Relative Repo Specialness in U.S. Treasuries

PAMELA C. MOULTON

PAMELA C. MOULTON is a senior economist at the New York Stock Exchange in New York City.
pmoulton@nyse.com

Repo rates are the rates at which bonds and notes can be financed on a collateralized basis. Most Treasury issues trade at the general collateral repo rate, but a few trade at "special" repo rates, which are below the general collateral repo rate. The owner of a security that is on special can obtain financing at an advantageous rate by using that security as collateral in a repurchase agreement. Duffie [1996], Keane [1995], and Sundaresan [1994] provide a detailed description of the repo market.

My research investigates the determinants of relative repo specialness between the most recently issued U.S. Treasury security (the on-the-run) and its immediate predecessor (the old). There are several reasons for investors as well as traders to care about relative specialness. Relative specialness varies considerably across pairs of issues and over time and is a key component of the relative value between bonds. Krishnamurthy [2002] shows that repo specialness severely limits the profitability of trades designed to capture the systematic convergence of the on-the-run to old bond yield spread over each auction cycle. Relative specialness may also signal the market's perception of relative liquidity. Duffie [1996] shows that in general more liquid bonds should trade more special, that is, at lower repo rates.

Most empirical work to date on repo specialness has focused on overnight repo rates and how overnight specialness is related to auction success (Sundaresan [1994]); auction cycles (Keane [1995]); and bond prices in the cash market (Jordan and Jordan [1997]). Longstaff [2000] shows that term general collateral repo rates are nearly unbiased estimates of overnight general collateral rates, but Buraschi and Menini [2002] find that term special repo rates are generally not unbiased estimators of future overnight repo specialness.

I focus on term repo specialness for two reasons. First, term repo can be used to lock in a forward price to the next auction date, when an on-the-run issue becomes old and thus would be expected to lose its liquidity advantage. Second, an examination of how term specialness varies suggests some reasons that special repo rates often violate the expectations hypothesis.

Many intriguing results emerge from this analysis. I find that the relative specialness of the on-the-run increases as the next auction approaches, indicating that pre-auction positioning pressures and declining collateral supply outweigh the on-the-run's approaching loss of its better liquidity. Both relative issue size and repo volatility affect relative specialness in ways that suggest a squeeze option is priced into term special rates. Credit spreads and their volatility emerge as important influences on relative specialness, evidence of integration between credit markets and the Treasury market. I also document a clear reduction in relative specialness in the note sector following expansion of the Fed's securities lending program in 1999.

Collectively these results suggest that collateral supply and demand dynamics play an important role in the evolution of relative specialness.

I. BACKGROUND

Duffie [1996] shows that specialness depends on the liquidity of an instrument. If two otherwise identical issues have different liquidity, the one with the greater liquidity should trade more special in the repo market. This provides a basic intuition for why recently issued Treasuries tend to trade on special.

In the Treasury market, on-the-runs and olds are both very liquid, with narrow bid-ask spreads and large trading volume in both issues. On-the-runs generally enjoy a slight liquidity advantage, which declines as the next auction approaches and the current on-the-run becomes the old issue.

Duffie [1996] also establishes that an issue's specialness increases with the demand for short positions, for a given total supply. Thus another explanation for the relative specialness of an on-the-run to an old is the relative demand to short the two issues. Finally, a decline in the collateral supply of an on-the-run versus an old should increase the on-the-run's relative specialness.

There is seasonality in shorting demand around Treasury auction dates. Sundaresan [1994] examines how bidder behavior and shorting demand drive overnight repo rates around Treasury auctions. He finds that dealer demand to short the on-the-run security rises in the days before a Treasury auction, and that more successful auctions precipitate greater position-squaring and more specialness following auctions. Using overnight repo data from the early 1990s, Jordan and Jordan [1997] find that Sundaresan's [1994] auction success intuition holds for up to four weeks beyond auction dates.

If we extend this intuition from overnight repo in the period immediately following auctions to term repo during the entire auction cycle, the number of days to next auction and the success of the most recent auction may help explain variations in the relative specialness of on-the-run Treasuries. The on-the-run's relative specialness should be negatively related to the time to next auction and positively related to the success of the on-the-run's auction.

