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# WHEN THE BACK OFFICE MOVED TO THE FRONT BURNER: SETTLEMENT FAILS IN THE TREASURY MARKET AFTER 9/11

- Following the September 11 attacks, many sellers of Treasury securities failed to meet their obligation to deliver the securities on the scheduled date. Settlement “fails” jumped from \$1.7 billion a day in the week ending September 5 to \$190 billion a day in the week ending September 19.
- Fails rose initially because of the destruction of trade records and communication facilities. They remained high because the method typically used to avert or remedy a fail—borrowing a security through a special collateral repurchase agreement—proved as costly as failing to deliver the security.
- The U.S. Treasury responded to the fails problem by reopening the on-the-run ten-year note. The increased supply made borrowing the note more attractive than failing.
- Alternative solutions to chronic fails include the creation of a Treasury facility that could lend specific securities on a temporary basis and the institution of a penalty fee for fails.

On Thursday, October 4, 2001, the U.S. Treasury announced an unprecedented “snap,” or same-day, auction of a coupon-bearing security. The auction reopened the on-the-run ten-year note and increased the outstanding supply of the note from \$12 billion to \$18 billion. The Treasury stated that the offering had “nothing to do with an increase of funding needs on our part” (*Bloomberg* 2001a). Rather, it sold the securities to help resolve an extraordinary volume of settlement fails precipitated by the attacks of September 11.

A settlement fail occurs when securities are not delivered and paid for on the date originally scheduled by a buyer and seller.<sup>1</sup> Fails are important because they expose market participants to the risk of loss in the event of counterparty insolvency. The prospect of such loss leads participants to devote resources to monitoring and controlling counterparty exposure and could, in an extreme case, lead them to limit their secondary-market trading. Treasury’s statement that it reopened the ten-year note to avoid damage to “the price discovery process and the smooth operating of the Treasury market” (*New York Times* 2001) suggests that policymakers were aware of the latter possibility.

This article describes the institutional and economic setting of the fails problem and suggests why that problem led

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The authors thank Kenneth Abbott, Peter Bakstansky, April Bang, Anne Baum, David Buckmaster, Tom Daula, Mary Ann Davis, Robert Elsasser, Eric Foster, Kenneth Guentner, David Harrison, Ivan Hurwitz, Jeff Huther, Anthony Isola, John Kambhu, Jim Mahoney, Frank O’Connor, Carol Osler, Omer Oztan, Deborah Perelmuter, Lawrence Radecki, Kimberly Reese, Raymond Stancil, Robert Toomey, Hank Wiener, two anonymous referees, seminar participants at the Federal Reserve Bank of New York, and especially Allen Clark and Jeffrey Ingber for assistance and comments. The views expressed are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

policymakers to depart so significantly from previous debt management practices. The next section sets the stage by reviewing how investors establish beneficial ownership of Treasury securities and how those securities are traded in the secondary market. We then describe the machinery that supports the secondary market: the settlement process and repurchase agreements (RPs) for financing long and short positions. A description of how settlement fails come about in the normal course of trading is then offered, along with an explanation of how fails are cured. Next, we review conditions in the Treasury market following September 11, explain how those conditions led to an extraordinary volume of fails, and describe the responses of the Federal Reserve and the Treasury. Alternative mechanisms for alleviating chronic fails are then examined.

## OWNING AND TRADING TREASURY SECURITIES

Most marketable Treasury securities are owned, directly or indirectly, through the Fedwire Book-Entry Securities Transfer System (Fedwire), an electronic safekeeping and transfer system operated by the Federal Reserve and the Treasury (Stigum 1988, Chapter 7). Only depository institutions and certain other designated entities can open Fedwire accounts and own Treasury securities directly in their own accounts. Other investors establish ownership indirectly through custodial relationships with depository institutions in which a custodian institution holds investors' commingled securities in its Fedwire account and maintains a record of the securities' beneficial owners. In some cases, there may be one or more additional custodians standing between a depository institution and the beneficial owners (Martin 1985).

Most secondary-market transactions in Treasury securities are executed with dealers that make markets in the securities (Fleming 1997; Dupont and Sack 1999). Treasury dealers range from regional banks and small broker-dealer firms to large, nationally prominent banks and broker-dealers. A "primary" dealer is one that has agreed to make markets to the Federal Reserve Bank of New York when it is conducting open market operations and that has satisfied other criteria prescribed by the New York Fed.<sup>2</sup>

Treasury dealers also trade among themselves to manage their inventory positions and risk exposures. They sell securities in the course of reducing positions acquired from customers, they buy securities to rebuild inventories

depleted by sales to customers, and they purchase and sell highly liquid on-the-run issues to manage their exposure to interest rate risk. (An on-the-run security is the most recently auctioned security in a particular series, for

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example, the most recently auctioned ten-year note. An off-the-run security is one that is no longer on the run. Fleming [2002] documents liquidity differences between on-the-run and off-the-run securities.)

Most inter-dealer trading is conducted through brokers that sponsor electronic trading systems where dealers can enter bids and offers, hit a bid posted by another dealer, and lift the offer of another dealer (Boni and Leach 2001). Trading through an inter-dealer broker is on a blind basis: the broker does not disclose the name of the buyer to the seller, or the name of the seller to the buyer. During 2001, primary dealers traded an average of \$306 billion a day in Treasuries: \$150 billion through brokers and \$156 billion otherwise.<sup>3</sup>

## SETTLING SECONDARY-MARKET TRANSACTIONS

To understand the nature of the settlement problem in the Treasury market after September 11, one needs to understand how Treasury securities settle in normal times. Most secondary-market transactions are for settlement, that is, delivery of securities to the buyer and payment of the invoice price to the seller, one business day after the trade date. This is known as "regular" settlement. However, a buyer and seller may agree to some alternative settlement, including "cash" settlement on the trade date or "forward" settlement on a date following the next business day.

Dealers play a central role in the settlement process because the vast majority of secondary-market transactions are either between an investor and a dealer or between two dealers. Many of the largest dealers maintain custodial accounts at one of two "clearing" banks—JPMorgan Chase Bank (JPMC) and the Bank of New York (BoNY)—that offer specialized dealer settlement services.<sup>4</sup>

## Bilateral Settlement

Suppose an investor sells Treasury notes to a dealer for regular settlement. Following negotiation of the terms of the sale (and usually after the close of business on the trade date), the investor instructs its custodian depository institution to deliver the notes and to collect the invoice price on the settlement date.

On the settlement date, the investor's custodian instructs Fedwire to transfer notes that the custodian knows to be beneficially owned by the investor from the Fedwire account of the custodian to the Fedwire account of the dealer's clearing bank, to collect the invoice price from the Fedwire account of the dealer's clearing bank, and to notify the dealer's clearing bank that the notes are to be credited to the dealer's custodial account. This is known as "delivery versus payment" because delivery of the securities occurs simultaneously with collection of the invoice price (Bank for International Settlements 1992). The funds are credited directly to the Fedwire account of the investor's custodian, and ultimately to the investor's custodial account.

A similar process takes place if an investor purchases notes from a dealer. On the settlement date, the dealer instructs (through software provided by its clearing bank) Fedwire to transfer notes beneficially owned by the dealer from the Fedwire account of the dealer's clearing bank to the Fedwire account of the investor's custodian and to collect the invoice price.

If the dealer's clearing bank and the investor's custodian are the same depository institution, securities are transferred from the seller to the buyer, and funds are transferred from the buyer to the seller, on the books of the common custodian and without Fedwire activity.

A sale of less than \$50 million (principal amount) is usually delivered in a single block. Larger sales are delivered in multiple separate blocks of \$50 million each plus (if required) a "tail" piece.<sup>5</sup> This means that a dealer that sells \$175 million of two-year notes to a single buyer does not have to accumulate (during the course of the settlement day) a \$175 million position in the notes before making delivery. The dealer can deliver part of the sale as soon as it has assembled a \$50 million block, and deliver more later as it receives notes from its own purchases.

## The Government Securities Clearing Corporation

Prior to 1989, bilateral settlement of inter-dealer trades compelled dealers to redeliver arriving securities repeatedly.

The Government Securities Clearing Corporation (GSCC) was organized in the late 1980s to simplify the settlement process, to reduce the volume of Fedwire transfers, and to mitigate risk arising from counterparty exposures. Until 2002, GSCC was owned primarily by its members and operated on a not-for-profit basis. (In January 2002, GSCC became a wholly-owned subsidiary of Depository Trust & Clearing Corporation.) GSCC's membership includes—but is not limited to—all of the primary dealers, a number of banks and broker-dealers that are not primary dealers, and the inter-dealer brokers.<sup>6</sup>

The Government Securities Clearing Corporation facilitates the comparison of trades between members, reduces deliveries to the smallest possible volume, and steps in as the counterparty in the net settlement of all compared trades.

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GSCC is not a depository institution and does not have a Fedwire account. It divides its settlement business between BoNY (for notes) and JPMC (for bills, bonds, STRIPS, and inflation-indexed securities).

### Trade Comparison

A trade is said to be "compared" when both the buyer and the seller have acknowledged the transaction and agreed to its terms, usually to a third party. Following a direct trade between two GSCC members, each member sends an advisory message to GSCC identifying the counterparty, the security, the quantity of the security, the invoice price, and the settlement date. GSCC deems the trade compared when it has matching information from the two parties.

Following a brokered trade between two GSCC members, the broker sends two messages to GSCC: one identifying the buyer and the terms of the trade, the other identifying the seller and the terms of the trade. Additionally, the buyer and seller each send messages of their own, identifying the terms of the trade, the broker, and their role (buyer or seller) in the transaction. GSCC compares the seller's message with the corresponding broker's message and the buyer's message with

the other broker's message separately. This two-part process is required because brokered trading is on a blind basis: a buyer and seller do not know each other's identity either before or after agreeing to a trade.

#### *Net Settlement*

After the cessation of trading at the end of a business day, GSCC computes, from all compared trades, the net obligation of each member to either receive or deliver securities the next business day, on an issue-by-issue basis.<sup>7</sup> Then, in a process known as "novation," that is, the substitution of a new legal obligation for an old one, GSCC steps in as the counterparty to every member. A member with a net obligation to deliver a security is instructed to deliver the security to GSCC; a member with a net obligation to receive a security is advised that it will receive the security from GSCC. (The deliveries to and receives from GSCC net to zero in every security. GSCC does not trade securities for its own account and is only a conduit for settlement purposes.) At the same time, GSCC instructs the clearing banks what securities it expects to receive and how much to pay for the securities, and it instructs the banks where the securities should be redelivered and how much to collect upon redelivery.

The primary advantage of this net settlement system is that each GSCC member need only deliver its net sales (or receive its net purchases), instead of both delivering its gross sales and receiving its gross purchases. On an average day in 2001, GSCC compared and netted about 55,000 transactions with a market value of about \$1.4 trillion. The transactions netted down to an average of about 11,000 deliveries with a value of about \$400 billion (Government Securities Clearing Corporation 2002, p. 2).

