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Forecasting the Treasury's Balance at the Fed

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Abstract

As part of the Fed's daily operating procedure, the Federal Reserve Bank of New York, the Board of Governors, and the Treasury make a forecast of that day's Treasury balance at the Fed. These forecasts are an integral part of the Fed's daily operating procedure. Errors in these forecasts can generate variation in reserve supply and, consequently, the federal funds rate. This paper evaluates the accuracy of these forecasts. The evidence suggests that each agency's forecast contributes to the optimal, i.e., minimum variance, forecast and that the Trading Desk of the Federal Reserve Bank of New York incorporates information from all three of the agency forecasts in conducting daily open market operations. Moreover, these forecasts encompass the forecast of an economic model.

JEL Classification: E40, E52
Key Words: open market operations; Treasury's balance; federal funds rate

The views expressed here are the author's and do not necessarily reflect the views of the Board of Governors of the Federal Reserve System, the Federal Reserve Bank of New York, the United States Treasury, or the Federal Reserve Bank of St. Louis. I would like to thank James Hamilton, Adrian Pagan, John Partlan, Robert Rasche, and Lucio Sarno for helpful comments and Jonathan Ahlbrecht, Joanna Barnish, Stephen Majesky, and Rachel Mandal for valuable research assistance.

1. Introduction

The Trading Desk of the Federal Reserve Bank of New York (hereafter, "the Desk") implements the policy directive of the Federal Open Market Committee (FOMC) by conducting open market operations in government securities. Conceptually, the Fed's operating procedure is relatively simple. The Desk estimates (i) the demand for reserves that is consistent with the FOMC's objective for the federal funds rate and (ii) the amount of reserves that will be supplied if the Desk does nothing that day. The Desk then buys or sells government securities equal to the amount of reserves that it estimates it needs to add or drain to meet the FOMC's funds rate objective.[1]

The operating procedure requires the Desk to estimate certain factors that are not controlled directly. Important among these is the Treasury's balance at the Fed. Errors in forecasting the Treasury's balance, or other factors that affect supply, generate reserve supply shocks that can cause the funds rate to deviate from the Fed's target.

The Federal Reserve Bank of New York, the Board of Governors (BOG), and the Treasury make separate and independent forecasts of the Treasury's balance each day.[2] The Desk combines these forecasts into a single estimate of the Treasury's balance, which is used, along with other forecasts, to determine each day's open market operation. This paper evaluates each agency's forecast relative to the forecast of the other agencies using the Diebold and Mariano (1995) test. The combination of these forecasts that minimizes the variance of the forecast error is then estimated. Using a result from

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1 See Feinman (1993) and Thornton (2001a,b) for a more detailed discussion of the Fed's operating procedure.
2 This is not the only set of multiple forecasts that the Desk uses to implement monetary policy daily. Each day the staffs of the Board of Governors and the Federal Reserve

Thornton (2001a), the relative weight that the Desk assigns to each forecast in carrying out its daily open market operations is estimated. These weights are compared with the minimum-variance forecast error weights to see whether the Desk makes efficient use of the information contained in each of the agency's forecast. Finally, the agencies' forecasts are compared with the forecast of an econometric model designed to capture the errors made by the Desk in forecasting the Treasury's balance each day.

Despite the fact that the agencies' forecasts are highly colinear, each contributes significantly to the optimal forecast, suggesting that each contains useful information not contained in the others. Estimates of the weight that the Desk gives to each agency's forecast in conducting daily open market operations, compared with the optimal weights, suggest that the Desk may have given more weight to the forecast of the Federal Reserve Bank of New York than is optimal. Nevertheless, consistent with the optimal forecast, the Desk appears to have given weight to each of the agencies' forecasts in conducting open market operations. Finally, each of the agencies' forecasts encompasses the forecast from the econometric model considered here.

The outline of this article is as follows. In Section 2, the forecasts of these agencies are presented and compared. The forecasting accuracy of these agencies is evaluated in absolute terms and relative to each other. Section 3 presents estimates of the weight that the Desk implicitly assigns to each forecast in carrying out daily open market operations and compares these estimates with those obtained from the minimum variance forecast error criterion. A comparison of each agency's forecast with the forecast from

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Bank of New York make separate forecasts of the path for nonborrowed reserves and borrowing.

an econometric model is presented in Section 4. The conclusions are presented in Section 5.

2. The Accuracy of Agency Forecasts

The data used in this study are daily and cover the period from March 2, 1987, to December 31, 1996. The data consist of the Treasury's balance at the Federal Reserve, $Tbal$, and the forecasts (F) of the Treasury's balance made by the Federal Reserve Bank of New York, ny, the BOG, bog, and the Treasury, tr. These data are ideal for evaluating the forecasting accuracy of these agencies because they are real-time forecasts that are made the morning of the day for which the forecast is made. Moreover, each agency has the same objective in forecasting the Treasury's balance at the Fed. While the forecasts are based on extensive knowledge of the process that generates the Treasury's balance each day, they are judgmental forecasts.

There is considerable persistence in $Tbal$ as indicated by the fact that the estimate of the AR(1) coefficient is 0.81. Nevertheless, $Tbal$ is a stationary time series. An augmented Dickey-Fuller test allowing for both a constant term and a time trend yields a test statistic of –12.11. Hence, the null hypothesis of a unit root is rejected at the 1-percent significance level.[3]

The forecasting performance of each agency is investigated by estimating the equation

(1) $$Tbal_t = \alpha + \beta_j Fj_t + \varepsilon_t ,$$

where $j = ny$, bog, or tr. If the forecasts are unbiased, hypothesis $\alpha = 0$ and $\beta_j = 1$ will not be rejected. Estimates of Equation 1 for each of the three agencies are presented

[3] The lag order used was 4, but the qualitative results are insensitive to the lag order.

in columns 2 - 4 of Table 1.[4] Each of the agencies' forecasts is biased, as the joint hypothesis $\alpha = 0$ and $\beta_j = 1$ is rejected at the 5 percent significance level in each case. The rejection of the joint hypothesis is largely due to the fact that the agencies under-predict $Tbal$ on average. For each agency, the null hypothesis, $\beta = 1$, is not rejected at the 5 percent significance level. The under-prediction is most severe for the Treasury. The extent of the bias appears to be rather small, however. For example, the standard deviation in the Treasury balance over this period is about $3.4 billion—more than 14 times larger than the average bias of the Treasury forecast.[5] In any event, each agency's forecast explains more than 92 percent of the variation in $Tbal$.

2.1 *The Relative Forecasting Performance*

The above results suggest that each agency does a relatively good job of forecasting the Treasury's daily balance at the Fed. To test whether one agency does significantly better than the others, the Diebold and Mariano (DM) (1995) test was conducted for two different loss functions. The *DM* statistic is

$$DM = \frac{\bar{d}}{\sqrt{\frac{2\pi\hat{f}(0)}{N}}}, \tag{2}$$

where $\bar{d}$ is the average of a general loss differential function and $\hat{f}(0)$ is a consistent estimate of the spectral density of the loss function at frequency zero. The *DM* statistic is

[4] The residuals from these estimated equations exhibited some small but statistically significant serial correlation. Consequently, the variances were estimated with the New-West correction with a truncation lag of 8.