Several other factors are also likely to influence shorting demand. Collin-Dufresne, Goldstein, and Martin [2001] find that an increase in credit spreads is associated with a widening of the old versus on-the-run Treasury yield spread. This flight to on-the-runs likely reduces net shorting demand for the on-the-run, suggesting that an increase in credit spreads should be accompanied by a reduced relative specialness for the on-the-run. Shorting demand should also be influenced by market volatility. Higher interest rate or credit spread volatility is likely to increase hedging demand, and as the cash hedging vehicles of choice on-the-run Treasuries are likely to witness the biggest surge in shorting demand, increasing their relative specialness.

Market direction may also influence shorting demand. Practitioners suggest that the pressure to establish shorts declines in a market rally, which will tend to ease the specialness of on-the-runs, as they are generally the most popular Treasuries to short. A market sell-off may prevent some investors who do not lend securities from selling them and realizing accounting losses, leading to higher repo specialness. One implication is that on-the-run relative specialness should be positively related to yield changes since the most recent auction.

Similarly, when mortgage refinancing activity increases, portfolio managers typically buy Treasuries to offset the declining duration of their mortgage securities. This increased buying demand is likely to reduce the relative specialness of on-the-run Treasuries, especially in maturities out to ten years.

On the supply side, there are two main factors that are likely to influence the relative pricing of term repo on Treasuries. First, the collateral supply of a particular Treasury generally declines over time as securities purchased by dealers at auction are sold to buy-and-hold investors less willing to make them available in the repo market. This placement effect is likely to be strongest for on-the-runs and thus contribute to the negative relation between relative specialness and the time to next auction.[1]

Second, the likelihood of a short squeeze may affect lenders' willingness to offer securities for a fixed term. Term repo rates appear to price in some possibility of a future squeeze. Buraschi and Menini [2002] find that term repo rates are generally lower than future overnight repo rates. From an asset pricing perspective, when bondholders lend bonds for a fixed term they are effectively short a squeeze option. They fail to benefit if a squeeze emerges in the issue, because they have locked in a term borrowing rate.

The optionality arises from the asymmetry of special repo relative to general collateral repo rates. Special repo never trades above the general collateral repo rate but can drop far below it in the event of a squeeze. To compensate for this asymmetric risk, term repo specials are normally priced below expected future overnight special repo rates.

The squeeze risk should be lower for larger issues, all else equal, so a higher on-the-run size relative to old size should correspond to a lower relative term specialness. Furthermore, the more volatile special repo rates are, the more concerned traders are likely to be about the

EXHIBIT 1

Summary Statistics for Term Repo Data

	2-Year	5-Year	10-Year	30-Year
On-the-Run Repo				
Mean	4.72%	4.16%	2.99%	3.38%
Std. Dev.	0.64	0.87	1.15	1.23
25%	4.25	3.55	2.22	2.48
75%	5.25	4.78	3.70	4.15
Old Repo				
Mean	5.03	4.83	4.23	4.55
Std. Dev.	0.51	0.62	0.98	1.00
25%	4.60	4.36	3.70	4.00
75%	5.35	5.24	4.75	5.17
Old-OTR Repo Spread				
Mean	0.30	0.67	1.23	1.17
Std. Dev.	0.37	0.65	1.06	1.08
25%	0.05	0.29	0.35	0.39
75%	0.45	0.90	2.08	1.91
Number of Obs	495	492	494	456

Period covered is April 15, 1998, through June 15, 2000.

possibility of a serious squeeze. An increase in repo volatility should cause term repo rates to fall more for the old issue because it is generally perceived to be slightly less liquid than the on-the-run and thereby potentially more squeezable. Thus an increase in repo volatility may reduce the on-the-run's relative specialness.

The supply of Treasuries available for borrowing increased significantly beginning in April 1999 when the Federal Reserve expanded its Treasury securities lending program. The Fed substantially increased dealers' borrowing limits and introduced an auction mechanism to make loan pricing and security allocation a competitive process, linking it more closely to the repo market. Fleming and Garbade [2003] report that the Fed's securities lending averaged $1.5 billion per day between April 1999 and November 2002, most of it in Treasury notes. Although the Fed's program is limited to lending securities overnight, the general impact of greater supply should be felt in the term repo market as well.

