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Monetary Tightening Cycles and the
Predictability of Economic Activity

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Abstract

Eleven of fourteen monetary tightening cycles since 1955 were followed by increases in unemployment; three were not. The term spread at the end of these cycles discriminates almost perfectly between subsequent outcomes, but levels of nominal or real interest rates, as well as other interest rate spreads, generally do not.

Key words: monetary policy, interest rates, term structure, discriminant analysis, logit

1   Classifying monetary tightening cycles

The extent to which real activity slows after monetary tightening is difficult to gauge in real time. In this article, we investigate the ability of financial indicators to discriminate between tightening cycles that are followed by declining real activity and those that are not. We investigate the forecasting power of the term spread, levels of nominal and real federal funds rates, the difference between the real federal funds rate and its long-run equilibrium value, and the spread between commercial paper and Treasury bill rates.

We consider tightening cycles since 1955 and assume a cycle ends when either one of these criteria is met: (1) the federal funds rate is higher than at any time from 12 months before to 9 months after and is at least 50 basis points higher than at the beginning of this period, or (2) the federal funds rate is higher than at any time from 6 months before to 6 months after and is 150 basis points higher than the average at these endpoints. The first criterion by itself identifies most of the cycles, but misses three (Aug. 1971, Sept. 1973, Apr. 1980) that involve quick substantial increases in the funds rate. Two of these three were followed by recessions.

Identifying the end of the most recent cycle presents an empirical challenge in that the fed funds rate was held at a nearly constant level for over thirteen months.[1] This unprecedented policy pattern led to a very narrow range of 5.24 to 5.26% for the monthly average fed funds rate from July 2006 to July 2007. The strict inequality embodied in the first criterion rules out all candidates in this period. However, if we allow for the end of the tightening cycle to occur when the fed funds rate is at the peak target level of 5.25% or above, the first criterion selects the four observations from August to November 2006. We identify September 2006 specifically as the

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[1] The FOMC raised the target fed funds rate by 25 basis points on June 29, 2006 and lowered the target by 50 basis points on September 18, 2007.

end of the tightening cycle because during that month the one-month fed futures rate went from higher than the spot rate to lower.[2]

The application of the foregoing principles leads to reasonable results, as shown in Figure 1. The ends of cycles (fourteen altogether) are indicated by vertical lines and NBER recessions by shading.

Our dating of the ends of monetary cycles agrees by and large with the chronology of the beginnings of tightening cycles in Romer and Romer (1989), although we tend to identify more cycles. Each Romer date within our sample period is followed directly by a cycle end date, with the lone exception corresponding to two consecutive Romer dates (Aug. 1978 and Oct. 1979) between which the monthly average federal funds rate did not fall.

2   Forecasting real activity at the end of tightening cycles

Is it possible to anticipate the evolution of real activity following the endings of tightening cycles? We investigate the forecasting ability of five financial indicators. The level of the nominal federal funds rate as a measure of monetary policy stance is proposed by Bernanke and Blinder (1992) and Bernanke and Mihov (1998), who examine its usefulness in an identified VAR framework. Laubach and Williams (2003) propose the gap between the current real interest rate and the natural rate of interest as measure of monetary tightness.

We use three alternative measures of the real federal funds rate: adjusted by CPI inflation over the last 12 months, adjusted by expected core PCE inflation, and the gap between the latter and the Laubach-Williams equilibrium real rate. We follow Laubach and Williams (2003) in

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[2] We are grateful to Jeff Fuhrer for this suggestion. Experience with the most recent cycle suggests that the first criterion (or perhaps both) would be more generally applicable if supplemented with information about fed funds targets and futures.

estimating PCE inflation expectations as the one-year-ahead percentage change predicted from an autoregressive model that is fitted to data over the previous 10 years on a rolling basis.[3] We use the equilibrium real rate from Laubach and William (2003), who estimate it together with the natural rate of output and its trend growth rate in a three-equation macro model.

We also examine the spread between the 10-year constant maturity Treasury rate and the bond-equivalent secondary market rate on 3-month Treasuries, which Estrella and Hardouvelis (1991) and others have shown forecasts recessions well, and the spread between commercial paper and Treasury bill rates, as in Friedman and Kuttner (1998). All interest rates are monthly averages of daily data.

