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The Use of Financial Market Indicators by Monetary Authorities

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ABSTRACT/RÉSUMÉ

In a new and changing environment for monetary policy, an interesting issue to examine is the use of financial market indicators by monetary policy authorities. With this in mind, the OECD canvassed a number of major central banks to get their views. This paper presents a synthesis of the responses and respects the confidentiality of individual central banks. Its main conclusions are as follows. In principle, financial market variables can provide additional information regarding the shocks that strike the economy, such as their perceived size and source as well as the process of feeding through the economy. A complementary function is to gauge market anticipations and reactions to policy changes, including the credibility of policy objectives. Regarding policy setting, monetary authorities are clearly aware of the dangers of mechanically targeting this information, which could lead to circularities. However, in some cases, they seem to find financial market indicators useful in evaluating policy credibility and in making tactical decisions. The most serious disadvantage of these indicators is the difficulty in disentangling their information content. Moreover, the relationships between them and the final target variables are sometimes poor, and financial markets tend to overreact to news and are thus subject to herding and potentially to speculative bubbles. In sum, the information can be highly distorted by various time-varying risk premia and, accordingly, the progress in understanding them has been limited, leaving a large judgmental role to the monetary authorities. Use of these data varies among monetary authorities and, overall, they are still feeling their way regarding the role for these newer financial market indicators.

JEL classification: E50, 358, G14
Keywords: monetary policy indicators, central bank policies, financial market indicators

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Dans un environnement de politique monétaire nouveau et en pleine évolution, il nous a semblé intéressant d'examiner l'usage que les autorités de la politique monétaire font des indicateurs du marché financier. C'est dans cette optique que l'OCDE a sollicité l'avis d'un certain nombre de grandes banques centrales. Ce document présente une synthèse de l'ensemble de leurs opinions, tout en respectant la confidentialité de chacune d'entre elles, dont les principales conclusions sont les suivantes. En principe, les variables concernant le marché financier peuvent fournir des informations supplémentaires en ce qui concerne les secousses qui frappent l'économie, en ce sens qu'elles en perçoivent l'ampleur, la source aussi bien que les répercussions sur le système économique. Une de leurs fonctions complémentaires est d'évaluer les anticipations du marché et les réactions aux changements de politique, ainsi que la crédibilité des objectifs politiques. Bien que les autorités monétaires soient pleinement conscientes du danger d'utiliser de façon mécanique ces informations, qui pourraient entraîner des crises circulaires, elles estiment que dans certains cas ces indicateurs du marché financier sont utiles pour évaluer la crédibilité des politiques et prendre des décisions tactiques. Le désavantage le plus sérieux de ces indicateurs réside dans la difficulté à démêler le contenu de leurs informations. De plus les relations entre ces indicateurs et les variables cibles finales sont quelquefois faibles, et les marchés financiers ont tendance à réagir de manière excessive aux informations et sont sujets à des réactions grégaires et potentiellement à des spéculations hasardeuses. En résumé, l'information peut être extrêmement déformée par diverses primes de risque à échéances variables, et, en conséquence, les progrès faits dans la compréhension des indicateurs sont restés limités, laissant aux autorités monétaires un important rôle de juge. L'usage de ces données varie selon les autorités monétaires, et, en général, le rôle de ces nouveaux indicateurs du marché financier en est encore au stade de l'exploration.

Classification JEL : E50, 358, G14
Mots-Clés : indicateurs de la politique monétaire, politiques des banques centrales, indicateurs du marché financier

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THE USE OF FINANCIAL MARKET INDICATORS BY MONETARY AUTHORITIES

Paul Mylonas and Sebastian Schich[1]

I. Introduction

1. In a new and changing environment for monetary policy, an interesting issue to examine is the use of financial market indicators by monetary policy authorities. With this in mind, the OECD canvassed a number of major central banks to get their views. The questions centred around the following:

- Are financial market indicators useful in setting monetary policy?
- Which ones are used by central banks and for what purpose?

2. This paper presents a synthesis of their views as a whole, while respecting the confidentiality of individual central banks. Information was also obtained from published central bank material and other research in the area. The second section of the paper describes briefly the forces that have generated interest in the use of these indicators by monetary policy makers. The third section reviews the cross-country experience of central banks with financial market indicators and rates them compared with other options such as monetary aggregates. The fourth section provides a description of the uses of, and drawbacks to, the information derived from specific financial market indicators (yield curves, forward market rates and, more recently, options), as compared with monetary aggregates and exchange rates. The fifth section attempts to describe the use of these indicators for monetary policy in practice. Main conclusions are presented at the end of the paper.

II. Why information derived from financial market indicators has attracted attention

3. The interest in financial market indicators is partly linked to increased uncertainty concerning the workings of the monetary transmission mechanism, in particular the instability of money demand in the mid-1980s which reduced the reliability of simple money-based intermediate target rules in most countries. Faced with a monetary transmission process which is probably becoming more complicated, and given the growing significance of different forms of intermediation and risk allocation, more emphasis has been placed on understanding movements in a wide range of financial market variables, complementing the information contained in monetary aggregates. They also have the potential to reflect developments at critical stages of the transmission process since financial markets, in general, adjust faster than goods markets, and their prices are more timely and less prone to measurement error than quantitative variables.

4. A related reason for the interest generated in financial market indicators is the larger role that is being attributed to expectations in shaping economic agents' decisions including, *inter alia*, their anticipations of, and reactions to, monetary policy action. Further attention in this area emanates from the search for methods to monitor the related issue of policy credibility. Though the important role of expectations has been traditionally recognised, more complete financial markets, coupled with advances in

1. The authors would like to thank Mike Kennedy for his assistance, and acknowedge the helpful comments of Ignazio Visco, Mike Feiner, Jorgen Elmeskov and Martine Durand. Thanks are also due to Laure Meuro and Catherine Lemoine for statistical assistance and to Paula Simonin for secretarial skills. The views expressed in this paper are those of the authors and are not necessarily shared by the OECD.

information technology, may be enhancing it, as well as transforming the transmission mechanism. In efforts to capture these changes, central banks have endeavoured to improve the role of expectations in their models.[2] Despite these efforts, it is generally recognised that obtaining measures of expectations remains difficult, the two main sources being surveys (not considered here) and data extracted from prices of financial instruments.

5. Finally, interest in financial market instruments is kindled by the attention given to other additional channels of monetary transmission. These include the exchange rate, wealth effects, the level of net indebtedness, quantity credit rationing (which raises the opportunity cost of funds), and the credit channel (which *inter alia* emphasises the impact of interest rates through balance sheet effects). The strengths of the last two channels is more controversial. For instance, balance sheet effects are said to amplify and propagate business cycles through the effect of interest rates on the value of firm assets used for collateral as well as the portfolio position of banks.

III. The role and importance of financial market indicators for central banks

6. Despite the increasing difficulties associated with the interpretation of movements in monetary aggregates in many countries, they continue to be a central building block for economic assessment at most central banks. They are considered by many to be better predictors of real activity and inflation than financial market indicators as they have relatively stable structural relationships. Moreover, many central banks have more confidence in relationships with well-understood theoretical underpinnings and are more suspicious of the reduced form relationships from which financial market indicators are derived (see below). That being said, individual monetary authorities have diverse applications for the monetary aggregates. For example, the Bank of Canada uses real M1 as a predictor of activity and nominal M1 and M2++ for predicting inflation. In contrast, Sweden's Riksbank relies on narrow money for predicting inflation with broad money being more closely linked to activity. The Bundesbank relied on broad money (M3) as a guide to medium-term inflation and the Bank of England links subsets of monetary aggregates to developments in specific sectors of the economy. The ECB uses a reference value for a monetary aggregate as the first pillar of its monetary strategy, but it also recognises the potentially useful role for supportive indicators in setting monetary policy in the euro area. Thus, the second pillar of its monetary policy strategy includes financial market indicators.

7. Nevertheless, monetary authorities in the majority of countries have been turning towards a more eclectic approach in assessing monetary conditions and underlying economic forces more generally (Bank of England, 1997). For example, use is often made of a set of stylised and smaller models, focusing on different aspects of the transmission mechanism and specific economic paradigms, as opposed to reliance on any one model and school of thought. This approach results in a reasonably stable and consistent framework for interpreting the reaction of the economy to many different types of shocks -- and one broad enough to encompass the complexity of the transmission process. For example, the Bank of England relies on a set of five models, comprising a large macroeconomic forecasting model, an output gap model, stylised macroeconomic models (e.g. the Dornbusch overshooting model), small analytical model projects (e.g. optimisation models of the real business cycle), and VAR models for short-term inflation projections. Similarly, the Bank of Canada relies on a large macroeconomic forecasting model (QPM), and various

2. In this regard, the Bank of England uses smaller stylised models, such as Dornbusch's overshooting model, to focus on this aspect of the transmission mechanism. The new FRB/US large macroeconomic model and the QPM model of the Bank of Canada have enhanced the role played by expectations, with the former containing a higher degree of (model consistent) rationality in the financial sectors than in the household sectors. Moreover, some central bank models are designed to take into account unanticipated deviations from markets' expectations.

smaller models based on real M1 for output, an M1-VECM and M2+ for inflation and a yield spread model.