II. DATA AND METHODOLOGY

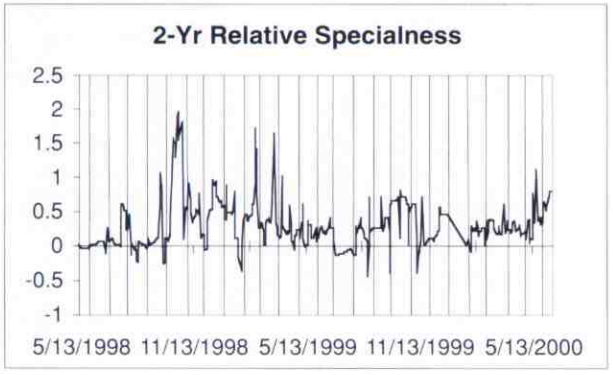
Relative specialness is measured as the old issue's special repo rate minus the on-the-run's special repo rate, both for the term ending on the next auction settlement date. I choose this particular term for two reasons. First, much of the theoretical basis for repo specialness rests on liquidity differences, and these differences are greatest when one issue is the on-the-run. Once a new issue is auctioned, the former on-the-run loses much of its status and associated liquidity advantages.

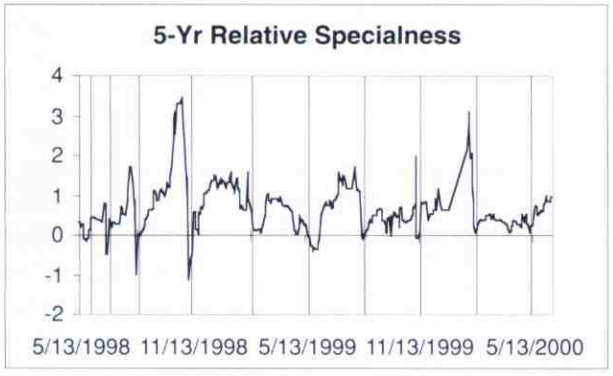
Second, the auction date is generally one of the most actively traded repo dates, so more reliable data are available than for other terms. Special term repo rates for each issue are Deutsche Bank traders' daily midmarket rates from April 15, 1998, through June 15, 2000 (hand-priced as of the end of the trading day in New York). No special repo data are available for January 2000 because of database changes, so that month is excluded from the analysis.

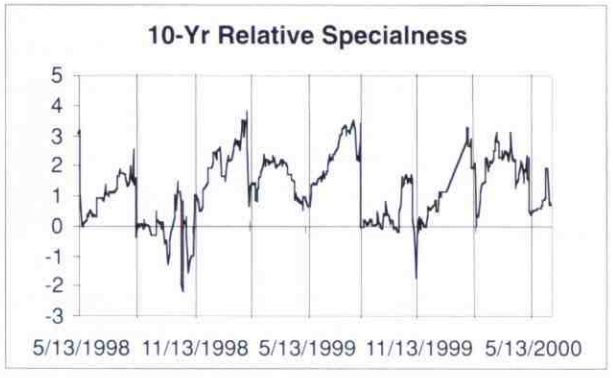
Exhibit 1 presents summary statistics for the term repo data and relative specialness of the four maturity sectors that were actively auctioned in this 1998–2000 period.

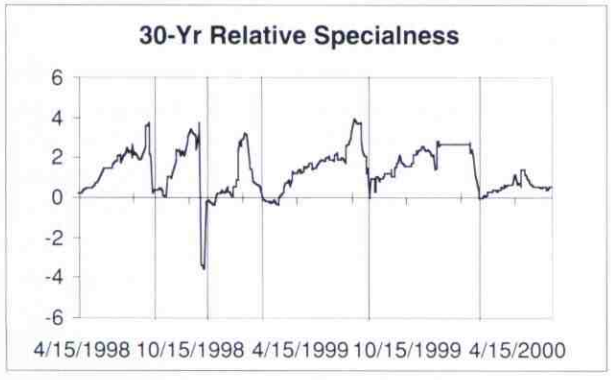
EXHIBIT 2

Relative Specialness versus Auction Schedule









Vertical lines denote auction dates.