We use two measures of subsequent real activity: conventional NBER turning points and the maximum cumulative increase in the unemployment rate. The unemployment rate measure avoids the implicit discretion in the NBER dating, relying instead on a mechanical rule. Each measure is converted into a dummy by asking whether a recession ensued within 24 months of the end of the tightening cycle, or whether the unemployment rate increased over the same period.[4]

In Table 1, we list the end dates of tightening cycles and the values of our financial and real indicators.[5] Of the fourteen cycles, only three did not lead to an increase in unemployment:

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[3] Laubach and Williams (2003) use an AR(3) model with quarterly data, whereas we use monthly data here. Thus, we forecast inflation over the following 12 months with lags from one through nine of the one-month inflation rate.

[4] The 24-month horizon allows for a predictive lead for the indicator variable, which has been found to be about one year for the term spread, and the length of an economic downturn, which is typically close to a year or longer.

[5] Data availability precludes calculation of the first observation for some indicators, and of the first two and the last observations for the federal funds rate gap.

Aug. 1971, Aug. 1984, and Apr. 1995. The other ten were followed by an increase in

unemployment and, with one exception, by an NBER-dated recession. The only discrepancy

between the unemployment and NBER indicators is after Nov. 1966, a period that has been

called a credit crunch or a mini-recession by many and an actual recession by Friedman (1968).

In Figure 2, we plot the (maximal) increase in the unemployment rate after each

monetary peak against the term spread in the month of the peak. An intriguing pattern emerges.

The three peaks that were not followed by an increase in unemployment were accompanied by a

term spread of 125 basis points or more. The remaining eleven fed funds peaks were

accompanied by a term spread below 35 basis points at the time of the policy reversal. It is

visually clear that the term spread correctly discriminates between positive and negative values

of the unemployment measure in all cases.

In Figure 3, we plot the relationships between four other interest rates measures at the end

of tightening cycles and subsequent changes in unemployment. This figure clearly suggests that

none of the other financial indicators is helpful in classifying the response of real activity to

monetary policy tightening. To confirm this result, however, we apply two formal statistical

techniques.

3   Statistical analysis

Discriminant analysis is a natural method for our problem. We would like to use a

financial indicator x_i (where i runs over the $n = 14$ ends of tightening cycles) to classify the

cases into one of two "populations," one in which real activity slows down and one in which it

does not. Let $y_i \in \{0,1\}$ be an indicator of an economic slowdown, based on either NBER dates

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or the rise in unemployment. Discriminant analysis provides a rule of the form: classify an observation as $y_i = 1$ if $f(x_i) > 0$ and otherwise as $y_i = 0$.

When x is a vector of indicators, the sample discriminant function is

$$f(x) = \log\left(\hat{\pi}_1/\hat{\pi}_0\right) - 1/2\left(\hat{\mu}_1'\hat{\Sigma}^{-1}\hat{\mu}_1 - \hat{\mu}_0'\hat{\Sigma}^{-1}\hat{\mu}_0\right) + \left(\hat{\mu}_1 - \hat{\mu}_0\right)'\hat{\Sigma}^{-1}x, \tag{1}$$

where $\hat{\pi}_j$ is the sample frequency of $y_i = j$, $\hat{\mu}_j$ is the sample mean of x_i conditional on $y_i = j$, and

$$\hat{\Sigma} = \frac{1}{n-2}\left[\sum_{y_i=1}\left(x_i - \hat{\mu}_1\right)\left(x_i - \hat{\mu}_1\right)' + \sum_{y_i=0}\left(x_i - \hat{\mu}_0\right)\left(x_i - \hat{\mu}_0\right)'\right].$$

Our second measure is based on a logistic regression of the form

$$P\left(y_i = 1\right) = F\left(\hat{\beta}_0 + \hat{\beta}_1 x_i\right), \tag{2}$$

where F is the cumulative logistic distribution. See Efron (1975) for a comparison of the two approaches.

