. However, in case of the exchange rate communication this information is indirect. Its assessment and interpretation depends on what market participants think of the central bank's reaction function, to what extent they expect that the central bank will change the interest rate level in order to attain the desired exchange rate level. Consequently, one would expect that the effect of the exchange rate communication on short-term yields is weaker than that of the interest rate communication, which provides direct information on the central bank's interest rate policy. Exchange rate communication can affect longer-term yields as well. As it can also indicate the central bank's commitment or provide information on long-term economic developments, its effect can resemble the effect of statements either regarding the interest rate path or macroeconomic outlook.

Market participants can infer the exchange rate level preferred by the central bank from indirect information as well. In case of interest rate communication it is expected that hints on tightening strengthen, while hints on easing weaken the exchange rate. In case of communication on economic outlook, the direction of the effect is not clear. On the one hand, new information related to developments in the fundamentals can directly affect the expectations regarding the equilibrium exchange rate, so communication with positive contents may result in exchange rate appreciation, while communication with negative contents may lead to a depreciation of the exchange rate. On the other hand, new information may also affect expectations regarding the interest rate policy, through which it may have an effect on the exchange rate. Since communication regarding macroeconomic prospects can influence interest rate expectations in both directions, its indirect effect on the exchange rate is also uncertain.

For inflation targeting central banks, shaping expectations plays an especially important role in the transmission of monetary policy. Therefore, in their case communication as a tool of influencing expectations is also more significant. By adopting inflation targeting, efficient communication became important for the MNB as well. Although theoretically there are still several means available for attaining central bank targets, efficient communication can provide important assistance in it. Of course, the MNB's communication must adjust itself to the institutional and economic environment as well. Similarly to the central banks of several small, open economies, the exchange rate is of key importance in the transmission mechanism, and thus it is an important aim of communication to influence the exchange rate indirectly or directly.

An important characteristic of the Hungarian monetary policy is that the central bank applies inflation targeting together with an exchange rate band.[6] The role of the exchange rate band in the period under consideration cannot be disregarded, because during most of the period the MNB's inflation target was consistent with an exchange rate level relatively close to the strong edge of the band. If an exchange rate close to the edge of the band belongs to attaining the central bank's inflation target, the exchange rate band allows and also enforces a more active exchange rate policy. The exchange rate band partly helps the exchange rate policy, since a credible band eliminates the possibility of an undesired strengthening of the exchange rate, and thus the central bank has to strive 'only' to prevent exchange rate depreciation. On the other hand, however, appreciation of the exchange rate is limited because of the band, and therefore, if the central bank aims at maintaining an average exchange rate level close to the edge of the band, it must react against forint depreciation in an aggressive manner. Overall, a more active exchange rate policy belongs to an

[6] In the study, we regard the exchange rate band as given. The advantages and disadvantages of the exchange rate band are not discussed; only the relationship between the band and communication is analysed.

exchange rate target close to the edge of the band, and thus the importance of exchange rate communication is much greater in case of the MNB than in case of other inflation targeting central banks. The existence of the exchange rate band has an effect on interest rate communication as well. Close to the edge of the band, external shocks may enforce an unexpected interest rate change, which makes difficult for the central bank to maintain a consistent interest rate communication.

The explicit aim of Hungary's economic policy is to meet the criteria to join the eurozone, which establishes a clear link between information on macroeconomic developments and exchange rate and interest rate expectations. Each piece of macroeconomic information (including central bank communication on economic outlook) can be interpreted as departing from or approaching the expected date of joining the eurozone. This may be reflected in exchange rate developments and the level of the risk premium, which, in turn, may modify expectations regarding the central bank policy rate. Accordingly, statements suggesting positive macroeconomic developments may result in a decline in yields and an appreciation of the exchange rate.

3. Literature overview

In recent years several empirical analyses examined the efficiency of various forms of central bank communication. These studies applied the framework used for examining the effects of macroeconomic data releases and central bank decisions.[7] The basic idea is that the importance of the information reaching the market is measured by the effect on asset prices. Studies analysing central bank communication typically examine the daily changes in asset prices following communication, extending the model explaining exchange rate or yield changes with variables indicating central bank communication (Andersson, Dillén and Sellin [2004], Fatum and Hutchinson [2002], Jansen and de Haan [2005], Fratzscher (2004), Jansen and de Haan [2004], Ehrmann and Fratzscher [2005] and Rozkrut, Rybinski, Sztaba and Szwaja [2005]).

Instead of measuring the effect of communication with price changes, some studies put the emphasis on the volatility of the asset prices. They consider the communication as efficient, if it influenced the variance of yields (Kohn and Sack [2003], Connolly and Kohler [2004], Reeves and Sawicki [2005]). Accordingly, in this context the question is only whether central bank communication represents new information for market participants, and not what price changes it caused.

In case of both approaches, the key questions are how central bank communication is measured, which channels of communication are examined and what categories are used to comprise decision makers' statements into variables.

3.1. CATEGORIES ACCORDING TO COMMUNICATION CHANNELS

In terms of communication channels there are two main approaches. The first one focuses on the analysis of mainly written means of communication, which are available on central banks' websites: statements by the central bank, reports on inflation, public minutes, decision makers' votes, parliamentary hearings and speeches of decision makers published on the website. This approach is followed by Kohn and Sack (2003), who, in case of the Fed, examine the effect of the statements accompanying decisions by the decision making body (FOMC) and of the governor's speeches and reports to the Congress, and by Andersson, Dillén and Sellin (2004), who analyse four of the Swedish central bank's means of communication: interest rate decisions, the inflation report, the published minutes of the meetings of the Monetary Council, and decision makers' statements. Connolly and Kohler (2004) compare the efficiency of several channels of communication in case of six central banks (the central banks of Australia, Canada, New Zealand and Great Britain, the Fed and the ECB).

The other possible approach interprets verbal communication in a wider sense, from the market participants' point of view, and identifies central bank decision makers' statements on the basis of news reported by the main news agencies (Reuters, Bloomberg, and Dow Jones). Fatum and Hutchinson (2002), Jansen and de Haan (2005), Fratzscher (2004) and Beine, Janssen and Lecourt (2004) analyse news containing central bank statements related to exchange rates and intervention. In addition, Jansen and de Haan (2004) also examine statements referring to monetary policy, while Ehrmann and Fratzscher (2005) identify statements on interest rate policy and macroeconomic outlook among the news reported.

The basic difference between the two approaches is that in the first case even verbal communication is pre-edited, the content of the statements is determined by the decision maker, and thus they can transmit the intended message better. On the contrary, the content of statements in news data bases is determined not only by the decision maker, but very often by questions asked by journalists and reporters. Moreover, the message is not based on a text edited by the central bank, but on news actually reaching market participants and interpreted – or perhaps misinterpreted – by news agencies. At the same time, for measuring market reactions, the news reported by the agencies are more relevant, since market participants react to news that reach them, rather than to the central bank's intentions directly.

[7] For example, Fleming and Remolona (1997), Fleming and Remolona (1999), Andersen, Bollerslev, Diebold and Vega (2002).

The relative efficiency of communication channels differs across central banks. According to the results of Connolly and Kohler (2004), verbal channels play the strongest role in case of the central banks of Australia and New Zealand, speeches and parliamentary hearings have an effect on most interest rates examined, and their effect over longer horizons is in many cases stronger than over short ones. Hearings play the biggest role in case of the Fed, in the case of the rest of the central banks other communication channels are more important. Andersson, Dillén and Sellin (2004) find that in case of the Swedish central bank, in addition to interest rate decisions, the verbal statements by decision makers have a significant effect on yields both statistically and economically. In case of the BoE, Reeves and Sawicki (2005) come to a different conclusion; the information content of written communication is greater than that of verbal channels.

Similarly to the studies by Rozkrut, Rybinski, Sztaba and Szwaja (2005) and Reeves and Sawicki (2005), in our analysis we examine the effects of both written and verbal communication. Because only few observations are available for distinguishing the various forms of communication, they are analysed in an aggregate manner, distinguishing only written and verbal channels. We use news reported by Reuters as a source for identifying verbal statements.

3.2. CATEGORIES ACCORDING TO THE CONTENT OF COMMUNICATION

In addition to categorizing on the basis of communication channels, grouping of statements according to their content is also common. As it was mentioned earlier, central banks can have more information than the market in two fields. On the one hand, they know their own preferences, reaction function and thus their expected decisions more precisely, and on the other hand, as they spend more resources on forecasting, central banks can have a more accurate picture of longer-term economic developments. Therefore, central bank communication focuses on two main topics: it transmits information on monetary policy (the expected future interest rate path, exchange rate preference of the central bank) and on macroeconomic outlook.

Due to the closed nature of the economies examined and the relatively small role of the exchange rate in the central bank's reaction function, when analysing the effect of interest rate communication, the literature focuses primarily on the effect on yields (Andersson, Dillén and Sellin [2004], Kohn and Sack [2003], Reeves and Sawicki [2005], Ehrmann and Fratzscher [2005]). In case of the exchange rate communication studies typically analyse the direct effect on the exchange rate (Fratzscher [2004], Fatum and Hutchinson [2002] and Jansen and de Haan [2005a]). Relatively little attention was paid to the analysis of the relationship between interest rate and exchange rate communications. The effect of interest rate and exchange rate communication on the euro-dollar exchange rate is examined by Jansen and de Haan (2005b), while Rozkrut, Rybinski, Sztaba and Szwaja (2005) examine their effect on the yield curves of Central-East European countries. Reeves and Sawicki (2005), Rozkrut, Rybinski, Sztaba and Szwaja (2005) analyse the effect of communication regarding macroeconomic outlook on the yield curve, Kohn and Sack (2003) and Ehrmann and Fratzscher (2005) also examine its effect on the exchange rate and stock markets.

The categories applied in our analysis are similar to the ones applied by Rozkrut, Rybinski, Sztaba and Szwaja (2005), when analysing the effect of communication both on the exchange rate and on yields. In addition to interest rate communication and statements about macroeconomic outlook we also distinguished statements regarding the exchange rate. The underlying reason is that in case of the MNB the exchange rate plays an important role in the central bank reaction function and in communication as well.

In the following two sections we summarize the results of the empirical literature on the effect of communication with various contents.[8]

3.2.1. The effect of communication on the yield curve

In case of short-term yields[9] empirical studies usually find that the effect of interest rate communication is dominant (Kohn and Sack (2003), Ehrmann and Fratzscher (2005), Rozkrut, Rybinski, Sztaba and Szwaja (2005)). The effect corresponds

[8] The findings of empirical literature are also summarized in the tables in Appendix A. It is important to note that the findings of the literature are not always intuitive, and in many cases the authors could not find any satisfactory explanation to this.

[9] Short-term yields hereinafter are the ones with less than 1 year maturity.

to the direction of the statement: statements suggesting tightening result in a yield increase, while statements suggesting easing lead to decline in yields. The results of Andersson, Dillén and Sellin (2004) point out the importance of interest rate communication in shaping market participants' short-term interest rate expectations. They found that the statements by the Swedish central bank had an asymmetric effect. While tightening statements had a stronger effect on market participants' expectations than the easing ones, actual interest rate increases had smaller effects on yields than interest rate cuts. This shows that if communication can succeed in shaping market participants' expectations, yields reflect the intentions of the central bank before the interest rate decision is made, and thus the effect of the actual step is negligible.

In addition to interest rate communication, Rozkrut, Rybinski, Sztaba and Szwaja (2005) also analysed the effect of exchange rate communication on yields in case of the Polish, Czech and Hungarian central banks. The effects were always in line with the intuition; statements aiming at the appreciation of the exchange rate resulted in an increase in short-term yields, while weakening statements caused their decline. At the same time, the role of exchange rate communication was usually smaller than that of interest rate communication, with the MNB as the only exception. In the MNB's case, exchange rate communication had the strongest effect on short-term yields. The results are probably driven by the fact that due to the exchange rate band, the exchange rate and thus exchange rate communication play an important role in the MNB's monetary policy. This partly explains also that the effect of the MNB's interest rate communication is usually insignificant, or its sign is counter-intuitive.

The role of communication related to economic outlook is relatively small in shaping short-term yields. In cases when its effect is significant, its coefficient is usually smaller than that of interest rate communication (Ehrmann and Fratzscher [2005], Rozkrut, Rybinski, Sztaba and Szwaja [2005]). The sign of communication regarding economic outlook is usually positive: short-term yields increase as a result of improving prospects, while they decline as a result of deteriorating prospects.

Interest rate communication often plays an important role in influencing long-term yields as well. Its effect on the middle part of the yield curve is sometimes stronger than that on short-term yields (Ehrmann and Fratzscher [2005], Andersson, Dillén and Sellin [2004]).

In case of the Fed, however, macroeconomic communication dominates in shaping long-term yields (Ehrmann and Fratzscher [2005], Kohn and Sack [2003]). Improving growth prospects make long-term yields increase, while deteriorating prospects make them decline. In case of the ECB, the BoE and Central-East European central banks the effect of statements related to macroeconomic outlook is smaller and less uniform (Ehrmann and Fratzscher [2005], Rozkrut, Rybinski, Sztaba and Szwaja [2005]). In case of the ECB, the communication on macroeconomic outlook accompanying decisions plays the most important role in shaping long-term yields. However, the direction of the effect is opposite compared to the one found in case of the Fed: improving growth prospects made yields decline, while deteriorating prospects made them increase. The communication of the Czech and Polish central banks related to macroeconomic outlook had an effect only on the middle section of the yield curve. Positive news regarding the economic outlook increased the Polish two-year yields, but the effect in case of the Czech yields was negative. Exchange rate communication did not influence long-term yields in case of any of the Central-East European central banks.

