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Financial Market Implications of the Federal Debt Paydown*

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Abstract

U.S. Treasury securities fill several crucial roles in financial markets: they are a risk-free benchmark, a reference and hedging benchmark, and a reserve asset to the Federal Reserve and other financial institutions. Many of the features that make the Treasury market an attractive benchmark and reserve asset are likely to be adversely affected by the paydown of the federal debt and recent developments suggest that this may be happening already. Market participants are responding by moving away from Treasuries as a reference and hedging benchmark towards agency debt securities, corporate debt securities, and interest rate swaps. The Federal Reserve is taking steps to adjust its portfolio and should be able to do so with minimal implications for monetary policy.

JEL classification: H63; G14; E52; G12; E43

Keywords: Treasury market, benchmark, reserve asset, liquidity

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Introduction

The fiscal situation of the U.S. government has improved markedly in recent years. The government ran consecutive budget surpluses in fiscal years 1998 and 1999 for the first time in over 40 years and is projected to run a record \$211 billion surplus in fiscal year 2000.¹ As shown in Figure 1, the surpluses have led the Treasury Department to start paying down the debt, with marketable Treasury securities outstanding falling from \$3.5 trillion on March 31, 1998 to \$3.0 trillion on July 31, 2000. Moreover, the Office of Management and Budget (OMB) projects that continuing surpluses will cause the debt held by the public to be fully redeemed in 2012.²

The debt paydown raises concerns as U.S. Treasury securities are central to the implementation of monetary policy and to financial markets more broadly. Treasury securities are the primary asset of the Federal Reserve and the instrument through which permanent changes in reserves are implemented. The securities are also a benchmark for risk-free interest rates and a reference and hedging benchmark for other fixed-income securities. The debt paydown thus raises questions as to the implications for monetary policy and the market's benchmark roles. The introduction of the debt buyback program in January 2000 and the striking inversion of the Treasury yield curve heightened interest in these questions and spurred discussion as to which assets might be suitable Treasury substitutes.

This paper starts by reviewing the many critical roles of U.S. Treasury securities in financial markets. As Treasury securities are free from default risk and highly liquid across a wide range of issues, the securities are a benchmark for risk-free interest rates. Well-developed derivatives markets that enable investors to sell Treasuries short combine with the securities' liquidity and creditworthiness to make them a reference and hedging benchmark for other fixed-income securities. Due to their creditworthiness and liquidity, Treasury securities are a popular reserve asset to numerous financial institutions and the primary asset of the Federal Reserve.

¹ "Mid-Session Review," Office of Management and Budget, June 26, 2000.

² Debt held by the public includes both marketable and nonmarketable securities and totaled \$3.4 trillion as of July 31, 2000. It excludes debt securities held as assets by U.S. government accounts (\$2.2 trillion as of July 31, 2000), but includes Federal Reserve holdings.

The paper argues that many of the features that make the U.S. Treasury market an attractive benchmark and reserve asset are likely to be adversely affected by the debt paydown. In fact, recent events are suggestive of reduced Treasury supply disrupting the market and may be indicative of future disruptions. In February 2000, for example, the Treasury announced that the issuance frequency of the one-year bill would be reduced from every four weeks to every 13 weeks. As the last bill auctioned on the old cycle aged, it became very expensive to borrow in the repurchase agreement (RP or repo) market. On May 31, for instance, a dealer had to lend out funds at a 2.25% annual rate in order to secure the one-year bill as collateral. The liquidity of the issue in the cash market also suffered, with bid-ask spreads widening and trading volume plunging. At the same time, the issue became extremely expensive relative to other Treasuries with similar maturities and relative to similar maturity non-Treasury instruments.

The paper then explains how market participants are moving away from U.S. Treasury securities as a reference and hedging benchmark towards agency debt securities, corporate debt securities, and interest rate swaps.³ These other instruments are liquid (albeit not as liquid as Treasuries), the debt securities can be borrowed in reasonably active repo markets, and a futures market was recently introduced for agencies (and is being discussed for corporates). Furthermore, the credit risk in these instruments gives them the potential to be better hedging vehicles than Treasuries as it can result in them trading more closely with other fixed-income securities that also have credit risk. Agencies and swaps, in particular, are increasingly used to hedge positions, price new securities, and evaluate existing securities in U.S. fixed-income markets.

Finally, the paper explains the steps the Federal Reserve has taken in response to the debt paydown. At its March 2000 meeting, the FOMC endorsed a “broad-gauge” study of the issues associated with the System's asset allocation.⁴ It also disclosed that until the study's completion the Fed could rely on temporary operations to meet reserve needs that could not comfortably be met with outright

³ The benchmark uses of the Treasury market, implications of the federal debt paydown, and the viability of alternative benchmarks are also discussed in Fleming (2000a).

⁴ Minutes of the Federal Open Market Committee: March 21, 2000 (<http://www.bog.frb.fed.us/fomc/MINUTES/20000321.HTM>).

purchases of Treasuries. In fact, the Federal Reserve already relies on short-term RPs and matched sale-purchase transactions (MSPs) to temporarily add and drain reserves rather than outright purchases and sales of Treasury securities. A declining stock of Treasuries should therefore not be problematic for the Federal Reserve's implementation of monetary policy.

It is possible, of course, that the projections of the OMB will prove inaccurate. Lower than expected growth, higher than expected spending, or lower than expected revenues could all cause significantly smaller surpluses and a correspondingly smaller paydown of the debt. Alan Auerbach and William Gale, for example, are much less optimistic than the OMB about forthcoming surpluses.⁵ Congressional Budget Office (CBO) projections are more optimistic, but assume that some debt will remain outstanding regardless of the surpluses since longer-term securities will not be available for redemption.⁶

Even in the absence of funding needs, the government could still choose to issue Treasury securities and accumulate private sector assets with the proceeds. The government would benefit from low funding costs as it met market demand for safe and liquid securities, and it would be helping to maintain the infrastructure of the Treasury market for potential future funding needs. The policy could be implemented by allowing Social Security funds to be invested in non-Treasury instruments, as has been recently proposed, or it could be implemented through another government entity. Such a policy has its drawbacks, however, as it means that the government would be allocating credit, assuming credit risk, and potentially influencing the institutions in which it invested.

Despite the uncertainties about the magnitude of the debt paydown, it remains likely that much of the outstanding marketable Treasury debt will be paid off over the next decade. Even if the projected surpluses do not materialize as projected, the stock of marketable Treasuries has already fallen significantly and it is on a steep downward trajectory that is unlikely to quickly reverse. Moreover, evidence suggests that the Treasury market has already been affected by the paydown, that market

⁵ Auerbach and Gale (2000).

⁶ "The Budget and Economic Outlook: An Update," Congressional Budget Office, July 2000.

participants are moving away from Treasuries as a hedging and reference benchmark, and that the Federal Reserve is taking steps to adjust its portfolio in expectations of a further paydown.

U.S. Treasury Market as a Benchmark and Reserve Asset

A number of features contribute to the U.S. Treasury market's prominent role in financial markets. Treasury securities are backed by the full faith and credit of the U.S. government and are therefore considered to be free of default risk. The creditworthiness and supply of Treasury securities have contributed to an extremely liquid round-the-clock secondary market with high levels of trading activity and narrow bid-ask spreads.⁷ In the first six months of 2000, for example, daily trading activity reported by the primary government securities dealers averaged \$207 billion per day.⁸ Treasuries also trade in an extremely active repo market in which dealers can borrow securities and finance their positions, as well as in an active futures market in which dealers can buy and sell securities for future delivery.⁹

As Treasuries are considered to be free of default risk, yields on these securities represent risk-free rates of return. These risk-free rates are used in a variety of analytical applications to forecast interest rates, inflation, and economic activity. Arturo Estrella and Frederic Mishkin, for example, show that the yield spread between the three-month Treasury bill and the ten-year Treasury note is valuable in predicting recessions.¹⁰ The rates are also used as risk-free benchmarks in the analysis of other fixed-

⁷ Fleming (1997) describes the round-the-clock market and Fleming (2000b) analyzes trading activity, bid-ask spreads, and other Treasury market liquidity measures. More general descriptions of the Treasury market include Dupont and Sack (1999) and Fabozzi and Fleming (2000).

⁸ Federal Reserve Bank of New York (<http://www.ny.frb.org/pihome/statistics/msytd.00>). Primary dealers are firms with which the Federal Reserve Bank of New York interacts directly in the course of its open market operations. As the trading volume data is collected from all of the primary dealers but no other entities, trades between primary dealers are counted twice and trades between non-primary dealers are not counted at all.

⁹ A repo is an agreement to exchange collateral for cash with a simultaneous agreement to buy back the collateral at a specified price at some point in the future. A dealer owning a particular Treasury note, for example, might agree to sell that security to another dealer while simultaneously agreeing to buy back the security the next day. The first dealer can thus use the repo market to finance its positions, often at a favorable rate, while the second dealer can use the repo market to borrow and then sell securities it does not hold in its portfolio. For a lengthier introduction to repos, see Duffie (1996) and Jordan and Jordan (1997).

¹⁰ Estrella and Mishkin (1998).

income and non-fixed-income markets. In estimating the capital asset pricing model, for example, the rate of a U.S. Treasury bill is typically used as a proxy for the risk-free rate.

While the creditworthiness of Treasury securities is essential to their use as a risk-free benchmark, the securities' liquidity across a wide range of issues is also important. In an illiquid market, bid-ask bounce or temporary order imbalances can cause significant price moves. The liquidity of the Treasury market, in contrast, ensures that observed prices are close to the market consensus of where prices should be and that changes in prices reflect revisions in the market consensus. Similarly, in a less integrated market, securities with similar cash flows might trade at very different prices. However, liquidity across Treasury issues, facilitated by the futures, repo, and zero-coupon (STRIPS) markets, helps ensure that Treasury securities with similar cash flows trade at similar prices, and that prices are only minimally affected by issue-specific differences in liquidity, supply, or demand.¹¹

Treasury securities are also used extensively as a reference and hedging benchmark for other U.S. dollar fixed-income securities. An estimated \$500 billion in adjustable-rate mortgages, for example, is referenced against the Treasury's one-year constant maturity rate.¹² Similarly, when a fixed-rate corporate debt issue is initially sold, it is typically marketed in terms of a yield spread to a particular Treasury security rather than at an absolute yield or price.¹³ Treasuries are also used as hedges to manage investors' interest rate exposure. A dealer might sell Treasuries at the same time it agrees to buy a block of agencies from one of its customers, and then buy back the Treasuries as the agency position is sold off. In this way, the dealer's exposure to changes in interest rates that are common to both Treasuries and

¹¹ For a recent analysis of Treasury market integration, see Bennett, Garbade, and Kambhu (2000).

¹² Sarah Landis, "Adjustable-Rate Mortgages Face Effect of the Elimination of One-Year Bills," *Wall Street Journal*, August 14, 2000. The one-year constant maturity rate is interpolated from the daily yield curve based on market quotations obtained from the Federal Reserve. Additional detail on the series is available at <http://www.bog.frb.fed.us/releases/H15/update/>.

¹³ In contrast, floating rate issues are typically marketed and priced relative to the London Interbank Offer Rate (LIBOR), the short-term rate charged among banks in the Eurodollar market. An August 1999 issue of DaimlerChrysler AG, for example, had a three-year floating-rate portion marketed relative to LIBOR along with five-year and ten-year fixed-rate portions marketed relative to comparable Treasuries (Gregory Zuckerman, "Under Boom Economy, Strain Over Debt," *Wall Street Journal*, August 18, 1999, p. C1).

agencies is eliminated. The ability to hedge in the Treasury market increases dealers' willingness to make markets and take positions in other markets, and thereby improves the liquidity of these other markets.