[5] On non-reserve-settlement days, the funds rate averages about 4 basis points above the funds rate target during this period with a median of 2 basis points. One cannot determine whether the under-prediction of the Treasury's balance accounts for this fact because what matters for the equilibrium funds rate is the under- or over-prediction of the

distributed standard normal under the null hypothesis of equal forecasting accuracy. Consistent estimates of $\hat{f}(0)$ are obtained using the Newey and West (1987) method, where the optimal truncation lag has been selected using the Andrews (1991) AR(1) rule.

The *DM* statistic for both the absolute-error and squared-error loss functions are presented in Table 2 for all pairings of the agencies' forecasts. All of the *DM* statistics are very small, indicating that the hypothesis of equal forecasting accuracy cannot be rejected at conventional significance levels. Hence, in terms of either the mean-square-error or absolute-error criteria, none of the agencies does better than the others in forecasting the Treasury's balance at the Fed.

2.2 *The Weighting of Agency Forecasts*

Scatter plots of $Tbal$ and each agency's forecasts are presented in Figures 1 – 3. The bias in each agency's forecast is evidenced by relatively more observations above than below the 45-degree line. It is obvious from these figures that the agencies' forecast are highly correlated. The coefficient of correlation between any two of the agencies' forecasts is 0.97 or higher. The high correlation suggests the possibility that one or more of the forecasts is redundant. If a forecast provides no marginal information when the forecast of another agency is known, there is no reason for several agencies to make separate forecasts. The Desk could perform its daily open market operations as effectively using any one of the agencies' forecasts.

The combination of these forecasts that minimizes the variance of the forecast errors can be obtained by estimating the equation

(3) $$Tbal_t = \mu + \beta_{ny} Fny_t + \beta_{bog} Fbog_t + \beta_{tr} Ftr_t + \varepsilon_t .$$

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sum of all of the factors that affect reserve supply (see Thornton, 2001b, for a detailed

The coefficient on each forecast is an estimate of the proportion of each agency's forecast that is useful for predicting Treasury balances, conditional on the forecasts of the other agencies. Hence, it reflects the contribution of each agency's forecast to the forecast that minimizes the variance of the forecast error.

It is very difficult to disentangle the separate influence of individual regressors in the face of severe multicollinearity. Nevertheless, estimates of Equation 2, presented in the fifth column of Table 1, show that each agency's forecast provides information not contained in the forecasts of the others. Estimates of β_j (for all j) are larger than 0.2, and the null hypothesis, $\beta_j = 0$, is rejected in each case at the 5 percent significance level.

While the sum of the coefficients, 1.018, is only slightly larger than 1.0, the hypothesis $\beta_{ny} + \beta_{bog} + \beta_{tr} = 1$ is easily rejected at the 5 percent significance level.[6] Nevertheless, the estimated weights when the restriction $\beta_{ny} + \beta_{bog} + \beta_{tr} = 1$ is imposed (reported in the sixth column of Table 1) differ only slightly from those obtained when the restriction is not imposed.

3. Has the Desk Made Efficient Use of the Agency Forecasts?

If the Desk made efficient use of the agency forecasts, the weight assigned to each of the agency's forecast in carrying out its daily open market operations would equal the weights that minimize the forecast errors. Any other set of weights would produce larger forecast errors, larger variation in reserve supply, and, other things the same, more volatility in the federal funds rate.

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analysis of this point).

3.1 *Estimating the Implied Desk Weights—Methodology*

Each day the Desk estimates the demand for reserves that is consistent with the Fed's objective for the federal funds rate and the supply of reserves that will be available if the Desk conducts no open market operations. Given the Desk's operating procedure, it can be shown (see Thornton, 2001a,b, for details) that the error that the Desk makes in forecasting the Treasury's balance is reflected dollar-for-dollar in nonborrowed reserves. Hence, the weights used by the Desk can be estimated by estimating the reduced form for nonborrowed reserves, NBR. To see how this is done, assume that the reduced form for NBR is of the general form,

(4) $$NBR_t = \varphi' X_t + \delta fe_t + \eta_t ,$$

fe_t denotes the true forecast error that the Desk makes in forecasting $Tbal$, and where X_t is a K by 1 vector of other variables that appear in the reduced form of NBR and φ is a K by 1 vector of coefficients. Hence, $\varphi' X$ represents all factors, other than the Desk's forecast error, that determine the level of *NBR*. The true forecast error can be represented by

(5) $$fe_t = Tbal_t - \omega_{ny} F_{ny,t} - \omega_{bog} F_{bog,t} - \omega_{tr} F_{tr,t} ,$$

where the ω's are the weights the Desk assigns to each agency's forecast in carrying out daily open market operations. Substituting Equation 5 into Equation 4 yields

(6) $$NBR_t = \underline{\varphi}' \underline{X}_t + \delta [Tbal_t - \omega_{ny} F_{ny,t} - \omega_{bog} F_{bog,t} - \omega_{tr} F_{tr,t}] + \eta_t .$$

Note that $\delta = -1$ if and only if the ω's equal the weights the Desk actually used to conduct open market operations during the period. Because of this, it is possible to

[6] This is largely due to the fact that each agency under-predicts the average level of Treasury balances over the period.

estimate the weights that the Desk actually used by estimating Equation 6 and finding the set of weights for which $\delta = -1$.

This approach assumes that the error the Desk makes in forecasting the Treasury balance is independent of other shocks. This need not be the case, however. For example, a transportation problem that causes the Treasury's balance to be higher than anticipated may also produce an unexpected rise in the float. For this reason, the estimate of δ could be biased. The direction of the bias would depend on whether shocks are positively or negatively correlated.