3.2.2. The effect of communication on the exchange rate

The findings about the effect of communication on the exchange rate are mixed.

Ehrmann and Fratzscher (2005) found that in case of the BoE, the Fed and the ECB, interest rate communication did not affect the exchange rate. Jansen and de Haan (2005a) concluded – for a different time period – that in case of the ECB, statements indicating a rise in interest rates resulted in a slight exchange rate depreciation, instead of the expected exchange rate strengthening effect.

In case of the BoE and the Fed, statements regarding macroeconomic outlook influenced short-term yields: indications of improving prospects resulted in the depreciation of the exchange rate, while indications of deteriorating prospects led to appreciation of the exchange rate (Ehrmann and Fratzscher [2005]).

The effect of exchange rate communication is ambiguous as well. Fratzscher (2004) shows that over the short run the verbal intervention by the ECB, the Fed and the BoJ had the desired effect on the euro/dollar (mark/dollar) and yen/dollar exchange rates, and in several cases it reduced the volatility. The effect on the exchange rate proved to be independent of the stance of monetary policy and of actual intervention. However, the effect of verbal intervention was found stronger when the contents of the statement were different from the usual messages of central banks (strong dollar and strong mark). Using intraday data, Jansen and de Haan (2005a) found that the effect of verbal intervention is small and fades away rapidly. Analysing the statements of ECB reported by Bloomberg according to various dimensions they conclude that statements in the headline are more effective, while on the days when macroeconomic data are disclosed verbal intervention is less efficient. Fatum and Hutchinson (2002) showed that the effect of statements is strongly asymmetric, statements that intend to strengthen the euro have no effect on the exchange rate, while statements of opposite sign result in significant exchange rate depreciation even over a one-week horizon. According to the findings of Jansen and de Haan (2005b), the decision makers of the ECB and of euro area central banks can not strengthen the exchange rate with their statements, but on the day of exchange rate communication the volatility of the exchange rate decreases. However, the decline in uncertainty is only temporary, and volatility increases markedly on the day following the statement, as various interpretations of the statement appear. Moreover, statements indicating intervention result in moderate exchange rate depreciation over the two-day horizon, instead of the intended exchange rate appreciation.

Beine, Janssen and Lecourt (2004) examine intervention-related statements from another aspect. They do not consider communication to be an independent monetary policy instrument, but they analyse whether statements by the Bundesbank, the ECB, the Fed and the Japanese central bank support actual intervention. Their findings suggest that central bank statements following, confirming or explaining an intervention add to the efficiency of the intervention, and reduce the volatility of the exchange rate.

3.3. THE RELATIONSHIP BETWEEN INSTITUTIONAL ASPECTS AND COMMUNICATION

Central bank decision making tends to move towards collective decisions, but the composition of bodies and the structure of decision making are diverse in international practice. Blinder and Wyplosz (2004) point out that in case of different decision making structures – individual decision making, collegial, individualistic or autocratic decision making bodies – different communication strategies may be appropriate.

Table 1

Decision making and communication[10]

			Decision making process	
		Individualistic	Collegial	Autocratic
Communication strategy	Synchronized	BoE	ECB	
	Not synchronized			Fed

Ehrmann and Fratzscher (2005) compare the communication strategies of the ECB, the Fed and the BoE, and conclude that very different communication strategies can be similarly successful (Table 1). Their empirical results show that the chosen communication strategy also influences which type of communication affects the expectations of market participants. In case of the Fed the statements of decision makers reflect a variety of opinions. Still, the

[10] Blinder and Wyplosz (2004) define the different types of decision making committee as follows:
Members of a *collegial committee* arrive at a group decision that somehow springs from the collective wisdom of the group and is embraced by all of its members.… members may argue strenuously for their own points of view behind closed doors, but they ultimately compromise on a group decision, of which each member then assumes ownership.
In what we call an *autocratically-collegial committee*, by contrast, the chairman more or less dictates the group "consensus." … the group's decision is essentially the chairman's decision.
In *an individualistic committee* each member not only expresses his or her own opinion verbally, but probably also acts on it by voting. The group's decision is made by majority vote–literally. And unanimity is not necessarily expected; it may not even be sought.

decisions of the central bank are forecastable, and communication influences yields and inflation expectations. The underlying explanation is that market participants recognize who plays the decisive role in decision making: market yields and inflation expectations usually react more strongly to the governor's statements than to other decision makers' communication. On the contrary, in case of the ECB, where the decision making process is collegial and the communication presents a consensus-based opinion, the reaction of market yields to the president's and other decision makers' statements are similar. As for the BoE, communication of individual decision makers reflects a relatively uniform view, although individual votes are dispersed. According to the empirical findings this strategy proved to be the least effective.

The results of Reeves and Sawicki (2005) also show, that in case of the BoE, the communication strategy does not match the individualistic decision making structure. They found that communication forms reflecting a collective opinion (published minutes and inflation reports) are more effective than communication transmitting individual opinions, which are not necessarily in line with individual votes (statements and parliamentary hearings).

The monetary council of the Swedish central bank can also be regarded as an individualistic body, but compared to the BoE, decision makers' communication is less synchronized. According to the findings of Andersson, Dillén and Sellin (2004), statements by the central bank still influence the yield curve. The effect of the governor's statements is the strongest, because market participants pay more attention to the opinion of the person whom they think to be the most influential.

Jansen and de Haan (2005b) point out that the statements of different persons can have different effects on the euro/dollar exchange. The statements of both the ECB staff and other members of the decision making body usually do not influence the level of the exchange rate, but often result in an increase in the conditional volatility. The presidents of the ECB and the German central bank turn out to be the expections, over a one-day horizon their statements have an effect even on the level of the euro/dollar rate. Jansen and de Haan (2005a) compare the statements of two groups of decision makers (ECB officials and presidents/governors of national central banks). They found that the effect did not depend on which group the decision maker belonged to.

4. Data and methodology

In our analysis we examine the direct, short-term effect of central bank communication on market yields and the exchange rate in the period between 1 August 2001 and 30 September 2005.

Dependent variables

We analyse changes in various asset prices: the 3-month government securities market benchmark yield and the 3-month spot, the 3 months ahead 3-month, the 1 year ahead 3-month, the 3 years ahead 1-year and the 5 years ahead 5-year forward yields calculated from the zero-coupon yield curve[11], the forint/euro exchange rate and the implied volatility of the forint-euro foreign-exchange options. We examine daily changes, because the daily is the highest frequency available for the whole sample period.

The Government Debt Management Agency Ltd. *(ÁKK)* publishes the government securities market reference yields at 14.30, and for calculating the values for a given day it uses primary dealers' offers submitted between 9:00 and 14:15. Within this period, primary dealers can modify quotes. As the quote is a binding offer, it can be assumed that benchmark yields of a given day reflect all information that became available before 14:15. The forward yields and the 3-month spot yield are calculated from the zero-coupon yield curve estimated using the Svensson method, based on the average of bid and ask prices available on Reuters between 9:00 and 11:00.

In case of both the benchmark yield *(r)* and forward yields *(f)* the change on day *'t'* is defined as the difference between the yields on the given and previous days *($dr_t=r_t-r_{t-1}$, and $df_t=f_t-f_{t-1}$)*. The change in the benchmark yield reflects the effect of information between 14:15 of the previous day and 14:15 of the given day, while the changes in yields calculated from the yield curve reflect the effect of information between 10:00 of the previous day and 10:00 of the given day.

We use exchange rate quotations available on Reuters to analyse the daily exchange rate changes. In accordance with the yields calculated from the yield curve, the exchange rate of a given day is defined as the logarithm of the average of bid and ask rates at 10:00. The difference between the exchange rates of the given and the previous day is considered to be the change belonging to day *'t'*.

Source of the implied volatility time series is the average of bid and ask volatility quotes of the Royal Bank of Scotland for the European-style ATM option with 1 month maturity, which are collected from the Reuters RBVN page between 10:00 and 10:30 on a daily basis. The RBS lists prices for 1-week, 1-, 2-, 3-, 6-, 9- and 12-month options; but only the 1-month maturity is analysed in our study. The market of longer-term options is less liquid, therefore information content of the prices is limited. Moreover, according to the findings by Gereben, Pintér (2005) implied volatility is able to predict actual volatility within a 1-month time horizon. However, the time series of 1-week maturity implied volatility are not available for the whole period, therefore, we decided to use the implied volatility with 1-month maturity.

Communication variables

We use news reported on Reuters and all kind of written communication by the MNB to create the variables describing central bank communication[12]. We include only those items in the database which contain some kind of guidance about the future, and each statement is taken into account only once, when it is mentioned first. We transform the communication database into dummy variables, alongside the following dimensions:

[11] The methodology of the yield-curve fitting used by the MNB is described in detail by Gyomai and Varsányi (2002).

[12] After a narrowing to news related to Hungary, pieces of Reuter's news were selected using the following keywords: central bank, Járai, governor, centralbanker, vice-governor. Monetary Council statements, press releases and published minutes available on the MNB's website are understood as written communication.

- verbal or written announcement,
- content: exchange rate (for example, hints on the preferred exchange rate level, intervention), policy rate (hints on the short-term interest rate path), economic outlook,
- sign.

We create 12 variables according to these dimensions. The formal definition of variables is given in Appendix B.

When we define the communication variables, we only consider statements which try to influence the level of either the exchange rate or that of yields, or call the attention to the increase or decline in risks in the longer term economic developments. They amount to approximately 73 per cent of all statements, while the rest of the statements can be considered neutral. In case of the MNB the ratio of neutral to all statements is similar to that of other central banks (Table 2). Central banks differ most in the intensity of the interest rate communication, but this mainly reflects the differences in the number of interest rate changes during the sample period.

Table 2

The share of non-neutral verbal statements at selected central banks (per cent)[13]

	MNB 2001–2005	Fed 1999–2004	BoE 1997–2004	ECB 1999–2004
Exchange rate	59			
Interest rate	86	71	59	38
Economic outlook	71	91	80	84
Memo item: Number of interest rate changes	31	19	32	18

We code the pieces of news from the market participants' point of view. The sign of statements is determined compared to market expectations. Comparing to market expectations is most important in case of interest rate communication, as a rising/declining interest rate path was often present in expectations. Accordingly, hints on a smaller cut than the anticipated interest rate cut[14] are considered as tightening.

The relative frequency of positive and negative statements is different in case of written and verbal communications (Table 3), which means that written and verbal communication sometimes transmits different messages.

Table 3

Number of the MNB's statements in the sample period

	Written		Verbal	
	+	–	+	–
Exchange rate	12	4	22	13
Interest rate	10	0	27	30
Macroeconomic outlook	26	12	31	44

+: exchange rate strengthening statements/statements suggesting tighter interest rate policy/improving economic outlook.
–: exchange rate weakening statements/statements suggesting looser interest rate policy/deteriorating economic outlook.

[13] In case of the Fed, the BoE and the ECB we have data on verbal statements only (Ehrmann and Fratzscher [2005]), therefore, Table 2 covers only these statements.
[14] The difference between the three-month benchmark and the policy rate is considered as the anticipated interest rate cut.

The encoding of statements was done as follows. Four people compiled the data base, and then the coding was checked by two of us again. We tried to reduce the subjectivity of coding in a way that doubtful cases were judged by several people independently.

Control variables

If they differ from expectations, central bank interest rate decisions and macroeconomic data announcements also affect market prices. Therefore, to separate the effect of central bank communication, the surprise content of interest rate decisions and of the disclosure of macroeconomic data are included in the model as control variables.[15]

In case of communication and control variables the timing of the announcement is determined consistently with the yield and exchange rate changes. Accordingly, in case of yields calculated from the yield curve and in case of the exchange rate, announcements between 10:00 of the previous day and 10:00 of the given day are considered to be events of the given day, while in case of the benchmark yield events of the given day are the announcements between 14:15 of the previous day and 14:15 of the given day.

In case of interest rate decisions, we consider the publication on Reuters as the time of the announcement. During the sample period the MNB's announcement policy changed: until 25 November 2002 decisions were disclosed at 16:00, later at 14:00 on the day of the meeting. Unscheduled meetings constituted an exception: on 15 and 16 January 2003 the decision was announced later than usual (around 16:00), on 4 June somewhat earlier (at 13:42 hours), and on 19 June and 28 November before noon (at 9:32 and 9:00, respectively).

The surprise content of the interest rate decision in case of forward yields – with the exception of the 3 months ahead 3-month forward yield – is measured with the change in the 3-month spot yield calculated from the yield curve on the day of the decision. In case of short-term yields, on the days of interest rate decisions we can not separate the effects of the decision and that of other information. Therefore, in case of the 3-month spot and benchmark yields and the 3 months ahead 3-month forward yield we exclude the days of the rate-setting meetings of the Monetary Council from the sample.

Building on the findings of M. Kiss (2004), we include the surprise component of the following macroeconomic data releases in the model: the consumer price index, the growth rate of the gross domestic product, the current account and the monthly-published foreign trade balance and the general government deficit. The surprise content of a given data release is defined as the difference between the average of analysts' expectations in the Reuters' survey and the actual value. Most data are published monthly, the only exception is the growth rate of the gross domestic product, which is disclosed quarterly[16]. Table 4 summarises the publication dates of macroeconomic data.

