



# **Uniform-Price Auctions: Update of the Treasury Experience**

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by

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## Foreword

While there has been a long-standing interest in the theory of uniform-price auctions, there had been very little empirical analysis when the Treasury inaugurated its experiment with regular uniform-price auctions of 2- and 5-year notes in September 1992. The October 1995 study and this update make valuable contributions to the body of empirical evidence.

The conclusions in this update reinforce those reached in 1995. They provide empirical support for the theoretical proposition that auction participants will bid more aggressively in uniform-price auctions since successful bidders in uniform-price auctions pay only the price of the lowest accepted bid, rather than the actual price they bid, as in the multiple-price approach. Our experience also shows that uniform-price auctions produce a broader distribution of auction awards. These results have important policy implications. The findings indicate that uniform-price auctions can allow the Treasury to make improvements in the efficiency of market operations and reduce the costs of financing the Federal debt. These results are also important in another sense: they provide a clear example of how economic theory can make a significant and direct contribution to public policy. The Treasury is proud to have played a role in bridging the gap between theory and application.

There are many people who contributed to this important effort, and while it is impossible to thank all the individuals involved, Secretary Rubin and I would like to personally commend the work of Deborah Danker, Darcy Bradbury, and Roger L. Anderson, who spearheaded these studies, as well as the staff of the Office of Market Finance, including Jill Ouseley, Paul Malvey, and Christine Archibald. Furthermore, we would like to thank Kerry Back, Sushil Bikhchandani, Jeremy Bulow, Carlo Cottarelli, Loretta Mester, Vincent Reinhart, and Suresh Sundaresan for their helpful insights and comments.

Lawrence H. Summers  
Deputy Secretary of the Treasury  
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# **Uniform-Price Auctions: Update of the U.S. Treasury Experience**

## **Introduction**

One of the recommendations of the Joint Report on the Government Securities Market<sup>1</sup> was that the Treasury consider alternatives to the multiple-price auction technique for auctioning Treasury securities. After an extensive review of the issues, the Treasury announced on September 3, 1992, that it would conduct a uniform-price auction experiment for all auctions of 2-year and 5-year notes. In October 1995, the Treasury published a study entitled, "Uniform-price Auctions: Evaluation of the Treasury Experience." (The "1995 Study") This paper is an update of the major results presented in that study.<sup>2</sup> It does not include an assessment of the performance of inflation-indexed securities, which Treasury began offering in January 1997 and are auctioned under a uniform-price format.

The Treasury's stated purpose in conducting uniform-price auctions is to determine whether the uniform-price auction technique reduces the Treasury's financing costs compared with multiple-price auctions, by encouraging more aggressive bidding by participants, and whether it broadens participation and reduces concentration of securities on original issue. Thus,

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<sup>1</sup> Joint Report on the Government Securities Market. Washington, D.C., Government Printing Office, 1992.

<sup>2</sup> Uniform-price Auctions: Evaluation of the Treasury Experience. Washington, D.C., U.S. Treasury, October, 1995.(Available on-line at <[www.ustreas.gov/domfin/final.pdf](http://www.ustreas.gov/domfin/final.pdf)>)

both the original evaluation and this update have focused on the impact on revenues and the breadth of initial distribution of awards.

The uniform-price technique differs in only one important way from the multiple-price auction technique that the Treasury has been using to issue notes and bonds since the 1970s.<sup>3</sup> In the multiple-price format, competitive bids state the amount and yield desired and are ranked from the lowest to the highest yield. Awards are made at successively higher yields until the amount allotted for competitive tenders is fulfilled, with awards at the highest yield prorated. The process for the uniform-price auctions is identical except that, instead of awards being made at the individual yields stipulated by the bidders, all accepted bids are filled at the highest yield of accepted competitive tenders.

### **Background**

The current state of auction theory involves many abstractions from the complexities of the real world.<sup>4</sup> For example, auction theory is usually couched in terms of a single, indivisible, homogeneous good being sold at a one-time event (e.g., auctions for works of art), with each bidder submitting a single bid at the relevant time in the auction process, and behaving according to certain restrictive assumptions. Auctions for Treasury securities, however, are repeated on a periodic basis and are for multiple goods, for which bidders may submit a whole schedule of bids, some of which may be viewed as underwriting bids; there is an active, well-defined WI market in which participants can purchase the identical good (but at a known yield) at the time of an auction or before or after; and there is a well-defined group of bidders, which may or may not act according to the assumptions of auction theory, that participate in virtually all auctions.

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<sup>3</sup> Treasury bills have been sold using multiple-price auctions since 1929.

<sup>4</sup> For recent surveys of auction theory, see McAfee and McMillan (1987) and Milgrom (1989). For surveys related specifically to Treasury auctions, see Mester (1988), Reinhart (1992), and Chari and Weber (1992). The following overview is based on these works.

One of the basic results of auction theory is that under a certain set of assumptions the revenue to the seller will be greater with uniform-price auctions than with multiple-price auctions. The reasoning is that in multiple-price auctions successful bidders will pay the actual price they bid, whereas in uniform-price auctions, successful bidders pay only the price of the lowest accepted bid. Thus, by virtue of winning in a multiple-price auction, a successful bidder demonstrates that he is willing to pay a higher price than the market consensus. In that sense, winning is losing -- submitting a higher bid signals to other participants that one's valuation exceeds that of others. There is a higher probability of a subsequent loss if the bidder were to attempt to sell the good in the after market. This is the "winner's curse." Its effect is to cause bidders to shade their bids below their true valuation of the goods. By contrast, in a uniform-price auction, all successful bidders pay the same price -- the lowest price accepted. Accordingly, bidders are less likely to shade their bids.

It can be shown that relaxing the assumptions regarding bidder behavior will affect the predictions of auction theory regarding expected revenues under the two auction formats, resulting in other revenues rankings, or rankings that are indeterminate.<sup>5</sup>

In light of the nonconformities between auction theory and practice, Milton Friedman has put forth an informal analysis based on auction theory suggesting that the Treasury's traditional multiple-price auction technique costs the Treasury money and also favors the dealer community.<sup>6</sup>

Friedman contends that switching to a uniform-price auction would reduce the cost of financing the debt. While the Treasury would give up the consumer surplus it receives as a discriminating monopolist, Friedman argues that the uniform-price format would more than offset this decline in revenue by increasing demand on two counts. First, as auction theory suggests, the

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<sup>5</sup> See McAfee and McMillan (1987) or Mester (1988).