The bias could also result from the fact that there is considerable uncertainty associated with the Desk's forecasts of the various factors that affect reserve supply. Because of this, the Desk may at times trade-off its $Tbal$ forecast with forecasts of other factors that affect supply, i.e., the float and borrowing. If the Desk behaves in this way, the estimate of the coefficient on the $Tbal$ forecast error in a model that does not explicitly include the other forecast errors will be positively biased, i.e., the estimate of the coefficient will be larger than −1.[7]

It is also important to note that the Desk's operating procedure is used only as a guide for the Desk's daily operations. On any given day, the Desk may undertake larger or smaller open market operations than a strict interpretation of its operating procedure would require. On days when the Desk does more than the procedure suggests, the implied coefficient would be less than −1. On days when the Desk does less than the procedure suggests, the implied coefficient would be greater than −1. If such instances averaged out over the period, there would be no problem. Such errors need not average out, however, because the Desk frequently takes no action when the size of the action, suggested by the operating procedure, is small. On such days the implied coefficient is zero. If on all other days the implied coefficient is −1, the estimated coefficient will be greater than −1. Consequently, the estimate of δ can be larger than −1 even if forecast errors are uncorrelated with other shocks.[8]

3.2 *Estimating the Implied Desk Weights—Results*

The weights used by the Desk to implement monetary policy are estimated by estimating a model identical to that used by Thornton (2001b).[9] Specifically,

$$
\begin{aligned}
(7) \qquad NBR_t = \alpha + \beta_1 dr_t + \beta_2 ff_t^* + \beta_3 \Delta ff_t^* + \beta_4 er_t^d + \beta_5 rr_t^d + \beta_6 (ff - ff^*)_{t-1} + \\
\delta(Tbal_t - \omega_1 F_{ny,t} - \omega_2 - F_{bog,t} - \omega_3 F_{tr,t}) + \eta_t \,,
\end{aligned}
$$

where dr denotes the discount rate, ff^* denotes the funds rate target, and er^d and rr^d denote the estimates of the demand for excess and required reserves, respectively, made by the Board of Governors. Because there were two major changes in reserve requirements during the period, rr^d is partitioned into three periods of different reserve requirements.[10] The estimated equation also includes two dummy variables, one for the last day of the maintenance period (settlement Wednesday), SW, and one for first two and last two days of the year, F/L.

Equation 7 is estimated over the entire sample period, imposing the restriction $\omega_{ny} + \omega_{bog} + \omega_{tr} = 1$ and searching over all possible combinations of weights from zero to

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[7] The direction of the bias stems from the fact that increases in Treasury balances drain reserves while increases in the float or borrowing add reserves.
[8] I would like to thank Jim Hamilton for drawing my attention to this possibility.
[9] The only difference is that Thornton (2001b) used the simple average of the forecasts to estimate the forecast error.
[10] The first occurred in December 1990 and the second in April 1992. See Thornton (2001b) for details.

1 by increments of 0.1.[11] The estimates, presented in Table 3, are quantitatively similar to those reported by Thornton (2001b) over two different periods. The estimate of δ is –0.86 with a standard error of 0.06. Consequently, the hypothesis $\delta = -1$ is rejected at the 5 percent significance level. The corresponding weights, $\omega_{ny} = 0.4$, $\omega_{bog} = 0.2$, and $\omega_{tr} = 0.4$, differ somewhat from the weights shown in the last column of Table 1. Specifically, the Desk appears to have assigned more weight than is optimal to the New York Fed's forecast and too little weight to the BOG's forecast. Nevertheless, consistent with the optimal forecast, the Desk appears to have given some weight to each of the forecasts in conducting daily open market operations.

When Equation 7 is estimated conditional on the weights given in Table 1, the estimate of δ increases only slightly to -0.853. Moreover, if each of the forecasts is weighted equally, the estimate of δ is -0.857. Hence, the estimate of δ appears to be relatively insensitive to the weighting of agency forecasts. This is perhaps not too surprising, given that any of the agencies' forecasts alone accounts for over 90 percent of the variation in $Tbal$. When one forecast is known, the information provided by the remaining forecasts—although statistically significant—is relatively small. Hence, the conclusion that the Desk gave disproportionate weight to the New York Fed's forecast is tenuous.

3.3 *Why Is the Estimate of δ Larger Than -1?*

As noted in Section 3.1, there are several possible reasons why the estimate of δ is significantly larger than −1. One of these—that δ is affected by the number of days when the Desk does not undertake any open market operations—can be investigated by

[11] Given that the estimate of δ was rather insensitive to the weights, a finer search was

estimating Equation 7 over periods when there is a marked difference in the proportion of days that the Desk took no actions.

From January 1990 through December 1992, the Desk undertook no open market operations on about 23 percent of the days (175 of 755 days). In contrast, during a period of nearly equal length, from January 1994 through December 1996, the Desk undertook no open market operations on about 32 percent of the days (243 of 754 days). Estimates of Equation 7 over these periods yield estimates of δ equal to -0.759 and -0.922 for the first and second periods, respectively. The estimate of δ was much closer to and not significantly different from -1 in the second period despite the fact that the Desk undertook no open market operations much more frequently during this period. Hence, the fact that the Desk does not undertake operations on days when its operating procedure suggests small operations are required does not appear to account for the fact that the estimate of δ over the entire period is greater than -1.

4. A Comparison of Agency and Econometric Model Forecasts

While each agency appears to do a good job forecasting the Treasury's balance at the Fed, it is interesting to investigate whether these forecasts could be improved using an econometric model. This question is investigated using Hamilton's (1997, 1998) forecasts of $Tbal$. Hamilton's (1997, 1998) forecasts are ideal for this purpose because he attempted to identify the liquidity effect at the daily frequency by replicating the forecast errors that the Desk makes each day in implementing its operating procedure.[12]

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not undertaken.

[12] Thornton (2001b) shows why the liquidity effect cannot be identified using Hamilton's procedure and presents evidence that Hamilton failed to identify the liquidity effect. He also presents evidence from an alternative method of identifying the liquidity effect at the daily frequency.

In contrast to the real-time forecasts of these agencies, Hamilton's forecasts incorporate all of the daily data on Treasury balances over the forecast period. It would be possible to update Hamilton's model each day, but these would not be real-time forecasts for two reasons. First, Hamilton's model specification is determined by extensively testing a number of alternative specifications using data over his entire sample period. Even if the model were reestimated each day, strictly speaking, the forecasts would not be real-time forecasts because the structure was identified using data over the entire sample period. Second, the structure of Hamilton's model changed during the two sample periods over which it was estimated, suggesting that the model specification may not be temporally stable.

For these reasons, Hamilton's actual forecasts are used. Hamilton's estimates are available for two sample periods, April 6, 1989–November 27, 1991 (Hamilton, 1997) and January 2, 1992 – December 30, 1994 (Hamilton, 1998).[13] Scatter plots of actual Treasury balances and Hamilton's forecast for the two periods are presented in Figures 4 and 5, respectively. For comparative purposes, scatter plots of the Treasury's forecast for these same two periods are presented in Figures 6 and 7.

A comparison of Figures 4 and 5 with Figures 6 and 7 suggests that the Treasury did a much better job of forecasting the Treasury's balance over both sample periods.[14] This impression is confirmed by the results of the *DM* test, reported in Table 4. Consistent with the comparison of Figures 4 and 5 with Figures 6 and 7, the null hypothesis of equal forecasting accuracy is easily rejected for the square-error criterion

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[13] Hamilton's forecasts can be obtained at <http://www.econ.ucsd.edu/~jhamilto/>.
[14] The scatter plots for the New York Fed and the BOG are very similar to those of the Treasury.

for both periods. The econometric model fares better by the absolute-error criterion, as the null hypothesis is rejected only once at the 5 percent significance level. This is not surprising. While the distributions of model and judgmental forecast errors are skewed, the degree of skewness is not too severe. Hence, it is not surprising that the mean difference in the absolute-error loss function is much smaller than the mean difference in the square-error loss function. Nevertheless, the null hypothesis is rejected in three other cases at the 10 percent significance level.