GSCC creates deliver and receive instructions in pairs. Each instruction to deliver a security to GSCC is paired with, or "bound" to, an instruction to receive an equal size block of the same security from GSCC. After the opening of Fedwire on a settlement day, GSCC begins to receive blocks of securities pursuant to the delivery instructions that it created the preceding night and promptly (in a matter of seconds) redelivers those blocks pursuant to its own novated delivery obligations. GSCC's practice of creating deliver and receive instructions in matched and bound pairs facilitates immediate redelivery because it never has to wait for additional securities to come in to make up an outgoing block.

#### *Transaction Adjustment Payments*

All deliveries of a security to GSCC, and all redeliveries of the same security from GSCC, are made against payment at a

common current market value (CMV). The CMV of a security is a representative price and is not necessarily equal to the price of any particular transaction. GSCC marks the transactions of each of its members in a security to the security's CMV by adding up the net excess of a member's purchase prices over the security's CMV and subtracting the net excess of the member's sale prices over the CMV. These net amounts are aggregated across all of the member's securities to produce a transaction adjustment payment. If the adjustment payment is greater than zero, the member is required to pay it into a GSCC account at BoNY by 10 a.m. on the settlement date. If it is negative, GSCC agrees to pay it out to the member by 11 a.m.

## FINANCING LONG AND SHORT POSITIONS

Some market participants, especially dealers and hedge funds, commonly commit themselves to paying amounts in excess of their cash balances when they purchase Treasury securities. Moreover, they sometimes sell more securities than they own, or sell securities short. In the former case, they have to borrow money to make the payment due upon delivery. In the latter case, they have to borrow securities to make delivery and get paid. Borrowing money to pay for a purchase, and borrowing securities to settle a short sale, are "financing" transactions, which are usually done with repurchase agreements. Repurchase agreements are important to understanding the fails problem after September 11 because they can be used to avoid or cure settlement fails and because they themselves may fail to settle.

To borrow money with an RP, a dealer sells securities (typically for cash, or same-day, settlement) and simultaneously agrees to repurchase the same securities from the buyer at a higher price on a future date. As illustrated in Box 1, an RP is tantamount to a collateralized loan. The proceeds of the sale are the principal amount of the loan, and the excess of the repurchase price over the sale price is the interest paid on the loan.

The opposite occurs when a dealer has to borrow securities: the dealer buys (again, usually for cash settlement) the securities that it needs from an investor and simultaneously agrees to sell the same securities back to the investor at a higher price on a future date. This transaction is an RP from the investor's perspective: a sale of securities today, coupled with an agreement to repurchase the securities on a future date. The dealer is said to enter into a "reverse repurchase agreement"—

“reversing in” the securities that it needs against lending money, or borrowing securities using cash as collateral.

Corporate and municipal treasurers and money market mutual funds have money to lend for short periods of time and are important sources of funds for dealers. Other investors, such as pension funds and life insurance companies, own Treasury securities and are in a position to lend them to dealers. However, one might wonder why a pension fund or life insurance company would want to borrow a dealer’s money. The answer lies in the distinction between a general collateral RP and a special collateral RP.

Box 1

### A Repurchase Agreement

On Monday, December 1, dealer A wants to finance \$10 million principal amount of Treasury notes. The notes have a 5 percent coupon payable in semi-annual installments on May 15 and November 15 and are quoted at a price of 99 percent of principal. Investor B agrees to lend the dealer money on an overnight repurchase agreement at a rate of 3 percent per annum.

Assume for simplicity that the dealer sells the notes to the investor at the quoted price plus accrued interest for cash settlement on December 1. The accrued interest on the notes is computed using the 5 percent coupon rate and an actual-over-actual-day count. There are 16 days from November 15 to December 1 and 182 days from November 15 to May 15 (assuming the absence of a leap day), so the accrued interest to December 1 is:

$$\text{accrued interest} = \frac{16}{182} \cdot \frac{1}{2} \cdot 5.00 = .219780 \text{ percent of principal amount.}$$

The amount borrowed, that is, the amount due upon delivery of the notes to investor B, is \$9,921,978 (\$9,921,978 = 99.219780 percent of \$10 million).

On Tuesday, December 2, dealer A repurchases the notes for the amount borrowed on December 1 plus interest on that amount at the rate of 3 percent per annum, calculated with an actual-over-360-day count:

$$\text{repurchase amount} = \$9,921,978 + \frac{1}{360} \cdot 3 \text{ percent of } \$9,921,978 = \$9,922,805.$$

## General Collateral Repurchase Agreements

A general collateral repurchase agreement is an RP in which the lender of funds is willing to accept any of a variety of Treasury securities as collateral. The lender is concerned primarily with earning interest on its money and with having possession of securities that can be sold quickly in the event of a default by the borrower. Reflecting the relative indifference of the lender to the specific identity of the collateral, interest rates on general collateral RPs are commonly negotiated early in the business day—more than half of all general collateral RPs are negotiated before 9 a.m.—while collateral may not be assigned until late morning.

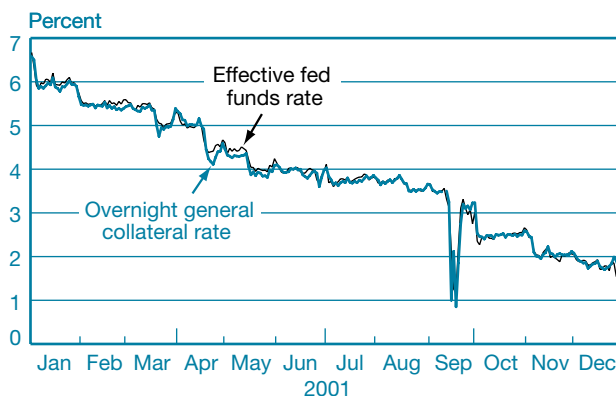
As shown in Chart 1, interest rates on overnight general collateral RPs are usually quite close to contemporaneous rates on overnight loans in the federal funds (fed funds) market. This comports with the essential character of a general collateral RP as a device for borrowing and lending money.

## Special Collateral Repurchase Agreements

A special collateral repurchase agreement is an RP in which the lender of funds has identified a particular security as the only acceptable collateral. The rate on a special collateral RP is commonly called a “special” rate. Each Treasury security has its own special rate. This reflects the essential character of a special collateral RP as a device for borrowing and lending securities.

CHART 1

### General Collateral and Effective Fed Funds Rates



Sources: Bloomberg; GovPX.

The owner of a Treasury security that a dealer wants to borrow may not have any particular interest in borrowing the dealer’s money, but can nevertheless be induced to lend the security if it is offered an opportunity to borrow at a specials rate below where it can relend the same funds on a general collateral RP. For example, if the rate on a special collateral RP is 2 percent and the rate on a general collateral RP is 3 percent, then—as shown in Exhibit 1—an investor can earn a 100-basis-point spread by borrowing money on the special collateral RP and relending the money on a general collateral RP.

*The Specials Rate for a Security and the “Specialness” of the Security*

The difference between the general collateral RP rate and the specials rate for a security is a measure of the “specialness” of the security (Duffie 1996; Keane 1996; Jordan and Jordan 1997). If the demand to borrow a security is modest relative to the supply of the security available for lending, a borrower of the security will usually be able to lend its money at a rate no lower than about 15 to 25 basis points below the general collateral rate.

If the demand to borrow a security is strong, or if the supply of the security available for lending is limited, the specials rate for the security may be materially below the general collateral rate and the specialness spread correspondingly large. In this case, a dealer borrowing the security has to sacrifice a significant portion of the interest that it could have earned from lending its money in the general collateral market. Conversely, a holder of the security will be rewarded with a “bargain” loan rate. Charts 2 and 3 show specials rates for on-the-run five- and ten-year notes, respectively, in 2001, and

EXHIBIT 1  
Lending Collateral (and Borrowing Money) on a Special Collateral Repurchase Agreement and Relending the Money on a General Collateral Repurchase Agreement

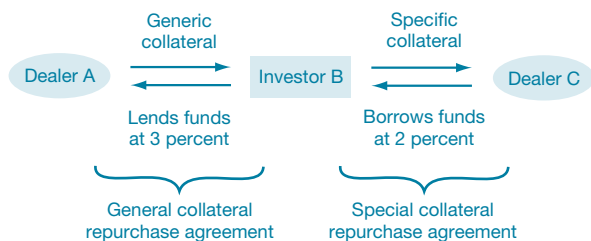


Table 1 shows average specialness spreads for these and other securities during the first eight months of 2001.<sup>8</sup>

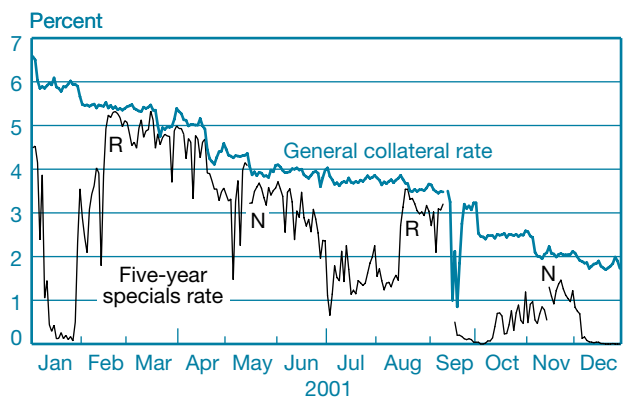
In cases of exceptionally strong demand, or exceptionally limited supply, the specials rate for a security can be driven to zero or nearly zero. Charts 2 and 3 show several such instances, including the period from late January to early February for the five-year note and the period from late April to early May for the ten-year note. Other instances of extremely low specials rates have been documented by Cornell and Shapiro (1989), Jordan and Jordan (1997, pp. 2058-9), and Fleming (2000, pp. 229-31).

*Supply, Demand, and Equilibrium in a Specials Market*

The specialness spread for a security is the economic price of, or fee for, borrowing the security and fluctuates to balance the demand for borrowing with the supply available for lending. Ceteris paribus, a larger spread elicits greater supply because it offers a greater reward to owners of the security who borrow funds in the specials market (thereby lending the security) and relend the funds in the general collateral market.

A larger spread also reduces the demand for borrowing a security. Borrowing demand stems primarily from the need to finance short positions. Ceteris paribus, a larger specialness spread increases the cost of financing a short position and thus reduces the attractiveness of being short. Additionally, as the specials rate for a security approaches zero, market participants

CHART 2  
RP Rates for the Five-Year Treasury Note and General Collateral

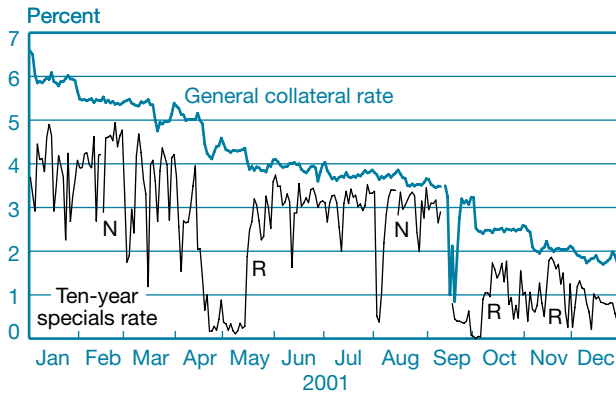


Sources: Bloomberg; GovPX.