Table 4

Characteristics of the examined data publications

	Frequency of publication	Publication time	Published by
Consumer price index	Monthly	9:00	CSO
GDP	Quarterly	9:00	CSO
Current account/trade balance	Quarterly/Monthly	8:30/9:00	MNB
General government deficit	Monthly	Varying	MoF

Notes: CSO: Central Statistical Office, MoF: Ministry of Finance.

[15] Using Hungarian data, the effect of macroeconomic data releases on the exchange rate and yields is analysed in detail by M. Kiss (2004), Rezessy (2005) analyses the effect of central bank decisions on the exchange rate and several financial asset prices, Pintér and Wenhardt (2004) on market interest rates.

[16] GDP data are published quarterly, but analysts issue forecasts every month in the Reuters analysts' surveys. When calculating the surprise content, the last survey published before the disclosure of the data for the given quarter was taken into account.

Methodology

We use the event study approach to analyse the effect of statements, i.e. we try to find out whether on those days when the central bank communicates the changes in asset prices are different from the changes observed on other days. We use a GARCH (1,1)[17] model, as specified below:

$$y_t = c + \sum \alpha_i * communication\_dummy_{it} + \sum \beta_i * control\_variable_{it} + \varepsilon_t \quad (1)$$

$$\sigma_t^2 = \omega + \lambda * \varepsilon_{t-1}^2 + \eta * \sigma_{t-1}^2 + \sum \gamma_i * communication\_dummy_{it} + \sum \delta_i * control\_variable_{it} + u_t \quad (2)$$

In equation (1) the dependent variable is the change in the exchange rate or yields. Dummies constructed from various types of statements are used as explanatory variables. The coefficients of these variables are in the centre of our analysis. The significant coefficient indicates that the communication has an effect on asset prices. All communication dummies appear in each regression, as it is also important, which coefficients are not significant.[18] In equation (1) the control variables are the surprise components of macro news and of interest rate decisions. We include only the control variables with a significant coefficient in the regressions.

In the variance equation (equation (2)), the variance of the given period is explained with the value of the variance one period earlier and the squared residuum of the previous period, in accordance with the GARCH(1,1) specification. We use only the communication and control variables with significant coefficients as additional explanatory variables. In the variance equation the significantly negative coefficient means that the variable belonging to it reduces the conditional variance of the asset price. If a central bank statement co-ordinates expectations, then market uncertainty can decline, and thus conditional variance may also be smaller.

In our estimated regressions, the distribution of the residuum is not normal, which is a general observation in case of financial time series, therefore we estimated the standard errors with the method recommended by Bollerslev and Wooldridge (1992).[19]

Although the central bank's communication policy[20] changed in the sample period, there are not enough observations for the estimation of time-varying parameters, thus we assume the parameters to be constant. Another methodological problem arises if it is not the central bank communication that influences financial variables, but rather asset price changes trigger statements by the central bank.[21] The GARCH estimation assumes that on a given day central bank communication does not react on the exchange rate and yield changes of that day. If this condition is not met, the estimated coefficients of the communication variables are biased and do not reflect the effect of communication properly. However, using daily data we can assume that, apart from extreme cases, the causality points from the central bank statement to the change in asset prices. We omitted the statement of 4 June 2003, which was on the day of the exchange rate band realignment, thus we can not distinguish the effects arising from the two sources.

We include the control variables to separate the effect of communication. However, there are many other factors that can potentially influence yields and the exchange rate e.g. foreign macroeconomic data, other central banks' decisions or communication. When disregarding them we implicitly assume that the MNB's communication is independent of these omitted variables. In this case, our estimated parameters are unbiased and can be interpreted as the effect of communication.

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[17] We used the GARCH model to account for the autocorrelated and time-varying variances of the error terms.

[18] Omission of the insignificant communication variables does not result in a change in the coefficients of the significant variables, as the variables are nearly orthogonal.

[19] For the estimation we used the standard Eviews option. In addition to the GARCH specification, the EGARCH models are also widespread in the literature. For the estimation of the variance equation, this model uses a different functional form, in order to exclude the possibility of negative conditional variance at the fitting and to allow for the asymmetric effect of negative and positive shocks on the conditional variance. In our case while fitting the EGARCH model, the parameter allowing for asymmetry was not significant, thus we chose the GARCH specification.

[20] See Appendix C for an overview of central bank communication and for the listing of major events relevant for the communication in the sample period.

[21] For example, in the sample period, the central bank made more statements in order to strengthen the exchange rate when the exchange rate was below the level considered appropriate by the central bank.

Another potential problem is that in our stylised asset price model the exchange rate and yields are determined independently. However, if this is not true, an explanatory variable which is probably not independent of central bank communication is omitted from our regressions. For example, if the change in exchange rate depends on the change of the short-term yield as well, then central bank communication can influence the exchange rate through two channels. First, statements can have a direct effect on the exchange rate, second, they also can have an indirect effect on the exchange rate through influencing short term yields. Siklos and Bohl (2006) could identify the direct effect of ECB's communication using the methodology proposed by Rigobon and Sack (2004).[22] Both the event study approach and the one applied by Siklos and Bohl (2006) assume that communication is exogenous, the main difference between them is that the first captures the total effect of communication on the asset price, while the second identifies a partial one, which excludes all the indirect effects. A more detailed analysis of the direct and indirect effects of the MNB's communication is beyond the scope of our study, but it can be an interesting direction for further research[23].

When interpreting our results, we have to take into account that our communication variables are dummy variables, so they do not measure the magnitude of the surprise content of statements. Therefore, the estimated coefficients show the average effects of statements with average surprise content.

In our study, we do not aim at forecasting asset prices, therefore the explanatory power of regressions is not in the focus of the analysis. The R^2s of the regressions typically fall into the range between 3 and 6 per cent, which is low, but very similar to values reported by other studies.

[22] The basic idea behind their method is to group the days in the sample according to the type of shocks that dominated on that day, and use this heteroscedasticity to estimate the parameters.

[23] In case of Hungarian data, Rezessy (2004) is analysing the direct effect of monetary policy decisions on several asset prices using the methodology suggested by Rigobon and Sack (2004).

5. Results

In this chapter we quantify the effect of the MNB's communication on the exchange rate, short-term yields and long-term yields.

5.1. REGRESSIONS EXPLAINING THE EXCHANGE RATE

We analyse the effect of communication on the exchange rate from several aspects. First, we measure the effect of statements on the level of the exchange rate, then we assess to what extend communication is able to influence the prevailing trend. Finally, we quantify the effect of statements on market uncertainty.

Table 5

The effect of communication on the exchange rate I

	Dependent variable		
	D(LOG(ER))	D(TREND)	IV1M
CPIS	+ (0.0468)$^{++}$		
MC_DECISION	- (0.1716)	+ (0.0447)$^{++}$	- (0.1203)
IV1M(-1)			+ (0.0000)$^{+++}$
ER_VERBAL_STRENGTHEN	+ (0.0842)$^{+}$	- (0.2421)	+ (0.1541)
ER_VERBAL_WEAKEN	+ (0.4649)	+ (0.0004)$^{+++}$	+ (0.0001)$^{+++}$
ER_WRITTEN_STRENGTHEN	- (0.9267)	- (0.0062)$^{+++}$	- (0.8196)
ER_ WRITTEN_WEAKEN	+ (0.2360)	+ (0.1055)	+ (0.0048)$^{+++}$
IR_WRITTEN_RAISE	- (0.9535)	+ (0.5247)	- (0.9208)
IR_VERBAL_RAISE	- (0.0118)$^{++}$	+ (0.3022)	- (0.2501)
IR_VERBAL_CUT	+ (0.2211)	- (0.7455)	+ (0.5927)
OUTL_WRITTEN_P	- (0.0026)$^{+++}$	- (0.3878)	- (0.1089)
OUTL_WRITTEN_N	- (0.2649)	- (0.0348)$^{++}$	- (0.5928)
OUTL_VERBAL_P	- (0.1511)	+ (0.3658)	- (0.9841)
OUTL_VERBAL_N	+ (0.6320)	- (0.5149)	+ (0.9091)
C	+ (0.8331)	+ (0.3258)	+ (0.0007)$^{+++}$

The table shows the signs of parameters. +, ++ and +++ indicate the parameters significant at 10%, 5% and 1% significance levels, respectively, p-values are shown in brackets.

Table 6

The effect of communication on the exchange rate II

	Variance equation		
C	+ (0.0000)$^{+++}$	+ (0.0000)$^{+++}$	+ (0.0000)$^{+++}$
ARCH(1)	+ (0.0756)$^{+}$	+ (0.0061)$^{+++}$	+ (0.0000)$^{+++}$
GARCH(1)	+ (0.0000)$^{+++}$	+ (0.0000)$^{+++}$	+ (0.0000)$^{+++}$
ER_VERBAL_WEAKEN		- (0.0000)$^{+++}$	
IR_WRITTEN_RAISE	- (0.0000)$^{+++}$		
OUTL_WRITTEN_P	- (0.0000)$^{+++}$	- (0.0000)$^{+++}$	
OUTL_WRITTEN_N	- (0.0000)$^{+++}$	- (0.0000)$^{+++}$	
OUTL_VERBAL_P	- (0.0000)$^{+++}$	- (0.0000)$^{+++}$	
OUTL_VERBAL_N	- (0.0000)$^{+++}$	- (0.0000)$^{+++}$	

The table shows the signs of parameters. +, ++ and +++ indicate the parameters significant at 10%, 5% and 1% significance levels, respectively, p-values are shown in brackets.

In the first regression most of the significant coefficients' signs are in line with the intuition.

- The central bank's tightening interest rate communication strengthens the exchange rate significantly.

- The central bank's statements on a positive economic outlook lead to an exchange rate appreciation (the coefficient of written communication is significant, while that of verbal communication is nearly significant). It means that the central bank shares relevant information with the market participants, which influences their exchange rate expectations. The same effect is not present when deteriorating economic developments are communicated. The coefficients are not significant, and the sign of written communication is not in line with the intuition.

- Exchange rate communication is not successful in influencing the exchange rate. The coefficients of weakening statements are not significant. The effect of the strengthening verbal communication is not intuitive, these statements are usually accompanied by a depreciation of the exchange rate.

It may be argued that the counterintuitive sign of the exchange rate strengthening communication is the result of that the central bank often intends to break a depreciating trend. In this case, statements can have an effect even if the trend continues, but the depreciation slows down. We try to capture this effect in the second equation, where we regress the change in the trend on the communication variables. The sign of the coefficients of the exchange rate communication variables is in line with the intuition, and most of them are significant or nearly significant. This seems to affirm our hypothesis: although the central bank's exchange rate communication often can not stop the market trend, at least it can put a brake on it.[24]

[24] In the regression, the change in the five-day trend ($\ln(\text{exchange rate}_{t+5}/\text{exchange rate}_t)-\ln(\text{exchange rate}_t/\text{exchange rate}_{t-5})$) is analysed, therefore, the significance of coefficients may reflect the effects of not only the communication, but also of other actions by the central bank. The central bank's actions are coordinated, therefore, it is likely that the coefficients are biased, and the effect of communication is less than reported. As five-day trend observations are overlapping, the error terms are autocorrelated. Therefore, we calculated the Newey-West standard errors, but the significance levels remained practically unchanged.

The variance equation of the first two regressions shows the effect of statements on exchange rate volatility. The sign of all significant coefficients is negative, which indicates that central bank statements either do not influence or reduce the volatility of the exchange rate. The third equation also intends to explain exchange rate volatility. The dependent variable here is the implied volatility, which captures a somewhat different aspect of market uncertainty. As it is a forward-looking indicator, it reflects market participants' expectations independent of the fact whether later it actually appears in the volatility of the exchange rate or not. In this regression the sign of exchange rate weakening communication is significantly positive. This means that statements aiming at weakening the exchange rate, at least in the short run, add to market uncertainty.

5.2. REGRESSIONS EXPLAINING SHORT-TERM YIELDS

We analyse the effect of communication on short-term yields examining three yields with partly different information contents. The three-month spot yield calculated from the yield curve and the three-month benchmark yield reflect expectations of the same time period, but they are subject to different measurement errors. The maturity of the benchmark yield is not exactly 3 month. When the reference paper is issued, the maturity is longer, and gets shorter until the benchmark paper is replaced. Although the maturity of the short-term yield calculated from the yield curve is constant, the yield curve fitting results in measurement errors. The third equation examines the effect on the three months ahead three-month forward yield, which reflects expectations with somewhat longer horizons than the previous ones. Comparing the results of the three regressions we can also assess the robustness of our findings.

In case of short-term yields we cannot reliably measure the surprise content of interest rate decisions, therefore, we examine the effect of communication on a sample which does not include the rate-setting meetings of the Monetary Council. Written communication typically falls on the same days as the decisions, which we exclude from the sample. Consequently, we only analyse the effect of verbal communication in this section.

Table 7

The effect of communication on short-term yields I

	Dependent variable		
	D(BM3M)	D(SPOT3M)	D(FW3M)
IR_VERBAL_RAISE	- (0.9987)	+ (0.2517)	+ (0.3928)
IR_VERBAL_CUT	- (0.8077)	- (0.5836)	+ (0.8844)
ER_VERBAL_STRENGTHEN	+ (0.0518)$^{+}$	+ (0.0227)$^{++}$	+ (0.0468)$^{++}$
ER_VERBAL_WEAKEN	- (0.3058)	- (0.5930)	- (0.7753)
OUTL_VERBAL_P	- (0.1390)	- (0.8032)	- (0.3475)
OUTL_VERBAL_N	- (0.7207)	- (0.6156)	- (0.3412)
CPI_S	+ (0.0003)$^{+++}$		
C	- (0.2877)	- (0.1841)	- (0.1582)

The table shows the signs of parameters. +, ++ and +++ indicate the parameters significant at 10%, 5% and 1% significance levels, respectively, p-values are shown in brackets.

