DOES THE YIELD SPREAD PREDICT THE OUTPUT GAP IN THE U.S.?

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ABSTRACT. Yes, but only at short horizons from 1 to 3 quarters over the full post-World War II sample. The predictive relation between the yield spread and the output gap is characterized by parameter instability. Differently from the predictive models of the yield spread for output growth, structural instability is not due to a loss of predictive ability after 1985. Rather, the predictive relation estimated on post-1985 data holds for a range of horizons larger than for pre-1985 data. I also show that the information on current monetary policy is statistically irrelevant for the prediction of the output gap over the post-1985 subsample.

KEYWORDS: output gap, yield spread, predictability

JEL CLASSIFICATION CODE: E43, E27

CONTENTS

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1. INTRODUCTION

Estrella and Hardouvelis (1991) have established the usefulness of the yield spread for predicting output growth. A measure of spread between long-term and short-term interest rates successfully predicts the future growth of output. Stock and Watson (2003) find that the yield spread is also a good predictor for output growth out-of-sample. However, in the formation of monetary policy decisions, predicting the output gap is an issue as relevant as predicting output growth. For instance Svensson (2006) describes the Norwegian experience with the implementation of an inflation targeting regime. He dedicates special attention to the way output gap projections are computed and communicated to the public.

This paper extends the results from the literature on macroeconomic predictability, and examines whether the yield spread is a valid predictor for the output gap in the U.S. economy. Contrary to the conventional findings from the predictability for future output growth, the results presented here indicate that there is in-sample predictability for the output gap only at short horizons, namely from 1 to 3 quarters ahead. However, like for the predictive models for output growth (see Giacomini and Rossi, 2005), the null of parameter constancy is rejected for most of the predictive horizons.

Dotsey (1998) documents a fall in the in-sample fit of the predictive models for output growth starting from 1985. I show that this result does not carry over to the prediction of the output gap. In particular, regressions estimated on post-1985 data exhibit a pattern of predictability more robust across horizons than models estimated on the pre-1985 period. Moreover, I find that structural instability affects the estimates from both pre- and post-1985 data.

Traditional explanations of the predictive power of the yield spread for output growth emphasize the fact that asset prices incorporate market views on the current stance of monetary policy. As monetary policy becomes tighter, the yield curve flattens and future output falls in the presence of nominal rigidity. The literature on estimated monetary policy rules, instead, identifies a relation of positive sign between policy rates and the output gap in the U.S. (see Clarida, Galí, and Gertler, 2000).

In other words, monetary policy tends to be countercyclical. Including the Federal funds rate among the predictors shows that the yield spread carries information that goes beyond the monetary policy stance. For pre-1985 data, the Fed funds rate is a statistically-significant variable. Somewhat surprisingly though, it has no explanatory power in the post-1985 subsample. In opposition to the standard wisdom, the sign of the estimated coefficients on the Fed funds rate is negative.

This paper is organized as follows. Section 2 describes the dataset. Section 3 discusses the model estimates and the results from the tests for out-of-sample predictability. Section 4 discusses the issues of parameter instability. Section 5 investigates the role of monetary policy for the predictability of the output gap. Section 6 presents some concluding remarks.

2. PRELIMINARIES

I use quarterly data obtained from the FREDII online database of the Federal Reserve Bank of St. Louis. The original source for the series of potential output is the Congressional Budget Office. The sample spans from the first quarter of 1954 to the second quarter of 2004 and includes 202 observations. The yield spread is computed as the difference between the 10-year yield and the 3-month yield on constant-maturity Treasury bonds.[1] The output gap is the percentage difference between current output and potential.

In the following section, I compute encompassing tests for out-of-sample predictability. These tests cannot be applied to nonstationary data (see Kilian, 1999). Figure 1 shows that there is persistence in the series. In order to investigate the issue of stationarity, I apply the variants of the tests of Dickey and Fuller (1979) and Phillips and Perron (1988) proposed by Perron and Ng (1996, 2001) for the null of a unit root.

[1] I have also estimated the predictive models with an alternative measure of the yield spread computed as the difference between the constant-maturity interest rate on 5-year government bonds and the yield on Treasury bills. The results are unchanged.

These tests retain good small-sample properties. Table 1 shows that the null of a unit root is rejected for all the tests. Hence, the series can be considered stationary, and there is no need for taking first differences before evaluating the out-of-sample predictability.

