Bayesian Probability Forecast of Recession 2001

Mehdi Mostaghimi, Ph.D.

Department of Economics and Finance

School of Business

Southern Connecticut State University

New Haven, Connecticut 06515

Phone: (203) 392-5625

Email: mostaghimi@SouthernCT.edu

URL: http://www.SouthernCT.edu/~mostaghi

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Approaches to Predicting A Downturn in an Economy

• There are two approaches to modeling predicting a turning point in the state of an economy: *Regression Based* and *Event Oriented.*

• Econometric models are mostly regression based with an orientation to predict the values of an economic variable, such as Real GDP, first, and then use it to infer about the state of the whole economy (Sims 1980, Sargent and Sims 1977, Stock and Watson 1989)

  • Their predictions of the overall economy have not been very accurate.

• Event Oriented models assume that recessions and expansions are two distinct states of the economy, each with its own behavior. Then, probability models are developed to detect a switch from one state to another (Neftci 1982, Hamilton 1989, Mostaghimi and Rezayat 1997).

  • Mostly use Composite Leading Indicators.

  • Produce good predictions of the overall state of an economy.

• A comparison of the performance of these two approaches is in Del Negro, 2001.

• The methodology of this research is event oriented.

Methodology I

- Suppose X_t is a stochastic variable measuring the percentage changes in the Composite Leading Indicators.
    - A Change in the behavior of X_t indicates a change in the behavior of the overall economy
- X_t œ $W = \{w_0, w_1, \ldots, w_M\}$
- X_t has two distinct and independent behaviors for before and after a time k.
- $q_d(X_d)$ and $q_u(X_u)$ are two multinomial probability distributions of a down turn and of an upturn in the economy, respectively.
- $F(X_t)$ is the actual probability of a change in the Composite Leading Indicators.
- At time t, the only information available about X is its mean value = q.

Methodology II

- Given that an economy is in a normal state of expansion, the interest is in finding the probability of a switch to a down turn state.
- Posterior probability density of a down turn:

$$Pr_d(F(X) \mid q_d * \theta_k, \theta_{(k\&1)}, \ldots, \theta_1) \mid$$

$$\frac{Pr_d(\theta_k, \theta_{(k\&1)}, .., \theta_1 * F(X) \mid q_d).Pr_d(F(X) \mid q_d)}{[Pr_d(\theta_k, \theta_{(k\&1)}, .., \theta_1 * F(X) \mid q_d).Pr_d(F(X) \mid q_d) \% Pr_u(\theta_k, \theta_{(k\&1)}, .., \theta_1 * F(X) \mid q_u).Pr_u(F(X) \mid q_u)]}$$

- $Pr_d(q_k, q_{(k-1)}, \ldots, q_1 \mid F(X) = q_d)$ is the likelihood function of a downturn.
- $Pr_d(F(X) = q_d)$ is the prior distribution of a downturn.
- The problem is to assess the likelihood functions of a downturn and of an upturn.

Assessment: Likelihood Function of A Downturn

- The likelihood function of a downturn is assessed as:

$$Pr_d(\theta_K, \theta_{(K-1)}, \ldots, \theta_1 * q_d) \propto \exp\{-\sum_{k=1}^{K} I_d^{k*(k-1),\ldots,1}\}.$$

- where $I_d^{k|(k-1),\ldots,1}$ is the mean conditional information measure of q_k of a downturn, given that $q_{(k-1)}, \ldots, q_1$ are already observed.
- The likelihood function of an upturn is similarly assessed.

Assessment: Information Measures

- The conditional information measure of a downturn is assessed as:

$$I_d^{k*(k\&1),\ldots,1} \cdot I_d^{k} \% I_d^{k,(k\&1),\ldots,1} \& I_d^{(k\&1),\ldots,1}$$

Marginal (incremental) information of q_k over $q_{(k-1)},\ldots, q_1$ about a downturn

- where
  - $I_d^{k} \triangleq I(p_d^{k*},q_d)$ is the minimum relative entropy information measure between q_k and q_d,
  - $I_d^{k,(k-1),\ldots,1}$ is the joint amount of information in q_k, $q_{(k-1)},\ldots, q_1$ about a downturn.
- Thus, the likelihood of a downturn is assessed as

$$Pr_d(\theta_k,\theta_{(k\&1)},\ldots,\theta_1 * q_d) \cdot \kappa \exp\{\&[\sum_{k=1}^{K} I_d^{k} \% I_d^{K,(K\&1),\ldots,1}]\}$$

Application to the U.S. Economy: 1959 - 1999

• This methodology is applied to the U.S. Economy, using the Composite Leading Indicators, to estimate the posterior probability of a downturn.

