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A Policymaker's Guide to Indicators of Economic Activity

Charles Evans, Steven Strongin,
and Francesca Eugeni

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ABSTRACT

This paper implements a set of time series techniques for evaluating indicators of economic activity that more closely match the actual use of such indicators in the day-to-day policy process. We view that process as primarily involving the re-assessment of short- to medium-term economic activity based upon indicator by indicator analysis with the primary decision matrix being whether it is necessary to ease or tighten policy in order to realize appropriate levels of economic activity. As policymakers typically use indicators one at a time, all of our analysis is carried out on a bivariate basis.

We consider four classes of indicators: nominal interest rate levels, interest rate spreads, monetary aggregates, and composite indicators. Within each class the indicator evaluation has three primary parts: ranking candidate indicators, characterizing the nature of the information in those indicators, and assessing their usefulness in practice. After selecting the best indicators from each class for each forecast horizon considered, we then determine what relative weight should be given to each indicator. We find that interest rate spreads are typically the most informative indicators at short- and medium-term horizons (1-, 2- and 4-quarters ahead). The monetary aggregates are typically not very informative at these horizons, with the exception of real M2 at the 4-quarter horizon.

INTRODUCTION

The evaluation of economic indicators has often progressed with an odd independence for the way in which such indicators are actually used in practice in the economic policy process. The search is often for one "best" indicator, where "best" typically refers to winning in some narrowly defined contest of general purpose forecasting ability measured over some pre-selected time-span. The actuality of the policy process is far richer. Indicators are used in a kind of chaotic democracy, each indicator casting a vote based on its own forecast and the policymakers weighing each vote, based on their assessment of the current credibility of the indicator.

This is quite different from the standard academic formulation of economic policy where a "true" model is developed and then policy run in a way that optimizes the performance of the model. Understanding this difference in approach leads to very different ways of evaluating indicators. It is not just enough to produce a "best" model; rather, it is important to understand what type of information is contained in a given indicator so that its message can be properly evaluated and also how much weight to give that message given what else is also known.

Indicators, like people, perform better or worse depending on the context in which they operate. Efficient usage requires matching indicators both with appropriate questions and with other complementary indicators. For instance, some indicators do far better at predicting short-run changes in activity, but do not do very well at pinning down the level of activity over longer time spans, while other indicators forecast short-run phenomena poorly, but do better at predicting average activity over longer time span. Also while some indicators have very close substitutes, such as the twenty or so short-term interest rates sometimes used in econometric studies, and thus provide little additional information beyond that already contained in other indicators, some indicators can provide substantial additional information, thus providing important confirming or contradicting information. The policymaker needs to know how to match questions with indicators depending on the current policy context. A swiss army knife is a fine general purpose tool, but it is hardly a substitute for a well-equipped workshop.

This paper seeks to develop and implement a set of techniques for evaluating indicators of economic activity that more closely match the actual use of such indicators in the day-to-day policy process. We see that process as primarily involving the re-assessment of short- to medium-term economic activity based on indicator by indicator analysis with the primary decision matrix being whether it is necessary to ease or tighten policy in order to realize appropriate levels of economic activity. We do not address the longer run issues of assessing appropriate levels of economic activity or other issues involving inflation or the value of the dollar nor do we address the question of how best to implement those decisions. Evaluating indicators in this context has four primary parts; ranking candidate indicators, characterizing the nature of the information in those indicators, assessing their usefulness in practice and determining what relative weight should be given to each indicator. The idea is to develop the information that a policymaker needs in order to interpret information as it comes in and to choose which indicators to watch depending on the questions being asked.

As policymakers typically use indicators one at a time, all of our analysis will be carried out on a bivariate basis. Multivariate regression models allow indicators to play off against one another so that if two indicators hold both common and independent information better statistical fits can usually be obtained by fitting one multivariate model rather than mixing 2 bivariate models. The advantage of using the mixing approach is that when one of the indicators begins to misbehave, which they do, you can, at least temporarily, just ignore that indicator. Second, by only using the primary information over-fitting is less of a worry. Third and most important, the mixing approach allows a much more precise assessment of exactly the type of information that is contained in each indicator and thus allows policymakers to reoptimize their choice of indicator sets based on the type of question being asked.

Beyond the focus on bivariate models, there are a number of other differences between our work and normal econometric practice that are worth noting. First, as will be shown in the paper different indicators are useful at different forecast horizons, so that we will not be suggesting one best model, but rather we will be suggesting ways of combining indicators depending on the precise policy question being asked. Second, along these same lines as we are more concerned with the interpretation of each of the individual indicators rather than the construction of a structural model of the economy, we will pay much more attention to characterizing the type of information in each individual indicator than is normally the case. Also, since the forecasts derived from the indicators typically get averaged together either informally in the policymaker's mind or formally in the mixing models shown in the last section of this paper, we analyze the degree to which one indicator can be said to have information which is independent from another. Policymakers are often faced with a variety of indicators pointing one way and another group pointing a different way, in such cases it is not only useful to know what weight would have produced the best forecast historically, but the degree to which the indicators are independent bits of information or the same information being repeated over and over again in a variety of guises. Policymakers quite rightly give greater weight to information which they see as independent confirmation. It is useful in this light to more fully analyze the independence of information in various indicators. It is also helpful to know if the indicator in question usually contains the type of information being sought.

METHODOLOGY

As noted above, the primary focus of this paper is the examination of various data series as indicators of changes in real economic activity, which we measure alternately as annualized log changes in real GDP, employment and industrial production. In most cases results are supplied for all three measures of economic activity. The major focus will be on forecasting real GDP, except in the sections of the paper which focus on issues of timing in which case employment will be used, since it is available at the monthly frequency allowing for more precise estimation of the pattern of impact over time.

Throughout the paper the indicators are used to produce forecasts of economic activity. The specific functional form of the forecasting equation is always the same. One year of data for the indicator and one year of lagged economic activity is included in the regression. Thus, the exercise is strictly equivalent to a bivariate VAR with one year of lags, 4 lags for the real GDP models and 12 lags for the employment and industrial production models. The models are estimated in log differences and rates of change are annualized. Interest rates and interest rate spreads are used in their level form. In many of the tables an additional forecast is provided with the label "NONE". In this case, the forecast is based solely on the past history of economic activity, a pure auto-regressive model with one year of lagged data. This pure auto-regressive forecast is referred to as the no-indicator forecast. When the horizon of forecast is varied, we simply change the dependent variable in the regression rather than dynamically iterate the one period ahead forecast. This optimizes the parameterization for the forecast horizon in question, rather than multiplicatively combining estimation errors forward. Symbolically the forecasting equation can be written:

$$Y_{t+k} - Y_t = A(L)\,\Delta Y_{t-1} + B(L)\ I_{t-1} + \omega_t$$

where Y_t it the log of economic activity at time t and I_t is the indicator at time t, k is the number of periods in the forecast horizon and A(L) and B(L) are polynomials in the lag operator L of order one year.

The indicators are split into four groups, which we call families. Each family is meant to represent a natural division of indicators into groups which are likely to share similar characteristics. For example, the first family we examine is interest rates, the second is money-based measures, the third is interest rate spreads and the fourth is composite indicators, such as the Department of Commerce Leading Indicators and the S&P 500. The fourth group also contains those series which do not fit neatly into the overall classification scheme.

The idea is to first examine the indicators within a family, finding out which indicators within each family produce the best forecasts and contain the most independent information and then taking these "best" indicators and examining what is to be gained by mixing the information from different families. This serves a number of purposes. First, by breaking the large list of potential indicators into smaller groups it makes each examination more manageable. Second, by using natural groupings it allows us to look at questions such as what is the best interest rate or the best money measure in a natural way. Third, one key issue for indicators is the degree to which they actually contain independent information. Focusing on groups which are already thought to have similar information provides a natural focus to learn if these preconceptions are accurate or if some of these groups contain more than one type of information. Lastly, by first selecting the best indicators at the family level and then mixing between families, we can produce a mixed forecast which, as noted above, closely approximates the way policy forecasting appears to be done in practice.

Each family of indicators is subjected to the same analysis. First, each family of indicators is described and a table is presented which lists the indicators examined and their means, standard deviations and their correlations with the measures of economic activity. Then each of the indicators is subjected to four evaluations, 1.) Classical goodness of fit rankings, 2.) Characterization of fit, 3.) Indicators performance in practice and 4.) Encompassing tests.

The classical goodness of fit rankings are based on simple full sample regressions estimated on data from the beginning of 1962 through the end of 1991. The results are presented in table two of each family analysis section. Table two shows the rankings for each indicators in the family based on the regression they produce. The idea is that the best indicators are the ones that produces the best fit where fit is measured by the R^2 of the regression or the standard deviation of the residual from the regression[1]. This closely approximates the oldest notions of evaluating the best indicators of economic activity for policy. It is also closely linked to the notion of Granger causality, which measures whether or not the indicators actually help forecast economic activity. The p-value for this test is also included in the table.

The second evaluation seeks to characterize the type of information in the indicator. Typically the question can be thought of as if the indicator goes up today how does that change my expectations about economic activity in the future. This is analyzed by calculating the dynamic response path of employment for each of the indicator forecasting equations, which shows how a one standard deviation[2] increase in the indicator changes expectations about future growth rate of employment for each month for the next 36 months[3]. This allows us to characterize the information in the indicator based on how fast economic activity responds, how much it responds and how long the change in activity lasts. Figure 1 in each family section graphs the dynamic response path for each indicator in the family, as well as the 2 standard deviation bands on the estimates of the dynamic response paths to show the amount of uncertainty about the response path. Table 3 summarizes this

1. In the appendix tables which include sub-sample results are also presented.

2. The standard deviation measure used is the one from a bivariate VAR for the indicator and the measure of economic activity. This is used to approximate the average size of movement in the indicator series.

3. This is basically the same as an impulse response function except that the identifying assumption is not derived from a specific decomposition of the error matrix, but on the assumed path of the actual series, i.e. the indicator changes given the level of current activity. This is arithmetically equivalent to an impulse response function using a Choleski decomposition with the indicator ordered last.

information in terms of the maximum response for all three of the measures of economic activity, showing the timing, size and uncertainty of the maximum response of economic activity for each indicator in the family.

The third evaluation switches the focus to how well the indicators are likely to work in practice. To this end, goodness of fit is reinterpreted in a way closer to the way forecasts are actually used. First, table 4 shows the goodness of fit ranking recalculated for a series of forecast horizons, so that we can get a better feel for what these indicators are good at. First, the single period horizon used in the first evaluation and then a one-quarter horizon, a two-quarter horizon and a one-year horizon[4]. Table 5 in each section then repeats this analysis using forecasting equations which do not contain any prior information. Specifically, the forecasting equations are estimated sequentially using Kalman filtering techniques using only the sample information available prior to the period being forecast. This provides a more accurate assessment of how an indicator is likely to perform in practice. These forecasts are then ranked by the mean squared error (MSE) of the forecasts from 1972 onward. The R^2s are no longer well defined. This analysis is followed up by Figure 2 in each section which graphs the cumulative residuals for Kalman forecasts from 1972 onward. This allows us to examine if these forecasts tend to perform badly during recessions or if there was some particular point in the past where they did especially well or poorly. It also tells us if the forecasts have tended to miss in some systematic fashion over time. The residuals are measured as the actual growth in economic activity minus the

4. It should be noted that these are not iterated VAR forecasts, rather the forecast parameters are chosen to maximize performance at the forecast horizon specified. This can either be thought of as a state space estimation minimizing the t+k forecast variance or as simple OLS with the dependent variable the t+k growth rate. This avoids any problem that might result from a indicator that performs poorly at high frequencies having that failure interfere with longer frequency forecasting.

forecasted growth. Thus, a downward trend in the cumulative residuals would indicate a prolonged period of over-predicting growth in activity.

The fourth evaluation switches the focus to independence of information. As noted above one of the most important factors to understand about indicators is whether of not they contain independent information relative to some other indicator. This allows a policymaker to assess whether a new piece of information actually contains any additional information or whether it is simply the same information with a different label. The way to evaluate this is through a set of techniques called encompassing tests. In the context of this paper, indicator A is said to *encompass* indicator B, if given the forecast implicitly based on A there is no additional information in indicator B. Indicator A is said to *dominate* indicator B if A encompasses B <u>and</u> B does not encompass A. The simplest way to test this is to run a regression with economic activity as the dependent variable and the forecast of activity based on indicator A and the forecast of activity based on indicator B as the independent variables. Symbolically this can be written

$$\Delta GDP_t = \phi \, for(A)_t + (1-\phi) \, for(B)_t + \varepsilon$$

Where $for(A)_t$ and $for(B)_t$ are the forecasts of GDP_t based on indicators A and B respectively and ϕ is relative weight OLS assigns to $for(A)_t$ and $for(B)_t$. If ϕ is significantly different from 0 then we can reject that for(A) is encompassed by for(B). Likewise if $1-\phi$ is significantly different from 0 then we can reject that *for*(B) is encompassed by *for*(A). If neither is encompassed then both indicators contain independent information and a better forecast can be obtained by mixing both sets of information with the relative weight given by ϕ. If only one is encompassed, then it is said to be dominated and only the other is necessary to produce an efficient forecast. If both are encompassed then either indicator alone can produce an efficient forecast, this occurs when there is a very high degree of collinearity and the standard error of the parameter estimate is large. In this case the indicator which has the best historical track record would likely be the superior choice. The generalization to longer horizons is straight forward, though the calculation of the standard errors is more complicated since the errors are no longer independent.

Table 6 in each family section contains the encompassing test. The table is read as follows. The indicators are listed both along the top and along the side. The numbers in the table refer to the test that the indicator listed along the side is encompassed by the indicator along the top. The test statistics are the significance levels for the test the indicator along the top does in fact contain all the information in the indicator along the side. For the sake of readability values below .05 are indicated with a dash.

The way to interpret these tables is that an indicator whose row is blank contains information that is independent of every other indicator in the family. An indicator whose column is full of high numbers is said to encompass those indicators. An indicator that did both would be said to dominate the family. In general, what we will search for is the set of indicators in each family which contains all the information in the family using as few indicators as possible. In general this will mean that the best variable from the previous tests will be included plus additional indicators which contain independent information, i.e. the indicators that add the most. Formally this means that all indicators that are not encompassed by any other indicators in the family plus whatever additional indicators are necessary to fully encompass or *cover* all the other indicators in the family. This is analogous to finding a set of minimum sufficient statistics.

The indicators that make it through this process will then be tested in the mixing model section of the paper in between-family encompassing tests, which examine whether or not there is independent information between families or not. Then a set of "best" indicators will be selected in order to develop mixing models of indicators which contain independent information for each of the forecasting horizons. These models will contain estimates of the appropriate relative weights that should be applied to the individual indicator-based forecasts. Completing the circle of policy forecasts, the mixing model will be time-varying to see if there is any gain from adjusting the weight applied to these individual forecasts based on recent performance.

INTEREST RATE LEVELS

Table 1.1 lists the nominal interest rates which were selected for investigation, along with some descriptive statistics. All of the rates are expressed at annual rates: the Federal Funds rate (FF), 3- and 6-month Treasury bill rates (TB03 and TB06), 1-, 3-, 5-, and 10-year constant maturity Treasury bond rates (CM01, CM03, CM05, and CM10), the 3-month Eurodollar rate (EUR03), the 6-month Commercial Paper rate (CP6), and the BAA bond rate (BAA). Each of these interest rates is negatively correlated with the economic activity variables. The interest rates with the largest absolute correlation with real GDP are the Federal Funds rate, the 3-month Eurodollar rate, and the 6-month Commercial Paper rate.

Table 1.2 reports statistics for the one-period-ahead forecasting model. Notice that all of the interest rates provide significant predictive power for all three economic activities. The R^2 fall within fairly narrow bands indicating that the relative rankings are not particularly important--all of these indicators are useful at the one-month forecast horizon.

Figure 1.1 graphs the response of the employment growth forecast to a one-standard deviation change in information about last period's indicator. As with the F-tests in Table 1.2, the response paths are virtually identical across the interest rates considered: employment growth rises for three or four months and then falls, eventually asymptoting back to zero from below the axis. The confidence bounds on these responses are sufficiently wide that the initial response could be zero. For all of the interest rates, however, there is a point within the first year that employment growth is significantly negative: the largest such effects are for the 6-month Commercial Paper rate and the BAA bond rate. For all of the indicators across all of the activities, the maximum effect is negative and occurs within one year of the impulse (see Table 1.3).

Tables 1.4 and 1.5 rank the indicator forecasts for in-sample and out-of-sample forecasting behavior. Focusing on the out-of-sample results first, notice that for industrial production and employment at the one-month horizon, the no-indicator forecasts perform better than the interest rate forecasts. But for GDP all of the interest rate forecasts outperform the no-indicator forecasts at all horizons. Focusing on GDP, the Federal Funds rate is ranked first at the four-quarter growth horizon; but the 3-month Eurodollar rate is best at the one- and two-quarter horizons. The success of the Eurodollar rate is also evident for industrial production and employment at all horizons beyond one-month. The 6-month Commercial Paper rate improves in forecasting accuracy as the horizon increases; this is true for GDP, industrial production, and employment (placing no worse than third at the one-year horizon). In general, the shorter maturity bills perform better than the longer maturity bonds (3-, 5-, and 10-year Treasuries).

The in-sample results of Table 1.4 indicate that the Eurodollar rate increases in ranking due in part to its out-of-sample stability. In the out-of-sample rankings the Eurodollar rate is first for industrial production (3-, 6-, 12-months), employment (6- and 12-month), and GDP (one- and two-quarters). In 6 of these 7 instances, these represent an increase in ranking from the in-sample results. In contrast to this stability, the 6-month Commercial Paper rate does not fare as well. At the shorter forecast horizons, it goes from being ranked number 1 or 2 in-sample to either 6, 9, or 10 out-of-sample. For the industrial production and employment, the Federal Funds rate also experiences a substantial out-of-sample forecast deterioration at the shorter forecast horizons relative to the in-sample rankings.