<sup>6</sup> Friedman originally proposed this idea in Friedman (1959). For a recent statement, see Friedman (1991).

switch to a uniform-price format would lead to more aggressive bidding, because the fear of the winner's curse is reduced.

Secondly, because uniform-price auctions are strategically simpler, they would reduce bid preparation costs and encourage more bidders to participate.<sup>7</sup> The primary dealers would lose the extra rents they earn by the services they perform in the current system. That is, dealers are viewed as having a technical edge in the resources devoted to sophisticated financial analysis of the general factors moving the market, and in particular, the strength of demand for a given issue. A uniform-price format is perceived as leveling the playing field by reducing the importance of this specialized knowledge. According to Friedman, more bidders would be induced to bid directly in auctions because the fear of being awarded securities at too high a price is eliminated.

The net impact of both factors, according to Friedman, would be to increase auction demand by enough to more than compensate for the revenues foregone by giving up discriminatory pricing.

### **The Methodology**

In an effort to isolate the impact of auction technique, we compared the uniform-price auction performance of the 2-year and 5-year notes since September 1992 to the multiple-price performance of the same securities over the previous two years. Also, we compared the performance of the 2-year and 5-year notes under both auction formats to the multiple-price auctions of 3-year and 10-year notes over the whole period.

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<sup>7</sup> Friedman's original argument regarding multiple-price auctions and the need for specialized knowledge also focused on the strong incentive for collusion among bidders. Reinhart (March 1992) and Chari and Weber (1992) also argue that uniform-price auctions will reduce market manipulation and the likelihood of a squeeze.

In addition to auction technique, however, a constellation of other factors also affects auction results, such as the economic outlook, expectations for movements in absolute or relative interest rates, and any other factors affecting the portfolio decisions of dealers and investors. For example, the Treasury auction process has undergone regulatory and other changes that may also have had an impact on bidding strategies and trading practices of market participants. Also, the composition of the primary dealer community, as well as the large investor community, has changed over the years. The confluence of these and other factors produces significant auction-to-auction volatility in the data, making it difficult to isolate the impact of auction technique itself.

For the 1995 Study, we divided the concentration data into two periods, the multiple-price auction period, January 1990 to August 1992, and the uniform-price period September 1992 to December 1994.<sup>8</sup> In this update, we have added the period January 1995 to July 1998.

The approach used to examine the effects of auction technique on concentration data was to compare concentrations of awards to the various groups and subgroups under the two auction techniques and to determine whether there was a statistically significant difference.

The revenue data for the 1995 Study was also divided into two periods, which are slightly different from the periods used for the concentration analysis because of differences in data availability. The multiple-price period in this case includes data from June 1991 to August 1992, and the uniform-price period is from September 1992 to September 1995. We examined the effects of auction technique on revenues by comparing auction results in terms of bid yields in the auctions and yields in the contemporaneous when-issued (WI) market. We also examined trading patterns for the 2-year and 5-year notes on the mornings of auctions, around the time of auctions,

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<sup>8</sup> We also broke each of these two periods into sub-periods. We divided the multiple-price period into the period before the Salomon Brothers improprieties were known (January 1990 to August 1991) and the period afterwards (September 1991 to August 1992). The uniform-price period was originally further divided into periods of steady interest rates, rising interest rates, and falling interest rates. However, with only a couple of minor exceptions, there were no differences in results among these sub-periods. Data on auction bids, distribution of bids, and auction awards are U.S. Treasury data.

and on the afternoons of auctions, both before and after the release of auction results, under the uniform-price and multiple-price techniques.<sup>9</sup> We then examined whether any differences in performance are consistent with the purpose of conducting uniform-price auctions and whether the differences are consistent with the predictions of auction theory.

The most direct way to determine the impact on revenue of auction technique is to compare auction prices under the alternate formats and determine if there is a statistically significant difference between the two. However, Treasury auctions are conducted in terms of yields, not prices. A direct comparison of auction yields is difficult because yields vary from auction to auction, giving rise to the need for a common reference point. Yields in the contemporaneous WI market provide such a common point of reference.<sup>10</sup>

The contemporaneous WI yields are used as a benchmark against which to measure auction yields under the two formats because potential bidders for auctioned securities have a choice between purchasing securities at auctions or purchasing securities in the WI market anytime after the announcement of the securities to be auctioned. In particular, potential bidders face the choice between bidding in an auction or purchasing in the WI market in the time period from shortly before an auction up until the time of the auction.<sup>11</sup>

The difference between auction yields and contemporaneous WI yields, or  $(Y_A - Y_{WI})$ , is commonly referred to as the auction spread. A positive spread (or markup) means that the yield

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<sup>9</sup> Data on intraday market bid and ask yields and cumulative trading volume were obtained from GOVPX.

<sup>10</sup> Treasury auctions are usually held at 1:00 p.m. In some cases, such as when more than one security is auctioned on the same day, auctions have been held at other times. All data have been appropriately adjusted.

<sup>11</sup> Other issues regarding the relevance of the contemporaneous WI market, such as relative transaction sizes in auctions versus the WI market, yield movements around auction time, and market liquidity are addressed in the 1995 Study.

in an auction is greater than the yield in the WI market at the time of an auction. Or, in terms of price, the price in an auction is lower than that in the WI market.

To look at the distribution of awards we examined competitive awards at Treasury auctions. The competitive awards data is based on large competitive awards (based on bids of \$1 million or greater) to primary dealers, their customers, and direct bidders through the New York, Chicago, and San Francisco Federal Reserve banks and branches.<sup>12</sup> We examined the concentrations of competitive awards, measured as percents of total private competitive awards, to the top five and top ten bidders and to respective bidder groups as a whole. We looked at four large bidder groups: primary dealers only for their own account; primary dealers plus their large customers; only large customers of primary dealers; and all large competitive bidders, whether primary dealers, other dealers, customers, or direct bidders.

## **The Results**

As previously noted, the primary focus of the analysis is Treasury's criteria for implementing the uniform-price auction technique: to determine whether it reduces financing costs, by encouraging more aggressive bidding, and whether it broadens bidder participation and distribution of awards on original issue.

### **Distribution of Awards**

It is argued that uniform-price auctions will encourage more bidders to participate in competitive bidding by reducing the importance of specialized knowledge of market demand and the information costs associated with its collection. In October 1995, we found that the uniform-price technique did not expand the bidder base by bringing new groups of bidders, such as smaller

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<sup>12</sup> Virtually all competitive bids and awards are made through these three banks and branches.

bidders, directly into the competitive auction process. Within the large bidder groups, a reduction in the concentration of awards can be viewed as a corollary to increased distribution.