To be an attractive reference benchmark, Treasury yields should tend to change in line with those of other securities. In bringing a new corporate issue to market, for example, Treasuries are used as a reference because Treasury yield changes are highly correlated with corporate yield changes. The liquidity of the Treasury market, the rarity of large idiosyncratic Treasury price changes, and the fact that much of a fixed-income security's interest rate exposure is common with that of a comparable maturity Treasury security have historically made Treasuries an attractive reference benchmark. The simplicity and familiarity of Treasury securities undoubtedly contributes to their popularity as a reference benchmark.

Treasury yields should also tend to change in line with those of other securities to be an attractive hedging benchmark, although liquidity and active repo and futures markets are also required. By definition, a hedge should mitigate one's interest rate exposure to a position by having a return that is highly and negatively correlated with the original position's return. Market liquidity is essential, as hedgers must be able to quickly buy and sell large positions with minimal transaction costs. As hedging frequently involves taking short positions, the ability to borrow securities at a low cost in the repo market or sell securities for future delivery in the futures market is also necessary.

The creditworthiness and liquidity of Treasury securities has also made them central to the implementation of monetary policy. In order to maintain the federal funds rate around its target level, the Federal Reserve adjusts reserve balances through open market operations. "Permanent" additions to reserves are conducted through secondary market purchases of Treasury securities and totaled \$45 billion (par value) in 1999 alone.¹⁴ As of August 3, 2000, Federal Reserve Banks held \$524 billion in U.S.

¹⁴ Domestic Open Market Operations During 1999, Federal Reserve Bank of New York (<http://www.ny.frb.org/pihome/annual.html>). These operations are termed "permanent" because they are intended to address permanent changes in the supply of or demand for balances at the Fed and because they permanently affect the size of the Fed's System Open Market Account. "Temporary" operations, in contrast, are used to address shorter-term movements in the supply of or demand for balances.

Treasury securities, representing 17% of outstanding marketable Treasuries.¹⁵ Temporary additions to reserves are conducted through intervention in the repo market. In these operations, the Fed effectively loans out funds for a period of one to 90 days while accepting Treasury securities, agency securities, or mortgage-backed securities as collateral. To temporarily drain reserves, the Fed enters into a MSP in which it effectively borrows funds for one to 90 days while providing a Treasury bill as collateral.

The creditworthiness and liquidity of U.S. Treasury securities also makes them a popular reserve asset of other financial institutions. As of August 2, 2000, foreign official and international accounts held \$615 billion in Treasury securities at Federal Reserve Banks, or 20% of outstanding marketable securities.¹⁶ These institutions' willingness to hold assets in U.S. dollars rests at least partially on their ability to invest in safe and liquid Treasuries. Likewise, domestic depository institutions held \$235 billion in U.S. Treasuries as of March 31, 2000 or 7% of outstanding marketable securities.¹⁷ Holding safe and liquid assets like Treasury securities gives these institutions the ability to meet their customers' unexpected liquidity needs by quickly selling such assets, if necessary.¹⁸

U.S. Treasury Market Implications of Paying Down the Federal Debt

As only a small fraction of the federal debt turns over each year, what might appear as a modest paydown to date has already resulted in substantial reductions in new issuance. Issuance sizes have been reduced (e.g., those of bills in March 1997), issuance frequencies have been reduced (e.g., that of the five-year note in 1998), and some issues have been eliminated altogether (e.g., the three-year note in 1998).¹⁹

¹⁵ System Open Market Account Holdings (<http://www.ny.frb.org/pihome/statistics/>), excluding the effects of sales under MSPs.

¹⁶ Federal Reserve Statistical Release H.4.1, Factors Affecting Reserve Balances (<http://www.bog.frb.fed.us/releases/H41/>). Foreign investors as a whole held \$1.2 trillion in U.S. Treasury securities as of June 30, 2000 or 40% of the marketable outstanding on that date (Treasury Bulletin, September 2000).

¹⁷ Treasury Bulletin, September 2000.

¹⁸ Saidenberg and Strahan (1999) discuss this "buffer stock" approach to providing liquidity in their analysis of bank lending during the financial market turmoil of fall 1998.

¹⁹ Significant debt-management changes are typically announced at the Treasury's Quarterly Refunding Press Conferences. The press releases for such conferences are posted at <http://www.treas.gov/press/releases>. Also see Dupont and Sack (1999), U.S. General Accounting Office (1999), and Bennett, Garbade, and Kambhu (2000) for a discussion of recent changes in Treasury debt management.

Treasury bill issuance through the first seven months of 2000 totaled \$933 billion, down 17% from the \$1.1 trillion issued in the comparable months of 1996.²⁰ Treasury coupon issuance fell a much sharper 49% over the same period, from \$375 billion to \$190 billion.

To maintain large auction sizes and the liquidity of the on-the-run issues, the Treasury announced a revision to the original issue discount (OID) rules in November 1999 and launched a debt buyback program in January 2000.²¹ Changes to the OID rules allow the Treasury to reopen its most recent issues within one year of issuance without concern that the price of the issues may have fallen by more than a small amount. As a result of this change, the Treasury was able to announce in February 2000 that every other auction of the five-, ten-, and thirty-year securities would be a reopening of the previous auction. Under the debt buyback program, the Treasury redeems outstanding unmatured Treasury securities by purchasing them in the secondary market through a reverse auction.

One possible implication of reduced Treasury issuance is that the cost of borrowing securities in the repo market increases. The recent behavior of the one-year Treasury bill is instructive. At its February 2000 Quarterly Refunding the Treasury announced that new issuance of the one-year bill would be reduced from every four weeks to every 13 weeks. The one-year bill auctioned February 29 (and maturing March 1, 2001) was the last sold on the old cycle and thus the first to remain on-the-run for 13 weeks instead of four weeks. The \$10 billion issue size of the bill was unchanged from that of its predecessors.²²

In late April 2000, the cost of borrowing the March 2001 bill became strikingly expensive. On April 30, for example, an investor had to lend out funds at a 4.00% annual rate to secure the one-year bill as collateral on an overnight repo. The general Treasury collateral rate on the same day was 5.75%. In such a case, when an investor must lend funds at a rate below the general collateral rate to borrow a

²⁰ Issuance figures are calculated using data available at the Bureau of the Public Debt's website (<http://www.publicdebt.treas.gov/of/ofaicqry.htm>).

²¹ "On-the-run" securities are the most recently issued securities of a given maturity. Older securities of a given maturity are called "off-the-run."

²² In contrast, when issuance of the five-year Treasury note was reduced from monthly to quarterly in 1998, issue sizes were increased from \$11 billion to \$16 billion.

security, the issue is said to be “on special.” The differential or “specialness” of the on-the-run one-year bill is plotted in Figure 2. It shows that the specialness of the bill reached 1.75% (or 175 basis points) on April 30 and peaked at 415 basis points on May 31. It also shows that the degree of specialness in the shorter-term bills was much less pronounced than that for the one-year bill and that bills, unlike coupon securities, are typically not very special. The sharp drop in specialness of the one-year bill on June 1 reflects the crossover from the March 2001 bill to the new one-year bill auctioned the previous day.

Why did the one-year bill become so expensive to borrow? Issues become expensive to borrow when borrowing demand is high relative to the lendable supply. On-the-run Treasury coupon securities frequently trade on special because coupon securities are often shorted for hedging or speculative purposes and because on-the-run securities are the most liquid. As on-the-run coupon securities age, they typically become more expensive to borrow in the repo market as they are sold off by the dealer community and their available supply decreases.²³ In the case of the one-year bill, dealers who shorted the issue when it was relatively new likely did not anticipate how scarce and expensive the issue would become as it aged beyond four weeks.

Despite this episode with the one-year bill, repo market borrowing costs have not generally shown much of an increase in recent years. Table 1 plots the average level of specialness by year for the on-the-run coupon securities. It shows that specialness in 2000 (through July 27) has been somewhat higher than usual for the two- and five-year notes, but lower than usual for the ten-year note and thirty-year bond. The absence of a substantial increase in specialness in light of reduced Treasury issuance may partially reflect reduced demand to borrow Treasuries (as investors adopt substitutes), but it probably also reflects the fact that the lendable supply of Treasuries has decreased less than issuance. This is because Treasury security investors, such as the Federal Reserve, have become more willing to lend out specific

²³ Frank Keane (1996) documents this pattern of repo rates over the auction cycle.

issues from their portfolios.²⁴ The Treasury's steps to increasingly reopen issues also results in increased issue sizes and hence lendable supply.

Another likely implication of the projected debt paydown is a deterioration in market liquidity. In fact, market participants are already raising concerns about the market's liquidity as the supply of marketable Treasuries has declined.²⁵ One reason to be concerned is that the market was less liquid in the past when it was smaller. While adequate data is not available to look at many measures of liquidity on a historical basis, average daily trading volume is available and is plotted by month for the past 40 years in Figure 3. Not surprisingly, the volume of trading in Treasuries was significantly lower when the supply of marketable debt was lower. Furthermore, the peak in trading roughly corresponds with the March 1997 peak in marketable securities outstanding.²⁶

Market liquidity can be assessed more precisely for recent years, and has shown a marked deterioration since 1998. Figures 4 and 5 plot average bid-ask spreads of the on-the-run bills and notes by week. While the spreads have in fact widened, suggesting a reduction in market liquidity, the role of reduced Treasury issuance in the widenings is not clear. Most of the sharp widenings in the bid-ask spreads are associated with equity market declines or general financial market turmoil (such as that around the near failure of Long-Term Capital Management in September 1998). In February 2000, however, the spread widenings seem to have been precipitated by debt-management announcements at the Treasury's Quarterly Refunding Press Conference. Even in this case, however, it is not easy to interpret the market's response since the announcements pertained to *future* issue sizes and frequencies.

The behavior of the one-year bill is again instructive as liquidity deteriorated markedly in this sector after the issuance frequency of the bill was reduced. As shown in Figure 4, one-year bill bid-ask

²⁴ See "Announcement of Revisions to the SOMA Securities Lending Program," Federal Reserve Bank of New York, February 12, 1999 (<http://www.ny.frb.org/pihome/news/announce/1999/soma.html>).

²⁵ See, for example, "Liquidity Angst Grows in Treasury Market," *BondWeek*, March 15, 1999, p. 1 and Gregory Zuckerman, "Pared Treasury Supply Poses Risks: Paying Off Debt Has a Downside," *Wall Street Journal*, January 27, 2000, p. C1.

²⁶ A separate figure available from the author plots volume as a percent of marketable securities outstanding. It shows that turnover increased rapidly between the mid 1970s and mid 1980s, and fluctuated around 6% between the mid 1980s and 2000.

spreads increased sharply in May 2000, averaging over 1.5 basis points in late May, higher than their peak in the fall of 1998. Furthermore, trading volume of the one-year bill plummeted in May 2000, as shown in Figure 6. Significantly, trading volume remained low in the new one-year bill auctioned in May 2000, suggesting long-lasting implications from the happenings with the previous bill. Dealers who had taken short positions in the previous bill, only to have difficulty covering them, were probably less willing to take short positions in the new bill.

