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# Current Issues

IN ECONOMICS AND FINANCE

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## Explaining Settlement Fails

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*The Federal Reserve now makes available current and historical data on trades in U.S. Treasury and other securities that fail to settle as scheduled. An analysis of the data reveals substantial variation in the frequency of fails over the 1990-2004 period. It also suggests that surges in fails sometimes result from operational disruptions, but often reflect market participants' insufficient incentive to avoid failing.*

In March 2004, the Federal Reserve Bank of New York began releasing statistics on trades of U.S. Treasury and other securities that fail to settle on the date agreed upon by a buyer and seller. These statistics not only reveal the frequency of settlement fails over the past decade and a half, but also shed light on the causes of the fails. Since fails are thought to affect market liquidity when they persist at high levels, the new data merit close attention.

In this edition of *Current Issues*, we examine the statistics on settlement fails for U.S. Treasury securities from July 1990—when the Fed began collecting the information—to December 2004. We show that settlement fails are not unusual, occurring in every week during the period. Moreover, we document significant variation in fails, with dealer delivery fails averaging just \$3.8 billion per day between mid-1990 and September 5, 2001, but as much as \$190 billion per day after the September 11 attacks and up to \$232 billion per day in the summer of 2003.

We also examine, on a conceptual level, why fails occur, how they can be avoided, and why they sometimes persist. Applying this analysis to the actual behavior of fails from 1990 to 2004 allows us to reach some conclusions about the causes of elevated fails. Specifically, we find that while

some episodes of high fails stem from operational disruptions, other episodes can be traced to market participants' insufficient incentive to avoid failing.

### The Fed's Settlement Fails Data

Primary government securities dealers—dealers that have a trading relationship with the New York Fed—regularly report market data to the Fed. The data cover transactions, positions, financing, and settlement activities in U.S. Treasury securities, agency debt securities, mortgage-backed securities, and corporate debt securities. The data are reported weekly, as of the close of business each Wednesday, and must be submitted by 4:00 p.m. the next business day.<sup>1</sup>

### Structure of the Fails Data

Settlement fails are reported by security class (that is, Treasury securities, agency debt securities, and so forth).<sup>2</sup> Dealers' failure to deliver securities they have sold and dealers' failure to receive securities they have purchased are reported separately. If primary dealer A does not deliver a security to primary dealer B as scheduled, for example, then dealer A reports a fail to deliver and dealer B reports a fail to receive. In contrast, if primary dealer A

does not deliver a security to customer C, then dealer A reports a fail to deliver and the fail to receive is not reported. A settlement fail goes unreported if neither the buyer nor the seller is a primary dealer.

Settlement fails are reported on a cumulative basis for each week, including nontrading days. For example, if a dealer fails to deliver \$50 million of securities to a customer as scheduled on a Thursday, but makes delivery on Friday, one day late, then the dealer reports \$50 million in fails. However, if the delivery is not made until Monday, four days late, then the dealer reports \$200 million in fails (\$50 million × 4 days). Fails thus continue to be counted until settlement occurs.

Outright and financing transactions are combined in the fails data. That is, failures to deliver securities sold outright are combined with failures to deliver securities sold or lent as part of a financing transaction (such as a repurchase agreement). Fails on outright transactions are reported at the par value of the transactions while fails on financing transactions are reported at the amount that was to be paid or received on the scheduled settlement date.

Although data on settlement fails have been reported to the Fed since the week ending July 4, 1990, the Fed first released fails data to the public on March 25, 2004. At the same time, the Fed released historical data on fails through March 17, 2004. The data are now released to the public each Thursday at 4:15 p.m., one week after they are collected. The data are aggregated across all dealers and are published only for broad security classes (see table); individual issue data, and individual dealer data, are not published or otherwise disclosed.

**An Overview of Fails from 1990 to 2004**

The data show that settlement fails are not unusual. Fails to deliver involving Treasury securities occurred in every week between July 4, 1990, and December 29, 2004, and averaged \$10.7 billion per day over this period.<sup>3</sup> Fails to receive were generally higher, averaging \$12.0 billion per day over the same period. Fails to deliver and fails to receive are highly correlated over time, with a correlation coefficient of 0.997. Because the two series behave so similarly, we choose to focus on fails to deliver.

