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An Examination of Treasury Term Investment Interest Rates

- The U.S. Treasury, through its Term Investment Option (TIO) program, lends excess cash balances to banks at interest rates determined by single-rate auctions.
- An important issue in TIO auctions is whether the Treasury receives a market rate of return on TIO funds.
- An analysis of the spread between rates on TIO auctions and rates on mortgage-backed-security (MBS) repos suggests that for small auction sizes, TIO rates are comparable to market rates, except on offerings with term lengths of fewer than five days.
- The study also finds that a more compressed auction schedule, in which the Treasury announces and auctions TIO funds on the same day, does not adversely affect TIO rates; thus, banks appear to be indifferent to more advance notice of auctions.

1. Introduction

The Term Investment Option (TIO) program is a cash management tool of the U.S. Treasury Department. Through TIO, which is part of the broader Treasury Tax and Loan (TT&L) program, the Treasury lends funds to depository institutions for a set number of days. The rate that the Treasury receives is determined via a single-rate auction format.

An important issue in TIO auctions is whether the interest rates received by the Treasury are comparable to market rates. In this article, we compare TIO rates with rates on mortgage-backed-security (MBS) repurchase (repo) agreements. MBS repo rates are the closest benchmark for TIO rates in several respects: depository institutions can obtain funds using both types of transactions, the transactions are collateralized, and the eligible collateral is similar. We study the 166 auctions held from November 2003, when TIO first became an official Treasury cash management facility, to February 2006.[1]

[1]TIO began as a pilot in April 2002. We do not examine the first twenty-seven auctions from April 2002 to October 2003. The structure of the 166 auctions we study is similar to the structure of future TIO auctions. During the TIO pilot, auctions tended to be held in the latter part of the year, so there were extended periods with no auctions.

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TIO auctions can shed light on bidding behavior in general, because they vary along more dimensions than traditional Treasury debt auctions. For example, TIO auctions are not held on a regular basis and their size and term length vary. Typical Treasury debt auctions, by comparison, are held on a regular schedule,[2] and the amount auctioned is usually the only variable.

A key finding of our work is that for small auction sizes, TIO interest rates are fairly comparable to MBS repo rates for term lengths of five days or more. However, shorter term lengths result in the Treasury receiving lower TIO rates relative to market rates. We also observe a negative relationship between the size of an auction and the spread between the TIO rate and the MBS repo rate. Finally, a more compressed auction schedule, in which the Treasury announces and auctions TIO funds on the same day, does not adversely affect TIO rates. This finding suggests that banks are indifferent to more advance notice of TIO auctions.

Our study proceeds as follows. In Section 2, we provide background information on the TT&L program, term investments, and repo transactions. Our data and our regression framework are presented in Section 3, while regression results can be found in Section 4. In Section 5, we draw conclusions.

2. Background

2.1 The Treasury Tax and Loan Program

Treasury funds are held either at Federal Reserve Banks (the Fed balance) or private depository institutions in what is known as the Treasury Tax and Loan program (see Garbade, Partlan, and Santoro [2004] for a discussion of recent innovations in Treasury cash management). The Fed balance does not earn explicit interest,[3] while balances held at private depository institutions, which can be withdrawn on demand, earn the TT&L rate, which is the weekly average overnight federal funds rate less 25 basis points.[4] Depository institutions specify the maximum TT&L balances they are willing to hold, and the balances must be collateralized. If balances exceed the lesser of the specified limit or the collateral value of assets pledged by the institution, the excess is transferred to a Treasury account at the Federal Reserve Bank of St. Louis.

There are three types of depository institutions in the TT&L program: collector institutions, which collect tax payments and transfer them to Treasury accounts at District Federal Reserve Banks; retainer institutions, which collect and hold funds until balances exceed their limit or collateral or until the Treasury withdraws the funds; and investor institutions, which are similar to retainer institutions but also accept direct placements of funds *from the Treasury*.

The management of Treasury funds directly affects the conduct of monetary policy, as the net movement of funds into and out of the banking sector generally has to be offset by open market operations.

The management of Treasury funds directly affects the conduct of monetary policy, as the net movement of funds into and out of the banking sector generally has to be offset by open market operations. Payments by the U.S. government are made from the Fed balance, while some tax receipts flow directly into the Fed balance. Depository institutions in the TT&L program collect the bulk of tax receipts. The Fed balance fluctuates daily as tax payments are received and outlays are paid. An increase in the Fed balance drains reserves available in the banking system, while a decrease adds them. The Treasury typically seeks to maintain a relatively stable Fed balance of $5 billion, with the remainder of its funds held at private depository institutions. The target balance is achieved through withdrawals from and deposits to the depository institutions. The maintenance of a stable Fed balance prevents changes in the balance from affecting the supply of bank reserves and minimizes the need for offsetting open market operations.

Assets acceptable as collateral in the TT&L program range from Treasury securities to insured student loans (Table 1). A lower collateral value is assigned to less liquid and less creditworthy assets.[5] Collateral must be held either at a Federal Reserve Bank or at a Treasury-approved third-party

[2]For example, four-, thirteen-, and twenty-six-week Treasury bills are auctioned every week.

[3]As funds in the Fed balance reduce the supply of bank reserves, open market operations to purchase Treasury securities are required to offset this drain. The interest earned on these securities is included in Federal Reserve earnings, which are remitted weekly to the Treasury. Thus, implicit interest is earned by the Treasury on the Fed balance.

[4]The weekly average rate is computed for a seven-day interval, beginning on a Thursday and ending the following Wednesday, with the rate for a Saturday, Sunday, or holiday taken as the rate for the preceding business day. The weekly average rate less 25 basis points is used to calculate a daily interest factor that is applied to the daily average amount of TT&L balances for each Thursday-Wednesday cycle, and interest is payable on the following Thursday.