The cumulated residuals from the Kalman forecasts in Figure 1.2 show that, overall, the indicators in our interest rate family consistently underforecasted real GDP between 1974 and 1982. The upward trend in the cumulated residuals during this period can be explained in part by an unprecedented increase in inflation, which caused interest rates to rise without the normally anticipated decline in output. On the other hand, between 1983 and 1989, the Federal Funds rate, the 6-month Commercial Paper rate, the Eurodollar rate, and all of the Treasury bill rates performed well, as shown by the flattening of their cumulated residuals slopes during this period. Between 1990 and 1991, however, the indicators performance deteriorated again, as all of the interest rates missed the 1990-91 recession and consistently overforecasted real GDP.

Table 1.6 reports the encompassing results for GDP. The simplest case is for the 4-quarter horizon: the Federal Funds rate dominates the other interest rates since it is unencompassed and it encompasses all other interest rates at this horizon. At the one- and two-quarter horizons, however, this domination does not hold; none of the interest rates are unencompassed at these horizons. Since all of the interest rates Granger-cause economic activity in Table 1.2, it is probably not surprising that each of the interest rates contains useful forecasting information. For example, at the one-quarter horizon the Federal Funds rate, the 3-month Eurodollar rate and the 6-month Commercial Paper rate all can be said to encompass each other, i.e. if you know one interest rate based forecast knowing another is not much help. Since all of these interest rate forecasts are encompassed by at least one other interest rate forecast, the next criterion for selection is to determine if any one of the interest rate forecasts can cover all of the other interest rate forecasts. In fact, at the one-quarter horizon, the Federal Funds rate, the 3-month Eurodollar rate, and the 6-month Commercial Paper rate all cover every other interest rate. The 3-month Eurodollar rate covers the Federal Funds rate and the 6-month Commercial Paper rate with higher levels of significance, and since, as noted above, the 3-month Eurodollar rate was the number one ranked indicator in the out-of-sample forecasts of GDP at the one-quarter horizon, the 3-month Eurodollar rate is selected as the best interest rate level indicator at the one-quarter horizon. Similar reasoning leads to the selection of the 3-month Eurodollar rate for the two-quarter horizon.

TABLE 1.1 - DESCRIPTIVE STATISTICS

	MONTHLY (Jan 62 - Feb 92)				QUARTERLY (Jan 62 - Dec 91)		
			Correlation with				Correlation with
Indicator	Mean	Std. Dev.	Industrial Production	Employment	Mean	Std. Dev.	Real GDP
FF	7.352	3.345	-0.230	-0.245	7.370	3.304	-0.353
TB03	6.605	2.715	-0.190	-0.222	6.620	2.686	-0.299
TB06	6.761	2.647	-0.186	-0.219	6.777	2.622	-0.295
CM01	7.265	2.872	-0.173	-0.215	7.282	2.849	-0.282
CM03	7.597	2.746	-0.162	-0.226	7.608	2.737	-0.257
CM05	7.736	2.708	-0.161	-0.231	7.744	2.705	-0.251
CM10	7.866	2.674	-0.154	-0.231	7.869	2.678	-0.237
EURO3	8.033	3.282	-0.224	-0.254	8.055	3.232	-0.352
CP6	7.341	2.879	-0.223	-0.252	7.359	2.844	-0.342
BAA	9.588	3.108	-0.188	-0.286	9.590	3.120	-0.269

TABLE 1.2 - CLASSICAL GOODNESS-OF-FIT STATISTICS

	MONTHLY (Jan 62 - Feb 92) INDUSTRIAL PRODUCTION					MONTHLY (Jan 62 - Feb 92) EMPLOYMENT					QUARTERLY (Jan 62 - Dec 91) GDP				
Indicator	R2	Change in R2	SEE	P-Value	Rank	R2	Change in R2	SEE	P-Value	Rank	R2	Change in R2	SEE	P-Value	Rank
FF	0.259	0.063	8.965	0.0057	10	0.423	0.050	2.303	0.0052	6	0.338	0.220	3.148	0.0000	3
TB03	0.263	0.067	8.940	0.0030	8	0.426	0.053	2.297	0.0028	5	0.293	0.176	3.252	0.0001	6
TB06	0.271	0.076	8.887	0.0007	5	0.429	0.055	2.291	0.0015	3	0.304	0.186	3.227	0.0000	5
CM01	0.273	0.078	8.875	0.0005	4	0.428	0.054	2.294	0.0020	4	0.309	0.191	3.216	0.0000	4
CM03	0.265	0.069	8.930	0.0022	7	0.421	0.047	2.307	0.0080	7	0.279	0.161	3.285	0.0002	7
CM05	0.263	0.067	8.941	0.0030	9	0.419	0.046	2.310	0.0109	8	0.268	0.150	3.310	0.0003	8
CM10	0.265	0.070	8.925	0.0020	6	0.417	0.043	2.315	0.0171	10	0.253	0.136	3.343	0.0009	10
EURO3	0.276	0.081	8.859	0.0003	3	0.431	0.057	2.287	0.0010	2	0.354	0.236	3.110	0.0000	1
CP6	0.286	0.091	8.797	0.0001	1	0.438	0.065	2.273	0.0002	1	0.348	0.231	3.123	0.0000	2
BAA	0.283	0.087	8.818	0.0001	2	0.419	0.045	2.312	0.0124	9	0.258	0.140	3.333	0.0007	9

TABLE 1.3 - MAXIMUM IMPACT OF DYNAMIC MULTIPLIERS

	MONTHLY (Jan 62 - Feb 92) INDUSTRIAL PRODUCTION			MONTHLY (Jan 62 - Feb 92) EMPLOYMENT			QUARTERLY (Jan 62 - Dec 91) GDP		
Indicator	Months to Max	Max Impact	Std. Dev. at Max	Months to Max	Max Impact	Std. Dev. at Max	Quarters to Max	Max Impact	Std. Dev. at Max
FF	7	-1.349	0.454	10	-0.406	0.129	3	-1.442	0.307
TB03	5	-1.577	0.499	9	-0.335	0.135	3	-1.250	0.280
TB06	5	-1.610	0.496	12	-0.365	0.130	3	-1.354	0.303
CM01	5	-1.655	0.468	12	-0.411	0.123	3	-1.443	0.308
CM03	5	-1.550	0.482	12	-0.414	0.146	3	-1.383	0.326
CM05	5	-1.446	0.480	10	-0.431	0.141	3	-1.367	0.303
CM10	12	-1.270	0.488	12	-0.382	0.145	3	-1.332	0.314
EURO3	5	-1.615	0.475	9	-0.494	0.124	3	-1.605	0.290
CP6	5	-1.793	0.484	9	-0.464	0.123	3	-1.502	0.282
BAA	5	-1.973	0.486	7	-0.395	0.138	3	-1.280	0.310

TABLE 1.4 - MULTIPERIOD FORECASTS (In-Sample)

	MONTHLY (Jan 62 - Feb 92) INDUSTRIAL PRODUCTION								MONTHLY (Jan 62 - Feb 92) EMPLOYMENT								QUARTERLY (Jan 62 - Dec 91) GDP					
	1 MON		3 MOS		6 MOS		12 MOS		1 MON		3 MOS		6 MOS		12 MOS		1 QTR		2 QTRS		4 QTRS	
INDICATOR	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK
FF	0.258	10	0.351	3	0.400	3	0.530	2	0.423	6	0.576	3	0.571	3	0.561	2	0.338	3	0.463	3	0.530	1
TB03	0.263	8	0.333	7	0.337	6	0.477	5	0.426	5	0.564	7	0.543	6	0.529	4	0.293	6	0.402	5	0.496	3
TB06	0.271	5	0.346	5	0.353	4	0.483	4	0.429	3	0.570	5	0.550	4	0.528	5	0.304	5	0.406	4	0.487	5
CM01	0.273	4	0.341	6	0.350	5	0.455	6	0.428	4	0.567	6	0.547	5	0.509	6	0.309	4	0.397	6	0.443	6
CM03	0.264	7	0.325	8	0.329	8	0.410	7	0.421	7	0.561	8	0.540	8	0.486	7	0.279	7	0.350	7	0.377	7
CM05	0.263	9	0.318	9	0.314	9	0.388	8	0.419	8	0.560	9	0.536	9	0.474	8	0.268	8	0.332	8	0.346	8
CM10	0.265	6	0.307	10	0.280	10	0.346	10	0.417	10	0.550	10	0.514	10	0.442	10	0.253	10	0.296	10	0.307	10
EURO3	0.276	3	0.371	2	0.420	2	0.509	3	0.431	2	0.581	2	0.575	2	0.546	3	0.354	1	0.471	2	0.490	4
CP6	0.286	1	0.382	1	0.438	1	0.541	1	0.438	1	0.592	1	0.592	1	0.564	1	0.348	2	0.475	1	0.516	2
BAA	0.283	2	0.348	4	0.332	7	0.361	9	0.419	9	0.570	4	0.543	7	0.468	9	0.258	9	0.329	9	0.315	9
NONE	0.196	11	0.201	11	0.115	11	0.097	11	0.373	11	0.489	11	0.414	11	0.269	11	0.118	11	0.123	11	0.076	11

TABLE 1.5 - KALMAN MULTIPERIOD FORECASTS (Out-of-Sample)

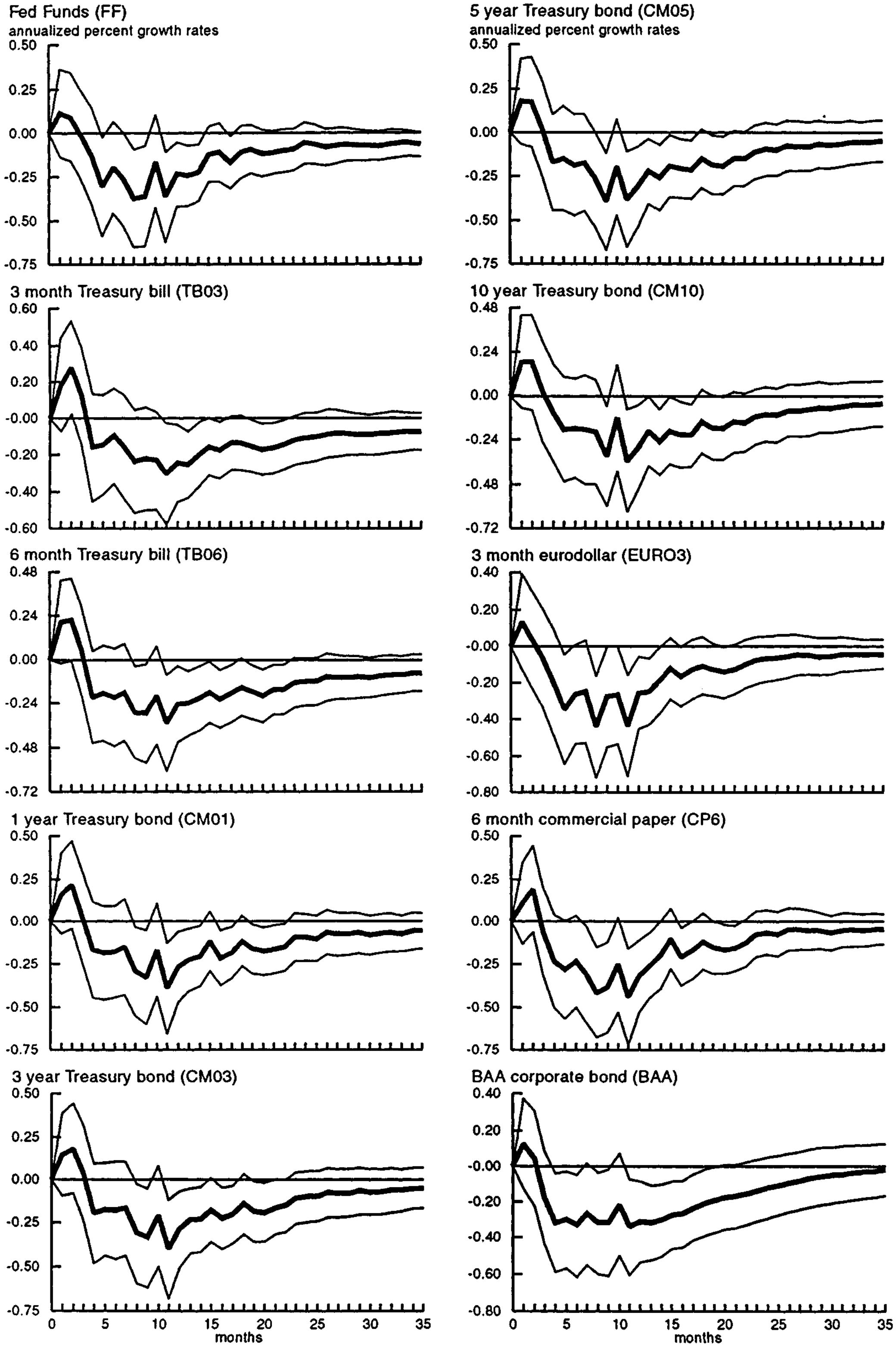
	MONTHLY (Jul 73 - Feb 92)								MONTHLY (Jul 73 - Feb 92)								QUARTERLY (Jul 73 - Dec 91)					
	INDUSTRIAL PRODUCTION								EMPLOYMENT								GDP					
	1 MON		3 MOS		6 MOS		12 MOS		1 MON		3 MOS		6 MOS		12 MOS		1 QTR		2 QTRS		4 QTRS	
INDICATOR	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK
FF	11.232	11	8.845	11	7.141	8	4.778	3	2.761	11	2.162	11	1.988	10	1.664	2	3.793	2	2.859	3	2.160	1
TB03	11.168	9	8.601	10	7.353	11	4.993	6	2.707	9	2.129	10	2.031	11	1.728	6	3.969	9	3.075	6	2.260	5
TB06	10.735	8	8.301	7	7.076	7	4.847	4	2.644	7	2.074	8	1.974	9	1.702	4	3.862	4	3.000	5	2.251	4
CM01	10.664	7	8.198	5	6.898	4	4.882	5	2.630	5	2.042	7	1.932	5	1.706	5	3.826	3	2.996	4	2.356	6
CM03	10.577	4	8.154	3	6.897	3	5.029	7	2.604	3	2.011	5	1.913	2	1.732	7	3.876	5	3.094	7	2.483	7
CM05	10.609	5	8.229	6	6.973	5	5.131	8	2.599	2	2.010	4	1.920	4	1.757	8	3.936	7	3.144	8	2.552	8
CM10	10.629	6	8.349	8	7.172	10	5.354	9	2.625	4	2.036	6	1.969	8	1.826	10	3.949	8	3.249	10	2.683	9
EURO3	10.483	2	7.899	1	6.415	1	4.531	1	2.630	6	1.993	2	1.847	1	1.610	1	3.622	1	2.754	1	2.222	3
CP6	11.196	10	8.426	9	6.801	2	4.724	2	2.752	10	2.124	9	1.951	6	1.686	3	3.880	6	2.827	2	2.216	2
BAA	10.518	3	8.184	4	7.158	9	5.495	11	2.657	8	1.998	3	1.915	3	1.784	9	4.006	10	3.197	9	2.725	10
NONE	9.901	1	7.902	2	7.068	6	5.485	10	2.463	1	1.948	1	1.953	7	1.913	11	4.015	11	3.358	11	2.819	11

TABLE 1.6 - MULTIPERIOD ENCOMPASSING TESTS (Sample Period: Jan 62 - Dec 91)
Probability Value for Null Hypothesis: X is Encompassed by Y