The superior performance of the judgmental forecast is also illustrated by estimating Equation 1 over the 1989-91 and 1992-94 periods. The results, reported in Table 5, show that the econometric model forecasts account for a much smaller proportion of the variation of $Tbal$ than any of the agency's forecast. The standard error of the model forecast is more than twice that of any of the agency's forecast during the April 6, 1989 – November 27, 1991, period and more than 70 percent larger for the second sample period.

The fact that each agency's forecast outperforms the econometric model does not necessarily imply that the Desk's forecast could not be improved by supplementing these forecasts with the forecast from an econometric model. To test whether the forecasts from the econometric model provide information not contained in all of the agencies' forecasts, the equation

$$(8) \qquad Tbal_t = \mu + \beta_{ny} Fny_t + \beta_{bog} Fbog_t + \beta_{tr} Ftr_t + \beta_h Fh_t + \varepsilon_t ,$$

was estimated, where Fh denotes Hamilton's forecast of $Tbal$.

Estimates of Equation 8 are presented in Table 6 for both periods along with estimates of Equation 3. In all cases, the restriction that the sum of the coefficients equals 1 was imposed.[15] The estimated weights for the three agencies for each period reported in Table 6 are similar those reported in the fifth column of Table 1, suggesting that there may be relatively little variation in the weighting of the agency forecasts over the sample period. It should be noted, however, that the estimated weight on the Board of Governors forecast is not statistically significant at the 5 percent level for the April 6, 1989 – November 27, 1991, period. Nevertheless, the estimates suggest that the model-based forecast does not add statistically significant information at the margin. The null hypothesis that $\beta_h = 0$ is not rejected at the 5 percent significance level during either period.

These results suggest that the Desk may not be able to improve its forecast by supplementing the judgmental forecasts with model-based forecasts. It is important to note, however, that these results are based on the forecast from one econometric model. The results could be different with different models. Furthermore, updating the forecast each day might improve the model's forecasting ability. If the Desk actually employed model-based forecasts, however, the structure of the forecasting model would be solely determined by the history of the data. Hence, the evidence presented here suggests that it may be difficult to improve the Desk's forecast of the Treasury balance with information obtained from an econometric model.

The superior performance of the agencies in forecasting the Treasury's balance is perhaps not surprising. These agencies have access to the detailed history of the components of Treasury receipts and expenditures, as well as knowledge of some categories of government expenditures for the day. Indeed, these real-time forecasters

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[15] The conclusion that the forecast from the econometric model adds little to the

may use information that might be difficult to effectively incorporate into an econometric model.

5. Conclusions

In implementing its operating procedure each day, the Trading Desk of the Federal Reserve Bank of New York must forecast that day's level of the Treasury's balance with Federal Reserve Banks. The Desk has access to three forecasts because the Federal Reserve Bank of New York, the Board of Governors, and the Treasury make separate and independent forecasts of that day's Treasury balance. The Desk uses these forecasts, along with other information and forecasts of other factors that affect the supply and the demand for reserves, to implement the FOMC's policy directive. Errors that the Desk makes in forecasting the Treasury's balance, and other factors that affect supply, show up as reserve supply shocks that can cause fluctuations in the federal funds rate from the target level.

This paper evaluates each agency's forecast of the Treasury's balance and the Desk's use of them. In addition to providing general information about the quality of each agency's forecast, this paper investigates the extent to which each forecast contributes to the minimum variance forecast and the extent to which the Desk follows this forecast in implementing monetary policy.

The following conclusions emerge. First, each agency's forecast accounts for a high proportion of the variation in Treasury balances, suggesting that individually each agency does a reasonably good job of forecasting the Treasury's balance at the Fed. On

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forecasting accuracy is not affected by imposing this restriction.

average the agencies tend to underestimate Treasury balances; however, the size of the average underestimate appears to be relatively small.

Second, despite the high degree of correlation among the agencies' forecasts, each contributes to the minimum variance forecast over the period. This not only suggests that these agencies make independent forecasts of the Treasury's balance, but that the procedure of having three separate forecasts is desirable. One would have to undertake a complete cost/benefit analysis, however, to determine whether this practice is economically desirable.

Third, each agency's forecast dominates model-based forecasts made by Hamilton (1997, 1998). Moreover, the model-based forecast was not statistically significant when included with the agency forecasts. This evidence suggests that the Desk's forecasting procedure may not be significantly improved by adding model-based information.

Finally, the Desk appears to have made effective use of these forecasts in conducting its daily open market operations in that it has given all three of the agencies' forecasts some weight in conducting daily open market operations. The estimates suggest that the Desk has given somewhat more weight to the New York Fed's forecast than is optimal; however, this conclusion is tenuous.

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Table 1: Forecasting Accuracy of Agency Forecasts

Const.	0.122* (2.68)	0.083 (1.46)	0.239* (6.08)	0.074 (1.82)	0.184* (8.86)
Fny	1.001* (139.39)	–	–	0.229* (3.69)	0.229* (3.56)
Fbog	–	1.010* (104.16)	–	0.375* (6.17)	0.363* (5.83)
Ftr	–	–	1.002* (161.92)	0.414* (10.86)	0.408* (10.56)
$\overline{R}^2$	0.925	0.927	0.925	0.938	0.938
s.e.	0.927	0.910	0.927	0.842	0.844
Unbiased[1/] F-statistic	18.57	25.03	60.75	na	na
F-statistic	0.021[2/]	1.140[2/]	0.063[2/]	7.707[3/]	na

Results reported in columns 2-4 are from estimating $Tbal_t = \alpha + \beta Fj_t + \varepsilon_t$ for each of the three agencies. The results in columns 5 and 6 are obtained by estimating $Tbal_t = \mu + \beta_{ny} Fny_t + \beta_{bog} Fbog_t + \beta_{tr} Ftr_t + \varepsilon_t$. Column 6 is obtained by estimating the equation by imposing the restriction $\beta_{ny} + \beta_{bog} + \beta_{tr} = 1$.

* Indicates statistical significance at the 5 percent level.

1/ Test of the hypothesis $\alpha = 0$ and $\beta = 1$.

2/ Test of the hypothesis $\beta = 1$.

3/ Test of the hypothesis $\beta_{ny} + \beta_{bog} + \beta_{tr} = 1$.

Table 2: Results From the *DM* Test

	DM Statistic		
	ny vs. *bog*	*ny* vs. *tr*	*tr* vs. *bog*
Square Error	0.12	-0.47	0.67
Absolute Error	0.07	-0.07	0.12

Table 3: Estimates of Equation 7		
	Estimate	t-statistic
Cont.	3.386*	2.28
β_1	0.127	0.64
β_2	-.087	0.57
β_3	-3.840*	4.54
β_4	-0.644	1.60
β_5^1	0.947*	43.56
β_5^2	0.964*	38.34
β_5^3	0.963*	41.15
β_6	1.933*	6.10
δ	-0.861*	14.03
SW	1.987*	8.78
F/L	1.521*	2.71
AR(1)	0.213	7.09
AR(19)	0.166*	8.22
$\overline{R}^2$	0.775	
s.e.	2.216	

* Indicates statistical significance at the 5 percent level.