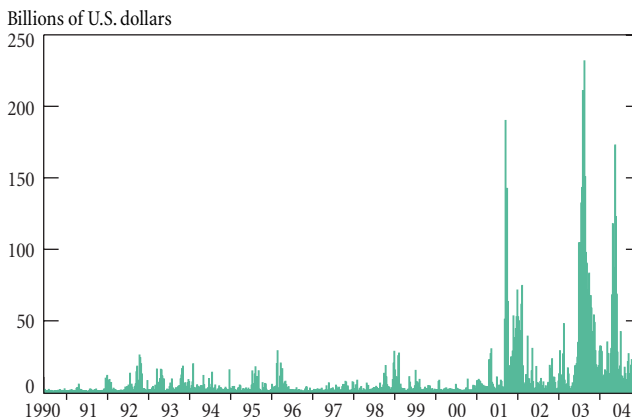
**Fails by Primary Dealers: Week Ended February 2, 2005**

Billions of Dollars

Type of Security	Fails to Receive	Fails to Deliver
U.S. Treasury securities	125.5	109.5
Agency debt securities	47.3	46.4
Mortgage-backed securities	65.5	62.7
Corporate debt securities	35.5	41.8

Source: Federal Reserve Bank of New York.

Chart 1  
Settlement Fails in U.S. Treasury Securities



Source: Federal Reserve Bank of New York, <[http://www.newyorkfed.org/markets/pridealers\\_failsdata.html](http://www.newyorkfed.org/markets/pridealers_failsdata.html)>.

Note: The chart plots average daily delivery fails of the primary dealers for the week ending July 4, 1990, through the week ending December 29, 2004.

While delivery fails of Treasury securities took place throughout the period examined, they surged after September 11, 2001, and in the summer of 2003 (Chart 1). (Fails were also quite high in the spring of 2004.) As explained later, these episodes can be attributed to the destruction of market infrastructure in the case of the 2001 fails and to market participants’ insufficient incentive to avoid failing in the case of the 2003 fails. Even before September 11, however, there are regular patterns in the fails data that can be attributed to variations in the incentive to avoid failing.

**Why Settlement Fails Occur**

Settlement fails occur for a variety of reasons. Miscommunication is one source of fails. A buyer and seller may not identify to their respective operations departments the same details for a given trade. On the settlement date, the seller may deliver what it believes is the correct quantity of the right security and claim what it believes is the correct payment, but the buyer will reject the delivery if it has a different understanding of the trade. If the rejection occurs late in the day, there may not be enough time for the parties to resolve the misunderstanding. Miscommunication tends to occur regularly on a small scale and explains why fails never fall to zero.

In other cases, operational problems may lead to the failure of a seller or a seller’s custodian to deliver securities. A notable example occurred on November 21, 1985, when a computer problem prevented the Bank of New York from delivering securities from its custodial accounts. The bank was unable to resolve the problem before the close of business

and had to finance the securities that it was unable to deliver by borrowing more than \$20 billion from the New York Fed.<sup>4</sup> A more extreme example occurred on September 11, 2001, when operational disruptions led to massive settlement problems.

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 cascading fails: A’s failure to deliver bonds to B causes B to fail on a delivery of the same bonds to C, causing C to fail on a similar delivery 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. Daisy chains and round robins explain why fails to receive and fails to deliver are so highly correlated.<sup>5</sup>

A final reason for fails is that a market participant may sell a security it does not own, that is, sell the security “short,” and have insufficient incentive to borrow it to make delivery. To understand why the incentive to avoid failing can sometimes be insufficient, however, one first needs to understand what happens when a fail occurs.

### Consequences of a Fail

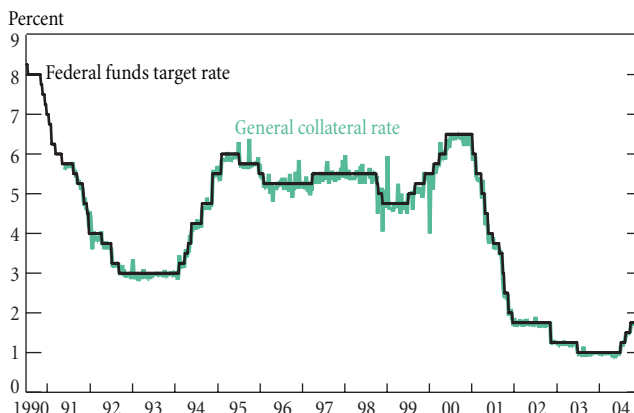
Settlement fails are generally not viewed as events of contractual default. Rather, market participants have adopted the convention of allowing a failing seller to make delivery the next business day at an unchanged invoice price.<sup>6</sup> A failing trade continues to be rescheduled until it finally settles. A trade that fails to settle on a Thursday thus has its settlement rescheduled for Friday; if it fails to settle on Friday, its settlement is rescheduled for Monday, and so on.