Table 8

The effect of communication on short-term yields II

	Variance equation		
C	+ (0.1265)	+ (0.0000)$^{+++}$	+ (0.0000)$^{+++}$
ARCH(1)	+ (0.6904)	+ (0.2424)	+ (0.0974)$^{+}$
GARCH(1)	+ (0.0302)$^{++}$	+ (0.0000)$^{+++}$	+ (0.0000)$^{+++}$
CPI_S	+ (0.0000)$^{+++}$	+ (0.0000)$^{+++}$	+ (0.0000)$^{+++}$
ER_VERBAL_WEAKEN	- (0.0002)$^{+++}$		- (0.0464)$^{++}$
IR_VERBAL_RAISE	- (0.0009)$^{+++}$	- (0.0001)$^{+++}$	- (0.0000)$^{+++}$
IR_VERBAL_CUT	- (0.0000)$^{+++}$	- (0.0033)$^{++}$	- (0.0000)$^{+++}$
OUTL_VERBAL_P	- (0.0000)$^{+++}$	- (0.0001)$^{+++}$	- (0.0055)$^{+++}$
OUTL_VERBAL_N	- (0.0001)$^{+++}$	- (0.0000)$^{+++}$	- (0.0000)$^{+++}$

The table shows the signs of parameters. +, ++ and +++ indicate the parameters significant at 10%, 5% and 1% significance levels, respectively, p-values are shown in brackets.

Results for different yields show a similar picture (Table 7). Statements influence only slightly market participants' expectations regarding the short-term interest rate path. Although the sign of the coefficients of the exchange rate and interest rate communication is in line with the intuition in most cases, they are usually not significant. The central bank's communication regarding economic outlook also does not affect the developments in short-term yields. Analysing the results in more detail, we find the following:

- In shaping short-term yields, exchange rate strengthening communication plays an important role. Coefficients of this variable are positive and significant in all the three equations.

- The central bank's interest rate communication does not contain new information on the short-term interest rate path, its effect is insignificant.

The relatively strong effect of exchange rate communication on short-term yields indicates that market participants assume that the exchange rate has a big weight in the central bank's reaction function even over the short term. Therefore, exchange rate communication carries more important information on interest rate policy than interest rate communication.

Our findings show that the effect of exchange rate communication on short-term yields is asymmetric, the exchange rate strengthening communication is more effective. This may indicate that in the sample period market participants considered the central bank's reaction function asymmetric. They assumed that the central bank is more likely to react with tightening when the exchange rate is weaker than desirable than with loosening in case of a stronger exchange rate.

The variance equations of regressions (Table 8) quantify the effect of communication on the volatility of short-term yields. All significant coefficients are negative, which means that central bank statements do not influence or reduce the conditional volatility of short-term yields.

5.3. REGRESSIONS EXPLAINING MEDIUM- AND LONG-TERM YIELDS

We analyse the effect of central bank communication on medium- and long-term yields by examining the one year, three years and five years ahead forward yields. The one year ahead forward yield partly reflects the short-term and partly the medium-term expectations, while the three years ahead and the five years ahead forwards represent medium-term and long-term expectations, respectively.

Table 9

The effect of communication on medium- and long-term yields I

	Dependent variable		
	D(FW1YEAR)	D(FW3YEAR)	D(FW5YEAR)
MC_DECISION			- (0.0042)$^{+++}$
CPI_S		+ (0.0475)$^{++}$	
GDP_S	- (0.0512)$^{+}$		
IR_WRITTEN_RAISE	- (0.1966)	+ (0.0078)$^{+++}$	- (0.8012)
IR_VERBAL_RAISE	- (0.0141)$^{++}$	- (0.4980)	- (0.0084)$^{+++}$
IR_VERBAL_CUT	+ (0.8241)	- (0.9778)	+ (0.7475)
ER_ WRITTEN_STRENGHTEN	+ (0.2398)	- (0.1782)	- (0.4596)
ER_ WRITTEN_WEAKEN	- (0.1440)	+ (0.2918)	- (0.1700)
ER_VERBAL_STRENGTHEN	+ (0.0541)$^{+}$	+ (0.1974)	+ (0.0563)$^{+}$
ER_VERBAL_WEAKEN	- (0.0443)$^{++}$	+ (0.6062)	- (0.2407)
OUTL_WRITTEN_P	- (0.1827)	- (0.0084)$^{+++}$	- (0.0037)$^{+++}$
OUTL_WRITTEN_N	+ (0.2919)	- (0.1953)	+ (0.1001)$^{+}$
OUTL_VERBAL_P	- (0.8493)	+ (0.8786)	+ (0.5007)
OUTL_VERBAL_N	+ (0.6130)	+ (0.8496)	- (0.0905)$^{+}$
C	- (0.6027)	- (0.5692)	+ (0.8944)

The table shows the signs of parameters. +, ++ and +++ indicate the parameters significant at 10%, 5% and 1% significance levels, respectively, p-values are shown in brackets.

Central bank communication plays a bigger role in shaping medium- and long-term expectations (Table 9) than in case of short-term expectations. Our findings can be summarised as follows:

- One can argue that statements suggesting a stricter interest rate policy should result in an increase in short-term yields, then, approaching a longer time horizon, this effect declines, and it may even turn at the end of the yield curve, if statements suggesting a tighter interest rate policy add to the credibility of the central bank. Compared to this, the results of the regressions are rather mixed. Tightening interest rate communication typically reduces yields over each horizon. An exception is the effect on the three years ahead forward rate, which is significantly positive. The effect of statements suggesting a looser interest rate policy is not significant.

Table 10

The effect of communication on long-term yields II

	Variance equation		
C	+ (0.0004)$^{+++}$	+ (0.0171)$^{++}$	+ (0.0000)$^{+++}$
ARCH(1)	+ (0.0827)$^{+}$	+ (0.3438)	+ (0.0434)$^{++}$
GARCH(1)	+ (0.0000)$^{+++}$	+ (0.0065)$^{+++}$	+ (0.0000)$^{+++}$
GDP_S	+ (0.0000)$^{+++}$		
CPI_S	+ (0.0476)$^{++}$		
BOP_S	+ (0.0030)$^{+++}$		+ (0.0000)$^{+++}$
IR_WRITTEN_RAISE	- (0.0000)$^{+++}$	- (0.0054)$^{+++}$	- (0.0000)$^{+++}$
IR_VERBAL_RAISE			- (0.0000)$^{+++}$
OUTL_WRITTEN_P	- (0.0125)$^{++}$		
OUTL_WRITTEN_N		- (0.0087)$^{+++}$	
OUTL_VERBAL_P	- (0.0000)$^{+++}$		
OUTL_VERBAL_N	-	-	-
	(0.0001)$^{+++}$	(0.0678)$^{+}$	(0.0000)$^{+++}$

The table shows the signs of parameters. +, ++ and +++ indicate the parameters significant at 10%, 5% and 1% significance levels, respectively, p-values are shown in brackets.

- In the case of exchange rate communication the picture is somewhat clearer. The effect of written communication is not significant on any of the horizons. Verbal communication has a greater effect, especially on the one-year horizon, where the coefficients of both weakening and strengthening statements are significant. It means that market participants assume that verbal exchange rate communication is relevant even to the MNB's interest rate policy one year after the statement. Over a longer time horizon one would expect a decline in the importance of exchange rate communication. Indeed, it does not affect three years ahead forward yields, but in case of the five years ahead forward rate the coefficient of the strengthening verbal communication is significantly positive again.

- The longer maturities we examine, the greater is the role of the risk premium relative to the expected interest rate policy in shaping the yields. With regard to the risk premium, the MNB's statements about macroeconomic outlook carry the most information. Accordingly, one would expect a growing importance of these statements in parallel with the increase in the time horizon. In case of written communication, the coefficients are in line with the intuition. While coefficients are not significant on a one-year horizon, in case of the three years ahead yields, statements about an improving economic environment do have an effect, and on the longest horizon statements about both deteriorating and improving economic prospects are significant. As opposed to the above, the effect of verbal statements about macroeconomic outlook is negligible. The sign of the only significant coefficient is counterintuitive, although the magnitude of the effect is small (see later).

Variance equations of regressions (Table 10) quantify the effect of communication on the volatility of the medium and long parts of the yield curve. The significant coefficients of communication variables are negative, while the effect of the surprise content of macroeconomic data releases is positive. This may suggest that among market participants there can be different interpretation of the macro data releases, and thus the direct, short-term effect of the information is an

increase in market uncertainty. On the other hand, central bank statements do not have an effect on volatility, or they help the co-ordination of market participants' expectations, thereby reduce uncertainty.

5.4. SUMMARY OF THE RESULTS

From several aspects, our results regarding the effect of the MNB's communication differ from those in the literature. The difference is apparent in the effect of communication on the exchange rate and especially on short-term yields. The MNB's interest rate communication does not affect short-term yields (Table 11), which is surprising, because the central bank can directly control the short-term yields, therefore communication should be the most effective on this horizon. Analysing the communication, we only use those statements which intended to influence market expectations. Therefore, effective interest rate communication should be reflected in the yield changes.

Table 11

The effect of communication on the exchange rate and yields

	Exchange rate	BM3M	SPOT3M	FW3M	FW1YEAR	FW3YEAR	FW5YEAR
ER_VERBAL_STRENGTHEN	*0.63 Ft*$^{+}$	9.02 bp	10.73 bp	11.71 bp	10.43 bp		*6.10 bp*$^{+}$
ER_VERBAL_WEAKEN					-5.15 bp		
ER_WRITTEN_STRENGTHEN							
ER_WRITTEN_WEAKEN							
IR_WRITTEN_RAISE						7.85 bp	
IR_VERBAL_RAISE	-0.56 Ft				-5.6 bp		-3.62 bp
IR_VERBAL_CUT							
OUTL_WRITTEN_P	-0.60 Ft					-6.81 bp	-8.77 bp
OUTL_WRITTEN_N							4.06 bp
OUTL_VERBAL_P							
OUTL_VERBAL_N							*-1.89 bp*$^{+}$

The table only reports the significant coefficients. Figures with + indicate counterintuitive values.

The effect of the MNB's interest rate communication on short-term yields is similar to the findings of Rozkrut, Rybinski, Sztaba and Szwaja (2005) in case of the Czech and Polish central banks. Although the interest rate communications of the Czech and Polish central banks have a statistically significant effect on the short-term, the size of the effect is below one basis point, economically it is not significant. As for long-term yields, the MNB's communication can be considered effective. The magnitude exceeds the values reported in literature, although relatively few coefficients are significant.

The MNB's tightening interest rate communication usually results in a decline in long-term yields. If this is due to the increase in credibility, our result indicates that on average communication can add to building up the credibility of the MNB. However, it also calls the attention to that the MNB was not always credible. Long-term yields react to written communication on the macroeconomic outlook in line with the intuition. This shows that market participants consider central bank analyses important, and incorporate their information content into their expectations.

Our results are asymmetric in a sense that strengthening and tightening statements are usually more effective than weakening and easing ones. The reason may be that market participants consider the MNB's reaction function to be asymmetric. If they assume that the MNB reacts faster to looser than desirable monetary conditions than to stricter ones, this leads to asymmetry in the effectiveness of statements as well.

Descriptive statistics of the communication data (Table 3) show that written and verbal communication sometimes transmits different messages, which is reflected in our results as well. In case of exchange rate and interest rate communications the verbal statements, while in case of economic outlook the written communication proves to be more effective. In case of economic outlook, the relative effectiveness of written communication can be explained by the fact

that the MNB mostly does not release but interprets macroeconomic data. However, interpreting macroeconomic developments exceeds the limits of a verbal statement.

The effect of central bank communication on volatility is similar to that of earlier studies. Central bank communication either has no effect on the volatility of asset prices or reduces uncertainty. The results for the variance of yields are especially intuitive. While the release of balance of payments and CPI data usually adds to volatility, certain central bank statements reduce it. This shows that central bank communication plays a role in the co-ordination of market expectations.

6. Factors influencing the efficiency of the MNB's communication

In this chapter we would like to give some possible explanations for the difference in the effects of communication (especially in the effect of interest rate communication on short-term yields) of the MNB and other central banks.

The number of statements

One possible explanation can be that we could not distinguish statements containing new information from the non-informative ones. If this was true, some of the statements do not carry new information on the preferences of the central bank. In this case although communication may attain its target, regressions are unable to capture the effect. The table below shows the frequency of selected central banks' communication.

Table 12

Number of central bank verbal interest rate and exchange rate statements per year[25]

MNB	Fed	ECB	CNB	NBP
22.06	37.9	30.46	14.75	42.75

Note: CNB: Czech National Bank, NBP: National Bank of Poland.

The figures show that the average number of the non-neutral statements in case of the MNB is relatively low, this indicates that we probably did not misclassify neutral statements. Therefore, the low effect of the MNB's interest rate communication on short-term yields may have other reasons as well.