Decreased Treasury issuance may also cause particular Treasury securities to perform disparately from other securities and particular sectors to perform disparately from other sectors. In early 2000, for example, the launch of the debt buyback program and speculation that issuance of the thirty-year bond might soon end contributed to a plunge in the thirty-year yield relative to shorter-term yields, documented in Figure 7.²⁷ Spreads between on-the-run and off-the-run securities widened further at the same time and remained wide as of July 31, 2000, as shown in Figure 8.²⁸ J. Huston McCulloch has noted that these spreads can be substantive enough as to imply negative forward rates.²⁹

Again, the behavior of the one-year bill is instructive. Figure 9 plots the yield spread between the first off-the-run and the on-the-run one-year bill. As discount obligations of the U.S. government with similar maturities, the securities are quite similar, and are typically valued similarly in the market. In May 2000, however, the on-the-run bill became striking expensive relative to the first off-the-run bill (and other Treasuries) with the yield spread averaging 22 basis points in the week ending May 26. The abrupt swing in the spread in early June reflects the crossover from the old bill to the new one-year bill auctioned May 31. The bill curve remained quite distorted as of July 31, 2000, as shown in Figure 10. On that day,

²⁷ Note that the timing of the inversion on and around the days of debt-management announcements suggests that economic fundamentals are not the sole explanation. Just a couple of the articles relating the debt-management changes to the inversion include William Pesek Jr., "It's a Tale of Two Bond Markets: The 30-Year Treasury and Everything Else," *Barron's*, January 31, 2000 and Joshua Chaffin, "Search on to Replace the 30-Year Bond: Most Bond Traders Have Turned to the 10-Year Note as the New Market Benchmark," *Financial Times*, May 19, 2000.

²⁸ Note that on-the-run/off-the-run spreads widened significantly during the financial market turmoil of fall 1998 (Fleming (2000a, 2000b)) and were already wider than usual before the Treasury's announcements.

²⁹ Using February 17, 2000 data he estimates that investors are paying the Treasury at a 3.09% rate to hold their principal for the year and a quarter between February 2029 and May 2030 (McCulloch, 2000). McCulloch argues that the anomaly is not adequately explained by differences in liquidity or expected specialness.

the on-the-run one-year bill traded at a yield of 6.05%, 44-47 basis points below two coupon securities maturing the same day.³⁰

Lastly, decreased Treasury issuance may also cause the whole Treasury market to perform disparately from other fixed-income markets as Treasuries become scarcer and relatively more valuable. Figure 11 plots yield spreads of interest-rate swaps, an agency debt securities index, and a corporate debt securities index to the ten-year U.S. Treasury note. After being relatively stable through much of the 1990s, spreads widened significantly in the fall of 1998 and also in early 2000. The coincidence of part of the widening with the debt-management announcements of early 2000 suggests that economic fundamentals are not the only explanation for the widening. Furthermore, the widening of one-year LIBOR to the one-year Treasury bill in May 2000, shown in Figure 12, is also indicative of reduced Treasury issuance leading to wider measured credit spreads.

The increasingly disparate performance of the U.S. Treasury market is also shown through Table 2, which reports the correlations among the four-week yield changes for the series plotted in Figure 11. Panel A reports the correlations from the beginning of the sample (April 19, 1991) through the month preceding the fall 1998 financial market turmoil (July 2000) and Panel B reports the correlations from then through the end of the sample (July 28, 2000). Panel A shows that each of the spread products' highest correlations is with Treasuries for the first part of the sample and Panel B shows that each of their lowest correlations is with Treasuries for the latter part of the sample. As an example, the correlation between agencies and Treasuries is 0.978 in Panel A versus 0.975 between agencies and swaps, whereas the correlation between agencies and Treasuries is 0.942 in Panel B versus 0.976 between agencies and swaps. The increasingly idiosyncratic behavior of the Treasury market due to reduced Treasury issuance partially explains the breakdown in the correlations with Treasuries.³¹

³⁰ The yield differential between Treasury bills and coupon securities is examined by Yakov Amihud and Haim Mendelson (1991) and the idiosyncratic behavior of bills is documented by Gregory Duffee (1996).

³¹ The correlations evidence is less compelling when the yield changes are measured over shorter intervals. This may reflect short-term idiosyncratic price behavior and/or data-measurement problems for the non-Treasury instruments.

The paydown of the federal debt could reasonably be expected to affect the attributes that make Treasury securities an attractive benchmark and, in fact, there is already evidence of market disruptions. The cost of borrowing one-year bills in the repo market thus increased sharply after issuance frequency of the bill was reduced. Furthermore, the entire Treasury market is less liquid than it once was, although the role of reduced Treasury supply in this development is not conclusive. In addition, particular Treasury securities (e.g., the one-year bill), certain Treasury sectors (e.g., the thirty-year sector), and possibly even the entire Treasury market are showing signs that the paydown is leading to increased scarcity value and increased idiosyncratic behavior among Treasuries.

Benchmark Implications of Paying Down the Federal Debt

The expected paydown of the federal debt challenges the U.S. Treasury market's benchmark role. In fact, recent changes in the market are already forcing market participants to reassess how they use the Treasury market as a benchmark and to start using other instruments in place of Treasuries. Concerns with the reference and hedging roles of Treasuries, in particular, are attracting significant attention.³² In contrast, relatively little attention has been paid to the implications of the paydown for Treasury securities' risk-free role. This may reflect the fact that Treasuries remain free of default risk and quite liquid, and that the market's uses as a risk-free benchmark are less pressing to market participants than its uses as a reference and hedging benchmark.

The idiosyncratic behavior of Treasury securities seems to explain much of the dissatisfaction with the reference and hedging roles of Treasuries. Changes in the premium accruing to on-the-run Treasury securities lead to a divergence in performance between on-the-run Treasuries and other fixed-income securities, making Treasuries a poorer hedge and a poorer reference rate. Reflecting this divergence, market participants have experimented with using off-the-run Treasuries as references for

³² See, for example, John M. Berry, "Treasuries' Vanishing Act; As U.S. Borrowing Shrinks, Investors Big and Small Seek Safety Elsewhere," *Washington Post*, July 30, 2000 and Simon Boughey, "Casting a Long Shadow: With Fewer Treasuries and Alternative Benchmarks Uncertain, the Credit Markets Turn Chaotic," *Investment Dealers' Digest*, April 3, 2000, p. 16.

bringing new corporate issues to market.³³ Unfortunately, the same feature that may make off-the-run Treasuries a better gauge of Treasury market performance - their relative lack of liquidity - also makes them more susceptible to idiosyncratic price changes and a poor hedging vehicle.

Like the on-the-run/off-the-run spread, the seemingly idiosyncratic behavior of the thirty-year sector leads to a divergence in performance between thirty-year Treasury bonds and other thirty-year securities, making the T-bond a less effective reference and hedging security. Underwriters bringing new corporate issues to market have thus tried using ten-year Treasuries as references for thirty-year corporates.³⁴ However, potential changes in the slope of the yield curve suggest that a ten-year Treasury is not a good benchmark for a thirty-year corporate.

In the short-end of the market as well, the idiosyncratic behavior of the one-year bill is having unintended consequences for the security's reference role. The August 14, 2000 Wall Street Journal notes that ““Anyone who has a mortgage referenced against the one-year CMT’ that has reset in the past few months is paying 0.35 percentage point less ‘than they would be without the scarcity of the one-year bill.’”³⁵ The Treasury indicated at its May and August 2000 Quarterly Refunding Press Conferences that, in consideration of the bill's elimination, it will work with Congress to revise the statutory provisions that reference the bill.

Agency Debt Securities

Alternatives to Treasury securities are also being investigated and adopted as reference and hedging benchmarks, including agency debt securities, corporate debt securities, and interest rate swaps. Agency securities are obligations of federal government agencies or government-sponsored enterprises

³³ Gregory Zuckerman, “Quirk in Yields is Making Bonds More Attractive,” Wall Street Journal, February 2, 1999, p. C1.

³⁴ Gregory Zuckerman and Sonoko Setaishi, “Treasury Prices Drop as Supply Concerns Ease: Vodafone Finds Demand for \$5.25 Billion Issue,” Wall Street Journal, February 8, 2000, p. C21.

³⁵ Sarah Landis, “Adjustable-Rate Mortgages Face Effect of the Elimination of One-Year Bills,” Wall Street Journal, August 14, 2000. The article is quoting Michael Cloherty, a Treasury Strategist at Credit Suisse First Boston Corp.

(GSEs) such as Fannie Mae, Freddie Mac, the Federal Home Loan Banks (FHLBanks), the Farm Credit Banks, Sallie Mae, and the Tennessee Valley Authority. The agencies issue debt securities to finance activities that are supported by public policy, including home ownership, farming, and education. The securities are typically not backed by the full faith and credit of the U.S. government, as is the case with Treasury securities, and therefore trade with some credit risk. They are nevertheless considered to be of high credit quality and are rated Aaa/AAA by the major rating agencies.³⁶

Seeking to capitalize on the reduction in Treasury supply and the market's interest in large, liquid issues, the agencies have introduced their own benchmark debt issuance programs, starting with Fannie Mae's Benchmark Notes program in January 1998. The programs provide for the regular issuance of large-sized, non-callable coupon securities in a range of maturities, and thus mimic the U.S. Treasury's issuance practices. As shown in Table 3, benchmark coupon issues of the three largest agencies generally range from \$2 to \$8 billion in size (as of July 31, 2000), and are thus about 1/5 to 2/3 as large as comparable U.S. Treasury issues.

The relative performance of agency securities with other fixed income securities suggests that they may be good reference and hedging benchmarks. As seen in Figure 11 and Table 2, yields on agency securities tend to move closely with those of swaps and corporates over long periods of time. The co-movements suggest a credit component to interest rate risk that is common to agencies, swaps, and corporates, but not Treasuries. Interestingly then, the credit risk in agency securities actually gives them the potential to be a better reference and hedging instrument than Treasuries. On the other hand, while credit risk may cause agencies to trade in line with other spread products, it also means that there is an idiosyncratic risk component to agency securities. This is particularly relevant given the proposals to end some of the GSEs' privileges.³⁷

³⁶ For additional details on the agency debt securities market, see Fabozzi and Fleming (2000).

³⁷ See, for example, Michael Schroder and Gregory Zuckerman, "Treasury Official's Warning Rocks Bond Market, Challenging Fannie Mae's Goal to Be Benchmark," Wall Street Journal, March 23, 2000 and Kathleen Day, "Greenspan Urges Review of Fannie, Freddie Subsidies," Washington Post, May 24, 2000.

An active repo market in agency securities has developed allowing market participants to borrow securities for hedging and trading purposes. In addition, an active futures market is quickly developing since contracts started trading on the Chicago Board of Trade and the Chicago Mercantile Exchange in March 2000. Agency securities often trade on special in the repo market, although differences in repo market specialness and liquidity have so far resulted in only minor valuation differences. The relative unimportance of idiosyncratic factors in determining yields helps explain why a plot of the Fannie Mae benchmark yield curve, shown in Figure 13, is relatively smooth, particularly when compared to the constant maturity U.S. Treasury yield curve. It's important to note, however, that increased demand to borrow and trade agency benchmark issues could cause issue-specific differences to become more important.

The liquidity of agency securities does not yet match that of Treasury securities. Daily trading in agency coupon securities by the primary government securities dealers averaged \$17.7 billion through the first six months of 2000 versus \$178.8 billion in Treasury coupon securities.³⁸ Bid-ask spreads of agency securities are roughly one-half to one basis point for on-the-run benchmark issues and one to two basis points for off-the-run issues.³⁹ In contrast, bid-ask spreads of Treasury notes, plotted in Figure 5 in price terms, are typically less than one-half basis point in yield terms.