Table 1

Acceptable and Unacceptable Collateral in the Treasury Tax and Loan Program

Panel A: Acceptable Collateral

Category 1	Obligations issued and fully insured or guaranteed by the U.S. government or a U.S. government agency. (See Category 4 for insured or guaranteed educational loans.)
Category 2	Obligations of government-sponsored enterprises and government-sponsored corporations of the United States that under specific statute may be accepted as security for public funds.
Category 3	Obligations issued or fully guaranteed by international development banks (acceptable only if denominated in U.S. dollars).
Category 4	Insured student loans or notes representing educational loans insured or guaranteed under a program authorized under Title IV of the Higher Education Act of 1965, as amended, or Title VII of the Public Health Service Act, as amended. (Securities issued by the Student Loan Marketing Association are included in Category 2.)
Category 5	General obligations issued by the states of the United States and by Puerto Rico.
Category 6	Obligations of counties, cities, or other U.S. government authorities or instrumentalities that are not in default on payments on principal or interest and that may be purchased by banks as investment securities under the limitations established by appropriate federal bank regulatory agencies.
Category 7	Obligations of domestic corporations that may be purchased by banks as investment securities under the limitations established by appropriate federal bank regulatory agencies.
Category 8	Qualifying commercial paper, commercial and agricultural loans, and bankers' acceptances approved by the Federal Reserve System at the direction of the Treasury.
Category 9	Qualifying publicly issued asset-backed securities that are Aaa/AAA rated by at least one nationally recognized statistical rating agency and approved by the Federal Reserve System at the direction of the Treasury.

Panel B: Unacceptable Collateral

Common and preferred stock.

Consumer paper or consumer notes.

Foreign-currency-denominated securities.

Mutual funds.

Construction loans.

Obligations issued by the pledging bank or by affiliates of the pledging bank.

Obligations of foreign countries (that is, sovereign debt).

Collateralized bond obligations, collateralized loan obligations, and collateralized mortgage-backed securities except as otherwise noted.

Real estate mortgage-backed securities (one-to-four-family mortgages are acceptable only if held in a borrower-in-custody arrangement to secure special direct investments).

Panel C: Stripped and Zero-Coupon Securities

Securities offered in stripped, zero, or residual forms are acceptable only when market prices are available.

U.S. government agency securities may be stripped into their separate components and are acceptable only when market prices are available.

Source: U.S. Treasury Department (<http://www.publicdebt.treas.gov/gsr/gsrttlaccxx0205.pdf>).

custodian.[6] During months with heavy tax inflows, balances at depository institutions can exceed available collateral, resulting in a transfer of these excess funds to the Fed balance and potentially causing the balance to exceed the $5 billion target.

[5]Refer to <http://www.easysaver.gov/instit/statreg/collateral/collateral_taxandloantablel.pdf> for the margins applied to the various types of collateral.

[6]Depository institutions can serve as third-party custodians; currently, the Depository Trust Company is the only non-depository institution approved by the Treasury.

2.2 The Term Investment Option Program

The TIO program is another option within the TT&L program for placing Treasury funds with depository institutions. It began on a pilot basis in April 2002 and was expanded in November 2003.[7] TIO offers greater certainty than the regular TT&L program about the amount of funds invested and the length of time funds will be invested.[8] Participation is limited to TT&L depositories that have executed a TIO agreement.[9] The only publicly available information on the number of institutions in the TIO program is as of September 2004; at that time, forty-three institutions were participating.[10] Depository institutions in the TIO program are not required to bid in TIO auctions, and the Treasury reserves the right not to place funds.

Depository institutions bid on TIO funds in auctions that follow a single-rate format. The identity of bidding institutions is known to the Treasury, but funds are allocated on the basis of auction bids. Participating institutions submit bids indicating the maximum rate they would pay on a specified quantity of funds. Institutions may submit multiple bids for differing amounts and rates.[11] The interest rate that fills the auction, known as the stop-out rate, is determined, and this rate applies to all successful bids (those at or above the stop-out rate). Bids at higher rates are filled in full and bids at the stop-out rate may be prorated. A single institution is limited to 50 percent of the *announced* amount.

One of the Treasury's motivations for initiating TIO [the Term Investment Option program] was to try to earn a market rate of return on its excess cash balances.

One of the Treasury's motivations for initiating TIO was to try to earn a market rate of return on its excess cash balances. On average, for the first 193 auctions TIO rates have been about 16 basis points higher than TT&L rates and 6.5 basis points lower than comparable MBS repo rates (the calculation is described below).

Another motivation was to increase TT&L capacity following the federal budget surpluses of the late 1990s and 2000-01. The surpluses occasionally resulted in Treasury balances available for investment with depository institutions exceeding TT&L collateral. As a result, Fed balances exceeded the $5 billion target and drained reserves from the banking system. Open market operations by the Federal Reserve were required to offset this drain. While federal budget surpluses are currently not an issue, TT&L capacity constraints are still important during months with large tax inflows, such as April.

After the TIO program became an official cash management tool, the Treasury began placing more term investments for greater cumulative and average amounts.

TIO collateral requirements are less restrictive than those for the regular TT&L program in the sense that collateral such as commercial loans can be held on the premises of the depository institution (or an affiliate) in a borrower-in-custody arrangement instead of at a Federal Reserve Bank. While collateral held in such an arrangement is acceptable only on an auction-by-auction basis, these loans typically have been accepted since June 2002.[12]

In the regular TT&L program, because commercial loans must generally be held at a Federal Reserve Bank, depositories are less likely to pledge these loans as collateral. As a result, even though depository institutions do not have to bring in new collateral to back term investments, allowing commercial loans to be held on depository premises leads institutions to bring in additional collateral that was previously unpledged. Capacity for the TT&L system as a whole is therefore increased. Requirements for all other collateral for TIO funds are similar to those for TT&L collateral: the collateral must be held either at a Federal Reserve Bank or at a Treasury-approved third-party custodian.

According to data from the Federal Reserve Bank of St. Louis, commercial loans comprise around 50 percent of collateral pledged in the TIO program; Treasury, federal agency, and corporate securities account for around 25 percent; mortgage-backed securities represent about 10 percent; and all other collateral make up the remaining 15 percent. The corresponding percentages for the regular TT&L program

[7]TIO no. 28 was the first TIO auction after the program became an official cash management tool of the Treasury.