Consider first the case of the term spread, with real activity defined in terms of NBER recessions. The discriminant condition for classifying an end of tightening as a slowdown is $x < 0.78$. Table 1 shows that the only observation not classified correctly is Nov. 1966. The spread also does well when gauged by the logit standard, especially relative to the other indicators, with an R-squared of 55%.

The other five financial indicators fare much worse with discriminant analysis. In most cases, the discriminant condition cannot sort out the differences, classifying all the observations as slowdowns. An exception is the real fed funds gap, which correctly classifies the two early non-recessionary cases but not the two most recent ones. Logit results also point to the term

spread as clearly having the best fit. Among the other indicators, the paper-bill spread performs best.

Results using the change in the unemployment rate over the following 24 months as a measure of real activity are qualitatively similar. The one salient difference is that the term spread has a perfect record using either discriminant or logit analysis. Also, the real fed funds gap, which provided some discriminatory power with regard to NBER dates, classifies all observations based on the unemployment rate as recessions.

The statistical reason for the relative success of the term spread is simple. Its range of values when unemployment subsequently rises is -2.38 to 0.31%, as compared with 1.25 to 1.82% when unemployment declines. Not only is there no overlap, but there is a substantial gap between the two ranges. In contrast, the non-recessionary observations for each of the other variables are interspersed among the recessionary cases, as shown in the four panels of Figure 3.

Note finally that classification rules other than $f(x_i) > 0$ are possible, such as rules that cap the probability of one type of classification error. For instance, when the unemployment indicator is used, the rule that classifies $y = 1$ when the term spread is less than 2 basis points limits the probability of misclassifying an expansion as a recession to 5%. Similarly, the rule that $y = 1$ when the term spread is less than 90 basis points limits the probability of misclassifying a recession as an expansion to 5%.

More generally, there is no guarantee that the future performance of the term spread will match the historical record since 1955. It seems clear from the evidence, however, that its potential usefulness as a leading indicator in periods of monetary tightening should not be overlooked. Moreover, recent evidence shows that the predictive power persisted during the

latest tightening cycle and recession, in spite of various special factors that some thought were

distorting the term structure of interest rates.[6]

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[6] Factors cited included a global savings glut, demand for Treasury securities from Asia and from long-term investors such as pension funds, declining risk premiums, and credit disintermediation.

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Table 1: End of Monetary Tightening Dates and Financial and Real Indicators

End of Tightening Date	Fed Funds Rate	Real Fed Funds Rate (Lagged CPI)	Real Fed Funds Rate (Expected PCE)	Real Fed Funds Gap (Expected PCE)	10-Year / 3-Month Spread	Commercial Paper - Bill Spread	Subsequent Change in Unemployment	NBER Recession Indicator
Oct-57	3.50	0.60	NA	NA	0.31	NA	3.0	1
Nov-59	4.00	2.63	1.59	NA	0.28	-0.04	1.3	1
Nov-66	5.76	2.26	2.25	-2.56	-0.31	0.22	0.4	0
Aug-69	9.19	3.90	4.30	-0.85	-0.51	0.77	2.6	1
Aug-71	5.56	1.29	0.90	-3.05	1.51	0.29	-0.1	0
Sep-73	10.78	3.68	4.68	1.61	-1.50	1.28	4.2	1
Jul-74	12.92	2.00	2.28	-1.59	0.01	3.33	3.5	1
Apr-80	17.61	3.99	8.68	6.13	-2.38	0.96	2.4	1
Jun-81	19.10	9.84	12.30	9.47	-2.04	-0.16	3.3	1
Aug-84	11.64	7.43	6.61	4.07	1.82	-0.21	-0.1	0
Mar-89	9.85	5.07	5.59	2.01	0.21	0.58	1.8	1
Apr-95	6.05	2.97	3.55	2.17	1.25	0.16	-0.1	0
Jul-00	6.54	3.00	4.85	1.87	-0.09	0.38	1.9	1
Sep-06	5.25	3.21	3.20	NA	-0.22	0.28	1.7	1

Notes: All variables are expressed in percent, except for the dichotomous NBER indicator. The real fed funds gap is computed by subtracting from the real PCE-adjusted rate the Laubach-Williams (2003) one-sided estimate of the equilibrium real rate for the quarter in which the monthly observation falls.

