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The emergence of new benchmark yield curves[1]

To properly guide decisions to borrow and invest in an economy, capital markets should incorporate all available information about the future prospects of borrowers and the willingness of investors to postpone consumption and take risks. The process by which prices in fixed income markets adjust to new information and move towards their equilibrium value is more efficient when market participants agree on certain instruments that can serve as references – or benchmarks – for pricing other securities. In recent decades, market participants have relied on government yield curves to assess the cost of funds at different borrowing horizons; price discovery about inflation prospects and other macroeconomic fundamentals occurred mainly in government securities markets. But private sector debt instruments, in particular collateralised obligations and interest rate swaps, also have the potential to serve as benchmark yield curves, and indeed are increasingly being used as such.

The benchmark role of government securities

Government securities are unique in financial markets

The benchmark status of government debt derives from a number of features that, when taken together, make government securities unique in financial markets. First, governments in most of the industrial countries are perceived to be the most creditworthy of borrowers; their securities are considered to be essentially free of the risk of default. For this reason, the government yield curve is widely regarded as the best proxy for the nominal risk-free rate. Second, the large amount of government debt outstanding and the fungibility of issues facilitate trading. Therefore, government paper, especially the most recently issued ("on-the-run") securities, tends to be more liquid than non-government paper. Third, owing to their large borrowing needs and long life, governments are able to offer a wider range of maturities than many other borrowers. This facilitates the construction of yield curves. Finally, the existence of well developed repo and derivatives markets for government

[1] This special feature draws extensively on a study undertaken by economists from six central banks plus the BIS on recent changes in the world's major fixed income markets. See *The changing shape of fixed income markets: a collection of studies by central bank economists*, *BIS Papers*, no 5, October 2001. The views expressed in this special feature are those of the author and not necessarily those of the BIS.

securities enables market participants to take short and long positions that reflect their views of future interest rate movements.

The usefulness of a yield curve as a benchmark for price discovery about macroeconomic fundamentals depends on the determinants of the term structure. The term structure should at any given time represent the market's current expectations of future short-term interest rates. In other words, no factors other than expected future spot rates should systematically affect forward interest rates. Empirical studies of the government yield curve tend not to support the pure expectations theory of the term structure. The forward rates embedded in government yields are affected by, in addition to expected future short-term rates, time-varying liquidity and term premia. In addition, different bonds have different convexities, and these convexity differences give rise to yield differences across maturities. Furthermore, idiosyncratic factors such as supply of and demand for specific securities appear to influence yields. For example, Hattori et al (2001) find that yields in the yen market vary with relative supplies of corporate and government bonds. Other studies find that absolute supply also matters (see below). Consequently, forward rates in government securities tend to be biased estimates of expected future spot rates.

Government yields are affected by a decline in arbitrage activity ...

In recent years, the importance of idiosyncratic factors in the determination of government yields has seemingly increased. The global financial market crisis of 1998 led many market participants, especially market-makers, to reassess their risk management practices (CGFS (1999b)). In particular, increased sensitivity to liquidity risk and to correlations across risks made dealers and other major players in bond markets less willing to engage in arbitrage activity. The demise of global macro hedge funds in the wake of the 1998 crisis – three of the most celebrated funds (Long-Term Capital Management, Tiger and Quantum) closed or restructured – is indicative of this change in investment philosophy (Graph 1 and Tsatsaronis (2000)). One consequence is that the pricing anomalies recorded in the right-hand panel of Graph 1, which had previously tended to disappear quickly, now last longer.

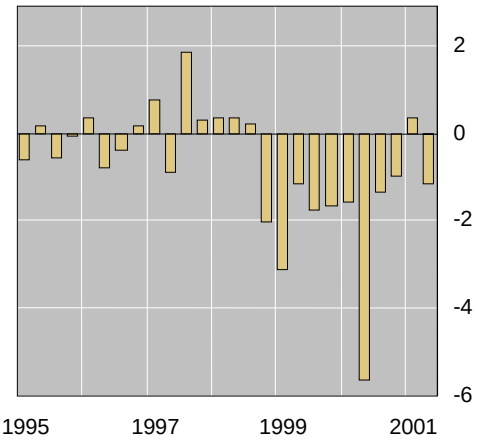
... a deterioration in liquidity ...