8. The more eclectic approach is extended to observing several price-based financial indicators, which supplement the model results with additional information. As a general rule, most monetary authorities look at all financial market indicators that are available to them. However, in some cases they are constrained by markets not being sufficiently liquid, especially those for options. Financial market indicators are used primarily to gauge market sentiment regarding expected changes to policy variables (especially interest rates and exchange rates). But some central banks also seem to use movements in these indicators to identify types and sources of shocks to the economy -- i.e. to relate movements to a plausible story. A third role for financial market indicators is as predictors of future developments in activity and inflation, with such predictions of longer-term inflation also being useful in checking the credibility of the authorities' commitments to their final price target. (These three potential uses of financial market indicators are described in more detail in Section IV.) Most monetary authorities appear to think that expectations thus derived are representative of economic agent's expectations more broadly, rather than just those of narrow financial markets. However, disparities have been observed between long-term inflation expectations from survey data and those coming from financial markets. Though the question remains open as to whether Main Street and Wall Street have the same swings in expectations, there is a feeling that they have indeed moved closer together in some countries, reflecting the increased participation of households in equity markets, including through mutual funds. Overall, use of these indicators appears to vary among central banks.

9. One major concern regarding financial market indicators is their unreliability: they seem to perform badly when needed most. It is generally held that financial markets, unlike goods markets, by their nature over-react to shocks and are susceptible to herding and speculative phenomena. Time-varying risk premia are probably the major drawback to their use in setting monetary policy. More work appears necessary before one could identify causes of variation in risk premia and obtain more reliable estimates of their magnitude.[3] To date, most progress has been made on the estimation of average premia over long periods. Little effort seems to have been made by central banks to correct estimates of short-term expectations for risk premia. Moreover, though some central banks may have in-house estimates, few explicitly acknowledge their choice of technique, with one exception being the estimates of short-term forward interest rates (3-month forward rates and overnight rates) undertaken by the Bank of Canada.[4] In part, this situation may reflect a view that, over short periods of time, the effect of risk premia variations may not be large and that first differences of the measures may eliminate these distortions. Alternatively, it could reflect the fact that policy may want to react to increases in (inflation) expectations as well as in (inflation) risk premia. Put differently, movements in the prices themselves could be a useful indicator of changes in risk premia.

10. Several additional indicators are important in assessing overall monetary conditions as part of a more eclectic approach. These include, in particular, measures of risk contained in the spread between government and lower quality commercial securities, as well as contemporaneous international interest rate differentials. Regarding the former, it is used basically as a measure of credit risk. International spreads, on the other hand, are used as signs of credibility of exchange rate objectives, especially in the case of the countries that formed the euro area, and of monetary policy more generally (e.g. medium- and longer-term spreads between Canadian and US interest rates). In addition, stock market indices and estimates of equity

3 . In addition, prices of financial variables are constantly adjusting to weakly anchored expectations, as well as technical factors such as lumpy order flows. These factors render their prices rather noisy, thereby making it difficult to understand the information that is being conveyed on a real time basis.

4. In the event, the methodology for estimating the risk premia is based on modelling procedures with little theoretical underpinnings (e.g. Gravelle, Muller and Stréliski in Bank of Canada, 1999).

premiums are used to view underlying trends in aggregate and sectoral stock market and corporate profit behaviour.

IV. Financial market indicators that have attracted the most attention

Yield curves

11. As a general rule, particular emphasis is placed by monetary authorities on the information content of the yield curve, in contrast to other financial market instruments. Specifically, use is made of this information to (i) measure expectations regarding short-term interest rate movements, and (ii) predict activity and inflation.

Implied forward rates: measures of the policy stance and indicators of types of shocks

12. The most straightforward use of the information content of yield curves is to examine financial market expectations regarding the future stance of monetary policy from the implied forward curve of interest rates (and its shifts).[5] An extension is to compare implied forward rates across countries in order to obtain a measure of expectations regarding exchange rate and inflation rate changes. However, the failings of the uncovered interest rate parity condition are largely responsible for the fact that this methodology results in unreliable predictions.

13. A related use of the implied forward curve is as an indicator of the type of shocks that hit the economy. In these situations, the position and slope of the yield curve are considered to be a reduced-form equation of a more complex model. However, because changes in the yield curve can be consistent with several types of shocks, with the response of monetary policy being potentially different in each case, such information is useful only in combination with other, additional information allowing a better identification of individual effects.

14. Estimates of movements in real interest rates permit monetary authorities to form a view as to the relative tightness of monetary conditions. In this regard, one central bank considers the longer-run future real interest rate embedded in the yield curve (which should be unaffected by the business cycle) as a benchmark for a neutral monetary policy, with higher near-term real rates representing a tightening of monetary conditions. In practice, when estimating real interest rates, most central banks resort to backward-looking inflation data as a proxy for inflation expectations. Technical difficulties in extracting implied forward rates and deriving measures of inflation expectations are limiting factors for deriving more forward-looking measures of monetary conditions (Box 1).

5. Actual forward rate contracts are used for the same purpose and arbitrage usually assures that they are in line with implied forward rates. However, forward markets are rarely sufficiently liquid past 15 months, while the implied forward curve can extend out as far as 10 or more years.

Box 1. Issues regarding the extraction of information from yield curves

The extraction of implied forward rates is straightforward when zero-coupon yields are available at a number of maturities. However, they are not often available and many central banks resort to parametric or non-parametric methods to derive implied forward curves, which interpolate missing points on the curve. Adjustments are made for distortions arising from estimating zero-coupon yields from coupon-bearing assets, as well as, sometimes, for different tax treatments. Other distortions arise from the existence of risk premia (see below) and the premium that applies for convexity (convexity bias): the lower return that investors are willing to accept for bonds when upside risk exceeds downside risk for equal-sized marginal moves in the interest rate. However, adjustments for this bias are often not made. In any case, co-operating with member countries' central banks, the BIS has recently established a data bank with zero-coupon yield curves. These are estimated from government bonds of its member countries and in most cases use a parametric method.

In view of these difficulties, a simpler technique based on interest-rate swap rates had been used by some central banks to calculate implied forward rates. In some cases, this technique could introduce distortions arising from the credit risk premia that may be embedded in swap rates, insofar as these swap rates apply to commercial creditors. The simpler methodology may, nevertheless, be sufficiently accurate in most situations for the purpose of assessing the policy stance and examining anticipations of monetary policy. However, the usefulness of this indicator could break down in stress situations, such as occurred in autumn 1998 when credit spreads ballooned in response to the turmoil in financial markets.

Limited use is currently made of forward-looking inflation expectations deduced from a comparison between the real yield of an index-linked bond and the nominal yield of a normal bond of similar maturity to estimate short-term inflation expectations. Index-linked bonds are a relatively recent innovation. Even in the United Kingdom, where index-linked gilts were first introduced in 1981 and whose markets are comparatively more liquid, fairly reliable inflation expectations can be currently derived for only 2 years ahead (Table 1). In most other cases, index-linked bond markets suffer from low liquidity, which may significantly bias the implied inflation expectation, due to the existence of premiums for that illiquidity. Moreover, estimates of expected inflation may also be distorted by varying inflation risk premia.

Yield gap: predictor of output and inflation

15. Central banks generally recognise the value for policy makers of the (positive) empirical relationship between the yield differential (e.g. 10-year minus 3-month rates) with respect to real output 1 to 2 years ahead, though they often note that it may not necessarily be stable. For example, the Bank of Canada has a yield gap model among the set of main models used for setting monetary policy and preliminary OECD analysis suggests that a similar relationship for the euro area as a whole could hold (Figure 1).[6] The predictive power of the yield differential regarding inflation prospects differs considerably across countries. Often, it seems to be weaker than for output over the horizons of one to three years -- which is probably the most relevant for setting monetary policy. Medium-term inflation expectations are derived from different maturity sections of the yield curve, depending on the strength of the empirical relationship, though most are in the 2-6 year range.

6. OECD (1999).

Problems due to risk premia

16. The following examples highlight problems encountered by monetary authorities in the use and interpretation of information contained in yield curves. They illustrate how their use is limited by problems in disentangling the information content, *inter alia*, due to difficulties in actually identifying the determinants of several sorts of time-varying risk premia: those related to uncertainties about 1) credit/default risk, 2) regime shifts, 3) future inflation and 4) future real interest rates.

1. In Canada, the yield spread had consistently overestimated output growth and the bias was eventually linked to increased risk premia due to a burgeoning public debt.

2. For countries whose exchange rate and economy are influenced by those of larger neighbouring countries, such as some of the EU countries prior to the introduction of the euro, the yield curve has usually been less informative regarding domestic economic conditions.

3. Lower inflation expectations and, more recently, flights to quality following the crises in emerging markets, are likely to be partly responsible for the reduction in both US and euro area yield gaps in early1999 and, without accurate estimates of these effects, the implications for gauging future output growth are unclear.

4. Finally, the information content of Japanese implied forward rates may be distorted by the floor of zero for nominal interest rates.

