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The changing information content of market interest rates[1]

Most central banks rely on a variety of information sources in forming their outlook for the economy and, accordingly, assessing the stance of monetary policy. Important among those sources are quotes on financial market instruments, because they are critical links in the monetary policy transmission mechanism, because they embed expectations about the future course of monetary policy and the economy, and because they are available on a real-time basis. However, many different factors potentially influence the prices of financial instruments, including movements in risk-free interest rates, perceptions about the risks of various assets and changes in the value that investors place on liquidity. Thus, extracting information from those prices can be difficult.

This paper attempts to provide some insight into the behaviour of key long-term interest rates in the United States since 1993 by parsing their movements into those of more fundamental underlying factors. In particular, the analysis decomposes the variations in five key market rates into factors representing the risk-free interest rate, liquidity preference and credit risk, as well as idiosyncratic shocks to the Treasury and swap markets. Concentrating on these underlying factors, rather than the market interest rates themselves, brings financial market developments over that period into sharper focus.

The results indicate that the importance of individual factors has shifted in recent years, with significant consequences for the information content of market interest rates and, presumably, the appropriate investment and hedging strategies of private investors. Among other findings, it appears that Treasury yields have varied more as a result of shocks specific to that market in recent years, and that corporate yield spreads have increasingly been affected by factors other than credit risk.

[1] The authors are on the staff of the Board of Governors of the Federal Reserve System. The views expressed in this paper are those of the authors and do not necessarily represent the opinions of the Board of Governors or the BIS. A more extensive version of this paper appears in BIS (2002).

A decomposition of US market interest rates

Several factors influence key US interest rates

Our attempt to identify several fundamental factors that explain the yields on key US fixed income assets focuses on the rates on five different assets with maturities of around 10 years:

- An *on-the-run Treasury yield*, which is the yield on the most recently issued 10-year Treasury note. The amount of trading activity in this security is extensive, and its liquidity is remarkable.[2]
- An *off-the-run Treasury yield*, which is the par yield on a 10-year security derived from a smoothed yield curve estimated from the prices of off-the-run notes and bonds and some coupon strips.[3] While much less liquid than on-the-run issues, off-the-run Treasury securities are still quite liquid relative to other fixed income assets.
- An *agency yield* based on a security issued by the Resolution Funding Corporation (Refcorp).[4] This security is essentially free of credit risk (its coupon payments are backed by the full faith and credit of the US government and the principal payments are fully collateralised by Treasury securities), but it is much less liquid than Treasuries. The Refcorp security is particularly useful for our purposes because of its explicit risk-free status.
- A *swap rate* based on a 10-year interest rate swap, which is the fixed rate one would receive in return for making floating rate payments tied to Libor. Notional amounts of outstanding interest rate swap contracts have grown tremendously in recent years, and market liquidity is generally superior to that of even the most frequently traded corporate bonds.
- A *corporate yield*, which is based on the Merrill Lynch AA corporate bond index. This index is a weighted average of the yields on all outstanding corporate debt securities with a AA credit rating and maturities between seven and 10 years, where the individual securities are weighted by their market capitalisation. The liquidity of the corporate bonds included varies but is generally well below the other assets considered.

The decomposition that follows assumes that the yields on these fixed income assets are influenced by five unobserved factors. The analysis places restrictions on how the factors affect the interest rates considered, which allows the factors to be identified from the co-movements among the observed

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[2] For a more complete discussion of the Treasury market, see Dupont and Sack (1999).

[3] The smoothed yield curve is estimated following the method of Fisher et al (1995). It abstracts from the idiosyncratic features that sometimes affect individual securities and controls for the maturity and coupon of each issue. More details are available in BIS (1999).

[4] The specific security used is the October 2020 Refcorp bond, of which $5 billion were issued in 1990. Because the security is estimated to be about 90% stripped, we consider the yield on the principal strip from this security.

yields. Specifically, the factors are assumed to affect market rates as follows:

Factors include the risk-free rate, liquidity preference and credit risk ...

(i) The 10-year *risk-free rate* is assumed to affect all yields equally. Note that the risk-free rate is not measured by the Treasury rate alone, but is instead defined by the common movements observed across all market yields.

(ii) The *liquidity preference factor* is the only factor that affects the spread between on-the-run and off-the-run Treasury securities, as this spread represents a premium that investors are willing to pay for the greater liquidity of on-the-run issues. We interpret the liquidity factor as reflecting investors' preferences for liquidity rather than shifts in the amount of liquidity.[5] The influence of the liquidity factor on other market yields is determined by the correlation of movements in those yields with the yield spread between on-the-run and off-the-run Treasury securities.