Notes: The chart plots overnight repurchase agreement (RP) rates for the on-the-run five-year U.S. Treasury note and general collateral from January 2 to December 31, 2001. “N” indicates the issuance of a new note and “R” indicates the reopening of an existing note.

CHART 3

RP Rates for the Ten-Year Treasury Note and General Collateral



Sources: Bloomberg; GovPX.

Notes: The chart plots overnight repurchase agreement (RP) rates for the on-the-run ten-year U.S. Treasury note and general collateral from January 2 to December 31, 2001. “N” indicates the issuance of a new note and “R” indicates the reopening of an existing note.

with short positions may begin to opt to fail on their delivery obligations rather than go to the trouble of lending money at a negligible rate of interest to borrow the securities needed to make delivery. This feature is critically important to understanding the fails problem following September 11 and will be examined later in more detail.

TABLE 1  
Specialness Spreads for Treasury Securities, January-August 2001

Security	On-the-Run		First-off-the-Run	
	Mean	Standard Deviation	Mean	Standard Deviation
Three-month bill	6.4	6.9	—	—
Six-month bill	5.4	3.2	—	—
Two-year note	107.8	101.7	82.2	92.4
Five-year note	142.2	156.2	18.5	20.0
Ten-year note	156.6	130.7	29.8	42.7
Thirty-year bond	7.9	6.9	8.0	8.4

Source: GovPX.

Notes: The table reports descriptive statistics (in basis points) for the daily differences between the overnight general collateral rate and the specials rates on the indicated U.S. Treasury securities. A first-off-the-run security is the most recently issued off-the-run security in a particular series.

## Settling a Repurchase Agreement

An RP involves two settlements: one at inception and the other at maturity. Following negotiation of the terms of an agreement, and usually on the same day, the lender of securities delivers the securities to its counterparty against payment of the principal amount of the RP. On the maturity date, the borrower of securities delivers the securities back to the original owner against payment of interest plus repayment of principal.

### Comparing and Settling RPs between GSCC Members

If both parties to a bilaterally negotiated RP are GSCC members, the parties can submit their agreement to GSCC’s comparison and netting processes. Following negotiation of the terms of the RP, each party sends a message to GSCC identifying its counterparty and describing the terms. GSCC deems the agreement compared if it receives matching information from the two parties.

If the agreement calls for cash settlement of the starting leg, settlement of that leg is bilateral between the borrower and lender because GSCC does not net and novate transactions until after the close of business. If the agreement provides for settlement of the starting leg on a date following the trade date, settlement is included in GSCC’s netting and novation process for that date. In either case, settlement of the closing leg of the RP is included in GSCC’s netting and novation process.

### Blind-Brokered RPs with Cash Settled Starting Legs

Inter-dealer brokers arrange RPs as well as outright transactions. Prior to 1996, a broker would “give up” the name of each side of a brokered RP that provided for cash settlement of the starting leg to the counterparty and leave the two sides to settle the starting leg bilaterally. This arrangement had the disadvantage of allowing the lender of money on a general collateral RP to gain some insight into the long positions held by its counterparty, and of allowing the lender of securities on a special collateral RP to acquire information on a short position that its counterparty needed to finance.

In mid-1996, GSCC began to facilitate a less revealing way to settle the opening leg of a blind-brokered RP. Following negotiation of a blind-brokered RP, the borrower of money delivers the collateral securities to the broker against payment of the principal amount of the loan and the broker redelivers the securities (against the same payment) to the ultimate lender. GSCC makes this possible by guaranteeing broker payment and delivery obligations on compared transactions. (The broker’s role in cash settlement of the starting leg of a

blind-brokered RP cannot be eliminated as long as GSCC does not net and novate transactions during a business day. This proved to be an important element of the fails problem following September 11.)

## Borrowing Securities from the Federal Reserve

The Federal Reserve's System Open Market Account (SOMA) is the largest single owner of marketable Treasury securities, holding \$575 billion in principal amount on December 31, 2001, or 19.4 percent of the \$2.968 trillion outstanding. The Federal Reserve allows primary dealers to borrow securities from SOMA as a "secondary and temporary source of securities . . . in order to promote smooth clearing of Treasury securities."<sup>9</sup> Federal Reserve efforts to mitigate settlement problems after September 11 were carried out through this securities lending program.

The program works as follows. Each day at noon, the New York Fed auctions a specified amount of every Treasury security in the SOMA portfolio for overnight lending. (From September 7, 1999, through September 26, 2001, the amount was 45 percent of the quantity beneficially owned by SOMA, subject to an upper limit of the amount actually in SOMA's account at the time of auction.) A participating dealer bids a borrowing fee that is economically equivalent to a specialness

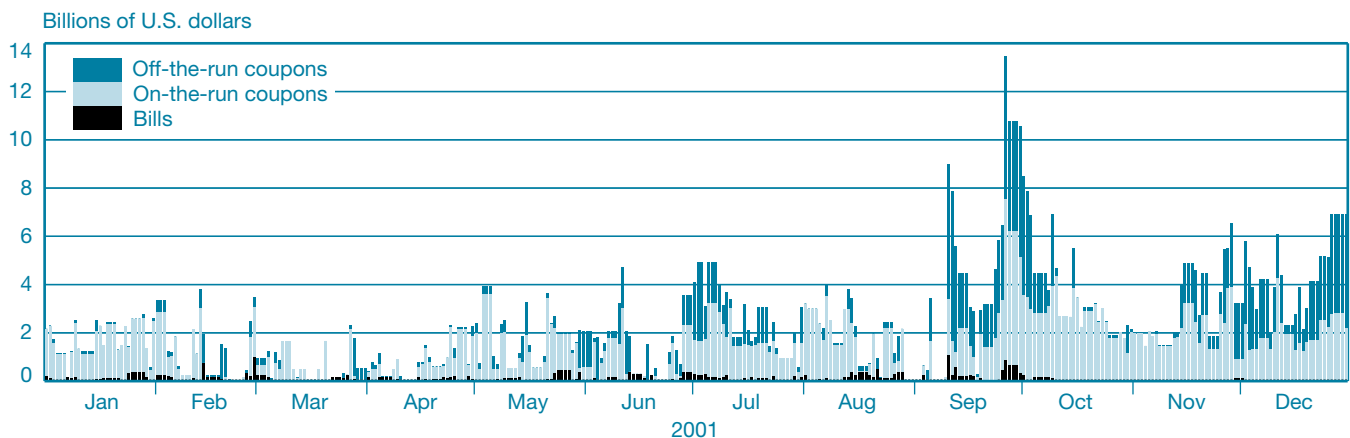
spread for each security that it wants to borrow. For example, a dealer might offer to pay a fee of 2 1/2 percent per annum to borrow a security if the general collateral rate is 4 percent and the specials rate for the security is 1 1/2 percent. Securities are awarded to the highest bidders at their bid rates until all bidders are satisfied or all of the available stock of a security has been allocated. Prior to September 11, a dealer had to bid a borrowing fee of at least 150 basis points and was limited to \$100 million of any one security and \$500 million in aggregate. Borrowings from SOMA are collateralized with other Treasury securities.

Chart 4 shows the volume of SOMA lending activity in 2001. Over the interval from January to August, primary dealers borrowed an average of \$1.6 billion in principal amount of securities per day. On-the-run notes and bonds accounted for 69.7 percent of the borrowings, off-the-run notes and bonds accounted for 25.2 percent, and the balance of 5.1 percent was in bills.

## SETTLEMENT FAILS

A settlement fail is the failure of a transaction to settle on the date originally agreed to by the buyer and seller. The transaction can be an outright sale, or the starting or closing leg of an RP. Although the post-September 11 period was characterized by an unprecedented level of fails, fails also occur

CHART 4  
SOMA Securities Lending



Source: Federal Reserve Bank of New York.

Notes: The chart plots daily lending of U.S. Treasury securities by the System Open Market Account (SOMA) of the Federal Reserve from January 2 to December 31, 2001. Total lending is broken down by lending in bills, on-the-run coupon securities, and off-the-run coupon securities.



in more normal times. During the first eight months of 2001, settlement fails in Treasury securities at primary dealers averaged \$7.3 billion per day. Chart 5 shows the behavior of fails in 2001.

Fails occur for a variety of reasons. One source of fails is miscommunication. Despite their best efforts to agree on terms, a buyer and seller may sometimes not identify to their respective operations departments the same details for a given transaction. On the settlement date, the seller may deliver what it believes is the correct quantity of the correct security and claim what it believes is the correct payment, but the buyer will reject the delivery and reclaim its funds if it has a different understanding of the transaction. If the rejection occurs late in the day, there may not be enough time for the parties to resolve the misunderstanding.

In some cases, a seller or a seller’s custodian may be unable to deliver securities because of operational problems. In an extreme example, a computer problem at BoNY on November 21, 1985, prevented the bank from issuing instructions to Fedwire to deliver securities from its custodial accounts. The bank was unable to resolve the problem until the following day. In the interim, it had to finance (at its own expense) the securities that it was unable to deliver. It borrowed in excess of \$20 billion from the New York Fed and incurred interest expenses of about \$5 million (*Wall Street Journal* 1985; Sender 1986).

Finally, and most commonly, a seller may be unable to deliver securities because of a failure to receive the same securities in settlement of an unrelated purchase. This can lead

to a “daisy chain” of cumulatively additive fails: A’s failure to deliver bonds to B causes B to fail on a sale of the same bonds

*Although the post-September 11 period was characterized by an unprecedented level of fails, fails also occur in more normal times. During the first eight months of 2001, settlement fails in Treasury securities at primary dealers averaged \$7.3 billion per day.*

to C, causing C to fail on a similar sale to D, and so on. A daisy chain becomes a “round robin” if the last participant in the chain is itself failing to the first participant.

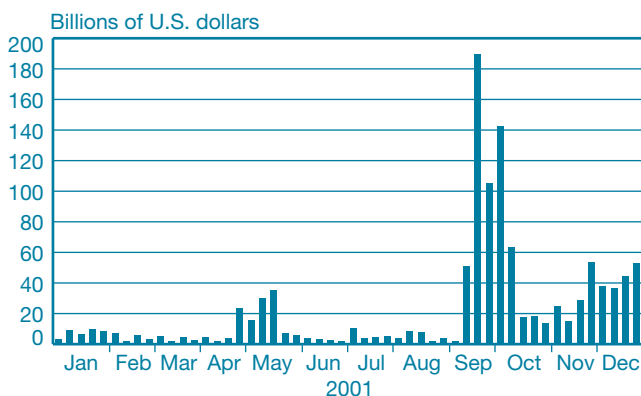
## The Cost of a Fail

Market participants recognize that miscues and operational problems occur from time to time, and have adopted the convention of allowing a failing seller to make delivery the next business day at an unchanged invoice price (Public Securities Association 1993, Chapter 8, Section C).<sup>10</sup> Settlement fails, however, are not costless.