A current illustration of the use of expectations indicators

17. Developments in the mature financial markets following the Russian and Brazilian crises can be used to illustrate one of the uses of the information content of the yield curve in gauging expectations regarding the future stance of monetary policy. Based on information on implied forward rates (from Bloomberg), US short-term interest rate expectations after the Russian crisis foresaw an approximately 50 basis points reduction by 1999 which should be compared with a total of 75 basis points that actually occurred prior to the end of 1998. Immediately after the Brazilian crisis, however, expectations regarding future interest rates remained relatively unchanged (Figure 2). Euro short-term interest rate expectations reflected much larger cuts following the Russian crisis, but, in the event, cuts of only 30 basis points occurred before the end of the year. However, after the Brazilian crisis, in contrast to US rates, expectations still reflected an additional near-term cut of 25 basis points (Figure 3), in large part related to domestic prospects, and a 50 basis point cut occurred in April 1999.[7]

Derivative instruments as measures of expectations and uncertainty

18. A more recent innovation has been the extraction of information regarding the degree and balance of risks surrounding prices of financial variables from option prices, e.g. on exchange rates and interest rates. The most widespread measures of risk used by monetary authorities are those of implied volatility, an estimate of the standard deviation of future price movements over the life of the option contract. Interest in implied volatility arises from the fact that it is more informative than historical

7. The implied forward curves for the United States and the euro area come from different sources, use interest rates from different markets and are derived using different techniques. The source for the United States is Bloomberg and for the euro area, the source is the ECB.

volatility, not only because it is forward looking but because it encompasses the range of expected, rather than actual, outcomes. Following the development of new techniques, central banks have turned to the derivation of estimates of even higher moments to help ascertain the balance of risks (i.e. not only measures of volatility). Taking this approach one step further, efforts are being made to derive the full probability density functions (pdf), so as to attach a probability to future individual outcomes (Box 2). Due to complications in derivation techniques and the lack of liquidity in many options markets, few monetary authorities appear to derive and publish pdfs on a regular basis (with the Bank of England, the Bank of Canada and, on occasion, the Swedish Riksbank being exceptions).[8]

Box 2. The derivation of measures of risk

The derivation of a probability density function (pdf) for interest rates and exchange rates from the information contained in options contracts is one of the newest techniques used by central banks. It provides more information than the implied volatility since the shape of the pdf can also be observed (skewness and kurtosis). The usefulness of this additional information is the ability to assess the balance of risks and the probability of extreme outcomes (the information contained in the "tails" of the pdf). This type of information is not contained in futures/forward rates since these are estimates of the expected (mean) values.

The derivation of a pdf from options contracts is complicated. Extraction techniques are relatively new and appear to differ among central banks (based on their technical papers). The techniques usually require making several simplifying assumptions. For example, non-parametric techniques for extracting the functional form require a sufficiently large set of options contracts of the same maturity and different exercise (strike) prices. Well-spaced exercise prices are necessary for this derivation; however, the most liquid ones are usually bunched near the actual price of the underlying asset (e.g. interest rate or exchange rate).*

To avoid some of these problems, a parametric form is typically assumed for the pdf. Most work attempting to extract probability density functions (pdfs) from options prices uses the weighted average of two lognormal distribution functions.**** It was generally acknowledged that both parametric and non-parametric methods run the risk of distorting the information content, especially that pertaining to extreme outcomes.

In addition, many of these techniques contain the simplifying assumption that investors are risk neutral. There is, however, an ongoing debate on the effects of this assumption, with some arguing that it will only shift the pdf, while others argue that it may also distort its shape.

In an effort to overcome these obstacles, the Bank of Japan studies the difference in the implied volatility between put and call options of the same maturity as a proxy for the skewness of the pdf (the implied volatility spread). This measure has the purported advantage that it is relatively easier to obtain. The value of an option called a "risk reversal" is a very similar summary statistic for the skewness of the pdf used by central banks (e.g. the Bank of Canada).

* A simple approach is to estimate individual points on the pdf. Each one is equal to the second derivative of the call price formula, which can be approximated by calculating the second difference of actual call prices divided by the differences of the respective strike prices.

** Empirical observations suggest that the implied volatility is "smile" shaped with respect to the exercise price. Specifically, more risk is connected to outcomes further away from the "at the money" exercise price. However, under the assumptions of the Black-Scholes option formula, the implied volatility of an option is constant for all exercise prices. This phenomenon suggests that parametric techniques should assume distributions with fatter tails than the lognormal distribution contained in the Black-Scholes methodology.

8. It should be noted, however, that the US Federal Reserve Board has played a leading role in developing and using these techniques.

Illustrations of the use of indicators of risk

19. Events at the time of, and following, the Russian crisis provide some illustrations of the information content of implied volatility as well. These measures show that implied volatility approximately doubled for short-term German interest rates, while that for comparable US interest rates almost tripled. There appears to have been a subsequent calming effect on this market following only the latest of the three interest rate cuts in the United States (November) and, to a lesser extent, the December cut in the euro region rates. The exception was a temporary blip in late December that was potentially linked to either the introduction of the euro or reflected year-end effects. Moreover, the respective volatilities did not pick up again by nearly as much following the Brazilian crisis (Figures 4 and 5). During the same period, the implied volatilities of the respective long-term interest rates did not increase markedly, perhaps reflecting a view that the turbulence was temporary. In contrast, the pick-up in long-term rates in Japan from end-1998 has been accompanied by higher volatility, which may reflect uncertainties pertaining to inflation risk and/or credit risk following the expansionary stance of monetary and fiscal policy (Figure 6). In the event, without the establishment of benchmark measures, based on data covering several cycles, an interpretation of these movements is made even more difficult.

20. A review of implied volatilities of the bilateral exchange rates of the yen and DM versus the US dollar during the period January 1998 to January 1999 indicates that exchange rate volatility increased by a much smaller degree than interest volatility following the start of this period of turmoil.[9] The exceptions are the period immediately following the crisis in Russia for the DM and the short period in early October when the yen appreciated markedly. This may suggest that the emerging market crisis influenced uncertainty in mature economies' credit markets more than that in their exchange markets, reflecting the expectations for a credit crunch that were set in train by the crisis (Figure 7).

21. As an example of the importance of the shape of the pdf, an examination of the Italian lira interest rates nearly one-year prior to the beginning of the third stage of the Maastricht treaty suggested entry with an average interest rate near to that of Germany. However, the pdf of the interest rate suggests that the financial markets placed significant probability on the extreme outcome of Italy not entering with the first group of countries (Figure 8). In another illustration, the contour of the pdf for short-term DM interest rates immediately following the August crisis in Russia reflected that the balance of risk had shifted towards a decrease in DM interest rates within the next 3 months (Figure 9).

Indicators of credit risk

22. Spreads between yields on government securities, swaps and corporate debt are among the indicators monitored closely by monetary authorities. They are interpreted as a signal of changes in credit risk and in liquidity premiums and are compared with an elaborate system of benchmarks, including those produced by the large rating agencies. Significant deviations in either direction can signal a dysfunctional market, while smaller ones can be signs of tightness or looseness of liquidity conditions.[10] For example, the spreads between corporate and government bond yields in Germany, Japan and the United States widened significantly from mid-August 1998, reflecting the flight to quality and a credit crunch on low quality credits (Figure 10, upper panel). Another example is the "Japanese premium", which reflects the

9 . For any comparison of implied volatility based on different underlying instruments, one may wish to normalise volatility, e.g. by dividing through by the mean.

10. The interest in corporate bond markets reflects the considerable development of alternatives to bank intermediation, such as bond and (small company) equity markets. However, the role of the credit channel and credit rationing in the transmission process is much debated, especially as the degree of credit rationing that exists is difficult to discern and is likely concentrated in smaller firms that depend largely on commercial bank credit. Reaching empirical conclusions is made difficult by the fact that credit demand is often counter-cyclical.

risk premium added to Japanese banks' borrowing cost in the euro-dollar market. The narrowing of this measure of Japanese bank credit risk in early 1999 has been interpreted by some market participants as a sign that the worst is over in that country's banking sector problems (Figure 10, lower panel).

V. Implications for monetary policy

23. Insofar as monetary policy formulation has become more eclectic, monetary authorities seem to generally conclude that it needs to be accompanied by more openness and transparency regarding the monetary authorities' actions and intentions, especially during the period before policy credibility has been fully established. Otherwise, the gain from the authorities' flexibility to react to nominal shocks entailed by a more eclectic policy setting may be offset by the introduction of an inflation bias in economic agents' expectations arising from concern that policies may be time inconsistent. As part of the policy of achieving a better understanding by the public of policy objectives and constraints, monetary authorities have adopted the practice of describing in more quantitative terms the uncertainty surrounding the attainment of their final objective. A well-known example is the Bank of England's "fan chart" denoting the probability of inflation deviations from the point target.

24. Monetary authorities generally agree that the expectations embedded in financial market instruments should not be a target. This would undermine their information content and, due to feedback properties involved in their formation (the Lucas critique, or Goodhart's Law), could lead to high variability of these expectations.[11] Moreover, even a less mechanistic use may be problematic to the extent that markets internalise the process by which the information is used for setting policy, thereby reducing the usefulness of these indictors due to similar problems. In order to reduce Lucas critique/Goodhart's Law type distortions, monetary authorities give priority to their own internally-derived projections, and avoid revealing precise rankings or descriptions of the role of specific financial indicators. That being said, the information content gleaned from financial indicators forms part of the monetary authorities' overall assessment of the economy. At a minimum, it provides cross checks and supportive information regarding the proximate causes of inflation, and/or early warning signals to complement conclusions from other (even model-based) projections.

25. In addition to their role in the assessment of the economy, financial market indicators appear to play an important tactical role, such as for the timing of moves. For example, if market expectations were at odds with the central bank's assessment, the central bank would make an effort not to surprise markets by signalling a move in advance through public statements. Central banks, which have traditionally been more credible, seem to pay less attention to such uses of financial market indicators, since the information they contain, especially regarding short-term developments, reflects this credibility and this makes their interpretation very difficult.