Table 4: Comparison of Agency and Econometric Model Forecasts: *DM* Test Statistics

	DM Statistic		
	h vs. ny	*h vs. bog*	*h vs. tr*
	April 6, 1989 - November 27, 1991		
Square Error	12.12*	12.28*	11.80*
Absolute Error	1.64	2.19*	1.65
	January 2, 1992 - December 30, 1994		
Square Error	7.60*	7.85*	7.30*
Absolute Error	1.52	1.65	1.40

*Indicates statistical significance at the 5 percent level.

Table 5: A Comparison of Agency and Econometric Model Forecasts								
	April 6, 1989 – November 27, 1991				January 8, 1992 – December 30, 1994			
Const.	0.102 (1.35)	0.063 (0.82)	0.218* (3.02)	0.160 (0.52)	0.132 (1.45)	0.186* (2.12)	0.255* (2.82)	-0.022 (0.00)
β_{ny}	1.007* (104.26)	–	–	–	0.995* (68.03)	–	–	–
β_{bog}	–	1.014* (101.97)	–	–	–	0.993* (67.44)	–	–
β_{tr}	–	–	1.000 (114.24)	–	–	–	1.007* (63.63)	–
β_{h}	–	–	–	1.009* (18.36)	–	–	–	1.000* (14.62)
$\overline{R}^2$	0.932	0.934	0.932	0.721	0.893	0.897	0.886	0.658
s.e.	0.916	0.902	0.918	1.856	0.973	0.953	1.005	1.739
Results are obtained from estimating the equation $Tbal_t = \alpha + \beta_j Fj_t + \varepsilon_t$, for $j = bog$, tr, ny, or h.								

* Indicates statistical significance at the 5 percent level.

Table 6: The Contribution of the Forecast from the Econometric Model				
	April 6, 1989 – November 27, 1991		January 8, 1992 – December 30, 1994	
Const.	0.180* (4.58)	0.183* (4.65)	0.187* (4.84)	0.180* (4.51)
Fny	0.295* (2.06)	0.280* (2.04)	0.254* (4.34)	0.243* (4.15)
Fbog	0.281 (1.55)	0.266 (1.47)	0.390* (3.62)	0.375* (3.52)
Ftr	0.424* (5.06)	0.416* (4.94)	0.356* (5.51)	0.341* (5.12)
Fh	–	0.038 (1.25)	–	0.041 (1.73)
$\overline{R}^2$	0.939	0.939	0.913	0.914
s.e.	0.867	0.865	0.875	0.874

Columns 2 and 4 report the estimates of $Tbal_t = \mu + \beta_{ny} Fny_t + \beta_{bog} Fbog_t + \beta_{tr} Ftr_t + \varepsilon_t$ with and without imposing the restriction $\beta_{bog} + \beta_{tr} + \beta_{ny} = 1$, respectively. Columns 3 and 5 report the estimates of $Tbal_t = \mu + \beta_{ny} Fny_t + \beta_{bog} Fbog_t + \beta_{tr} Ftr_t + \beta_h Fh_t + \varepsilon_t$, without and with imposing the restriction $\beta_{bog} + \beta_{tr} + \beta_{ny} + \beta_h = 1$, respectively.

*Indicates statistical significance at the 5 percent level.

Figure 1: Actual and BOG's Forecast of the Treasury's Balance
(March 2, 1987 - December 31, 1996)

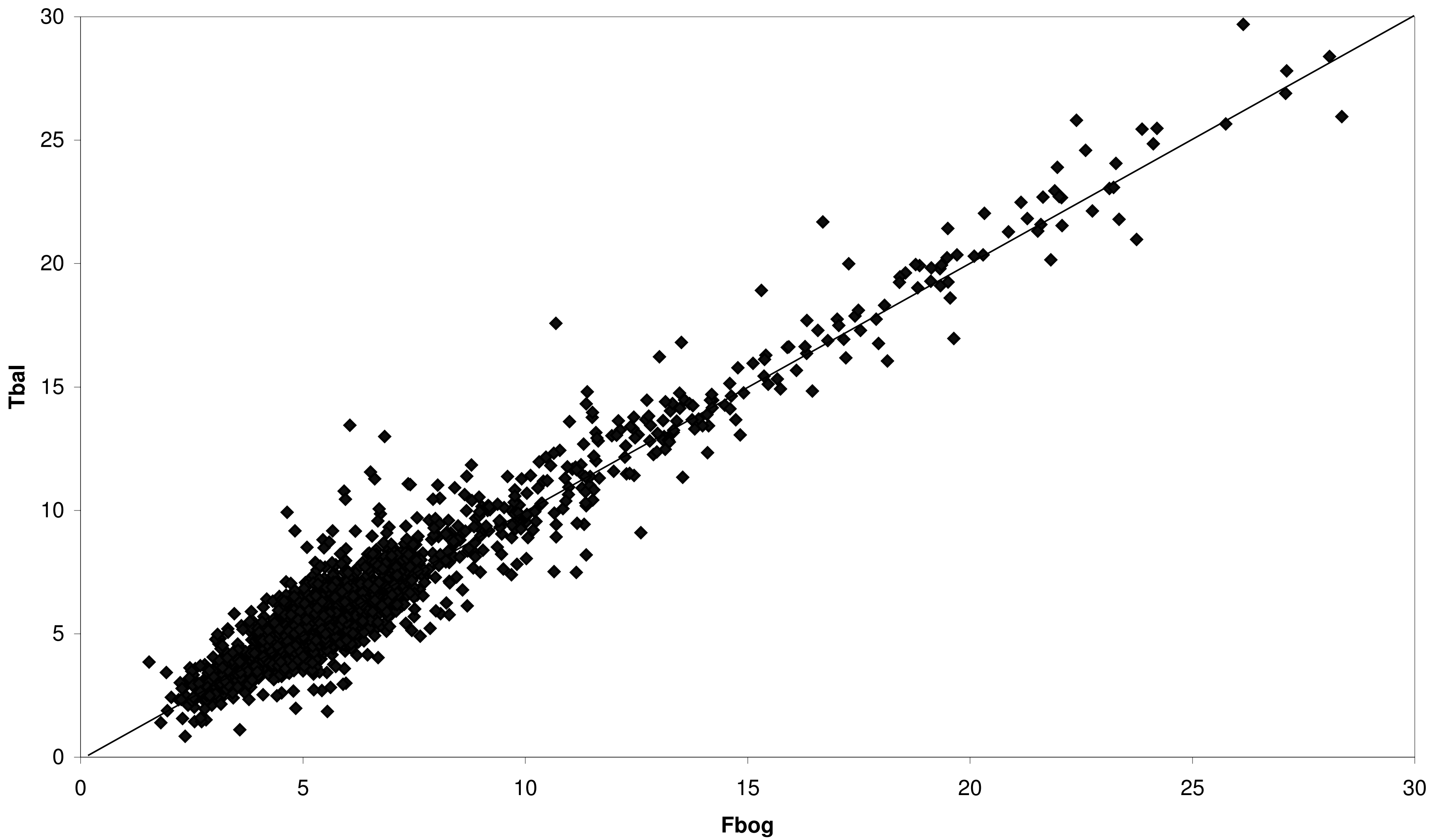

Figure 2: Actual and Treasury's Forecast of the Treasury's Balance
(March 2, 1987 - December 31, 1996)