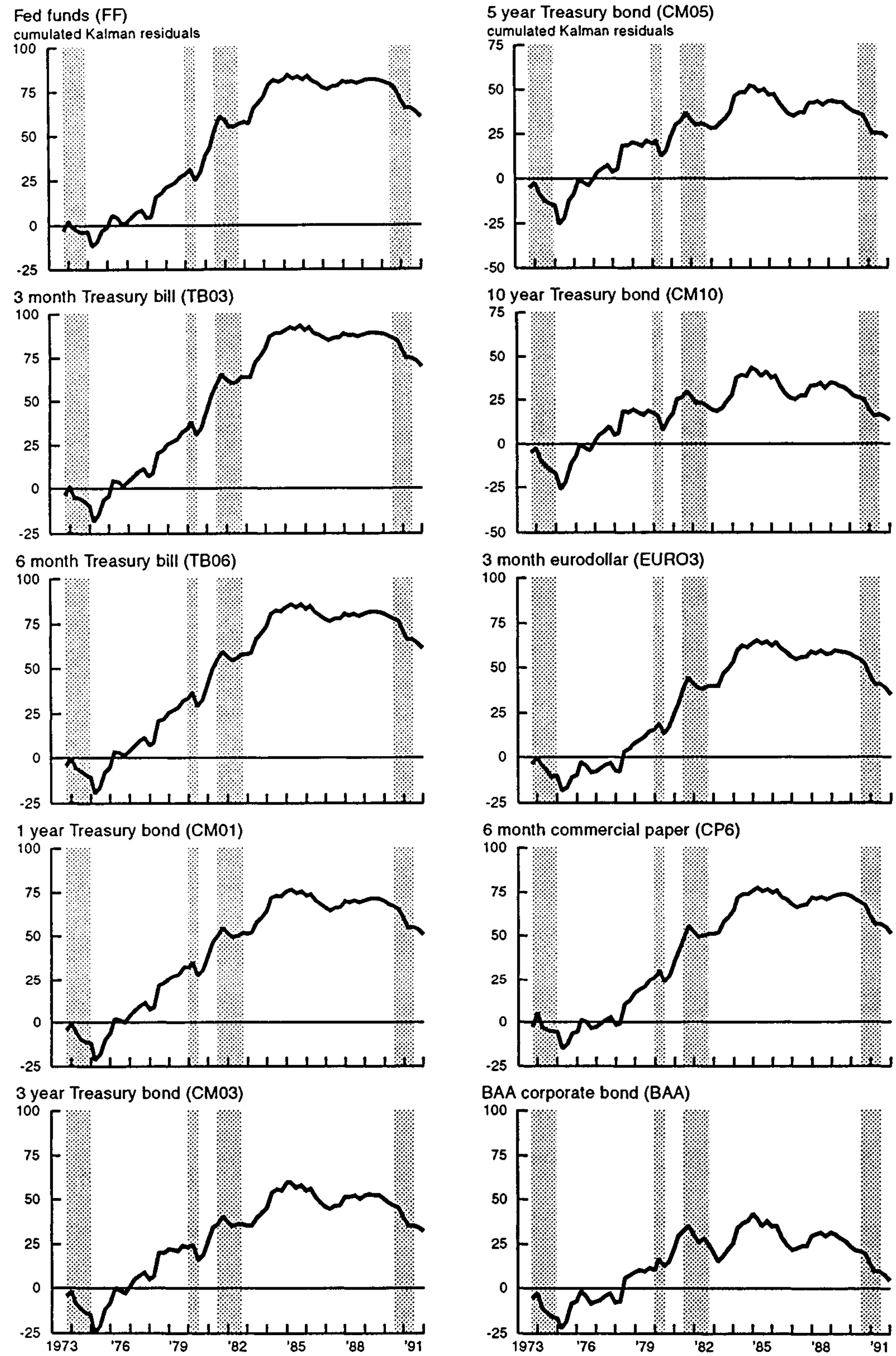
X \ Y	FF	TB03	TB06	CM01	CM03	CM05	CM10	EURO3	CP6	BAA	Maximum P Value
					GDP: 1 qtr						
FF	n.a.	--	--	--	--	--	--	0.932	0.856	--	0.932
TB03	0.482	n.a.	0.796	0.830	0.061	--	--	0.391	0.262	--	0.830
TB06	0.945	0.204	n.a.	0.947	--	--	--	0.403	0.241	--	0.947
CM01	0.677	0.103	0.342	n.a.	--	--	--	0.723	0.524	--	0.723
CM03	0.682	0.343	0.949	0.264	n.a.	0.065	--	0.803	0.601	0.053	0.949
CM05	0.637	0.375	0.910	0.412	0.251	n.a.	0.066	0.906	0.702	0.154	0.910
CM10	0.464	0.371	0.798	0.684	0.508	0.563	n.a.	0.818	0.976	0.380	0.976
EURO3	0.119	--	--	--	--	--	--	n.a.	0.240	--	0.240
CP6	0.272	--	--	--	--	--	--	0.659	n.a.	--	0.659
BAA	0.326	0.221	0.431	0.638	0.485	0.407	0.253	0.666	0.783	n.a.	0.783
					GDP: 2 qtrs						
FF	n.a.	--	--	--	--	--	--	0.605	0.867	--	0.867
TB03	0.090	n.a.	0.925	0.310	--	--	--	0.340	--	--	0.925
TB06	0.337	0.448	n.a.	0.220	--	--	--	0.250	--	--	0.448
CM01	0.582	0.515	0.864	n.a.	--	--	--	0.293	--	--	0.864
CM03	0.617	0.959	0.443	0.109	n.a.	--	--	0.360	0.107	--	0.959
CM05	0.694	0.975	0.520	0.191	0.132	n.a.	--	0.450	0.197	0.137	0.975
CM10	0.665	0.763	0.418	0.210	0.096	--	n.a.	0.491	0.263	0.794	0.794
EURO3	0.231	--	--	--	--	--	--	n.a.	0.598	--	0.598
CP6	0.214	--	--	--	--	--	--	0.340	n.a.	--	0.340
BAA	0.574	0.302	0.635	0.837	0.429	0.228	--	0.989	0.742	n.a.	0.989
					GDP: 4 qtrs						
FF	n.a.	--	--	--	--	--	--	--	--	--	0.044
TB03	0.963	n.a.	0.152	--	--	--	--	0.139	0.661	--	0.963
TB06	0.920	0.910	n.a.	--	--	--	--	0.255	0.662	--	0.920
CM01	0.596	0.373	--	n.a.	--	--	--	0.980	0.157	--	0.980
CM03	0.593	0.363	--	--	n.a.	--	--	0.623	0.166	--	0.623
CM05	0.541	0.302	--	--	--	n.a.	--	0.506	0.140	--	0.541
CM10	0.588	0.362	0.130	0.074	--	0.072	n.a.	0.555	0.211	0.419	0.588
EURO3	0.539	0.263	0.173	--	--	--	--	n.a.	0.785	--	0.785
CP6	0.746	--	--	--	--	--	--	0.052	n.a.	--	0.746
BAA	0.845	0.776	0.507	0.534	0.692	0.895	0.101	0.767	0.456	n.a.	0.895

NOTE: Values less than or equal to 0.05 are marked with a dash.

1.1. Dynamic Response of Employment to Interest Rate Levels



1.2. Interest Rate Levels: Cumulated Kalman Residuals in Forecasting Real GDP



THE MONETARY AGGREGATES

Table 2.1 lists the monetary indicators which were selected for investigation, along with some descriptive statistics. For this family of indicators all but one of the variables are expressed as (log) growth rates: the monetary base [Board of Governors (MB) and St. Louis (MBSTL) versions], M1, M2, M3, L, and long-term debt of nonfinancial institutions, as well as real M1 and real M2 (deflated by the consumer price index). The other monetary indicator is the ratio of nonborrowed reserves (this period) to total reserves (last period) (NBRX). Strongin (1991) has found that this normalized reserve aggregate contains much of the information about monetary policy actions which Sims (1991) attributes to innovations in the Federal Funds rate (orthogonalized relative to output and prices).

Two observations about the descriptive statistics seem to be in order. First, these aggregates are plausible choices as monetary indicators of economic activity. Focusing on GDP, the aggregates tend to be correlated with GDP, and the highest correlations are with the real aggregates M1 and M2. In fact, it appears to be roughly the case that as the endogenous component of the monetary aggregate increases, the contemporaneous correlation with economic activity increases. This is loosely the causation/reverse causation debate--do the larger monetary aggregates influence activity more than the narrower aggregates, or are they influenced more? Second, for most of the aggregates the standard deviations are about one-half or less than the average growth rates; however, for real M1 and M2, the standard deviations are 2 and 6 times greater than the average growth rate. It turns out below, that these two aggregates, nominal M2, and the NBR/TR ratio are the most useful indicators.

Table 2.2 reports statistics for the one-period-ahead forecasting model, an autoregression of the economic activity variable with lagged values of the indicator included. Focusing on GDP, notice that nominal M2, real M1, real M2, and the NBR/TR ratio provide significant predictive power for GDP beyond the information contained in past values of GDP. These three indicators consistently provide predictive power for industrial production and employment as well. For GDP the lowest ranking indicators tend to be nonfinancial debt, the monetary base, and the broad aggregate L.

Figure 2.1 graphs the response of the employment growth forecast to a one-standard deviation change in information about last period's indicator. For all of the monetary indicators, a positive impulse eventually leads to a positive growth of employment. For most of these indicators, however, the imprecision of these forecasts is large enough so that the response is either not statistically significant for most of the response path (nominal M1, M3, L and nonfinancial debt) or entirely insignificant (both monetary bases). Real M1 and M2 all have similar response patterns: persistent and quick, with the M1 response being a bit earlier. The responses of nominal M2 and the NBR/TR ratio are also persistent with a bit more raggedness than the responses to the real aggregates. The NBR/TR ratio also has the longest significant response. For all of the indicators and economic activity variables, the maximum one-period impact occurs within one year (reported in Table 2.3).

Tables 2.4 and 2.5 rank the indicator forecasts for in-sample and out-of-sample forecasts at various horizons. Turning to Table 2.5 first, notice that for the one-month forecast horizon for both industrial production and employment, the best forecast is one without any monetary indicators. For GDP there are four indicators which consistently provide additional information for forecasts: real M2 (which is always first), the NBR/TR ratio (always second), nominal M2 and real M1. These indicators are also useful for industrial production and employment for six-month horizon and beyond. They are also the highest ranked indicators in Table 2.4 for the in-sample forecasts.

The monetary aggregates which consistently provide no additional predictive power beyond the no-indicator model in the out-of-sample rankings are the two monetary base measures, nominal M1, and L. They also do poorly in the in-sample rankings. This lack of information is stable across forecast horizons.

The cumulated residuals from the Kalman forecasts shown in Figure 2.2 provide another perspective of the out-of-sample performance of our family of money based measures. In our case, the best indicator is again real M2 as its cumulated residuals path clearly stays near zero values, except for isolated periods of large forecast errors in 1978 and 1981, when real M2 underforecasted economic activity. Real M2's performance was again noticeably good between 1990 and 1991, when most of the other money based indicators clearly failed to predict the recession. The NBR/TR ratio was relatively stable from 1973 to 1981, but has shown a consistent pattern of overforecasting output growth since 1982. This deterioration may be due to increasing reluctance on the part of banks to borrow from the discount window. The performance of other monetary aggregates is less reliable and clearly more volatile than the behavior of real M2 and the NBR/TR ratio. For example, the two measures of the monetary base and M1 consistently underforecasted real GDP between 1974 and 1977, as shown by their upward sloping paths. Overall, the path of nominal aggregates plunged during the credit control program of 1980, overpredicting output growth during the mild recession. From 1983 to 1988, these nominal aggregates performed fairly well, exhibiting uncharacteristic stability, except for M1 which did substantially worse between 1983 and 1984. Finally, between 1990 and 1991, there was a considerable deterioration in the performance of M1, L, and the two measures of the monetary base, as they consistently overpredicted economic growth.

Table 2.6 reports the encompassing results for GDP. For each of the forecast horizons, we find that real M2 is not dominated by any of the other forecasts (reading across the real M2 row, the hypothesis is always rejected at low marginal significance levels). None of the other indicator forecasts can cover the information contained in real M2. Furthermore, the real M2 forecasts cover the information contained in all of the other indicator forecasts (reading down the real M2 column, the hypothesis that real M2 covers each forecast is not rejected). Therefore, real M2 is a dominant indicator within the class of monetary indicators selected here for GDP.

TABLE 2.1 - DESCRIPTIVE STATISTICS

Indicator	MONTHLY (Jan 62 - Feb 92)				QUARTERLY (Jan 62 - Dec 91)		
	Mean	Std. Dev.	Correlation with Industrial Production	Correlation with Employment	Mean	Std. Dev.	Correlation with Real GDP
MBSTL	6.785	3.617	-0.014	-0.058	6.784	2.195	0.034
MB	6.710	3.321	-0.021	-0.027	6.662	2.282	0.013
M1	6.160	5.864	0.005	-0.033	6.055	3.730	0.157
M2	7.750	4.082	0.119	0.013	7.769	3.292	0.236
M3	8.323	4.072	0.113	0.092	8.363	3.520	0.246
L	8.138	3.662	0.167	0.175	8.183	3.057	0.239
DBTNF	8.977	2.752	0.175	0.290	9.017	2.446	0.180
M1R	1.085	7.245	0.063	0.009	0.971	5.143	0.297
M2R	2.675	5.837	0.156	0.053	2.685	4.868	0.353
NBRX	0.976	0.027	0.059	-0.026	0.983	0.029	0.154

TABLE 2.2 - CLASSICAL GOODNESS-OF-FIT STATISTICS

	MONTHLY (Jan 62 - Feb 92) INDUSTRIAL PRODUCTION					MONTHLY (Jan 62 - Feb 92) EMPLOYMENT					QUARTERLY (Jan 62 - Dec 91) GDP				
Indicator	R2	Change in R2	SEE	P-Value	Rank	R2	Change in R2	SEE	P-Value	Rank	R2	Change in R2	SEE	P-Value	Rank
MBSTL	0.225	0.029	9.169	0.3997	8	0.393	0.019	2.363	0.5618	9	0.166	0.049	3.532	0.1744	7
MB	0.222	0.027	9.182	0.4760	9	0.389	0.015	2.370	0.7445	10	0.145	0.027	3.577	0.4734	9
M1	0.221	0.026	9.188	0.5172	10	0.401	0.028	2.346	0.2192	8	0.172	0.055	3.519	0.1284	5
M2	0.252	0.057	9.003	0.0144	3	0.442	0.069	2.264	0.0001	2	0.219	0.101	3.419	0.0084	4
M3	0.229	0.033	9.144	0.2755	7	0.412	0.039	2.324	0.0383	5	0.169	0.052	3.525	0.1483	6
L	0.236	0.041	9.100	0.1246	5	0.404	0.030	2.341	0.1486	6	0.164	0.046	3.538	0.1993	8
DBTNF	0.231	0.036	9.128	0.2092	6	0.401	0.028	2.346	0.2156	7	0.124	0.006	3.620	0.9352	10
M1R	0.244	0.048	9.054	0.0477	4	0.418	0.044	2.314	0.0148	4	0.250	0.132	3.351	0.0012	2
M2R	0.284	0.089	8.808	0.0001	1	0.444	0.071	2.260	0.0001	1	0.346	0.228	3.128	0.0000	1
NBRX	0.277	0.081	8.854	0.0003	2	0.426	0.053	2.297	0.0028	3	0.249	0.131	3.352	0.0012	3

TABLE 2.3 - MAXIMUM IMPACT OF DYNAMIC MULTIPLIERS

	MONTHLY (Jan 62 - Feb 92) INDUSTRIAL PRODUCTION			MONTHLY (Jan 62 - Feb 92) EMPLOYMENT			QUARTERLY (Jan 62 - Dec 91) GDP		
Indicator	Months to Max	Max Impact	Std. Dev. at Max	Months to Max	Max Impact	Std. Dev. at Max	Quarters to Max	Max Impact	Std. Dev. at Max
MBSTL	4	1.054	0.489	8	0.221	0.148	2	0.787	0.323
MB	10	0.894	0.508	5	0.192	0.138	2	0.410	0.300
M1	7	1.145	0.515	3	0.370	0.126	2	0.671	0.328
M2	7	1.755	0.476	9	0.705	0.137	2	0.904	0.309
M3	7	1.393	0.538	9	0.500	0.149	3	0.787	0.344
L	7	1.655	0.507	9	0.458	0.143	3	0.739	0.333
DBTNF	2	1.214	0.447	5	0.332	0.126	4	0.113	0.301
M1R	7	1.371	0.513	5	0.485	0.124	2	1.011	0.321
M2R	7	1.567	0.464	5	0.568	0.128	2	1.069	0.289
NBRX	12	1.467	0.496	8	0.449	0.148	3	1.047	0.308

TABLE 2.4 - MULTIPERIOD FORECASTS (In-Sample)

	MONTHLY (Jan 62 - Feb 92)								MONTHLY (Jan 62 - Feb 92)								QUARTERLY (Jan 62 - Dec 91)					
	INDUSTRIAL PRODUCTION								EMPLOYMENT								GDP					
	1 MON		3 MOS		6 MOS		12 MOS		1 MON		3 MOS		6 MOS		12 MOS		1 QTR		2 QTRS		4 QTRS	
Indicator	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK
MBSTL	0.225	8	0.230	8	0.144	10	0.113	10	0.393	9	0.506	8	0.434	8	0.274	10	0.166	7	0.154	8	0.102	8
MB	0.222	9	0.226	9	0.145	8	0.135	8	0.389	10	0.499	9	0.424	9	0.276	9	0.145	9	0.144	9	0.121	5
M1	0.221	10	0.259	7	0.199	6	0.127	9	0.401	8	0.523	7	0.454	7	0.288	7	0.172	5	0.183	7	0.096	10
M2	0.252	3	0.335	3	0.333	3	0.268	4	0.442	2	0.581	2	0.540	2	0.394	4	0.219	4	0.249	4	0.186	4
M3	0.229	7	0.274	5	0.211	5	0.165	5	0.412	5	0.546	5	0.487	5	0.324	5	0.169	6	0.189	5	0.107	7
L	0.236	5	0.269	6	0.195	7	0.146	7	0.404	6	0.527	6	0.461	6	0.291	6	0.164	8	0.184	6	0.097	9
DBTNF	0.231	6	0.225	10	0.144	9	0.151	6	0.401	7	0.496	10	0.420	10	0.285	8	0.124	10	0.133	10	0.121	6
M1R	0.244	4	0.320	4	0.304	4	0.282	3	0.418	4	0.557	4	0.517	4	0.415	3	0.250	2	0.288	3	0.244	3
M2R	0.284	1	0.413	1	0.478	1	0.567	1	0.444	1	0.609	1	0.604	1	0.573	1	0.346	1	0.447	1	0.514	1
NBRX	0.277	2	0.365	2	0.386	2	0.417	2	0.426	3	0.562	3	0.525	3	0.446	2	0.249	3	0.327	2	0.292	2
NONE	0.196	11	0.201	11	0.115	11	0.097	11	0.373	11	0.489	11	0.414	11	0.269	11	0.118	11	0.123	11	0.076	11

TABLE 2.5 - KALMAN MULTIPERIOD FORECASTS (Out-of-Sample)