26. Monetary authorities that have explicit inflation targets appear to make the most widespread use of, and have the most research interest in, deriving information from financial market instruments (the Bank of England, the Bank of Canada and the Swedish Riksbank). Monetary authorities following more eclectic policies also appear to have a high level of interest in this type of information, as do the larger countries, in general, whose financial markets and economies are relatively more independent. However, those that had intermediate targets, whether exchange rates (EMU countries, excluding Germany, prior to 1999) or monetary targets (Germany prior to 1999 and Switzerland), seemed to place less emphasis on

11. A notable exception was Israel's targeting of market forecasts, but this strategy likely reflected a situation where the monetary policy lacked credibility. Another such example was the Bank of Italy's 1994 efforts at "credibility building" by purposely tightening monetary policy by more than was expected by the market.

these variables, though the former set of countries used to look carefully at measures of exchange rate credibility *vis-à-vis* the DM.

VI. Main conclusions

27. Monetary authorities have long looked at monetary and financial variables, *inter alia*, monetary aggregates, interest rates and exchange rates -- which form part of the early stages of the transmission mechanism. The deepening of government securities markets and the development of derivative markets have improved the availability of forward-looking data on financial market expectations and risk dispersions, most importantly, for movements in interest and exchange rates.

28. However, the use of these data varies among monetary authorities. In principle, financial market variables can provide additional information regarding the shocks that strike the economy, such as their perceived size and source, as well as the process of feeding through the economy. A complementary function is to gauge market anticipations and reactions to policy actions, including the credibility of policy objectives. Regarding policy setting, monetary authorities are clearly aware of the dangers of mechanically targeting this information, which could lead to circularities, however, they seem to find financial market indicators useful in evaluating policy credibility and in making tactical decisions.

29. It seems fair to say that monetary authorities are still feeling their way regarding the role for these newer financial market indicators. The most serious disadvantage of these indicators is the difficulty in disentangling their information content. They are often based on reduced-form or arbitrage relationships, with little theoretical underpinnings linking them to developments in activity and prices. Partly as a result, the relationships between them and the final target variables are often poor, as they change in response to regime shifts and other shocks. In addition, the extraction of the information content is highly sensitive to small changes in technical assumptions. Another factor for the lack of predictable links is that financial markets tend to overreact to news and are thus subject to herding and potentially to speculative bubbles. Moreover, idiosyncratic events, such as structural changes, or international developments feeding through to the domestic economy due to international capital mobility, are also likely to distort the information content. In sum, the information can be highly distorted by various time-varying risk premia, and only limited progress has been made in understanding it, leaving a large judgmental role to the monetary authorities in assessing the information contained in financial prices.

30. A major constraint to the use of the indicators obtained from derivatives is the underdeveloped nature of some of these markets. Derivative markets are liquid only in very short-term maturities, usually up to 15 months ahead for forward markets and 6 to 9 months ahead for options. These periods, while helpful, are usually not considered sufficiently forward-looking for monetary policy setting. Moreover, forward and options contracts are traded on both the over-the-counter (OTC) markets as well as on organised futures markets, such as LIFFE, CBOT, EUREX and CME. Obtaining information regarding OTC instruments is less straightforward than from organised electronically-traded futures exchanges and the contracts may be less uniform. Based on a recent BIS survey of derivatives markets, liquidity varies by instrument and currency, with the (notional) value of interest-rate related derivatives exceeding by far that for exchange rate ones, and more than half the contracts denominated in dollars (Tables 2 and 3). In sum, the instruments available for the purpose of extracting indicators of expectations vary widely and are relatively limited for the smaller countries, especially those not inside a common currency area.

31. Looking forward, one could draw the conclusion that further financial market development is critical to obtaining more confidence in the information contained in these instruments. If markets are not

liquid, the interpretation of these instruments can be made even more difficult due to the need to apply additional technical assumptions so as to extract the sought-after information. As time passes, and benchmarks are established for degrees of risk and perhaps even for types of risk premia, the role of these financial instruments may grow. However, to date, most instruments -- except the yield curve -- do not extend sufficiently past 1 1/2 years into the future, which is the usual time lag for the effectiveness of monetary policy. Moreover, financial markets could be affected by reduced issuance in the future in those countries which have improved their budgetary positions significantly. However, in the longer run, other, private sector, instruments could be used in their place.

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Table 1. **Details of selected inflation-indexed government bond markets**

Issuer	Australia	Canada	New Zealand
Instruments	Treasury Indexed Bonds (TIBs)	Real Return Bonds (RRBs)	Inflation Adjusted Bonds (IABs)
First issued	1985	1991	November 1995 (other series issued from 1977 through 1984)
Index	Consumer Price Index (CPI)	Consumer Price Index (CPI)	The All Groups consumer Price Index
Index lag	Two quarters	Two months	About two quarters
Amount outstanding	US$4 003 million (February 1996)	US$5 825 million (February 1996)	US$75 million (November 1995).
As per cent of total domestic debt outstanding	3.9 per cent (June 1995)	1.1 per cent (July 1995)	Less than one per cent
Secondary market turnover	Average daily turnover of US$21.9 million (1994) much lower than for non-indexed bonds.	US$109 million per month compared with $56.4 billion per month for nominal government bonds (1994)	Small
Bid/offer spread	>2 basis points (May 1997)	>C$0.10	>5 basis points

Issuer	Sweden	United Kingdom	United States
Instruments	Index-linked Treasury Bonds	Index-linked Gilts (IGs)	Treasury Inflation-Protection Securities (TIPS)
First issued	1994	1981	1997
Index	Consumer Price Index (CPI)	Retail Price Index (RPI).	
Index lag	Between two and three months	Eight months	Three months
Amount outstanding	95 billion kronor (June 1995).	£23.4 billion (March 1995).	US$47 billion (July 1998)
As per cent of total domestic debt outstanding	13 per cent (December 1998).	11 per cent in nominal terms	n.a.
Secondary market turnover	Small	Av. daily turnover of US$256.2 million (1994) much lower than for conventional gilts.	Small
Bid/offer spread	n.a.	£4/32 instead of £1/32 for liquid issues	n.a.

Note: Other OECD countries having issued indexed-linked bonds include Iceland and Mexico and, most recently, France since September 1998

Sources: Bank of England (1995), Campbell and Shiller (1996), Price (1997), J.P. Morgan (1997) and Dewald (1998).

Table 2. **Interest rate and currency derivatives on organised exchanges**
US$ trillion

	Organised exchanges			
	Turnover in notional amounts[a]			Notional amounts outstanding
	1992	1995	1997	at end-1997
Interest rate futures	141.0	266.3	274.6	7.5
On short-term instruments	113.3	218.2	223.2	7.1
Of which:				
3-month euro-dollar rates	66.9	104.1	107.2	2.6
3-months euro-yen rates	14.0	46.8	29.9	1.6
3-month euro-DM rates	7.5	18.4	25.3	1.0
3-month PIBOR	5.8	15.9	12.3	0.2
On long-term instruments	27.7	48.2	51.4	0.4
Of which:				
US Treasury bonds	7.1	8.7	10.1	0.1
Japanese government bonds	9.7	16.2	10.6	0.1
German government bonds	3.2	9.3	14.5	0.1
French government bonds	2.8	3.4	3.1	0.0
Interest rate options[b]	25.5	43.3	48.6	3.6
Currency futures	2.3	3.3	3.5	0.1
Currency options[b]	1.4	1.0	0.7	0.0

a) Notional turnover amounts capture the relative scale and growth of activity and provide rough measures of market transfer risk comparable with transactions in underlying markets. (BIS, 1998b).

b) Calls and puts.

Source: BIS (1998a).

Table 3. **Interest rate and currency derivatives on over-the-counter markets**

US$ trillion

	Over-the-counter markets (rounded values)			
	Notional amounts outstanding[a]		Gross market values[b]	
	March 1995	June 1998	March 1995	June 1998
Interest rate derivatives	26.6	42.4	0.6	1.2
FRAs	4.6	5.1	0.0	0.0
Swaps	18.3	29.4	0.6	1.0
Options	3.5	7.9	0.1	0.1
Up to 1 year	11.7	17.4	..	..
Between 1 and 5 years	11.5	16.8	..	..
Over 5 years	3.5	8.1	..	..
US dollar	9.3	13.2	0.2	0.3
German mark	3.4	6.5	0.1	0.2
Japanese yen	5.6	7.2	0.2	0.2
Other	8.4	15.6	0.2	0.5
Foreign exchange derivatives	13.1	18.7	1.0	0.8
Outright forwards and forex swaps	8.7	12.1	0.6	0.5
Currency swaps	2.0	1.9	0.3	0.2
Options	2.4	4.6	0.1	0.1
Up to 1 year	10.3	16.3	..	..
Between 1 and 5 years	2.1	1.8	..	..
Over 5 years	0.7	0.6	..	..
US dollar	10.7	16.2	..	0.7
German mark	3.3	4.7	..	0.1
Japanese yen	4.2	5.6	..	0.4
Other	7.9	11.0	..	0.4

a) Notional turnover amounts capture the relative scale and growth of activity and provide rough measures of market transfer risk comparable with transactions in underlying markets.

b) Gross market values have been calculated as the sum (in absolute terms) of the positive market values of all reporters' contracts and the negative market value of reporters' contracts with non-reporters (as a proxy for the positive market value of the latter's positions). It measures the replacement cost of all outstanding contracts, showing therefore the transfer of financial wealth which would have taken place if all outstanding contracts had been on that given date. All figures are adjusted for double-counting.

Source: BIS (1998b).