Agency debt securities are used as both reference and hedging benchmarks. The yields on benchmark securities are used as barometers of the agency market for monitoring and analytical purposes and new debt issues have been marketed relative to benchmark agency securities.⁴⁰ Agencies are also actively used as hedging vehicles for both corporate debt and mortgage-backed securities. Agency debt securities are likely to assume an increasingly significant benchmark role, although their liquidity is limited by the size of the market, and their credit risk is likely to remain a concern.

³⁸ Federal Reserve Bank of New York (<http://www.ny.frb.org/pihome/statistics/msytd.00>).

³⁹ Fannie Mae, Funding Notes, Vol. 5, June 2000, p. 3.

⁴⁰ In August 1999, for example, a new issue of Private Export Funding Corp. was marketed in terms of Fannie Mae's benchmark ten-year note (Gregory Zuckerman and John Montgomery, "Bonds Sustain Rally on Low Inflation, Expectations of Fed Restraint on Rates," Wall Street Journal, August 26, 1999, p. C17).

Corporate Debt Securities

Corporate issuers have recently increased issuance sizes and regularity as well to meet investor demand for large, liquid issues. Ford Motor Co., in particular, announced its Global Landmark Securities (or GlobLS) program in June 1999, modeled off the programs of Fannie Mae and Freddie Mac. Under the program, Ford and its financing subsidiary Ford Motor Credit Co. announced they would bring offerings of at least \$3 billion to market two to four times per year.

As shown in Figure 11, corporate yields as a group tend to change in line with those of agencies and swaps. Indexes do not necessarily make good reference benchmarks, however (for one thing, they are often only calculated once a day), and they cannot be used for hedging. Individual issues, on the other hand, often carry significant credit risk such that their performance deviates sharply from that of other issues. Ford's latest ten-year GlobLS issue, for example, rose 25 basis points relative to Treasuries in August 2000 in the midst of the Bridgestone/Firestone tire recalls, in a month when comparable corporates widened 13 basis points.⁴¹

The corporate debt market is less liquid than that of the agency debt market. While the corporate debt market is larger than the agency debt market, with debt outstanding totaling \$3.1 trillion on March 31, 2000 versus \$1.6 trillion in agency securities, it is far more fragmented.⁴² Corporate issuers are simply not large enough to issue debt securities in the sizes and frequencies of the agencies or the U.S. Treasury. Ford, for example, had debt outstanding of \$155 billion on March 31, 2000 versus \$558 billion for Fannie Mae, \$535 billion for the FHLBanks, and \$378 billion for Freddie Mac.⁴³ Bid-ask spreads of Ford GlobLS are reported to be one to two basis points versus three to five basis points for smaller issues

⁴¹ The yields are from Bloomberg and the comparable corporate reference is Merrill Lynch's 7-10 year corporate A2 index. The tire recalls are cited as a factor in the widening spreads in Steven Vames, "Economic Data Help Push Treasuries Ahead, But Some Worry That Market Can't Rally More," Wall Street Journal, September 1, 2000.

⁴² The corporate debt figure is from the Bond Market Association and the agency debt figure is from the September 2000 Federal Reserve Bulletin.

⁴³ Ford's debt figure is from its earnings report for the quarter ending March 31, 2000 whereas the agency debt figures are from the September 2000 Federal Reserve Bulletin.

of similar quality.⁴⁴ The repo market for corporates is fairly active, albeit less active than for agencies or Treasuries. There is no futures market for corporates although such a market is being considered.⁴⁵

Ford GlobLS play a limited benchmark role in the corporate market. They are used as reference rates for monitoring the performance of the corporate market and evaluating other outstanding corporate debt securities. They are also used in the marketing of some new corporate issues.⁴⁶ Hedging activity using corporate issues is also taking place, albeit less actively than that with agency securities and interest rate swaps. As noted, fragmentation limits the corporate debt market's liquidity and thereby inhibits it from assuming a more significant benchmark role.

Interest Rate Swaps

Interest rate swaps have also started to be used as a reference and hedging benchmark. An interest rate swap is an agreement between two parties to exchange one stream of interest payments for another stream of interest payments. The most common interest rate swap exchanges fixed interest rate payments for floating interest rate payments for a given principal amount and period of time. The floating rate in such contracts is often based on LIBOR.

Swap rates are quoted in terms of the fixed rate that must be paid to convert to floating. At the close of July 31, 2000, for example, the quoted ten-year swap rate was 7.26%. An entity therefore had to make semi-annual fixed interest payments for 10 years at an annual rate of 7.26% to get semi-annual floating interest payments for 10 years based on three-month LIBOR (for the same principal amount). Swap rates are often quoted relative to a U.S. Treasury security, so that the ten-year spread on July 31 was quoted as 122 basis points (calculated as the 7.26% swap rate less the 6.04% yield on the on-the-run ten-

⁴⁴ "Ford Credit's \$5 Billion Sale Taps Demand for Big Issues," Bloomberg, October 21, 1999.

⁴⁵ Barbara Etzel, "Bond Market Assn. Forms Task Force to Study a Corporate Futures Contract," Investment Dealers' Digest, July 10, 2000, p. 3.

⁴⁶ "Ford Reinforces Benchmark Status of GlobLS Programme," Euroweek, March 10, 2000. In this case, an outstanding Ford GlobLS issue was used to price a new Ford GlobLS issue. Referencing another security from the same issuer is attractive when marketing a new security as both securities are likely to be similarly affected by firm-specific as well as general credit market developments (i.e., they are close substitutes).

year Treasury note). Swap rates exceed those on Treasuries mainly because the floating payments are based on a rate that contains credit risk (LIBOR is an Aa/AA rate).

Since they are based on a floating rate that contains credit risk, swap rates often change in line with yields on other spread products, as shown in Figure 11 and Table 2. Swaps therefore also have the potential to be a better reference and hedging benchmark than Treasuries. At the same time, the counterparty credit risk in a swap contract is minimal. While there is some risk that that one's counterparty in a swap defaults on their end of the agreement, dealers mitigate this risk by executing swaps out of credit-enhanced subsidiaries and by structuring swaps so that they automatically unwind if a party's Aaa/AAA credit rating is lost.

The swaps market is very active with narrow bid-ask spreads. A market survey by the Federal Reserve Bank of New York found daily trading in U.S. dollar interest rate swaps to be \$22 billion per day in April 1998.⁴⁷ Bid-ask spreads for active contracts are reported to be about one basis point. Liquidity may be hindered somewhat by the lack of fungibility in swaps contracts. A dealer who has engaged in a swaps contract and wants to unwind it has to either go back to the original counterparty, who may not want to unwind, or find a third party to take their side of the swap who is also acceptable to the original counterparty.

The absence of an underlying fundamental asset is an advantage of the swaps market. There is no supply limit on swaps contracts and no need to borrow securities to go short as an entity can enter into as many swaps contracts as it wants. Specific issue concerns are also mitigated by the nature of swaps. The ability to create swaps combined with the fungible nature of the underlying cash flows prevents swaps with the same or nearly the same cash flows from trading at widely different rates. These features of swaps help explain why the swaps curve was fairly smooth on July 31, 2000, as shown in Figure 13.

⁴⁷ Federal Reserve Bank of New York, "Foreign Exchange and Interest Rate Derivatives Market Survey: Turnover in the United States," September 29, 1998. Note that this is the average notional principal amount on which parties agreed to exchange interest payments rather than a value of securities traded.

Swaps are actively used as reference and hedging benchmarks. They are used for evaluating the performance of other fixed-income markets, and numerous new corporate and asset-backed securities have been marketed off of swap rates.⁴⁸ Swap rates are also used as reference rates for forecasting the future path of LIBOR rates. Positions in the agency debt, corporate debt, and mortgage-backed securities markets are all hedged using interest rate swaps. Swaps are likely to assume an increasingly important benchmark role as Treasury supply diminishes. As mentioned, swaps trade in line with other spread products without containing the credit risk of other spread products, and there is no fundamental limit to the quantity of swaps contracts that can be created.

In sum, market participants are experimenting with and adopting agency debt securities, corporate debt securities, and interest rate swaps as reference and hedging benchmarks. Agencies and swaps, in particular, have the greatest potential. Agencies are offered in large and liquid issues, are structured similarly to familiar U.S. Treasury securities, and tend to perform similarly to other fixed-income securities with credit risk. Swap rates are unaffected by supply considerations and tend to move closely with yields of fixed-income securities that have credit risk even while swap contracts themselves have minimal credit risk. Treasuries remain the predominant benchmark, but these alternative markets are likely to assume greater reference and hedging roles as the Treasury debt is paid down.

Monetary Policy Implications of Paying Down the Federal Debt

Changes in the U.S. Treasury market resulting from the paydown of the federal debt also present challenges for the implementation of monetary policy. While the creditworthiness of Treasuries is not in question, the desirability of the securities for monetary policy also rests on the market's size and liquidity. Should the need arise, the Federal Reserve must be able to quickly add or drain reserves. Market liquidity allows the Fed to do so with minimal costs to itself and minimal disruptions to the market.

⁴⁸ See, for example, Gregory Zuckerman, "Treasuries Stumble as Some Investors Make Move to Agency Securities on Hopeful U.S. Comments," Wall Street Journal, April 12, 2000 and Kara Scannell, "Ford Motor Credit Sells \$4.5 Billion of Bonds, A Further Sign of Revival in Corporate Issuance," Wall Street Journal, June 8, 2000.

As noted earlier, Federal Reserve holdings amounted to 17% of marketable Treasury securities as of August 2000. As the stock of marketable securities declines, and as Fed holdings continue to increase, the percent of securities held by the Fed is likely to increase rapidly. Assuming that the debt shrinks according to the CBO's July 2000 projections, that Fed holdings grow at the same rate as they did between 1989 and 1999 (8.5% compound annual growth rate), and that the nonmarketable debt remains a constant 11.0% of the public debt, Fed holdings would grow to 25% in 2002, 50% in 2005, and close to 100% in 2007.

It is not clear at what level Federal Reserve holdings become unduly large relative to the stock of Treasury securities outstanding. At the March 2000 FOMC meeting, however, the manager of the Fed's System Open Market Account suggested limits of 35-40% for bill issues in order to maintain a liquid portfolio.⁴⁹ At the same meeting, the FOMC endorsed a study to consider alternative asset classes and selection criteria "in light of declining Treasury debt." Limits on system holdings ranging from 35% for bills down to 15% for longer-term coupon securities were then announced in July 2000 in order to manage the liquidity and average maturity of the Fed's portfolio.⁵⁰ As noted in the announcement, the application of the limits has already constrained Federal Reserve purchases in the bill sector.

In evaluating the Fed's ability to conduct monetary policy as the debt is paid down, it's important to reiterate the Fed's practice of using temporary operations to meet shorter-term changes in reserves. In 1999, for example, the Fed arranged 244 RPs (to add reserves) and 13 MSPs (to drain reserves).⁵¹ The \$15 billion average value of RPs outstanding in 1999 masks considerable variation across the year. In particular, to address the unprecedented reserve needs at the turn of the millenium, RPs outstanding reached \$141 billion on December 31, 1999. Large and rapid increases and subsequent decreases in reserves have therefore been addressed through temporary operations.

⁴⁹ Minutes of the Federal Open Market Committee: March 21, 2000 (<http://www.bog.frb.fed.us/fomc/MINUTES/20000321.HTM>).

⁵⁰ Announcement of Changes in the Management of the System Open Market Account, July 5, 2000 (<http://www.ny.frb.org/pihome/news/announce/2000/an000705.html>).

⁵¹ Domestic Open Market Operations During 1999, Federal Reserve Bank of New York (<http://www.ny.frb.org/pihome/annual.html>).