In October 1995, we found no significant change in awards to the primary dealer community as a whole, but we found statistically significant evidence that the concentration of awards to the top primary dealers for their own accounts had been reduced. (See Chart 1.) The average shares of auction awards of 2-year and 5-year notes to the top five and top ten dealers declined, with the reductions ranging from about 5 percent to 15 percent. By contrast, the shares to the top dealers in 3-year and 10-year note multiple-price auctions either remained essentially the same or increased significantly.

At the same time, the shares of awards to the top five, ten, and all large customers increased, with the total rising from about 17 percent to 25 percent for both the 2-year and 5-year notes, suggesting greater auction participation by large customers. (See Chart 2.) By contrast, the shares of awards to large customers for 3-year and 10-year multiple-price auctions over the same time periods did not change significantly.

The reduced concentrations of awards to the top dealers reported in the 1995 Study may be attributed to two interrelated factors. The first is a widening in the overall distribution of auction bids under the uniform-price technique, as one might expect from auction theory. Under multiple-price auctions, there is a relatively tight distribution of large bids around the auction average because successful bidders pay the price actually bid. Under uniform-price auctions, however, the distribution of bids is much broader because there is no penalty for submitting bids well ahead of the market to ensure supply, unless such aggressive bids in the aggregate match or exceed the auctioned amount.

The second factor is that the evidence suggests large dealers changed bidding strategies, in response to expected wider bid distributions, by splitting bids into more numerous smaller bids -- some ahead of the market, some at the market, and some trailing off the market.

The combined effect of the broader distribution of bids and the greater incidence of bid splitting is that the bids of the larger, usually more aggressive dealers are increasingly interspersed with the more aggressive bids of other market participants (particularly large customers) who are trying to ensure supply in an auction. The net result is that at the margin the share of awards to the top groups of primary dealers has decreased.

The recent data on the distribution of auction awards (January 1995 through July 1998) show similar results. Awards to the top five and top ten competitive bidders, whether primary dealers, dealers' large customers, or direct bidders, declined by significant amounts for the 2- and 5-year notes during each part of the uniform-price period and for the period as a whole. (See Chart 3.) In most cases, the declines in concentration have remained relatively large over the whole period. For example, as originally reported, the share of awards to the top five competitive bidders for 2-year notes fell by about 10 percent, from about 45 percent to 35 percent, that for 5-year notes fell by 17 percent, from about 53 percent to 36 percent, and the shares of both groups have remained around their lower levels since then. Meanwhile, the shares of awards to the top five, top ten, and all competitive bidders for 3-year and 10-year notes has remained essentially the same or increased.

In addition, the data show there have continued to be statistically significant reductions over the entire uniform-price period in the shares of awards to the top primary dealers for their own accounts for the 2-year and 5-year notes. Over the same period, the shares of awards to the top five and top ten primary dealers of 3-year and 10-year notes remained essentially the same or increase.

However, since 1995 there appears to have been an easing of the trend toward less concentration in the shares of awards to the top groups of primary dealers and to the top groups of large customers for both the 2-year and 5-year notes. For instance, although the shares of awards to the top dealers generally remain lower for the uniform-price period as a whole relative to the multiple-price period, the concentrations of awards to dealers have drifted upward. (See

Chart 1.) Similarly, in the latest period, there has been some pullback in awards to large customers, so that their share of awards, although still higher, are no longer statistically different than under the multiple-price format. (See Chart 2.) The evidence suggests that some large customers may have returned to buying new supply from dealers rather than bidding in auctions through dealers.

While the uniform-price technique continues to indicate reduced award concentrations to the top bidders, the recent trend toward slightly greater concentrations is a reflection of bids having become less dispersed. The tightening of bid distributions indicates a learning pattern on the part of primary dealers. As they have become increasingly experienced with the uniform-price technique, they have become more adept at gauging the relevant bidding ranges for the auctions.<sup>13</sup>

### **Impacts on Revenue**

As described earlier, the most straightforward way to test whether the uniform-price auction technique reduces financing costs relative to the multiple-price technique, is to directly compare auction spreads, the difference between auction yields and contemporaneous WI yields, or  $(Y_A - Y_{WI})$ , under the two techniques. If the auction spread is significantly smaller under the uniform-price technique, then the premium to bidders is smaller, or alternatively, expected revenue to the Treasury is greater.

Auction spreads are measured by comparing the announced auction yield results to the bid side of contemporaneous WI yields because dealers who need to cover short positions are far and away the primary participants in Treasury auctions, and short positions are established at the bid side of the WI market.

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<sup>13</sup> This finding is supported by anecdotal evidence in conversations with primary dealers.

In the 1995 Study we examined the yields on accepted competitive bids in the 2-year and 5-year note auctions held under the multiple-price auction format, from June 1991 through August 1992, and the uniform-price auction format, from September 1992 through September 1995. The data showed that the average spreads of auction yield results over contemporaneous WI bid yields for 2-year and 5-year uniform-price auctions were smaller than those for multiple-price auctions, but the difference in yield spreads between the two auction techniques was not statistically significant.

Chart 4 shows the average spreads between auction yield results and 1:00 p.m. WI bid yields for the multiple-price period, the whole uniform-price period, and also for two subperiods, that included in the 1995 Study and the data since then. As shown in the 1995 Study, the average auction spread for 2-year notes during the multiple-price period, 0.41 of a basis point, was cut by about half, to 0.22 of a basis point during the first part of the uniform-price period. For 5-year note auctions, the spread was reduced by about a third, from 0.33 to 0.20 of a basis point. The data since show the same results. By contrast, the spreads for the 3-year and 10-year note auctions, all held under the multiple-price format, increased during the latter period.

Yet in spite of the proportionately large changes in the average auction spreads under the two auction techniques, we cannot say that there is a statistically significant difference between them for either the 2-year or 5-year note auctions. The primary reason for the lack of a statistically significant difference between auction spreads under the two formats is that under the uniform-price auction technique there is greater auction-to-auction volatility of the results with respect to the WI market. The greater volatility is partly a result of the broader and more volatile distributions of bids, and partly a result of the difference in the yield measure used to report auction results under the two techniques. In multiple-price auctions, an average yield concept is used, while in uniform-price auctions, the reported yield is not an average, but a marginal or stop-out yield. An average of a relatively stable set of numbers is inherently less volatile than the endpoint of another set of numbers that exhibits more variability. Thus, uniform-price auctions

may produce greater revenue on average, but present greater uncertainty regarding revenue at any given auction.