The 1998 crisis also highlighted the risks inherent in the use of government bonds and related derivatives to hedge positions in non-government securities – a routine strategy among dealers up until that time. Periodic breakdowns in the normally stable relationship between government and non-government yields had earlier forced market participants to re-examine their use of US Treasury bills as hedging instruments for private instruments in the dollar money market, eventually leading participants to reference the eurodollar rate instead (McCauley (2001)). The events of August–October 1998 triggered a similar process in bond markets. Among euro-based investors, the introduction of the single currency and squeezes in German government bond futures contracts reinforced this search for new hedging vehicles.[2] Each market participant who gives up using government

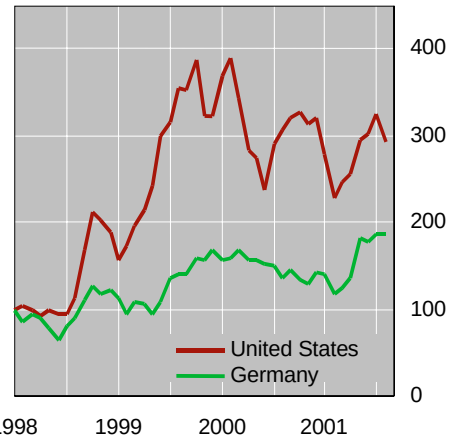
[2] Schulte and Violi (2001) analyse changes in European derivatives markets since the introduction of the euro and concerns about squeezes in bund and bobl futures contracts.

Yield curve arbitrage

Flows into global macro hedge funds[1]



Government yield deviations[2]



[1] In billions of US dollars. [2] Standard deviation of static spreads of all non-callable government bonds over a zero coupon yield curve; January 1998 = 100.

Sources: TASS Research; Datastream; BIS calculations. Graph 1

securities to hedge private instruments subtracts liquidity from the government debt market and adds it to non-government markets. In the self-reinforcing process whereby liquid markets become more liquid, this raises the incentive for other participants to do likewise. Various indicators confirm that liquidity has declined in the US Treasury and UK gilt markets (BIS (2001), Fleming (2001)). Government securities markets in the euro area and Japan, however, have retained, if not gained, liquidity.

... and supply shocks

Actual and prospective declines in the supply of government securities have further amplified idiosyncratic movements in government yields and impaired liquidity conditions. Since the mid-1990s, most industrial countries, with the exception of Japan, have made considerable progress towards fiscal balance. This has resulted in a substantial decline in government bond issuance, and even the retirement of debt in those countries with fiscal surpluses. For example, the outstanding stock of US Treasury securities fell by 15% between December 1998 and June 2001. Using swap spreads as a measure of the possible divergence between government bond yields and true risk-free interest rates, Cooper and Scholtes (2001) find some evidence that such declines depressed US Treasury and UK gilt yields below risk-free rates. Reinhart and Sack (forthcoming) decompose movements in 10-year US Treasury yields into several unobserved factors, including an idiosyncratic component to capture supply and other effects that impact only Treasury securities. They conclude that this idiosyncratic component has increased in recent years, and that as a result Treasury yields have become increasingly divorced from risk-free interest rates.

Corporate bonds compete for benchmark status

A benchmark yield curve need not be a risk-free curve

While government yields were, at least until recently, synonymous with nominal risk-free rates, a benchmark yield curve need not be a risk-free curve. Price discovery about macroeconomic prospects need not centre on an instrument that is itself devoid of risk. Liquidity is certainly crucial. Movements in benchmark yields should not be driven by order imbalances but rather should exclusively reflect new information about fundamentals. But the absence of a credit risk premium is not a prerequisite. To derive market expectations about macroeconomic developments, the risk premia embedded in forward rates need only be predictable.

Corporate bonds used to be benchmarks ...

In the past, when government securities markets were less developed than they are today, private sector debt instruments were commonly used to assess market expectations of future short-term interest rates and inflation. In the US dollar market in the 1950s and 1960s, market participants referred to bonds issued by top-grade corporations, in particular American Telephone and Telegraph, to gauge expectations of future interest rates. Similarly, in Japan during the same period, bank debentures and telegraph and telephone bonds effectively served as benchmarks. These bonds were not necessarily default-free instruments, but at the time the stable (regulated) nature of the issuer's business activities limited the volatility of any associated credit spreads.