Average on-the-run Treasury specialness ranges from 30 basis points in the two-year to 123 basis points in the ten-year over this period. The on-the-run ten-year typically enjoys the greatest term repo specialness relative to its old issue, consistent with the ten-year's emergence as the new benchmark of the U.S. Treasury curve in recent years.[2]

The two-year exhibits the least relative specialness, likely reflecting its monthly auction schedule and possible lower collateral demand, given the abundance of highly liquid substitutes (such as Eurodollar futures strips) in the two-year sector. General collateral one-month and three-month term repo over this period averaged 5.29%.

The considerable variation in repo specialness is clearly tied to the auction cycle, as illustrated in the graphs of Exhibit 2. The relative specialness of on-the-runs appears to increase as the next auction approaches, consistent with Sundaresan's [1994] observation that dealers display an increasing desire to short the on-the-run as a hedge going into the next auction.

The graphs in Exhibit 3 provide a closer look at this link between relative specialness and the approach of the next auction, lining up the auction dates in event time.

The background discussion above suggests a number of other variables that may help to explain variations in relative specialness. Repo volatility is calculated using the old repo rate. The TED spread, three-month Treasury minus Eurodollar yields, is used as a proxy for credit spreads. For interest rate volatility, I use implied volatility on at-the-money three-month options on 2-year, 5-year, 10-year, and 30-year Treasuries. The relative bid-cover ratio between the old and on-the-run auctions captures relative auction success. Changes in the Mortgage Bankers Association Refinancing Index are calculated from the weekly series. Data for the explanatory variables are from the Treasury website, Bloomberg, and Deutsche Bank.[3]

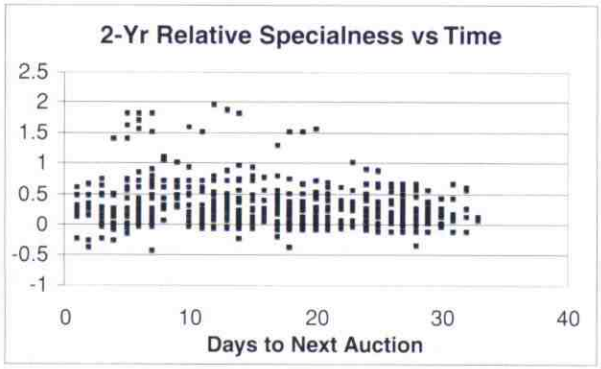
For each maturity sector, the regression equation estimated is:

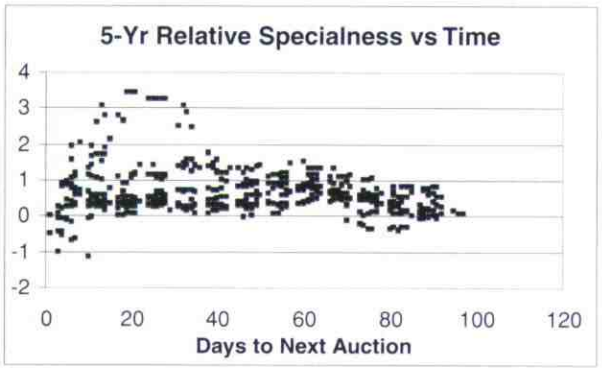
$$\begin{aligned} RelSpec_t = \alpha &+ \beta_1 DaysNext_t + \beta_2 RelBidCov_t + \\ &\beta_3 TED_t + \beta_4 IntVol_t + \beta_5 TEDVol_t + \\ &\beta_6 YldChg_t + \beta_7 RefiChg_t + \beta_8 RelSize_t + \\ &\beta_9 RPVol_t + \beta_{10} SecLend_t + \varepsilon_t \end{aligned}$$

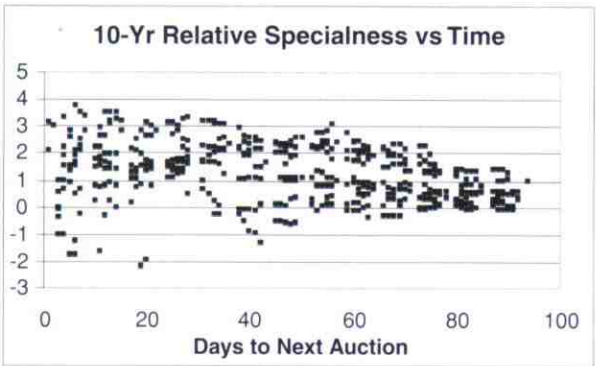
where: $RelSpec_t$ = old minus on-the-run term repo rates to next auction date, in percent;
$DaysNext_t$ = days to next auction date;
$RelBidCov_t$ = relative auction bid-cover ratio (on-the-run/old);