(iii) The *credit risk factor* reflects changes in compensation for bearing credit risk, which could reflect shifts both in the perceived amount of credit risk and in investors' willingness to bear credit risk. This factor pushes up the yields on private securities relative to the risk-free rate by different amounts based on their credit risk. Note that movements in liquidity preferences and idiosyncratic shocks can also affect these spreads, though.

The final two factors are idiosyncratic shocks to Treasuries and swaps, which are identified because they impact only those particular securities:

... as well as idiosyncratic shocks to Treasuries and swaps

(iv) A decrease in the *idiosyncratic Treasury factor* pushes down Treasury yields relative to all other assets, causing all spreads relative to Treasuries to widen. This shock is distinguished from a credit risk shock because it has an equal impact on all spreads to Treasuries, whereas a credit risk shock has a differential impact according to the credit quality of the asset. The idiosyncratic Treasury factor may reflect any benefits to holding Treasury securities that are not shared by other assets, such as their transparency for balance sheet reporting or their widespread use as collateral in derivatives and repo transactions.

(v) The *idiosyncratic swap factor* is identified in a similar manner.

Three of the interest rates included in the exercise – on-the-run Treasury, off-the-run Treasury and Refcorp security – are free of credit risk, yet they can differ from each other considerably. According to the decomposition, one reason why the yields of these securities differ is the differences in their levels of liquidity. In fact, because assets are described by both their risk exposure and their liquidity, the risk-free interest rate can only be defined for an assumed

Assets are described by both risk exposure and liquidity

[5] In effect, we assume that the relative liquidity of on-the-run and off-the-run Treasury securities remained relatively stable over the sample. Of course, the liquidity of these and other securities considered may have shifted, but we do not address that possibility here.

level of liquidity. In the results that follow, we define the risk-free rate as corresponding to the liquidity level of the off-the-run Treasury security.[6]

Even adjusting for liquidity, there is still some difference between the Treasury rates and the risk-free rate, which indicates that some other factor is influencing these yields. In our exercise, we have assumed that this other factor is an idiosyncratic component of Treasury yields.[7] One implication of this assumption is that the risk-free interest rate is not simply given by the return on Treasury securities. Under our decomposition, an investor holding Treasury securities has exposure not just to the risk-free rate, but also to the idiosyncratic Treasury factor. This seems to accord well with recent history: investors holding Treasuries in recent years have clearly been exposed to the risks associated with changes in their supply, as discussed below.

The factors have significant effects on all the assets

The estimated parameters from the decomposition (not shown) are all significant with the expected signs.[8] In particular, the liquidity factor is found to push up agency, corporate and swap yields relative to Treasury yields, while the credit risk factor pushes up both corporate yields and swap rates relative to Treasury yields. Note that swaps are found to have exposure to credit risk, but with a loading on that factor that is only about half that of AA corporate bonds.

The behaviour of the underlying factors

With the model solved, one can describe financial market developments in terms of the underlying factors rather than in terms of market interest rates. The five factors derived from the decomposition are shown in Graph 1.[9] All data are weekly averages of daily rates and cover the period from 6 January 1993 to 5 September 2001.

The risk-free rate varied considerably over the sample

The risk-free rate varied in a fairly wide range over the sample, hitting its peak during the tightening of monetary policy in 1994 and falling to its low during the policy easing in autumn 1998. The other factors were relatively steady up to the first half of 1998, but they have become larger and more volatile in recent years. Three interesting phenomena are evident in these estimated factors, related to changes in their behaviour over time, the

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[6] As a benchmark for pricing other assets, one might want to construct a risk-free rate with the same liquidity loading as the asset being priced. Decomposing market rates into these fundamental factors allows one to do so.