Figure 1. Yield spread as a prediction of real GDP growth in the euro area

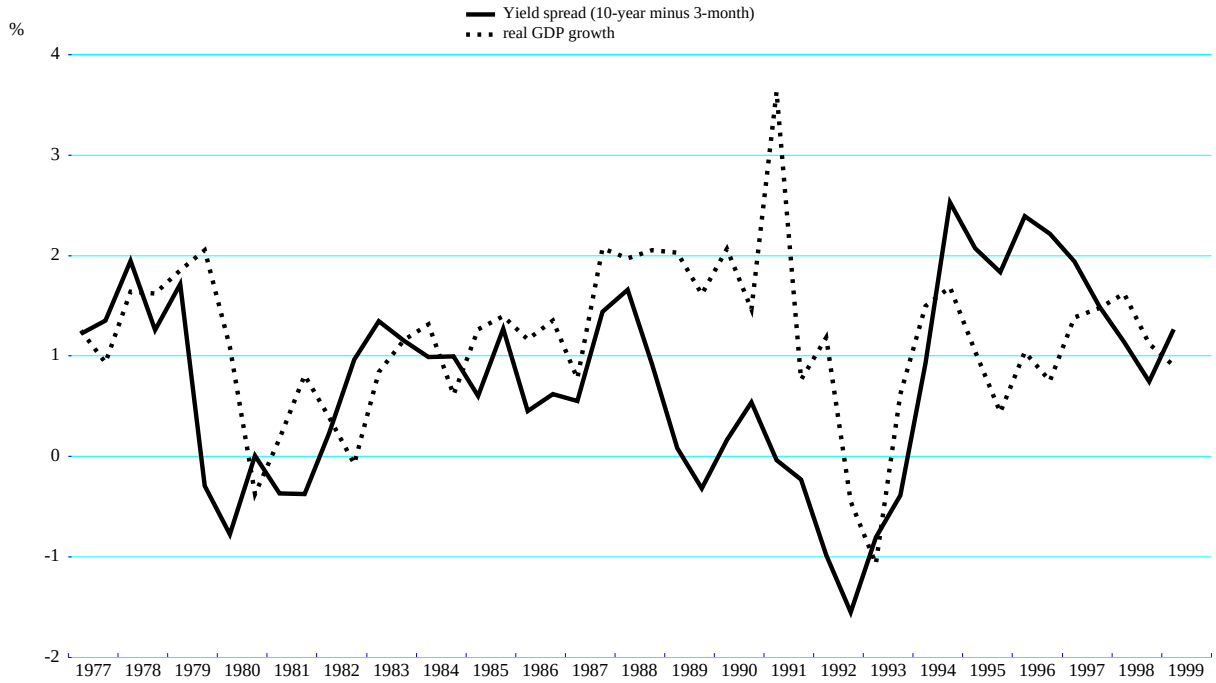
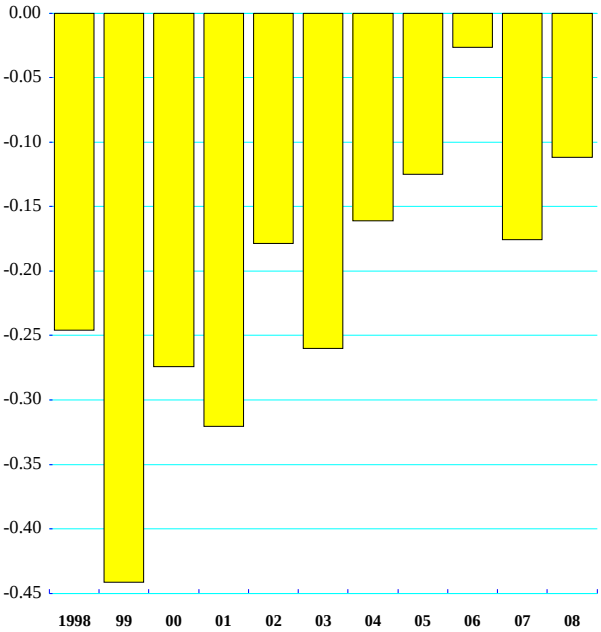
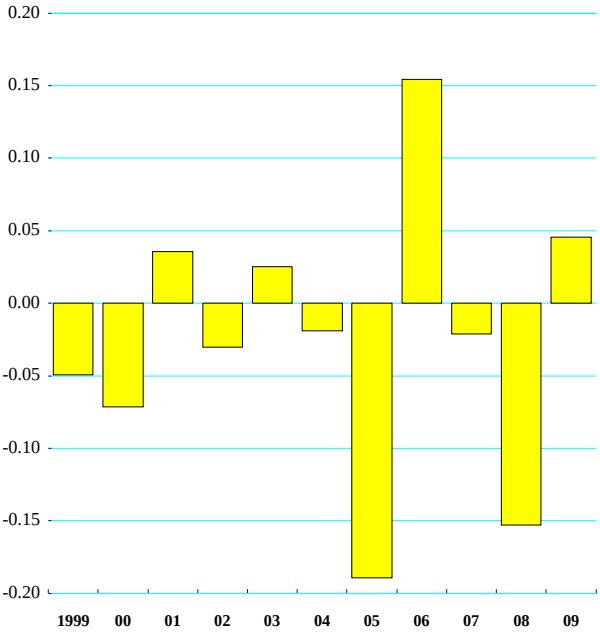


Figure 2. Implied US forward curves before and after Russian and Brazilian crises

Changes in implied forward rates around Russian crisis of August 1998 (1)



Changes in implied forward rates around Brazilian crisis of January 1999 (2)



Source : OECD Secretariat and Bloomberg.
1. Rates of 14 August minus rates of 4 September 1998.
2. Rates of 6 January minus rates of 27 January 1999.
Explanation : Bloomberg derives implied forward curves from swap curves.