[8]The Treasury reserves the right to call back funds placed in the TIO program before maturity, but it would be assessed a penalty in the form of interest. Moreover, such a call would likely result in reduced future participation in the program, and an early call has never occurred.

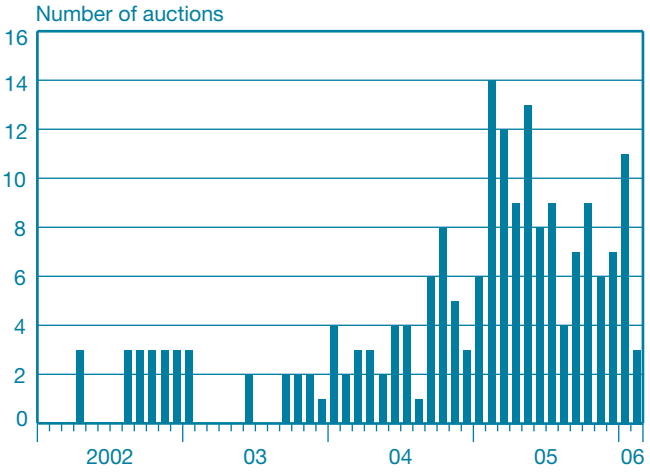
[9]All types of TT&L depositories (collector, retainer, and investor institutions) are eligible to participate in the TIO program.

[10]See <http://www.fms.treas.gov/tip/TIO-Presentation.ppt>. There are approximately 8,000 TT&L depositories.

[11]There is a $10 million minimum for bids. There is no limit on the number of bids that may be submitted by a single institution.

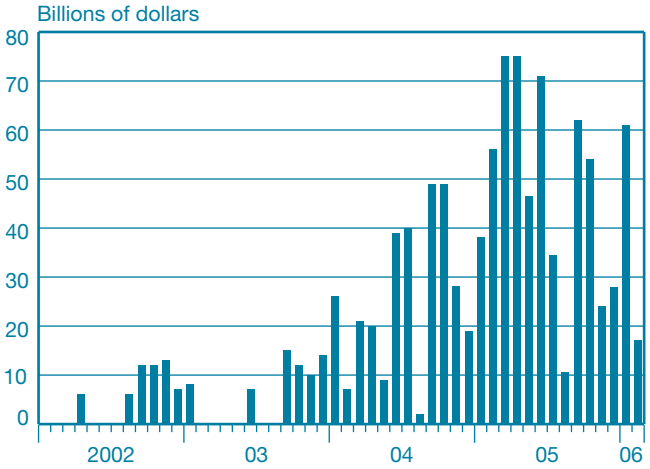
[12]See <http://www.publicdebt.treas.gov/gsr/gsrcltio.htm> for information on acceptable collateral for the TIO program.

Chart 1
Term Investment Option Auctions, Monthly Totals



Source: Author's calculations, based on data from the U.S. Treasury Department (<http://www.fms.treas.gov/tip>).

Chart 2
Term Investment Option Auctions, Monthly Total Amounts Placed



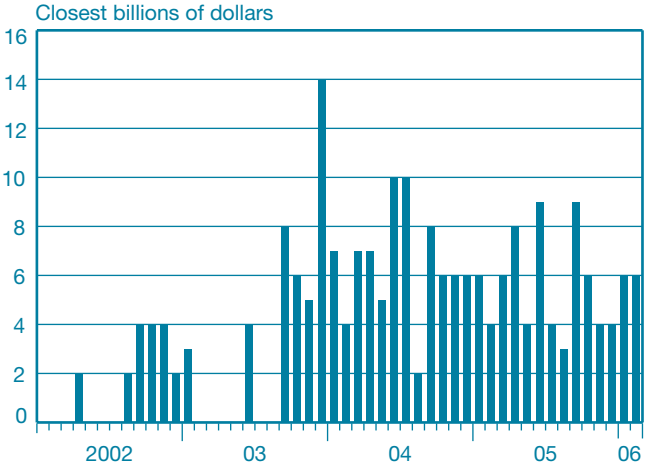
Source: Author's calculations, based on data from the U.S. Treasury Department (<http://www.fms.treas.gov/tip>).

are approximately 3 percent, 10 percent, 60 percent, and 27 percent.

The Treasury sponsored 193 term investments through February 2006.[13] At that point, it faced a debt-limit crisis that

[13]The last TIO auctioned in February 2006 was no. 194, but auction no. 173 was canceled "due to adjustments to cash balance projections" (<http://www.fms.treas.gov/tip/auctions/HistoricalFinal05.pdf>).

Chart 3
Term Investment Option Auctions, Monthly Average Amounts Placed



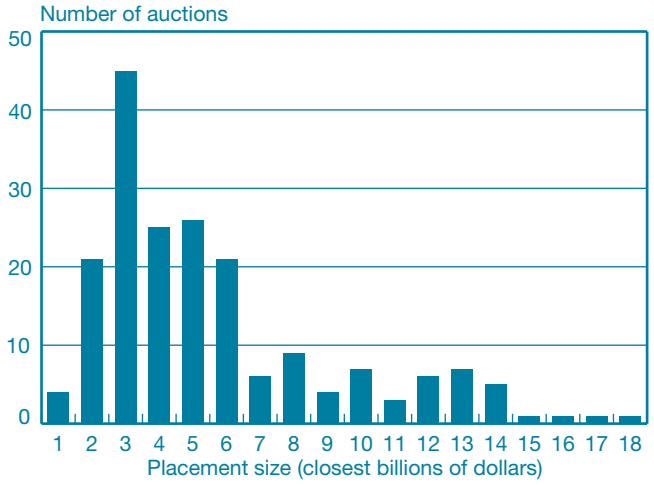
Source: Author's calculations, based on data from the U.S. Treasury Department (<http://www.fms.treas.gov/tip>).

was not resolved until March 20, 2006. No TIO auctions were held during this period, disrupting the typical schedule for these auctions.[14] Chart 1 displays the number of investments each month since the program's inception through February 2006. Term investments generally were relegated to the latter half of the year for 2002 and 2003. After the TIO program became an official cash management tool, the Treasury began placing more term investments for greater cumulative (Chart 2) and average (Chart 3) amounts. Chart 4 shows that of the first 193 auctions, the largest single offering was $18 billion, with most offerings being less than $7 billion. Term lengths have varied from one day to as many as nineteen, but very few have been greater than fifteen days (Chart 5).