The most important cost of a fail is that the seller loses the time value of the invoice price over the interval of the fail. (This cost may be reimbursed by the buyer if the buyer’s actions caused the fail, for example, by improperly rejecting securities properly tendered by the seller, or by a third party if the third party’s actions caused the fail, for example, a custodian failing to deliver securities pursuant to the instructions of the seller.) This implicit penalty (which can be quantified as the interest that could have been earned in the fed funds or general collateral markets) provides an incentive to sellers to avoid and cure fails. (There is an exactly offsetting benefit to a buyer that fails to receive securities and therefore does not have to pay for them as soon as originally scheduled: it can invest the invoice price until the securities arrive. Stigum [1988, pp. 181-5] and DeGennaro and Moser [1990] describe the relationship between fails and dealer behavior.)

Additionally, a fail exposes both the buyer and the seller to replacement cost risk. The buyer faces the risk that the seller becomes insolvent before settlement and that the price of the security increases prior to the seller’s insolvency. Conversely,

CHART 5  
Settlement Fails in U.S. Treasury Securities



Source: Federal Reserve Bank of New York.

Note: The chart plots daily average settlement fails to deliver of U.S. Treasury securities as reported by the primary dealers for the weeks ending January 3 through December 26, 2001.

the seller faces the risk that the buyer becomes insolvent and that the price of the security declines prior to the buyer's insolvency. The significance of replacement cost risk exposure may be small for a fail that does not last more than a few days, but it increases as a fail continues. Aged fails generally prompt market participants to step up their monitoring of counterparties.

*A fail exposes both the buyer and the seller to replacement cost risk . . . . The significance of replacement cost risk exposure may be small for a fail that does not last more than a few days, but it increases as a fail continues.*

Initially, the increased monitoring may be nothing more than a phone call to identify whether there has been a misunderstanding, but it can escalate to credit reviews and requests for ad hoc mark-to-market price adjustments.<sup>11</sup> Additionally, the net capital requirement for regulated brokers and dealers adopted by the Securities and Exchange Commission assesses capital charges for two types of aged fails (17 CFR 240.15c3-1(c)(2)(iv)(E) and 17 CFR 240.15c3-1(c)(2)(ix)).

## Avoiding and Curing Fails

Market participants have adopted a variety of techniques to avoid fails attributable to miscommunication and to avoid and cure fails attributable to a failure to receive securities that are to be redelivered. Most importantly, GSCC's comparison process limits fails attributable to miscommunication, and its netting and novation process limits daisy chain and round robin fails among its members. For example, if member A sells \$25 million of bonds to member B, B sells \$25 million of the same bonds to member C, and C sells \$25 million of the bonds to member D, then, after netting and novation, A owes \$25 million of the bonds to GSCC and GSCC owes \$25 million of the bonds to D. If A fails to GSCC (and GSCC consequently fails to D), the aggregate fails to deliver and receive will be limited to \$50 million each. In the absence of netting and novation, A's failure to deliver could result in aggregate fails to deliver and receive of \$75 million each.

GSCC's net settlement process does not completely eliminate round robin fails, because GSCC fails are not usually renetted every day.<sup>12</sup> A GSCC member that fails to deliver securities

pursuant to a GSCC instruction must ultimately make that specific delivery, even if the member is a net buyer of an equal or larger amount of the same issue for settlement on the next business day. Similarly, GSCC remains obligated to redeliver the securities pursuant to its matched and bound redelivery instruction, even if the member to whom GSCC owes the securities is a net seller of an equal or larger amount of the same issue for settlement on the next business day. Thus, it is possible for a GSCC member to be failing to GSCC and for GSCC to be failing simultaneously to the same member in the same security on a delivery instruction created on a different date.

As shown in Exhibit 2, fails stemming from an inability to deliver securities because of a failure to receive the same securities can be cured (or avoided entirely) by reversing in the securities needed for delivery and delivering the borrowed securities. The reverse RP can be closed out when the seller finally makes delivery. A market participant with offsetting fails is usually better off earning the specials rate on the money it lends out against reversing in the securities needed to make

*Market participants have adopted a variety of techniques to avoid fails attributable to miscommunication and to avoid and cure fails attributable to a failure to receive securities that are to be redelivered.*

delivery, even if that rate is below the general collateral rate. The alternative to reversing in securities is to fail and forgo interest altogether on the sale proceeds.

## When Fails Can Become Chronic

The incentive of a seller to borrow securities to avoid or cure a fail declines with the specials rate for the security. When the specials rate is near zero, a seller has little to gain lending money (at nearly no interest) to borrow the needed securities.<sup>13</sup> This suggests that market participants may have little incentive to break daisy chains and round robins when the specials rate for a security is near zero. This aspect of the market is important to understanding the fails problem after September 11.

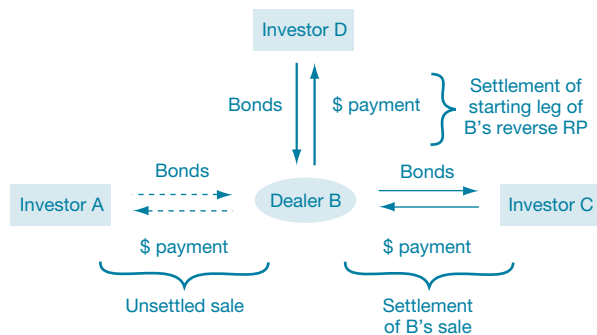
A specials rate near zero becomes increasingly likely when there is strong demand for borrowing a security. As noted, demand for a security will be strong when there is substantial short interest in the security (due to hedging requirements or

EXHIBIT 2

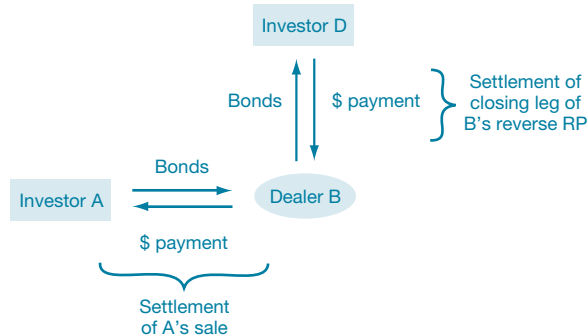
### Borrowing Securities to Cure a Settlement Fail



Suppose investor A sells bonds to dealer B, who then resells the bonds to investor C. The delivery and payment obligations of A, B, and C on the morning of the settlement date are shown with dashed lines.



Assume that A fails to deliver the bonds to B, causing B to fail to C. To cure its fail to C, B can reverse in the bonds from investor D and deliver the borrowed bonds. Actual movements of bonds and funds are shown with solid lines. The continuing (unfulfilled) obligations of A to deliver bonds to B and B to pay for the bonds are shown with dashed lines.



When A finally delivers the bonds to B, B can terminate its reverse repurchase agreement (RP) with D.

expectations of interest rate changes). In addition, such short interest is usually concentrated in highly liquid on-the-run issues. This suggests why specials rates for on-the-run five- and ten-year notes fall (Charts 2 and 3) and fails rise (Chart 5) around mid-quarter refunding auctions, a time when market participants are actively engaged in taking positions based on their assessments of the relative values of different securities and the prospect for change in the level and shape of the yield curve (Garbade 1996, Chapter 8).

Additionally, the specials rate for a security will be driven to its lower limit more frequently when the fed funds rate, and hence the general collateral rate, is lower. This follows because the gross compensation earned by a lender of securities at any given specials rate is the difference between the general collateral rate and the specials rate. A lower general collateral rate rations marginal lenders of securities out of the specials market and reduces the quantity of securities available for lending at a given specials rate. This leads to a lower equilibrium specials rate and hence to a more common occurrence of the specials rate driven to nearly zero.

### SETTLEMENT FAILS FOLLOWING SEPTEMBER 11

The attacks of September 11 precipitated an extraordinary increase in settlement fails in the Treasury securities market. As shown in Chart 5, daily average fails jumped from \$1.7 billion during the week ending Wednesday, September 5, to \$190 billion during the week ending September 19. (Our fails data begin in mid-1994. The previous high-water mark had been \$35 billion during the week ending May 16, 2001.) The Federal Reserve responded by relaxing restrictions on its securities lending program. When the volume of fails did not abate after three weeks and when fails began to threaten, according to Treasury, “the price discovery process and the smooth operating of the Treasury market” (*New York Times* 2001), Treasury reopened the on-the-run ten-year note.

### Initial Events

American Airlines Flight 11 crashed into the north tower of the World Trade Center at 8:46 a.m. on Tuesday, September 11. United Airlines Flight 175 hit the south tower sixteen minutes later, and both towers collapsed before 10:30 a.m. The catastrophe destroyed the offices and business records of several inter-dealer brokers and damaged the facilities of Verizon Corporation, located immediately north of the north tower, thereby impairing telecommunication services throughout Lower Manhattan.

#### *Destruction of Broker Offices and Records*

Although trading stopped soon after the first attack, purchases and sales of about \$80 billion of Treasury and related securities, and about \$500 billion in repurchase agreements, had already been negotiated on September 11. Most of the inter-dealer

transactions had been arranged by brokers, several of which were located in the towers of the World Trade Center. Those that did not submit trade data on a real-time basis had not yet advised GSCC of the terms of many of the transactions, and they had not yet given their clearing banks instructions for redelivering securities received in settlement of the starting legs of many of the RPs. This led to two significant operational problems.

First, the starting legs of numerous blind-brokered RPs failed to settle. Under normal conditions, if dealer A financed, through broker B, a purchase or repurchase of \$10 million of bonds with dealer C, dealer A would send the bonds to B's

*Although trading stopped soon after the first attack, purchases and sales of about \$80 billion of Treasury and related securities, and about \$500 billion in repurchase agreements, had already been negotiated on September 11.*

clearing bank and the broker would instruct its bank to redeliver the bonds to dealer C. (Both of these deliveries would be against payment of the principal amount of the RP.) On September 11, however, the clearing banks never received redelivery instructions for many RPs and the securities either remained in the brokers' clearing accounts or were returned to the putative borrowers.

Second, GSCC could not compare numerous brokered transactions because it was missing the brokers' advisory messages. Uncompared transactions were liable to be excluded from the netting and novation process scheduled for the evening of September 11 and thrown back on GSCC's members to resolve as best they could. Resolution would, however, be extraordinarily difficult because the buyers and sellers did not know the identities of their ultimate counterparties and because the offices and records of some of the brokers had been destroyed.