Because the buyer does not pay the seller until the seller delivers the securities, the seller loses (and the buyer gains) the time value of the transaction proceeds over the fail interval.<sup>7</sup> This time value can be quantified as the interest that could have been earned on the transaction proceeds in the overnight federal (fed) funds market or in the closely related market for general collateral (GC) repurchase agreements (Chart 2).<sup>8</sup> The prospect of losing the time value of the transaction proceeds provides an incentive for the seller to make delivery on the settlement date or as soon as possible thereafter.

### Avoiding Fails

Fails caused by miscommunication or operational problems are difficult to eliminate completely, but fails due to other factors can often be avoided. A fail stemming from an inability to deliver securities because of a failure to receive securities can usually be averted by borrowing the securities from

Chart 2  
Federal Funds Target Rate and General Collateral Rate



Source: Bloomberg L.P.

Note: The chart plots the federal funds target rate for the week ending July 6, 1990, through the week ending December 31, 2004, and the overnight general collateral rate for the week ending May 24, 1991, through the week ending December 31, 2004.

a third party and delivering the borrowed securities. (The borrowed securities are returned when the securities the borrower was expecting to receive finally arrive.) A fail stemming from a market participant’s short sale can also be averted by delivering borrowed securities. (The borrowed securities are returned when the short position is closed out.) Treasury securities are usually borrowed through repurchase agreements (see box on page 4).

In deciding whether to borrow securities to avoid a fail, market participants balance the cost of borrowing against the cost of failing. As we noted earlier, the most immediate cost of failing is the time value of money, approximated by the GC rate. It follows that market participants should be willing to borrow securities to avoid failing as long as the cost of borrowing is less than the GC rate.

### Why Fails Sometimes Persist

Most of the time and for most securities, borrowing costs remain well below the GC rate and fails remain at low levels. At times, however, borrowing costs approach and reach the GC rate.<sup>9</sup> As the cost of borrowing securities rises, the incentive to borrow securities to avoid failing declines. When the cost of borrowing equals the GC rate, many market participants are roughly indifferent between failing and borrowing securities to avoid failing. Periods when security borrowing costs are persistently near the GC rate thus tend to be characterized by persistently high fails.

Borrowing costs are most likely to approach the GC rate when there is strong demand to borrow a security or when

## Borrowing Treasury Securities with Repurchase Agreements

Market participants commonly lend and borrow Treasury securities through repurchase agreements (“repos” or “RPs”) and reverse repurchase agreements. A participant executing an RP sells securities and simultaneously agrees to repurchase the securities from the buyer at a higher price on a future date. The transaction is tantamount to lending securities and borrowing money, with the excess of the repurchase price over the sale price being the interest paid on the money borrowed. The counterparty to the transaction executes a reverse RP, borrowing (or “reversing in”) securities against lending money.

There are two types of RPs. A *general collateral RP* 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 having possession of securities that can be sold quickly in the event of a default by the borrower. Interest rates on general collateral RPs are usually quite close to rates on loans in the fed funds market. This reflects the essential character of a general collateral RP as a device for borrowing and lending money.

A *special collateral RP* is an RP in which the lender of funds wants to borrow a particular security. It is, consequently, a device for borrowing and lending securities rather than borrowing and lending money. The rate on a special collateral RP is commonly called a “specials” rate. The

owner of a security may be induced to lend the security if it is offered an opportunity to borrow money at a specials rate below the rate at which it can relend the same funds on a general collateral reverse RP.<sup>a</sup>

The difference between the GC rate and the specials rate for a security is the cost of borrowing the security and is called the “specialness” spread. If the demand to borrow a security is modest relative to the supply available for lending, a borrower of the security will usually be able to lend its money at a rate no lower than about 1/8 to 1/4 percent below the GC rate. If the demand to borrow 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 GC rate and the specialness spread correspondingly large; the security is then said to be “on special.”