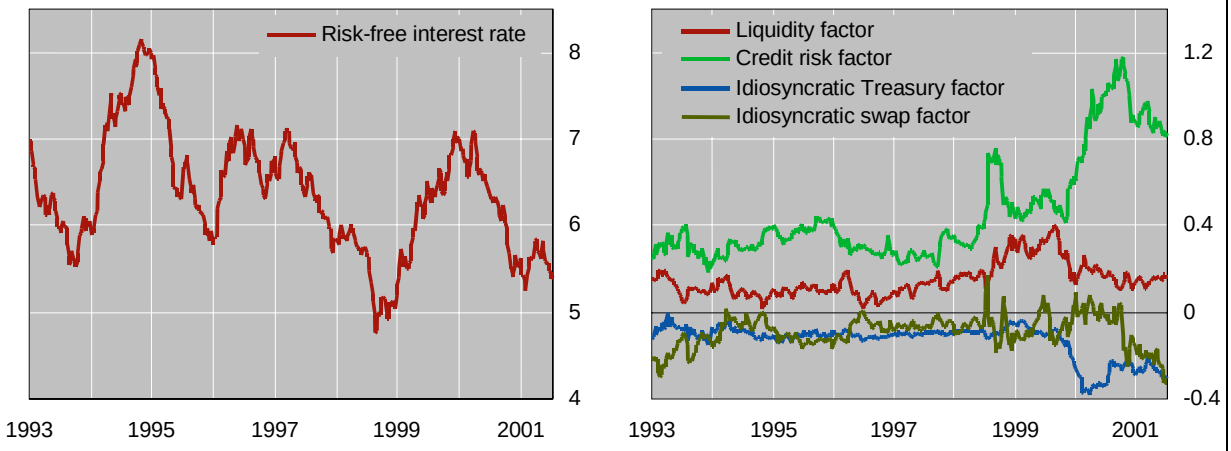
[7] We could alternatively have assumed that an idiosyncratic factor influenced agency yields, but our readings of the market are that Treasury securities had an important idiosyncratic component over the period, which motivated the structure of our model.

[8] For details on the procedure for solving the decomposition, see the more extensive version of this paper. The parameter estimates are given in Table 1 of that paper.

[9] If the factors identified truly represent fundamental influences on asset prices such as liquidity preference, credit risk and risk tolerance, then one would expect them to have some influence on the prices of a wider range of financial assets. One can measure the factor loadings of other assets simply by regressing their yields on our factor measures. In the more extensive version of the paper, we do so for the Merrill Lynch BBB corporate bond index.

The factors underlying market interest rates

In percentages



Graph 1

movement of the risk-free interest rate, and the varying role of credit risk premiums.

Changes in the behaviour of the factors in recent years

Other factors have become more volatile ...

The starting point for the shift in the behaviour of the factors appears to be autumn 1998. The events of that time are well known and have been generally described as a flight to quality.[10] In terms of our model, the flight to quality was evidenced by a sharp increase in both the liquidity preference and credit risk factors. But these factors continued to exert a sizeable influence on market interest rates even after the period of financial market turbulence. The liquidity preference factor remained elevated in 1999 before falling off to some extent in 2000. The credit risk factor instead widened considerably in 2000 in response to the slowing economy and falling stock prices. The idiosyncratic Treasury and swap factors have also become more prominent in recent years, as discussed in more detail below.

The upper portion of the table reports the average levels of all the factors, where the sample is divided into three subperiods to highlight the behaviour of the factors in recent years. The shifts in the size of various factors are evident from the bold entries. Moreover, as indicated in the lower portion of the table, the volatility of many of these factors has increased substantially in recent years. In particular, the liquidity factor was particularly volatile in the 1998–99 subperiod, while the idiosyncratic Treasury factor was more volatile over the period beginning in 2000. In addition, both the credit risk factor and the idiosyncratic swap factor were very volatile during both of the more recent periods.

[10] The events of autumn 1998 are reviewed in detail in CGFS (1999).

Recent behaviour of the factors

In basis points

	1993:1 to 1998:2	1998:3 to 1999:4	2000:1 to 2001:3
Average levels			
Risk-free rate	660	577	613
Liquidity	11	**28**	**16**
Credit risk	31	**51**	**90**
Idiosyncratic Treasury	–10	–9	**–28**
Idiosyncratic swap	–10	–7	–9
Average weekly changes			
Risk-free rate	8.0	8.6	7.5
Liquidity	1.0	**1.9**	**1.3**
Credit risk	1.6	**2.5**	**3.1**
Idiosyncratic Treasury	0.9	0.7	**1.3**
Idiosyncratic swap	1.3	**3.3**	**2.9**

... which accounts for the sharp rise in the volatility of spreads

The behaviour of these factors accounts for another interesting development in US fixed income markets in recent years – the sharp increase in the volatility of the yield spreads across many different US fixed income securities, as shown in Graph 2. The volatilities of these yield spreads jumped in the more recent subperiods to several times their earlier levels, even though the volatilities of the rates themselves changed only modestly. The factor decomposition offers some explanation of these patterns. The volatility of the risk-free rate – the common component of all yields – did not change much, thus keeping the volatilities of all of the market interest rates relatively steady. However, the increase in the volatilities of other factors in the more recent periods produced greater variation in yield spreads.