#### *Impaired Telecommunication Links*

Damage to telecommunication facilities impaired connectivity between many market participants and affected BoNY especially severely (MacRae 2001; *Wall Street Journal* 2001a, d; Bond Market Association 2001). Several brokers whose offices were not destroyed were nevertheless unable to advise GSCC of

trades they had arranged on the morning of September 11. Moreover, GSCC and several dealers could not verify what came into and what left their custodial accounts at BoNY, they could not advise BoNY of securities they expected to receive, and they could not give BoNY instructions for delivering securities. Additionally, GSCC was unable to verify the movement of funds into and out of its account at BoNY (GSCC Important Notice GSCC068.01).

#### *GSCC Initiatives*

GSCC took two actions on the night of September 11 to minimize the problems caused by the destruction of broker records and by the loss of telecommunication links (GSCC Important Notice GSCC070.01). First, it created, as best it could from the dealer messages that it had received, the missing broker messages on more than 2,000 trades valued at more than \$70 billion.<sup>14</sup> This action brought the trades into GSCC's netting and novation process and centralized the reconciliation of transactions that might have otherwise proved irreconcilable. Second, GSCC assumed responsibility for starting-leg fails on almost \$100 billion of blind-brokered RPs, even though it had not been able to compare many of the agreements with the brokers and their counterparties.

#### *Consequences for Settlement Fails*

GSCC classifies as a fail any delivery instruction for which it does not receive a report of good delivery (GSCC Important Notice GSCC074.01). In the absence of complete information on deliveries into and out of its account at BoNY on September 11, and as a result of its assumption of settlement fails on the starting legs of blind-brokered RPs, GSCC recorded (after the close of business on September 11) \$266 billion in transactions that apparently failed to settle.<sup>15</sup>

After the close of business, GSCC followed its normal practice and paired off starting-leg fails on overnight RPs with the closing legs of the same agreements and canceled both legs.<sup>16</sup> (It marked its remaining fails to market and created new delivery instructions for those fails.<sup>17</sup>) Also after the close of business on September 11, GSCC netted member transactions scheduled to settle on September 12 (including the brokered transactions for regular settlement for which it had created missing broker messages), novated the net purchase or sale obligations of each of its members, and created delivery instructions for the novated obligations.

Continuing connectivity problems prevented GSCC from giving BoNY delivery instructions after the close of business on September 11 and prevented it from acquiring information on activity in its account at BoNY during the day on September 12. Consequently, GSCC recorded \$440 billion in settlement fails as of the close of business on September 12.

As market participants gradually reacquired connectivity in succeeding days, they began to reconcile their incomplete and erroneous trade and settlement information. Settlement fails at GSCC dropped to \$403 billion on September 13, to \$225 billion on September 14, and to about \$90 billion by the end of the following week.

## Initial Federal Reserve Actions

The Federal Reserve reacted promptly to the September 11 attacks. The best-known dimensions of the response are the expansion of discount window loans and RPs with primary dealers that ensured bank liquidity and the integrity of the payments system (Federal Reserve Bank of New York 2002; McAndrews and Potter 2002). On the securities side, the New York Fed acted to make Treasury collateral more readily available to primary dealers. On September 11, it suspended the \$500 million limit on borrowings of SOMA securities by a single dealer, as well as the issue limit of \$100 million for a single dealer. (The post-September 11 changes to the securities lending program are posted at <http://www.newyorkfed.org/pihome/news/opnmktops/2001/omo010911.html>.) As shown in Chart 4, securities borrowings increased from \$100 million on September 10 to \$8.9 billion on September 11 and then declined gradually in the following days, to \$7.8 billion on September 12, \$5.6 billion on September 13, and steadily lower amounts the following week.

## Persistence of Settlement Fails

Despite painstaking efforts by market participants to reconcile their transactions, and despite the expanded volume of securities borrowings from the System Open Market Account, settlement fails in the Treasury market did not abate quickly to pre-attack levels. As shown in Chart 5, primary dealers reported daily average fails of \$190 billion for the week ending September 19, \$105 billion for the week ending September 26, and \$142 billion for the week ending October 3.

The persistence of high levels of fails can be most immediately attributed to specials rates at or close to zero in the weeks following September 11 (Charts 2 and 3). With specials rates so low, market participants had limited incentive to reverse in securities to break the daisy chains and round robins that had appeared during the chaos of September 11 and the days immediately following. Additionally, the low specials rates

may have given some market participants an incentive to fail “strategically,” or to agree to lend securities on special collateral RPs and then to fail intentionally on the starting legs of the agreements (Box 2).

Specials rates were driven down to negligible levels by contractions in the supply schedules of securities available for lending. This resulted in part from the reduction in the target fed funds rate from 3 1/2 percent to 3 percent on Monday, September 17. The action reduced the gross economic return to lending Treasury securities at any given specials rate and rationed some marginal lenders of securities out of the specials market.

Box 2

### Strategic Fails

When the specials rate for a security is close to zero, a market participant with no position in the security may sometimes lend the security on a term repurchase agreement (RP) and then fail intentionally on the RP’s starting leg.

Suppose, for example, the three-week specials rate for a five-year note is 10 basis points and that XYZ Co. believes the two-week specials rate will be 50 basis points in one week. If XYZ contracts (in the specials market) to borrow \$50 million for three weeks against lending the note, it will owe interest of \$2,916.67 at the end of three weeks ( $\$2,916.67 = (21/360) \cdot .0010 \cdot \$50,000,000$ ). It will owe this amount even if it fails to deliver the note during the entire three-week interval. XYZ Co. has effectively purchased an implicit option (for \$2,916.67, payable in three weeks) on an exchange of \$50 million for the five-year note at any time during the next three weeks for the balance of the three-week interval.

XYZ Co. could choose to let its implicit option expire unexercised and simply pay the \$2,916.67 premium at the end of three weeks. However, if XYZ Co.’s expectations prove correct, it can exercise the option after one week by reversing in the five-year note for two weeks against lending \$50 million at 50 basis points (earning interest of \$9,722.22) and delivering the note in (delayed) settlement of its earlier negotiated three-week RP ( $\$9,722.22 = (14/360) \cdot .0050 \cdot \$50,000,000$ ). The \$50 million received from delivering the note funds the loan that allows XYZ Co. to reverse in the note, and XYZ Co. has net interest earnings of \$6,805.55 ( $\$6,805.55 = \$9,722.22$  interest income less \$2,916.67 interest expense). More generally, a very low specials rate presents an opportunity to speculate on an increase in the rate—by lending on an RP with the intention of failing at least initially—with limited downside exposure.

The supply schedules of securities available for lending also contracted as a result of a prospective increase in the operational costs of lending. After outright trading in Treasury securities reopened on Thursday, September 13, market participants became aware of the substantial volume of fails precipitated by the events of September 11. They realized that if they lent Treasury securities on RPs, they might not receive their securities back promptly at the end of the agreements. This would leave them exposed to the risk of counterparty

*Despite painstaking efforts by market participants to reconcile their transactions, and despite the expanded volume of securities borrowings from the System Open Market Account, settlement fails in the Treasury market did not abate quickly to pre-attack levels.*

failure and necessitate the allocation of scarce resources to monitor and control that risk. (The withdrawal of some institutional lenders from the specials markets after September 11 was widely noted. See, for example, *Dow Jones Newswire* [2001a, b], *Bloomberg* [2001b, in which Peter Fisher, Treasury’s Under Secretary for Domestic Finance, remarked on the “reluctance by institutional investors to lend into a market that is suffering from extraordinarily high fails levels”], *Wall Street Journal* [2001b], *New York Times* [2001], and *Washington Post* [2001].)

Some market observers also suggested that a nontrivial quantity of Treasury securities may have been acquired in a “flight to quality” after the attacks by investors who normally invested in other types of securities and who were not prepared to lend the Treasury securities that they acquired (*Bloomberg* 2001a; *Wall Street Journal* 2001c). Any such migration of ownership would have further reduced the supply of securities available for lending at any given specials rate.

#### *Comment*

The inverse relationship between settlement fails and the quantity of securities available for lending at a given specials rate suggests that there may be multiple equilibria in the specials markets. The surge in fails on and immediately after September 11 may have moved the market to a new

equilibrium characterized by higher levels of fails, lower levels of securities lending at any given specials rates, and lower equilibrium specials rates. Market participants were not ignorant of the possibility that the specials markets may have arrived at a new equilibrium in late September. A broker was quoted as wondering whether “desks aren’t lending because they’re scared [trades] won’t settle,” or whether “trades won’t settle because nobody is lending?” (*Dow Jones Newswire* 2001a). Under Secretary Fisher later described the relationship between fails and reluctance to lend as “self-compounding” (*New York Times* 2001).

### Subsequent Federal Reserve and Treasury Actions

The persistence of settlement fails in late September led the New York Fed to continue to relax restrictions on the SOMA securities lending program. On September 18, it reduced the minimum fee for borrowing securities from 150 basis points to 100 basis points, and on September 27, it increased the amount of a security that it was prepared to lend to 75 percent of the amount owned. As shown in Chart 4, the higher lending limit led to a sharp increase in aggregate borrowings, from \$6.4 billion on September 26 to \$13.4 billion on September 27. Nevertheless, specials rates for the on-the-run five- and ten-year notes remained close to zero and, as noted above, the volume of fails remained unusually high, averaging \$142 billion per day for the week ending October 3.

#### *Reopening the Ten-Year Note*

At 11 a.m. on Thursday, October 4, the Treasury took the unprecedented step of announcing that it would sell, at 1 p.m. that day, an additional \$6 billion of the on-the-run ten-year note (the 5 percent note maturing August 15, 2011), thereby increasing the outstanding supply of the note to \$18 billion. This was the first unscheduled snap auction of a coupon-bearing security since the regularization of note and bond auctions in the late 1970s and early 1980s.<sup>18</sup> The new securities were issued shortly after 9 a.m. the following morning.

The immediate reason for Treasury’s unusual response to market conditions was a desire to reduce the volume of fails; Treasury attributed the decision to the “chronically high fails rate” (*Bloomberg* 2001a). More fundamentally, officials had become concerned that fails might begin to affect the performance and efficiency of the market. Under Secretary

Fisher stated that “we want to reduce the risk that these settlement problems turn into a much bigger problem for the Treasury market” and that “we wanted to prevent technical problems in the back office from causing wider problems in the pricing of government securities” (*New York Times* 2001; *Washington Post* 2001).

The additional ten-year notes, and the prospect that Treasury might also reopen the on-the-run five-year note,<sup>19</sup> appear to have had the intended effect. As shown in Chart 5, daily average fails fell from \$142 billion during the week ending October 3 to \$63 billion the next week and then to about \$18 billion in each of the following two weeks. The specials rate for the ten-year note jumped to 90 basis points on October 5 and continued to rise to 173 basis points on October 12. The specials rate for the five-year note rose more modestly, but

*At 11 a.m. on Thursday, October 4, the Treasury took the unprecedented step of announcing that it would sell, at 1 p.m. that day, an additional \$6 billion of the on-the-run ten-year note.*

reached 40 basis points by October 12. As shown in Chart 4, aggregate borrowings of securities from SOMA also declined after the reopening.