In today's more liberalised commercial and financial environment, the credit ratings of even the highest-quality borrowers are occasionally downgraded. Issuers can employ various mechanisms to demonstrate their resolve to maintain the quality of their assets. Bond covenants might restrict significant alterations in the operational or financial risk characteristics of a firm, or coupon payments might be linked to the issuer's credit rating. Still, it seems unlikely that a market consensus will emerge that elevates the status of bonds issued by a particular private entity to that of a benchmark.

... and could be again

An index of yields on similarly rated bonds is more promising. Yield curves constructed from a population of comparable bonds are already the benchmark for pricing credit risk in the primary market. Furthermore, many asset managers benchmark their performance against an index. In principle, the benchmark role of fixed income indices could also extend to yield curves for pricing interest rate risk. A wide range of corporate bond indices has long been available, but to date none has gained broad acceptance among market participants in this latter role. Further improvements in their pricing and liquidity are necessary before they can become viable benchmark yield curves. To this end, consideration is being given to the construction of a futures contract based on a basket of corporate bonds.

Debt instruments issued by government-sponsored enterprises (GSEs) and supranational institutions are possible candidates for elevation. GSEs and supranationals are often as highly rated as the governments that support them. In an effort to improve the liquidity of their securities, several now mimic the US Treasury's issuance strategy of large, regular bond offerings at key maturities. Fannie Mae and Freddie Mac of the United States, Kreditanstalt für

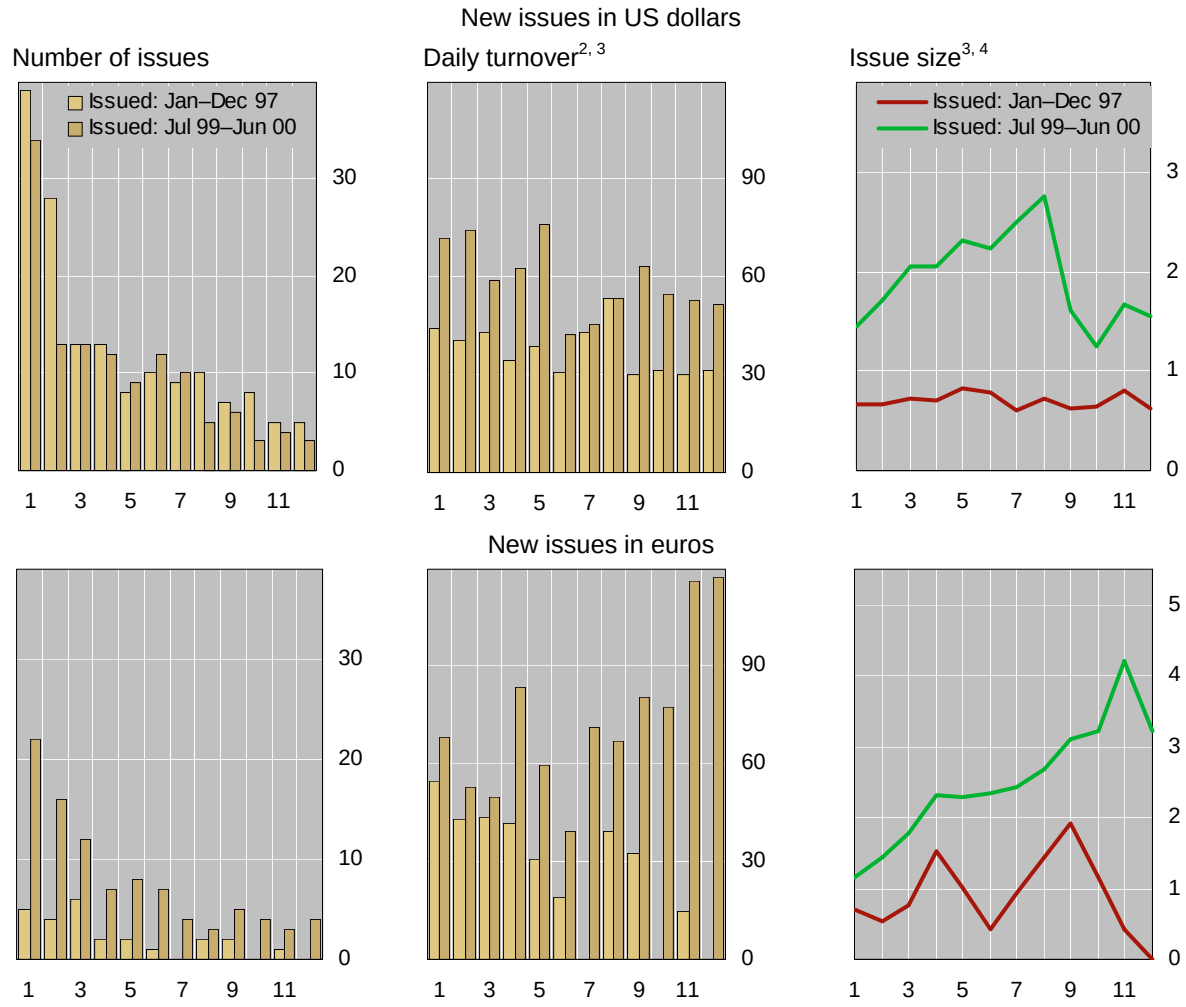
Wiederaufbau (KfW) of Germany, and the European Investment Bank (EIB) have all established so-called "benchmark" programmes in recent years.