The table below shows specials rates and specialness spreads for several recently issued Treasury notes on March 3, 2005, when the GC repo rate was 2.50 percent.

Security	Specials Rate (Percent)	Specialness Spread (Percent)
3 3/8% note of February 28, 2007	2.32	0.18
3 3/8% note of February 15, 2008	2.44	0.06
3 1/2% note of February 15, 2010	1.98	0.52
4% note of February 15, 2015	0.26	2.24

<sup>a</sup>For a more extensive discussion of the specials market, see Duffie (1996), Keane (1996), Jordan and Jordan (1997), and Fisher (2002).

the lendable supply of the security is limited. Demand to borrow a security is particularly strong when there are substantial short positions in the security. Lendable supply differs across securities because of differences in issue amounts and the willingness of current owners to lend their securities, and it varies over securities’ life cycles as the securities change hands.

A common pattern, documented by Keane (1996), Cherian, Jacquier, and Jarrow (2004), and Moulton (2004), is for security borrowing costs to first increase as a security ages, and then decrease around the time the next security in the same series comes to market. The increase occurs for two reasons. First, short positions, and hence borrowing demand, are usually concentrated in the most recently issued Treasury security of a given series. Second, the lendable supply of a security decreases steadily after the security has been issued as dealers sell off their inventories to investors that are less likely to lend the security. Once the Treasury issues a new

security in the same series, short positions move to the new security and borrowing costs for the old security decline.

Episodes of fails can be self-perpetuating. If borrowing costs rise to near the GC rate and fails mount, some market participants that would otherwise lend securities may decide to step back from the market to avoid borrowers that might fail to return their securities. The reduced supply of securities available for lending exacerbates and prolongs the fails situation.

Because the benefit to avoiding a fail declines as the cost of borrowing securities rises toward the GC rate, an important factor in explaining fails is the general level of interest rates. When the fed funds rate, and hence the GC rate, are low, security borrowing costs can reach their upper limit more quickly. When the fed funds rate was only 1 percent in 2003 and 2004, for example, there was only a small margin before security borrowing costs reached the GC rate and the incentive to borrow securities became negligible.



### Ancillary Costs of Fails

We have seen that the most immediate cost to a seller of failing to deliver a security is the interest that could have been earned on the transaction proceeds. However, there are other costs of failing, which can become significant if fails persist. One ancillary cost of failing is an increase in counterparty credit risk. If a buyer becomes insolvent before the settlement of a trade, the seller will incur a loss if the price of the security has fallen and the seller has to find a replacement buyer at a lower price. Conversely, if a seller becomes insolvent before settlement, the buyer will incur a loss if the price of the security has risen and the buyer has to find a replacement seller at a higher price.

In recognition of the counterparty credit risk associated with fails, the Securities and Exchange Commission (SEC) imposes capital charges on aged fails.<sup>10</sup> Dealers have to maintain additional capital for fails to deliver more than five business days old and for fails to receive more than thirty calendar days old. The charges absorb capital that would otherwise be available to support profitable risk-taking activities and thus impose opportunity costs on dealers.

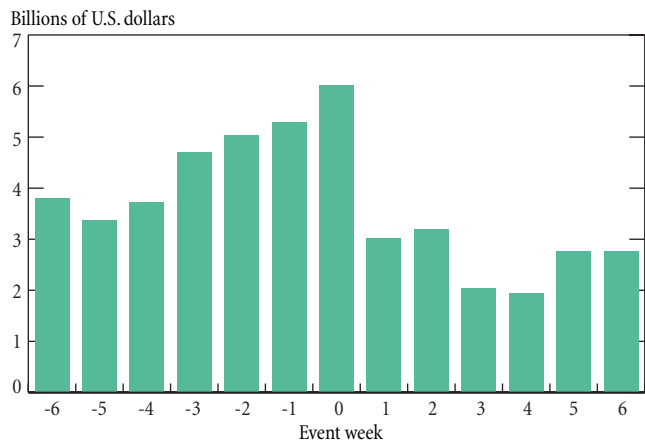
Increased labor costs and worsened customer relations can also result from fails. Labor costs can rise as dealers divert back-office personnel from their usual assignments to efforts aimed at reducing fails. Customers can become unhappy when they do not receive the securities they have purchased, even after long delays. This leaves customers in the position of involuntarily financing dealer short positions and means that they themselves have nothing to deliver should they decide to sell.