Economic environment

The magnitude of uncertainty related to the macroeconomic developments may affect the efficiency of communication. In a transition economy the volatility of the risk premium is bigger, financial markets are more vulnerable to shocks in investors' preferences and risk perceptions, structural changes in the economy make it difficult to establish stable long-term relationships to base forecasts on, just to mention some sources of uncertainty surrounding both the macroeconomic forecasts and financial markets. In a more uncertain economic environment the central bank reacts to unexpected shocks more often, therefore, the forward-looking nature of communication diminishes, and its effect on market prices becomes smaller. Having this in mind it is understandable why the MNB's communication is less able to influence the yields compared to the Fed, the ECB and the BoE, while the effectiveness of the Czech and Polish central banks' communications is similar to that of the MNB.[26]

Effect of the strong exchange rate preference

In international comparison the effect of the MNB's communication is the smallest in case of interest rate communication. An explanation can be that maintaining an exchange rate level consistent with central bank's goals played an important role in the MNB's interest rate decisions. Due partly to the volatility of economic developments and partly to changes in investors' risk appetite, the volatility of risk premium was high in the sample period. Therefore maintaining a relatively

[25] The indices are based on Rozkrut et al. (2005), Ehrmann and Fratzscher (2005) and Fratzscher (2004). Because we did not examine neutral/ambiguous statements, we did not take those into account in case of foreign central banks either. The periods considered are slightly different for the central banks, and they all fall between 1999 and 2004.

[26] Of course, the differences between the two groups of countries can be caused not only by the difference in the stability of the macroeconomic environment. Another important factor can be the difference in the credibility of the central banks.

stable exchange rate level sometimes required large changes in the central bank's policy rate. Since the central bank is unable to predict the external shocks that influence the interest rate level needed to maintain the preferred exchange rate, statements regarding the interest rate path often lost their validity, which reduced the credibility of interest rate communication.

Consistency of communication and decisions

If the interest rate communication and the decisions of the central bank are not consistent, that may reduce the efficiency of communication in the longer run. In Table 13 the consistency of the interest rate communication and interest rate decisions of selected central banks is compared. In case of all four central banks the communication and decisions following the statements are positively correlated (if there is no correlation that means a 50 per cent ratio). The consistency of the MNB's decisions and communication is lower than that of other central banks; the difference is significant at a 10 per cent confidence level in case of the BoE and at 1 per cent in case of the Fed and the ECB.

Table 13

The consistency of interest rate communication and the next interest rate change[27]

Ratio of consistent statements	Consistent with the direction*	Consistent compared to the previous change**
Federal Reserve (May 1994-May 2004)	84.1%	-
Bank of England (May 1997-May 2004)	78.0%	-
European Central Bank (January 1999-May 2004)	87.8%	-
Magyar Nemzeti Bank (August 2001-September 2005)	67.3%	72.7%

** The given statement is considered consistent with the next interest rate change, if the direction of the interest rate change following the statement is in line with the direction indicated in the statement.*

*** A given statement is considered consistent with the next interest rate change in two cases. First, if the direction of the interest rate change following the statement is in line with the direction indicated the statement. Second, if the direction of the next interest rate change and the direction indicated in the statement are different, but the change is smaller than the previous one. According to this definition, a statement suggesting stricter monetary policy can be consistent with an interest rate cut as well, if the cut is smaller than the previous cut. This indicator takes into account that communications aiming at reducing interest rate cut or interest rate raise expectations were considered as tightening or loosening statements, respectively.*

Decision making mechanism and communication

The decision making structure may play an important role in the efficiency of communication. Empirical results show that communication is more efficient if the central bank has a stable reaction function and is able to transmit it to the market participants (Ehrmann and Fratzscher [2005]).

The increase in the number of members of the Monetary Council (see details in Appendix C) changed the decision making mechanism of the MNB. Earlier, the decision making process was collegial, and the central bank's – basically the governor's – communication reflected well the consensus view of the Council. Following the increase in the number of Monetary Council members, the council was characterized by increased differences in opinions, and from time to time there was no consensus view regarding short-term monetary policy[28]. The central bank's decision making became more individualistic, but the communication did not adjust to the change in the decision making mechanism. The governor's statements continued to dominate, but sometimes did not reflect all the views in the Monetary Council.

Despite the differences of opinions within the Monetary Council, transparency can still help to make communication more efficient. If individual views and opinions are reflected in communication and in the decision making with the same

[27] The source of data for the Fed, the BoE and the ECB: Ehrmann and Fratzscher (2005). Indices for the MNB are based on our own calculations.

[28] The press started to group the members into hawks and doves after the enlargement, which clearly shows that the council was regarded more individualistic.

weight, market participants can obtain a clearer picture of the divergence of views in case of each decision. In this case communication carries more information, which makes monetary policy more predictable. A step in this direction is that the MNB started to publish the minutes of meetings and the division of votes cast since the meeting on 20 December 2004. Individual votes are also published since October 2005.

7. Summary

In our study, we examined the effectiveness of the MNB's communication. We found that the MNB's communication related to monetary policy had only a small effect on asset prices. Short-term yields were only influenced by the exchange rate communication, and interest rate communication did not play a role in shaping market participants' short-term yield expectations at all. The role of the exchange rate communication can be explained by the fact that in a small and open economy, exchange rate and interest rate policies and their communications cannot be regarded independent. However, in itself this does not provide a full explanation of the small effect of interest rate communication; the high volatility of the risk premium, differences in opinions in the Monetary Council, and the occasional inconsistencies of interest rate decisions and communication could also have played a role. We found that central bank communication was the most successful in influencing long-term yields.

The effect of communication regarding monetary policy is asymmetric. Tightening and exchange rate strengthening statements are usually more effective than easing and exchange rate weakening statements. If market participants assume that the central bank has an asymmetric reaction function, it reacts quicker if the monetary conditions have to be tightened and slower if it considers the monetary conditions to be too strict, that may explain our result.

An asymmetry can also be observed in the effect of different communication channels. In case of exchange rate and interest rate communications the verbal statements, while in case of macroeconomic outlook the written communication proves to be more effective. This latter can be explained by the fact that the MNB mainly does not release, but interprets data. However, interpreting macroeconomic developments exceeds the limits of a verbal statement.

When analysing the variance of yields we found that while certain macroeconomic data releases added to the volatility, central bank statements did not affect or reduced it. This suggests that market participants interpret macro releases in different ways, therefore in the short run market uncertainty increases. Central bank statements usually reduce the volatility of asset prices and market uncertainty, because they can co-ordinate expectations. Exchange rate weakening statements are an exception; in the short run they add to the uncertainty surrounding the expected exchange rate developments.

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Appendix A: Empirical literature about central bank communication

Table A1

	Effect on the exchange rate			Effect on the exchange rate volatility		
Content of communication	Interest rate	Exchange rate	Macroeconomic outlook	Interest rate	Exchange rate	Macroeconomic outlook
Jansen and de Haan (2004) ECB (EUR/USD)	+ tightening statements weaken the exchange rate	+ statements on intervention have temporary effects	+ exchange rate strengthens as inflation outlook improves	+ temporary effects	+ temporary effects	+ communication on inflation outlook increases volatility
Jansen and de Haan (2005) ECB (EUR/USD, intraday data)		-/+ negligible effect, statements in headline are efficient				
Ehrmann and Fratzscher (2005) ECB (EUR/USD)	+ only statements by members are effective		-/+ only communication following decisions is effective	+ reduces volatility		+ increases volatility
Ehrmann and Fratzscher (2005) Fed (EUR/USD)	-/+ effect of statements by the governor and other decision makers		+	+ increases volatility		-/+ communication following decisions reduces volatility
Ehrmann and Fratzscher (2005) BoE (GBP/EUR)	-	+ only statements by the governor are effective	+ statements add to, minutes reduce volatility		+ reduces volatility	
Fratzscher (2004) Fed (Yen/USD, USD/EUR), ECB (USD/EUR), BoJ (Yen/USD)		+ effect is stronger if departsfrom usual communication			-/+ communication different from usual sometimes reduces volatility	
Fatum and Hutchinson (2002) ECB (EUR/USD)		-/+ only weakening statements are effective				
Gábriel and Pintér (2006) MNB (HUF/EUR)	+ tightening statements are effective	+ statements mainly weakened the trend	+ written communication is effective	+ reduces volatility	+ reduces volatility	+ reduces volatility

Note: in the table, +/- indicate if the communication with given contents affected/did not affect the exchange rate. An empty cell means that the effect of the communication with those given contents was not examined by the authors. The first cell of each row contains the reference to the paper, the central bank whose communication was analysed, and the exchange rate used to measure the effect of the communication.

Table A2

	Effect on the short-term yield			Effect on the volatility of short-term yield		
Content of communication	Interest rate	Exchange rate	Macroeconomic	Interest rate	Exchange rate	Macroeconomic
Kohn and Sack (2003) Fed				+ effect is stronger than that of macroeconomic communication		+
Andersson et al. (2004) Sveriges Riksbank	+ effect of tightening statements is stronger					
Ehrmann and Fratzscher (2005) ECB	+	+	+ increases volatility	+ statements following meetings reduce volatility, otherwise effects are mixed	+ the governor's statements dominate	+ increases volatility
Ehrmann and Fratzscher (2005) Fed	+ the governor's statements dominate					+ reduces volatility
Ehrmann and Fratzscher (2005) BoE	+ the governor's statements dominate		-/+ affects the 3-month yield, statements of the governor and external members are effective	+ reduces volatility		-/+ reduces volatility in case of 3- and 6-month yields
Rozkrut et al. (2005) CNB	+	-/+ affects only the 6-month yield	-/+ affects 6-month and 1-year yields	+ verbal reduces, written increases volatility	-/+ effects on 3-month and 1-year yields are mixed	-/+ effects on 3- and 6-month yields are mixed
Rozkrut et al. (2005) NBP	+ only verbal communication is effective	-/+ only affects the 1-year yield	-/+ only written communication has an effect on the 1-year yield	-	-	-
Rozkrut et al. (2005) MNB	-/+ only effective in case of 3-month yield, the effect of verbal communication is counter-intuitive	-/+ effective in case of the 3-month and 1-year yields	-/+ only effective in case of the 1-year yield	+ increases volatility	-/+ increases volatility for 6-month and 1-year yields	-
Gábriel and Pintér (2006) MNB	+/- in case of 3-month yields, tightening statements are effective	+/- in case of 1-year and 3-month yields effective	-	+ reduces volatility	+/- reduces volatility in case of benchmark yield	+ reduces volatility

Note: in the table, +/- indicate if the communication with given contents affected/did not affect short-term yields. An empty cell means that the effect of the communication with those given contents was not examined by the authors. The first cell of each row contains the reference to the paper and the central bank whose communication was analysed.

Table A3

	Effect on the long-term yield			Effect on the volatility of long-term yield		
Content of communication	Interest rate	Exchange rate	Macroeconomic	Interest rate	Exchange rate	Macroeconomic
Kohn and Sack (2003)				+		+ has stronger effect than interest rate communication
Andersson et al. (2004)	+ effect is stronger than on short-term yields					
Ehrmann and Fratzscher (2005) ECB	+		-/+ for 10- and 20-year yields, statements of internal members are effective	+ statements following meeting increase, others reduce volatility		+ statements following meetings reduce, others increase volatility
Ehrmann and Fratzscher (2005) Fed	+ up to the 5-year yield, only the governor's statements are effective		+ up to the 20-year yield, statements of all decision makers are effective	+ statements following meetings reduce, others increase volatility		+ statements following meetings increase, others reduce volatility
Ehrmann and Fratzscher (2005) BoE	-		+ only internal members' statements are effective	+ reduces volatility		+ increases volatility
Rozkrut et al. (2005) CNB				-/+ affects the 2-year yield case of the 5-year yield	-/+ increases volatility in + effects are mixed	+ increases volatility
Rozkrut et al. (2005) NBP	+ only verbal communication is effective	-	-/+ only written communication has an effect on the 2-year yield	-	-	-
Rozkrut et al. (2005) MNB	-	-	-	+ increases volatility	-	-
Gábriel and Pintér (2006) MNB	+ the tightening statements are effective	+/- effects only the 5-year yield	+ affects the 3- and 5-year yields	+ reduces volatility	-	+ reduces volatility

Note: in the table, +/- indicate if the communication with given contents affected/did not affect short-term yields. An empty cell means that the effect of the communication with those given contents was not examined by the authors. The first cell of each row contains the reference to the paper and the central bank whose communication was analysed.