While the main parameters of a TIO auction are under the Treasury's control, in deciding the size and term length of a TIO auction the Treasury primarily relies on forecasts of future cash balances, which are dependent on forecasts of tax receipts and outlays. The Treasury also examines the expected forecast errors, which are based on historical data. Naturally, forecast errors for days further out are typically larger than errors over one or two days. Term investment parameters are chosen so that the Treasury's remaining cash balances will likely be sufficient to maintain the $5 billion Fed balance target during the length of the term investment. As a result, TIO offering announcements provide insight into the Treasury's anticipated

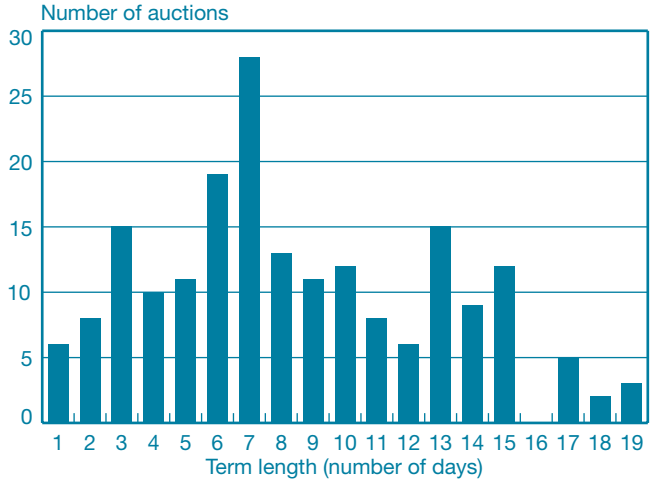
[14]Term investments are typically made during the second half of a month (when receipts are greater) and in the first few days of the following month.

Chart 4
Term Investment Option Auctions, Distribution of Placement Sizes, January 2002–February 2006



Source: Author's calculations, based on data from the U.S. Treasury Department (<http://www.fms.treas.gov/tip>).

Chart 5
Term Investment Option Auctions, Distribution of Term Lengths, January 2002–February 2006



Source: Author's calculations, based on data from the U.S. Treasury Department (<http://www.fms.treas.gov/tip>).

cash balances and, by implication, the Treasury's borrowing requirements.

If receipts are weaker than anticipated or outlays stronger than anticipated, the Treasury can reduce the amount of funds that it auctions from the amount that was announced.[15] In the extreme, the Treasury could auction no funds (that is, cancel an auction). The Treasury does not reduce auction sizes after announcement in response to expectations of interest rates. If receipts are stronger than forecasted or outlays weaker than forecasted, the Treasury cannot increase the size of a given auction after announcement. In the analysis below, auction size amounts are based on the announced auction size, not the actual amount that the Treasury auctions. The Treasury has never altered the announced term length of a given auction.

The Treasury occasionally compressed the [auction] schedule into two days, announcing and auctioning on the same day and placing the funds the following day.

[15]Other reasons why amounts placed can be less than amounts announced include collateral deficiencies and insufficient bids. Of the first 193 auctions, there were 9 occasions on which the amount placed was less than the amount announced.

Our analysis would be more complex if the Treasury set the size and term length of TIO offerings based on rate-of-return considerations. If the Treasury did exercise this discretion, it may prefer to hold more (less) funds in regular TT&L balances when the federal funds rate is trading significantly higher (lower) than the target set by the Federal Open Market Committee. This is because a higher effective federal funds rate increases the TT&L rate. Table 2 presents simple regression results for 2004-05 relating the percentage of total Treasury funds held in the regular TT&L program with dummy variables for cases when, on the previous day, the effective federal funds rate traded 10 or more basis points higher or lower than the target.[16] The results show that the dummy variable coefficients are not statistically significant; the Treasury does not hold more funds in regular TT&L balances (and less in TIO balances) when the federal funds rate is trading significantly higher than the target and vice versa. Therefore, even though the parameters of TIO auctions are under the Treasury's control, these results suggest that they are not set based on rate-of-return considerations.

Beginning in 2004, movements in term investment balances began to parallel closely movements in total TT&L balances, as the Treasury became more active in placing term investments. Chart 6 shows monthly average total TT&L balances divided into

[16]The effective federal funds rate can be found at <http://www.newyorkfed.org>. Information on TT&L balances can be found in the Daily Treasury Statement (<http://www.fms.treas.gov/dts>).

Table 2

Ordinary Least Squares Regression Results

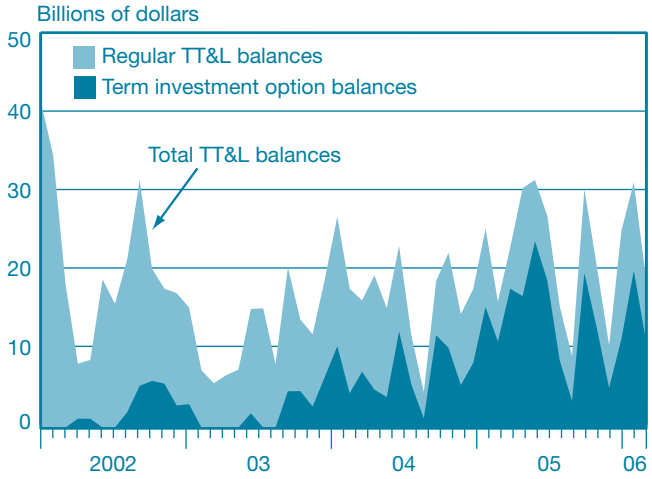
	Dependent Variable: Regular TT&L Balance/Total Balances
Intercept	0.36
	(23.151)
1 (effective fed funds rate minus target $_{t-1}$ > 9 bp)	-0.02
	(-0.559)
1 (effective fed funds rate minus target $_{t-1}$ < -9 bp)	-0.05
	(-0.858)
R^2	0.002

Source: Author's calculations.