Table 2: Statistical Analysis of the Relation between Interest Rates and Real Activity

Measure of Real Activity:	NBER Recessions			Increase in Unemployment Rate		
Indicator	Discriminant condition	Correctly classified	Logit R-Squared	Discriminant condition	Correctly classified	Logit R-Squared
Term Spread	< 0.78	13/14	0.548	< 0.96	14/14	1.000
Fed Funds Rate	> 0.15	10/14	0.071	> -10.02	11/14	0.025
Real Fed Funds Rate (CPI)	> -15.64	10/14	0.003	< 37.31	11/14	0.002
Real Fed Funds Rate (Core PCE)	> 0.23	9/13	0.106	> -5.40	10/13	0.036
Real Fed Funds Gap (PCE)	> -1.77	9/11	0.120	> -14.85	8/11	0.014
Commercial Paper-Bill Spread	> -0.47	9/13	0.252	> -1.07	10/13	0.218

Note: Discriminant conditions are expressed in percent. Logit R-squared is the Estrella (1998) measure of fit.

Figure 1: The Fed Funds Rate, Ends of Tightening Cycles (grid), and
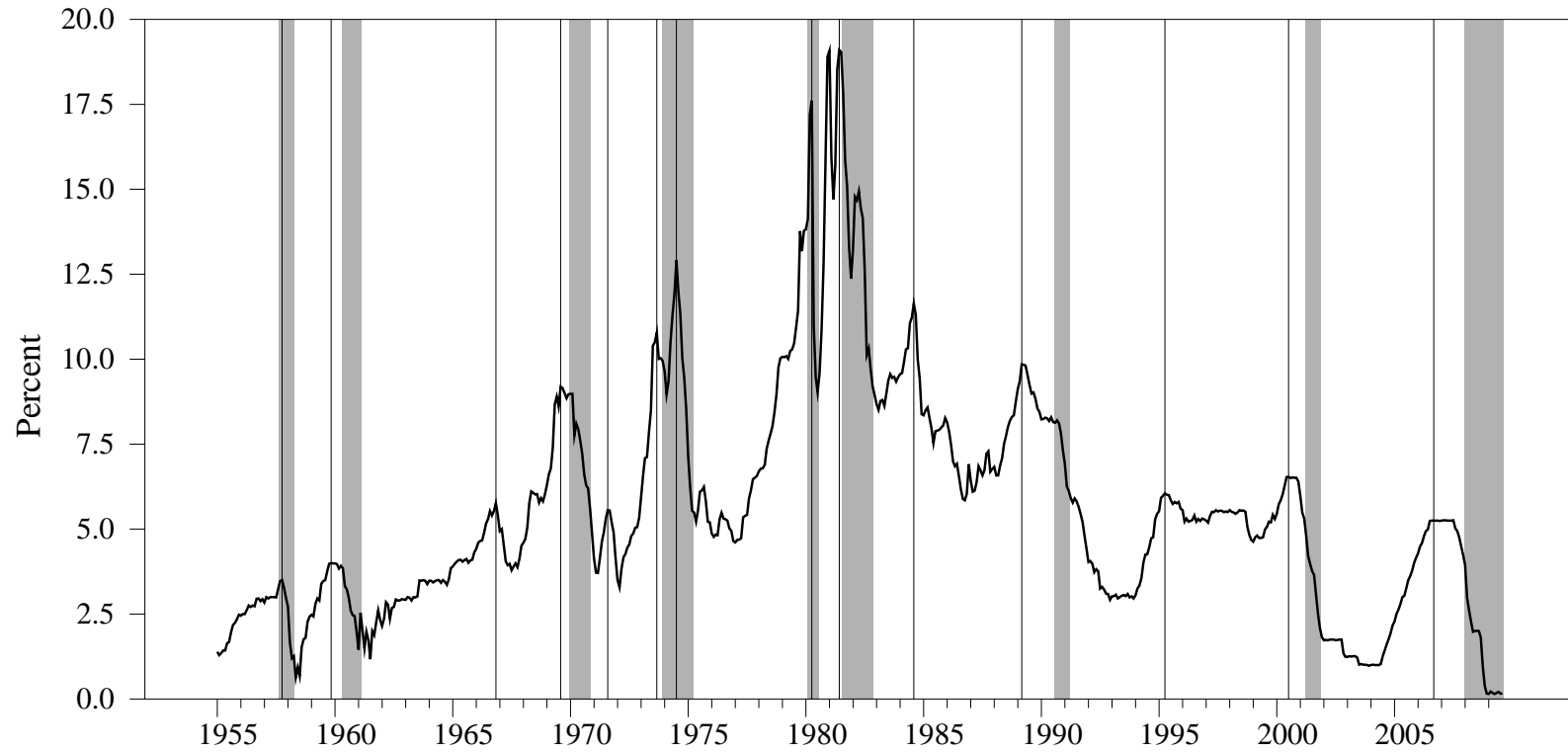
NBER Recessions (shading)