The Fed could thus increasingly rely on short-term operations to meet the expected growth in reserve needs with minimal disruptions. In fact, the minutes of the March 2000 FOMC meeting disclose that the Fed could rely on temporary operations to meet the growth in reserves that could not easily be met by additional outright purchases of Treasury securities, pending the completion of the Fed's asset allocation study. An increased reliance on short-term operations would be facilitated by an expansion of the pool of collateral eligible in RPs. Temporary approval of mortgage-backed securities as eligible collateral was approved by the FOMC at its August 1999 meeting, and then extended at the March 2000 meeting pending completion of the Fed's study. The Fed indicated, however, that the temporary extension of authority "should not be read as indicating in any way how the Committee might ultimately choose to allocate the portfolio."

The Fed could also diversify its permanent portfolio should the availability of Treasury securities decline as projected. The Federal Reserve Act already allows the Fed to buy agency securities, certain municipal securities, foreign exchange, and sovereign debt. In fact, as of June 30, 2000 the Fed held \$15.6 billion in foreign currency denominated securities and \$140 million in agency debt securities.⁵² Should it wish to, the Fed could seek authority to transact in a broader range of assets through technical changes in the Federal Reserve Act. While other assets may be less liquid than Treasury securities, the Fed's entire portfolio need not be comprised of highly liquid instruments for it to effectively manage reserves.

Diversification of the Federal Reserve's permanent portfolio does raise some concerns, however. First, the Fed would inevitably be seen as favoring some sectors over others in its credit allocation decisions, and there's a risk that those decisions could be seen as an accreditation of those sectors. Second, the Fed would likely be assuming a greater amount of credit risk. Of course the Fed already holds assets with significant risk -- longer-term Treasury securities -- although the risk primarily comes from general yield curve changes rather than specific credit exposure. One can therefore imagine the Fed

⁵² Federal Reserve Bulletin, September 2000.

shifting its portfolio in a way that assumes greater credit risk, but that does not necessarily increase overall risk.

In sum, the declining stock of U.S. Treasury securities should not be particularly problematic for the Federal Reserve's implementation of monetary policy. The Fed relies on temporary operations to meet short-term changes in its reserve needs, and applied such operations to address the unprecedented changes in reserve needs that occurred at the turn of the millenium. The range of securities accepted in such operations could be expanded beyond Treasuries, agencies, and mortgage-backed securities. The permanent portfolio could also be expanded to include less liquid securities. While the Fed may want to maintain a high degree of liquidity in a large part of its portfolio to address anticipated and unanticipated changes in reserve needs, the Fed's entire portfolio need not be as liquid as U.S. Treasury securities have historically been.

As discussed earlier, many financial institutions besides the Federal Reserve use U.S. Treasury securities as a reserve asset, including foreign central banks and domestic depository institutions. While Treasury securities are a much smaller share of these institutions' portfolios, the paydown of the federal debt could be even more pertinent to their operations. The Fed largely relies on short-term financing markets to meet marginal changes in reserve needs, but some of these other institutions may be relying on the safety and liquidity of Treasury securities to meet marginal changes in liquidity needs. Furthermore, some of these institutions may not have access to the same investment options as the Fed due to regulatory restrictions or inadequate investment expertise.

Conclusion

The paydown of the federal debt raises concerns as U.S. Treasury securities are central to the implementation of monetary policy and to financial markets more generally. The securities are the primary asset of the Federal Reserve, they are a benchmark for risk-free interest rates, and they are a reference and hedging benchmark for other fixed-income securities. Many of the market's attributes that make it so attractive are likely to be affected by the debt paydown and preliminary evidence suggests that

the paydown has already contributed to higher repo market borrowing costs and lower liquidity among certain securities as well as increased idiosyncratic price behavior.

Market participants are responding to the paydown through the consideration of alternative benchmarks and reserve assets. To hedge positions and price new issues in other fixed-income markets, agency debt securities, corporate debt securities, and interest rate swaps are increasingly being adopted. As noted, these securities often move more closely with other fixed-income securities than Treasuries, giving them the potential to be better hedging and reference benchmarks. The Federal Reserve is also taking steps towards adjusting its portfolio and should be able to do so with minimal implications for monetary policy.

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Table 1: Repo Specialness of On-the-Run U.S. Treasury Coupon Securities

	Two-Year	Five-Year	Ten-Year	Thirty-Year
1997	28.3 (38.3)	63.0 (70.4)	132.6 (118.2)	65.4 (95.2)
1998	32.0 (54.8)	81.6 (101.9)	159.4 (141.8)	151.1 (149.9)
1999	33.6 (48.5)	79.7 (91.5)	180.7 (153.7)	118.2 (120.9)
2000 (through July 27)	50.6 (42.6)	103.4 (129.6)	146.1 (108.4)	54.8 (80.8)

Source: Author's calculations, based on data from GovPX.

Note: The table reports the means and standard deviations of the daily average differences between the overnight general collateral rate and the collateral rates on the indicated on-the-run securities (in basis points).

Table 2: Yield Change Correlations

Panel A: April 19, 1991 – July 31, 1998				
	U.S. Treasury	Agency	AA Corporate	Swap
U.S. Treasury	1.000	0.978	0.986	0.993
Agency	0.978	1.000	0.973	0.975
AA Corporate	0.986	0.973	1.000	0.981
Swap	0.993	0.975	0.981	1.000

Panel B: July 31, 1998 – July 28, 2000				
	U.S. Treasury	Agency	AA Corporate	Swap
U.S. Treasury	1.000	0.942	0.955	0.940
Agency	0.942	1.000	0.964	0.976
AA Corporate	0.955	0.964	1.000	0.964
Swap	0.940	0.976	0.964	1.000

Source: Author's calculations, based on data from Bloomberg and Merrill Lynch.

Notes: The table reports the correlations of four week yield changes between the indicated securities/indices for the noted time periods. Yields are for the on-the-run ten-year U.S. Treasury note, Bloomberg's ten-year option-free agency index, Merrill Lynch's 7-10 year AA corporate index, and the ten-year semi-annual fixed versus three-month LIBOR swap rate.

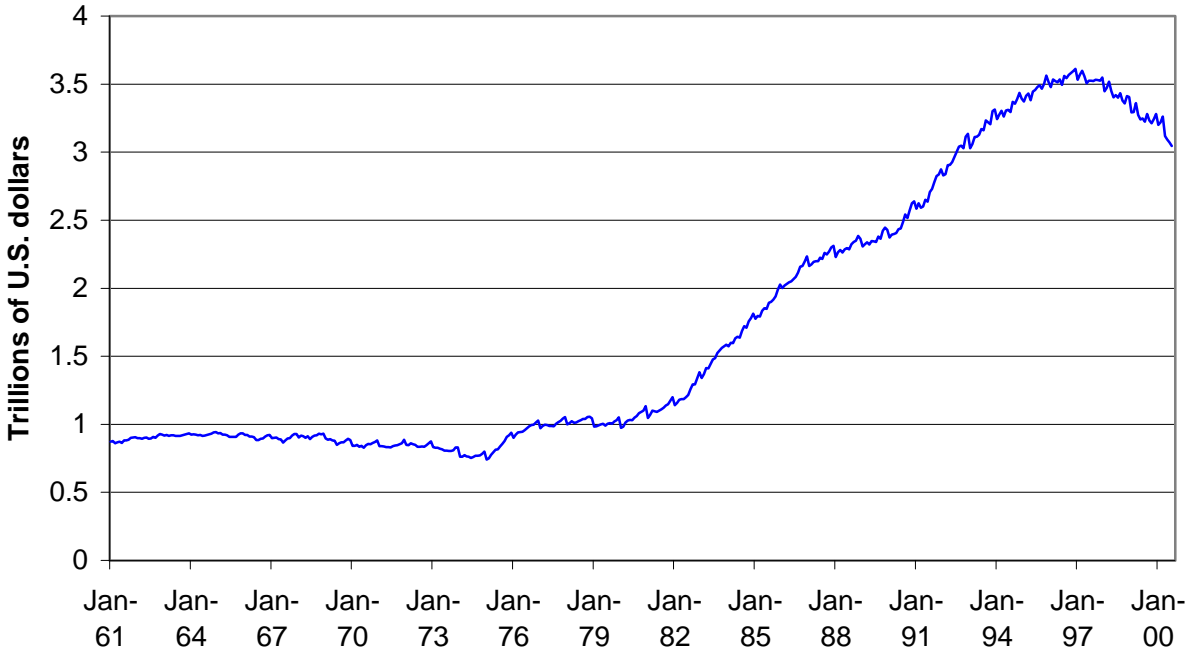
Table 3: Issue Sizes of Agency and U.S. Treasury Coupon Securities as of July 31, 2000

Issue	Fannie Mae Benchmark	Freddie Mac Reference	FHLBanks Global	FHLBanks Tap	U.S. Treasury
Two-year	3.0	-	3.0	2.3 ^r	10.0
Three-year	3.0	5.0	-	2.4 ^r	-
Five-year	5.5	4.0	-	1.5 ^r	12.0
Seven-year	4.0	-	-	0.5 ^r	-
Ten-year	3.0	8.0 ^r	-	1.0 ^r	18.0 ^r
Thirty-year	2.0	3.0 ^r	-	-	10.0

Sources: Bloomberg; Fannie Mae; FHLBanks, Office of Finance; Freddie Mac.

Notes: The table reports the sizes of the most recent non-callable benchmark coupon issues as of July 31, 2000 in billions of U.S. dollars. Securities more than one year old are excluded. Listed FHLBanks Tap issues are limited to those designated on-the-run by the FHLBanks. U.S. Treasury issue sizes exclude amounts issued to refund maturing securities of Federal Reserve Banks as well as amounts bid for by Federal Reserve Banks on behalf of foreign and international monetary authorities. A superscript r indicates an issue that was reopened.

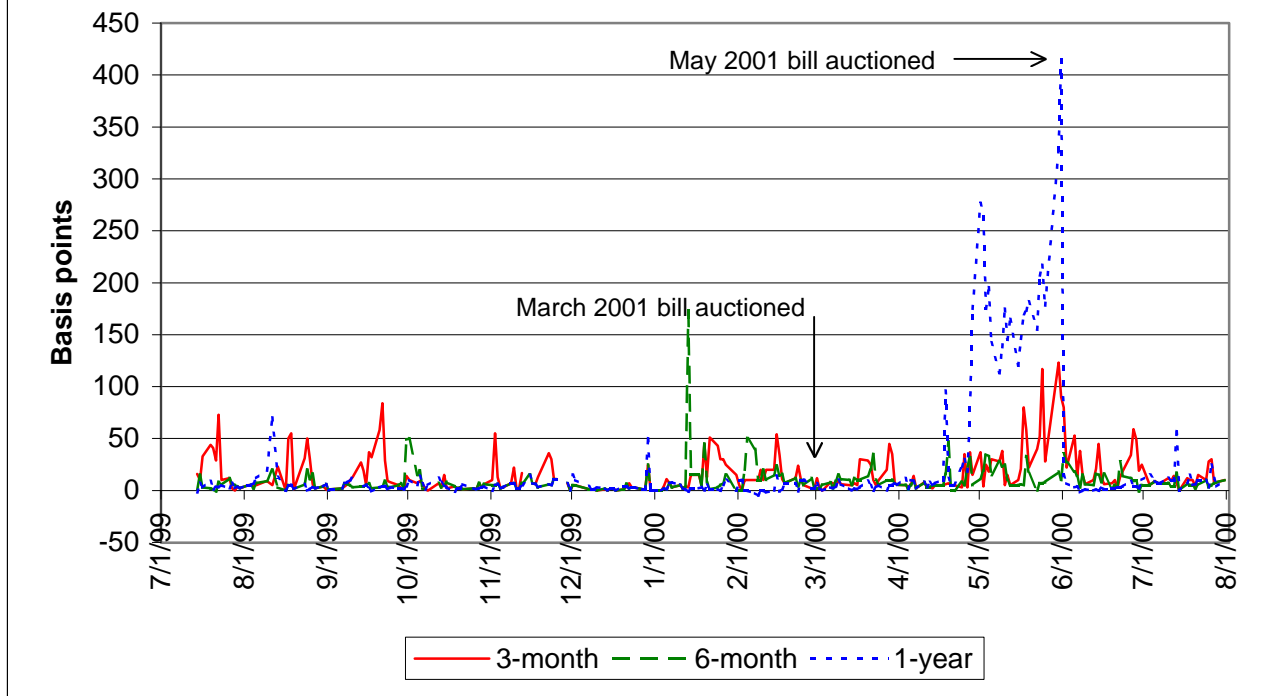
Figure 1: Marketable U.S. Treasury Securities Outstanding



Source: U.S. Treasury.