Thus, a direct comparison of the average spreads under the two auction formats through September 1995 did not provide sufficient evidence to conclude that uniform-price auctions increased expected revenue to the Treasury relative to multiple-price auctions. However, by examining the average yield spreads for each technique separately, we did obtain significant results. That is, instead of comparing the spreads to each other, we examined whether auction results under the two techniques were significantly different from the yields in the contemporaneous WI market -- or whether the spreads themselves are significantly different from zero. The presence of statistically significant positive spreads between the auction results and the 1:00 p.m. WI bid yields would represent expected premiums to successful competitive bidders, and expected revenue foregone by the Treasury.

The results indicated that the average spreads between the auction average yields and the contemporaneous WI bid yields were positive and statistically different from zero for the 2-year and 5-year notes under the multiple-price format. For the 3-year and 10-year notes, the average spreads for the whole study period were also positive and statistically different from zero.

By contrast, under the uniform-price format the average spreads for the 2-year and 5-year notes were not significantly different from zero. That is, the data showed that there was a statistically significant premium to successful bidders in multiple-price auctions, which implies that expected revenue to the Treasury is reduced, whereas there was no similar evidence of a significant premium to successful bidders under the uniform-price technique. This result is consistent with other evidence that there is a statistically significant premium for dealers bidding in multiple-price auctions.<sup>14</sup>

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<sup>14</sup> See Simon (1994) and Nyborg and Sundaresan (1995).

Chart 4 also shows the data updated through May 1998. The addition of 64 more 2-year and 5-year note auctions, 32 of each, generates results consistent with those obtained previously. The average uniform-price auction spread for 2-year notes, at 0.20 of a basis point for the whole uniform-price period, still represents about a fifty percent reduction from the spread during the multiple-price period. Likewise, the average auction spread for 5-year notes, of 0.22 of a basis point, continues to reflect a drop of one-third from the multiple-price period. In addition, as measured by the standard errors, the volatility of auction-to-auction results for uniform-price auctions has been reduced in the latest period.

The updated results continue to suggest, albeit not strongly, that expected revenue under the uniform-price technique is at least as great and probably greater than under the multiple-price technique.

### **Volatility of auction-to-auction results**

The primary reason for the lack of statistical significance in the comparison of the yield results under the uniform-price technique to the contemporaneous WI yields is the auction-to-auction volatility. Charts 5 through 9 show the behavior of the spreads of auction results to 1:00 p.m. bid yields on an auction-to-auction basis for the 2-, 3-, 5-, 10- and 30-year securities. As charts 5 and 6 show, the behavior of the 2-year and 5-year spreads on an auction-to-auction basis under the two techniques is notably dissimilar. For the thirty multiple-price 2-year and 5-year note auctions from June 1991 to August 1992, the spreads between individual auction results and the 1:00 p.m. WI bid yields are almost uniformly non-negative (with the September 1991 2-year note auction being the only exception). For the forty multiple-price 3-year and 10-year note auctions (shown in Charts 7 and 8, respectively), in only three of the auctions have the average yields been below the 1:00 p.m. WI bid yields.

Thus, the data show that under the multiple-price format there is a relatively stable and statistically significant average premium to successful competitive bidders. By contrast, under the

uniform-price auction format, in more than half (70 out of 138) of the individual auctions from September 1992 to May 1998 the auction yields have been below the 1:00 p.m. WI bid yields, producing negative auction spreads. The import of this volatility for the purposes of this study is that, while on average uniform-price auctions may reduce financing costs, it is much less certain what the impact on revenue will be in any individual auction.

### Conclusions

The Treasury's purpose in conducting uniform-price auctions is to determine whether the uniform-price auction technique reduces the Treasury's financing costs compared with multiple-price auctions, by encouraging more aggressive bidding by participants, and whether it broadens participation and reduces concentration of securities on original issue. Those are the criteria: the impact on revenues and the breadth of the initial distribution of awards.

The main issue in empirically assessing the relative performance of the two auction techniques according to the criteria is actually two-fold: first, periodic Treasury auctions are only one of a vast array of very complex interdependent financial and economic events that occur every day. The auctions are not conducted *ceteris paribus*, as in a laboratory environment. The second, and corollary, factor is that, while the empirical results regarding breadth of distribution, or reduced concentration, are statistically significant, the results regarding the effects on revenues are weaker. In a direct comparison of the impact on revenues between the two techniques, the data show a small increase in revenues to the Treasury under the uniform-price technique, but the difference is not statistically significant.<sup>15</sup> On this basis, we are unable to conclude that there is a difference in expected revenue.

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<sup>15</sup> This is consistent with other findings. For example, see Heller and Lengwiler (1998).

However, by comparing the average auction yield spreads separately to the yields in the WI market, and testing whether each spread is statistically distinguishable from zero, we did obtain statistically significant results. The data show that the average yield spread is different from zero in multiple-price auctions, whereas there is no similar evidence for the uniform-price technique. On this basis, expected revenue under the uniform-price technique is marginally greater than under the multiple-price technique.

The primary reason for the lack of a statistically significant difference between auction yields and WI yields under the uniform-price auction technique is greater auction-to-auction volatility of the results with respect to the WI market. The greater volatility is partly a result of the broader and more volatile distributions of bids, and partly a result of the difference in the yield measure used to report auction results under the two techniques. In multiple-price auctions, an average yield concept is used, while in uniform-price auctions, the reported yield is not an average, but a marginal or stop-out yield. An average of a relatively stable set of numbers is inherently less volatile than the endpoint of another set of numbers that exhibits more variability.

Thus, uniform-price auctions may produce greater revenue on average, but they present greater uncertainty regarding revenue at any given auction.