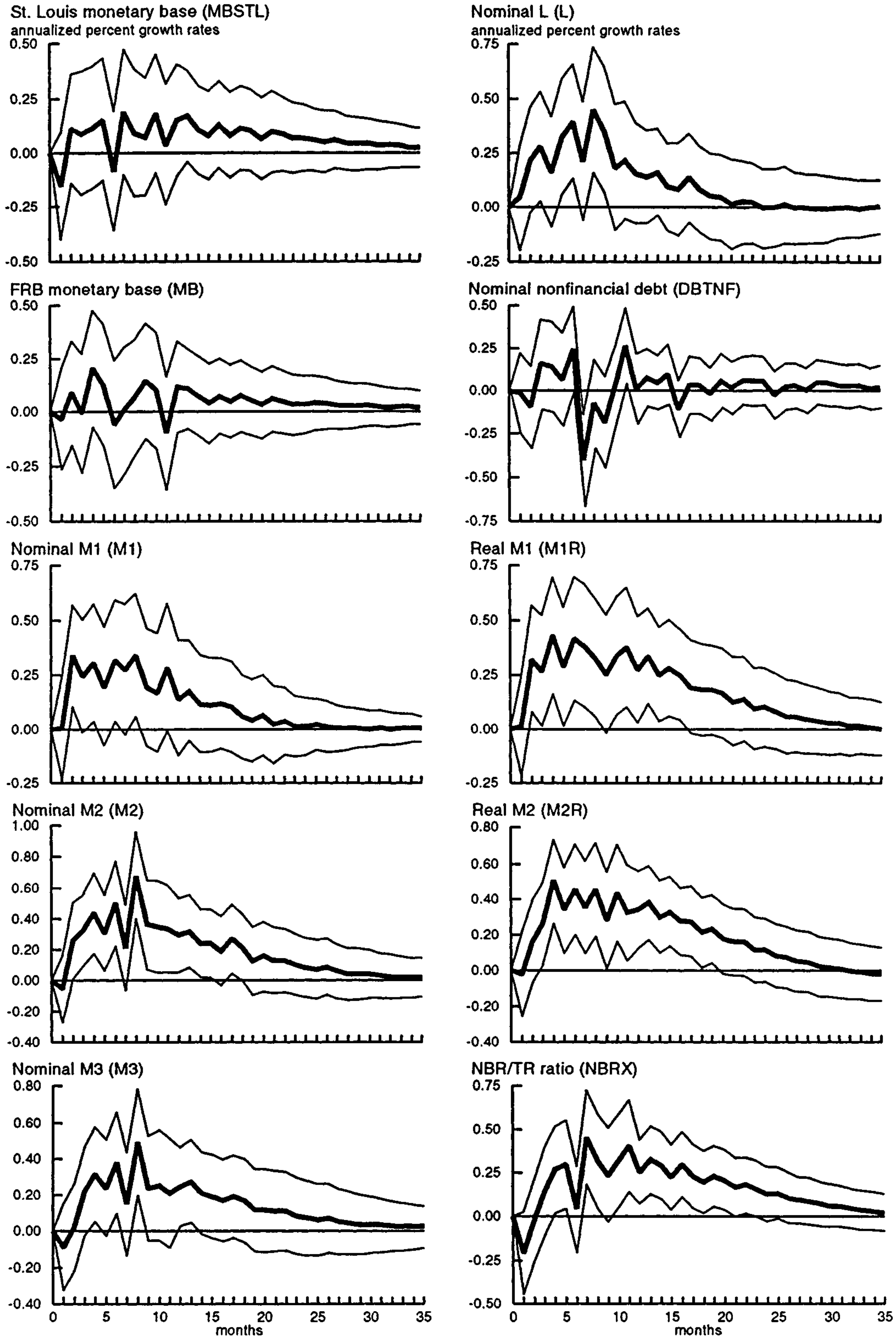
	MONTHLY (Jul 73 - Feb 92)								MONTHLY (Jul 73 - Feb 92)								QUARTERLY (Jul 73 - Dec 91)					
	INDUSTRIAL PRODUCTION								EMPLOYMENT								GDP					
	1 MON		3 MOS		6 MOS		12 MOS		1 MON		3 MOS		6 MOS		12 MOS		1 QTR		2 QTRS		4 QTRS	
Indicator	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK
MBSTL	10.406	8	8.317	11	7.468	11	5.736	8	2.583	6	2.040	10	2.058	11	2.012	9	4.108	7	3.474	10	2.904	8
MB	10.275	5	8.142	5	7.244	6	5.594	7	2.553	5	2.011	6	2.023	7	1.986	7	4.114	8	3.426	7	2.840	7
M1	10.452	10	8.218	10	7.273	8	5.760	9	2.587	8	2.022	7	2.030	8	2.023	10	4.149	10	3.455	9	2.992	11
M2	10.368	6	7.780	3	6.648	3	5.425	4	2.585	7	1.931	3	1.896	3	1.894	3	3.944	3	3.252	3	2.809	4
M3	10.447	9	8.161	8	7.308	9	5.843	10	2.610	9	1.998	5	2.006	6	1.997	8	4.073	5	3.394	6	2.948	10
L	10.405	7	8.174	9	7.382	10	5.843	11	2.630	10	2.028	8	2.050	10	2.043	11	4.136	9	3.432	8	2.926	9
DBTNF	10.112	4	8.157	6	7.270	7	5.498	6	2.535	4	2.034	9	2.041	9	1.955	6	4.242	11	3.495	11	2.820	6
M1R	10.630	11	8.159	7	6.952	4	5.309	3	2.671	11	2.064	11	2.004	5	1.905	4	4.097	6	3.285	4	2.775	3
M2R	10.111	3	7.368	2	5.902	1	4.229	1	2.483	3	1.838	1	1.731	1	1.558	1	3.674	1	2.844	1	2.219	1
NBRX	9.947	2	7.362	1	6.096	2	4.594	2	2.477	2	1.903	2	1.828	2	1.711	2	3.799	2	3.003	2	2.550	2
NONE	9.890	1	7.894	4	7.064	5	5.485	5	2.463	1	1.948	4	1.953	4	1.913	5	4.015	4	3.358	5	2.819	5

TABLE 2.6 - MULTIPERIOD ENCOMPASSING TESTS (Sample Period: Jan 62 - Dec 91)
Probability Value for Null Hypothesis: X is Encompassed by Y

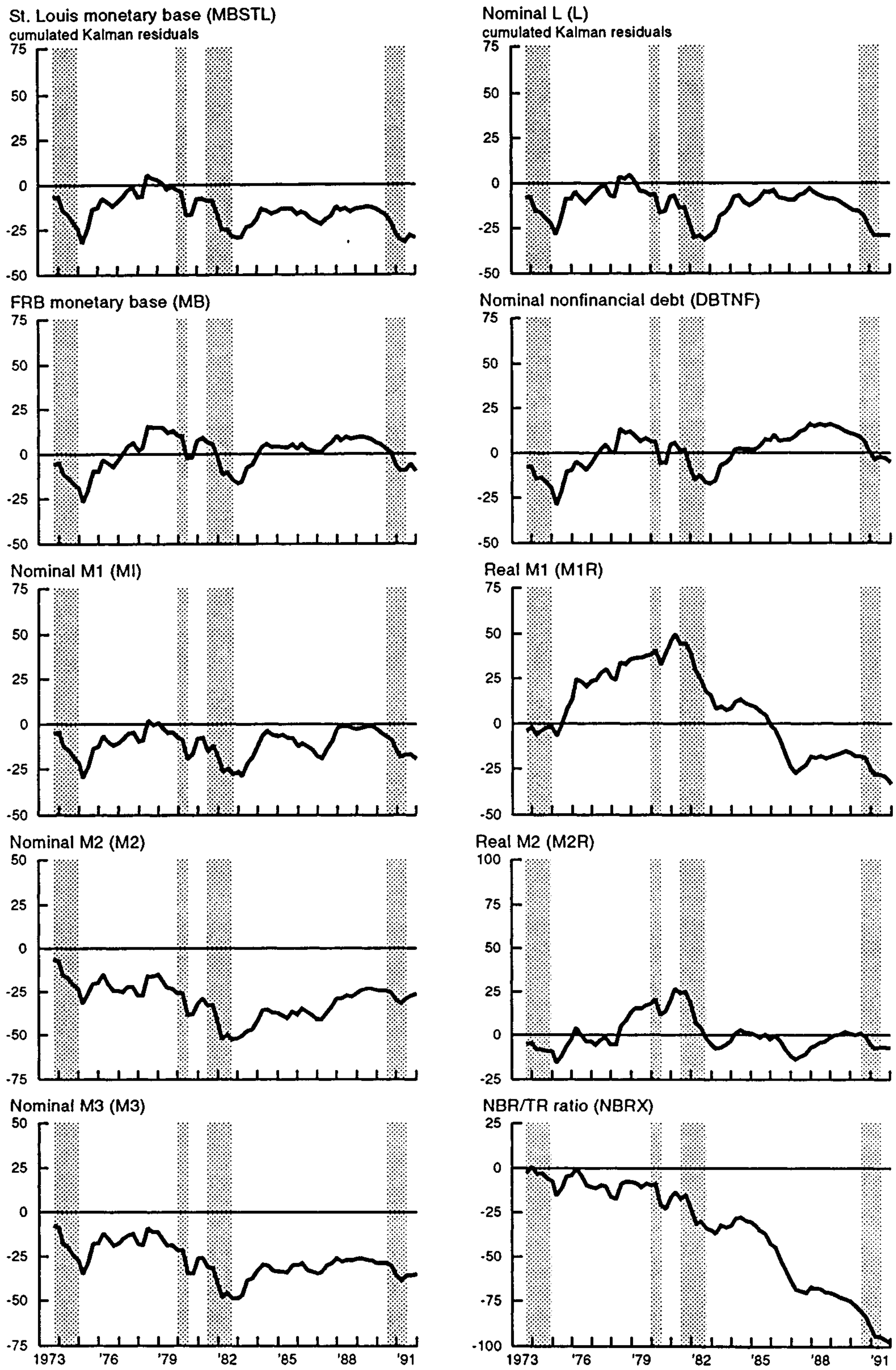
X \ Y	MBSTL	MB	M1	M2	M3	L	DBTNF	M1R	M2R	NBRX	Maximum P Value
					GDP: 1 qtr						
MBSTL	n.a.	0.064	0.150	0.462	0.178	0.094	--	0.763	0.759	0.411	0.763
MB	0.726	n.a.	0.307	0.569	0.296	0.224	0.075	0.682	0.936	0.500	0.936
M1	0.055	--	n.a.	0.506	0.105	0.054	--	0.658	0.855	0.671	0.855
M2	--	--	--	n.a.	--	--	--	0.098	0.954	--	0.954
M3	0.138	--	0.135	0.733	n.a.	0.174	--	0.327	0.653	0.149	0.733
L	0.119	--	0.136	0.407	0.324	n.a.	--	0.322	0.449	0.286	0.449
DBTNF	0.694	0.755	0.669	0.771	0.716	0.825	n.a.	0.829	0.970	0.755	0.970
M1R	--	--	--	--	--	--	--	n.a.	0.924	--	0.924
M2R	--	--	--	--	--	--	--	--	n.a.	--	0.000
NBRX	--	--	--	--	--	--	--	--	0.286	n.a.	0.286
					GDP: 2 qtrs						
MBSTL	n.a.	0.266	0.760	0.817	0.484	0.359	--	1.000	0.954	0.959	1.000
MB	0.595	n.a.	0.516	0.654	0.477	0.445	0.167	0.686	0.994	0.722	0.994
M1	--	--	n.a.	0.667	0.112	--	--	0.803	0.970	0.845	0.970
M2	--	--	--	n.a.	--	--	--	0.173	0.833	0.119	0.833
M3	--	--	0.064	0.603	n.a.	0.197	--	0.323	0.560	0.193	0.603
L	--	--	--	0.258	0.294	n.a.	--	0.274	0.284	0.333	0.333
DBTNF	0.490	0.715	0.604	0.691	0.533	0.697	n.a.	0.774	0.973	0.745	0.973
M1R	--	--	--	--	--	--	--	n.a.	0.752	0.101	0.752
M2R	--	--	--	--	--	--	--	--	n.a.	--	0.000
NBRX	--	--	--	--	--	--	--	--	0.133	n.a.	0.133
					GDP: 4 qtrs						
MBSTL	n.a.	0.930	0.341	0.604	0.525	0.344	0.659	0.840	0.782	0.896	0.930
MB	0.336	n.a.	0.126	0.248	0.228	--	0.330	0.362	0.817	0.464	0.817
M1	0.658	0.693	n.a.	0.914	0.669	0.439	0.517	0.987	0.841	0.958	0.987
M2	--	--	--	n.a.	--	--	--	0.263	0.430	0.400	0.430
M3	0.452	0.392	0.424	0.612	n.a.	0.442	0.375	0.776	0.918	0.746	0.918
L	0.521	0.523	0.396	0.523	0.626	n.a.	0.652	0.802	0.824	0.975	0.975
DBTNF	0.196	0.331	0.072	0.230	0.209	0.089	n.a.	0.300	0.836	0.334	0.836
M1R	--	--	--	--	--	--	--	n.a.	0.257	0.305	0.305
M2R	--	--	--	--	--	--	--	--	n.a.	--	0.000
NBRX	--	--	--	--	--	--	--	--	0.473	n.a.	0.473

NOTE: Values less than or equal to 0.05 are marked with a dash.

2.1. Dynamic Response of Employment to Money Based Measures



2.2. Money Based Measures: Cumulated Kalman Residuals in Forecasting Real GDP



INTEREST RATE SPREADS

Recent research on financial market indicators of economic activity has brought renewed attention to interest rates spreads. Laurent (1988), Bernanke (1990), Estrella and Hardouvelis (1991), Friedman-Kuttner (1992), Kashyup-Stein-Wilcox (1991), and Stock-Watson (1989) have suggested and tested various interest rate spreads as predictors of economic activity with significant success. The idea behind most of these spreads is that the difference in yields between two different debt instruments provides information beyond that in the level of interest rates. The two primary types of interest rates spreads that have been used are risk-spreads which measure the difference in yield between a private debt instrument and the yield on a government bond of equivalent maturity and term-spreads which measure the difference in yield of government debt instruments of different maturities.

Typically, the motivation for the risk spreads is that the risk in the private debt instrument is a measure of the market's assessment of the near term risk in the relevant business environment and that high risk implies a tough time for business ahead. Friedman-Kuttner have argued that this interpretation is probably flawed since the spreads are typically too large to be explained by any reasonable estimate of the risk inherent in the private debt instruments and suggest that liquidity considerations play a significant role in the pricing of public-private spreads. Following their lead, we also will refer to these spreads as public-private spreads.

The term-spreads seek to measure the relative availability of credit through time. The convention is that the shorter maturity yield is subtracted from the longer. Thus, a positive spread would indicate that short term funding is available at a lower rate than longer term funding. The normal interpretation is that if short-term funds are especially cheap relative to long-term funds this will encourage borrowing and economic activity. An alternative explanation is that the higher long-term yields are signaling expectations of higher future credit demand resulting from increased economic activity. A third interpretation is that by taking the difference between a short- and long-term interest rate you are correcting the shorter term rate for changes in inflationary expectations and taxes, leaving a better measure of short-run credit conditions. In any case, all of these term-spread measures have the counter-intuitive implication that a rise in long-term interest rates is good for the near-term outlook of the economy. Estrella and Hardouvelis (1991) and Strongin (1990) attempt to reconcile the term-spread results with current theory with limited success.

We test 3 public-private spreads and 5 term-spreads[5]. The specific measures we use are the TED or Eurodollar spread which is the 3-month Eurodollar rate minus the 3-month Treasury bill rate. The Commercial Paper spread which is the 6-month Commercial Paper spread minus the 6-month Treasury bill rate, and the Baa spread which is the Baa yield minus the 10-year Treasury bond rate[6]. The five term-spreads contain three spreads based on the Federal Funds Rate, a short, a medium, and a long spread -- the short spread is the 3-month bill rate minus the Federal Funds rate -- the medium spread is the 12-month bill rate minus the Federal Funds rate -- the long spread is the 10-year bond rate minus the Federal Funds rate. There are two intermediate spreads as well, the 12-month/3-month spread and the 10-year/1-year spread.

Table 3.1 shows that as expected the public-private spreads all show a strong negative correlation with economic activity and the term-spreads all show a positive correlation with activity: the shorter the term-spread, the higher the correlation.

Table 3.2 indicates that based on classical measures of fit all of the spreads do fairly well in explaining all three measures of economic activity. The R^2s for industrial production

5. These are the only commonly used spreads available for the entire data sample. We also examined other spreads for shorter sample periods, but the results did not change and the public-private spreads here presented continued to dominate.

6. The 10-year rate is used because the 7-year which might be preferred is not available for a sufficient time span.

range from .236 to .339; the range for employment growth is .416 to .459; and the range for GDP is from .234 to .339. With the exception of the 12-month/3-month term-spread, every spread Granger causes activity at a high level of significance. The only exception is the 12-month/3-month spread which fails to Granger cause industrial production. The public-private spreads do a better job of predicting employment and industrial production with the Commercial Paper spread and the Baa spread ranking 1 and 2. For GDP the results are more mixed with the Commercial Paper spread and 12-month/Federal fund spread coming in 2nd.