• Percentage monthly changes in the Composite Leading Indicators (CLI) for the period of 1959 – 1999 are used to:

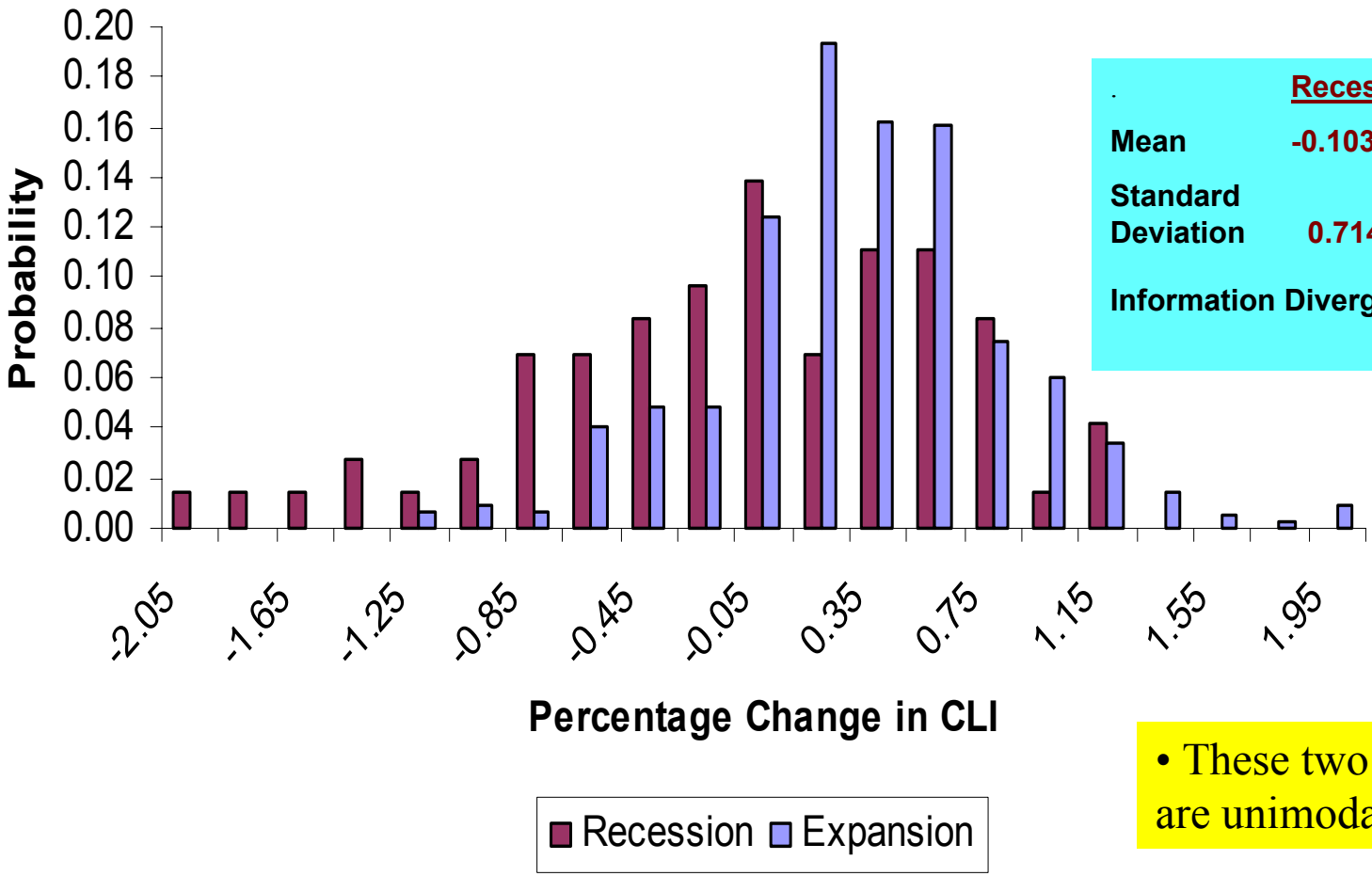
  • Estimate probability mass functions of downturn (q_d) and of upturn (q_u).

  • Estimate the joint information measures for downturn ($I_d^{k,(k-1),...,1}$) and for upturn ($I_u^{k,(k-1),...,1}$).

• This information is used to estimate the likelihood functions of downturn and of upturn and the posterior probabilities of downturn.

  • Non-informative prior probabilities are used.

Distributions of Percentage Change in CLI - 1959:1999 - CLI1996 = 100



	Recession	Expansion
Mean	-0.103	0.283
Standard Deviation	0.714	0.520

Information Divergence = 0.72

• These two distributions are unimodal symmetric.

Joint Information Measures for Downturn and Upturn Periods: 1959 - 1999

• Under a normality assumption, the joint information measure of a downturn is a function of its correlation matrix W_d:

$$I_d^{k,(k\&1),\ldots,1} \cdot \&\frac{1}{2}\ln * W_d *.$$

• The same assumption is made for the upturn joint information measure.