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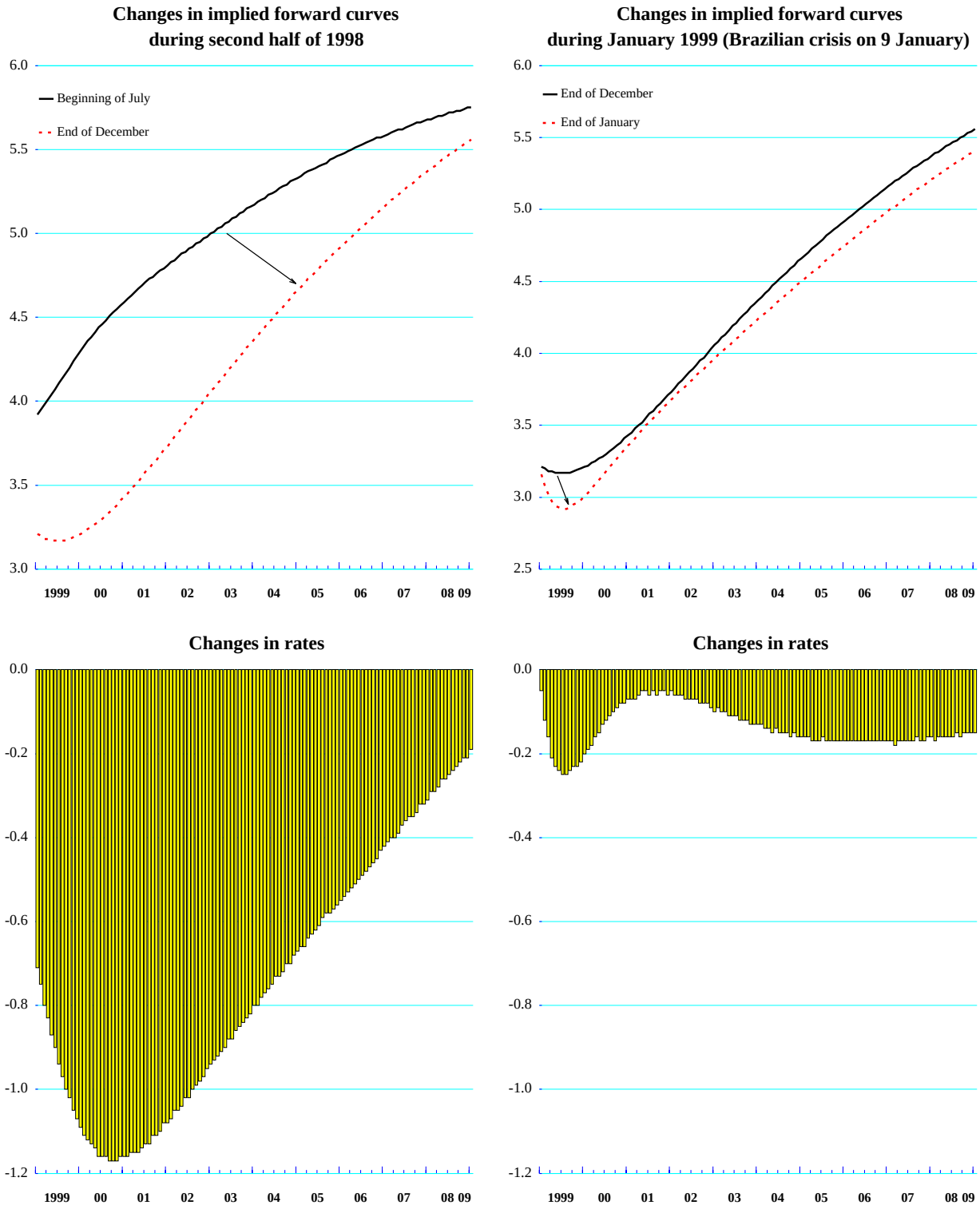
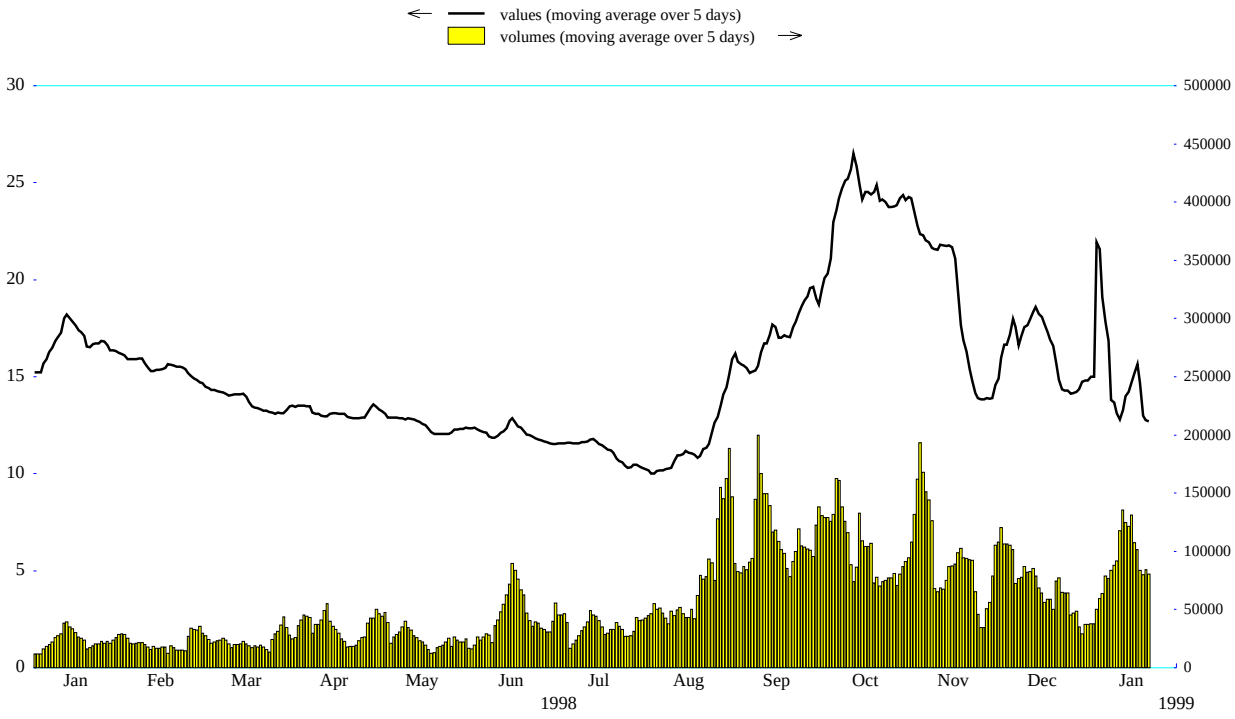
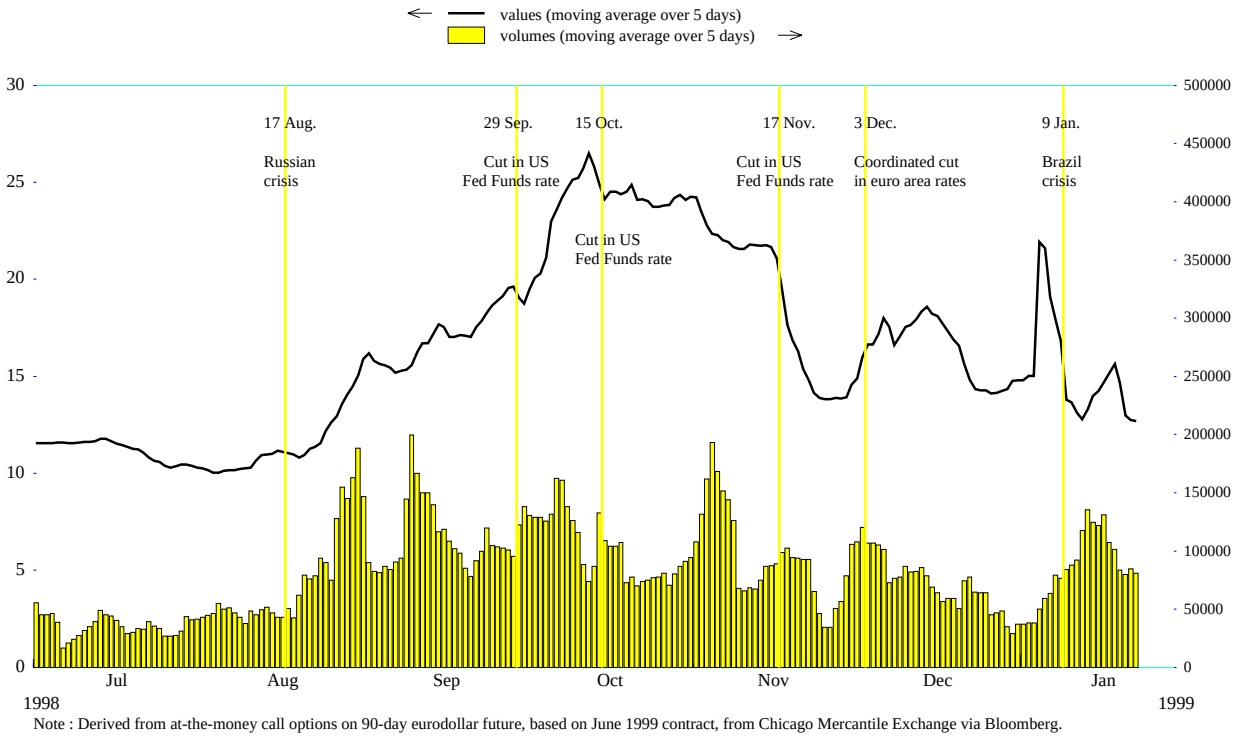
Figure 3. Implied forward euro area overnight interest rates



Source: ECB estimation using the method outlined in Svensson (1994); see also ECB (1999).

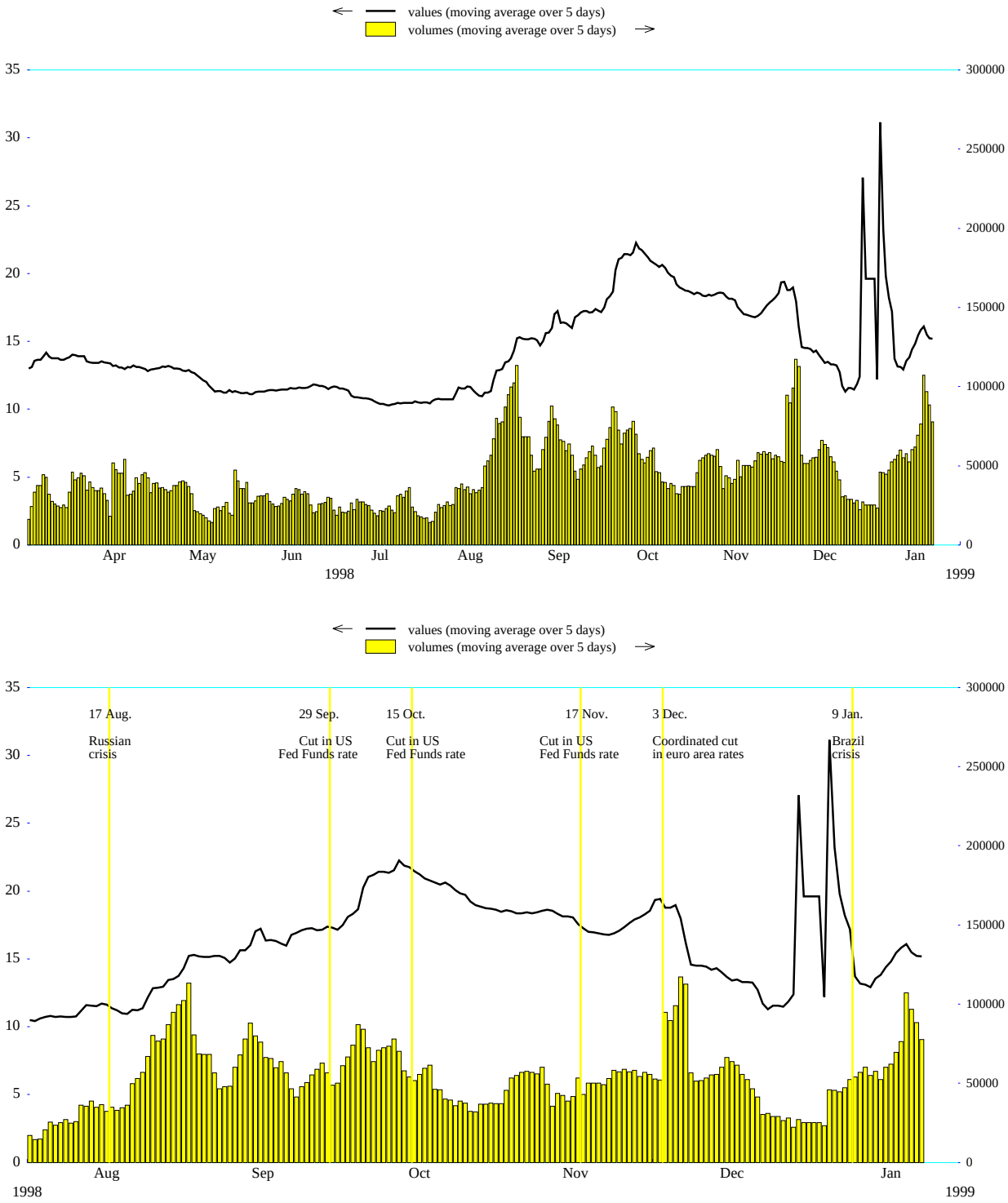
Figure 4 : Implied volatility for short-term eurodollar interest rates





Note : Derived from at-the-money call options on 90-day eurodollar future, based on June 1999 contract, from Chicago Mercantile Exchange via Bloomberg.