Tracking the risk-free interest rate

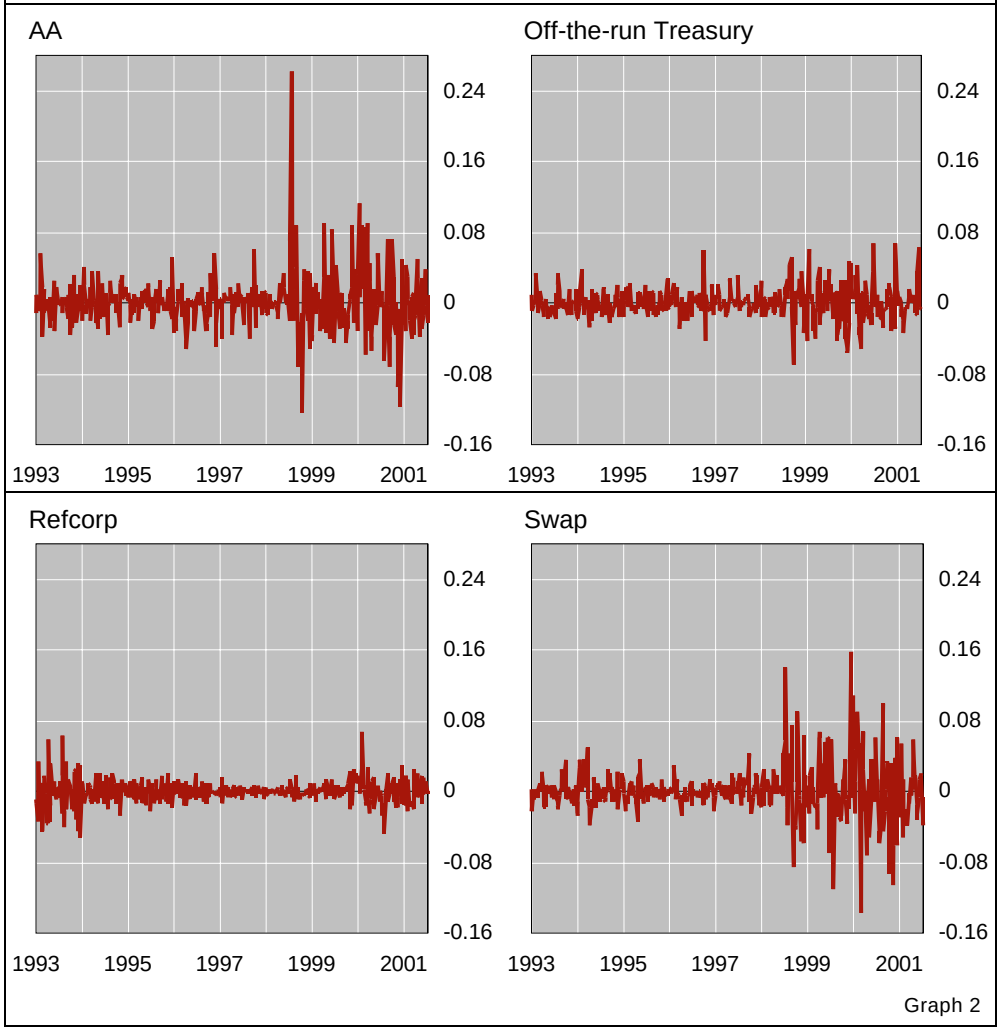
Greater idiosyncratic variation has pushed the Treasury yield away from the risk-free rate

Over much of the sample, the yield on the off-the-run Treasury security provided an effective measure of the 10-year risk-free interest rate. Recall that the Treasury yield deviates from the risk-free rate by the idiosyncratic Treasury factor. This factor was remarkably flat from 1993 to 1999, leaving the Treasury rate below the risk-free rate by a nearly constant amount, as is apparent from Graph 3.[11] However, as shown in the table, the idiosyncratic Treasury premium has become much larger since 2000, pushing the Treasury rate down relative to other market interest rates and increasing the wedge between the Treasury

[11] Because there is no idiosyncratic factor affecting the Refcorp yield, any portion of the spread between the Refcorp and the off-the-run Treasury yields not explained by liquidity must be attributed to the Treasury factor, which pushes it away from the risk-free interest rate by this constant amount. However, the more interesting focus of the model is on the movements in the factors, not on the constant terms.