Appendix B: Definition of variables

Table B1

Communication variables		
	Value of the variable	
	1	0
ER_VERBAL_STRENGTHEN	if there was exchange rate strengthening verbal communication on the given day	else
ER_VERBAL_WEAKEN	if there was exchange rate weakening verbal communication on the given day	else
ER_WRITTEN_STRENGTHEN	if there was exchange rate strengthening written communication on the given day	else
ER_WRITTEN_WEAKEN	if there was exchange rate weakening written communication on the given day	else
IR_WRITTEN_RAISE	if on the given day there was written interest rate communication suggesting tightening	else
IR_WRITTEN_CUT	if on the given day there was written interest rate communication suggesting loosening	else
IR_VERBAL_RAISE	if on the given day there was verbal interest rate communication suggesting tightening	else
IR_VERBAL_CUT	if on the given day there was verbal interest rate communication suggesting loosening	else
OUTL_WRITTEN_P	if on the given day there was written communication suggesting an improvement in macroeconomic prospects	else
OUTL_WRITTEN_N	if on the given day there was written communication suggesting a deterioration of macroeconomic prospects	else
OUTL_VERBAL_P	if on the given day there was verbal communication suggesting an improvement in macroeconomic prospects	else
OUTL_VERBAL_N	if on the given day there was verbal communication suggesting a deterioration of macroeconomic prospects	else

Table B2

Dependent variables	
D(LOG(ER))	daily change in the logarithm of the forint/euro exchange rate
D(TREND)	daily change in the five-day trend of the forint/euro exchange rate
IV1M	implied volatility calculated from 1-month maturity European ATM call forint/euro option
D(BM3M)	daily change in the 3-month benchmark yield published by the Government Debt Management Agency Ltd. (ÁKK)
D(SPOT3M)	daily change in the 3-month spot yield calculated from the yield curve
D(FW3M)	daily change in the 3 months ahead 3-month forward yield calculated from the yield curve
D(FW1YEAR)	daily change in the 1 year ahead 3-month forward yield calculated from the yield curve
D(FW3YEAR)	daily change in the 3 years ahead 1-year forward yield calculated from the yield curve
D(FW5YEAR)	daily change in the 5 years ahead 5-year forward yield calculated from the yield curve
Control variables	
MC_DECISION	surprise component of the Monetary Council's interest rate decision
GDP_S	surprise content of the GDP data release
BOP_S	surprise content of the current account data release
CPI_S	surprise content of the consumer price index data release

Appendix C: Important events and overview of the MNB's communication

In this appendix first we list the most important events in the sample period which had an effect on central bank communication, and then we present a brief overview of the MNB's communication.

a) Important events in the sample period

- Attack against the edge of the band

  By end-2002 the forint appreciated close to the strong edge of the exchange rate band. On 15 and 16 January 2003 the MNB faced an extremely strong appreciation speculation. Due to foreign speculators' high-amount forint purchases the central bank had to buy 5.3 billion euros within two days. As a consequence of the speculative attack, in addition to the interest rate cuts, the MNB temporarily limited the access to central bank instruments.[29]

- Exchange rate band realignment

  On 4 June 2003 on the government's initiative, the Magyar Nemzeti Bank and the government depreciated the central parity by 2.26%, leaving the width of the fluctuation band of the exchange rate at +/-15% unchanged. The measure aimed to avoid the excessive strengthening of the exchange rate and to contribute to the improvement of the competitiveness of the Hungarian economy. After the decision, the exchange rate depreciated significantly.

- Increase in the number of Monetary Council members

  From 1 March 2004 and 1 March 2005 the number of Monetary Council members was increased by two and four, respectively. Following the increase in the number of decision makers, the Council was characterised by increased differences in opinions.

b) Overview of the MNB's communication

The sample period can be divided into several subperiods based on the main topics and intensity of the communication.

- From the terrorist attack against the USA, until the autumn of 2002

Following the terrorist attack against the USA, striving to calm the market, the central bank emphasised the temporary character of negative shocks. In order to stabilise the exchange rate, the communication aimed at reducing interest rate cut expectations. After the terrorist attack, for several months the exchange rate fluctuated at a weaker-than-earlier level, therefore, instead of the earlier range of 245-250 HUF/EUR the central bank announced that a 245-260 HUF/EUR range was also appropriate, adding that over the medium term it did not consider an exchange rate around 260 HUF/EUR optimal.

Following a decline in the uncertainty caused by the terrorist attack, the exchange rate strengthened up to 250 HUF/EUR, which the central bank regarded relatively strong, and stated that it was possible to attain the inflation target even with a weaker exchange rate. Following a modest, temporary weakening, the exchange rate stabilised at around 245 HUF/EUR by end-2001. Starting from October 2001, emphasising the favourable developments in inflation, interest rate communication also indicated the possibility of a rate cut, depending on the stabilisation of the external environment and

[29] The events preceding and leading up to the attack against the band and the subsequent central bank steps are described in detail by Barabás (2003).

Chart C1

Exchange rate communication and exchange rate developments

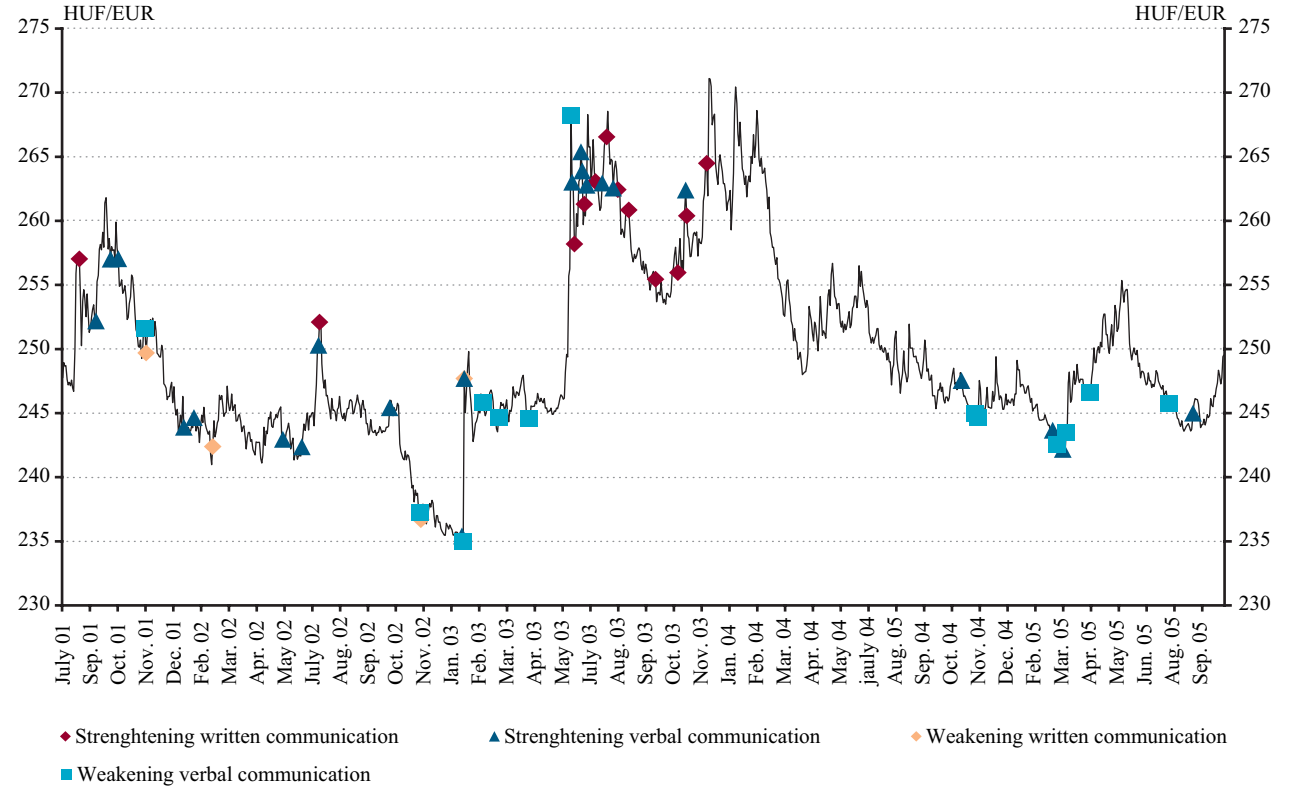


Chart C2

Interest rate communication, three months ahead three-month forward yield and central bank base rate

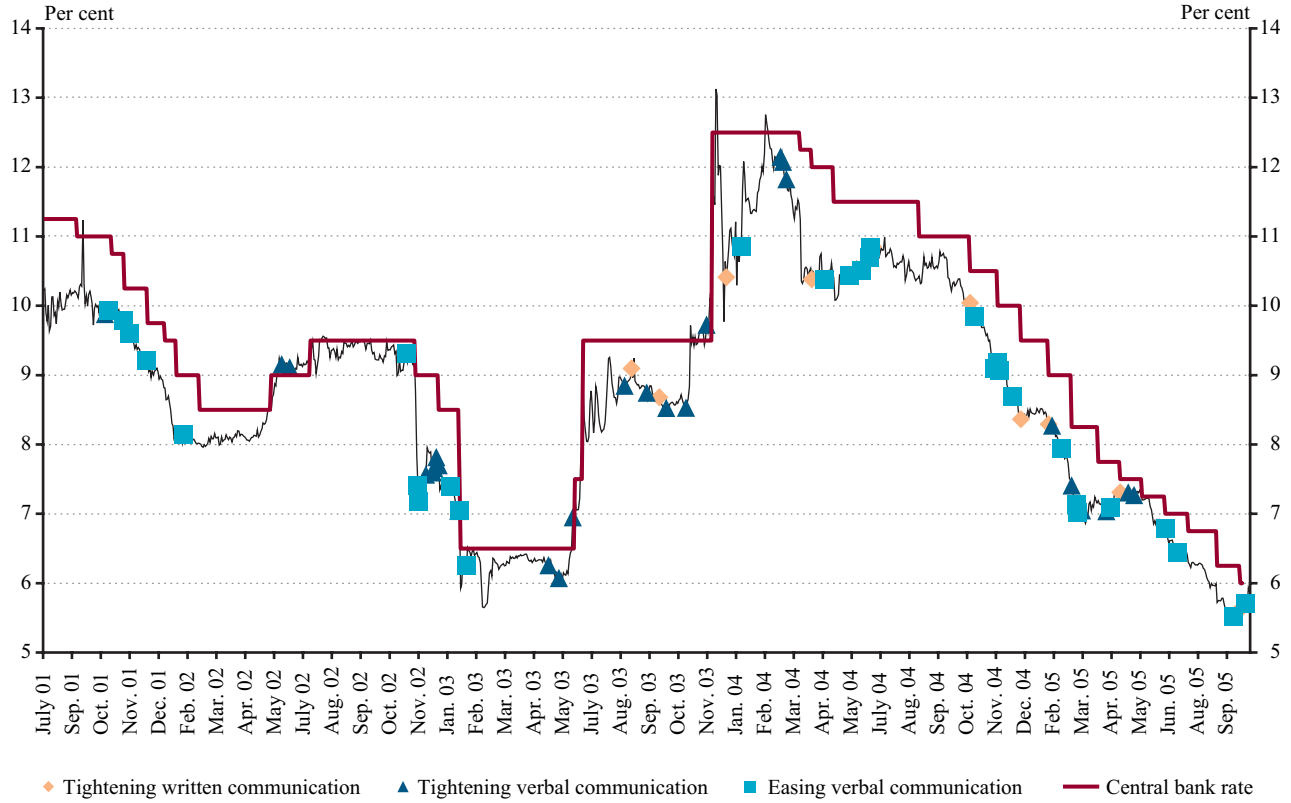
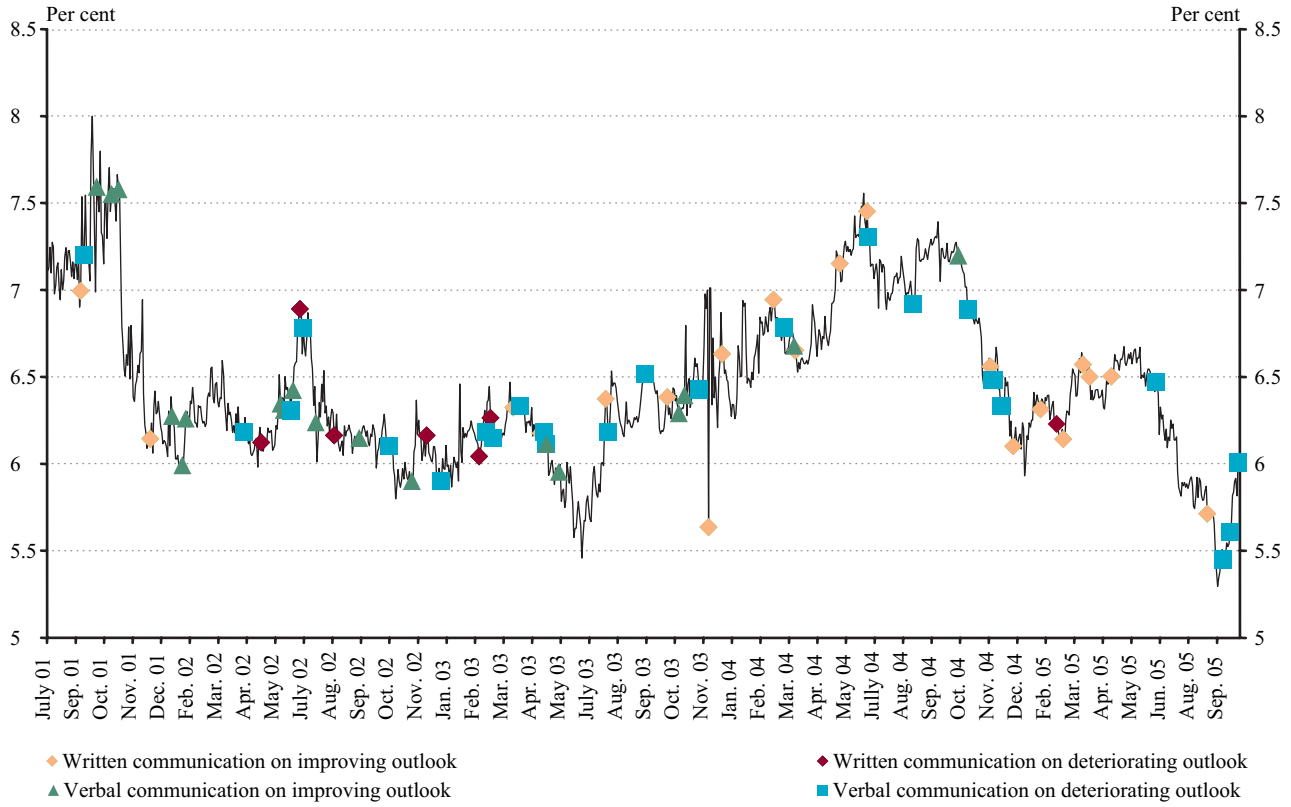


Chart C3

Macroeconomic communication and the five years ahead five-year forward yield



of the exchange rate. After starting to decrease the interest rate, the central bank expressed that it was following the decline in inflation by its interest rate moves.