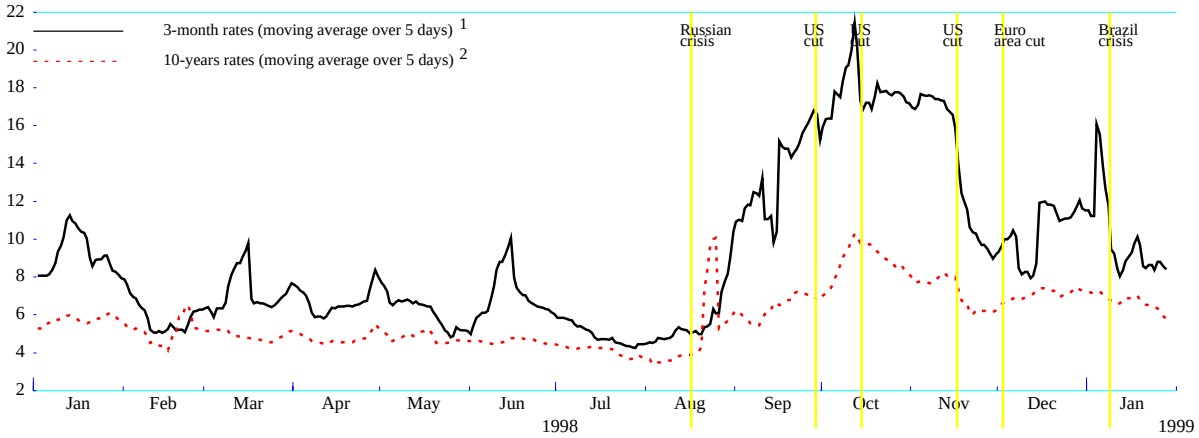
Figure 5 : Implied volatility for short-term German interest rates



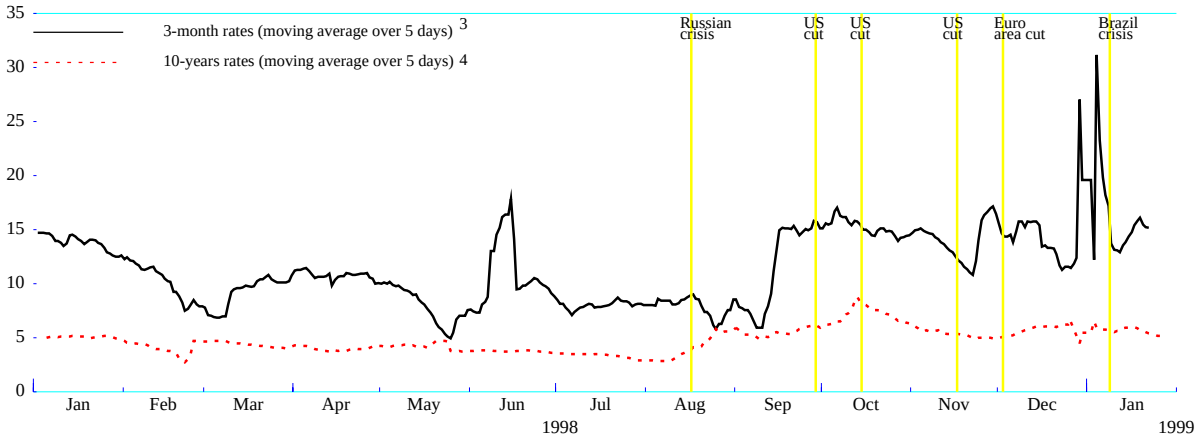
Note : From prices of at-the-money call options on 90-day DM future, based on March 1999 contract, from LIFFE via Bloomberg.

Figure 6 : Implied volatility on short-term and long-term instruments (from call options on generic interest futures)

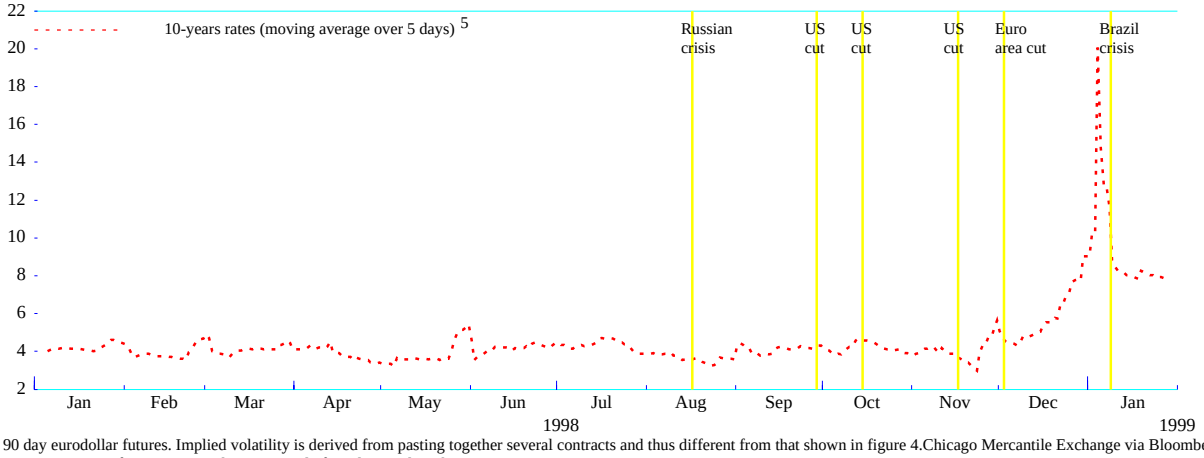
United States



Germany



Japan

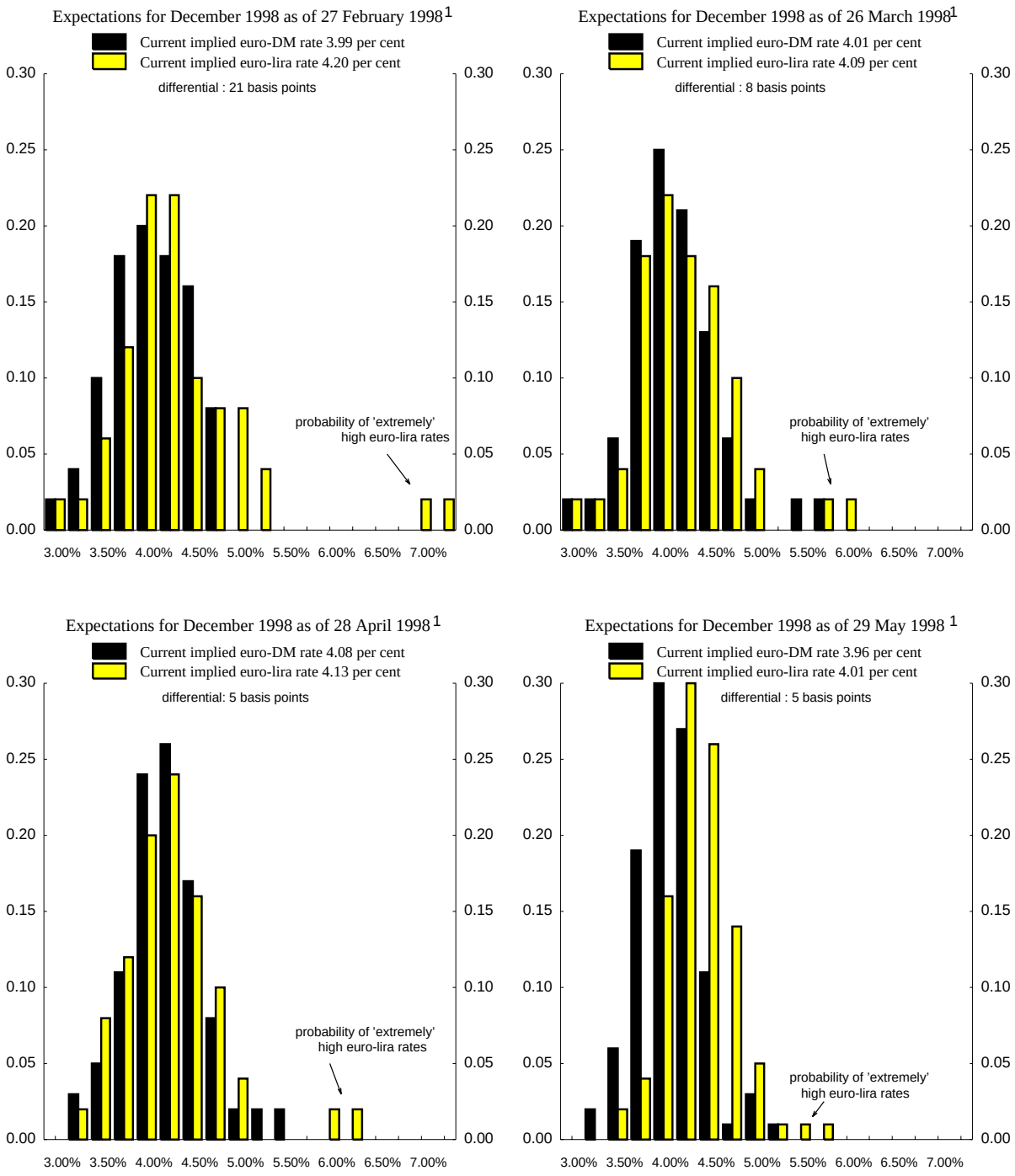


1) 90 day eurodollar futures. Implied volatility is derived from pasting together several contracts and thus different from that shown in figure 4.Chicago Mercantile Exchange via Bloomberg.
2) US 10-Year note futures. From Chicago Board of Trade via Bloomberg.
3) 3-month Euro-DM futures. Implied volatility is derived from pasting together several contracts and thus different from that shown in figure 5. From LIFFE via Bloomberg.
4) German 10-Year futures. From Eurex Deutschland via Bloomberg.
5) Japan 10-Year bond futures. From Tokyo Stock Exchange via Bloomberg.