3. MAIN RESULTS

The model is a standard OLS regression of the output gap h quarters ahead on the current yield spread:

$$gap_{t+h} = \alpha + \beta sp_t + \epsilon_{t+h} \tag{1}$$

where gap_t and sp_t denote, respectively, the output gap and the yield spread. The standard errors are estimated through the autocorrelation-consistent covariance estimator proposed by Newey and West (1987) with 12 lags. The predictive ability of the yield spread is examined through the t-statistic on the estimated coefficient $\hat{\beta}$. Over the full sample, the predictive relationship is statistically significant at standard confidence levels only up to 3 quarters ahead (see Table II). The significant slope estimates have a negative sign. A justification for this result is hard to uncover.

The existing theories on the predictive power of the yield spread for output growth suggest that the slope of the yield curve embodies market views on current monetary policy. A tight monetary policy raises real short-term interest rates in the presence of nominal price rigidity. The opportunity cost of real investment rises, thus making future output fall. Since the long-term rates are unchanged, the yield curve flattens (see Estrella and Hardouvelis, 1991). We can safely assume that potential output is not affected by the cyclical course of monetary policy.[2] As a result, the gap between current and potential output widens — or falls — depending on potential output being higher — or lower — than current output before the policy change. However the second panel of figure 1 shows that the prevailing sign of the output gap is negative over the full postwar sample. This suggests that the conventional wisdom on the sources of the predictive power of the yield spread falls short of evidence here.[3]

The subsequent question of interest is whether the estimated models for the full sample are affected by parameter instability. The first part of Table III reports the results from a battery of tests for a one-time structural break, namely the tests of Andrews (1993), Andrews and Ploberger (1993) and Nyblom (1989). The null is that of parameter stability. The low p-values for most of the predictive horizons suggest the models suffer from structural instability.

The second part of Table III includes the results from a set of optimal tests for parameter stability and no predictive content proposed by Rossi (2005), namely the optimal Exponential Wald test, the optimal Mean Wald test, and the optimal Nyblom test (each denoted by a star). These tests are suitable for model selection between two nested models in the presence of underlying parameter instability. The low p-values support the case for time-varying predictability of the output gap.

Finally I investigate whether the estimated models are able to predict out-of-sample. I compute the tests for forecasting comparisons of nested models proposed by Clark and McCracken (2001). Like in Stock and Watson (2003), the nested model postulates that the output gap is unpredictable — i.e. it follows a random walk with $\hat{\alpha} = \hat{\beta} = 0$. The forecast-encompassing tests are applied to split-sample, recursive and rolling forecasts. In the case of the split sample, the model parameters are estimated on a fraction of data and kept constant throughout the forecasting process. For the recursive tests, the parameter estimates are updated on an expanding window that includes all the available observations from the beginning of the sample. Tests on rolling windows are instead based on estimates that use only the most recent observations. The

[2]This assumption finds support in the long-term determinants that are traditionally identified for potential output, namely demographic trends, productivity growth and labour utilisation rates.

[3]The finding of a slope sign not grounded on the available theories is not uncommon in the literature on the predictability of the yield spread. For instance Zagaglia (2006) provides evidence of a negative long-run relation between the yield spread and future output growth.

estimation is initialized on the first half of the sample. The null hypothesis is that the nested and non-nested model have equal predictive ability. Since there is strong evidence in favour of parameter instability, my comments focus on the forecast-encompassing tests based on rolling-window estimates.[4] The last row of table IV shows that, although not statistically reliable at all the horizons, the predictive models are able to forecast out-of-sample.

4. THE ISSUE OF PARAMETER STABILITY

The tests for paramater constancy bring up the issue of the nature of the breakdown in the predictive relation. Dotsey (1998) and Haubrich and Dombrosky (1996) report evidence of a fall in the predictive power of the term spread for output growth after 1985. Giacomini and Rossi (2005) show that also the predictive models for output growth are characterized by structural instability. Their findings indicate that the Seventies and the Eighties are characterized by a predictability breakdown. Here I investigate whether the source of parameter instability consists in the loss of predictive power after 1985.

Table V shows that this is not the case. The predictive relation for the post-1985 period is statistically significant from 1 to 10 quarters ahead, and appears as a feature more robust than for the pre-1980 subsample. Interestingly, the estimates for the slope are positive from 7 to 10 quarters ahead. This finding can be reconciled with both the theoretical predictions and the stylized facts outlined earlier.