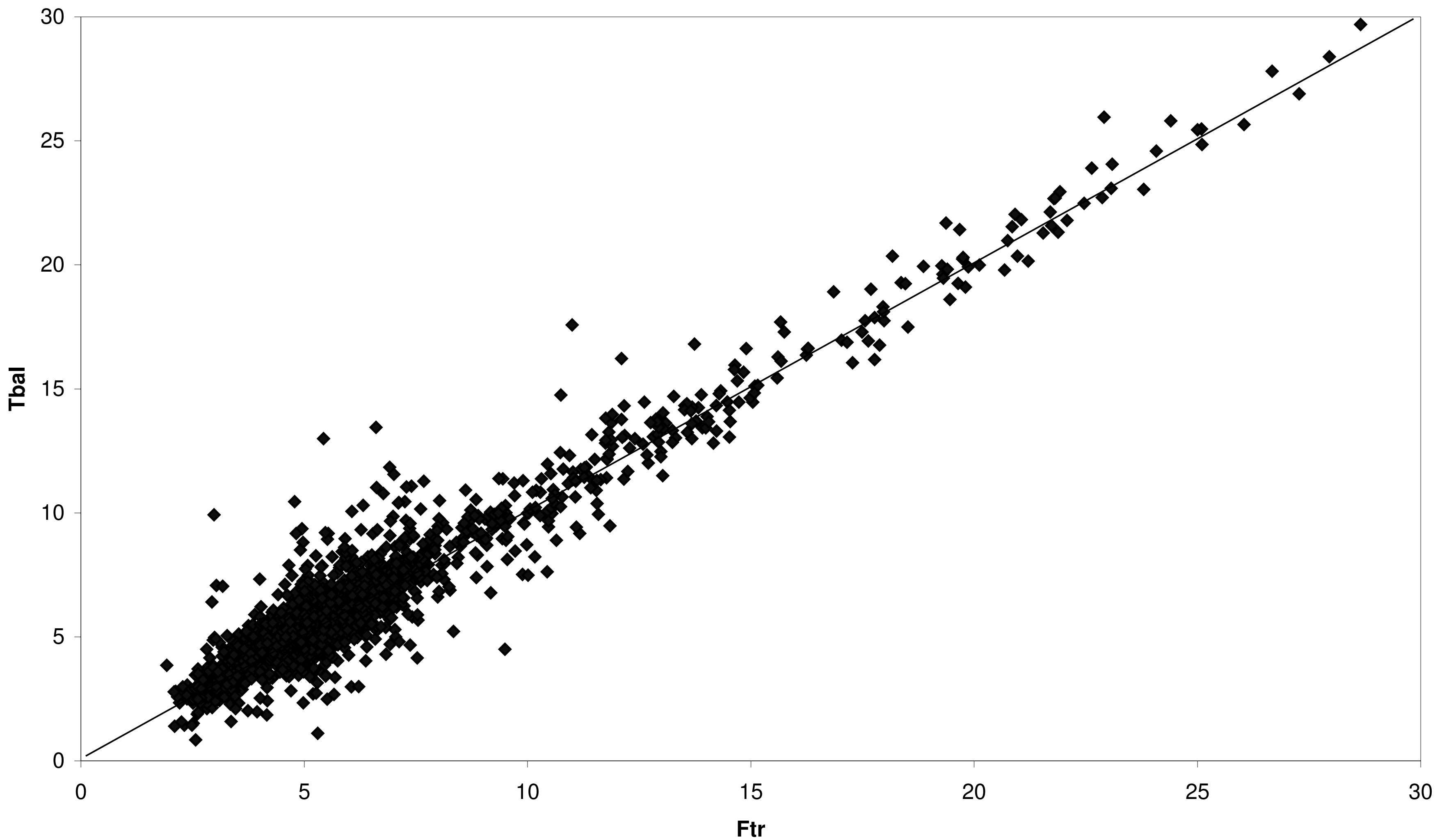

Figure 3: Actual and New York Fed's Forecast of the Treasury's Balance
(March 2, 1987 - December 31, 1996)