From early 2002 the forint fluctuated within a narrow range. The central bank usually considered the exchange rate level appropriate, but after smaller depreciation trends it argued for a stronger forint. Starting from April 2002, statements suggesting interest rate cut disappeared from central bank communication, and the central bank considered the prevailing yield level appropriate. The central bank did not indicate a turn of the interest rate cycle, and only called the attention to a potential tightening – referring to the loose budget – in two statements before the second interest rate raise in June.

In case of the communication regarding macroeconomic outlook, positive signals dominated at the beginning of the period. First, external and internal equilibrium was in the centre of attention, emphasising the long-term sustainability of the developments, and that the Maastricht criterion regarding the budget can also be met. Later, the focus of the communication was on the favourable development in inflation and the central bank's and the government's commitment to the inflation target. Starting from May 2002, in parallel with positive statements regarding the outlook, communication underlining risks also appeared. Among the risks to inflation, mainly wage developments and the uncertainty surrounding fiscal developments were emphasised.

- November 2002 – February 2003

In the period preceding the speculative attack, communication was basically determined by the coexistence of inflation targeting and the exchange rate band. In early November, welcoming the planned fiscal adjustment, the central bank still made statements on the possibility of an interest rate cut, then, as another argument for the cut, the appreciating exchange rate also appeared in the communication. The central bank and the government together denied market rumours of a band realignment, and reassured the commitment to maintain the exchange rate band. Starting from December, interest rate communication concentrated on the inflation outlook again, and, emphasising the risks of the

budget deficit and of the increase in wages, strived to eliminate interest rate cut expectations. After the exchange rate appreciated close to the edge of the band, the central bank communication became uncertain, and both statements affirming and denying an interest rate cut were made. Right before the speculative attack, the central bank specified the interest rate level which kept the exchange rate at the top of the band as an explicit aim.

In terms of macroeconomic outlook, this period was characterised by the dominance of negative messages. In addition to the risk of higher wage inflation, the limits of attaining the inflation target due to the exchange rate band and the budget deficit were emphasised in the communication.

- February 2003 – end-2003

In the period following the speculative attack, the central bank rarely revealed its views on the expected stance of monetary policy, and communication's primary focus was to restore stability. In May, the central bank warned twice that in absence of stricter fiscal and wage policies attaining the inflation target would require a stronger exchange rate, and the central bank was committed to maintain it even if higher interest rates were required.

The intensity of statements increased sharply following the exchange rate band realignment, and communication was determined by the efforts to stop the weakening of the exchange rate and restrengthening it to the desired level of around 250 HUF/EUR. In these months, the central bank confirmed several times in its verbal and written communication that the loose budget and the high rate of wage outflows required an exchange rate around 250 HUF/EUR, and would conduct it's interest rate policy accordingly. In parallel with the exchange rate strengthening into the range preferred by the central bank, communication continued to aim at eliminating interest rate cut expectations. Starting from the second part of October, statements indicated interest rate raises with reference to increasing macroeconomic risks.

In this period, the shift of the planned eurozone entry date and doubts related to the reality of meeting the criteria determined the communication of macroeconomic outlook. The central bank urged fiscal adjustment several times, and indicated that it considers the non-fulfilment of the budget criterion as the greatest risk to the adoption of the euro in 2008. Starting from October, several positive statements appeared, the central bank considered wage developments favourable, and welcomed fiscal consolidation.

- From 2004

Central bank communication regarding the exchange rate almost disappeared in 2004. Although with minor interruptions, the forint appreciated steadily, central bank statements regarding the exchange rate remained neutral.

In parallel with this, the intensity of interest rate communication increased. In early 2004 – partly as a response to the government's communication, which urged an interest rate cut and was becoming more and more intense – referring to macroeconomic risks, the central bank aimed to eliminate interest rate cut expectations. This effort continued in March and April as well, after the beginning of the interest rate cut cycle. Although statements suggested an improvement in the equilibrium, they pointed out its fragility and the importance of consolidating investors' confidence, and continued to emphasise the need for cautious monetary policy. From April to June 2004, statements indicating a possible interest rate cut started to prevail, then in the second half of the year statements stressing risks and statements suggesting interest rate cuts alternated.

From early 2005 interest rate communication became less consistent, which reflected the divergence in views of decision makers. Referring to the favourable inflation outlook, some verbal statements predicted an interest rate cut, but others emphasised the external and internal risks and the necessity of a cautious interest rate policy. In contrast to the mixed verbal statements, written communication focused basically on the risks. The statement following the MC meeting on 19 September had indicated the end of the interest rate cut cycle, which was later confirmed in a verbal statement as well.

In 2004, positive messages prevailed in the written communication regarding economic outlook, while verbal statements showed a mixed picture. While in the first part of the year the decline in the imbalances and positive messages related

to the medium-term programme of the government had been emphasised, from June on the balance of payments deficit and the further delay in the eurozone entry were increasingly stressed in statements. Central bank statements continued to concentrate on these subjects in 2005 as well. In addition to the favourable inflation outlook, the budget deficit, the increasing indebtedness and its unsustainability and consequently the decline in the probability of the eurozone entry in 2010 were emphasized.

Appendix D: Regressions

Table D1

Exchange rate

Dependent Variable: D(LOG(ER))
Method: ML - ARCH (Marquardt)
Date: 12/30/05 Time: 09:57
Sample(adjusted): 2 1045
Included observations: 1044 after adjusting endpoints
Convergence achieved after 15 iterations
Bollerslev-Wooldrige robust standard errors & covariance
Variance backcast: ON

	Coefficient	Std. Error	z-Statistic	Prob.
CPI_S	0.004947	0.002488	1.988357	0.0468
MC_DECISION	-3.95E-05	2.89E-05	-1.367116	0.1716
ER_VERBAL_STRENGTHEN	0.002512	0.001454	1.727084	0.0842
ER_VERBAL_WEAKEN	0.001192	0.001632	0.730734	0.4649
ER_WRITTEN_STRENGTHEN	-0.000169	0.001833	-0.091970	0.9267
ER_WRITTEN_WEAKEN	0.006558	0.005534	1.185094	0.2360
IR_WRITTEN_RAISE	-8.02E-05	0.001376	-0.058297	0.9535
IR_VERBAL_RAISE	-0.002238	0.000889	-2.519144	0.0118
IR_VERBAL_CUT	0.000939	0.000767	1.223736	0.2211
OUTL_WRITTEN_P	-0.002402	0.000797	-3.012355	0.0026
OUTL_WRITTEN_N	-0.001269	0.001138	-1.114906	0.2649
OUTL_VERBAL_P	-0.000968	0.000674	-1.435566	0.1511
OUTL_VERBAL_N	0.000240	0.000502	0.478931	0.6320
C	2.94E-05	0.000139	0.210751	0.8331
Variance Equation				
C	2.00E-05	3.18E-06	6.300350	0.0000
ARCH(1)	0.148217	0.083413	1.776901	0.0756
GARCH(1)	0.591239	0.068251	8.662682	0.0000
IR_WRITTEN_RAISE	-1.70E-05	4.16E-06	-4.079452	0.0000
OUTL_WRITTEN_P	-1.49E-05	3.59E-06	-4.156558	0.0000
OUTL_WRITTEN_N	-1.74E-05	3.24E-06	-5.381138	0.0000
OUTL_VERBAL_P	-2.24E-05	3.67E-06	-6.104584	0.0000
OUTL_VERBAL_N	-1.52E-05	2.59E-06	-5.842888	0.0000
R-squared	0.053223	Mean dependent var		6.97E-06
Adjusted R-squared	0.033769	S.D. dependent var		0.004973
S.E. of regression	0.004888	Akaike info criterion		-7.631724
Sum squared resid	0.024420	Schwarz criterion		-7.527397
Log likelihood	4005.760	F-statistic		2.735813
Durbin-Watson stat	2.141958	Prob(F-statistic)		0.000044

Table D2

Five-day exchange rate trend

Dependent Variable: D(TREND)
Method: ML - ARCH (Marquardt)
Date: 01/09/06 Time: 13:14
Sample(adjusted): 7 1040
Included observations: 1034 after adjusting endpoints
Convergence achieved after 10 iterations
Bollerslev-Wooldrige robust standard errors & covariance
Variance backcast: ON

	Coefficient	Std. Error	z-Statistic	Prob.
ER_VERBAL_STRENGTHEN	-0.004586	0.003920	-1.169803	0.2421
ER_VERBAL_WEAKEN	0.010431	0.002972	3.509554	0.0004
ER_WRITTEN_STRENGTHEN	-0.015293	0.005592	-2.734772	0.0062
ER_WRITTEN_WEAKEN	0.010549	0.006518	1.618567	0.1055
IR_WRITTEN_RAISE	0.002536	0.003986	0.636156	0.5247
IR_VERBAL_RAISE	0.001892	0.001833	1.031831	0.3022
IR_VERBAL_CUT	-0.000507	0.001561	-0.324549	0.7455
OUTL_WRITTEN_P	-0.002025	0.002345	-0.863691	0.3878
OUTL_WRITTEN_N	-0.006962	0.003299	-2.110415	0.0348
OUTL_VERBAL_P	0.001532	0.001693	0.904417	0.3658
OUTL_VERBAL_N	-0.000945	0.001451	-0.651206	0.5149
MC_DECISION	-6.70E-05	3.34E-05	-2.007923	0.0447
C	0.000378	0.000385	0.982698	0.3258
Variance Equation				
C	0.000173	2.23E-05	7.774211	0.0000
ARCH(1)	0.138785	0.050614	2.742016	0.0061
GARCH(1)	0.525201	0.060825	8.634621	0.0000
ER_VERBAL_WEAKEN	-0.000196	3.80E-05	-5.152327	0.0000
OUTL_WRITTEN_P	-0.000178	2.64E-05	-6.739038	0.0000
OUTL_WRITTEN_N	-0.000183	3.15E-05	-5.814912	0.0000
OUTL_VERBAL_P	-0.000183	1.93E-05	-9.493350	0.0000
OUTL_VERBAL_N	-0.000138	1.95E-05	-7.051829	0.0000
R-squared	0.042144	Mean dependent var		5.38E-05
Adjusted R-squared	0.023233	S.D. dependent var		0.015385
S.E. of regression	0.015205	Akaike info criterion		-5.577106
Sum squared resid	0.234198	Schwarz criterion		-5.476753
Log likelihood	2904.364	F-statistic		2.228508
Durbin-Watson stat	0.680389	Prob(F-statistic)		0.001504

Table D3

Implied volatility

Dependent Variable: IV1M
Method: ML - ARCH (Marquardt)
Date: 12/01/05 Time: 09:52
Sample(adjusted): 2 1045
Included observations: 1044 after adjusting endpoints
Convergence achieved after 126 iterations
Variance backcast: ON

	Coefficient	Std. Error	z-Statistic	Prob.
IV1M(-1)	0.978639	0.004395	222.6954	0.0000
MC_DECISION	-0.002055	0.001282	-1.602667	0.1090
ER_VERBAL_STRENGTHEN	0.153732	0.107732	1.426992	0.1536
ER_VERBAL_WEAKEN	0.227486	0.050101	4.540546	0.0000
ER_WRITTEN_STRENGTHEN	-0.059623	0.259962	-0.229353	0.8186
ER_WRITTEN_WEAKEN	0.300122	0.106349	2.822044	0.0048
IR_WRITTEN_RAISE	-0.017510	0.180773	-0.096862	0.9228
IR_VERBAL_RAISE	-0.109768	0.096591	-1.136421	0.2558
IR_VERBAL_CUT	0.028321	0.056625	0.500145	0.6170
OUTL_WRITTEN_P	-0.161705	0.101124	-1.599078	0.1098
OUTL_WRITTEN_N	-0.086054	0.156374	-0.550305	0.5821
OUTL_VERBAL_P	-0.003519	0.106358	-0.033084	0.9736
OUTL_VERBAL_N	0.008666	0.065470	0.132367	0.8947
C	0.135537	0.039826	3.403224	0.0007
Variance Equation				
C	0.011226	0.000737	15.23235	0.0000
ARCH(1)	0.133434	0.009411	14.17777	0.0000
GARCH(1)	0.826588	0.007378	112.0299	0.0000
R-squared	0.950353	Mean dependent var		8.025805
Adjusted R-squared	0.949579	S.D. dependent var		2.486184
S.E. of regression	0.558261	Akaike info criterion		1.098928
Sum squared resid	320.0704	Schwarz criterion		1.179544
Log likelihood	-556.6403	F-statistic		1228.686
Durbin-Watson stat	1.935528	Prob(F-statistic)		0.000000

Table D4

Three-month spot yield

Dependent Variable: D(SPOT3M)
Method: ML - ARCH (Marquardt)
Date: 05/22/06 Time: 16:03
Sample(adjusted): 2 1045
Included observations: 1044 after adjusting endpoints
Failure to improve Likelihood after 40 iterations
Bollerslev-Wooldrige robust standard errors & covariance
Variance backcast: ON