Liquidity is concentrating in large, regularly offered bonds ...

There are some signs that such programmes are having the desired effect of concentrating liquidity. Graph 2 shows the trading cycle on Euroclear of newly issued US dollar- and euro-denominated bonds during successive months following the one in which they were issued. A relatively large number of bonds trade actively on Euroclear in the first month after they are issued. The number of bonds that trade actively in subsequent months rapidly diminishes, probably reflecting the unloading of inventories by underwriters. The trading cycle in the dollar market was already well developed in 1997, and there are no signs of a deterioration in the persistence of turnover in 2000. In the euro market, relatively few bonds issued in 1997 traded actively more than

Trading cycle of non-government bonds

New bond issues traded actively on Euroclear following the month of issuance[1]



[1] Excluding bonds issued under medium-term note programmes. Euroclear stopped publishing turnover data in January 2001 and so the July 1999 to June 2000 sample underestimates trading activity beyond seven months. [2] In millions of US dollars. [3] Average of all new issues traded actively during the month. [4] In billions of US dollars.

Sources: Euroclear; BIS (2001). Graph 2

a month after issuance. However, by 2000, several bonds were still trading actively up to 12 months after issuance, and the average daily turnover of such bonds had approximately doubled. Moreover, trading in the dollar and euro markets had concentrated in issuers who tapped the market on a regular basis for large amounts. The size of new dollar and euro issues that still traded actively several months after issuance was approximately twice as large in 2000 as in 1997: $2 billion versus $1 billion. The mix of names that traded actively was more clearly dominated by issuers with large borrowing requirements: in the US dollar market, Ford Motor Credit, the Inter-American Development Bank and the World Bank; in the euro market, Pfandbrief issuers (Depfa and Dexia), the Caisse d'Amortissement de la Dette Sociale, the EIB and KfW.

... but they have not yet gained acceptance as benchmarks

Despite these favourable trends in cash markets, activity in futures markets suggests that GSE securities have yet to gain broad market acceptance as benchmark instruments. After an initial period of rapid growth, the turnover of futures contracts traded on Fannie Mae and Freddie Mac securities quickly peaked at little more than 1% of the turnover of US Treasury futures. Furthermore, whereas the turnover of US government bond contracts picked up noticeably in the first quarter of 2001 following a surprise rate cut by the Federal Reserve, trading in agency futures stagnated. Futures contracts traded on Pfandbriefe met with a similar experience after their (short-lived) introduction in 1998.

The greater liquidity of government bond contracts partially explains the reluctance of market participants to switch from using Treasury futures to agency futures. Owing in part to the existence of liquid repo and securities lending markets, transaction costs for positioning and hedging with government securities are frequently lower than the costs associated with other instruments, and so government securities remain attractive positioning and hedging vehicles. Another reason for the reluctance to switch is the continuing debate about the scope of government involvement in the activities of GSEs and supranationals.[3] Such debate contributes to uncertainty about future credit spreads on their securities.

Collateralised debt is the benchmark at short maturities

Averages of yields on collateralised obligations could be used to construct benchmark yield curves. In the major debt markets, interest rates in the general collateral repo market are already widely regarded as the benchmark yield curve at very short maturities (CGFS (1999a)). The importance of repos is evidenced by their use as monetary policy instruments by many central banks.