Note: Figures before 1999 are scaled into 1999 dollars using the implicit GDP deflator.

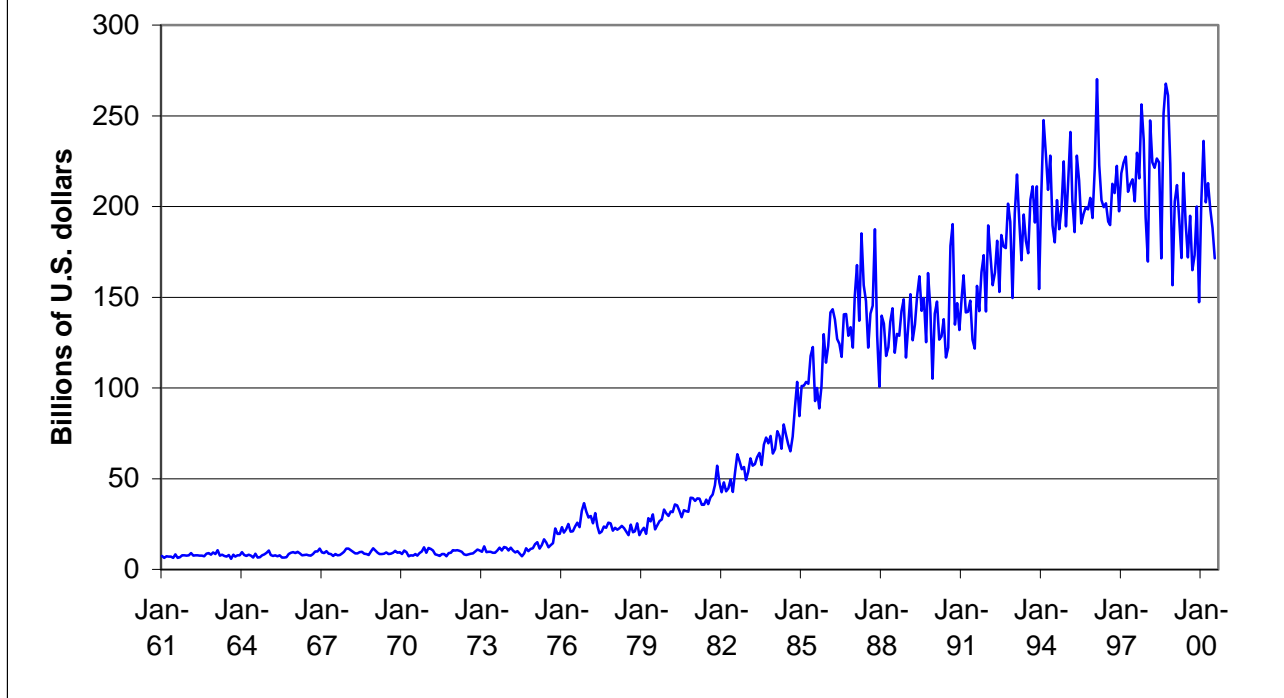
Figure 2: Repo Market Specialness of U.S. Treasury Bills



Source: Author's calculations, based on data from GovPX.

Note: The figure plots the general collateral rate less the collateral rate for the on-the-run bills by day using 9:00 a.m. quotes.

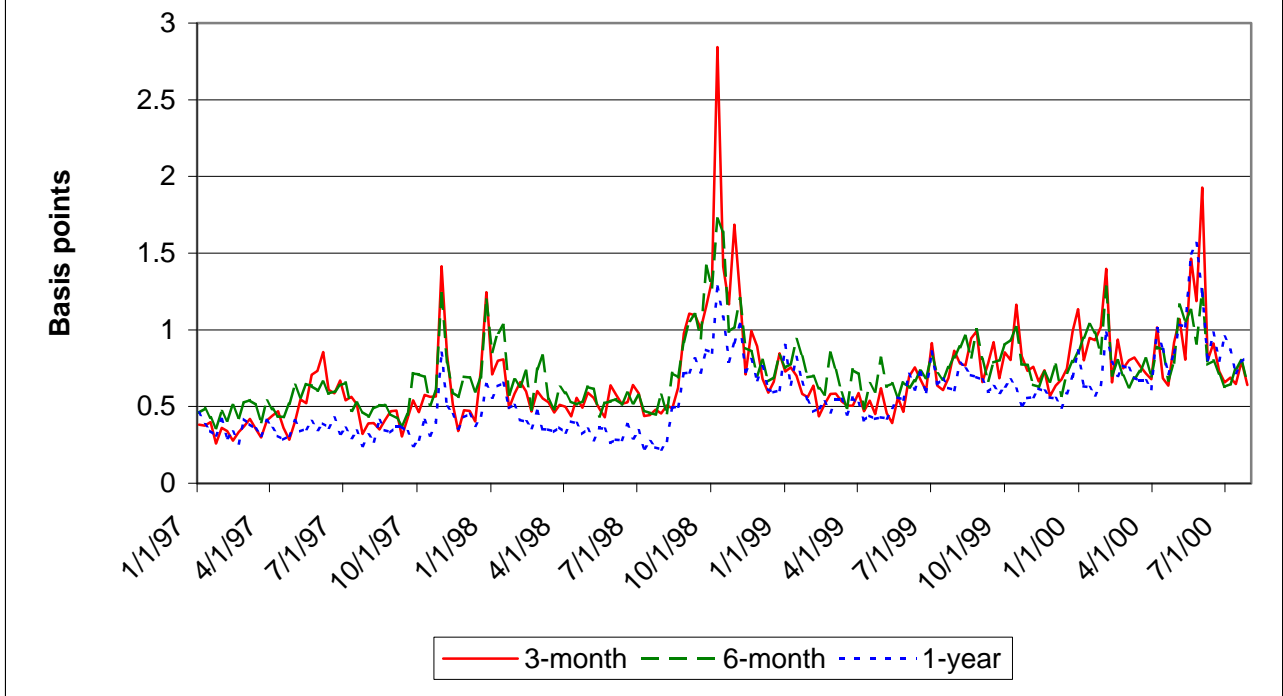
Figure 3: Daily Trading Volume of U.S. Treasury Securities



Sources: Federal Reserve Bank of New York; Federal Reserve Bulletin (various issues).

Notes: The figure plots average daily trading volume (par value) by month as reported by the primary dealers. Trades between primary dealers are reported by both counterparties and are therefore double-counted. Figures before 1999 are scaled into 1999 dollars using the implicit GDP deflator.

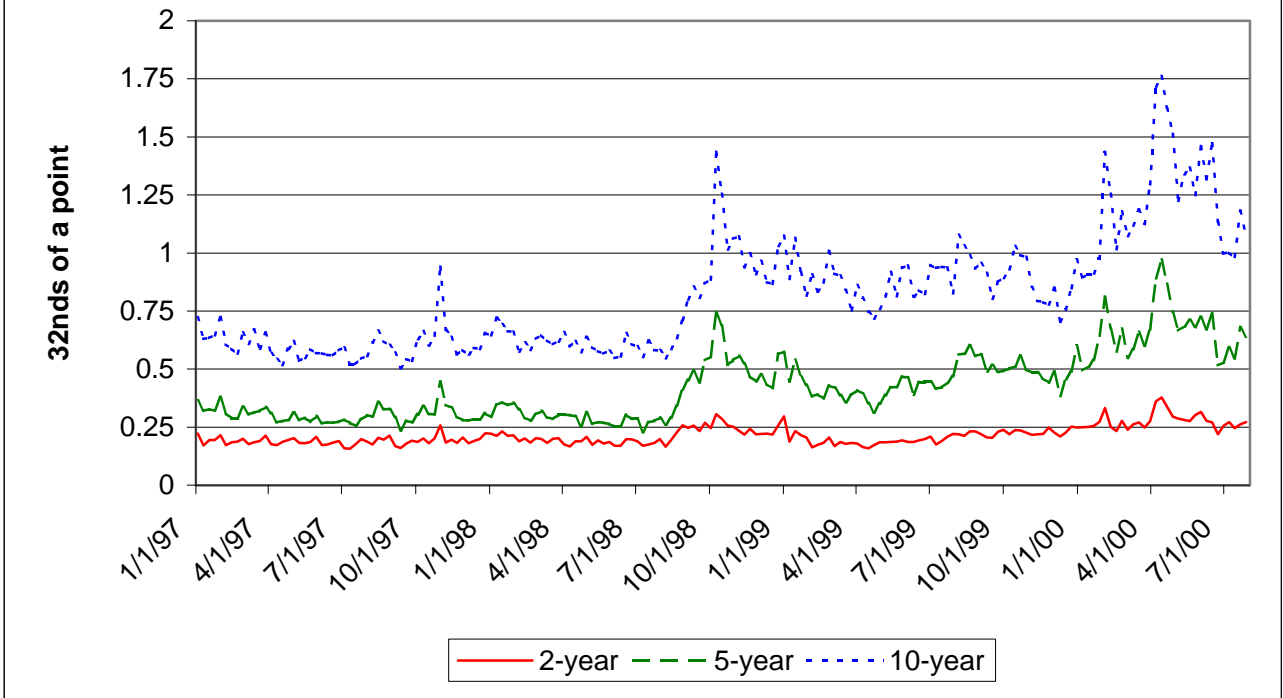
Figure 4: Bid-Ask Spreads of U.S. Treasury Bills



Source: Author's calculations, based on data from GovPX.