	Coefficient	Std. Error	z-Statistic	Prob.
IR_VERBAL_RAISE	0.017761	0.015493	1.146322	0.2517
IR_VERBAL_CUT	-0.016396	0.029908	-0.548205	0.5836
ER_VERBAL_STRENGTHEN	0.107301	0.047084	2.278912	0.0227
ER_VERBAL_WEAKEN	-0.017275	0.032324	-0.534449	0.5930
OUTL_VERBAL_P	-0.004171	0.016736	-0.249199	0.8032
OUTL_VERBAL_N	-0.007416	0.014769	-0.502129	0.6156
C	-0.003792	0.002855	-1.328298	0.1841
Variance Equation				
C	0.018077	0.004212	4.291544	0.0000
ARCH(1)	0.142859	0.122210	1.168962	0.2424
GARCH(1)	0.565936	0.108383	5.221634	0.0000
IR_VERBAL_RAISE	-0.013711	0.003480	-3.939759	0.0001
IR_VERBAL_CUT	-0.014151	0.004819	-2.936340	0.0033
OUTL_VERBAL_P	-0.012083	0.003112	-3.882941	0.0001
OUTL_VERBAL_N	-0.012245	0.001935	-6.328415	0.0000
CPI_S	0.059315	0.003118	19.02329	0.0000
R-squared	0.013559	Mean dependent var		-0.002975
Adjusted R-squared	0.000138	S.D. dependent var		0.143699
S.E. of regression	0.143689	Akaike info criterion		-0.994349
Sum squared resid	21.24517	Schwarz criterion		-0.923216
Log likelihood	534.0500	F-statistic		1.010303
Durbin-Watson stat	2.163190	Prob(F-statistic)		0.440099

Table D5

Three-month benchmark

Dependent Variable: D(BM3M)
Method: ML - ARCH (Marquardt)
Date: 11/16/05 Time: 18:40
Sample(adjusted): 2 1045
Included observations: 1044 after adjusting endpoints
Convergence achieved after 16 iterations
Bollerslev-Wooldrige robust standard errors & covariance
Variance backcast: ON

	Coefficient	Std. Error	z-Statistic	Prob.
ER_VERBAL_STRENGTHEN	0.090167	0.046372	1.944435	0.0518
ER_VERBAL_WEAKEN	-0.029176	0.028491	-1.024058	0.3058
CPI_S	0.074717	0.020831	3.586794	0.0003
IR_VERBAL_RAISE	-2.42E-05	0.015392	-0.001571	0.9987
IR_VERBAL_CUT	-0.005810	0.023874	-0.243364	0.8077
OUTL_VERBAL_P	-0.021227	0.014349	-1.479369	0.1390
OUTL_VERBAL_N	-0.005172	0.014464	-0.357567	0.7207
C	-0.002592	0.002438	-1.063274	0.2877
Variance Equation				
C	0.017950	0.011748	1.527952	0.1265
ARCH(1)	0.152217	0.382111	0.398358	0.6904
GARCH(1)	0.594311	0.274245	2.167081	0.0302
ER_VERBAL_WEAKEN	-0.019197	0.005117	-3.751848	0.0002
CPI_S	0.055113	0.005705	9.661060	0.0000
IR_VERBAL_RAISE	-0.011645	0.003504	-3.323618	0.0009
IR_VERBAL_CUT	-0.012748	0.003130	-4.072399	0.0000
OUTL_VERBAL_P	-0.013996	0.002779	-5.036002	0.0000
OUTL_VERBAL_N	-0.013819	0.003644	-3.792254	0.0001
R-squared	0.010139	Mean dependent var		-0.002945
Adjusted R-squared	-0.005282	S.D. dependent var		0.137875
S.E. of regression	0.138238	Akaike info criterion		-1.040260
Sum squared resid	19.62585	Schwarz criterion		-0.959643
Log likelihood	560.0156	F-statistic		0.657457
Durbin-Watson stat	2.395113	Prob(F-statistic)		0.837124

Table D6

Three months ahead three-month yield

Dependent Variable: D(FW3M)
Method: ML - ARCH (Marquardt)
Date: 05/29/06 Time: 08:17
Sample(adjusted): 2 1045
Included observations: 1044 after adjusting endpoints
Failure to improve Likelihood after 13 iterations
Bollerslev-Wooldrige robust standard errors & covariance
Variance backcast: ON

	Coefficient	Std. Error	z-Statistic	Prob.
EXCHR_CB_VERBAL_STRENGTHEN	0.117104	0.058907	1.987938	0.0468
EXCHR_CB_VERBAL_WEAKEN	-0.007935	0.027803	-0.285399	0.7753
CB_INT_VERB_RAISE	0.015479	0.018113	0.854604	0.3928
CB_INT_VERB_CUT	0.005098	0.035061	0.145393	0.8844
CB_OUTL_VERBAL_P	-0.019086	0.020316	-0.939501	0.3475
CB_OUTL_VERBAL_N	-0.019167	0.020137	-0.951850	0.3412
C	-0.005568	0.003946	-1.411212	0.1582
Variance Equation				
C	0.020544	0.004685	4.385412	0.0000
ARCH(1)	0.143840	0.086785	1.657426	0.0974
GARCH(1)	0.553956	0.104423	5.304917	0.0000
EXCHR_CB_VERBAL_WEAKEN	-0.013317	0.006685	-1.992129	0.0464
CB_INT_VERB_RAISE	-0.020493	0.003515	-5.829536	0.0000
CB_INT_VERB_CUT	-0.021303	0.004855	-4.388132	0.0000
CB_OUTL_VERBAL_N	-0.012344	0.002304	-5.357161	0.0000
CB_OUTL_VERBAL_P	-0.009566	0.003444	-2.777839	0.0055
CPIS	0.054671	0.006034	9.059939	0.0000
R-squared	0.010844	Mean dependent var		-0.002283
Adjusted R-squared	-0.003590	S.D. dependent var		0.154462
S.E. of regression	0.154739	Akaike info criterion		-0.843620
Sum squared resid	24.61453	Schwarz criterion		-0.767745
Log likelihood	456.3697	F-statistic		0.751295
Durbin-Watson stat	2.019204	Prob(F-statistic)		0.732592

Table D7

One year ahead three-month yield

Dependent Variable: D(FW1YEAR)
Method: ML - ARCH (Marquardt)
Date: 12/30/05 Time: 10:23
Sample(adjusted): 2 1045
Included observations: 1044 after adjusting endpoints
Failure to improve Likelihood after 23 iterations
Bollerslev-Wooldrige robust standard errors & covariance
Variance backcast: ON

	Coefficient	Std. Error	z-Statistic	Prob.
ER_WRITTEN_STRENGTHEN	0.062412	0.053100	1.175374	0.2398
ER_WRITTEN_WEAKEN	-0.354243	0.242436	-1.461185	0.1440
ER_VERBAL_STRENGTHEN	0.104311	0.054154	1.926210	0.0541
ER_VERBAL_WEAKEN	-0.051526	0.025624	-2.010818	0.0443
IR_WRITTEN_RAISE	-0.060211	0.046630	-1.291250	0.1966
IR_VERBAL_RAISE	-0.056085	0.022859	-2.453478	0.0141
IR_VERBAL_CUT	0.007175	0.032283	0.222265	0.8241
OUTL_WRITTEN_N	0.046101	0.043743	1.053910	0.2919
OUTL_VERBAL_P	-0.001731	0.009110	-0.189977	0.8493
OUTL_VERBAL_N	0.009136	0.018061	0.505858	0.6130
OUTL_WRITTEN_P	-0.037910	0.028449	-1.332546	0.1827
GDP_S	-0.059158	0.030347	-1.949395	0.0512
C	-0.001950	0.003745	-0.520568	0.6027
Variance Equation				
C	0.018282	0.005202	3.514152	0.0004
ARCH(1)	0.144313	0.083169	1.735176	0.0827
GARCH(1)	0.539944	0.132602	4.071911	0.0000
IR_WRITTEN_RAISE	-0.018194	0.004479	-4.061917	0.0000
OUTL_VERBAL_P	-0.018325	0.002985	-6.139191	0.0000
OUTL_VERBAL_N	-0.012718	0.003181	-3.997719	0.0001
OUTL_WRITTEN_P	-0.010713	0.004291	-2.496427	0.0125
BOP_S	0.000140	4.70E-05	2.968652	0.0030
CPI_S	0.030285	0.015286	1.981259	0.0476
GDP_S	0.042468	0.009054	4.690423	0.0000
R-squared	0.038727	Mean dependent var		-0.002604
Adjusted R-squared	0.018014	S.D. dependent var		0.150599
S.E. of regression	0.149237	Akaike info criterion		-0.910576
Sum squared resid	22.73931	Schwarz criterion		-0.801507
Log likelihood	498.3208	F-statistic		1.869711
Durbin-Watson stat	2.044616	Prob(F-statistic)		0.008897

Table D8

Three years ahead one-year yield

Dependent Variable: D(FW3YEAR)
Method: ML - ARCH (Marquardt)
Date: 12/30/05 Time: 10:48
Sample(adjusted): 3 1045
Included observations: 1043 after adjusting endpoints
Failure to improve Likelihood after 24 iterations
Bollerslev-Wooldrige robust standard errors & covariance
Variance backcast: ON

	Coefficient	Std. Error	z-Statistic	Prob.
IR_WRITTEN_RAISE	0.078528	0.029495	2.662465	0.0078
IR_VERBAL_RAISE	-0.016379	0.024172	-0.677621	0.4980
IR_VERBAL_CUT	0.000921	0.033064	0.027840	0.9778
OUTL_WRITTEN_P	-0.068145	0.025875	-2.633602	0.0084
OUTL_WRITTEN_N	-0.034504	0.026642	-1.295075	0.1953
OUTL_VERBAL_P	0.003888	0.025459	0.152734	0.8786
OUTL_VERBAL_N	0.002886	0.015215	0.189664	0.8496
ER_WRITTEN_STRENGTHEN	-0.056510	0.041972	-1.346368	0.1782
ER_WRITTEN_WEAKEN	0.194323	0.184327	1.054227	0.2918
ER_VERBAL_STRENGTHEN	0.052296	0.040568	1.289089	0.1974
ER_VERBAL_WEAKEN	0.017295	0.033548	0.515514	0.6062
CPI_S	0.242090	0.122182	1.981384	0.0475
C	-0.002170	0.003813	-0.569264	0.5692
D(FW3YEAR(-1))	-0.067169	0.050030	-1.342592	0.1794
Variance Equation				
C	0.016664	0.006990	2.384069	0.0171
ARCH(1)	0.103770	0.109613	0.946694	0.3438
GARCH(1)	0.551111	0.202543	2.720956	0.0065
IR_WRITTEN_RAISE	-0.014719	0.005290	-2.782626	0.0054
OUTL_WRITTEN_N	-0.013410	0.005109	-2.624892	0.0087
OUTL_VERBAL_N	-0.008487	0.004647	-1.826473	0.0678
R-squared	0.030370	Mean dependent var		-0.001085
Adjusted R-squared	0.012361	S.D. dependent var		0.140039
S.E. of regression	0.139171	Akaike info criterion		-0.969694
Sum squared resid	19.81408	Schwarz criterion		-0.874778
Log likelihood	525.6953	F-statistic		1.686374
Durbin-Watson stat	2.049810	Prob(F-statistic)		0.032824

Table D9

Five years ahead five-year yield

Dependent Variable: D(FW5YEAR)
Method: ML - ARCH (Marquardt)
Date: 12/30/05 Time: 10:50
Sample(adjusted): 3 1045
Included observations: 1043 after adjusting endpoints
Convergence achieved after 16 iterations
Bollerslev-Wooldrige robust standard errors & covariance
Variance backcast: ON

	Coefficient	Std. Error	z-Statistic	Prob.
OUTL_WRITTEN_N	0.040582	0.024681	1.644248	0.1001
OUTL_VERBAL_P	0.009413	0.013980	0.673319	0.5007
OUTL_VERBAL_N	-0.018862	0.011144	-1.692583	0.0905
OUTL_WRITTEN_P	-0.087733	0.030190	-2.906040	0.0037
ER_WRITTEN_STRENGTHEN	-0.034390	0.046504	-0.739510	0.4596
ER_WRITTEN_WEAKEN	-0.125893	0.091735	-1.372354	0.1700
ER_VERBAL_STRENGTHEN	0.060969	0.031940	1.908866	0.0563
ER_VERBAL_WEAKEN	-0.052898	0.045089	-1.173172	0.2407
IR_WRITTEN_RAISE	-0.006208	0.024653	-0.251808	0.8012
IR_VERBAL_RAISE	-0.036228	0.013735	-2.637517	0.0084
IR_VERBAL_CUT	0.007097	0.022046	0.321910	0.7475
C	0.000969	0.003262	0.297120	0.7664
MC_DECISION	-0.001863	0.000651	-2.862620	0.0042
D(FW5YEAR(-1))	-0.277535	0.050941	-5.448208	0.0000
Variance Equation				
C	0.010666	0.001506	7.083841	0.0000
ARCH(1)	0.126746	0.062744	2.020038	0.0434
GARCH(1)	0.520129	0.075157	6.920598	0.0000
OUTL_VERBAL_N	-0.009941	0.001604	-6.198869	0.0000
IR_WRITTEN_RAISE	-0.011954	0.001734	-6.893782	0.0000
IR_VERBAL_RAISE	-0.010187	0.001923	-5.296741	0.0000
BOP_S	0.000110	1.33E-05	8.219598	0.0000
R-squared	0.156840	Mean dependent var		-0.001075
Adjusted R-squared	0.140339	S.D. dependent var		0.127247
S.E. of regression	0.117981	Akaike info criterion		-1.414734
Sum squared resid	14.22564	Schwarz criterion		-1.315072
Log likelihood	758.7837	F-statistic		9.505318
Durbin-Watson stat	2.041973	Prob(F-statistic)		0.000000

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