Spreads versus on-the-run Treasury yields

In percentage points



Graph 2

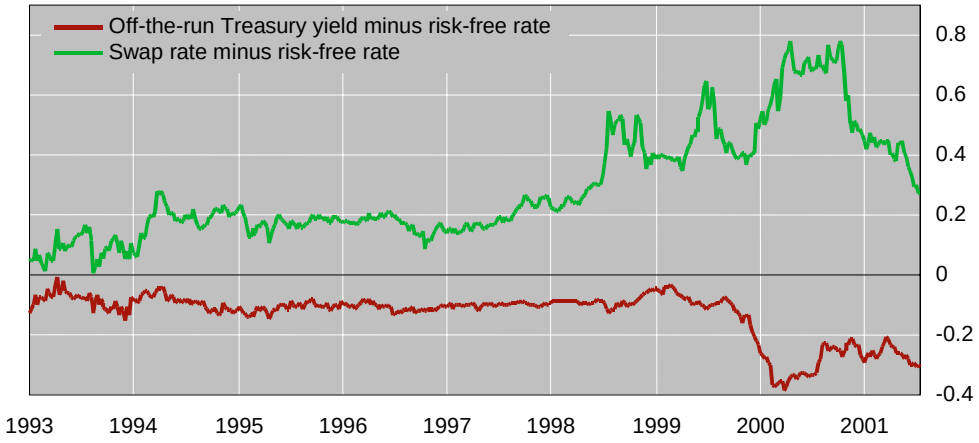
yield and the risk-free interest rate.[12]

The decline in Treasury yields relative to all other market yields in early 2000 may have resulted from a "scarcity premium" on Treasury securities. Indeed, the publication in early 2000 of the Congressional Budget Office's forecasts for sizeable surpluses over the coming decade and the Treasury's implementation of a debt buyback programme and other debt management decisions seemed to focus the market's attention on the possibility that the Treasury would pay down its outstanding debt over the coming decade. Concerns that Treasury securities would become increasingly scarce appeared

[12] A research report by Lehman Brothers (see Kocic et al (2000)) reaches a similar conclusion using a different methodology. They assume that the risk-free rate is a random walk and apply a Kalman filter approach, controlling for liquidity and credit risk in a manner similar to ours.

Tracking the risk-free rate: Treasuries versus swaps

In percentage points



Graph 3

to strongly affect the yields of those securities, particularly at longer maturities where fewer safe and liquid substitutes are available.[13]

The larger idiosyncratic premium on Treasury securities raises the question of whether some other asset could serve as a better proxy for the risk-free interest rate. Indeed, there has been considerable discussion about a possible transition to interest rate swaps as a "benchmark" for the pricing and hedging of other fixed income assets. Our results indicate that the swap rate is not a precise proxy for the risk-free rate but, rather, does include some compensation for credit risk, albeit less than most corporate bonds.[14] Indeed, the swap rate has deviated from the risk-free rate by more than the Treasury rate in recent years (Graph 3), reflecting the impact of the credit risk and liquidity factors.

The swap rate is not a precise proxy for the risk-free rate ...

Of course, the fact that swaps have some credit risk may be an important advantage in becoming a benchmark for the pricing and hedging of private instruments. Much of the discontent with intermediate- and longer-term Treasuries as hedging instruments began in autumn 1998, when the flight to quality discussed above pushed down Treasury yields and pushed up lower-rated corporate yields. Unlike Treasuries, swaps have exposure to both the credit risk and the liquidity preference factors, the two factors influenced by the flight to quality, which makes them more comparable to corporate bonds. Thus, swaps may well have provided a better hedge for corporate bonds during that period.

... but swaps may provide a better hedge for private debt instruments

Nevertheless, swaps appear to also have a significant idiosyncratic factor that reduces their effectiveness as a hedging instrument, and that component

[13] See Reinhart and Sack (2000) for a discussion of the implications of the paydown of US government debt.