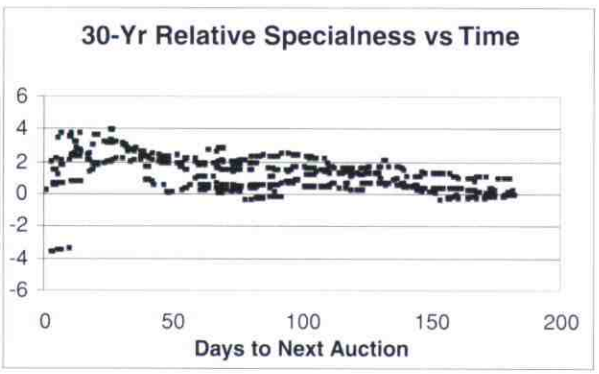
EXHIBIT 3

Relative Specialness versus Days to Next Auction









TED_t = 3-month Treasury – Eurodollar spread, in basis points;

$IntVol_t$ = implied interest rate volatility of 3-month options on on-the-run;

$TEDVol_t$ = 20-day historical volatility of TED spread;

$YldChg_t$ = yield change since last auction, in basis points;

$RefiChg_t$ = weekly change in MBA mortgage refinancing index;

$RelSize_t$ = relative issue size (on-the-run/old);

$RPVol_t$ = 20-day historical volatility of old repo rate; and

$SecLend_t$ = dummy equal to 0 prior to the Fed's revamping of its securities lending program, and 1 thereafter.

The days to next auction, TED spread, refinancing index change, relative size, repo volatility, and change in the Fed's securities lending program are expected to be negatively related to the relative specialness. Relative auction bid-cover, interest rate volatility, TED spread volatility, and yield change since last auction are expected to be positively related to the relative specialness of on-the-run Treasuries. These sign predictions are summarized in Exhibit 4.

The dependent variable, relative specialness, is continuous so the equation is estimated using ordinary least squares. Newey-West standard errors with five lags are used because preliminary analysis shows significant autocorrelation in all four maturities.[4]

III. EMPIRICAL RESULTS

Exhibit 5 presents the estimation results. The coefficient on days to next auction is significantly negative in all four maturity sectors. This suggests that the on-the-run's relative specialness rises throughout the interauction period, likely indicating declining collateral supply of the on-the-run as it gets placed with buy-and-hold investors as well as pre-auction positioning.

The other auction effect suggested by Sundaresan [1994] does not extend as smoothly from overnight repo in the immediate post-auction period to term repo over the entire auction cycle. Relative auction success, measured as the relative bid-cover ratio between the on-the-run and old issues, has the predicted significantly positive sign for the 30-year bond, but is significantly negative for the 5-year and 10-year notes.

The predicted positive result in the 30-year is likely

EXHIBIT 4
Predicted Signs of Explanatory Variables

Explanatory Variable	Predicted Sign	Motivation
Days to Next Auction	Negative	Pre-auction shorting demand; declining collateral supply
Relative Bid-Cover Ratio	Positive	Post-auction position-squaring
TED Spread	Negative	Flight to on-the-runs
Interest Rate Volatility	Positive	Hedging demand
TED Spread Volatility	Positive	Hedging demand
Yield Change	Positive	Hedging demand
Refi Index Change	Negative	Mortgage portfolio buying
Relative Size	Negative	Squeeze optionality
Repo Volatility	Negative	Squeeze optionality
Securities Lending Revision	Negative	Increased supply

due to uncertainty over the Treasury's prospective financing strategy as well as the direct auction effects documented by Sundaresan [1994]. In the 1998-2000 period, there was considerable discussion of how the Treasury might change its issuance strategy in the face of declining financing needs. Speculation focused on whether the 30-year bond would be discontinued. Concerns about the potentially disappearing 30-year combined with limited 30-year substitutes likely exacerbated the increased specialness of on-the-run 30-years following a successful auction.

Five- and ten-year Treasuries were not viewed as in danger of discontinuation and had more viable substitutes. Even so, the reason for their significant negative coefficients is unclear and is contrary to results in studies using overnight repo rates over shorter post-auction periods in the early 1990s.