Notes: *t*-statistics, in parentheses, are based on Newey-West (1987) standard errors. The number of observations is 503. The period examined is January 5, 2004, to December 30, 2005. TT&L is Treasury Tax and Loan program; bp is basis points.

Chart 6

Monthly Average Treasury Tax and Loan (TT&L) Program Balances



Source: Author's calculations, based on U.S. Treasury Department, Daily Treasury Statement (<http://www.fms.treas.gov/dts>).

regular TT&L balances and TIO balances. During 2002 and 2003, there is very little correlation between total TT&L balances and term investment balances. The correlation coefficient between the balances for 2002-03 is -.03, while the coefficient for 2004 is .79. The coefficient for 2005 is even higher, at .93.

For the time period studied here, the term investment auction process typically took place over three *business* days. This process is coordinated by the Federal Reserve Bank of St. Louis as the fiscal agent for the Treasury:

- Day t: The Treasury announces that it will auction $X billion for Y days.
- Day t+1: Participating institutions bid on the funds and the Treasury announces the results.
- Day t+2: Funds are placed and the Fed balance falls by $X billion.
- Day t+2+Y: $X billion plus interest is returned to the Fed balance.

The Treasury occasionally compressed the schedule into two days, announcing and auctioning on the same day and placing the funds the following day.[17] A compressed schedule allows the Treasury to take into account more information on cash flows before deciding on the auction size. The Treasury has also occasionally auctioned two term investments of different amounts and lengths on the same day.

[17]Since May 2006, the Treasury has moved to a standard process of announcing and auctioning TIO funds on the same day.

2.3 Repurchase Transactions

A repo is essentially a purchase and subsequent sale of an asset with the price differential reflecting the interest on the transaction. The transaction resembles a collateralized loan, as the lender of funds receives an asset as collateral to protect against default. A general collateral (GC) repo transaction does not involve a specific security within a class of securities, such as Treasury, federal agency, and mortgage-backed securities. For example, all Treasury bills, notes, and bonds (including inflation-indexed securities) are eligible for a GC Treasury repo transaction. GC repo rates are quoted for various lengths, such as overnight, one week, two weeks, and three weeks.

TT&L depositories that participate in the TIO program and bid on TIO funds can also obtain funds via repos; therefore, repo rates can be considered a benchmark for TIO rates.[18] Acceptable collateral for mortgage-backed-security repos is also most similar to collateral pledged in the TIO program. Acceptable collateral for GC MBS repos consists of Treasury securities, non-mortgage-backed securities from agencies such as the Federal National Mortgage Association and the Federal Home Loan Mortgage Corporation, and mortgage-backed securities.

[18]From the Treasury's standpoint, the TT&L rate is the proper rate against which to compare the TIO rate because the TT&L rate represents what TIO funds would have earned had they not been placed in the TIO program. However, TT&L rates are not known at the time of TIO auctions.

Repos can settle either as a delivery-versus-payment (DVP) transaction or via a tri-party clearing arrangement. In the former, collateral and funds are exchanged directly between counterparties. In the latter, the transaction is conducted through a third-party clearing bank (see Garbade [2006, p. 38]). There are several benefits to a tri-party repo compared with a DVP repo. For example, in a tri-party repo, the clearing bank, instead of the counterparties, is responsible for the settlement of funds and collateral. In addition, specific collateral does not have to be allocated when the counterparties agree on the transaction amount. Also, many different pieces of collateral can be cleared together. Most MBS repos are tri-party transactions, as the transfer of MBS collateral, which typically consists of various heterogeneous securities, is potentially very burdensome.[19]

TT&L [Treasury Tax and Loan] depositories that participate in the TIO program and bid on TIO funds can also obtain funds via repos; therefore, repo rates can be considered a benchmark for TIO rates.

3. Data and Regression Framework

Our regression framework is as follows:[20]

$$TIO - MBS\ repo\ rate_i\ spread = \alpha + \beta_1 X_{1,i} + \ldots + \beta_N X_{N,i} + \varepsilon_i$$
$$\varepsilon_i \sim N(0,\ \sigma_\varepsilon^2),$$

where the subscript i represents the TIO auction number. We analyze auctions after TIO became an official Treasury cash management tool (those after no. 27) through February 2006, for a total of 166 auctions. Auctions held in this sample period are more similar to the way in which TIO auctions are likely to be structured and conducted in the future than auctions held during the pilot program. For example, TIO auctions now occur more frequently than they did during the pilot program. $X_1,\ldots,X_N$ represent the independent variables that influence the TIO-MBS repo rate spread (the spread). These include the size of the term investment auction and the term length. The coefficients to be estimated are represented by α and the βs, and ε represents a random error term.

One complication when calculating comparable market rates is that MBS repo rates are not observed for term intervals other than overnight, one week, two weeks, etc., so exact comparisons of rates are not possible for TIO term lengths of two to six days, eight to thirteen days, etc. In addition, implied forward rates are the appropriate benchmark because TIO funds are placed on the next business day after the day of auction. In contrast, a repo transaction typically starts on the trade date.

We calculate comparable MBS repo rates in two steps. First, we compute repo rates for a length of time equal to $t+k$ days, where t is the number of days from auction to placement and k is the term length.[21] We calculate these rates by linearly interpolating comparable rates using the MBS repo term structure.

For example, TIO no. 54 was auctioned on September 14, 2004, was issued on September 15, 2004, and matured on September 27, 2004, for a term length of twelve days, so that $t = 1$ and $k = 12$. The one-week MBS repo rate on the day of auction, September 14, 2004, was 1.55 percent and the two-week MBS repo rate was 1.62 percent. The difference between these two rates (.07 percent) is multiplied by the number of days within the seven-day interval between two weeks and one week that is covered by $t+k$, (13-7)/7.[22] This product is added to the one-week MBS repo rate to arrive at the thirteen-day MBS repo rate for TIO no. 54 (see Chart 7):

One complication when calculating comparable market rates is that MBS [mortgage-backed-security] repo rates are not observed for term intervals other than overnight, one week, two weeks, etc., so exact comparisons of rates are not possible for TIO term lengths of two to six days, eight to thirteen days, etc.