#### *Comment*

The impact of the reopening on the specials rate for the five-year note and on the general level of settlement fails is consistent with the idea that there may be multiple equilibria in the specials markets. In particular, the highly unusual and widely publicized Treasury action may have moved the market back toward an equilibrium characterized by a lower level of fails, a higher volume of securities lending at any given specials rate, and higher equilibrium specials rates. Market participants may have come to the conclusion that Treasury would take unprecedented steps to resolve the fails problem and that there was less reason to continue to hold back on lending securities out of concern that the securities might not be returned promptly.

## ALLEVIATING CHRONIC FAILS

Settlement fails can become widespread and persistent when specials rates are near zero, as we discussed. Demand to borrow securities may substantially exceed lending supply at a specials rate just above zero, but the option to fail precludes an equilibrium rate below zero. Initiatives to alleviate chronic fails must therefore either increase an issue’s lendable supply when specials rates approach zero or increase the cost of a fail and allow specials rates to go below zero.

### Reopening Issues on an Unscheduled Basis

One way to alleviate chronic fails in an issue is to increase the issue’s outstanding supply. Treasury adopted this approach when it reopened the ten-year note in October 2001. The reopening increased the lendable supply of the note, causing the specials rate on the issue to rise and making borrowing the note more attractive than failing.

Although the reopening seemed effective at resolving fails in the ten-year note (as well as in other issues), ad hoc reopenings have drawbacks. Above all, such reopenings do not necessarily meet Treasury’s financing needs. As noted, Treasury indicated that the reopening of the ten-year note had “nothing to do with an increase of funding needs on our part.” Financing the federal government is, of course, the purpose of debt issuance in the first place. Selling securities to enhance market efficiency could be seen as a matter of the tail wagging the dog.

Unscheduled reopenings also disrupt Treasury issuance patterns, both with respect to the reopening itself and with respect to any subsequent disruptions resulting from the additional funds. Since the early 1980s, Treasury has maintained a regular and predictable schedule of note and bond auctions (Fisher 2002b). Predictable offerings are believed to help minimize Treasury borrowing costs by reducing uncertainty among market participants.

Perhaps because of these drawbacks, Treasury has indicated that unscheduled reopenings are unlikely to become a prominent debt management tool. In early 2002, Under Secretary Fisher said, “never is a long time, so it would be imprudent of me to say that the Treasury will never again hold such an auction. But you should not count on it. . . . We want to rely on [market participants] to reconcile the forces of supply and demand” (Fisher 2002a).

## Expanding Federal Reserve Securities Lending

Another way to alleviate chronic fails is to foster lending by large owners. Treasury securities owned by the Federal Reserve's System Open Market Account are in fact made available for overnight borrowing, as we discussed. However, the ability of SOMA lending to mitigate settlement problems is constrained by limits on the quantities of securities available for lending. As shown in Charts 6 and 7, such limits were binding on fifty trading days in 2001 for the on-the-run five-year note and on seventy-nine days for the ten-year note. (We classify the lending limit as binding when the amount borrowed is within 1 percent of the limit.)

The temporary relaxation of program rules on September 27 that made 75 percent of SOMA holdings available for lending allowed securities borrowing to expand.<sup>20</sup> Nonetheless, even the higher limit was sometimes binding and it was unable to move specials rates much above zero for some securities. SOMA lending is ultimately constrained by SOMA ownership. In September 2001, SOMA owned only \$1 billion of the \$12 billion on-the-run ten-year note.<sup>21</sup> The temporary increase of the SOMA lending limit from 45 percent to 75 percent thus allowed for additional lending of only \$300 million of that issue.

## Introducing Treasury Securities Lending

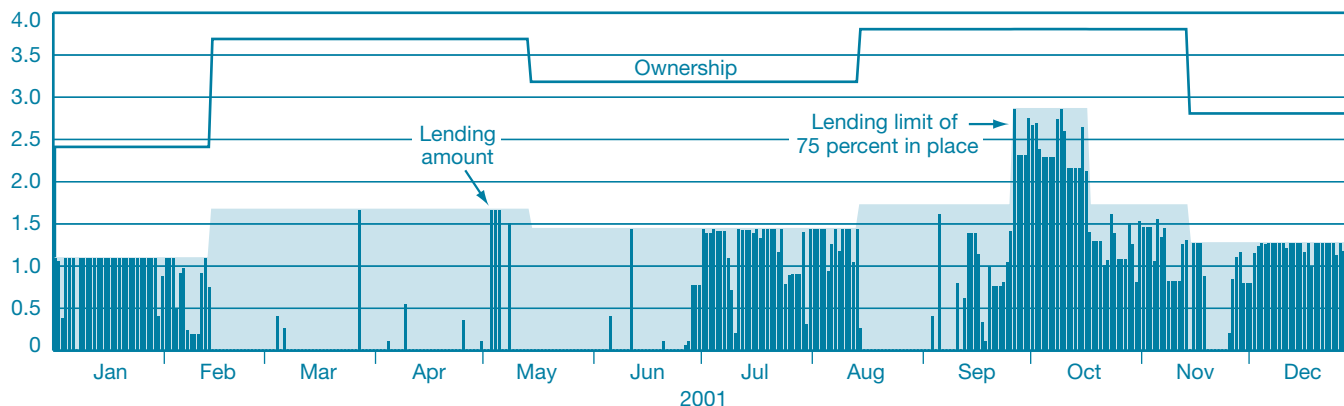
As Treasury has the ability to create new securities, it could alleviate chronic fails by introducing a securities lending facility of its own. Such a facility was recommended by the Treasury Advisory Committee in the aftermath of September 11 (*Bloomberg 2001c*). The facility would enable market participants to borrow specific issues on a temporary basis, thereby expanding the supply of a security when it is in particularly high demand without permanently increasing its supply. As with the SOMA program, Treasury could require that any borrowed securities be collateralized with other Treasury securities.

In contrast to the SOMA program, a Treasury facility need not set limits on the quantity of securities it lends out. Treasury might instead want to specify the fee at which securities can be borrowed and then fill all applications at that fee. An appropriate fee might be one that was just below the general collateral rate, such as the general collateral rate less 10 basis points. With borrowing collateralized by other Treasury securities, such a fee would be equivalent to Treasury lending securities (and borrowing money) at a specials rate of 10 basis points and then relending the money (and borrowing other securities) at the general collateral rate. The fee would introduce a near infinite elasticity of supply of securities at a specials rate just above zero, but make borrowing securities from Treasury unattractive as long as specials rates were greater than 10 basis points.

CHART 6

### SOMA Lending versus Lending Limits for the Five-Year Treasury Note

Billions of U.S. dollars



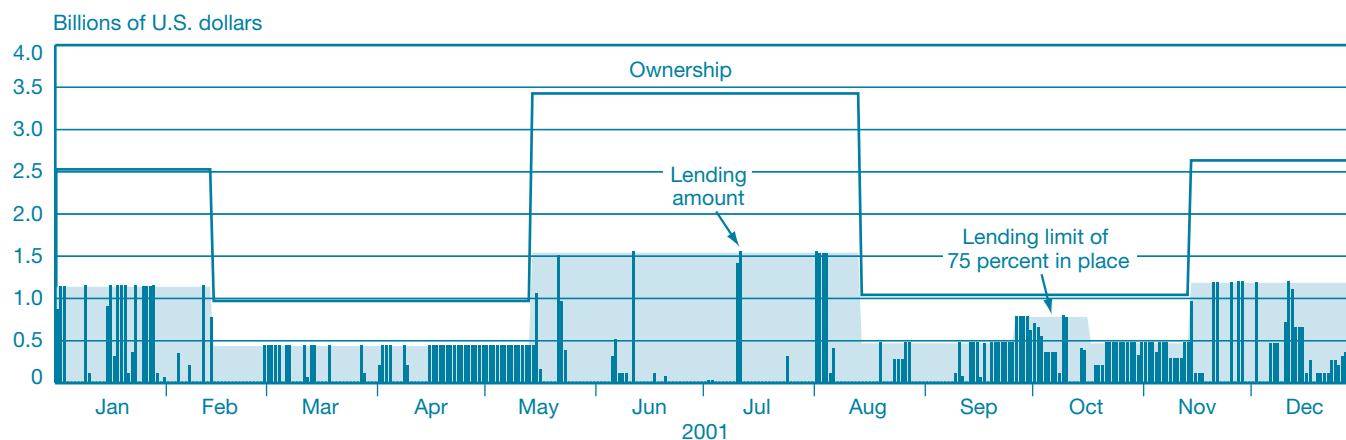
Source: Federal Reserve Bank of New York.

Notes: The chart plots daily lending of the on-the-run five-year U.S. Treasury note by the System Open Market Account (SOMA) of the Federal Reserve against SOMA securities lending limits and ownership from January 2 to December 31, 2001. The shading indicates the lending limit.



CHART 7

## SOMA Lending versus Lending Limits for the Ten-Year Treasury Note



Source: Federal Reserve Bank of New York.

Notes: The chart plots daily lending of the on-the-run ten-year U.S. Treasury note by the System Open Market Account (SOMA) of the Federal Reserve against SOMA securities lending limits and ownership from January 2 to December 31, 2001. The shading indicates the lending limit.

A fee marginally less than the general collateral rate would preserve the incentive to borrow an issue rather than fail without affecting the normal functioning of the specials market. Market participants would have an incentive to borrow a security from Treasury only when the specials rate dropped below 10 basis points, so issue specialness would likely be only minimally affected.<sup>22</sup> To the extent that issue specialness did not decrease, Treasury borrowing costs would not be adversely affected.<sup>23</sup> In fact, the mitigation of settlement problems could enhance market liquidity and efficiency, leading to lower Treasury borrowing costs.

In addition to the SOMA program, there is precedent for a Treasury securities lending facility from other debt issuers, as described below. Table 2 compares key features of the various lending facilities.

#### *United Kingdom Debt Management Office RP Facilities*

The United Kingdom Debt Management Office has had a “special” RP facility available for several years. The facility allows the office, at its sole discretion, to create and repo out gilts to “dissuade manipulation” of specific issues and to “address instances of market disruption or dislocation when a particular stock is temporarily in extremely short supply” (United Kingdom Debt Management Office 1999). Such operations would likely allow market makers to borrow specific issues overnight against lending money at a zero percent rate, while simultaneously requiring them to borrow funds against

general collateral at the Bank of England’s RP rate (to offset the cash flow implications of the special RP).<sup>24</sup> The special RP facility has never been utilized, although it was made available on one occasion (Bank of England 1998).

The Debt Management Office introduced a nondiscretionary standing RP facility in June 2000 that provides for the creation and lending of any issue on demand and that largely supersedes the special RP facility (United Kingdom Debt Management Office 2000). The facility is available to market makers willing to lend money at a rate equal to 10 percent of the Bank of England’s RP rate against borrowing a specific issue, and requires that they simultaneously borrow money (against general collateral) at the bank’s RP rate. A market maker thus effectively pays a fee equal to 90 percent of the bank’s RP rate to borrow a specific issue, while providing generic securities as collateral. The facility was first used on December 29, 2000, and has been used several times since (United Kingdom Debt Management Office 2001, p. 35).