Figure 2: The 10-year minus 3-month spread and subsequent unemployment increases
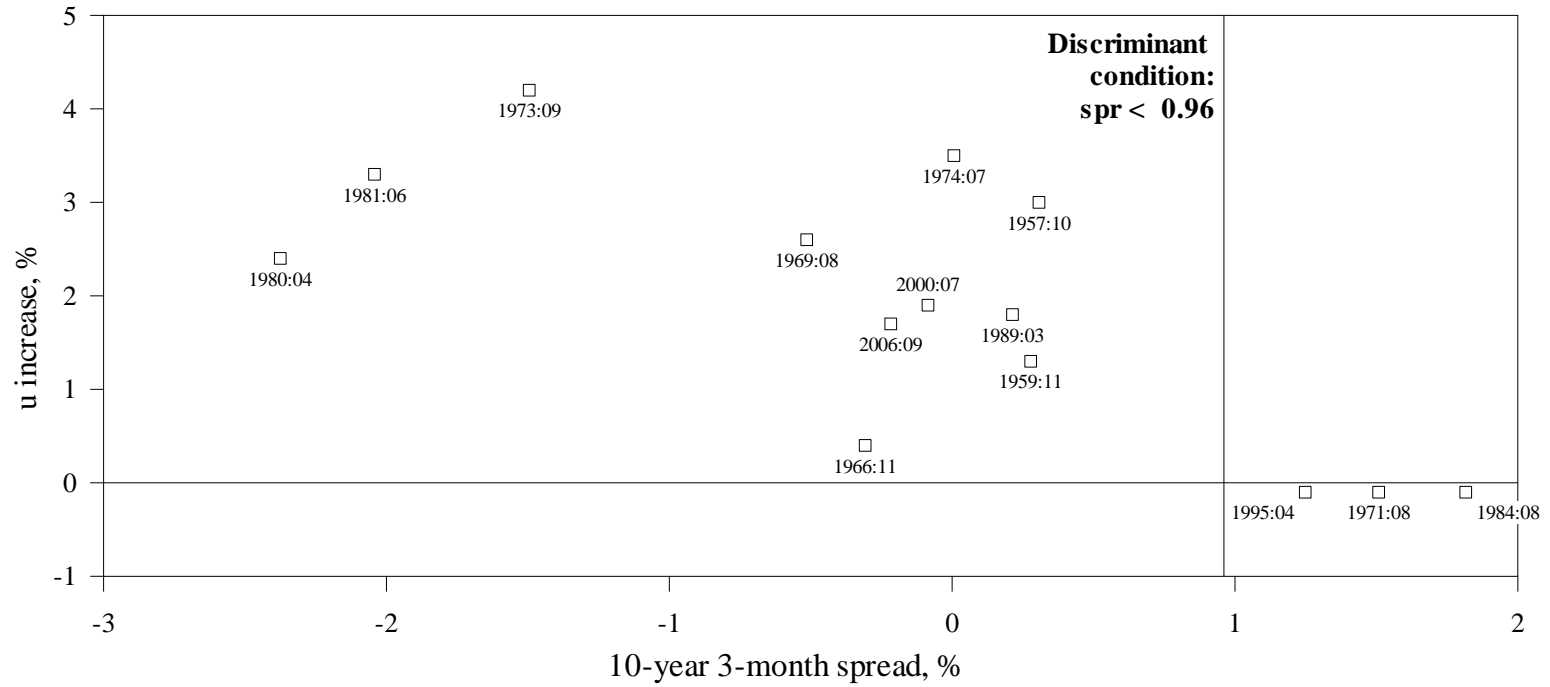
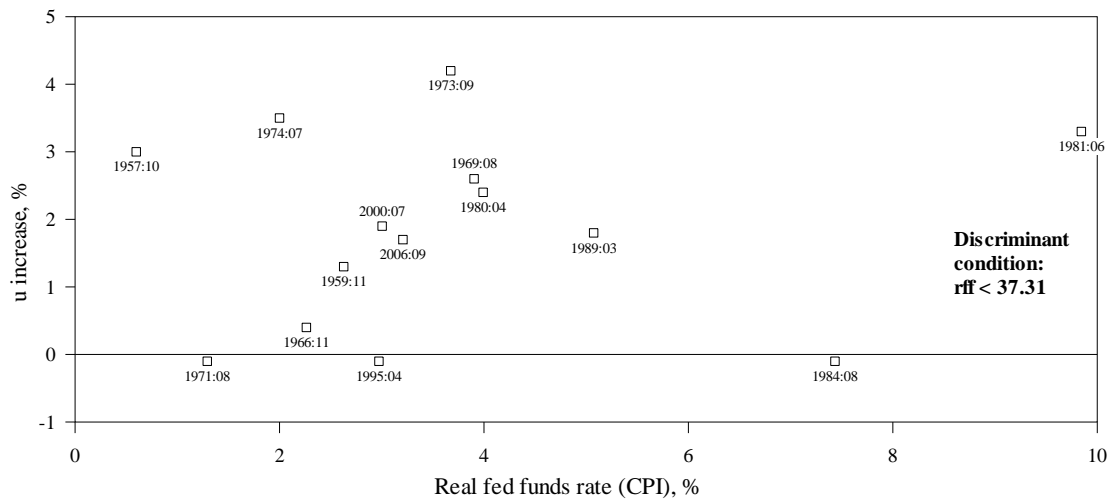