The explanatory variables indicating non-auction-related shorting demand generally have the predicted relation to relative specialness. An increase in credit spreads, as proxied by the TED spread, is associated with a reduction in relative specialness, as flight-to-quality concerns encourage the taking of long rather than short positions in the on-the-runs. Both interest rate volatility and TED spread volatility are positively related to relative specialness, with increased hedging demand raising the shorting demand for the on-the-runs. The coefficient on yield change since the last auction is significant only in the ten-year sector, where it has the predicted positive sign.

The mortgage refinancing index coefficient is most strongly negative in the ten-year sector and is also significantly negative in the two-year sector. These results fit well with the expectation that increases in mortgage refinancings motivate mortgage portfolio buying of Treasuries, reducing the net demand to go short, and thus the relative specialness of on-the-runs.

The coefficient estimates on relative size and repo volatility suggest that relative term specialness is related to perceptions of squeeze risks. A higher relative issue size reduces relative specialness, as a larger issue should be less squeezable, all else equal. Higher repo volatility appears to reduce the relative specialness of the on-the-run, as it increases the term specialness of the less-liquid old issue more than that of the on-the-run. The repo volatility effect is particularly significant in the 10-year and 30-year sectors, where repo squeezes are more frequent. These results suggest that the negative bias in term special repo rates documented by Buraschi and Menini [2002] is due to perceived squeeze risks.

The expansion of the Federal Reserve's securities lending program is associated with a strong reduction in relative specialness in all three note sectors, as the supply of notes available for shorting increased. Although the potential supply of bonds also increased, Fleming and Garbade [2003] find that bonds account for less than 3%

EXHIBIT 5

Regression Results for Relative Repo Specialness

	2-Year	5-Year	10-Year	30-Year
Constant	0.0503	4.2954[a]	3.4879[a]	2.5134
	(0.08)	(4.07)	(6.71)	(1.30)
Days to Next Auction	-0.0070[b]	-0.0036	-0.0075[b]	-0.0116[a]
	(-2.42)	(-1.59)	(-2.42)	(-6.22)
Relative Bid-Cover Ratio	0.0786	-3.0635[a]	-0.9163[b]	1.7552[a]
	(0.45)	(-5.00)	(-2.34)	(3.14)
TED Spread	0.0007	-0.0013	-0.0042	-0.0098[b]
	(0.52)	(-0.45)	(-1.52)	(-2.52)
Interest Rate Volatility	0.0064[a]	0.0048[b]	0.0065	-0.0302
	(4.11)	(2.26)	(1.65)	(-1.82)
TED Spread Volatility	0.0009	0.0038[a]	-0.0022	0.0071[a]
	(0.99)	(2.67)	(-1.39)	(3.26)
Yield Change	0.0017	0.0002	0.0097[a]	-0.0078
	(0.76)	(0.07)	(3.83)	(-1.87)
Refi Index Change	-0.0003[a]	-0.0002	-0.0003[a]	0.0003
	(-2.85)	(-0.80)	(-2.63)	(0.79)
Relative Size	-0.4556	-.9722	-0.5882[a]	-0.5873[b]
	(-1.01)	(-1.67)	(-3.17)	(-2.54)
Repo Volatility	0.0001	-0.0003	-0.0008[a]	-0.0010[a]
	(1.32)	(-0.79)	(-5.50)	(-2.84)
Securities Lending Revision	-0.1424[b]	-0.2053[b]	-0.3139[b]	0.6831[a]
	(-2.41)	(-2.24)	(-2.14)	(3.77)
Number of Obs	495	492	494	456

t-statistics in parentheses, using Newey-West standard errors with five lags.

[a] *Significant at 1%.*

[b] *Significant at 5%.*

of the Treasuries borrowed through the Federal Reserve's securities lending program from April 1999 through November 2002. Thus the effective increase in the 30-year supply was minimal, and the positive coefficient may reflect increased speculation about the 30-year's fate in the second half of the sample period.