The dynamic response path graphs in Figure 3.1 show substantial difference in the dynamic response of employment growth by type of spread. The response of employment to an increase in the Baa spread shows a quickly rise, peaking at only 3 months. The response then dies just as quickly. The response paths for the two shorter-term public-private spreads, the Commercial Paper spread, and the Eurodollar spread build rapidly then plateau for a number of months and then die quickly. The term-spread response paths, with exception of the 12-month/3-month spread, all build slowly, peak and then slowly die out. Only in the case of the Baa spread is there a well-defined peak in the response path, all of the other spreads show extended periods of impact. This would suggest that the strength of the Baa spread will be in very short horizon forecasts, the strength of the Commercial Paper and Eurodollar spreads will be at short and middle horizons, while the strength of the term-spreads will be in longer term forecasts. Table 3.3 suggests similar conclusions with the Baa spread showing the quickest, largest and most tightly estimated peak for employment and industrial production. The longer horizon GDP results show the impact of the Baa spread falling off considerably, though still very quickly.

Tables 3.4 and 3.5 strongly re-enforce these conclusions and provide some startling evidence on the effect of forecast horizons on indicator performance. First, in Table 3.4 it is clear that the performance of the Baa spread falls off dramatically as the forecast horizon is increased. Ranking 2nd for industrial production and employment at the one-month horizon, the rank drops to 6th and 7th for industrial production and employment respectively for the three-month horizon and is dead last by six months for all measures of activity. The Commercial Paper spread, on the other hand, does very well ranking 1st until the one-year horizon in both employment and industrial production, when it is superseded by a number of term-spreads. In forecasting GDP, the Commercial Paper spread still does very well at the one-quarter horizon, but fades quickly falling to 4th at the six-month horizon and 6th at the one-year horizon. The Federal Funds rate based spreads do very well as the forecasting horizon lengthens. Starting out in the middle to back of the pack at the shortest horizons they rise to dominate the top of the ranking at the one-year horizon with the 12-month/Federal Funds spread rising to 1st for all three measures of activity. The intermediate spreads rarely do well.

Table 3.5, showing the out-of-sample results, shows a very similar story in terms of rankings. The interesting additional fact is how well the spread models stand up to the no-indicator model. At every horizon except one-month the spread models strongly outperform the no-indicator model, though at the one-month horizon the no-indicator model does outperform all of the spread models except the Baa spread, which is only good at short horizons. Clearly the forecast horizon is extremely important to the evaluation of interest rate spread models.

The cumulated residuals from the Kalman forecasts in Figure 3.2 show some striking similarities in the overall forecasting performance of our family of interest rate spreads. Except for the 3-, 6-, and 12-month/Federal Funds rate spreads, all of our spreads tend to overforecast real GDP, as shown by their consistently negative residuals. While the 3-, 6-, and 12-month/Federal Funds rate spreads performed fairly well from 1973 to 1980, they clearly failed during the last three recessions. In fact, they all underforecasted economic activity between 1980 and 1982, and then overpredicted real GDP between 1990 and 1991.

Between 1982 and 1989, their path was conspicuously flat. This suggests that these spreads do well in forecasting normal periods of economic activity, but periodically fail in predicting recessions. Although the 5-year/ and 10-year/Federal Funds rate spreads follow a similar pattern between 1973 and 1981, after 1982 their cumulated residuals path never stabilized but plunged to persistently negative values. Our intermediate term spreads (12-month/3-month and 10-year/1-year spreads) failed during all of the recessions in our sample period (including the 1973-1975 recession), and developed a consistently negative bias after 1982, as they clearly overpredicted real GDP. All of the private/public spreads followed the same general pattern of mediocre performance from 1973 to 1981, and persistent overprediction of economic activity thereafter. In general, we conclude that, although a persistent bias in forecasting exists in all of the interest rate spreads we investigated, some of them did fairly well during most of our sample period, but failed during periods of large scale financial restructuring.

The encompassing tests in Table 3.6 are exactly what would be expected given the previous results. To fully encompass all of the information in the interest rate spreads it is usually necessary to include both a public-private spread and a term-spread. Also not surprisingly, the Commercial Paper spread and the 12-month/Federal Funds rate spreads dominate their respective groupings at the one- and two-quarter horizons. It is interesting to note that the Stock-Watson leading indicator index, which was designed to fit data at the six-month horizon, chose the Commercial Paper spread and the 10-year/1-year spread. For our sample period, the 12-month/Federal Funds spread narrowly dominates the 10-year/1-year spread. At the 4-quarter horizon the public-private spread no longer contains additional information beyond that contained in the 12-month/Federal Funds spread. The 12-month/Federal Funds spread, however, does not dominate since it fails to cover (only) the 10-year/1-year spread. We selected the 10-year/Federal Funds spread since it covers more spreads than the 10-year/1-year spread, covers the 10-year/1-year spread, and performs better out-of-sample. The selection of two term spreads is consistent with the previously noted results that the public-private spreads do not contain as much long run information as the term-spreads. It is interesting to note that examination of the entire encompassing results indicate that the separation between the public-private spreads and the term-spreads is not very clear. At some horizons some term-spreads encompass some public-private spreads while at other horizons the results reverse. This would seem to indicate that there are common multiple driving forces in the determination of these spreads, and that those driver factors associated with longer horizon economic activity predominate in the term-spreads with the common factors that drive short-run performance and dominate the public-private spreads.

TABLE 3.1 - DESCRIPTIVE STATISTICS

	MONTHLY (Jan 62 - Feb 92)				QUARTERLY (Jan 62 - Dec 91)		
			Correlation with				Correlation with
Indicator	Mean	Std. Dev.	Industrial Production	Employment	Mean	Std. Dev.	Real GDP
TB3FF	-0.747	0.864	0.291	0.252	-0.750	0.807	0.449
TB6FF	-0.591	0.948	0.292	0.255	-0.593	0.886	0.442
TB12FF	-0.577	1.149	0.291	0.254	-0.580	1.082	0.425
CM05FF	0.384	1.586	0.210	0.123	0.373	1.511	0.321
CM10FF	0.514	1.791	0.200	0.114	0.499	1.713	0.309
TB12TB3	0.170	0.468	0.177	0.158	0.170	0.434	0.225
CM10CM1	0.601	1.036	0.083	0.001	0.588	0.997	0.170
EUROTB3	1.428	0.931	-0.235	-0.248	1.434	0.885	-0.378
CP6TB6	0.579	0.489	-0.305	-0.297	0.582	0.461	-0.431
BAACM10	1.722	0.698	-0.248	-0.390	1.720	0.690	-0.297

TABLE 3.2 - CLASSICAL GOODNESS-OF-FIT STATISTICS

	MONTHLY (Jan 62 - Feb 92)					MONTHLY (Jan 62 - Feb 92)					QUARTERLY (Jan 62 - Dec 91)				
	INDUSTRIAL PRODUCTION					EMPLOYMENT					GDP				
Indicator	R2	Change in R2	SEE	P-Value	Rank	R2	Change in R2	SEE	P-Value	Rank	R2	Change in R2	SEE	P-Value	Rank
TB3FF	0.291	0.095	8.769	0.0000	3	0.435	0.062	2.278	0.0004	3	0.327	0.209	3.174	0.0000	3
TB6FF	0.280	0.085	8.834	0.0002	4	0.430	0.057	2.289	0.0012	5	0.321	0.204	3.187	0.0000	4
TB12FF	0.275	0.079	8.866	0.0004	5	0.429	0.055	2.291	0.0016	6	0.330	0.212	3.166	0.0000	2
CM05FF	0.256	0.061	8.981	0.0084	7	0.415	0.042	2.318	0.0224	10	0.302	0.185	3.231	0.0000	6
CM10FF	0.254	0.059	8.992	0.0111	8	0.416	0.043	2.316	0.0186	9	0.309	0.191	3.216	0.0000	5
TB12TB3	0.236	0.041	9.099	0.1224	10	0.424	0.050	2.302	0.0047	7	0.238	0.120	3.377	0.0026	9
CM10CM1	0.250	0.054	9.018	0.0207	9	0.417	0.044	2.315	0.0163	8	0.284	0.166	3.273	0.0001	8
EUROTB3	0.274	0.079	8.870	0.0004	6	0.431	0.058	2.286	0.0009	4	0.294	0.177	3.250	0.0001	7
CP6TB6	0.340	0.144	8.462	0.0000	1	0.459	0.086	2.229	0.0000	1	0.339	0.221	3.145	0.0000	1
BAACM10	0.303	0.108	8.691	0.0000	2	0.437	0.064	2.274	0.0002	2	0.234	0.116	3.386	0.0033	10

TABLE 3.3 - MAXIMUM IMPACT OF DYNAMIC MULTIPLIERS

	MONTHLY (Jan 62 - Feb 92)			MONTHLY (Jan 62 - Feb 92)			QUARTERLY (Jan 62 - Dec 91)		
	INDUSTRIAL PRODUCTION			EMPLOYMENT			GDP		
Indicator	Months to Max	Max Impact	Std. Dev. at Max	Months to Max	Max Impact	Std. Dev. at Max	Quarters to Max	Max Impact	Std. Dev. at Max
TB3FF	7	1.991	0.483	6	0.500	0.127	3	1.408	0.310
TB6FF	7	1.731	0.468	6	0.466	0.128	3	1.283	0.277
TB12FF	7	1.446	0.466	6	0.412	0.125	3	1.259	0.285
CM05FF	7	1.091	0.478	15	0.355	0.087	3	1.195	0.294
CM10FF	7	1.022	0.497	9	0.370	0.134	3	1.243	0.293
TB12TB3	14	1.375	0.382	14	0.534	0.111	5	0.879	0.282
CM10CM1	5	1.471	0.486	9	0.342	0.134	3	1.243	0.296
EUROTB3	7	-2.083	0.515	12	-0.553	0.146	3	-1.493	0.338
CP6TB6	9	-2.476	0.480	8	-0.711	0.136	3	-1.449	0.312
BAACM10	3	-2.645	0.473	3	-0.519	0.121	2	-0.833	0.312

TABLE 3.4 - MULTIPERIOD FORECASTS (In-Sample)

	MONTHLY (Jan 62 - Feb 92)								MONTHLY (Jan 62 - Feb 92)								QUARTERLY (Jan 62 - Dec 91)					
	INDUSTRIAL PRODUCTION								EMPLOYMENT								GDP					
	1 MON		3 MOS		6 MOS		12 MOS		1 MON		3 MOS		6 MOS		12 MOS		1 QTR		2 QTRS		4 QTRS	
Indicator	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK
TB3FF	0.291	3	0.402	2	0.477	2	0.524	3	0.435	3	0.591	3	0.585	4	0.549	6	0.327	3	0.446	3	0.437	5
TB6FF	0.280	4	0.382	3	0.456	3	0.547	2	0.430	5	0.590	4	0.595	3	0.595	2	0.321	4	0.459	2	0.490	4
TB12FF	0.275	5	0.369	5	0.438	4	0.555	1	0.429	6	0.593	2	0.604	2	0.626	1	0.330	2	0.470	1	0.518	1
CM05FF	0.256	7	0.334	7	0.381	7	0.488	4	0.415	10	0.569	7	0.569	6	0.585	4	0.302	6	0.428	6	0.498	2
CM10FF	0.254	8	0.337	6	0.385	6	0.484	5	0.416	9	0.572	5	0.574	5	0.587	3	0.309	5	0.435	4	0.491	3
TB12TB3	0.236	10	0.286	10	0.269	9	0.358	8	0.424	7	0.567	8	0.563	7	0.572	5	0.238	9	0.333	9	0.383	7
CM10CM1	0.250	9	0.305	9	0.296	8	0.361	7	0.417	8	0.552	10	0.526	9	0.489	8	0.284	8	0.374	7	0.396	6
EUROTB3	0.274	6	0.380	4	0.413	5	0.323	9	0.431	4	0.571	6	0.542	8	0.431	9	0.294	7	0.364	8	0.230	9
CP6TB6	0.340	1	0.500	1	0.559	1	0.426	6	0.459	1	0.634	1	0.623	1	0.506	7	0.339	1	0.429	5	0.289	8
BAACM10	0.303	2	0.324	8	0.218	10	0.168	10	0.437	2	0.553	9	0.461	10	0.293	10	0.234	10	0.175	10	0.138	10
NONE	0.196	11	0.201	11	0.115	11	0.097	11	0.373	11	0.489	11	0.414	11	0.269	11	0.118	11	0.123	11	0.076	11

TABLE 3.5 - KALMAN MULTIPERIOD FORECASTS (Out-of-Sample)

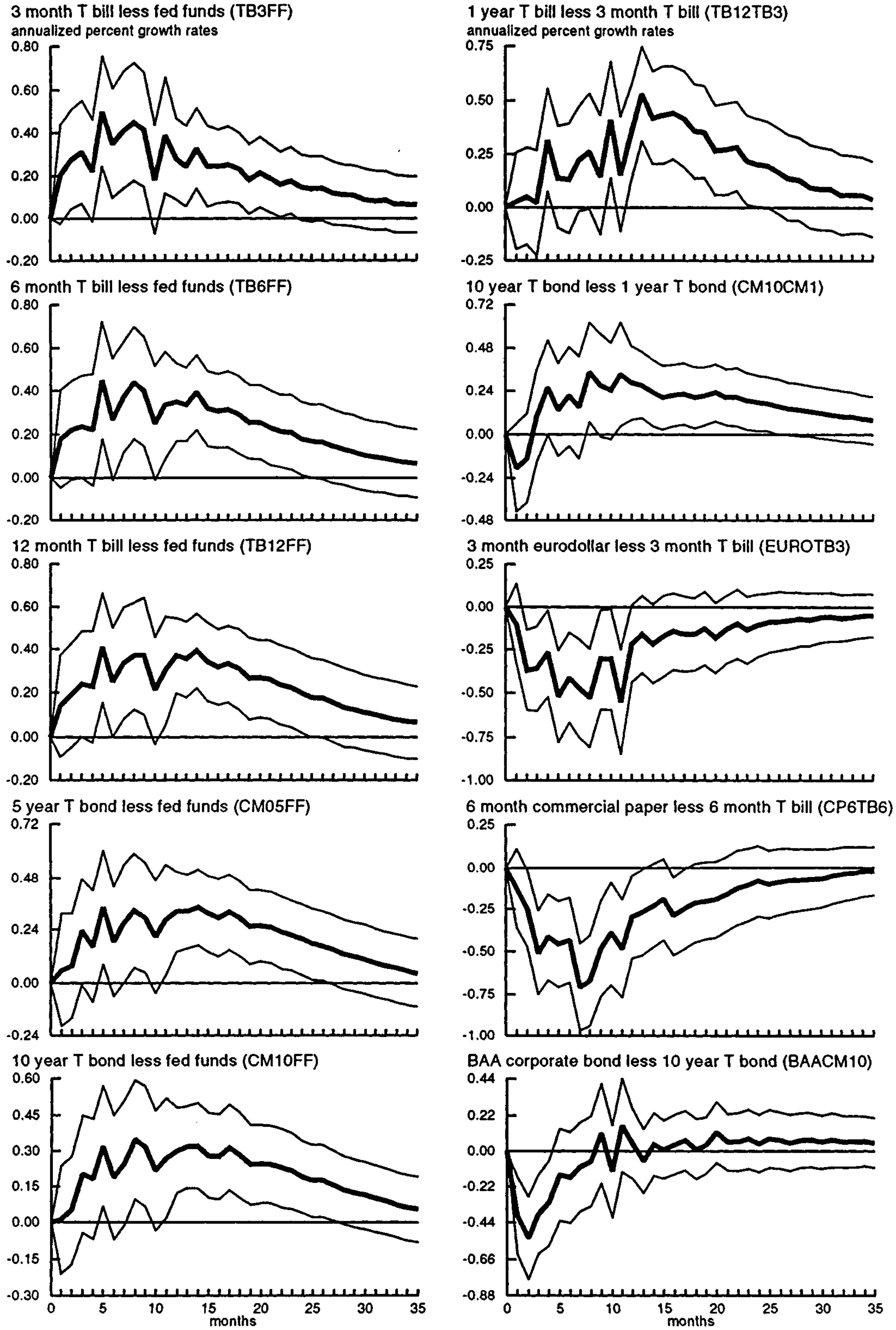
	MONTHLY (Jul 73 - Feb 92) INDUSTRIAL PRODUCTION								MONTHLY (Jul 73 - Feb 92) EMPLOYMENT								QUARTERLY (Jul 73 - Dec 91) GDP					
	1 MON		3 MOS		6 MOS		12 MOS		1 MON		3 MOS		6 MOS		12 MOS		1 QTR		2 QTRS		4 QTRS	
Indicator	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK
TB3FF	10.161	5	7.421	3	5.763	2	4.209	3	2.581	5	1.937	4	1.785	3	1.599	6	3.609	1	2.674	1	2.253	5
TB6FF	10.371	6	7.768	4	6.075	4	4.081	1	2.624	7	1.960	6	1.775	2	1.492	3	3.691	3	2.691	2	2.081	2
TB12FF	10.582	8	8.164	8	6.539	5	4.207	2	2.658	9	1.986	7	1.791	4	1.435	1	3.753	6	2.754	3	2.015	1
CM05FF	10.931	9	8.386	9	6.742	7	4.517	4	2.708	10	2.055	9	1.866	8	1.504	5	3.745	5	2.811	6	2.111	3
CM10FF	10.970	10	8.390	10	6.656	6	4.542	5	2.740	11	2.063	11	1.853	6	1.495	4	3.763	7	2.785	5	2.161	4
TB12TB3	11.054	11	8.539	11	7.169	11	4.906	7	2.653	8	2.030	8	1.866	7	1.479	2	4.197	11	3.187	9	2.370	6
CM10CM1	10.572	7	8.149	7	6.891	8	5.053	9	2.622	6	2.055	10	1.937	9	1.674	7	3.857	8	2.970	8	2.389	7
EUROTB3	9.898	3	7.289	2	5.937	3	5.048	8	2.512	3	1.926	3	1.834	5	1.779	9	3.698	4	2.886	7	2.721	8
CP6TB6	9.930	4	6.703	1	4.922	1	4.806	6	2.543	4	1.790	1	1.632	1	1.710	8	3.656	2	2.760	4	2.744	9
BAACM10	9.858	1	7.785	5	7.025	9	5.575	11	2.446	1	1.913	2	1.972	11	1.998	11	3.983	9	3.485	11	2.846	11
NONE	9.890	2	7.894	6	7.064	10	5.485	10	2.463	2	1.948	5	1.953	10	1.913	10	4.015	10	3.358	10	2.819	10