[14] Conversely, Kocic et al (2000) argue that swaps have become a better proxy for the risk-free rate than Treasuries.

became larger in 2001 (Graph 1) for reasons that are not obvious. One conjecture is that the increased use of swaps as hedging instruments may have caused their rates to be increasingly influenced by the amount of corporate bond issuance or prepayment risk on mortgage-backed securities. In addition, the government-sponsored enterprises (GSEs) have reportedly been very active in the swaps market in recent years. Changes in their behaviour or strategies could introduce variation in swap rates that would be viewed as idiosyncratic in this model.[15]

It is possible that some of the idiosyncratic variation in Treasury yields has diminished more recently. Indeed, the fiscal outlook shifted substantially in late 2001 in a manner that should make the paydown in Treasury debt less rapid and more uncertain.

The determinants of corporate yield spreads

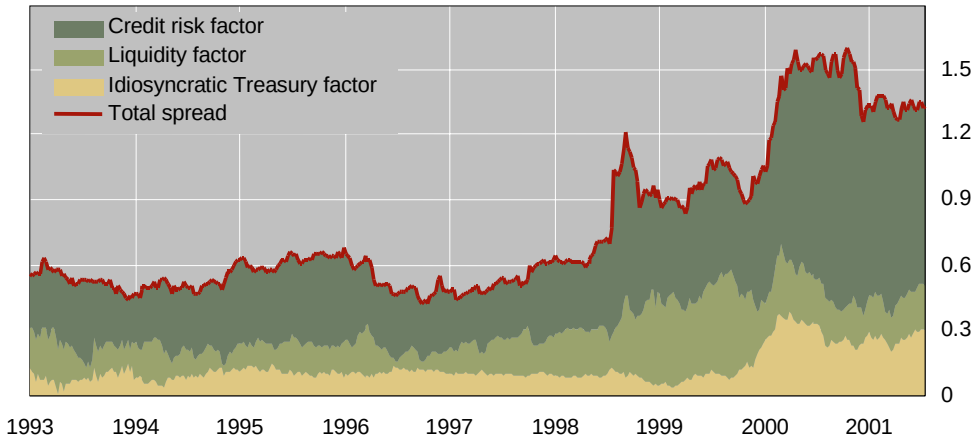
Corporate spreads are increasingly influenced by factors other than credit risk

Spreads between various yields have become harder to interpret in recent years because they have been increasingly influenced by a number of different factors. Graph 4 shows the factor decomposition for the AA corporate yield spread measured relative to on-the-run Treasury securities.

The credit risk factor accounted for a sizeable portion of the average yield spreads from 1993 up to the first half of 1998. The AA yield spread jumped higher from the second half of 1998 to the end of 1999, but the heightened preference for liquidity over this period contributed as much to the widening of the spread as did the increase in credit risk. Over the period beginning in 2000,

Decomposing corporate spreads

Decomposition of AA spread over on-the-run Treasury yields, in percentage points



Graph 4

[15] If we regress the yield on the 10-year Fannie Mae benchmark security since 1998 (the beginning of that programme) on the five factors, we find that the swap factor enters with a strongly significant coefficient. This supports the notion that there is some linkage between the swap factor and the behaviour of the GSEs.

the yield spread again increased sharply. According to the results, the credit risk factor accounted for most of the increase in spreads, although the idiosyncratic Treasury factor at that time added about 20 basis points to the average widening of spreads. Overall, these results emphasise the importance of considering factors other than credit risk for interpreting corporate yield spreads, as both liquidity and Treasury-specific factors have strongly influenced corporate yield spread movements in recent years.

Conclusions

This paper argues that movements in the fundamental factors influencing market interest rates are more informative than the market rates themselves. We derive five fundamental factors based on the co-movements of the yields on different types of US fixed income assets. Those factors offer a clearer interpretation of market events since 1993, which could potentially provide monetary policymakers with a more useful set of information for formulating appropriate policy decisions. Similarly, market participants would also benefit from understanding the fundamental factors driving movements in fixed income prices, which would allow them to more accurately assess the risks and potential rewards associated with their investment and hedging strategies.

Significant shifts in the importance of the underlying factors have taken place in recent years, with important consequences for interpreting market interest rates. Overall, the increased variation of a number of different types of shocks in recent years has made it more difficult to derive information from individual market rates or spreads. Two examples are highlighted in the paper: Treasury yields became increasingly separated from the risk-free interest rate, and corporate yield spreads were increasingly influenced by shocks other than credit risk. As a consequence, policymakers and investors should rely more heavily on using the co-movements in yields across a number of different securities to effectively identify movements in the fundamental factors that drive the markets.

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