The models estimated on each subsample are still affected by parameter instability (see Table VI). There is clear evidence against the proposition that the output gap is unpredictable in the subsamples, and that the lack of predictability is constant through time. This confirms that the lack of parameter constancy is due to factors other than a loss of statistical significance in the slope of the predictive model. Finally Table VII indicates that, differently from the case of predictability for output growth, the models estimated on pre-1985 data are unable to forecast the output gap out-of-sample.

5. THE ROLE OF MONETARY POLICY

The conventional wisdom on the predictive power of the yield spread for output growth suggests that the slope the yield curve embodies market views on monetary policy actions and on its consequences on future output (see Estrella and Hardouvelis, 1991). In order to gain insight into the sources of predictability, I study whether indicators of monetary policy exhaust the explanatory power of the yield spread for future output gaps. Following Estrella and Hardouvelis (1991), I include the Federal funds rate among the predictive variables, and check whether the estimated coefficient $\hat{\beta}$ on the yield spread is statistically significant. The model becomes:

$$gap_{t+h} = \alpha + \beta sp_t + \gamma ffr_t + \epsilon_{t+h} \tag{2}$$

where ffr_t is the nominal federal funds rate. Table VIII suggests that the predictive power of the yield spread over the full sample is due to factors different from the expected course of monetary policy. The sign of the estimated coefficient on the yield spread is negative like in the models without the Fed funds rate. The empirical studies on monetary policy rules show that policy rates are countercyclical (e.g. see Clarida, Galí, and Gertler, 2000). Hence it is natural to expect a positive coefficient on the output gap. However, the predictive models discussed here report a negative relation between the Federal funds rate and future output growth.

Estimating the regressions on pre- and post-1985 data reveals interesting features of the data. For the pre-1985 subsample, the slope estimates in the models without the Fed funds rate have the expected positive sign from 7 to 10 quarters ahead (see Table V). Table IX indicates that the inclusion of the Fed funds rate

[4] I do not report the results from the tests of Diebold and Mariano (1995) since these tests do not apply to comparisons between nested models.

wipes away the predictive content of the yield spread at these horizons. For the post-1985 period, the current stance of monetary policy is uninformative for the prediction of the output gap. It should be noted that the interaction between the yield spread and the Fed funds rate makes the predictability disappear from 5 to 10 quarters ahead.

6. CONCLUSION

This paper considers the issue of whether the yield spread predicts future output gaps in the U.S. economy. The results indicate that the yield spread retains predictive power only at short horizons, namely from 1 to 3 quarters. There is evidence of parameter instability over the full post-World War II sample. However this is not due to the type of forecast breakdown after 1985 that Dotsey (1998) advocates for the prediction of output growth. In fact the predictive relation estimated on post-1985 data is statistically significant for a range of horizons larger than for the pre-1985 period. Finally, differently from what the conventional wisdom postulates, I show that monetary policy plays no statistically-significant role in the predictive model estimated on post-1985 data.

These results open some fruitful avenues for future research. It would be interesting to check if alternative asset prices, such as returns, retain predictive power for the output gap. More important, one should investigate the reasons for predictability in the post-1985 period to be more robust than in the pre-1985 period.

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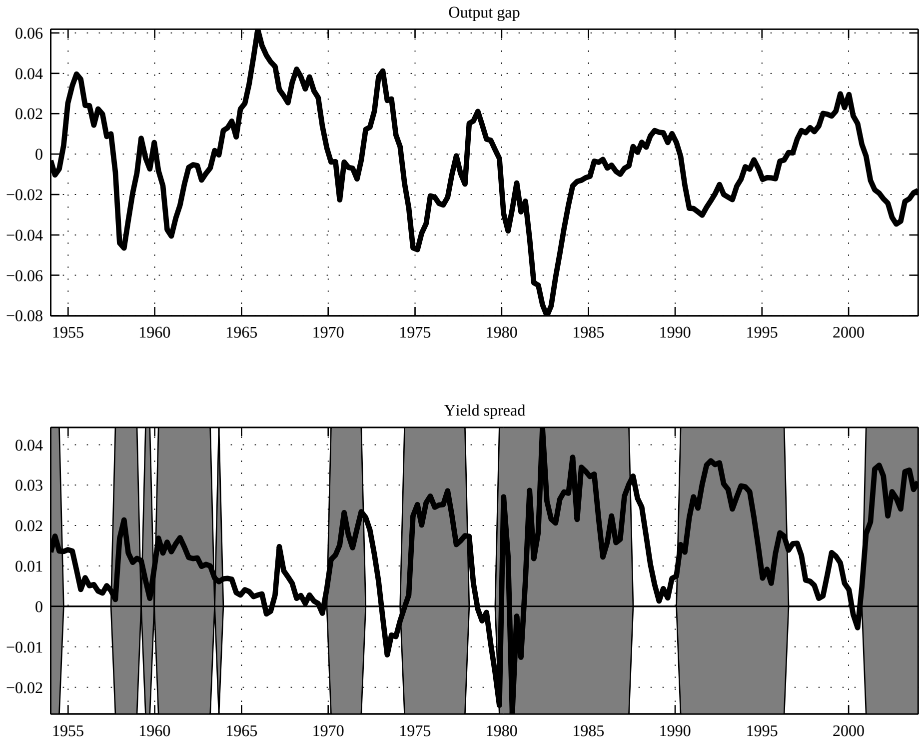