[3] For example, concerns had emerged in the early part of 2000 about the credit standing of Fannie Mae and Freddie Mac after proposals were introduced in the US Congress to remove their government credit lines and local tax exemptions. This legislative pressure abated towards the end of the year when Fannie Mae and Freddie Mac undertook to raise their capital ratios and improve their disclosure practices.

Repo rates are benchmark yields at very short maturities ...

Risk-free instruments, in particular government securities, have historically been the preferred form of collateral in repo transactions. However, in principle, other instruments could substitute for government securities. In a report on the uses of collateral in wholesale financial markets, the Committee on the Global Financial System (2001) suggests that securitisation techniques could be applied to develop substitute instruments with high credit quality and liquidity. Furthermore, the steps that non-government issuers such as Fannie Mae and Freddie Mac are taking to enhance the transparency and liquidity of their securities could make them more attractive as collateral. Improvements in risk management and market structure could also ease the use of collateral bearing higher issuer and liquidity risks.

The primary difficulty with using repo rates as benchmarks is their illiquidity beyond the very short term. Repo markets in the industrial countries are typically liquid out to about three months (12 months in the United States), and so expectations extracted from the term structure of repo rates are unlikely to be accurate at longer maturities. In the euro market, there is the added difficulty that an integrated repo market does not yet exist. National repo markets have become more closely connected since the launch of the euro, but types of collateral, prices and liquidity conditions still differ in each market (ECB (2001); Schulte and Violi (2001)).

... and ABSs and MBSs could fulfil a similar role at longer maturities

Features of the broader collateralised debt market might argue in favour of using yields on asset- and mortgage-backed securities as benchmarks. First, ABSs and MBSs are among the most liquid non-government securities available: for example, Mastroeni (2001) finds that bid-ask spreads for Jumbo Pfandbriefe compare favourably with those of German government bonds. Second, maturities can extend out to 30 years or more. Third, ABSs and MBSs are often structured such that the risk of default is minimal. Finally, repo markets for Pfandbriefe and other forms of collateralised debt are beginning to develop. The US Federal Reserve's decision in 1999 to expand the pool of collateral eligible for use in repo operations to include agency MBSs should accelerate this process.

A significant drawback of using ABSs or MBSs as benchmark instruments, however, is that prepayment risk and other embedded options can make it difficult to back out interest rate expectations. Furthermore, market participants sometimes disagree about how to assess the credit risk of these instruments. Pfandbriefe are the most prominent example. When rating Pfandbriefe, Standard & Poor's focuses principally on the quality of the collateral. Moody's, on the other hand, also stresses the creditworthiness of the issuing bank. Moody's argues that because of the dynamic nature of the pool backing the security – new assets are added to replace loans that are repaid – it is not possible to monitor the collateral without also monitoring the bank managing the assets.

Interest rate swaps are increasingly used as benchmarks

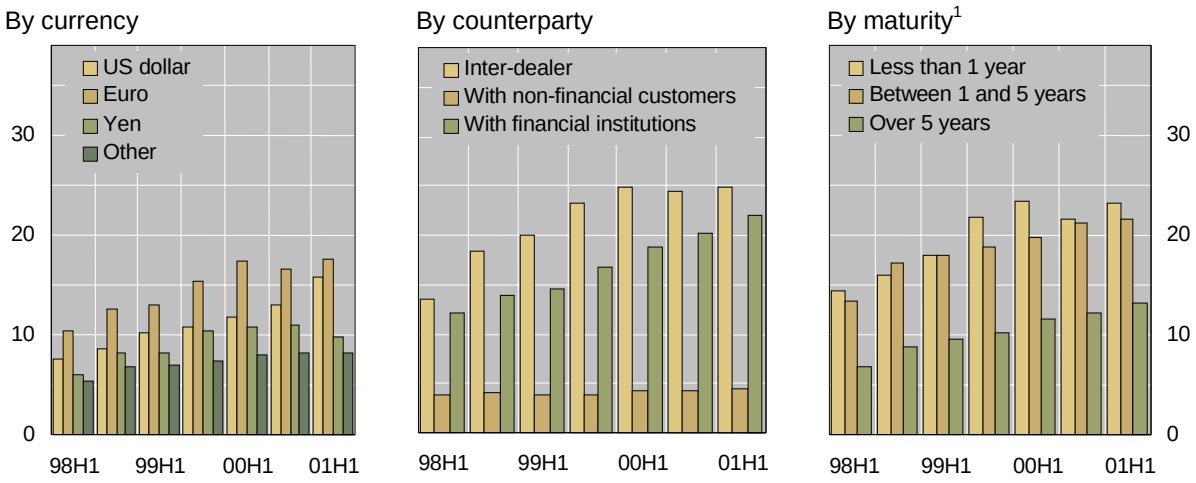
Liquidity and credit premia in swaps have declined ...