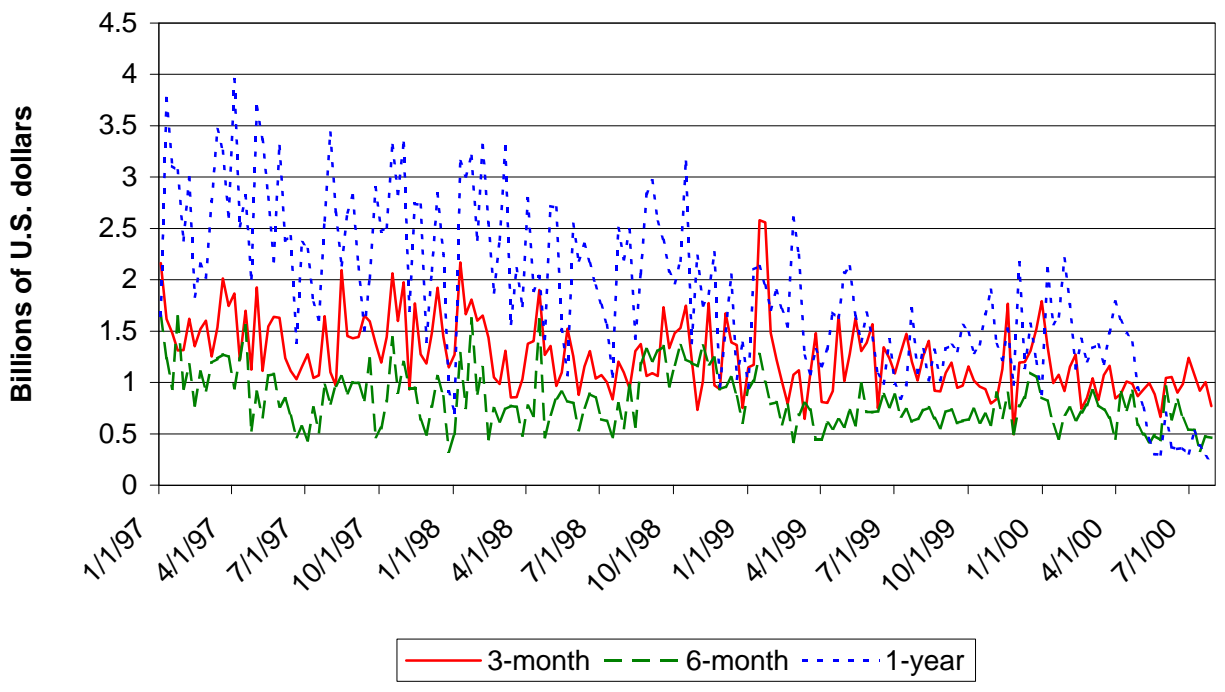
Note: The figure plots mean interdealer bid-ask spreads by week for the on-the-run bills.

Figure 5: Bid-Ask Spreads of U.S. Treasury Notes



Source: Author's calculations, based on data from GovPX.
Note: The figure plots mean interdealer bid-ask spreads by week for the on-the-run notes.

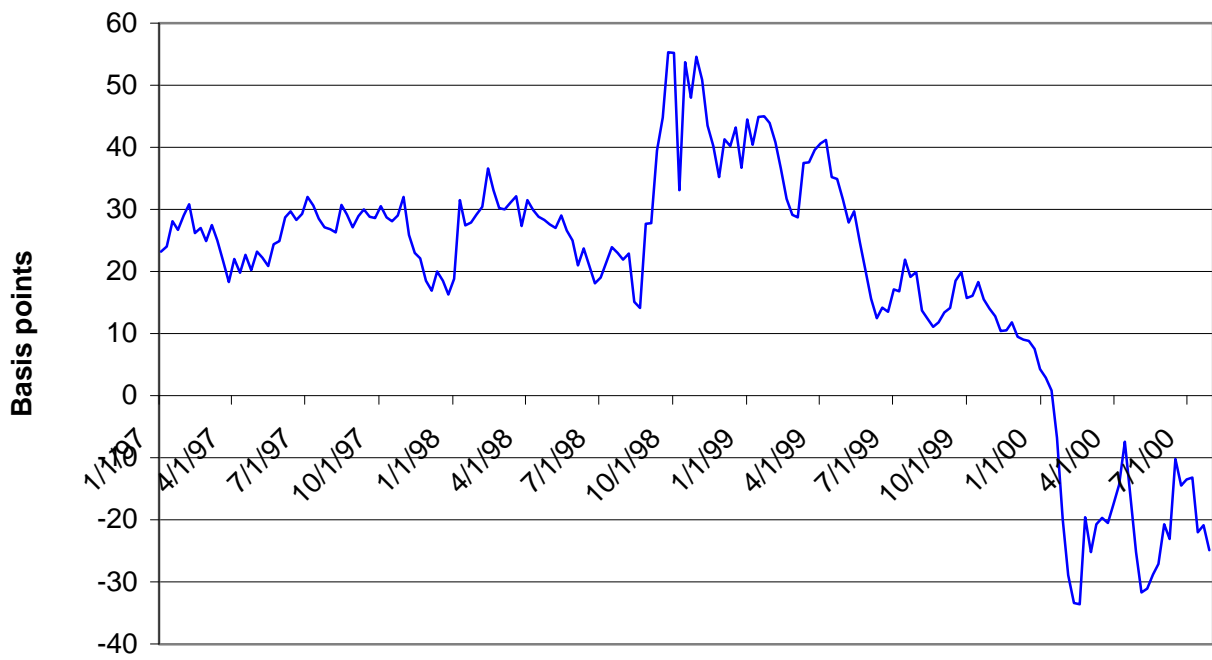
Figure 6: Daily Trading Volume of U.S. Treasury Bills



Source: Author's calculations, based on data from GovPX.

Note: The figure plots mean daily interdealer trading volume by week for the on-the-run bills.

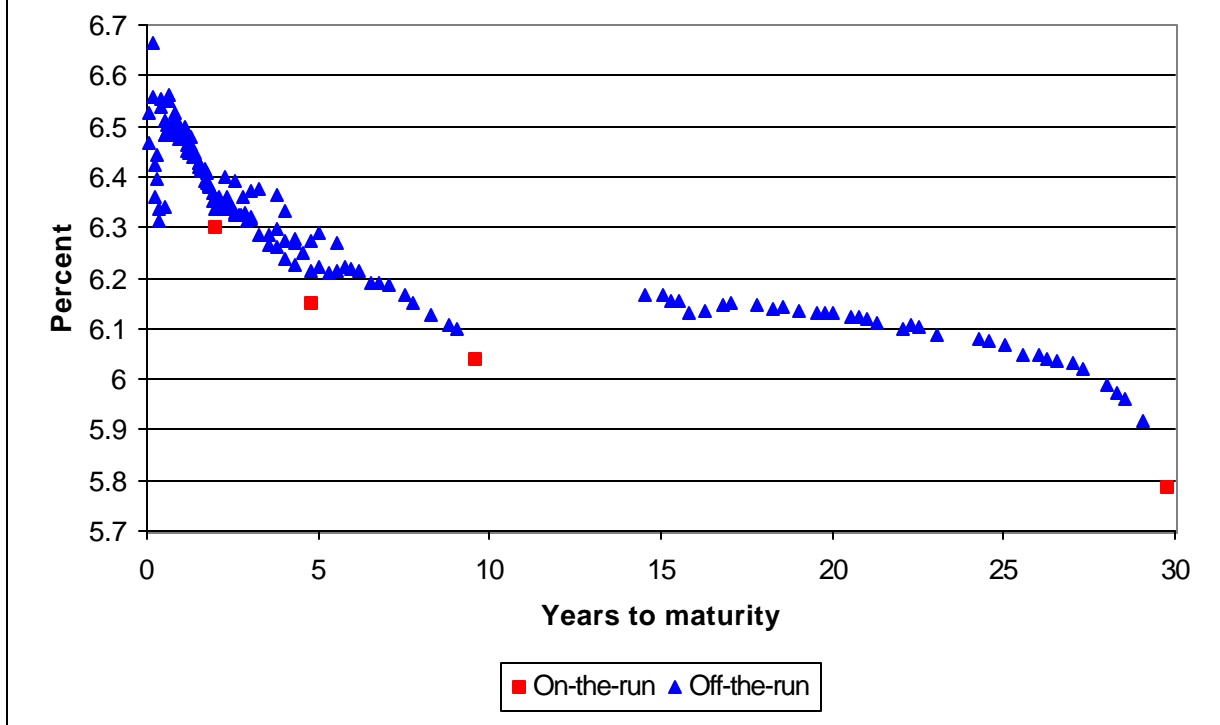
Figure 7: 30-Year/10-Year U.S. Treasury Yield Spread



Source: Author's calculations, based on data from Bloomberg.

Note: The figure plots the 30-year yield less the 10-year yield by week.

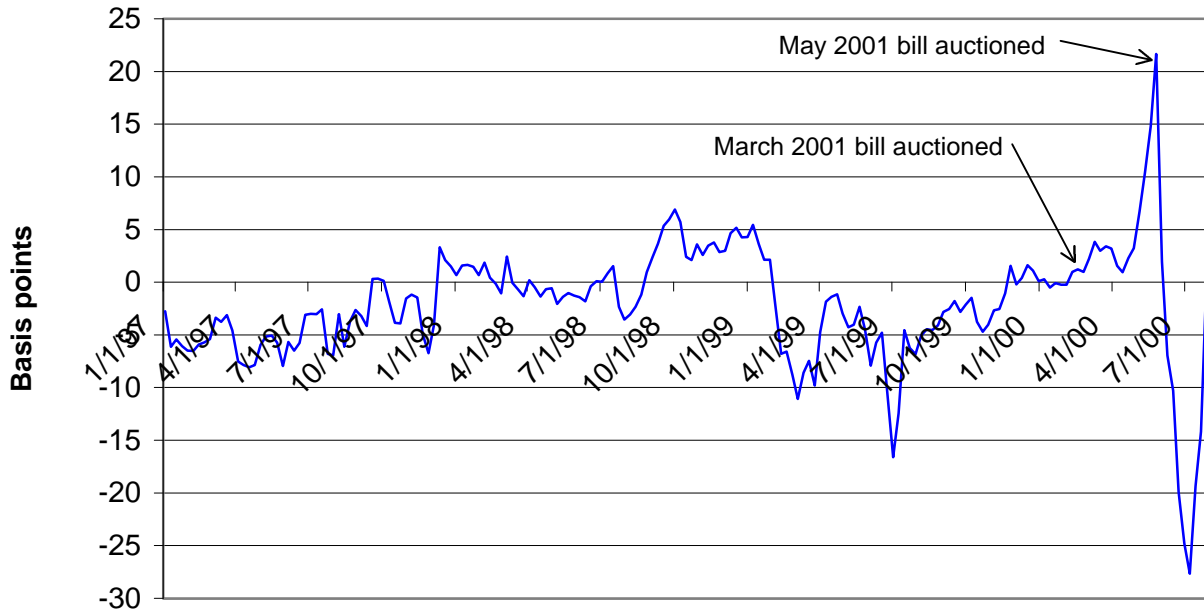
Figure 8: U.S. Treasury Coupon Curve on July 31, 2000



Sources: Bear Stearns; GovPX.

Note: The figure plots yields against years to maturity for Treasury coupon securities with more than 30 days to maturity (excluding callable bonds, flower bonds, and inflation-indexed securities).