More broadly, market liquidity can be adversely affected if dealers reduce their participation in a market to mitigate the costs associated with fails. The effect of fails on market liquidity has been deemed significant enough on some occasions to warrant a response from policymakers. Most notably, the U.S. Treasury Department responded to a sustained and large volume of settlement fails after the September 11 attacks by reopening a Treasury note in a “snap” or previously unscheduled, auction. Under Secretary of the Treasury Peter Fisher indicated that the department took this step in order “to reduce the risk that these settlement problems turn into a much bigger problem for the Treasury market” and “to prevent technical problems in the back office from causing wider problems in the pricing of government securities.”<sup>11</sup>

### Explaining Settlement Fails over Time

The analysis of why settlement fails occur and why they sometimes persist gives us the background needed to understand the behavior of fails over time. Miscommunication explains why there are always some fails, but most of the

Chart 3  
Settlement Fails around Quarterly Refundings



Source: Authors' calculations, based on data from the Federal Reserve Bank of New York.

Notes: The chart plots average daily delivery fails of U.S. Treasury securities in the weeks surrounding the Treasury Department's quarterly refundings from June 28, 1990, to September 5, 2001. Event week 0 includes the refunding issuance date. The analysis excludes weeks that include the last business day of the calendar quarter.

significant variation in fails stems from other factors. The insufficient incentive of market participants to avoid failing when security borrowing costs approach the general collateral rate is probably the most important factor.

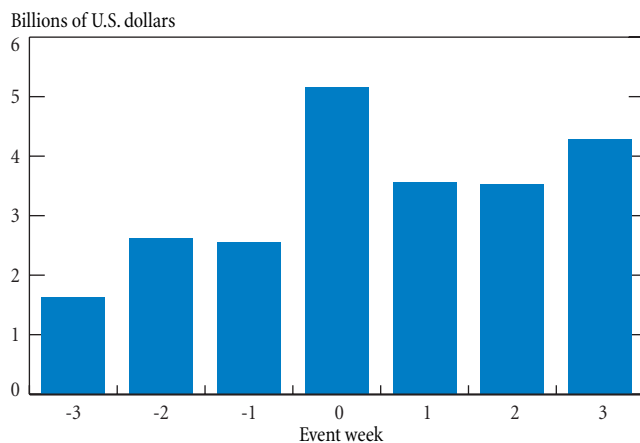
Before September 11, 2001, fails tended to be at their highest levels in the weeks preceding and including the Treasury's quarterly refundings in mid-February, mid-May, mid-August, and mid-November (Chart 3). (The highest level of fails before September 11 occurred in the week ending May 16, 2001.) Borrowing costs of certain securities often approach the GC rate before and during the refundings for two reasons. First, the lendable supplies of securities issued three months earlier have declined. Second, market participants frequently take short positions before and during a refunding based on their assessment of a security's relative value—a practice that increases the demand to borrow the securities.<sup>12</sup>

Fails also tend to be elevated in weeks that include the end of a calendar quarter (Chart 4). Many lenders of securities withdraw from the market at the end of a quarter so as not to show financing transactions on their balance sheets. The reduced supply drives up security borrowing costs, sometimes causing those costs to approach the GC rate.

### Fails following September 11, 2001

The surge in fails immediately after September 11 is attributable to operational disruptions on a massive scale.<sup>13</sup> The destruction of broker offices and records located in the towers

Chart 4  
Settlement Fails around Quarter-Ends



Source: Authors' calculations, based on data from the Federal Reserve Bank of New York.

Notes: The chart plots average daily delivery fails of U.S. Treasury securities in the weeks surrounding calendar quarter-ends from June 28, 1990, to September 5, 2001. Event week 0 includes the last business day of the quarter.

of the World Trade Center made it impossible for brokers to transmit confirmations and settlement information on trades that had already been executed. Moreover, impaired telecommunication links prevented many market participants from verifying what came into and what left their custodial accounts at their clearing banks, from advising their clearing banks of securities they expected to receive, and from giving their clearing banks instructions to deliver securities.