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# Chart 1

## Large Competitive Awards to Primary Dealers Own Accounts as a Percentage of Total Private Awards#

	<u>Top</u>	Multiple-price vs. Uniform-price		Uniform-price Period	
		Jan '90- Aug '92	Sept '92- July '98	Sept '92- Dec '94	Jan '95- July '98
Two-Year	5	38.3	32.3 *	31.1 *	33.2 *
	10	50.8	47.6	45.4 *	49.1
	All	66.2	66.8	63.4	69.0
Five-Year	5	46.3	33.4 *	32.0 *	34.5 *
	10	57.1	49.1 *	46.6 *	50.9 *
	All	69.2	67.5	63.9	70.1
Three-Year	5	45.1	42.5	45.6	40.5
	10	57.7	56.6	58.9	55.1
	All	72.8	74.6	74.3	74.8
Ten-Year	5	44.0	50.8	56.3 *	47.7
	10	58.3	64.6	69.0 *	62.1
	All	72.4	77.5	80.8	75.7
Thirty-Year	5	49.1	47.5	46.5	48.1
	10	62.8	59.1	57.1	60.4
	All	76.0	68.3	66.7	69.4

\* Indicates statistically significant difference from the multiple-price period (Jan. '90- Aug. '92).

# Large competitive awards (based on bids greater than or equal to \$1 million) to primary dealers for their own accounts through the New York, Chicago, and San Francisco Federal Reserve Banks and branches.

Note: The Thirty-Year bond was not included in the October 1995 study.

## Chart 2

### Top Competitive Awards to Primary Dealers' Large Customers#

	<u>Top</u>	Multiple-price vs. Uniform-price		Uniform-price Period	
		<u>Jan '90- Aug '92</u>	<u>Sept '92- July '98</u>	<u>Sept '92- Dec '94</u>	<u>Jan '95- July '98</u>
Two-Year	5	12.9	14.2	16.1	12.9
	10	14.8	17.6	20.0 *	16.0
	All	16.3	22.1 *	25.5 *	19.8
Five-Year	5	14.5	14.5	15.6	13.7
	10	16.8	18.2	19.7	17.0
	All	18.6	23.2	25.3 *	21.6
Three-Year	5	12.1	12.6	13.1	12.2
	10	13.8	15.0	15.7	14.5
	All	15.5	17.6	18.9	16.8
Ten-Year	5	15.1	13.0	9.4	15.0
	10	17.6	15.1	11.5	17.1
	All	20.0	17.1	13.7	19.0
Thirty-Year	5	13.2	20.3	20.1	20.3
	10	15.6	23.4	24.5	22.7
	All	17.9	26.7 *	29.5	24.8

\* Indicates statistically significant difference from the multiple-price period (Jan. '90- Aug. '92).

#Large competitive awards (based on bids greater than or equal to \$1 million) to the customers of primary dealers through the New York, Chicago, and San Francisco Federal Reserve Banks and branches.

Note: The Thirty-year bond was not included in the October 1995 study.

## Chart 3

### Top Large Competitive Awards to Primary Dealers, Large Customers, or Direct Bidders#

	<u>Top</u>	Multiple-price vs. Uniform-price		Uniform-price Period	
		<u>Jan '90- Aug '92</u>	<u>Sept '92- July '98</u>	<u>Sept '92- Dec '94</u>	<u>Jan '95- July '98</u>
Two-Year	5	45.5	35.6 *	35.8 *	35.5 *
	10	61.3	53.5 *	53.6 *	53.5 *
	All	87.9	90.8 *	91.9 *	90.1 *
Five-Year	5	53.1	36.3 *	35.8 *	36.6 *
	10	67.5	55.1 *	54.6 *	55.5 *
	All	91.1	92.9	92.7 *	93.0
Three-Year	5	50.7	46.2	49.6	44.0
	10	64.4	62.5	65.4	60.7
	All	89.4	92.7	93.4	92.3
Ten-Year	5	49.9	54.4	57.0	53.0
	10	67.1	71.0	72.0	70.4
	All	93.6	95.3 *	95.0 *	95.4
Thirty-Year	5	51.9	56.5	54.8	57.6
	10	68.8	72.0	69.4	73.7
	All	95.3	95.4	96.3 *	94.8

\* Indicates statistically significant difference from the multiple-price period (Jan. '90- Aug. '92).

#Large competitive awards (based on bids greater than or equal to \$1 million) to primary dealers for own accounts, to customers of primary dealers, or to direct bidders through the New York, Chicago, and San Francisco Federal reserve Banks and branches.

Note: The Thirty-year bond was not included in the October 1995 study.

## Chart 4

### Average Spreads Between Auction Results and 1:00 pm WI Bid Yields (Basis Points, Standard Error in Parentheses)

Securities	Multiple-price Period 6/91-8/92	Uniform-price Period			Whole Period 6/91-5/98
		Total 9/92-5/98	Results Released in October Study 9/92-9/95	Results Since October Study 10/95-5/98	
2-YR	0.41 ** (0.13)	0.20 (0.15)	0.22 (0.25)	0.17 (0.15)	
5-YR	0.33 ** (0.06)	0.22 (0.21)	0.20 (0.32)	0.24 (0.26)	
2-YR & 5-YR	0.37 ** (0.07)	0.21 (0.13)	0.21 (0.20)	0.21 (0.15)	
3-YR	0.50 (0.22)	0.49 ** (0.09)	0.58 ** (0.17)	0.39 ** (0.07)	0.49 ** (0.09)
10-YR	0.56 (0.40)	0.66 ** (0.14)	0.79 ** (0.22)	0.53 * (0.19)	0.64 ** (0.13)
30-YR	0.36 (0.19)	0.46 * (0.17)	0.61 * (0.22)	0.29 (0.26)	0.43 ** (0.13)
3-YR, 10 YR & 30-YR	0.47 ** (0.15)	0.55 ** (0.08)	0.67 ** (0.11)	0.43 ** (0.10)	0.53 ** (0.07)

\* Significantly different from zero at the 95% level.