Another possible benchmark yield curve is the fixed rate leg of interest rate swaps. Historically, the credit risk of swap dealers was a concern, and liquidity conditions beyond short maturities were relatively poor. Since the mid-1990s, the establishment of AAA-rated derivatives subsidiaries and various risk mitigation techniques, including margining and collateralisation, have allayed many of the concerns about counterparty credit risk (Remolona et al (1996)). The liquidity premia embedded in interest rate swaps have also declined, with tighter bid-ask spreads and greater market depth accompanying the rapid growth of the swaps market in the late 1990s. Liquidity is still greatest at the short end of the curve. Indeed, swaps referenced to the euro overnight index average rate (EONIA) are now the most liquid segment of the euro money market (ECB (2001)). But as is evident in the right-hand panel of Graph 3, the longer-term segment is becoming more widely traded.

The range of players using interest rate swaps continues to expand. This can be seen from the growth of the dealer-customer segment (financial institutions and non-financial customers) depicted in the centre panel of Graph 3. Commercial and investment banks were perhaps the first investors to make greater use of swaps as benchmark yield curves. The liabilities of most banks are based on a short-term interbank rate such as Libor or Euribor. Therefore, banks tend to benchmark prices against the swap curve, which embodies expectations of future Libor or Euribor. End investors with investment portfolios in multiple currencies and large borrowers with funding programmes in multiple currencies have also gradually started to talk in terms of yield spreads relative to swaps rather than government paper. Whereas differences in government securities markets complicate cross-country comparisons of government yield curves, swap curves offer a reasonably simple way of comparing returns

Interest rate swaps

Notional amounts outstanding, in trillions of US dollars



[1] Includes forward rate agreements, which account for approximately 15% of the total notional amount outstanding.

Source: BIS. Graph 3

or borrowing costs across markets. Today even governments are beginning to use swaps to manage their risk exposures. The shift towards swaps is farthest advanced in the euro market, where investors quickly realised the advantages of referencing one euro swap curve instead of choosing from among 12 government yield curves. The dollar swaps market is quickly catching up.

... but further declines could depend on the migration of swaps trading to an organised exchange

Nevertheless, the attractiveness of the interest rate swap curve as a benchmark yield curve is diminished by the structure of the market. Trading in the interest rate swap market – indeed, in all over-the-counter markets – is dominated by a few highly rated dealers. The swap market thus probably labours under higher transaction costs and remains less liquid than it might be if swaps were traded on an organised exchange (McCauley (2001)). Steps have been taken in this direction, but at present exchange-traded activity accounts for an insignificant fraction of global swaps trading. Also, because they are based on unsecured interbank deposit rates, swap rates remain susceptible to changes in the credit quality of banks. For example, the low credit standing of Japanese banks adds to uncertainty about the future path of yen swap rates, and so deters market participants from using yen swaps as benchmark yields.

Conclusions

Price discovery is shifting from a single (government) market to a range of (non-government) markets

As a result of changes in fixed income markets triggered by the events of 1998, shifts in supply and the introduction of the euro, government securities are no longer the pre-eminent benchmark instrument that they were just a few years ago. Over time, market participants will settle on only one benchmark yield curve; the market saves on resources if price discovery is concentrated in only one homogeneous instrument. But at the present juncture, a multiplicity of instruments are competing for benchmark status, and no single yield curve has yet emerged as the locus for positioning and hedging in interest rate risk.

As the long-dominant benchmark, government securities retain many advantages. Foremost among these is their tremendous liquidity. Even if liquidity conditions in some government securities markets have deteriorated, they remain better than in most other fixed income markets. But repo rates have already displaced government yields as benchmark yields at the very short end of the yield curve. Further improvements in the liquidity and structure of collateralised obligations and interest rate swaps could enhance the attractiveness of these instruments as benchmarks at longer maturities too.

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