Fails persisted in the weeks after September 11 even as operational disruptions were gradually overcome. Some securities lenders withdrew from the market and the cost of borrowing certain securities rose as high as the GC rate, eliminating many market participants' incentive to avoid failing and perpetuating daisy chains and round robins of fails. The Treasury Department took the unprecedented step of selling additional amounts of a ten-year note—even though it had no pressing need for the proceeds—to help mitigate the settlement problems.

### *Fails in the Summer and Fall of 2003*

During the twenty-one months after September 11, a series of rate cuts reduced the fed funds target rate to its lowest level in forty-five years. The low funds rate placed a low ceiling on the level to which security borrowing costs could rise before settlement problems occurred. As a result, the stage was set for significant settlement fails when market participants turned bearish in June 2003 and sold short a large quantity of ten-year Treasury notes to hedge their exposure

to risk on other fixed-income investments.<sup>14</sup> The rapid expansion in demand to borrow the note (to deliver against the short sales) quickly drove the note's borrowing costs to the GC rate, after which additional borrowing demand spilled over into fails.<sup>15</sup>

As shown in Chart 1, the fails episode in 2003 was both severe and sustained. As a result, the ancillary costs of failing became substantial for many market participants. Some participants became willing to pay more than the GC rate to borrow the ten-year note to make deliveries and avoid the ancillary costs. In addition, labor-intensive industry efforts were undertaken to identify and net offsetting fails. As a result, market stresses gradually eased in the fall of 2003.

### Conclusion

The recent release of data on settlement fails enhances our understanding of market functioning. The data reveal when trades are more or less likely to clear, and hence when a market participant is more or less likely to receive securities it has purchased or borrowed or is due to receive back at the expiration of a loan. Moreover, the data highlight periods when liquidity may be jeopardized by elevated and persistent fails.

The evidence suggests that most episodes of elevated settlement fails are related to market participants' incentive to avoid failing. Fails have tended to be high in the weeks before and during the Treasury Department's quarterly refundings and in the weeks that include the end of a calendar quarter, when security borrowing costs tend to be high. After September 11, when there was an initial surge in fails due to massive operational disruptions, insufficient incentive to resolve fails contributed to their persistence. More recently, in the summer of 2003, low interest rates put a low ceiling on security borrowing costs and created the conditions for fails to expand and persist.

### Notes

*We thank Kathryn Chen and Frank Keane for helpful comments.*

1. Links to the reporting form and instructions and to related information are available on the New York Fed's website at <http://www.newyorkfed.org/markets/primarydealers.html>.
2. In addition to providing this aggregate data, dealers report fails for the most recently issued Treasury note or bond of a given maturity and can be asked to report fails on a daily basis for specific securities.
3. Given the cumulative manner in which the fails data are reported, per day averages are calculated by dividing the reported weekly numbers by seven. Fails in fixed-income securities other than Treasury securities tend to be lower. Fails to deliver averaged \$1.4 billion per day for agency debt securities and \$8.5 billion for mortgage-backed securities over the period from July 4,

1990, to December 29, 2004. Fails to deliver involving corporate debt securities, first reported for the week ending July 4, 2001, averaged \$4.5 billion per day between then and December 29, 2004.

4. See “A Computer Snafu Snarls the Handling of Treasury Issues,” *Wall Street Journal*, November 25, 1985, p. 58, Sender (1986), and U.S. House (1985).

5. Delivery obligations are netted among members of the Fixed Income Clearing Corporation (FICC), mitigating the occurrence of daisy chains and round robins. FICC is a subsidiary of the Depository Trust and Clearing Corporation and is the central clearing agency in the Treasury securities market. Fleming and Garbade (2002) describe net settlement through FICC.

6. See, for example, the Public Securities Association’s 1993 *Government Securities Manual*: “If securities are not delivered on the agreed upon settlement date, there is a fail. Regardless of the date the securities were actually delivered, the buyer of the securities pays the seller the original settlement date figures” (chap. 8, sect. C).

7. Degennaro and Moser (1990) find that Treasury bill prices reflect the likelihood of obtaining interest-free financing due to settlement fails.

8. The fed funds and GC markets are both short-term (typically overnight) financing markets. Fed funds transactions are unsecured loans between depository institutions, whereas GC transactions are loans secured by collateral between any of a variety of market participants. The mechanics of a GC transaction are discussed in the box on page 4.