#### *Fannie Mae RP Facility*

In the United States, the Federal National Mortgage Association (Fannie Mae), a government-sponsored enterprise, introduced an RP lending facility in October 2001. The facility is intended to enhance the liquidity and trading activity of Fannie Mae’s securities in the cash and collateral markets “by reducing the possibility of fails and providing collateral when there is limited lendable supply” (Fannie Mae 2001, p. 1).

TABLE 2

## Comparison of Securities Lending Facilities

Category	System Open Market Account Securities Lending Program	United Kingdom Debt Management Office Standing RP Facility	Fannie Mae RP Facility	Treasury Securities Lending Facility
Introduced	April 1999 <sup>a</sup>	June 2000	October 2001	Proposed
Offering process	Daily auction	Fixed price offering	Daily auction	Fixed price offering
Fee/rate	Minimum fee of 100 bp	Fixed fee of 90 percent of the Bank of England's RP rate <sup>b</sup>	Maximum rate of GC-100 bp <sup>c</sup>	Fixed fee such as GC-10 bp
Collateral	Other securities	Other securities	Cash	Other securities
Lending limit	45 percent of holdings	None	60 percent of holdings	None
Term	Overnight	Overnight	Overnight	Overnight

Sources: Federal National Mortgage Association (Fannie Mae); Federal Reserve Bank of New York; United Kingdom Debt Management Office.

Note: Information for the three existing facilities is as of December 31, 2001.

<sup>a</sup>The program was implemented in its current form at this time but was first established in 1969.

<sup>b</sup>This is the implicit fee; the facility provides for securities lending at 10 percent of the Bank of England's repurchase agreement (RP) rate while requiring market makers to put up general collateral (GC) at the bank's RP rate against the issues being lent.

<sup>c</sup>Such a requirement is roughly equivalent to a minimum 100-basis-point (bp) fee in the other programs.

The program works as follows. Fannie Mae issues to its own account an additional 25 percent of each new "benchmark" issue brought to market. (Fannie Mae's benchmark securities are issued in large sizes, on a regular basis, and across a range of maturities.) Fannie Mae then lends out, on a daily basis, up to 60 percent of the amount of any security held in its own account. For example, if Fannie Mae brings a \$5 billion issue to market, it retains an additional \$1.25 billion of the issue, and makes up to \$750 million of the issue available for lending on any single day. The RPs bring in funds for Fannie Mae, which it presumably relends in the general collateral market or uses in lieu of borrowings from other sources.

The amount lent out and corresponding rate are determined through a multiple price auction, with the highest acceptable bid rate based on the level of market rates. In December 2001, for example, the highest acceptable bid rate was set at the general collateral rate less 1.00 percent. (If the general collateral rate were 1.75 percent, such a requirement called for dealers to bid 0.75 percent or less.) Fannie Mae's RP facility was first used on November 26, 2001, and has been used numerous times since (Fannie Mae 2001, p. 2).

### Instituting a Penalty Fee for Fails

Chronic fails can also be alleviated by increasing the cost of failing with a penalty fee. The penalty would give sellers an

economic incentive to borrow securities, even at specials rates below zero, in order to make delivery. Specials rates below zero would also draw lenders into the market that might otherwise be unwilling to lend (because of inadequate compensation or because of concern that their securities might not be returned promptly) and would curtail borrowing demand arising out of short sales. Provision for market clearing specials rates below zero would also bring the Treasury market into line with U.S. equity markets, where stock loan rates can, and do, go below zero (D'Avolio forthcoming), and would be consistent with Under Secretary Fisher's intention "to rely on . . . the forces of supply and demand."

The penalty fee could possibly be instituted through good-practice recommendations of the Bond Market Association. Failed deliveries would be rescheduled for the next business day at a slightly lower invoice price (under certain circumstances), as opposed to an unchanged invoice price (the current practice). The operational burden of changing an invoice price following a delay in settlement would undoubtedly be substantial, but the burden could be limited by restricting the penalty to aged fails, such as those outstanding a week or more. Restricting the penalty to aged fails would also avoid penalizing fails arising from operational problems or miscommunication, which tend to get resolved quickly in any event.

The penalty fee could be set high enough so that failing is rarely an attractive option, but not so high as to unduly punish fails attributable to operational problems and/or lead to

protracted conflict between buyers and sellers over the specific causes of fails. For example, suppose the penalty fee were set at a rate of 5 percent per annum minus the general collateral rate, with a minimum of zero. The fee would then be implemented only at general collateral rates of less than 5 percent and only to bring the total cost of failing to 5 percent. If the general collateral rate were 3 percent, for example, the penalty fee would be 2 percent. Failure to deliver in such circumstances would result in settlement being rescheduled for the next business day, with the invoice price reduced at the annualized penalty rate of 2 percent. The failing party would incur an explicit cost of failing of 2 percent per annum in addition to the implicit cost of 3 percent per annum due to the delayed receipt of funds. Failing would not be an attractive option as long as the specialness spread on a security was less than 5 percent.

## CONCLUSION

The attacks of September 11 destroyed the offices of several inter-dealer brokers in the Treasury securities market, impaired telecommunication services in and through Lower Manhattan, and precipitated an extraordinary volume of settlement fails in Treasury securities. The Federal Reserve

responded by relaxing restrictions on its securities lending program, thereby making Treasury collateral more readily available. As connectivity was gradually restored, market participants began reconciling incomplete and erroneous trade information, and the volume of fails started to decline.

Despite painstaking efforts by market participants to reconcile their transactions, however, and despite an expanded volume of securities borrowings from SOMA, settlement fails did not abate quickly to pre-attack levels. The persistence of high levels of fails can be most immediately attributed to specials rates at or close to zero in the days and weeks following September 11. Specials rates were driven down by a contraction in lending associated with a lower fed funds rate and as a result of a prospective increase in the operational costs of lending. With specials rates so low, a fail was not an unattractive alternative to borrowing securities to make delivery.

The persistence of settlement fails ultimately led the Treasury to announce an unprecedented snap reopening of the on-the-run ten-year note. The reopening increased the note's specials rate and aggregate fails quickly declined. However, such reopenings are unlikely to become a recurrent debt management tool. Alternative, less disruptive, ways of alleviating chronic fails include the introduction of a securities lending facility run by Treasury and the institution of a penalty fee for fails.

## ENDNOTES

1. Bank for International Settlements (2001) offers an excellent glossary of many of the terms that appear in this article.
2. The criteria are described at <http://www.newyorkfed.org/bankinfo/regrept/primary.html>. The primary dealers are listed at <http://www.newyorkfed.org/pihome/news/opnmktops/2002/an020401.html>.
3. There is some double counting in the figures, especially for brokered trading, as trades between primary dealers are reported by both parties. Trading volume statistics are posted at <http://www.newyorkfed.org/pihome/statistics/>.
4. JPMorgan Chase Bank resulted from the merger of the Chase Manhattan Bank and Morgan Guaranty Trust Company of New York on November 10, 2001. Clearing bank services were provided by the Chase Manhattan Bank prior to the merger. For expositional clarity, we refer to JPMC even when speaking of events prior to the merger.
5. The Federal Reserve limits a single Fedwire transfer to no more than \$50 million (Board of Governors of the Federal Reserve System 2002, Section 10.2). The market practice of delivering larger sales in multiple separate blocks of \$50 million (plus a tail piece, if required) is based on the delivery guidelines of the Bond Market Association (Public Securities Association 1993, Chapter 7, Section A.4.b).
6. Membership requirements are described in the GSCC Overview and the GSCC Rulebook, both of which are posted at [http://www.gsc.com/important\\_notices\\_frame.html](http://www.gsc.com/important_notices_frame.html) under Other Important Documents. Membership is posted at [http://www.gsc.com/participants\\_frame.html](http://www.gsc.com/participants_frame.html).
7. This net obligation also includes forward settling trades executed on preceding days and scheduled to settle on the following business day and (as described in the next section) closing legs of repurchase agreements terminating on the following business day. It does not include trades executed earlier in the same day for cash settlement. Cash settlement trades are settled bilaterally during the business day, even if both the buyer and the seller are GSCC members, because GSCC does not assess net receive and deliver obligations until after the close of business.
8. In the collateral markets, a security is on the run if it is the most recently *issued* security in a particular series (as opposed to the most recently auctioned security), because securities lending cannot take place until a security has been issued.
9. In “Announcement of Revisions to the SOMA Securities Lending Program,” Federal Reserve Bank of New York, February 12, 1999, posted at <http://www.newyorkfed.org/pihome/news/announce/1999>. Details on the securities lending program as it existed prior to September 11 also appear in announcements dated April 20, August 26, and September 7, 1999.
10. However, the Master Repurchase Agreement suggested by the Bond Market Association (posted at <http://www.bondmarkets.com/market/agreements.shtml>) provides, inter alia, that the lender of money on an RP may, at its option, declare an event of default following a failure by the borrower of money to deliver securities on the starting leg of the RP, and that the borrower of money may, at its option, declare an event of default following a failure by the lender of money to deliver securities on the closing leg of the RP (see paragraph 11 of the agreement). Outright transactions do not usually have comparable express default provisions, but a buyer may specify at the time a transaction is negotiated that it needs “guaranteed delivery.”
11. GSCC marks fails to market every day and thereby eliminates the replacement cost risk of a continuing fail. The invoice price specified in an instruction to deliver a security to GSCC is revised to the contemporaneous current market value of the security each day that a member continues to fail to deliver the security. The change in invoice price is offset with a cash payment called a “fail mark.” If the CMV increases, the member has to make a payment equal to the product of the increase in the CMV and the quantity of securities to be delivered. (The member recovers this payment when it delivers the security at the revised, higher CMV.) Conversely, if the CMV declines, the member will receive a cash payment. At the same time, GSCC marks to market its own fail to the member that was issued the matched and bound redelivery instruction.
12. See GSCC Rulebook, Rule 12, Section 4 (January 10, 2002). However, GSCC does have the right, at its sole discretion, to renet and pair off fails. See GSCC Rulebook, Rule 11, Section 8 (January 10, 2002). GSCC exercises its right of pair-off on opening-leg fails of blind-brokered RPs (GSCC Important Notice GSCC054.96, dated July 9, 1996, p. 4). In April 2002, GSCC introduced an automated pair-off process for members that have receive and deliver obligations for identical principal amounts of the same security (GSCC Important Notice GSCC018.02, dated March 1, 2002). GSCC important notices are posted at <http://www.gsc.com>.

## ENDNOTES (CONTINUED)

13. However, some participants have, on rare occasions, reversed in securities at even negative specials rates when a settlement fail would entail an additional penalty. Such penalties can arise in failing to settle short futures positions and guaranteed delivery sales.

14. This process was not flawless. Not all of the dealers had reported all of their brokered trades to GSCC, so GSCC failed to capture one side of some brokered trades and failed to capture other brokered trades entirely. The omissions were ultimately corrected in the course of a prolonged and painstaking reconciliation process.