TABLE 3.6 - MULTIPERIOD ENCOMPASSING TESTS (Sample Period: Jan 62 - Dec 91)
Probability Value for Null Hypothesis: X is Encompassed by Y

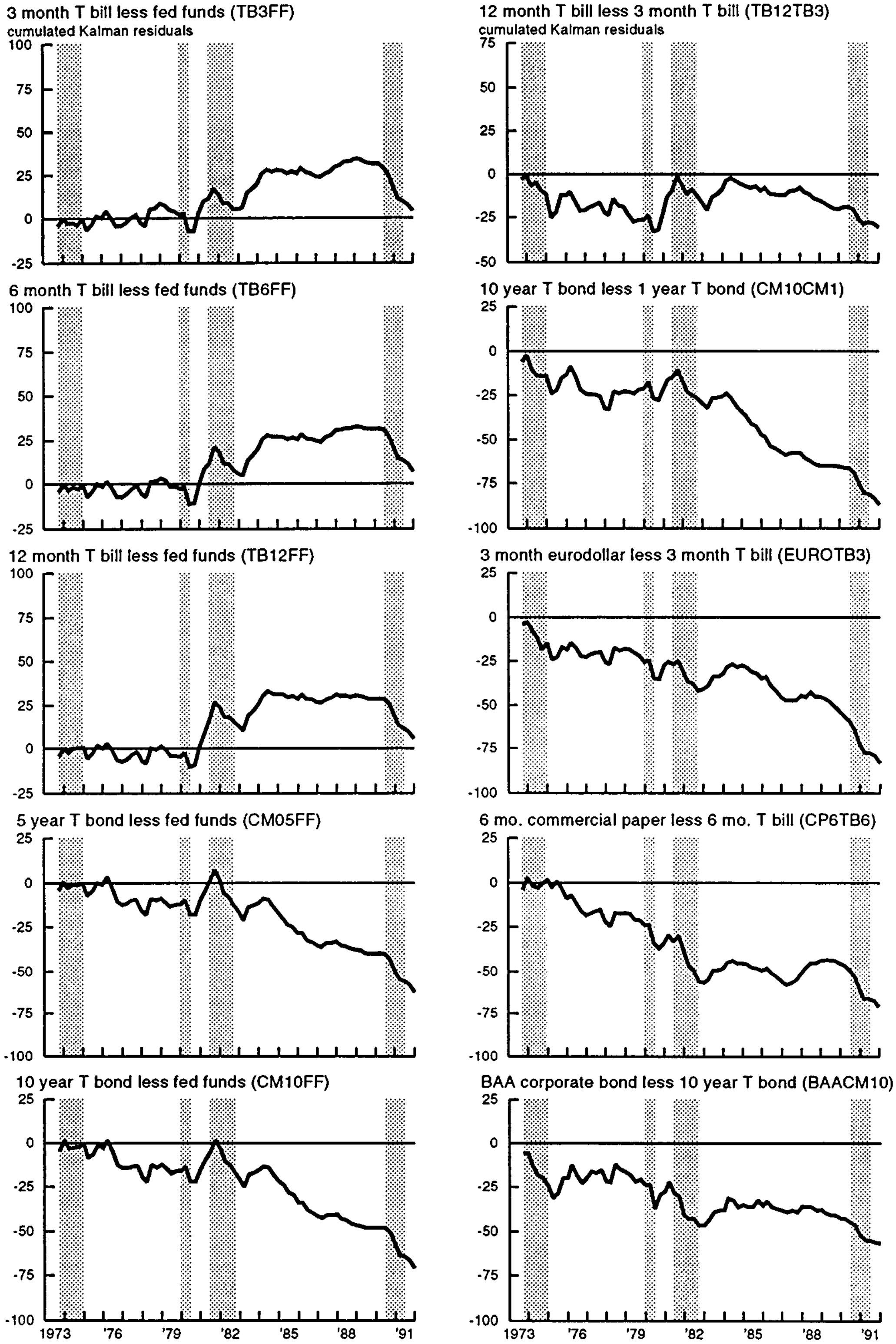
X \ Y	TB3FF	TB6FF	TB12FF	CM05FF	CM10FF	TB12TB3	CM10CM1	EUROTB3	CP6TB6	BAACM10	Maximum P Value
GDP: 1 qtr											
TB3FF	n.a.	0.185	0.167	--	--	--	--	--	0.156	--	0.185
TB6FF	0.462	n.a.	0.999	--	--	--	--	--	0.109	--	0.999
TB12FF	0.105	0.227	n.a.	--	--	--	--	--	--	--	0.227
CM05FF	--	0.109	0.389	n.a.	0.540	--	0.098	--	0.053	--	0.540
CM10FF	--	0.062	0.231	0.215	n.a.	--	0.077	--	--	--	0.231
TB12TB3	0.093	0.333	0.797	0.430	0.413	n.a.	0.115	--	0.055	--	0.797
CM10CM1	--	--	0.106	0.454	0.699	--	n.a.	--	--	--	0.699
EUROTB3	0.125	--	--	--	--	--	--	n.a.	0.186	--	0.186
CP6TB6	0.066	--	--	--	--	--	--	--	n.a.	--	0.066
BAACM10	--	--	--	--	--	--	0.072	0.053	0.104	n.a.	0.104
GDP: 2 qtrs											
TB3FF	n.a.	0.569	0.467	--	--	--	--	--	--	--	0.569
TB6FF	0.070	n.a.	0.798	--	--	--	--	--	--	--	0.798
TB12FF	--	0.155	n.a.	--	--	--	--	--	--	--	0.155
CM05FF	--	0.092	0.337	n.a.	0.665	--	--	--	--	--	0.665
CM10FF	--	0.055	0.206	0.271	n.a.	--	--	--	--	--	0.271
TB12TB3	--	0.256	0.755	0.370	0.353	n.a.	0.071	--	--	--	0.755
CM10CM1	--	--	0.126	0.876	0.710	--	n.a.	--	--	--	0.876
EUROTB3	0.214	--	--	--	--	--	--	n.a.	0.222	--	0.222
CP6TB6	0.093	--	--	--	--	--	--	--	n.a.	--	0.093
BAACM10	0.545	0.459	0.580	0.908	0.991	0.436	0.935	0.807	0.936	n.a.	0.991
GDP: 4 qtrs											
TB3FF	n.a.	0.322	0.548	0.131	0.092	--	--	--	--	--	0.548
TB6FF	--	n.a.	0.197	0.056	--	--	--	--	--	--	0.197
TB12FF	--	--	n.a.	--	--	--	--	--	--	--	0.027
CM05FF	--	--	0.176	n.a.	0.170	--	--	--	--	--	0.176
CM10FF	--	--	0.144	0.720	n.a.	--	--	--	--	--	0.720
TB12TB3	--	0.142	0.576	0.333	0.261	n.a.	--	--	--	--	0.576
CM10CM1	--	--	0.062	0.593	0.230	--	n.a.	--	--	--	0.593
EUROTB3	0.752	0.989	0.979	0.899	0.965	0.094	0.428	n.a.	0.560	--	0.989
CP6TB6	0.883	0.870	0.840	0.774	0.783	--	0.115	--	n.a.	--	0.883
BAACM10	0.500	0.392	0.442	0.863	0.930	0.111	0.973	0.569	0.575	n.a.	0.973

NOTE: Values less than or equal to 0.05 are marked with a dash.

3.1. Dynamic Response of Employment to Interest Rate Spreads



3.2. Interest Rate Spreads: Cumulated Kalman Residuals in Forecasting Real GDP



COMPOSITE INDICATORS

The composite indicator family consists of the NBER experimental leading indicator series (XLI) and the NBER experimental non-financial recession index (XRI2) (which measures the probability of a recession), the Department of Commerce leading indicators (LEAD), the National Association of Purchasing Managers Index (PMI), the change in the S&P 500 (S&P), changes in sensitive materials prices (SMPS), and the Kashyap-Stein-Wilcox "mix" (KSWMIX), which is the ratio of bank lending to the sum of bank lending and commercial paper lending [see Kashyap et al. (1991)]. It should be noted that the NBER experimental index includes the 10-year/1-year interest rate spread and the Commercial Paper spread and that the Department of Commerce leading indicator index includes real M2, which have been used in previous sections. All three leading indicator composites are designed to predict economic activity at a six-month horizon, though the optimization for the Department of Commerce index is not as specific as either of the NBER indices.

Table 4.1 shows that most of these series have the expected correlation with contemporaneous economic activity, except for the change in the S&P 500 which has small negative correlations with growth in industrial production and employment and only a small positive correlation with growth in real GNP. The KSWMIX variable is positively correlated with real GDP: one interpretation of this correlation is that increased (decreased) bank lending is associated with expansions (contractions).

Table 4.2 shows that all of these series perform very well in classical regression analysis. They all produce high R^2s. The R^2s for industrial production range from .289 to .391; the range for employment growth is .434 to .527; and the range for GDP is from .205 to .455. Further, each of these indicators Granger causes activity at a high level of significance. In terms of ranking, the Department of Commerce leading indicators and NBER experimental index are 1st and 2nd for all of the measures of economic activity, with the Department of Commerce leading indicators coming in 1st for industrial production and employment and the NBER experimental index coming in 1st for real GNP. The change in S&P 500 comes in last in every category and the change in sensitive materials prices comes in next to last in every category.

The dynamic response path graphs in Figure 4.1 show somewhat similar patterns.[7] For all three leading indicators series -- the NBER leading indicator, the NBER nonfinancial recession index and the Department of Commerce's leading indicators -- employment growth shows a rapid rise peaking at 5 months. From that peak all three graphs exhibit significantly different behaviors. The NBER leading indicator graph plateaus for 4-5 months and then drops off before the end of the year. Employment's response to changes in the NBER nonfinancial recession index drops off steadily from the peak while the response to changes in the Department of Commerce's response path is in-between with a high initial peak followed by a stable period then a steady decline.

The response of employment to the changes in the Purchasing Managers Index and the change in sensitive material prices both show dramatic jumps in forecasted employment growth peaking at 3 and 2 months, respectively. Employment increases then falls steadily in the Purchasing Managers Index graph while it plateaus in the sensitive material prices graph. The S&P 500 graph is similar, showing a leap up followed by a steady decline, except it has a small initial drop in the first month. It is interesting to note that all of these dynamic response paths are barely significant at the one year mark, despite showing fairly precisely estimated effects earlier. As a group these series seem to hold a lot of information about short-run changes in economic activity, with most of that information centered at the 3-9 month horizon.

Tables 4.4 and 4.5, which examine the forecasting ability of these indicators at different forecast horizons, in-sample and out-of-sample, show very stable rankings as the

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7. The dynamic response of employment to the KSWMIX variable is not reported since it is only available on a quarterly basis.

forecast horizon changes. The leading indicator series do best, posting very similar performances. The other series do not do as well, though the Purchasing Manager's Index does well at the one-month horizon for industrial production. Placing 3rd in-sample and 2nd out-of-sample for the one-month horizon then falling off at longer horizons. Among the leading indicator series, the Department of Commerce series does best at horizons of less than six months, while the NBER index ranks first for horizons of 6 months and longer. For GDP, the NBER index always does better with the differential in performance increasing with horizon. The KSWMIX variable does reasonably well in-sample, but out-of-sample it performs worse than "NONE," the no-indicator forecast. The one anomaly in the tables is that the change in sensitive material prices does very well out-of-sample for GDP at the 4 quarter horizon, actually outperforming all of the other indicators except the NBER leading indicator series.

The cumulated Kalman residuals in Figure 4.2 show some striking similarities and some differences in actual performance across these indicators. Except for KSWMIX, all of our composite indicators have overforecasted real GDP over time, as their cumulated residuals are consistently negative. This bias is clearly evident during recessions and becomes more dramatic after 1980. After 1982, while the negative bias is exacerbated in the NBER leading indicator and S&P 500, the path becomes somewhat more stable for most of our indicators. The NBER nonfinancial recession index is our best performer during this period, which is not surprising since the index was originally developed in response to the failure of the NBER leading indicator index to forecast the 1990-1991 recession.

The encompassing results in Table 4.6 show that for horizons of two- and four-quarters the NBER index dominates this entire family of indicators, with the possible exception of the KSWMIX. At the one-quarter horizon both the Department of Commerce and the NBER nonfinancial recession indices are not encompassed by any of the other forecasts. These results are not surprising in light of the ranking discussed earlier and the fact that the NBER leading indicator index was designed to provide a "best" forecast of economic activity at a six-month horizon, using virtually all of the macroeconomic data available. At the one- and two-quarter horizons, the KSWMIX is encompassed by the NBER index at the 5% significance level, but not the 10% level. We chose not to include the KSWMIX in the survivor list of indicators due to its poor out-of-sample performance in Table 4.5.

TABLE 4.1 - DESCRIPTIVE STATISTICS

Indicator	MONTHLY (Jan 63 - Feb 92)				QUARTERLY (Jan 63 - Dec 91)		
	Mean	Std. Dev.	Correlation with Industrial Production	Correlation with Employment	Mean	Std. Dev.	Correlation with Real GDP
XLI	3.070	4.162	0.439	0.429	3.039	4.067	0.547
XRI2	0.157	0.139	-0.556	-0.523	0.156	0.131	-0.649
LEAD	2.990	11.148	0.454	0.249	2.993	8.832	0.600
PMI	53.380	7.668	0.524	0.681	53.400	7.473	0.632
S&P	6.463	42.410	-0.028	-0.050	6.451	24.588	0.185
SMPS	0.319	0.930	0.325	0.444	0.322	0.912	0.278
KSWMIX					0.925	0.040	0.316

TABLE 4.2 - CLASSICAL GOODNESS-OF-FIT STATISTICS

	MONTHLY (Jan 63 - Feb 92) INDUSTRIAL PRODUCTION					MONTHLY (Jan 63 - Feb 92) EMPLOYMENT					QUARTERLY (Jan 63 - Dec 91) GDP				
Indicator	R2	Change in R2	SEE	P-Value	Rank	R2	Change in R2	SEE	P-Value	Rank	R2	Change in R2	SEE	P-Value	Rank
XLI	0.369	0.165	8.353	0.0000	2	0.484	0.104	2.198	0.0000	2	0.455	0.338	2.893	0.0000	1
XRI2	0.338	0.134	8.555	0.0000	4	0.483	0.102	2.200	0.0000	3	0.385	0.268	3.073	0.0000	3
LEAD	0.391	0.187	8.204	0.0000	1	0.527	0.146	2.104	0.0000	1	0.405	0.288	3.022	0.0000	2
PMI	0.355	0.152	8.439	0.0000	3	0.463	0.083	2.241	0.0000	4	0.265	0.148	3.359	0.0005	4
S&P	0.289	0.085	8.864	0.0002	6	0.434	0.054	2.301	0.0029	6	0.205	0.089	3.493	0.0222	7
SMPS	0.300	0.096	8.795	0.0000	5	0.436	0.056	2.297	0.0019	5	0.232	0.115	3.433	0.0045	6
KSWMIX											0.243	0.126	3.410	0.0023	5

TABLE 4.3 - MAXIMUM IMPACT OF DYNAMIC MULTIPLIERS

	MONTHLY (Jan 63 - Feb 92) INDUSTRIAL PRODUCTION			MONTHLY (Jan 63 - Feb 92) EMPLOYMENT			QUARTERLY (Jan 63 - Dec 91) GDP		
Indicator	Months to Max	Max Impact	Std. Dev. at Max	Months to Max	Max Impact	Std. Dev. at Max	Quarters to Max	Max Impact	Std. Dev. at Max
XLI	6	2.441	0.455	5	0.650	0.124	3	1.731	0.310
XRI2	3	-2.668	0.446	5	-0.811	0.137	2	-1.829	0.309
LEAD	5	2.475	0.453	5	0.766	0.132	2	1.851	0.274
PMI	2	2.655	0.454	3	0.617	0.124	2	1.223	0.314
S&P	5	2.310	0.487	7	0.596	0.145	2	0.935	0.322
SMPS	2	1.801	0.468	2	0.401	0.120	7	-0.679	0.246
KSWMIX							2	1.021	0.302

TABLE 4.4 - MULTIPERIOD FORECASTS (In-Sample)

	MONTHLY (Jan 63 - Feb 92) INDUSTRIAL PRODUCTION								MONTHLY (Jan 63 - Feb 92) EMPLOYMENT								QUARTERLY (Jan 63 - Dec 91) GDP					
	1 MON		3 MOS		6 MOS		12 MOS		1 MON		3 MOS		6 MOS		12 MOS		1 QTR		2 QTRS		4 QTRS	
Indicator	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK	R2	RANK
XLI	0.369	2	0.555	2	0.638	1	0.510	1	0.484	2	0.675	2	0.694	1	0.608	1	0.455	1	0.568	1	0.401	1
XRI2	0.337	4	0.419	3	0.364	3	0.255	6	0.484	3	0.646	3	0.584	3	0.417	3	0.382	3	0.316	3	0.168	6
LEAD	0.391	1	0.569	1	0.606	2	0.460	2	0.527	1	0.705	1	0.656	2	0.500	2	0.405	2	0.341	2	0.247	2
PMI	0.355	3	0.389	4	0.356	4	0.255	5	0.463	4	0.580	4	0.483	5	0.325	6	0.265	4	0.203	7	0.173	5
S&P	0.289	6	0.364	5	0.349	5	0.269	4	0.434	6	0.572	5	0.530	4	0.381	4	0.205	7	0.216	5	0.152	7
SMPS	0.300	5	0.346	6	0.327	6	0.334	3	0.436	5	0.547	6	0.479	6	0.345	5	0.232	6	0.206	6	0.229	3
KSWMIX	-		-				-	-								-	0.243	5	0.249	4	0.193	4
NONE	0.204	7	0.204	7	0.116	7	0.088	7	0.381	7	0.493	7	0.417	7	0.282	7	0.117	8	0.117	8	0.072	8