Several alternative specifications support the robustness of these results. A specification including the square of days to next auction yields weaker results for the negative time relation, because of collinearity between days and days-squared, but other coefficient estimates are generally unchanged. Using the log of days to next auction yields coefficient estimates of lower significance but the same sign as using days to next auction. Using auction bid dispersion instead of relative bid-cover ratio to measure auction success yields similar results. Results are also unchanged when the on-the-run bid-cover ratio is used to measure absolute, rather than relative, auction success, and when percentage changes are used for the mortgage refinancing index.

Market direction over the entire auction-to-auction period is insignificant as an explanatory variable. I find no

evidence of quarter-end or month-end effects in relative term repo specialness; the only significant seasonality appears to be related to the auction cycle.

Results are unchanged when a seemingly unrelated regression framework is used instead of individual regressions, as the correlations among the residuals are low. Splitting the sample on the date that the Federal Reserve changed its securities lending program yields similar results, but causes a loss in power for several explanatory variables. Detailed results of robustness checks are available on request.

IV. CONCLUSIONS

In this empirical analysis I find evidence that relative repo specialness between on-the-run and old Treasuries is driven by a wide range of factors. While previous theoretical work has focused on the role of relative liquidity in repo specialness, my analysis of highly liquid issues accentuates the importance of collateral supply and demand. On the collateral supply side, changes in the Fed's securities lending program, dealers' selling off inventory to buy-and-hold investors, and concerns about future squeezes all emerge as important factors in relative specialness. On the demand side, several hedging-related factors are significant, including credit spreads, volatility, and mortgage refinancing activity.

This work highlights the need for a richer theory of repo specialness that incorporates squeeze risks and other collateral supply and demand factors in addition to liquidity as determinants of repo specialness. Such a theory should be able to resolve the failure of the expectations hypothesis in special term repo rates, an important goal given the pivotal role of repo in the fixed-income markets. An analysis of repo specialness during the time Treasury auctions were changed from discriminatory to single-price should also provide further insight into the link between repo specialness and the auction cycle.

ENDNOTES

The author thanks Michael Fleming, Laurie Simon Hodrick, Charles Jones, and Suresh Sundaresan for helpful comments, and David Myers and Deutsche Bank for generously providing data. The opinions expressed here do not necessarily reflect the opinions of the members, officers, or employees of the New York Stock Exchange.

[1]Cherian, Jacquier, and Jarrow [2004] document a similar cyclicality in overnight repo specialness for on-the-run Treasuries over the 1987-1997 period.

[2]The shift toward the 10-year and away from the 30-year as the U.S. Treasury benchmark culminated with the end of 30-year Treasury bond issuance in October 2001.

[3]The Treasury website is www.publicdebt.treas.gov.

[4]Similar results are obtained by estimating an AR(1) model using the Prais-Winsten method. Results are available on request.

REFERENCES

Buraschi, A,. and D. Menini. "Liquidity Risk and Specialness." *Journal of Financial Economics*, 64 (2002), pp. 243-284.

Cherian, J., E. Jacquier, and R. Jarrow. "Pricing the Convenience Yield of Treasury Securities: Theory and Evidence." Forthcoming, *Review of Derivatives Research*, 2004.

Collin-Dufresne, P., R. Goldstein, and J.S. Martin. "The Determinants of Credit Spread Changes." *Journal of Finance*, 56 (2001), pp. 2177-2207.

Duffie, D. "Special Repo Rates." *Journal of Finance*, 51 (1996), pp. 493-526.

Fleming, M., and K. Garbade. "The Specials Market for U.S. Treasury Securities and the Federal Reserve's Securities Lending Program." Federal Reserve Bank of New York Research Paper, 2003.

Jordan, B., and S. Jordan. "Special Repo Rates: An Empirical Analysis." *Journal of Finance*, 52 (1997), pp. 2051-2072.

Keane, F. "Expected Repo Specialness Costs and the Treasury Auction Cycle." Federal Reserve Bank of New York Research Paper, 1995.

Krishnamurthy, A. "The Bond/Old Bond Spread." *Journal of Financial Economics*, 66 (2002), pp. 463-506.

Longstaff, F. "The Term Structure of Very Short-Term Rates: New Evidence for the Expectations Hypothesis." *Journal of Financial Economics*, 58 (2000), pp. 397-415.

Sundaresan, S. "An Empirical Analysis of U.S. Treasury Auctions: Implications for Auction and Term Structure Theories." *The Journal of Fixed Income*, September 1994, pp. 35-50.