FIGURE 1—: Plots of the series

Legend: Shaded areas denote quarters with output below potential.

TABLE 1: Unit-root tests for the full sample

	Output gap	Yield spread
GLS detrending		
Phillips-Perron	-25.40*	-44.55*
Modified Phillips-Perron Mza	-24.96*	-39.60*
Modified Phillips-Perron Mzt	-3.53*	-4.42*
Modified Sargan-Bhargava	0.14*	0.11*
Point-optimal test	3.65*	2.43*
Modified point-optimal test	3.66*	2.41*
Augmented Dickey-Fuller	-3.59*	-4.98*
OLS detrending		
Phillips-Perron	-26.12*	-60.64*
Modified Phillips-Perron Mza	-25.59*	-54.83*
Said-Dickey-Fuller	-3.67*	-4.68*

Legend: Auxiliary models include both a constant and a trend. For all the tests, the null is that of one unit root. The Phillips-Perron test is from Phillips and Perron (1988), the modified Phillips-Perron are all outlined in Perron and Ng (1996), the point-optimal test is from Elliott and Stock (1996) and is amended in Perron and Ng (2001) together with Sargan and Bhargava (1983)'s test. The distinction between GLS and OLS detrending can be found in Perron and Ng (2001). All the tests: * significant at the 5% level.

TABLE II:
PREDICTIVE MODELS FOR THE FULL SAMPLE

	$h=1$	$h=2$	$h=3$	$h=4$	$h=5$	$h=6$
$\hat{\alpha}$	0.010 [1.436]	0.006 [0.783]	0.003 [0.325]	0.001 [−0.052]	−0.003 [−0.402]	−0.005 [−0.618]
$\hat{\beta}$	−0.956 [−3.516]	−0.669 [−2.218]	−0.429 [−1.369]	−0.213 [−0.663]	0.001 [0.003]	0.128 [0.377]
R^2	0.209	0.102	0.041	0.01	0	0.004

	$h=7$	$h=8$	$h=9$	$h=10$	$h=11$	$h=12$
$\hat{\alpha}$	−0.01 [−0.83]	−0.01 [−0.96]	−0.01 [−1.01]	−0.01 [−1.01]	−0.01 [−0.99]	−0.01 [−0.98]
$\hat{\beta}$	0.001 [0.003]	0.128 [0.377]	0.35 [1.07]	0.34 [1.04]	0.32 [0.97]	0.30 [0.91]
R^2	0	0.004	0.03	0.03	0.02	0.02

Legend: Square brackets indicate t-values.

TABLE III:
PARAMETER STABILITY TESTS FOR THE FULL SAMPLE

Statistic	Predictive horizon											
	1	2	3	4	5	6	7	8	9	10	11	12
QLR	35.55	31.74	33.47	39.37	45.81	47.78	50.18	49.96	50.78	53.37	57.21	54.32
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exp-W	13.94	12.02	13.05	16.16	19.59	20.26	21.21	21.09	21.69	23.27	25.65	24.30
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nyblom	2.23	2.07	2.54	3.34	4.11	4.31	4.44	4.17	3.82	3.77	4.01	3.76
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exp-W*	83.08	61.74	45.26	32.71	26.48	23.40	26.05	28.36	33.02	36.18	34.91	31.84
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean-W*	99.78	65.33	45.96	35.22	31.33	29.14	29.32	29.36	29.46	30.09	29.67	28.24
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nyblom*	11.58	5.49	2.86	1.79	1.84	2.16	2.54	2.65	2.49	2.30	2.18	2.19
p-value	0.00	0.00	0.10	0.30	0.28	0.20	0.14	0.12	0.14	0.18	0.20	0.20
QLR*	173.90	131.08	97.59	72.03	60.11	54.18	59.76	64.29	73.31	79.17	75.99	69.72
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Legend: This table reports the test statistics and p-values for series of tests for a one-time structural break: the tests of Andrews (1993), labeled QLR, Andrews and Ploberger (1993), labeled Exp-W and Mean-W, and Nyblom (1989), labeled Nyblom.