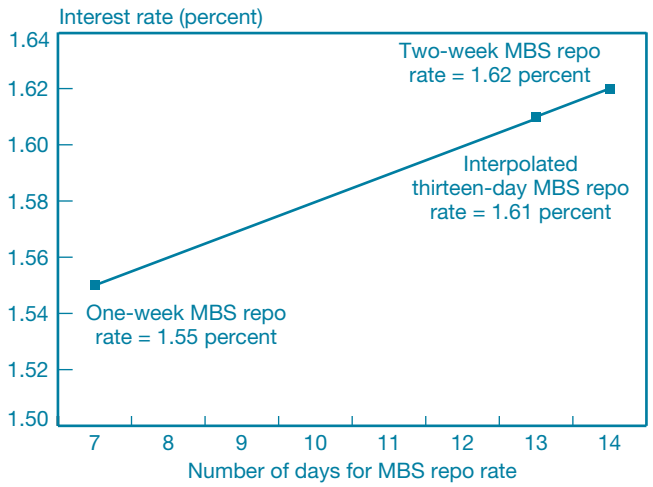
[19]Special thanks to John McGowan for his insights into DVP and tri-party repos. For more on repo markets, see Meulendyke (1998, pp. 101-4).

[20]The data on term investment auctions studied here are publicly available. See <http://www.wrightson.com/treasury/data/tio> (registration required) or <http://www.fms.treas.gov/tip>. These websites contain information on dates of announcement, auction, placement, and maturity; the amount auctioned; and the TIO auction award rate (the TIO rate). Comparable MBS repo rates are calculated from the opening MBS repo rate, which can be obtained via Bloomberg.

[21]The parameter t can take on values greater than 1 because of weekends and holidays.

Chart 7

Interpolation of Thirteen-Day Mortgage-Backed-Security (MBS) Repo Rate for Term Investment Option No. 54



Sources: Author's calculations; Bloomberg.

Table 3

Summary Statistics

	Mean	Standard Deviation
TIO-TT&L rate spread (basis points)	16.34	7.12
TIO-MBS repo rate spread (basis points)	-6.14	6.99
Size (billions of dollars)	5.98	3.74
Term (days)	8.01	4.36
Term investments outstanding on day of placement (billions of dollars)	14.99	13.02
Days since last TIO auction	5.04	7.12
1 (announcement day = auction day)	0.283	0.452
1 (first auction if two auctions on same day)	0.054	0.227
1 (second auction if two auctions on same day)	0.054	0.227

Source: Author's calculations.

Notes: The number of observations is 166. TIO is term investment option; TT&L is Treasury Tax and Loan program; MBS is mortgage-backed security.

$$R_{t+k} = R_{13} = 1.55\ percent + .07\ percent * (6/7) = 1.61\ percent.$$

Second, implied forward rates must be calculated. The forward rate is the proper comparison rate because TIO investments are placed on the next business day after auction. To calculate the comparable MBS repo rate for a given TIO auction, f_k, we use:

$$(1) \qquad \left[1 + \frac{k}{360} f_k\right] = \frac{\left[1 + \frac{t+k}{360} R_{t+k}\right]}{\left[1 + \frac{t}{360} R_{o/n}\right]},$$

where $R_{o/n}$ represents the overnight MBS repo rate, and overnight is defined as the next business day. Thus, for TIO no. 54, $R_{o/n}$ on September 14, 2004, was 1.5 percent, and given the calculation of R_{13} to be 1.61 percent, we substitute values into equation 1:

$$\left[1 + \frac{12}{360} f_{12}\right] = \frac{\left[1 + \frac{13}{360} .0161\right]}{\left[1 + \frac{1}{360} .015\right]}.$$

[22]Note that for $t+k<7$, the interval will typically be six days (seven days for a one-week transaction minus one day for an overnight transaction). The proper interval will also be affected by weekends and holidays. For example, an overnight transaction conducted on a Friday will be for three days, assuming no holiday on the following Monday.

Therefore, the comparable MBS repo rate for TIO no. 54 is:

$$MBS\ repo\ rate_{54} = f_{12} = .01619, \textit{ or } 1.619\ percent.$$

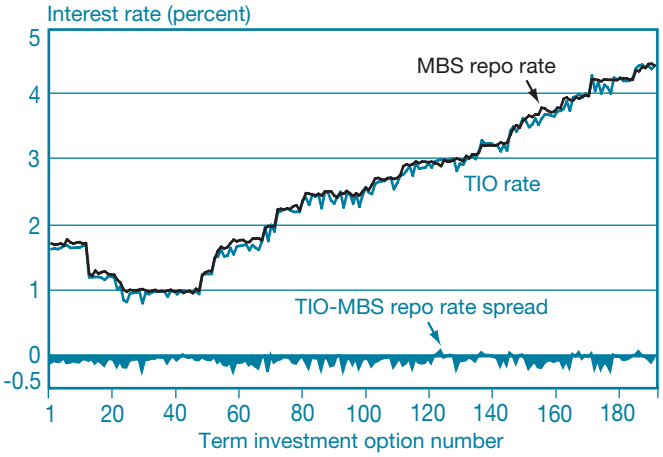
We present summary statistics for the variables in Table 3. For the sample period, the average spread is negative, at -6.14 basis points. The average TIO investment is for $5.98 billion for a term of eight days. While the Treasury only began announcing and auctioning term investments on the same day in 2005, 28.3 percent of term investments in the sample were announced and auctioned on the same day.

Chart 8 depicts TIO and MBS repo rates. Consistent with the negative average spread, the MBS repo rate typically trades slightly above the TIO rate. The spread between the two rates is also plotted in the chart. The largest spread was 8.8 basis points for TIO no. 125 and the smallest spread was -24.5 basis points for TIO no. 70. While the spread is typically negative, there are a number of cases where it is positive. There does not appear to be any obvious trend in the spread over time despite the growth of the TIO program.