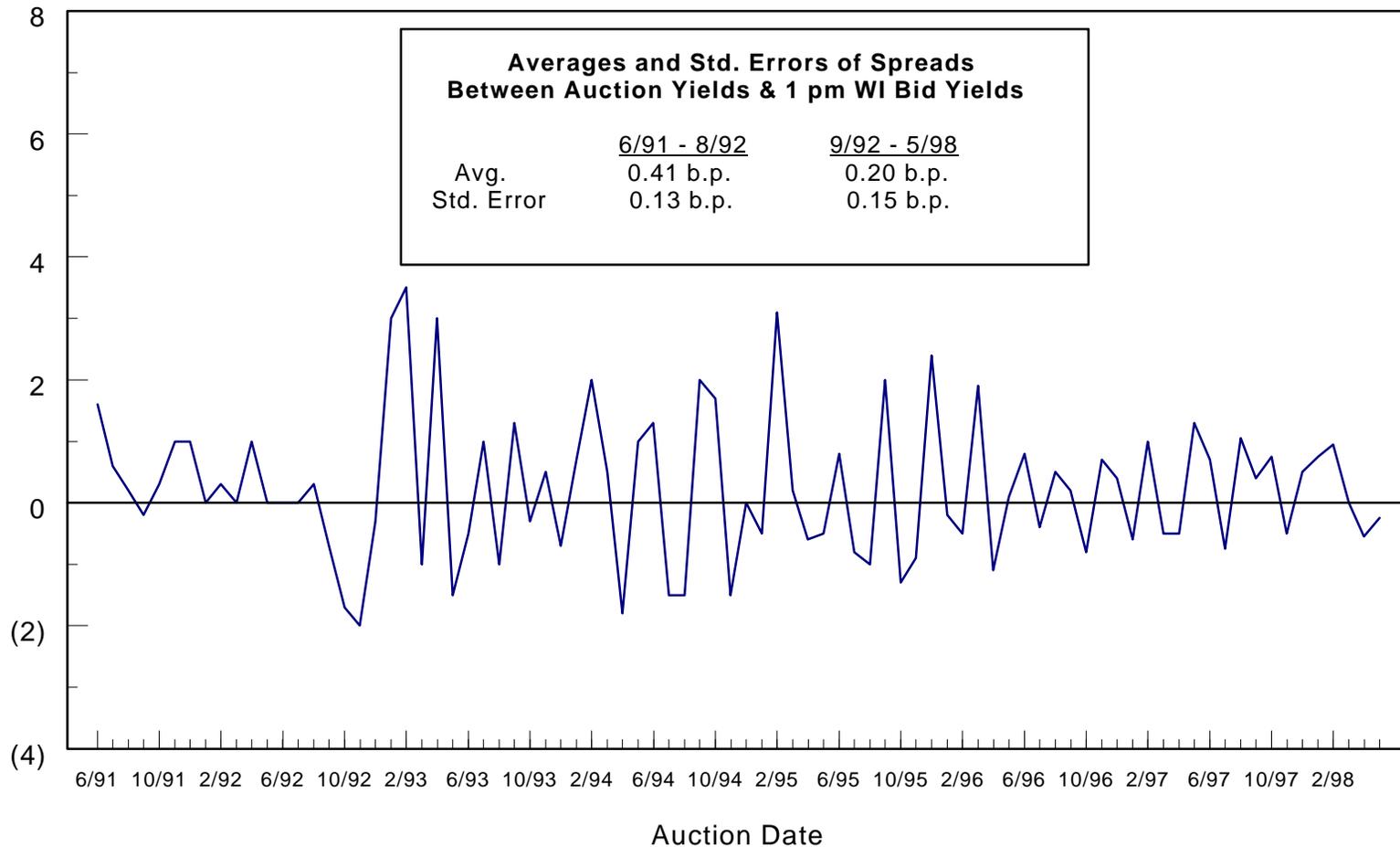
\*\* Significantly different from zero at the 99% level.

Note: The 30-year Treasury bond was not included in the October study.

Source: GOVPX, Inc.

**AUCTION SPREADS  
 AUCTION RESULTS - 1 PM WI BID YIELDS  
 2-YEAR NOTES  
 (June '91 through May '98)**

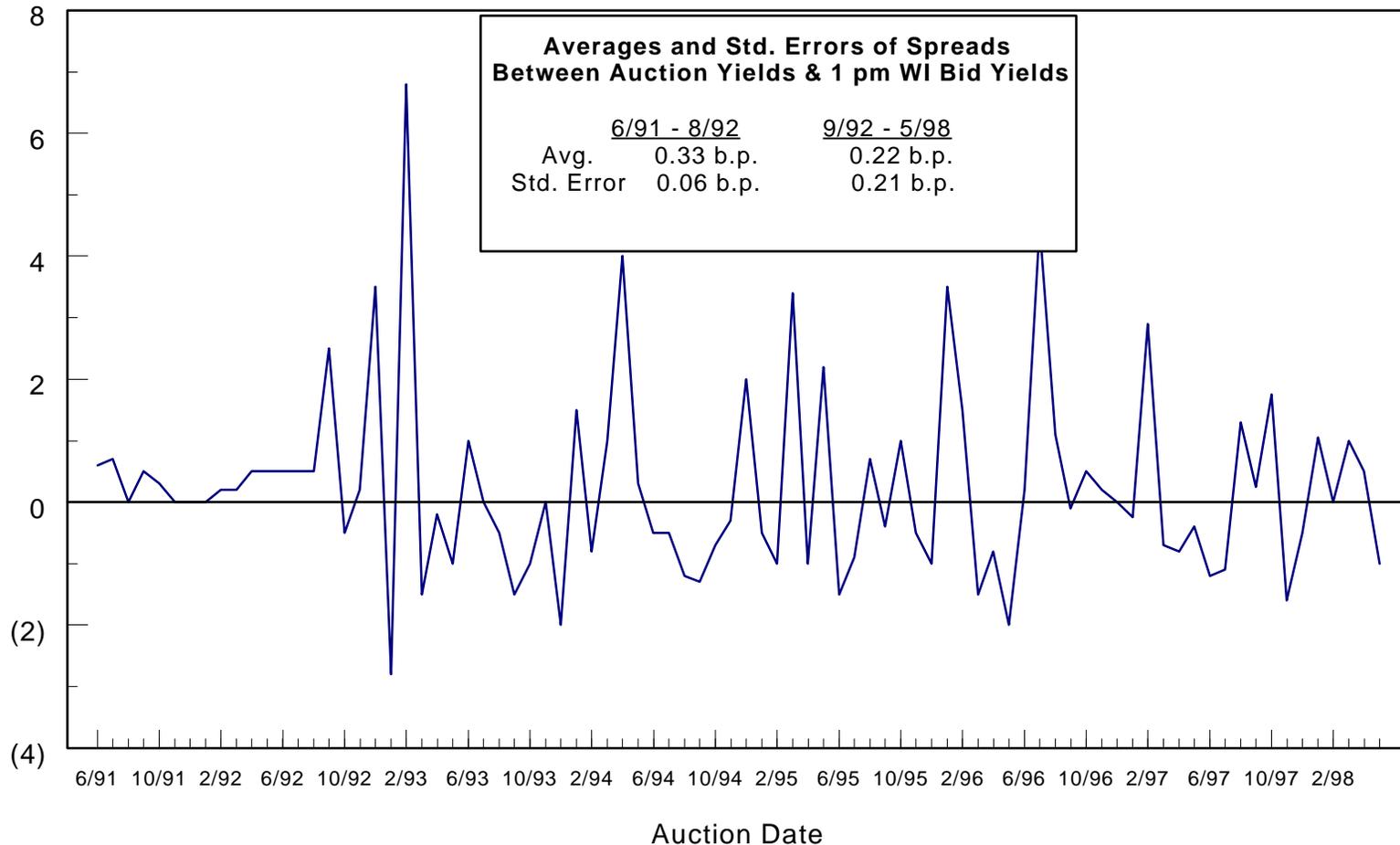
Basis Points



Source: GOVPX, Inc.