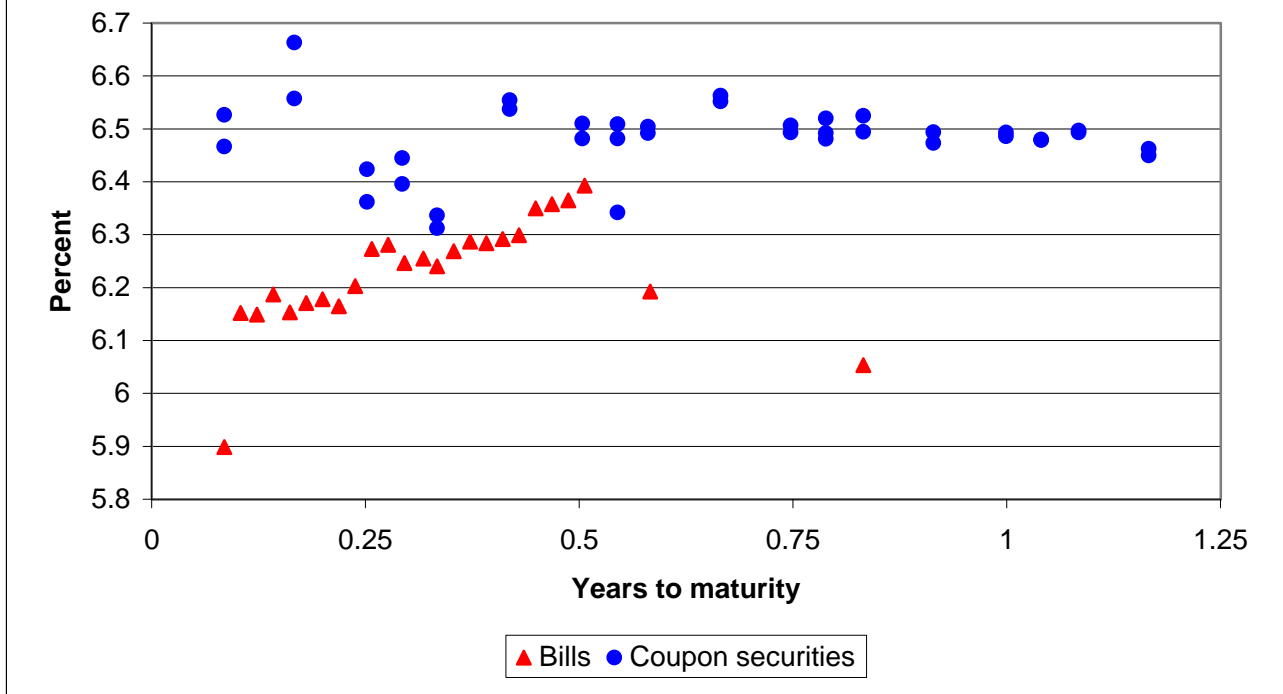
Figure 9: Off-the-Run/On-the-Run Yield Spread of One-Year U.S. Treasury Bill



Source: Author's calculations, based on data from Bear Stearns and GovPX.

Note: The figure plots the mean off-the-run/on-the-run yield spread by week for the one-year bill. The spread is calculated daily as the yield of the first off-the-run bill less the yield of the on-the-run bill.

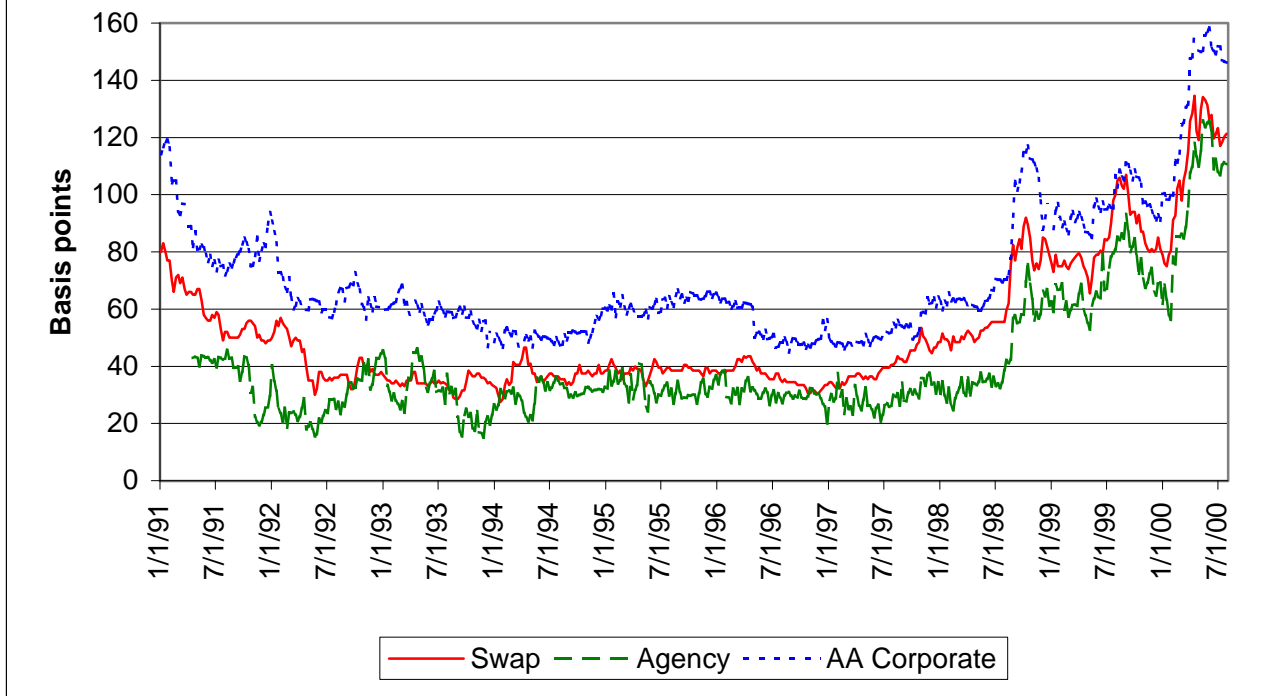
Figure 10: U.S. Treasury Bill Curve on July 31, 2000



Sources: Bear Stearns; GovPX.

Note: The figure plots yields against years to maturity for Treasury securities with more than 30 days but not more than 1 1/4 years to maturity.

Figure 11: Yield Spreads to the Ten-Year U.S. Treasury Note



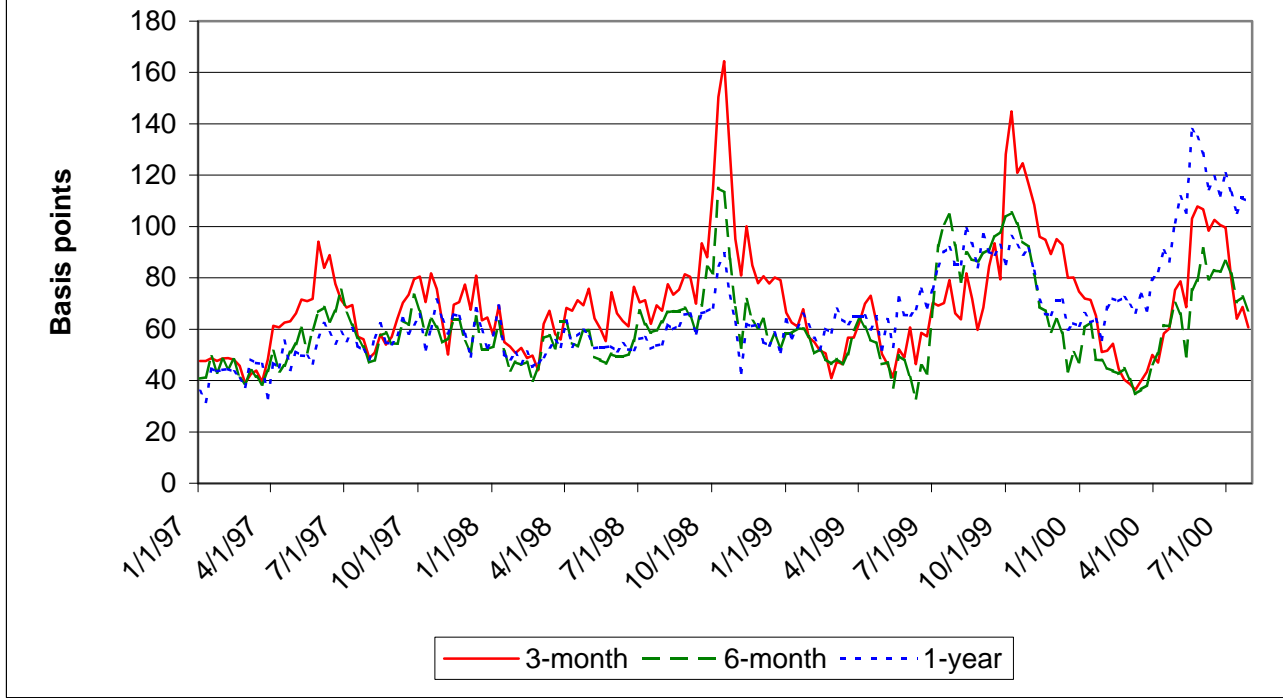
Source: Author's calculations, based on data from Bloomberg and Merrill Lynch.

Notes: The swap rate is the ten-year semi-annual fixed versus three-month LIBOR rate from Bloomberg.

The AA corporate yield is the 7-10 year index yield from Merrill Lynch.

The agency yield is the ten-year option-free index yield from Bloomberg.

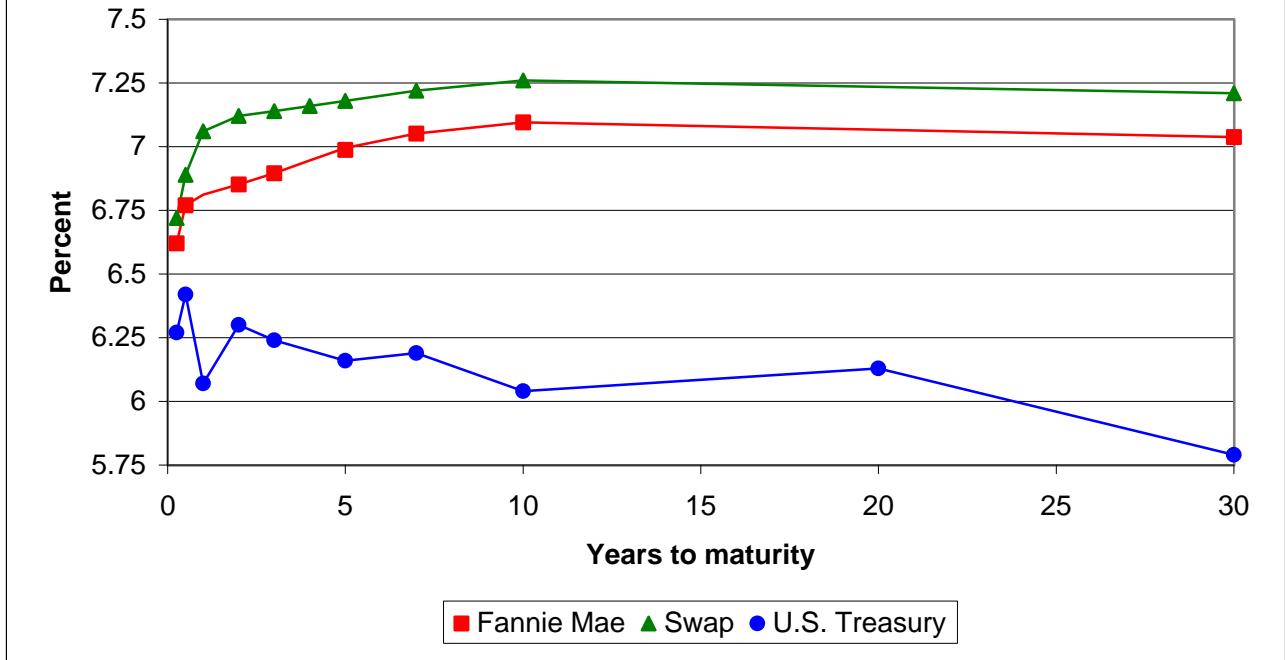
Figure 12: LIBOR/U.S. Treasury Bill Spread



Source: Author's calculations, based on data from Bloomberg.

Note: The figure plots LIBOR less the U.S. Treasury bill yield by week for the indicated maturities.

**Figure 13: Fannie Mae, Swap, and U.S. Treasury Yield Curves
on July 31, 2000**



Sources: Bloomberg; Federal Reserve Board.

Notes: The figure plots the points on the Fannie Mae benchmark curve, the swap curve, and the U.S. Treasury constant maturity yield curve. Three-month and six-month LIBOR are used for the short end of the swap curve.