TABLE IV:
OUT-OF-SAMPLE PREDICTABILITY TESTS FOR THE FULL SAMPLE

Statistic	Predictive horizon											
	1	2	3	4	5	6	7	8	9	10	11	12
Split	47.45*	8.62*	-8.95	-16.21	-13.75	-8.12	-1.39	3.66**	-2.34	-8.73	-14.54	-18.25
Recursive	56.47*	9.85*	-4.19	-7.58	-0.31	11.27*	19.93*	30.19*	19.47*	11.38*	9.37*	6.09*
Rolling	68.51*	17.99*	2.61***	-1.82	4.24**	13.77*	19.81*	25.40*	15.97*	7.78*	6.46*	4.10**

Legend: This table reports the test statistics and p-values for out-of-sample relative forecast comparisons discussed by Clark and McCracken (2001). **Significant at the 5% level. ***Significant at the 10% level.

TABLE V:
PREDICTIVE MODELS FOR THE PRE- AND POST-1980 SUBSAMPLES

	Pre-1985					
	$h=1$	$h=2$	$h=3$	$h=4$	$h=5$	$h=6$
$\hat{\alpha}$	0.008 [1.01]	0.004 [0.47]	0.0008 [0.08]	−0.002 [−0.24]	−0.005 [−0.56]	−0.007 [−0.73]
$\hat{\beta}$	−1.01 [−2.72]	−0.62 [−1.53]	−0.28 [−0.71]	0.006 [0.02]	0.30 [0.72]	0.44 [1.12]
R^2	0.17	0.06	0.01	0	0.01	0.02
	$h=7$	$h=8$	$h=9$	$h=10$	$h=11$	$h=12$
$\hat{\alpha}$	−0.009 [−0.90]	−0.01 [−0.99]	−0.009 [−0.96]	−0.009 [−0.88]	−0.008 [−0.81]	−0.008 [−0.77]
$\hat{\beta}$	0.59 [1.58]	0.66 [1.82]	0.61 [1.73]	0.53 [1.43]	0.45 [1.13]	0.40 [0.95]
R^2	0.05	0.06	0.05	0.04	0.03	0.02

	Post-1985					
	$h=1$	$h=2$	$h=3$	$h=4$	$h=5$	$h=6$
$\hat{\alpha}$	0.02 [1.84]	0.02 [1.79]	0.02 [1.69]	0.02 [1.64]	0.02 [1.57]	0.02 [1.64]
$\hat{\beta}$	−0.96 [−1.70]	−0.96 [−1.62]	−0.90 [−1.48]	−0.84 [−1.43]	−0.73 [−1.43]	−0.71 [−1.72]
R^2	0.18	0.18	0.16	0.13	0.1	0.09
	$h=7$	$h=8$	$h=9$	$h=10$	$h=11$	$h=12$
$\hat{\alpha}$	0.02 [1.69]	0.01 [1.59]	0.01 [1.48]	0.01 [1.32]	0.01 [1.09]	0.009 [0.70]
$\hat{\beta}$	−0.71 [−2.16]	−0.70 [−2.17]	−0.71 [−1.95]	−0.65 [−1.63]	−0.49 [−1.18]	−0.17 [−0.45]
R^2	0.09	0.09	0.09	0.07	0.04	0.005

Legend: The pre-1985 subsample goes from the first quarter of 1954 to the fourth quarter of 1985. Square brackets indicate t-values.