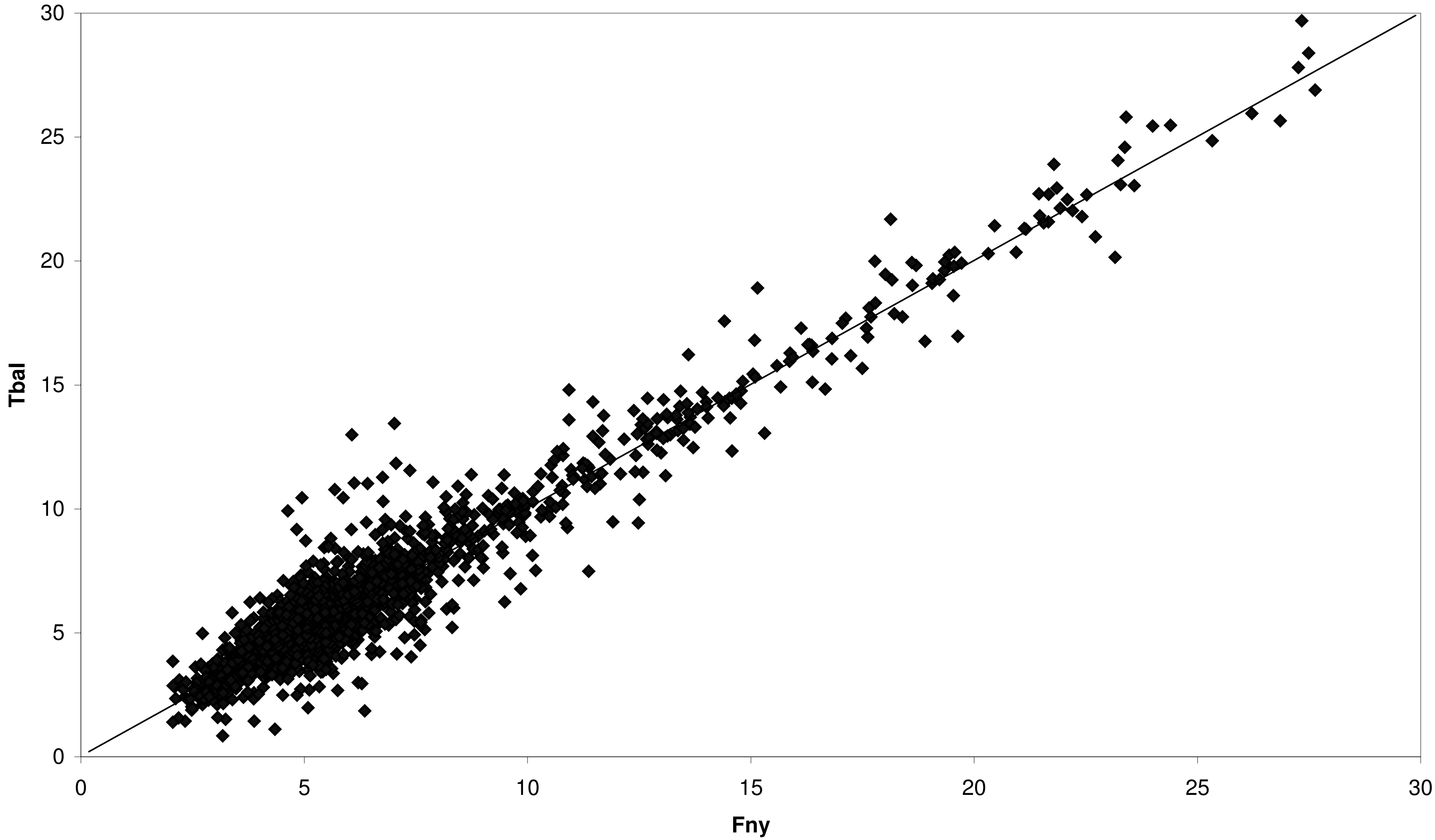

Figure 4: Actual and Hamilton's Forecast of the Treasury's Balance (April 6, 1989 - November 27, 1991)

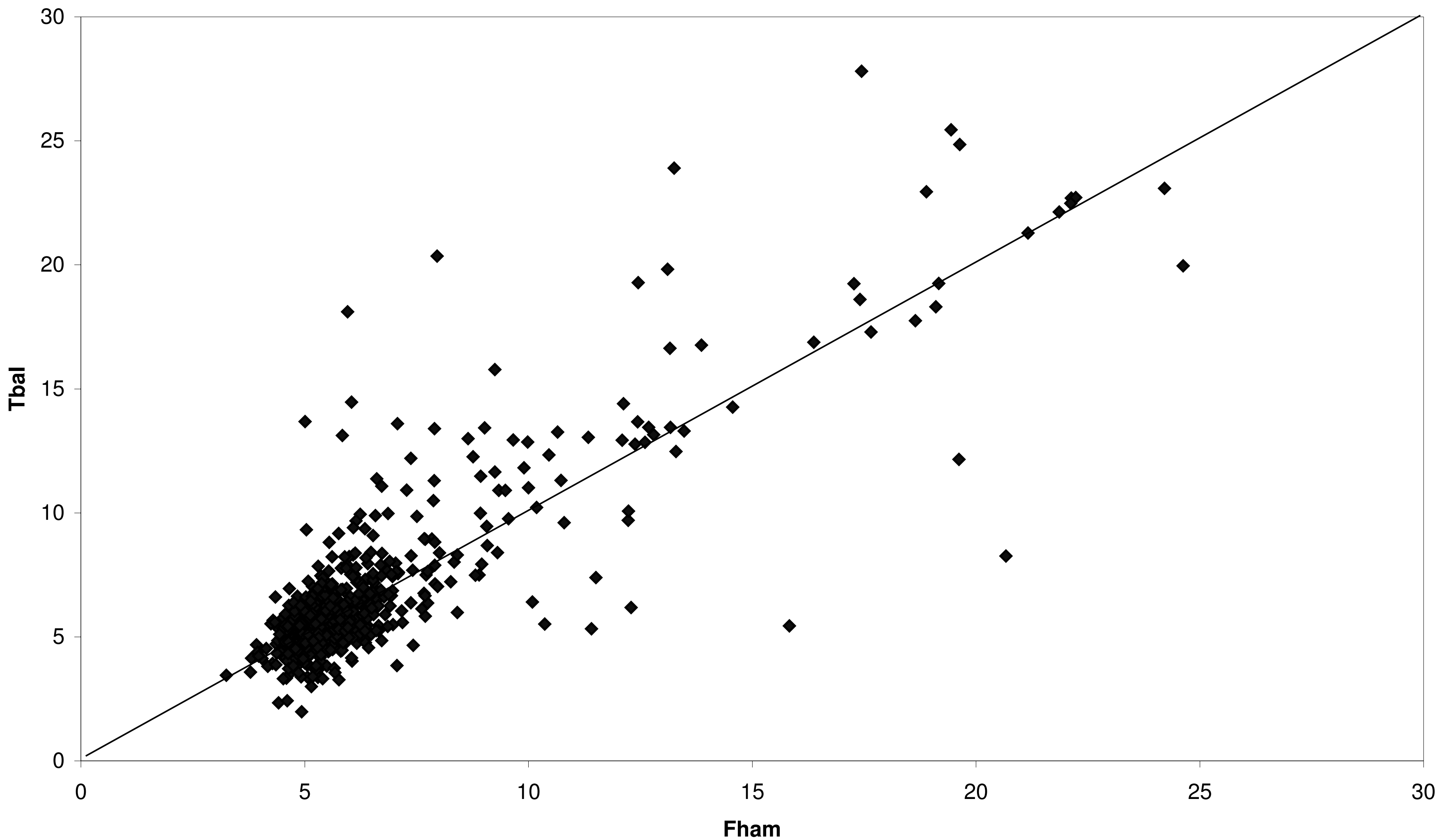

Figure 5: Actual and Homilton's Forecast of the Treasury's Balance
(January 8, 1992 - December 30, 1994)