**AUCTION SPREADS  
AUCTION RESULTS - 1 PM WI BID YIELDS  
5-YEAR NOTES  
(June '91 through May '98)**

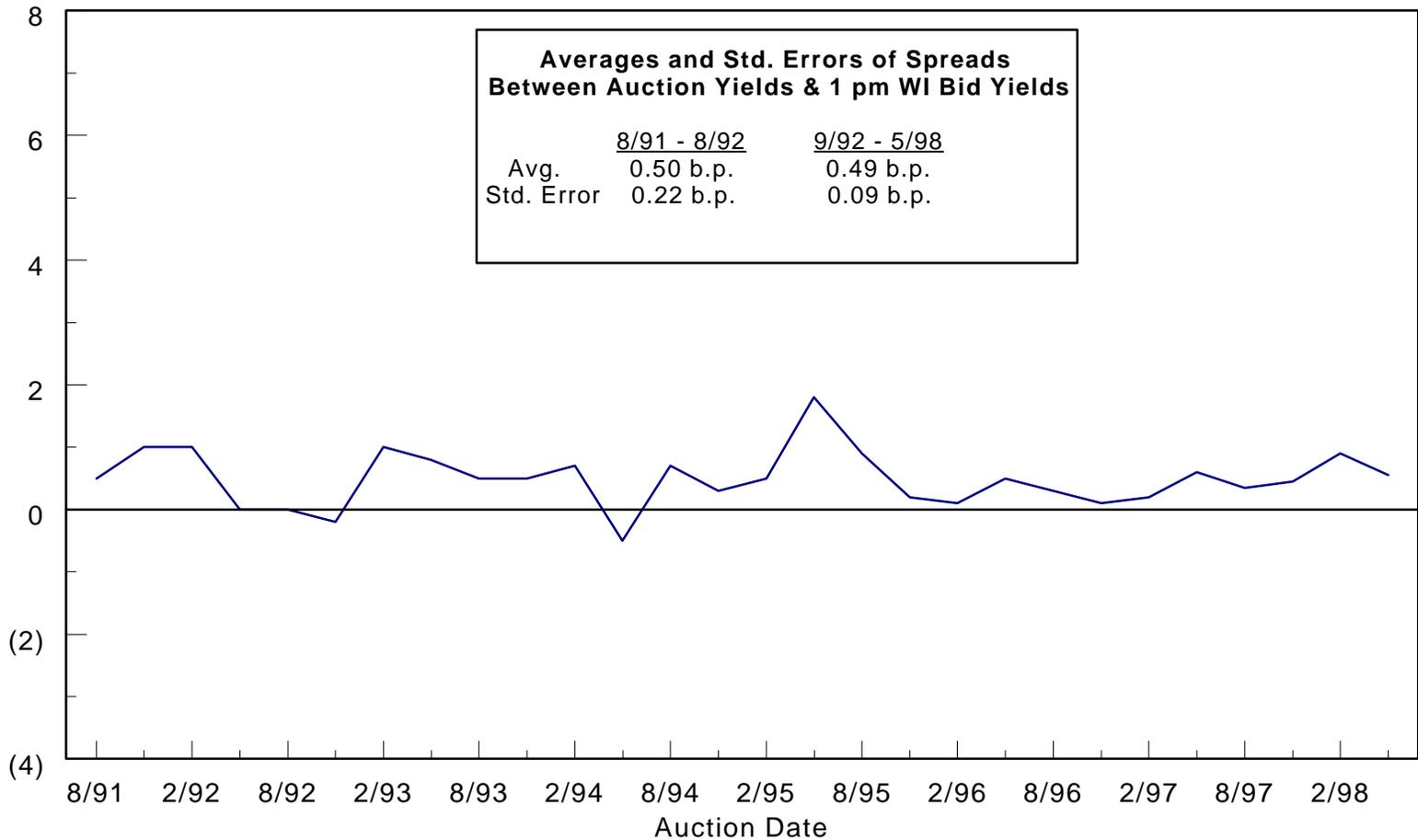
Basis Points



Source: GOVPX, Inc.