In terms of expected signs for the regression coefficients, as more TIO funds are auctioned (the supply of term investments increases), assuming a downward-sloping demand curve, the TIO rate is expected to fall. Therefore, the spread is expected to narrow or become more negative, so the size of the auction is expected to be negatively related to the spread.[23] The amount of term investments outstanding is also expected to have a

Chart 8

Term Investment Option (TIO) Rate Compared with Mortgage-Backed-Security (MBS) Repo Rate



Sources: Author's calculations; U.S. Treasury Department (<http://www.fms.treas.gov/tip>); Bloomberg.

negative relationship with the spread, as banks are expected to bid less aggressively as more of their allocated collateral is exchanged for TIO funds.[24] The need for funding assets will also generally be reduced by prior TIO awards. As the auctioned amount can differ from the amount actually placed (on rare occasions), the auctioned amount is used in the regressions because this is the amount on which banks are bidding.[25] Because the benchmark rate is for the same term length, it is not clear that longer term lengths should have any relationship with the spread. We also analyze the number of days since the last auction. More frequent auctions are generally associated with more TIO funds outstanding, so more time between auctions is expected to be positively related to the spread. However, this coefficient should be interpreted carefully.

In addition, in the sample period the Treasury occasionally compressed the TIO auction schedule by announcing and auctioning term investments on the same day. We investigate the relationship between a compressed schedule and the spread using a dummy variable for auctions announced and auctioned on the same day. This coefficient is expected to be negative if banks bid less aggressively when they have less time to prepare for an auction. The Treasury has also occasionally held two auctions for different amounts and term lengths on the same day. A casual observation of the data suggests that the rate for the second auction of a multiple-auction day is low compared with the rate for the first auction. Dummy variables for days of the week of an auction are also investigated.

4. Regression Results

Column 1 of Table 4 presents a basic specification with only an intercept, the size of the TIO auction, and the term length. The size of the TIO auction is negatively related to the spread, so an increase in supply leads to lower bids. The term length is positively related to the spread. All coefficients are statistically significant.

Column 2 adds other explanatory variables and represents the preferred specification. For the other variables, we add quadratic and cubic terms for the term length as well as a dummy variable for one-day TIOs. A casual observation of the data shows that the six TIO offerings with one-day term lengths in the sample resulted in relatively low spreads. The dummy variable for one-day terms explicitly controls for these auctions. As expected, one-day term lengths result in very poor outcomes for the Treasury.[26] The linear term coefficient is now larger in magnitude and still statistically significant. The squared term coefficient is negative, while the cubic term coefficient is positive.

Overall, for small auction sizes . . . for term lengths of five to nineteen days, the Treasury appears to receive an interest rate comparable to market rates.

Holding all other variables at zero, we plot in Chart 9 the effect of term length on the spread. The effect of increasing term length is greatest for lengths of one to four days. For term lengths of five to sixteen days, predicted spreads are close to zero, and the effect of increasing term length is not large in magnitude. Beyond sixteen-day terms, the cubic term starts to dominate and the effect of increasing term length starts to climb again. Overall, for small auction sizes, the chart shows that for term lengths of five to nineteen days, the Treasury appears to receive an interest rate

[23]For Treasury debt auctions, Seligman (2006), Fleming (2002), Simon (1991, 1994), and Duffee (1996) find that increases in the size of issuance lead to higher yields (lower prices for Treasury debt).

[24]When two auctions occur on the same day, we set the amount outstanding for the second (higher numbered) auction to include the amount in the first auction. The higher numbered auction will have a later closing time.

[25]This scenario can occur for a variety of reasons. For example, the announced amount for TIO no. 137 was $3 billion, but because of a collateral deficiency only $2.96 billion was placed (<http://www.fms.treas.gov/tip/auctions/HistoricalFinal05.pdf>).

[26]When a dummy variable for two-day term investments was added, its coefficient was negative but not significant.

Table 4

Ordinary Least Squares Regression Results

	Dependent Variable: TIO-MBS Repo Rate Spread				
	(1)	(2)	(3)	(4)	(5)
Intercept	-0.068	-0.123	-0.105	-0.132	-0.136
	(-4.424)	(-3.745)	(-3.194)	(-4.326)	(-3.524)
Size	-0.005	-0.007	-0.007	-0.007	-0.007
	(-2.538)	(-3.936)	(-3.784)	(-3.728)	(-3.858)
Term	0.004	0.035	0.036	0.033	0.038
	(3.328)	(3.331)	(3.171)	(3.067)	(3.269)
$Term^2$		-0.003	-0.003	-0.003	-0.004
		(-2.934)	(-2.762)	(-2.871)	(-3.028)
$Term^3$		0.0001	0.0001	0.0001	0.0001
		(2.705)	(2.576)	(2.788)	(2.881)
1 (term = 1)		-0.059	-0.065	-0.058	-0.040
		(-2.530)	(-2.601)	(-2.534)	(-1.452)
Term investments outstanding on day of placement		-0.001	-0.001		-0.001
		(-1.029)	(-2.687)		(-1.653)
Days since last TIO auction		0.006		0.008	0.005
		(1.988)		(3.334)	(1.802)
Days since last TIO $auction^2$		-0.0001		-0.0002	-0.0001
		(-1.705)		(-2.562)	(-1.309)
Tuesday					-0.017
					(-1.138)
Wednesday					-0.022
					(-1.074)
Thursday					-0.012
					(-0.706)
Friday					-0.0004
					(-0.022)
1 (announcement day = auction day)					0.008
					(0.513)
1 (first auction if two auctions on same day)					-0.0002
					(-0.009)
1 (second auction if two auctions on same day)					-0.038
					(-1.129)
Time trend					0.018
					(1.325)
Adjusted R^2	0.104	0.272	0.249	0.266	0.287
Durbin-Watson	1.59	1.39	1.41	1.42	1.41

Source: Author's calculations.