TABLE VI:
PARAMETER STABILITY TESTS FOR PRE- AND POST-1985 SUBSAMPLES

Statistic	Predictive horizon											
	1	2	3	4	5	6	7	8	9	10	11	12
	Pre-1985 subsample											
QLR	84.70	78.42	61.35	57.01	83.97	63.39	67.24	70.46	74.18	76.18	76.28	67.70
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exp-W	37.91	34.75	26.54	25.44	37.54	28.30	30.13	31.88	33.84	34.91	35.17	30.96
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nyblom	5.81	5.20	5.12	5.28	5.84	6.09	6.53	6.96	7.62	8.24	8.34	7.14
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exp-W*	43.93	39.50	29.03	27.08	49.48	36.87	50.02	64.09	96.86	88.74	48.35	36.47
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean-W*	52.68	32.88	26.63	27.04	33.98	37.92	49.86	66.04	88.69	83.41	57.13	43.15
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nyblom*	6.10	3.10	1.87	1.49	1.67	1.80	1.87	1.74	1.46	1.23	1.16	1.15
p-value	0.00	0.08	0.28	0.39	0.33	0.29	0.27	0.31	0.41	0.50	0.54	0.54
QLR*	96.60	87.92	66.80	60.30	107.84	81.20	107.32	134.89	202.53	186.28	101.93	78.53
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Post-1985 subsample											
QLR	78.35	98.56	93.93	97.16	109.31	105.14	91.46	91.46	102.08	66.11	56.53	50.56
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exp-W	35.24	45.36	43.06	45.32	51.00	49.06	42.65	42.01	47.22	29.28	25.18	21.54
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nyblom	2.89	3.39	3.77	4.70	6.13	6.49	6.19	5.05	4.33	2.86	2.59	2.71
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exp-W*	171.45	113.18	189.75	212.90	277.71	127.45	96.71	130.02	313.34	307.78	300.07	90.34
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean-W*	136.63	106.08	89.67	90.06	82.29	69.76	67.85	66.71	79.71	74.74	81.26	45.24
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nyblom*	7.46	6.03	4.51	3.37	2.72	2.39	2.21	2.19	2.15	2.23	2.36	2.72
p-value	0.00	0.00	0.02	0.06	0.12	0.16	0.19	0.20	0.20	0.19	0.16	0.12
QLR*	350.77	234.19	387.31	433.56	563.17	261.77	201.08	267.70	634.32	623.17	607.72	187.14
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Legend: This table reports the test statistics and p-values for series of tests for a one-time structural break: the tests of Andrews (1993), labeled QLR, Andrews and Ploberger (1993), labeled Exp-W and Mean-W, and Nyblom (1989), labeled Nyblom.

TABLE VII:
OUT-OF-SAMPLE PREDICTABILITY TESTS FOR PRE- AND POST-1985 SUBSAMPLES

Statistic	Predictive horizon											
	1	2	3	4	5	6	7	8	9	10	11	12
	Pre-1985 subsample											
Split	9.60	0.01	-7.57	-13.06	-16.19	-17.41	-17.65	-17.75	-16.33	-14.87	-14.88	-15.90
Recursive	32.88	0.77	-7.11	-7.00	-0.30	7.71	12.86	16.95	8.22	3.95	4.10	3.80
Rolling	29.22	0.57	-6.20	-4.99	2.78	13.88	17.54	24.31	14.55	13.57	17.48	20.30
	Post-1985 subsample											
Split	65.37*	37.38*	22.40*	7.99*	-1.53	-5.21	-4.93	-3.59	-1.44	0.07	1.07	0.82
Recursive	119.41*	81.28*	65.77*	53.57*	29.08*	8.56*	-1.36	-3.95	-2.28	0.43	1.93***	1.61***
Rolling	102.55*	62.60*	34.92*	19.43*	6.01*	-2.17	-9.53	-13.84	-18.91	-20.87	-20.40	-16.59

Legend: This table reports the test statistics and p-values for out-of-sample relative forecast comparisons discussed by Clark and McCracken (2001). **Significant at the 5% level. ***Significant at the 10% level.