Figure 7 : Future exchange rates and implied volatilities for the DM and the Yen versus the US dollar

Source : Chicago Mercantile Exchange.

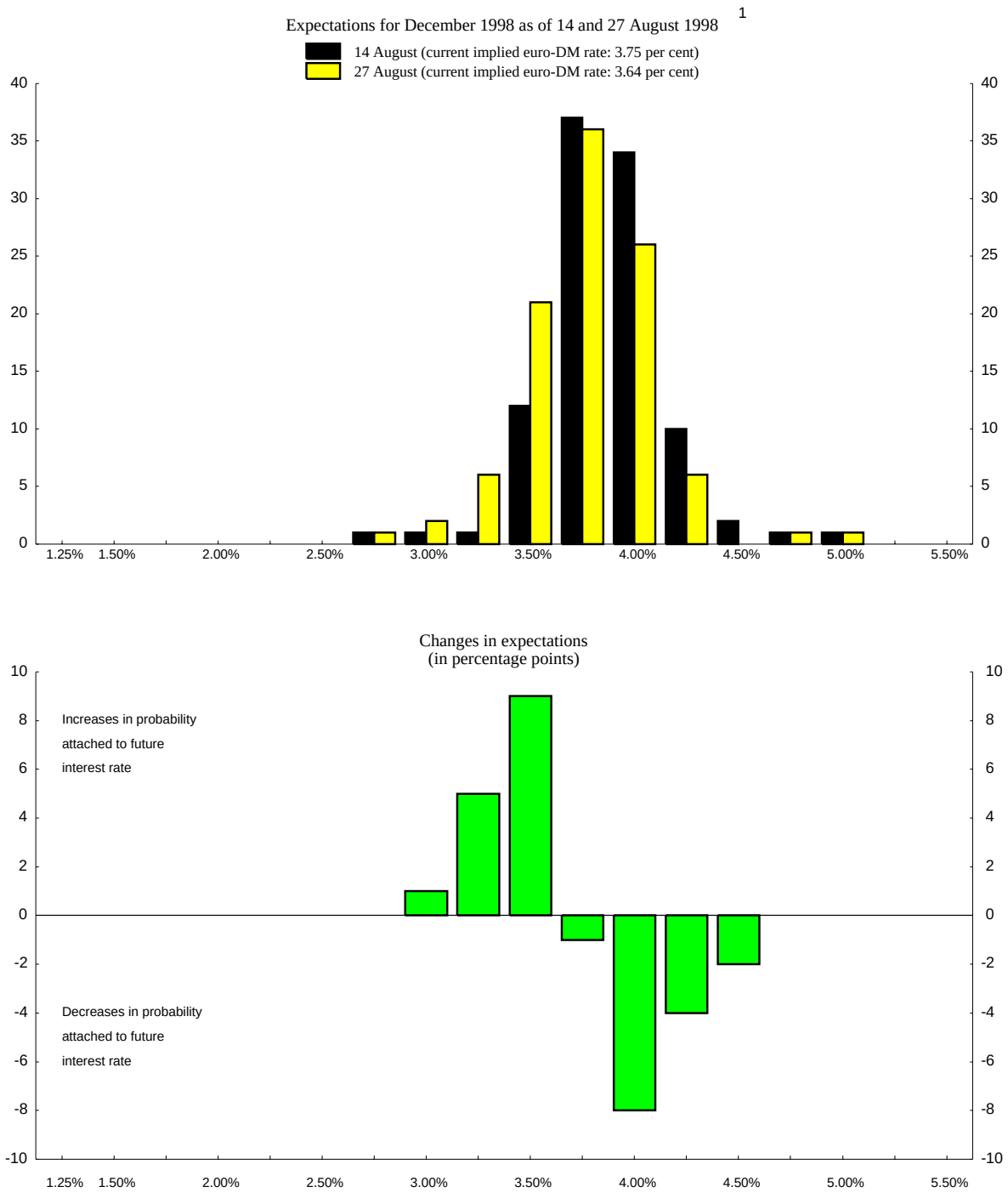
Figure 8. Convergence of interest rate expectations up to choice of EMU-members



1. Estimations of implied probability distributions of short-term euro-lira and euro-DM interest rate expectations are derived from premiums on options on three-month euro-mark and three-month euro-lira interest rate futures for December 1998. An approximate probability density function is obtained, as suggested by Neuhaus (1995), by a second-order difference quotient of the call option price with respect to the strike price.

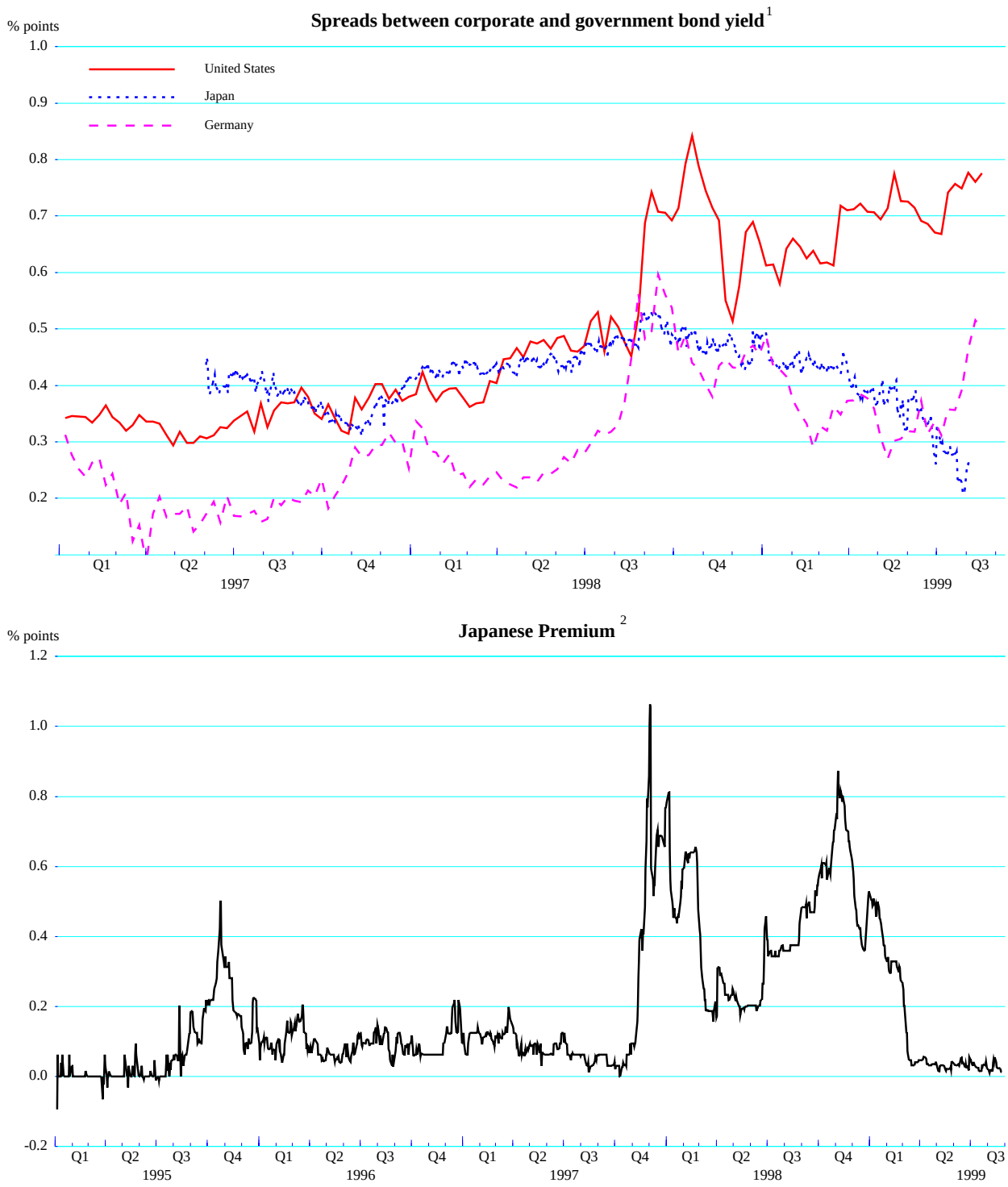
Source: OECD calculations based on raw data from LIFFE.

Figure 9. DM interest rate expectations before and after the Russian crisis



1. Estimations of implied probability distributions of short-term euro-DM interest rate expectations are derived from premiums on options on three-month euro-mark interest rate futures for December 1998. An approximate probability density function is obtained, as suggested by Neuhaus (1995), by a second-order difference quotient of the call option price with respect to the strike price.
Source: OECD calculations based on data from LIFFE.

Figure 10. Measures of credit risk



Sources: Bloomberg, Japanese Securities Dealers Association, Federal Reserve Board.

1). United States: AAA-rated paper; Japan: AAA bonds; Germany: Pfandbrief/kommunal 10-year. Government bond yields are for 10-year benchmark bonds.

2). The premium is calculated as the average of Mitsu, and Fuji euro-dollar interest rates minus the US Libor.

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