15. In some cases, a GSCC member made good delivery to GSCC on September 11 but GSCC nevertheless recorded a fail in the absence of knowledge of the delivery (GSCC Important Notice GSCC068.01).

16. Such pair-offs were part of the original design of the program for blind-brokered RPs. See GSCC Important Notice GSCC054.96, p. 4.

17. See the discussion of marking fails to market in endnote 11. In some cases, GSCC marked fails to market erroneously and created erroneous revised delivery instructions because it did not know that members had in fact made good delivery on September 11 (GSCC Important Notice GSCC087.01).

18. Prior to 2001, Treasury overtly tailored the sale of a coupon-bearing security to market conditions on only one occasion—in November 1992, when it reopened the 6 3/8 percent ten-year note maturing August 15, 2002, “in order to alleviate an acute, protracted shortage” (Office of Financing press release, dated November 3, 1992). However, that action amounted to no more than a decision to reopen the ten-year note in a regularly scheduled auction in lieu of selling a new note. In contrast, the note sale on October 4, 2001, was a reopening in an unscheduled snap auction.

Between 1979 and 2001, Treasury conducted two snap auctions of cash management bills, on May 30, 1980, and April 6, 1993. Both auctions came promptly after Congressional action to extend or increase the statutory ceiling on the federal debt and were the result of Treasury’s need for cash rather than an unusual demand for the securities by market participants (*Wall Street Journal* 1980, 1993).

19. Market participants had been aware of chronic settlement fails in the five-year note since late September (*Dow Jones Newswire* 2001a). At the time Treasury announced the reopening of the ten-year note, it stated that “we will observe how effective this is at trying to deal [with the fails problem]. We will then consider whether a similar extraordinary auction of five years is something we might do next week” (*Bloomberg* 2001b).

20. Although the 45 percent limit was reimposed after three weeks, the limit was subsequently raised to 65 percent on May 15, 2002. The May 2002 changes are posted at <http://www.newyorkfed.org/pihome/news/opnmktops/2002/an020424.html>.

21. One reason SOMA owned only \$1 billion of the ten-year note was that the security had just been issued in August and was not scheduled to be reopened until November. After the November reopening, SOMA ownership jumped to \$2.6 billion. (SOMA could not participate in the unscheduled October reopening because it did not have any contemporaneously maturing securities that it could roll over.)

22. It is possible, however, that the facility could have a more significant effect on specialness by reducing lenders’ concerns regarding chronic fails, leading to an expansion in the supply schedule of securities available for lending and a reduction in the time period over which an issue trades near a specials rate of zero.

23. Duffie (1996) explains why issue specialness should be reflected in securities prices, and Jordan and Jordan (1997) present empirical evidence supporting the hypothesis. Such specialness can be expected to be incorporated into prices at auction, leading to lower Treasury borrowing costs (all else equal).

24. The Bank of England’s RP rate is the official short-term rate at which the bank lends to the money market and accordingly implements monetary policy (Bank of England 1999).

## REFERENCES

- Bank for International Settlements*. 1992. "Delivery versus Payment in Securities Settlement Systems." Committee on Payment and Settlement Systems, September. Available at <<http://www.bis.org/cpss/cpsspubl.htm>>.
- . 2001. "A Glossary of Terms Used in Payments and Settlement Systems." Committee on Payment and Settlement Systems, July. Available at <<http://www.bis.org/cpss/cpsspubl.htm>>.
- Bank of England*. 1998. "Delivery of 9% Treasury Loan 2008 into the March Long Gilt Future Contract on LIFFE." News Release, February 16. Available at <<http://www.bankofengland.co.uk/pr98017.htm>>.
- . 1999. "The Transmission Mechanism of Monetary Policy." Monetary Policy Committee, April. Available at <<http://www.bankofengland.co.uk/montrans.pdf>>.
- Bloomberg*. 2001a. "U.S. to Sell \$6 Billion in 10-Year Notes to Help Meet Demand." October 4.
- . 2001b. "U.S. Sells \$6 Billion in 10-Year Notes to Help Overcome Shortage." October 4.
- . 2001c. "Treasury Advisory Committee Recommends Repo Facility Creation." November 1.
- Board of Governors of the Federal Reserve System*. 2002. "Operating Circular 7, Book-Entry Securities Account Maintenance and Transfer Services." Available at <<http://www.frbservices.org/industry/pdf/Oc7.pdf>>.
- Bond Market Association*. 2001. "Minutes of Emergency Meetings of the Bond Market Association, September 11-21, 2001." Available at <[http://www.bondmarkets.com/market/9-11\\_minutes.shtml](http://www.bondmarkets.com/market/9-11_minutes.shtml)>.
- Boni, Leslie, and J. Chris Leach*. 2001. "Depth Discovery in a Market with Expandable Limit Orders: An Investigation of the U.S. Treasury Market." Unpublished paper, University of New Mexico and University of Colorado, July.
- Cornell, Bradford, and Alan Shapiro*. 1989. "The Mispricing of U.S. Treasury Bonds: A Case Study." *REVIEW OF FINANCIAL STUDIES* 2, no. 3: 297-310.
- D'Avolio, Gene*. Forthcoming. "The Market for Borrowing Stock." *JOURNAL OF FINANCIAL ECONOMICS*.
- DeGennaro, Ramon, and James Moser*. 1990. "Failed Delivery and Daily Treasury Bill Returns." *JOURNAL OF FINANCIAL SERVICES RESEARCH* 4, no. 3: 203-22.
- Dow Jones Newswire*. 2001a. "After Attack, Settlement Woes Still Clogging Repo Market." September 26.
- . 2001b. "Grim Repo Still Causing Headaches for Treasurys." September 28.
- Duffie, Darrell*. 1996. "Special Repo Rates." *JOURNAL OF FINANCE* 51, no. 2: 493-526.
- Dupont, Dominique, and Brian Sack*. 1999. "The Treasury Securities Market: Overview and Recent Developments." *FEDERAL RESERVE BULLETIN* 85, no. 12: 785-806.
- Fannie Mae*. 2001. "Fannie Mae Initiates New Lending Facility to Enhance Repurchase Financing Market for Bullet Benchmark Securities." *FUNDINGNOTES*, November. Available at <[http://www.fanniemae.com/markets/debt/pdf/fundingnotes\\_11\\_01.pdf](http://www.fanniemae.com/markets/debt/pdf/fundingnotes_11_01.pdf)>.
- Federal Reserve Bank of New York*. 2002. "Domestic Open Market Operations during 2001." Available at <<http://www.newyorkfed.org/pihome/omo/omo2001.pdf>>.
- Fisher, Peter*. 2002a. "Remarks before the Bond Market Association Legal and Compliance Conference." January 8. Available at <<http://www.treas.gov/press/releases/po906.htm>>.
- . 2002b. "Bloomberg News' Bonds Roundtable 2002." February 13. Available at <<http://www.treas.gov/press/releases/po1010.htm>>.
- Fleming, Michael*. 1997. "The Round-the-Clock Market for U.S. Treasury Securities." *Federal Reserve Bank of New York ECONOMIC POLICY REVIEW* 3, no. 2 (July): 9-32.
- . 2000. "Financial Market Implications of the Federal Debt Paydown." *BROOKINGS PAPERS ON ECONOMIC ACTIVITY*, no. 2: 221-51.

## REFERENCES (CONTINUED)

- . 2002. “Are Larger Treasury Issues More Liquid? Evidence from Bill Reopenings.” *JOURNAL OF MONEY, CREDIT, AND BANKING* 34, no. 3: 707-35.
- Garbade, Kenneth*. 1996. *FIXED INCOME ANALYTICS*. Cambridge, Mass.: MIT Press.
- Government Securities Clearing Corporation*. 2002. *GSCC – 2001 IN REVIEW*. New York: Government Securities Clearing Corporation.
- Jordan, Bradford, and Susan Jordan*. 1997. “Special Repo Rates: An Empirical Analysis.” *JOURNAL OF FINANCE* 52, no. 5: 2051-72.
- Keane, Frank*. 1996. “Repo Rate Patterns for New Treasury Notes.” Federal Reserve Bank of New York *CURRENT ISSUES IN ECONOMICS AND FINANCE* 2, no. 10 (September).
- MacRae, Desmond*. 2001. “Looking into the Abyss.” *GLOBAL CUSTODIAN*, winter: 70-6.
- Martin, A. E.* 1985. “The Book-Entry System for Treasury Securities.” Federal Reserve Bank of Atlanta *ECONOMIC REVIEW* 70, no. 8: 15-6.
- McAndrews, James J., and Simon M. Potter*. 2002. “Liquidity Effects of the Events of September 11, 2001.” Federal Reserve Bank of New York *ECONOMIC POLICY REVIEW* 8, no. 2 (November): 59-79.
- New York Times*. 2001. “U.S. Acts on Shortage of Treasuries.” October 5, p. C1.
- Public Securities Association*. 1993. *GOVERNMENT SECURITIES MANUAL*. New York: Public Securities Association.
- Sender, Henny*. 1986. “The Day the Computers Went Down.” *INSTITUTIONAL INVESTOR*, March: 203-7.
- Stigum, Marcia*. 1988. *AFTER THE TRADE: DEALER AND CLEARING BANK OPERATIONS IN MONEY MARKET AND GOVERNMENT SECURITIES*. Homewood, Ill.: Dow Jones-Irwin.
- United Kingdom Debt Management Office*. 1999. “Consultation Paper on DMO Policy Regarding ‘Special’ Gilt Repo Operations.” September 17. Available at <<http://www.dmo.gov.uk/publication/g2gil.htm>>.
- . 2000. “Response to DMO Consultation Document on ‘Special’ Gilt Repo Operations.” February. Available at <<http://www.dmo.gov.uk/publication/g2gil.htm>>.
- . 2001. “DMO Annual Review.” September. Available at <<http://www.dmo.gov.uk/publication/f2ann.htm>>.
- Wall Street Journal*. 1980. “Treasury to Offer \$16.2 Billion in Bills, Notes This Week.” June 2, p. 31.
- . 1985. “A Computer Snafu Snarls the Handling of Treasury Issues.” November 25, p. 58.
- . 1993. “Bond Prices Rise on Report that Treasury Study Will Urge Change in U.S. Borrowing Patterns.” April 7, p. C19.
- . 2001a. “Treasury Market Is Faced with Incomplete Trades.” October 3, p. C10.
- . 2001b. “Treasury Sale Averts a Crisis in ‘Repo’ Market.” October 5, p. C1.
- . 2001c. “Treasuries Fall as Wall Street Urges the Treasury to Sell More 5-Year Notes to Ease ‘Repo’ Problems.” October 10, p. C15.
- . 2001d. “Banks and Regulators Drew Together to Calm Markets after Attack.” October 18, p. A1.
- Washington Post*. 2001. “In Surprise, Treasury Holds Auction of 10-Year Notes.” October 5, p. E1.

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