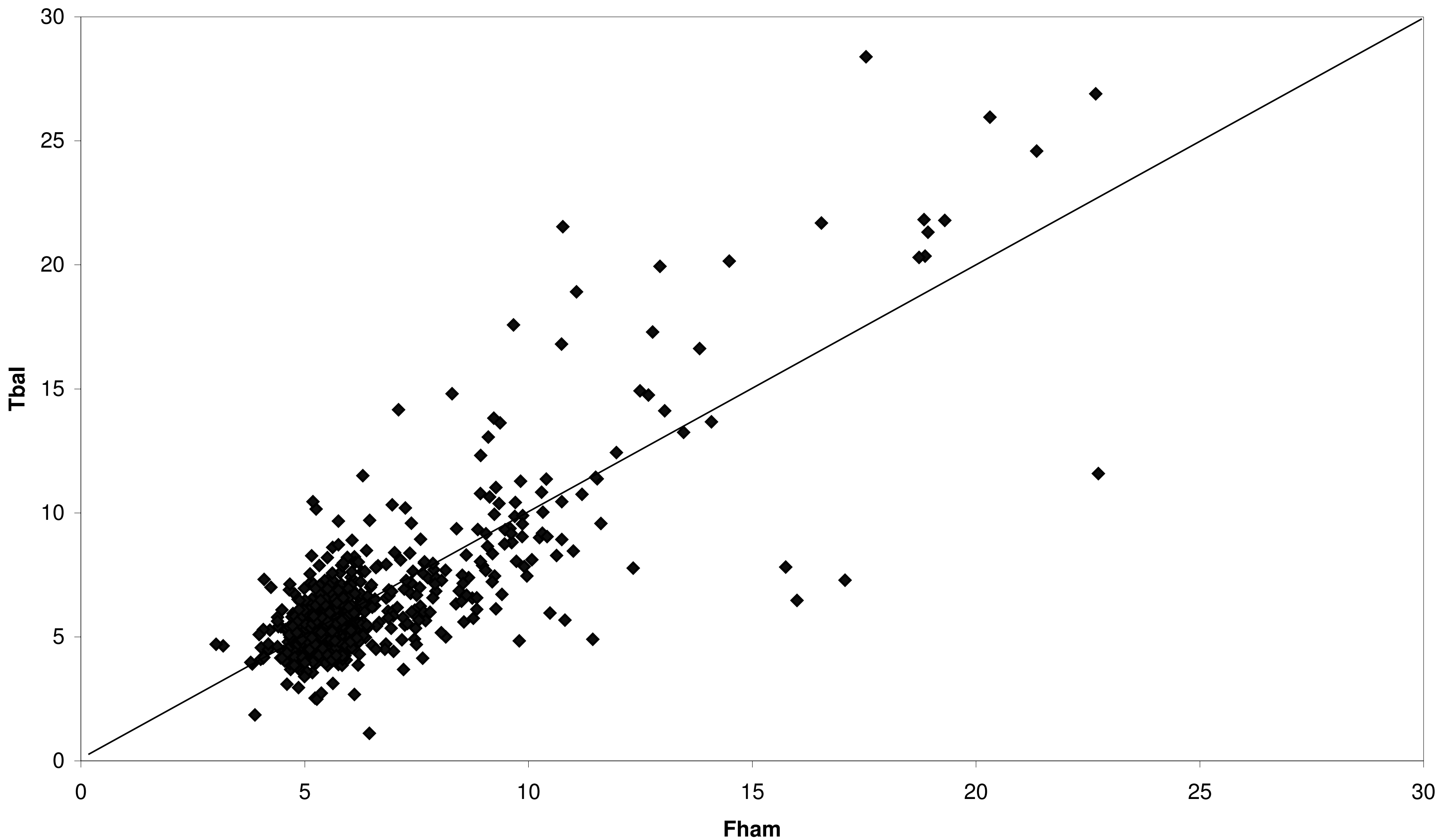

Figure 6: Acutal and Treasury's Forecast of the Treasury's Balance
(April 6, 1989 - November 27, 1991)

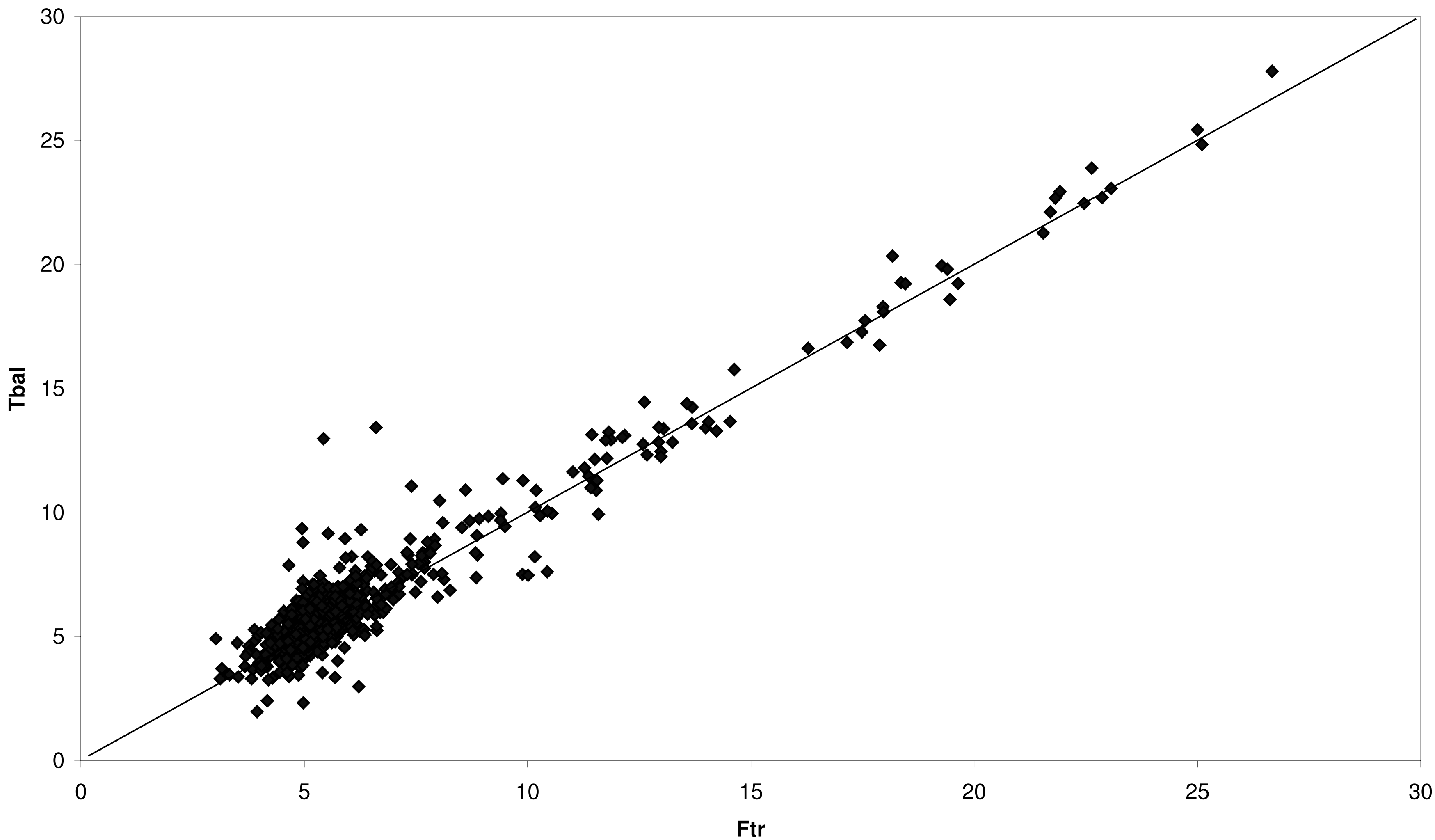

Figure 7: Actual and Treasury's Forecast of the Treasury's Balance
(January 2, 1992 - December 30, 1994)