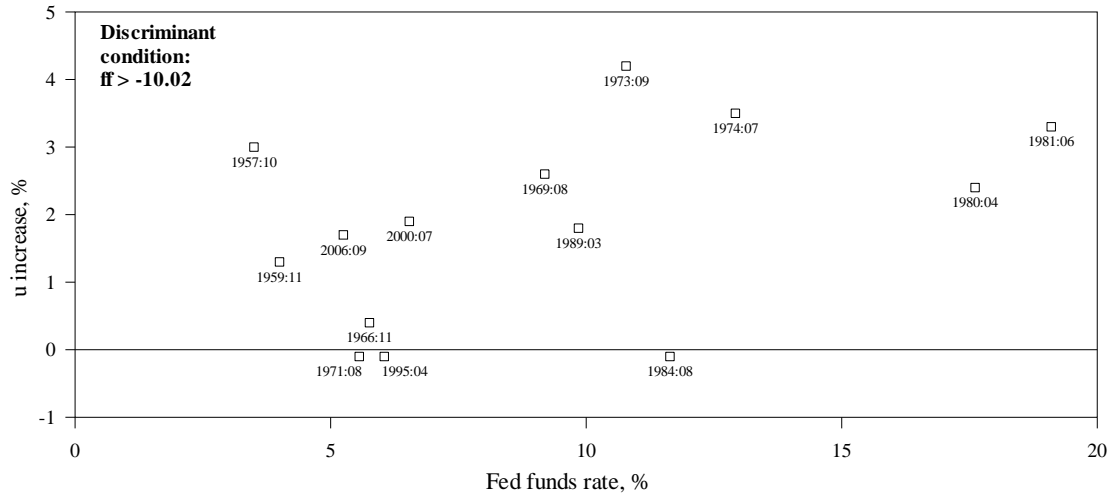**Figure 3: The Fed Funds Rate and Subsequent Unemployment Changes**

Figure 3: The Fed Funds Rate and Subsequent Unemployment Changes (cont.)