TABLE 4.5 - KALMAN MULTIPERIOD FORECASTS (Out-of-Sample)

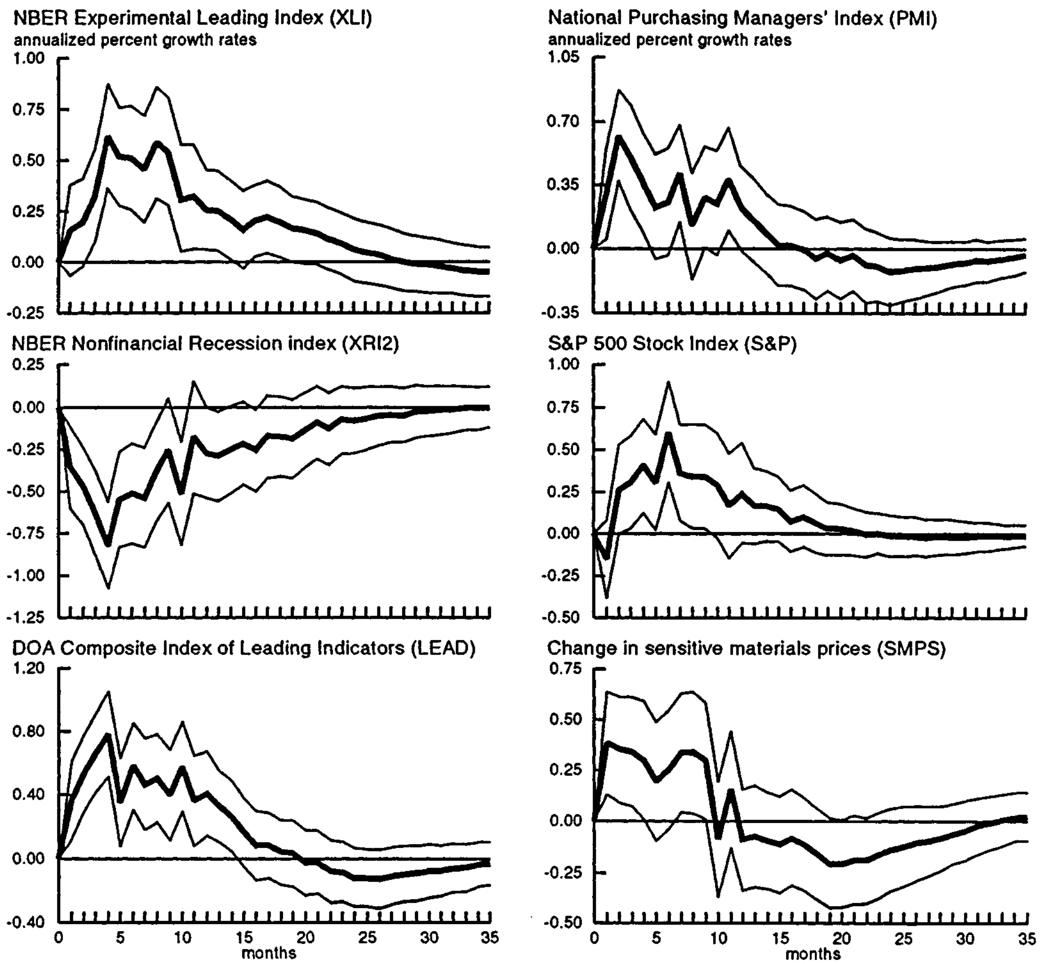
	MONTHLY (Jul 73 - Feb 92) INDUSTRIAL PRODUCTION								MONTHLY (Jul 73 - Feb 92) EMPLOYMENT								QUARTERLY (Jul 73 - Dec 91) GDP					
	1 MON		3 MOS		6 MOS		12 MOS		1 MON		3 MOS		6 MOS		12 MOS		1 QTR		2 QTRS		4 QTRS	
Indicator	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK	RMSE	RANK
XLI	9.441	3	6.293	2	4.586	1	4.226	1	2.405	3	1.662	2	1.481	1	1.473	1	3.246	1	2.376	1	2.392	1
XRI2	9.589	4	7.353	4	6.604	6	5.444	6	2.439	4	1.801	3	1.839	3	1.897	4	3.427	3	3.026	3	2.758	5
LEAD	9.057	1	6.081	1	4.899	2	4.449	2	2.290	1	1.614	1	1.632	2	1.717	2	3.307	2	3.024	2	2.669	3
PMI	9.172	2	7.163	3	6.156	3	5.101	4	2.402	2	1.864	4	1.935	6	1.978	7	3.838	4	3.319	6	2.736	4
S&P	9.921	7	7.442	6	6.287	4	5.124	5	2.522	7	1.921	5	1.884	4	1.882	3	3.964	6	3.253	4	2.758	6
SMPS	9.685	5	7.391	5	6.291	5	4.779	3	2.495	6	1.944	6	1.926	5	1.915	5	3.914	5	3.306	5	2.612	2
KSWMIX		-										-	-	-	-		4.078	8	3.377	8	2.846	8
NONE	9.894	6	7.945	7	7.125	7	5.575	7	2.467	5	1.953	7	1.966	7	1.943	6	4.052	7	3.369	7	2.799	7

TABLE 4.6 - MULTIPERIOD ENCOMPASSING TESTS (Sample Period: Jan 63 - Dec 91)
Probability Value for Null Hypothesis: X is Encompassed by Y

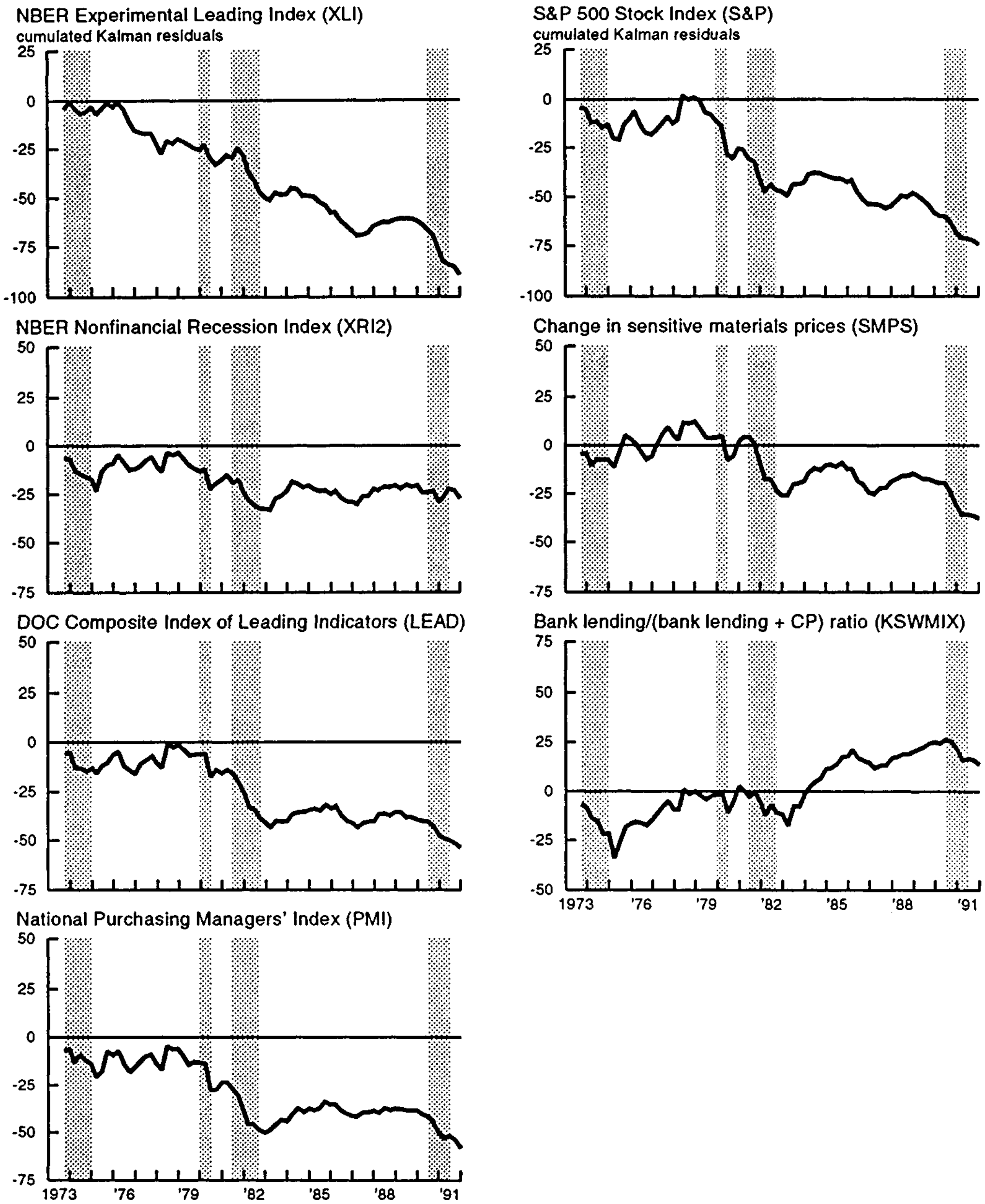
X \ Y	XLI	XRI2	LEAD	PMI	S&P	SMPS	KSWMIX	Maximum P Value
					GDP: 1 qtr			
XLI	n.a.	--	--	--	--	--	--	0.001
XRI2	--	n.a.	--	--	--	--	--	0.012
LEAD	--	--	n.a.	--	--	--	--	0.030
PMI	0.300	0.195	0.889	n.a.	--	--	--	0.889
S&P	0.754	0.334	0.619	0.100	n.a.	0.090	--	0.754
SMPS	0.598	0.114	0.923	0.127	--	n.a.	--	0.923
KSWMIX	0.061	--	0.088	--	--	--	n.a.	0.088
					GDP: 2 qtrs			
XLI	n.a.	--	--	--	--	--	--	0.000
XRI2	0.370	n.a.	--	--	--	--	--	0.370
LEAD	0.761	--	n.a.	--	--	--	--	0.761
PMI	0.609	0.603	0.314	n.a.	0.065	0.197	0.143	0.609
S&P	0.897	0.211	0.861	--	n.a.	0.097	0.064	0.897
SMPS	0.644	0.305	0.728	0.162	0.160	n.a.	0.179	0.728
KSWMIX	0.087	--	0.060	--	--	--	n.a.	0.087
					GDP: 4 qtrs			
XLI	n.a.	--	--	--	--	--	--	0.000
XRI2	0.939	n.a.	0.690	0.282	--	0.310	0.113	0.939
LEAD	0.420	--	n.a.	0.076	--	0.087	--	0.420
PMI	0.903	0.244	0.829	n.a.	0.121	0.636	0.181	0.903
S&P	0.616	0.104	0.748	0.303	n.a.	0.329	0.142	0.748
SMPS	0.377	0.055	0.153	--	--	n.a.	0.090	0.377
KSWMIX	0.166	0.056	0.056	0.113	--	0.196	n.a.	0.196

NOTE: Values less than or equal to 0.05 are marked with a dash.

4.1. Dynamic Response of Employment to Composite Indicators



4.2. Composite Indicators: Cumulated Kalman Residuals in Forecasting Real GDP



MIXING MODELS FOR REAL GDP

This section analyzes those indicators drawn from the previous sections that contain independent information and did well in the out-of-sample Kalman rankings. The indicators are subjected to another round of encompassing tests and rankings. Finally the usefulness of these final indicators is assessed in the context of a time-varying forecast-mixing model.

Table 5.1 presents the Kalman forecast RMSE for the one-, two-, and four-quarter horizon forecasts of real GDP. For the one-quarter horizon the best indicators are the NBER composite indicators (XLI and XRI2), and the Department of Commerce Leading Indicators Index (LEAD). The spreads and real M2 do the worst at this short horizon, but all of the remaining indicators do contribute information beyond the own past history of GDP (NONE). At the two-quarter horizon, the best indicator is the NBER leading indicator index with the 12-month/Federal Funds rate spread coming in a distant second: the NBER leading indicator index is 14% more accurate than the 12-month/Federal Funds rate spread. This is not surprising since the NBER leading indicator index was constructed by Stock and Watson to produce the "best" forecast of the growth in economic activity over the six-month horizon considered here. Turning to the four-quarter horizon, it seems surprising that the NBER leading indicator index comes in last after the 12-month/Federal Funds rate spread, the Federal Funds rate, the 10-year/Federal Funds spread, and real M2. This demonstrates again that the choice of economic indicators depends critically upon the horizon being forecast-- at the four-quarter growth horizon, a different collection of interest rate spreads than the ones selected by Stock and Watson are useful.

New encompassing results are displayed in Table 5.2. At this point, the purpose of these tests is to narrow the list of indicators in a structured manner. However, a rigid adherence to a statistical significance level is not maintained if an indicator is relatively useful and of independent interest. At the one-quarter horizon, the composite indicators (the NBER leading indicator index, the NBER nonfinancial recession index, and the Department of Commerce leading indicators) are each undominated and together sufficient. The two-quarter horizon is more interesting. Three indicators are clearly necessary. The NBER leading indicator index is undominated, and the 12-month/Federal Funds rate spread is undominated at the 10% level. The 3-month Eurodollar rate is not covered by these two indicators, and it is not dominated at the 11% significance level. Real M2 is also included in this final cut for two reasons: it is only covered by the NBER leading indicator index at the 14% significance level and it is of inherent interest as the best monetary aggregate considered here. Finally, notice that the 6-month Commercial paper spread (CP6TB6) did not make the final list at the two-quarter forecast horizon, but it is a component of the NBER leading indicator index.

At the four-quarter horizon, three indicators are undominated: the Federal Funds rate, real M2, and the 12-month/Federal Funds rate spread. The NBER leading indicator index does not contain independent information beyond these indicators. The 10-year/Federal Funds rate spread is included in the final list for three reasons: it is undominated at the 15% significance level, it covers the NBER leading indicators index better than the shorter end of the term structure (12-month/Federal Funds rate spread), and it is interesting to include a long spread at this horizon since Stock and Watson found a long spread useful at the two-quarter horizon.

The next step is to combine these forecasts into a forecasting model (for each horizon) which allows the weights on the indicators to vary over time depending upon their recent performance. Essentially we would like the model to take the following form:

$$F_t = \phi_{1t}\, for(A)_t + \phi_{2t}\, for(B)_t + \phi_{3t}\, for(C)_t$$

where *for*(A) represents a forecast based upon indicator A and F_t is the combined forecast. The weights ϕ_{it} should be non-negative and sum to one: in this case, the indicator's weight is a direct measure of its importance for the forecast. When the weights vary over time according to their forecast accuracy, the time path of the weights provide a direct measure of the indicators' reliability over time. We implement this model in the following way. Let ϵ_{it}^2 be the sum of (recent) squared forecast errors based upon indicator i's model. In this paper, we take "recent" to be one year of known forecast errors (4 quarters). Let $avg_t(\epsilon_{it}^2)$ be the average of the ϵ_{it}^2s at time t and μ_i is the average of ϵ_{it}^2 - $avg_t(\epsilon_{it}^2)$ over time. Then ϕ_{it} is defined to be:

$$\phi_{it} = \alpha_i - \beta_i \left(\epsilon_{it}^2 - avg_t(\epsilon_{it}^2) - \mu_i\right), \qquad \alpha_i, \ \beta_i \geq 0$$

where the parameters α and β can be estimated by a linear regression model if the non-negativity constraints are ignored, or nonlinear methods if the constraints are imposed.[8] Since ϵ_{it}^2 - $avg_t(\epsilon_{it}^2)$ - μ_i is mean zero by construction, the time-variation due to the β's nets out to zero over time. Consequently, the α estimates represent the average weight associated with each indicator forecast. However, over short periods of time when an indicator's forecast misbehaves, its errors ϵ_{it}^2 will be larger than the average errors; this will lead to the indicator's forecast receiving a temporarily smaller weight.

Table 5.3 displays the estimated α weights for these models. The one-quarter results indicate that the NBER leading indicator index is the most reliable, having an average weight of .533 in the combined forecast. The other indices (NBER Experimental Recession Index and the BEA Leading Indicators Index) received about equal shares of the remaining weight. The β's in this case are estimated to be zero; that is, there is no significant contribution to the forecast accuracy by allowing the weights to vary over time.