TABLE VIII:
PREDICTIVE MODELS WITH THE FEDERAL FUNDS RATE, FULL SAMPLE

	$h=1$	$h=2$	$h=3$	$h=4$	$h=5$	$h=6$
$\hat{\alpha}$	0.03 [2.84]	0.03 [2.65]	0.02 [2.45]	0.02 [2.23]	0.02 [1.98]	0.02 [1.79]
$\hat{\beta}$	-1.21 [-4.71]	-0.96 [-3.52]	-0.74 [-2.61]	-0.53 [-1.81]	-0.32 [-1.04]	-0.18 [-0.60]
$\hat{\gamma}$	-0.30 [-2.38]	-0.35 [-2.72]	-0.38 [-2.95]	-0.40 [-3.10]	-0.41 [-3.22]	-0.41 [-3.26]
R^2	0.35	0.3	0.27	0.27	0.27	0.27
	$h=7$	$h=8$	$h=9$	$h=10$	$h=11$	$h=12$
$\hat{\alpha}$	0.01 [1.56]	0.01 [1.36]	0.01 [1.18]	0.01 [1.01]	0.01 [0.82]	0.008 [0.65]
$\hat{\beta}$	-0.03 [-0.12]	0.05 [0.19]	0.10 [0.37]	0.12 [0.44]	0.13 [0.49]	0.13 [0.49]
$\hat{\gamma}$	-0.39 [-3.21]	-0.37 [-3.07]	-0.35 [-2.82]	-0.31 [-2.48]	-0.27 [-2.13]	-0.24 [-1.84]
R^2	0.26	0.25	0.22	0.18	0.15	0.12

Legend: Square brackets indicate t-values.

TABLE IX:
PREDICTIVE MODELS FOR THE PRE- AND POST-1980 SUBSAMPLES

	Pre-1985					
	$h=1$	$h=2$	$h=3$	$h=4$	$h=5$	$h=6$
$\hat{\alpha}$	0.03 [2.73]	0.03 [2.55]	0.03 [2.35]	0.03 [2.12]	0.02 [1.85]	0.02 [1.68]
$\hat{\beta}$	−1.23 [−4.05]	−0.89 [−3.04]	−0.61 [−2.12]	−0.36 [−1.23]	−0.10 [−0.34]	0.01 [0.05]
$\hat{\gamma}$	−0.35 [−2.91]	−0.42 [−3.39]	−0.45 [−3.66]	−0.47 [−3.80]	−0.47 [−3.82]	−0.47 [−3.79]
R^2	0.38	0.35	0.35	0.37	0.39	0.39
	$h=7$	$h=8$	$h=9$	$h=10$	$h=11$	$h=12$
$\hat{\alpha}$	0.02 [1.46]	0.01 [1.26]	0.01 [1.14]	0.01 [1.01]	0.01 [0.86]	0.01 [0.71]
$\hat{\beta}$	0.13 [0.42]	0.21 [0.67]	0.17 [0.57]	0.10 [0.33]	0.06 [0.20]	0.05 [0.16]
$\hat{\gamma}$	−0.45 [−3.55]	−0.41 [−3.22]	−0.38 [−2.83]	−0.34 [−2.41]	−0.30 [−2.05]	−0.26 [−1.77]
R^2	0.37	0.33	0.28	0.22	0.16	0.13

	Post-1985					
	$h=1$	$h=2$	$h=3$	$h=4$	$h=5$	$h=6$
$\hat{\alpha}$	0.004 [0.28]	0.003 [0.19]	0.003 [0.16]	0.003 [0.13]	0.002 [0.11]	0.002 [0.09]
$\hat{\beta}$	−0.85 [−2.39]	−0.75 [−1.96]	−0.67 [−1.63]	−0.58 [−1.29]	−0.46 [−0.94]	−0.33 [−0.63]
$\hat{\gamma}$	0.11 [0.69]	0.10 [0.48]	0.07 [0.30]	0.04 [0.16]	0.01 [0.03]	−0.02 [−0.08]
R^2	0.47	0.35	0.25	0.17	0.09	0.04
	$h=7$	$h=8$	$h=9$	$h=10$	$h=11$	$h=12$
$\hat{\alpha}$	0.002 [0.07]	0.004 [0.14]	0.004 [0.15]	0.006 [0.23]	0.007 [0.32]	0.01 [0.44]
$\hat{\beta}$	−0.19 [−0.36]	−0.12 [−0.22]	−0.007 [−0.01]	0.05 [0.12]	0.09 [0.20]	0.04 [0.09]
$\hat{\gamma}$	−0.06 [−0.19]	−0.12 [−0.38]	−0.15 [−0.52]	−0.21 [−0.73]	−0.25 [−0.93]	−0.29 [−1.12]
R^2	0.01	0.01	0.02	0.05	0.07	0.08

Legend: The pre-1985 subsample goes from the first quarter of 1954 to the fourth quarter of 1985. Square brackets indicate t-values.