**AUCTION SPREADS  
 AUCTION RESULTS - 1 PM WI BID YIELDS  
 3-YEAR NOTES  
 (August '91 through May '98)**

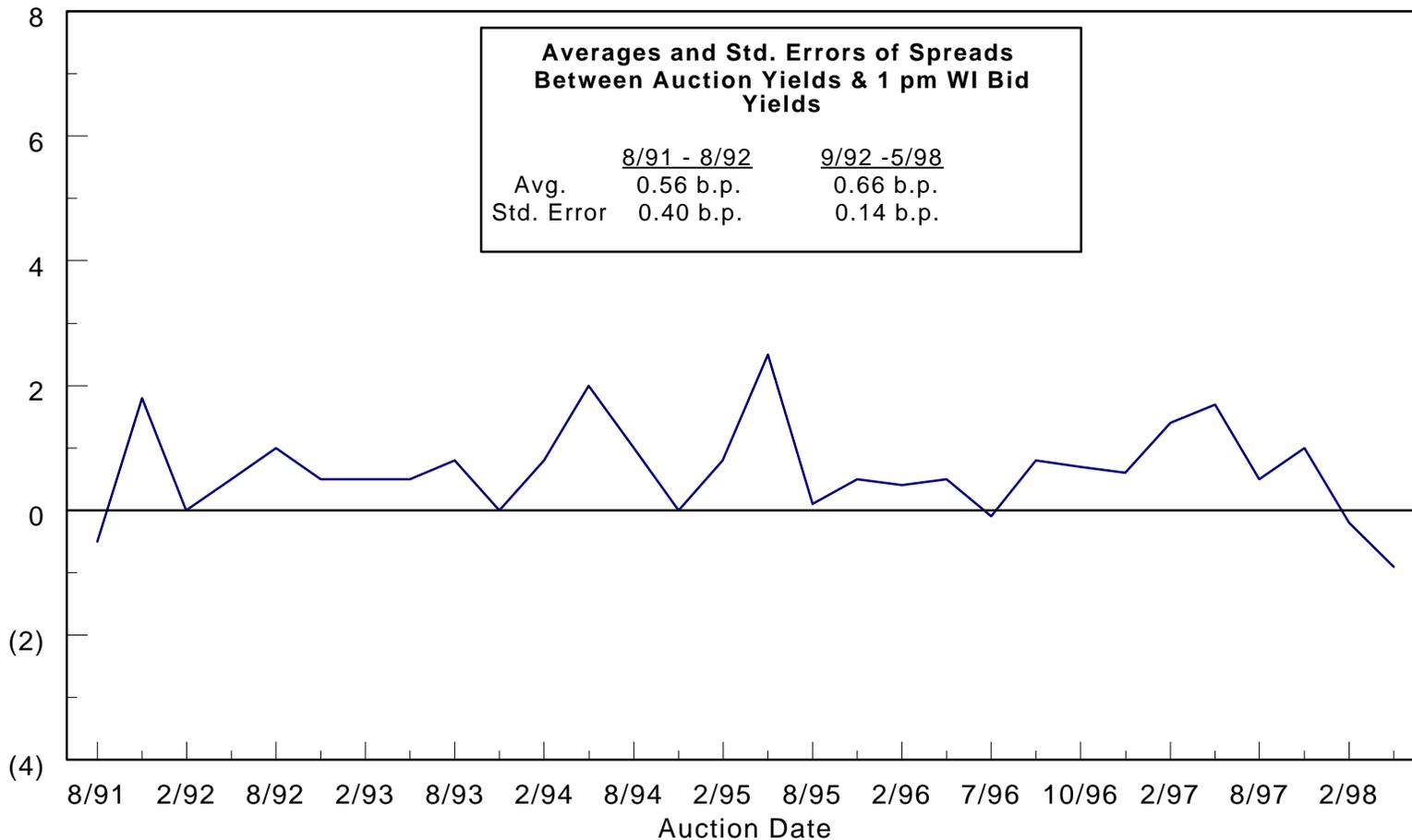
Basis Points



Source: GOVPX, Inc.

**AUCTION SPREADS  
 AUCTION RESULTS - 1 PM WI BID YIELDS  
 10-YEAR NOTES  
 (August '91 through May '98)**

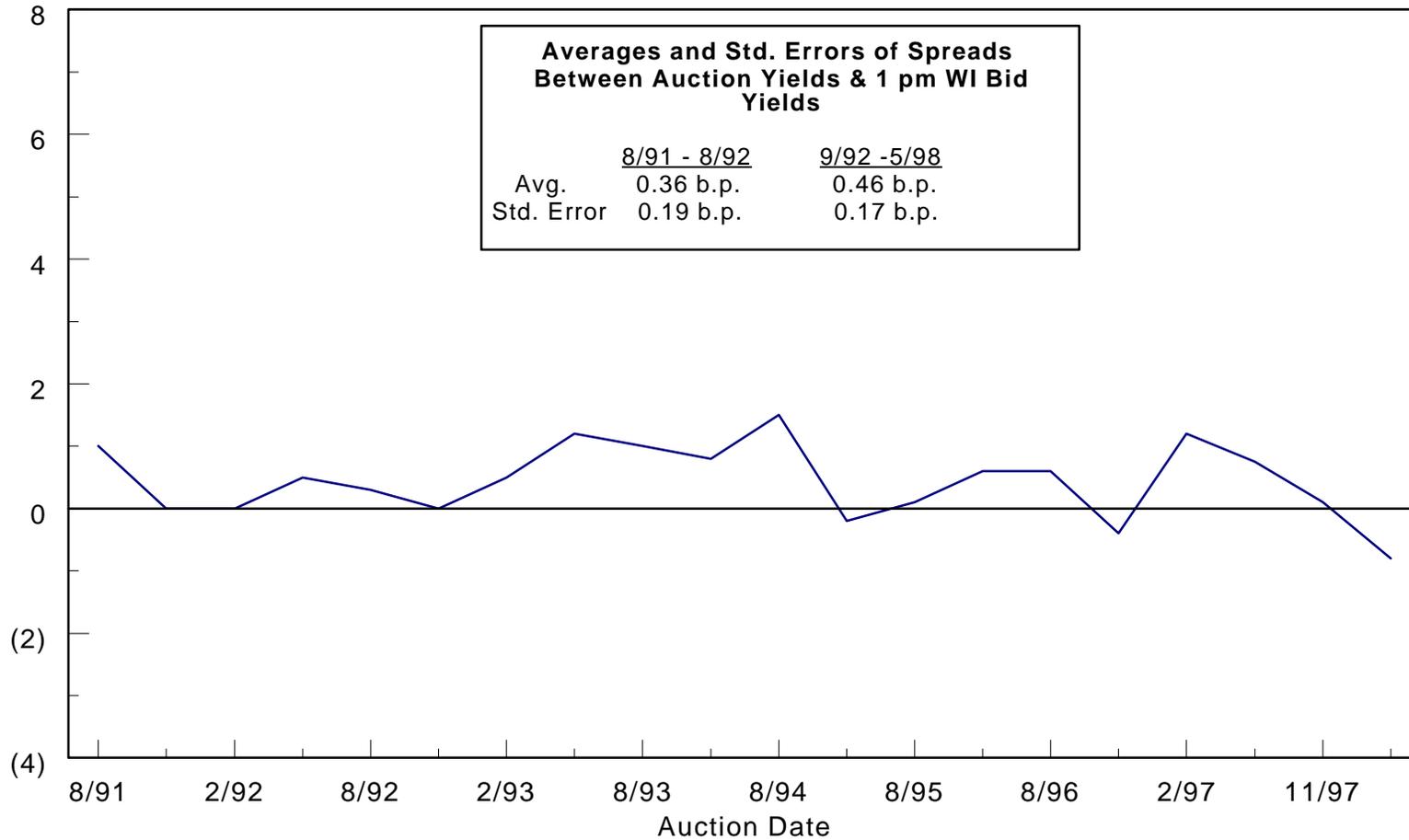
Basis Points



Source: GOVPX, Inc.

**AUCTION SPREADS  
 AUCTION RESULTS - 1 PM WI BID YIELDS  
 30-YEAR BONDS  
 (August '91 through May '98)**

Basis Points



Source: GOVPX, Inc.