9. Instances of securities being expensive to borrow are documented by Cornell and Shapiro (1989), Jordan and Jordan (1997, pp. 2058-9), Fleming (2000, pp. 229-31), and Fleming and Garbade (2004).

10. Code of Federal Regulations, title 17, part 240, sections 15c3-1(c)(2)(iv)(E) and 15c3-1(c)(2)(ix), April 1, 2001. SEC capital charges are not imposed on fails of transactions due to be settled through FICC because FICC mark-to-market provisions mitigate the counterparty credit risk that usually occurs with fails.

11. “U.S. Acts on Shortage of Treasuries,” *New York Times*, October 5, 2001, p. C1, and “In Surprise, Treasury Holds Auction of 10-Year Notes,” *Washington Post*, October 5, 2001, p. E1.

12. For example, a market participant may sell an outstanding issue short against buying a forthcoming issue in the “when-issued” market if it believes the outstanding issue is overpriced relative to the new issue (Garbade 1996, chap. 8).

13. For a detailed discussion of fails after September 11, see Fleming and Garbade (2002).

14. See “Supply Dries Up Following Fall in Prices,” *Financial Times*, August 27, 2003, p. 27, Shatz and Elders (2003), and “Mortgage Bonds: a Game of Chicken,” *Wall Street Journal*, November 26, 2003, p. C10.

15. For a detailed description of this episode, see Fleming and Garbade (2004).

## References

- Cherian, Joseph A., Eric Jacquier, and Robert A. Jarrow. 2004. “A Model of the Convenience Yields in On-the-Run Treasuries.” *Review of Derivatives Research* 7, no. 2 (August): 79-97.
- Cornell, Bradford, and Alan C. Shapiro. 1989. “The Mispricing of U.S. Treasury Bonds: A Case Study.” *Review of Financial Studies* 2, no. 3 (fall): 297-310.
- Degennaro, Ramon P., and James T. Moser. 1990. “Failed Delivery and Daily Treasury Bill Returns.” *Journal of Financial Services Research* 4, no. 3 (October): 203-22.
- Duffie, Darrell. 1996. “Special Repo Rates.” *Journal of Finance* 51, no. 2 (June): 493-526.
- Fisher, Mark. 2002. “Special Repo Rates: An Introduction.” Federal Reserve Bank of Atlanta *Economic Review* 87, no. 2 (second quarter): 27-43.
- Fleming, Michael J. 2000. “Financial Market Implications of the Federal Debt Paydown.” *Brookings Papers on Economic Activity*, no. 2: 221-51.
- Fleming, Michael J., and Kenneth D. Garbade. 2002. “When the Back Office Moved to the Front Burner: Settlement Fails in the Treasury Market after 9/11.” Federal Reserve Bank of New York *Economic Policy Review* 8, no. 2 (November): 35-57.
- . 2004. “Repurchase Agreements with Negative Interest Rates.” Federal Reserve Bank of New York *Current Issues in Economics and Finance* 10, no. 5 (April).
- Garbade, Kenneth. 1996. *Fixed Income Analytics*. Cambridge, Mass.: MIT Press.
- Jordan, Bradford D., and Susan D. Jordan. 1997. “Special Repo Rates: An Empirical Analysis.” *Journal of Finance* 52, no. 5 (December): 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).
- Moulton, Pamela C. 2004. “Relative Repo Specialness in U.S. Treasuries.” *Journal of Fixed Income* 14, no. 1 (June): 40-7.
- Sender, Henny. 1986. “The Day the Computers Went Down.” *Institutional Investor*, March: 203-7.
- Shatz, Joseph, and Gregory Elders. 2003. “Repo Specialness: Deficits to the Rescue.” *Fixed Income Strategy*. Merrill Lynch, Pierce, Fenner and Smith, Inc., Global Securities Research and Economics Group, September 12.
- U.S. House. Committee on Banking, Finance, and Urban Affairs. 1985. *The Federal Reserve Bank of New York Discount Window Advance of \$22.6 Billion Extended to the Bank of New York. Hearings before the Subcommittee on Domestic Monetary Policy of the Committee on Banking, Finance, and Urban Affairs*. 99th Cong., 1st sess., December 12.

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*Current Issues in Economics and Finance* is published by the Research and Statistics Group of the Federal Reserve Bank of New York. Dorothy Meadow Sobol is the editor.

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