The two-quarter results are more interesting. As was expected from the encompassing results, the NBER leading indicator index receives the bulk of the weight in

8. The results in Table 5.3 were obtained by imposing the nonnegativity constraints. Initially, each of the β's was constrained to be positive. If the initial estimate was on the boundary (zero), its corresponding time-varying component was deleted from the estimation. The α's were constrained to be positive and sum to one.

the final forecast (61%). This agrees with the analysis of Stock and Watson who constructed the NBER leading indicator index explicitly for its ability to forecast at this two-quarter ahead horizon. We do find that real M2 receives a substantial weight (19%), while the 12-month/Federal Funds rate spread is at 10% and the 3-month Eurodollar rate is 9%. Figure 5.1 graphs the time path of the ϕ weights for these four indicators, as well as the two-quarter GDP forecast and actual. Notice first that the NBER leading indicator index forecasts have been quite reliable, only once dropping below a 50% weight in the combined forecast. Real M2, however, has varied dramatically in its usefulness, going negative on two occasions: in 1976 and immediately following the 1981-82 recession. During that recession, real M2 did not forecast negative growth at any time (although it did in the 1980 recession), whereas the 3-month Eurodollar rate, the 12-month/Federal Funds rate spread, and the NBER leading indicators index did forecast negative growth during some portion of this recession.[9] This poor performance is captured in the time-varying model by decreasing the weight on the real M2 forecast temporarily until it begins to improve. On the other hand, during the most recent recession real M2 has gone above a 50% weight (keep in mind that the average weight for real M2 is .19). During this time, real M2 has grown only slowly and this lead to a forecast of slow growth during 1991 (see Figure 5.1). At this same time, the 3-month Eurodollar rate, the 12-month/Federal Funds rate spread, and the NBER leading indicators index signalled substantially higher growth than was realized. Each of these indicators is currently receiving less than its average weight. Consequently, the time-varying mixing model finds that real M2 has been an unusually useful indicator during the recent recession,

9. It is useful to remember that the primary components of the NBER leading indicators index are the 6-month Commercial paper spread and the 10-year/1-year spread. So it should not be surprising that the NBER leading indicator index misbehaved during this period when the 3-month Eurodollar rate and the 12-month/Federal Funds rate spreads also misbehaved.

despite its generally erratic performance at this horizon versus its relative failure at the twelve month horizon.

By contrast the four-quarter horizon results appear to be a picture of stability. Real M2 and the 12-month/Federal Funds rate spread receive the largest unconditional weights, 41% and 37% respectively. The Federal Funds rate and the 10-year/Federal Funds rate spread receive considerably less (around 10% each). The graphs of the time-varying weights indicate that, at this horizon, real M2 and the 12-month/Federal Funds rate spread have been reasonably reliable indicators, always staying near their unconditional weight. On the other hand, the 10-year/Federal Funds spread has been extremely unreliable, going to zero or negative in 1987-88 and during the recent recession.

The contrast between the dominance of the NBER leading indicator index at the six-month forecast horizon versus its lack of independent information at the twelve-month horizon demonstrates strongly the need for a different set of indicators for each forecast horizon. The usefulness of the 12-month/Federal Funds rate spread and real M2 for forecasting real GDP at the twelve-month horizon indicates that a different index would be constructed if this forecast horizon was the relevant objective. A note on standard errors is in order. Examination of Table 5.3 indicates that the standard errors associated with the parameters of these mixing models are fairly large. This is not surprising in light of the high degree of collinearity that would be expected of a set of reasonably successful forecasts. In fact, it is typically the case that only the strongest indicator at a given horizon is statistically significant. All this is saying is that the relative weights among successful indicators is subject to substantial uncertainty and that the marginal information after the first one or two indicators is quickly dropping toward 0. Nevertheless the point estimates and time paths of these relative weights provide a useful bench-mark, even though the precision they are estimated with would not change strongly held prior beliefs.

TABLE 5.1 - KALMAN RESIDUALS FOR SURVIVING INDICATORS

Quarterly (Jul 73 - Dec 91)

Real GDP

	1 Qtr		2 Qtrs		4 Qtrs	
Indicator	RMSE	Rank	RMSE	Rank	RMSE	Rank
EURO3	3.622	4	2.754	3	n.a.	n.a.
FF	n.a.	n.a.	n.a.	n.a.	2.160	2
M2R	3.674	6	2.844	5	2.219	4
CP6TB6	3.656	5	2.760	4	n.a.	n.a.
TB12FF	3.753	7	2.751	2	2.002	1
CM10FF	n.a.	n.a.	n.a.	n.a.	2.161	3
XLI	3.246	1	2.376	1	2.392	5
XRI2	3.427	3	n.a.	n.a.	n.a.	n.a.
LEAD	3.307	2	n.a.	n.a.	n.a.	n.a.
NONE	4.052	8	3.369	6	2.799	6

n.a.: The indicator is not an initial survivor at this forecast horizon.

TABLE 5.2 - MIXED MULTIPERIOD ENCOMPASSING TESTS (Sample Period: Jan 63 - Dec 91)
Probability Value for Null Hypothesis: X is Encompassed by Y

X \ Y	EURO3	FF	M2R	CP6TB6	TB12FF	CM10FF	XLI	XRI2	LEAD	Maximum P Value
					GDP: 1 qtr					
EURO3	n.a.	0.100	--	--	--	--	0.107	--	--	0.107
FF	0.958	n.a.	--	--	0.067	--	0.144	--	--	0.958
M2R	--	--	n.a.	--	--	--	0.168	--	0.055	0.168
CP6TB6	--	--	--	n.a.	--	--	0.288	--	--	0.288
TB12FF	0.186	0.193	--	--	n.a.	--	0.453	--	--	0.453
CM10FF	0.168	0.098	--	--	0.260	n.a.	0.809	--	--	0.809
XLI	--	--	--	--	--	--	n.a.	--	--	0.001
XRI2	--	--	--	--	--	--	--	n.a.	--	0.012
LEAD	--	--	--	--	--	--	--	--	n.a.	0.030
					GDP: 2 qtrs					
EURO3	n.a.	0.110	--	--	--	--	--	--	--	0.110
FF	0.868	n.a.	--	--	0.161	--	--	--	--	0.868
M2R	--	--	n.a.	--	--	--	0.139	--	--	0.139
CP6TB6	--	--	--	n.a.	--	--	0.304	--	--	0.304
TB12FF	0.064	0.082	--	--	n.a.	--	0.062	--	--	0.082
CM10FF	0.076	--	--	--	0.228	n.a.	0.514	--	--	0.514
XLI	--	--	--	--	--	--	n.a.	--	--	0.000
XRI2	--	--	0.066	--	--	--	0.370	n.a.	--	0.370
LEAD	--	--	0.230	0.088	--	--	0.761	--	n.a.	0.761
					GDP: 4 qtrs					
EURO3	n.a.	0.609	--	--	--	--	--	--	--	0.609
FF	--	n.a.	--	--	--	--	--	--	--	0.023
M2R	--	--	n.a.	--	--	--	--	--	--	0.007
CP6TB6	0.270	0.327	0.420	n.a.	0.850	0.779	0.401	--	--	0.850
TB12FF	--	--	--	--	n.a.	--	--	--	--	0.011
CM10FF	--	--	--	--	0.147	n.a.	--	--	--	0.147
XLI	--	--	0.105	--	0.157	0.298	n.a.	--	--	0.298
XRI2	0.791	0.817	0.959	0.364	0.839	0.711	0.939	n.a.	0.690	0.959
LEAD	0.102	0.122	0.960	--	0.240	0.300	0.420	--	n.a.	0.960

NOTE: Values less than or equal to 0.05 are marked with a dash.

TABLE 5.3 - RELATIVE WEIGHTS IN MIXING REGRESSIONS

	Real GDP		
Indicator	**1 Qtr**	**2 Qtrs**	**4 Qtrs**
EURO3	*	0.093 (0.260)	n.a.
FF	n.a.	n.a.	0.105 (0.209)
M2R	*	0.187 (0.227)	0.414 (0.178)
CP6TB6	*	*	n.a.
TB12FF	*	0.103 (0.238)	0.368 (0.259)
CM10FF	n.a.	n.a.	0.114 (0.212)
XLI	0.533 (0.174)	0.617 (0.197)	*
XRI2	0.214 (0.155)	n.a.	n.a.
LEAD	0.253 (0.206)	n.a.	n.a.

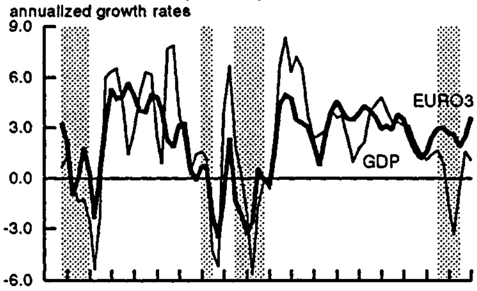
NOTES:
- Numbers in parenthesis are standard errors.
- n.a.: The indicator is not an initial survivor at this forecast horizon.
- (*): The indicator is encompassed by other indicators at this horizon.

5.1. Mixing Results

2 Quarter Ahead Forecast vs. Actual

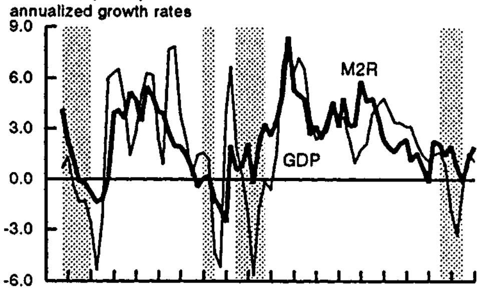
3 month eurodollar (EURO3)

annualized growth rates

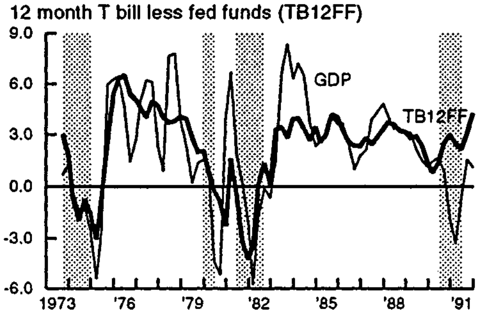


Real M2 (M2R)

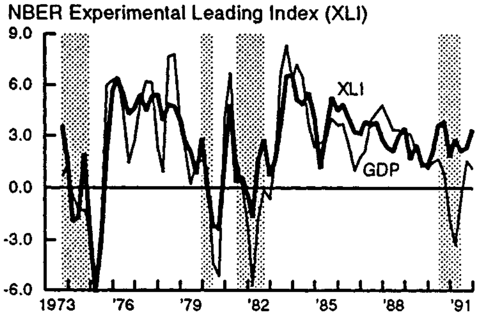
annualized growth rates



12 month T bill less fed funds (TB12FF)



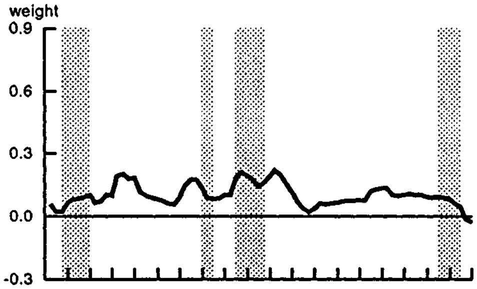
NBER Experimental Leading Index (XLI)



Forecast Reliability Weight

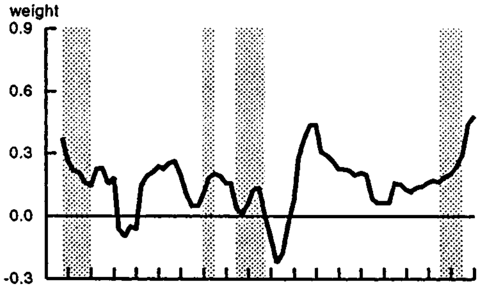
3 month eurodollar (EURO3)

weight

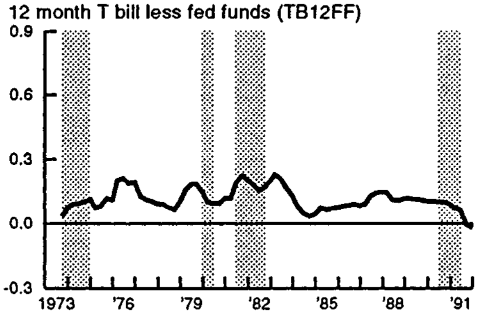


Real M2 (M2R)

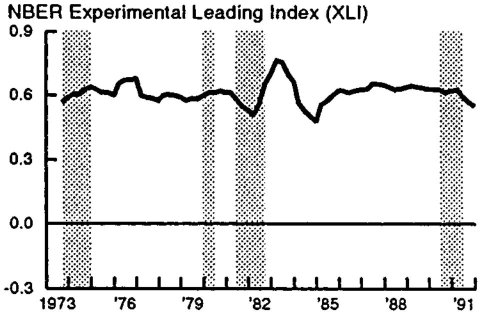
weight



12 month T bill less fed funds (TB12FF)

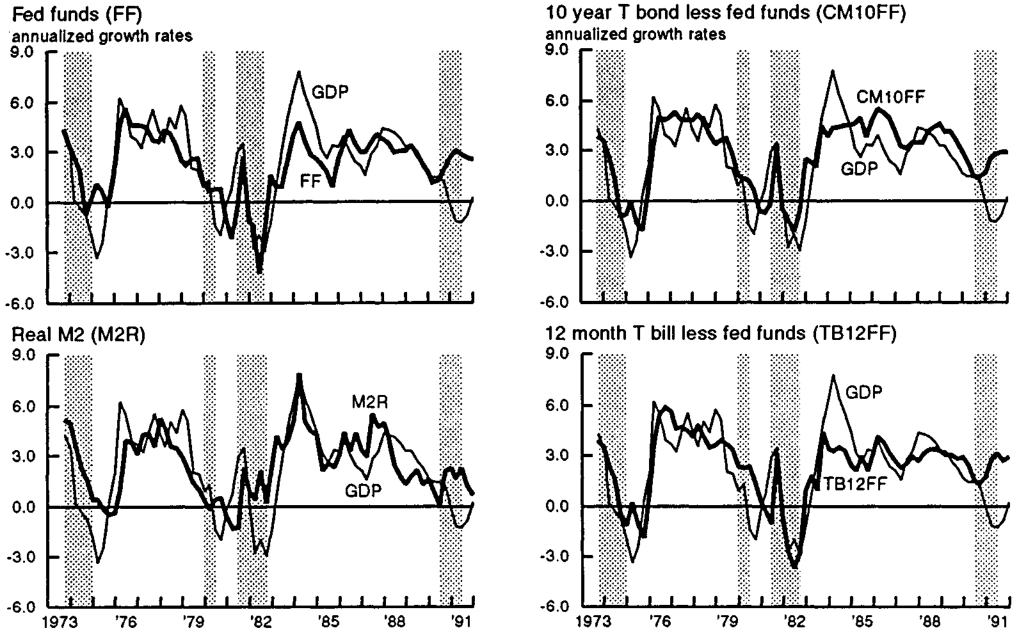


NBER Experimental Leading Index (XLI)

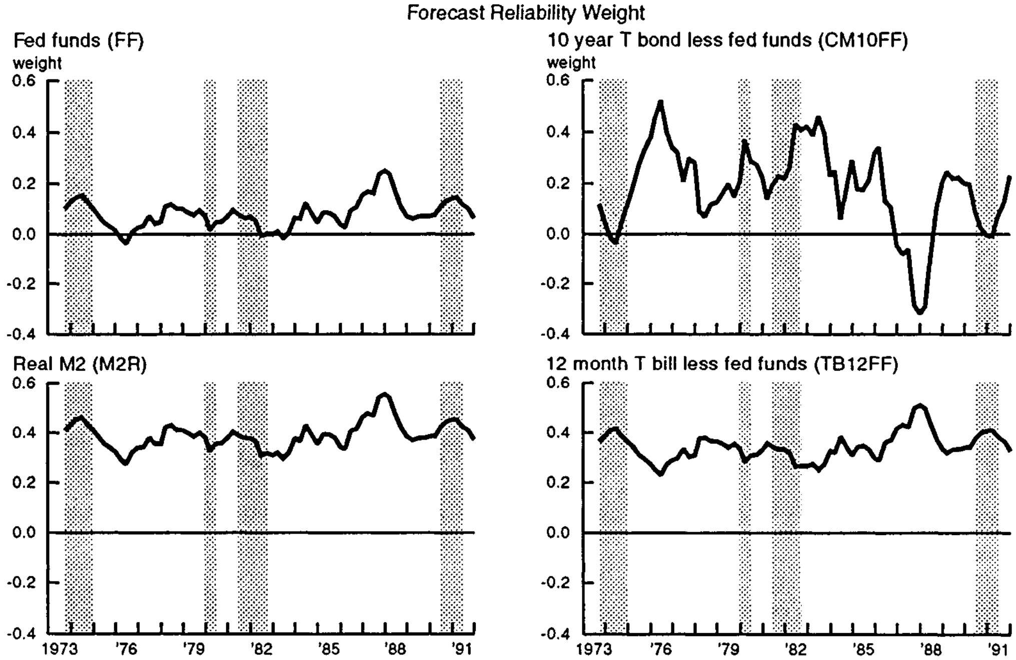


5.2. Mixing Results

4 Quarter Ahead Forecast vs. Actual



Forecast Reliability Weight



CONCLUSION

Four things become clear as the preceding analysis developed. First, the forecast horizon is an essential aspect of choosing and evaluating indicators. Second, substantial information resides in the term and public-private spreads and that both of these seemingly very different types of spreads seem to include significant common as well as distinct information sets. Third, while composite indicators may be extremely useful they are only as good as their design allows. The Stock-Watson NBER leading indicator series does very well at precisely what it was designed for, forecasting economic activity at a six-month horizon. Its usefulness beyond this is far more limited than prior analysis would have suggested. The analysis is also suggestive that the type of general purpose target variable that the old monetary targeting literature sought, probably does not exist at least in terms of real economic activity. Policymakers will continue to need to mix information according to their current focus. Mixing models of the sort used in this paper are meant to be preliminary work in this regard. The early results are intriguing.

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