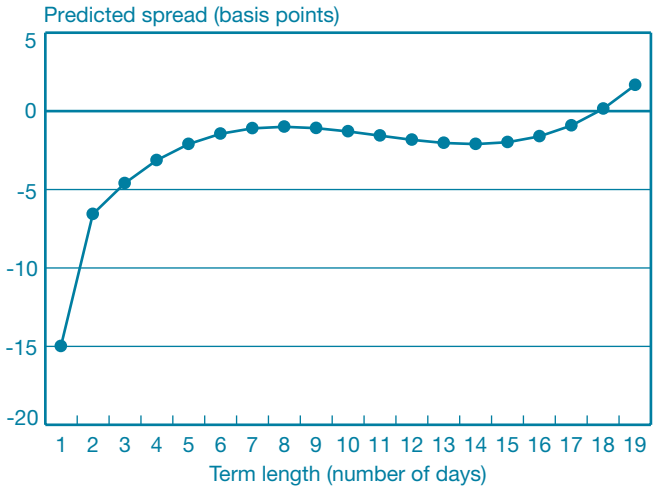
Notes: *t*-statistics, in parentheses, are based on Newey-West (1987) standard errors. The number of observations is 166. TIO is term investment option; MBS is mortgage-backed security.

comparable to market rates. We note that the effect on the spread for term lengths greater than sixteen days should be interpreted with caution, because—as Chart 5 shows—only ten offerings were for term lengths of more than sixteen days.

For term lengths of one to four days, the impact on the spread may be associated with the more cumbersome process of transferring TIO collateral compared with MBS repo collateral. As we discussed, the settlement of TIO transactions with

Chart 9

Intercept and Term Length Coefficients; Other Variables Set to Zero



Source: Author's calculations.

noncommercial loans pledged as collateral is essentially via delivery-versus-payment.[27] However, MBS repos are predominantly settled via tri-party, the more operationally efficient method of settlement. Accordingly, depository institutions may consider the transfer of TIO collateral back and forth for term lengths of less than five days to be particularly burdensome, leading to low relative TIO rates for short term lengths.[28]

As expected, the coefficient on the amount of term investments outstanding on the day of placement is negative, but the coefficient is not statistically significant.[29] The magnitude of this coefficient is also smaller than the coefficient for size of auction. The number of days since the last TIO auction is positive and significant; the coefficient on the quadratic term is negative and significant at the 90 percent level.

Columns 3 and 4 of Table 4 present results in which the number of days since the last TIO auction and the amount of term investments outstanding, respectively, are deleted from the specification. The interaction of these variables may be confounding their coefficients in column 2. As we discussed, more frequent auctions generally are associated with more TIO funds outstanding. In column 3, the variables for the number of days since the last auction are deleted and the amount of term investments outstanding is retained. Whereas in column 2 the coefficient for the amount of term investments outstanding is insignificant, the coefficient in column 3 is now statistically significant at the 95 percent confidence level.

In column 4, the variables for the number of days since the last auction are retained and the amount of term investments outstanding is deleted. Compared with their values in column 2, the coefficients for both the linear and quadratic terms for the number of days since the last auction are larger in magnitude and statistically significant at the 95 percent confidence level.

Furthermore, an F-test of the null hypothesis that these three coefficients are jointly equal to zero can be rejected at the 99 percent confidence level.[30] As a result, we retain these three variables in the preferred specification in column 2.

4.1 Additional Issues

Table 4, column 5, presents a fuller specification with additional variables for the day of the week of auction, cases when TIO funds are announced and auctioned on the same day, dummy variables for days with multiple auctions, and a time trend (in decimal years).[31] None of the additional coefficients is statistically significant. Therefore, column 2 represents the preferred specification.

The insignificant time trend suggests that spreads did not narrow over the sample period. Higher order terms for the time trend (not presented) also were insignificant. The coefficient on the dummy variable for auctions announced and auctioned on the same day is positive, but insignificant. This result suggests that compressing the auction schedule does not negatively affect the Treasury in terms of the spread; banks appear to be indifferent to more advance notice of a TIO auction.

In addition, coefficients on the dummy variables for days with multiple auctions are not significant.[32] Note that the amount of term investments outstanding is always greater for the second auction on a day with multiple auctions. Also, the number of days since the last auction is always zero for the second auction. While the magnitude of the coefficient for the second auction on a multiple-auction day suggests that the Treasury may need to be somewhat cautious in conducting multiple auctions on the same day, the statistical insignificance of the coefficient implies that this variable does

[27]At this time, it is not clear whether the Treasury has the legal authority to engage in tri-party transactions.

[28]For a given cost of transferring collateral, the average cost (per day) is larger for shorter term lengths.

[29]This amount does not include the amount being placed.

[30]The test statistic has a value of 6.82, which exceeds the 1 percent $F_{3,157}$ critical value of 3.78.

[31]Thus, the time trend takes on a value of 1 on November 21, 2004, one year after the sample period began.

[32]In the sample, there are nine occasions on which two auctions occurred on the same day.

not add much explanatory value beyond the effects of the amount of term investments outstanding and the time since the last auction.

5. Conclusion

This article considers whether the interest rates received by the Treasury through TIO auctions are comparable to market rates. Central to our study is an analysis of the spread between rates on TIO auctions and rates on mortgage-backed-security repos. We study the 166 TIO auctions held from November 2003, when TIO became an official Treasury cash management tool, through February 2006.

We find that for small auction sizes, TIO interest rates and MBS repo rates are comparable for auctions with term lengths of five days or more. However, the Treasury tends to receive lower TIO rates relative to market rates when term lengths are of shorter durations. We also find that the spread between the TIO rate and the MBS repo rate is negatively related to auction size. Finally, banks appear to be indifferent to more advance notice of TIO auctions. We base this conclusion on our finding that TIO interest rates are not adversely affected by a more compressed auction schedule, whereby the Treasury announces and auctions TIO funds on the same day.

These findings may be of interest to a variety of market participants. For instance, the Treasury would be interested in whether its term investments are receiving a rate of return comparable to market rates. In addition, those who study Treasury auctions may find our results informative, because TIO auctions vary along more dimensions than do typical Treasury debt auctions and hence can offer new insight. Finally, our work may be of interest to other central banks, as the management of treasury funds affects the level of bank reserves and thus the conduct of monetary policy.[33]

[33] Different countries have different frameworks for managing government funds. For example, in Japan all government funds are held at the central bank and no funds are held at banking institutions. See Bank of Japan (2004).

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