• Percentage monthly changes in the Composite Leading Indicators (CLI) for the period of 1959 – 1999 are used to measure autocorrelations:

Autocorrelations of percentage changes in CLI for the Recession and Expansion Periods: 1959 - 1999

		Lag Time									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Average	**Recession Periods**	0.111	-0.002	-0.102	-0.085	-0.111	-0.219	-0.091	-0.016	-0.031	-0.133
	Expansion Periods	0.312	0.225	0.083	0.106	0.017	0.113	0.043	0.036	0.025	0.019

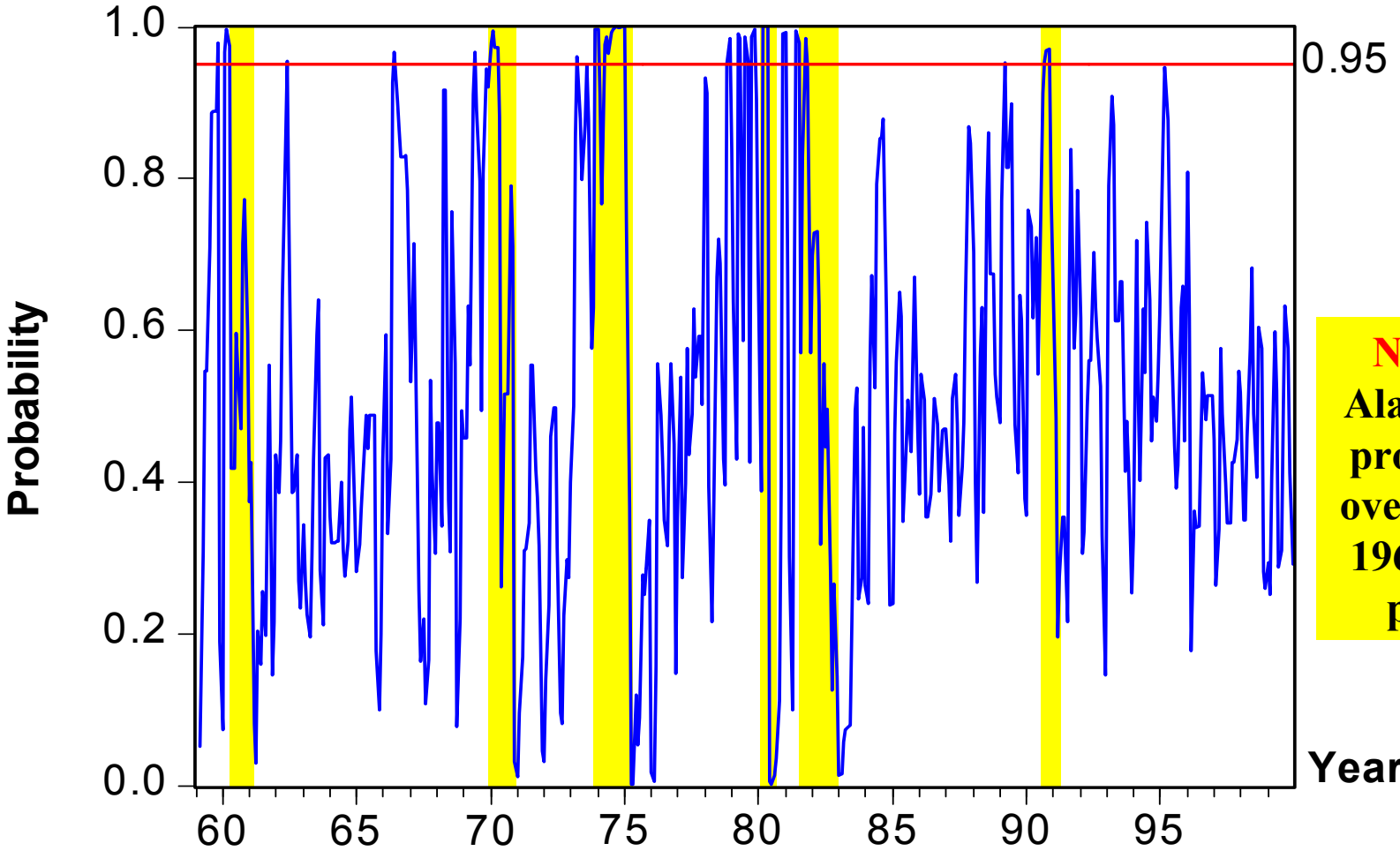
-Recession periods are overwhelmingly negatively correlated.

-Expansion periods are all positively correlated.

Posterior Probability Forecast of A Downturn in the U.S. Economy: 1959 – 1999.

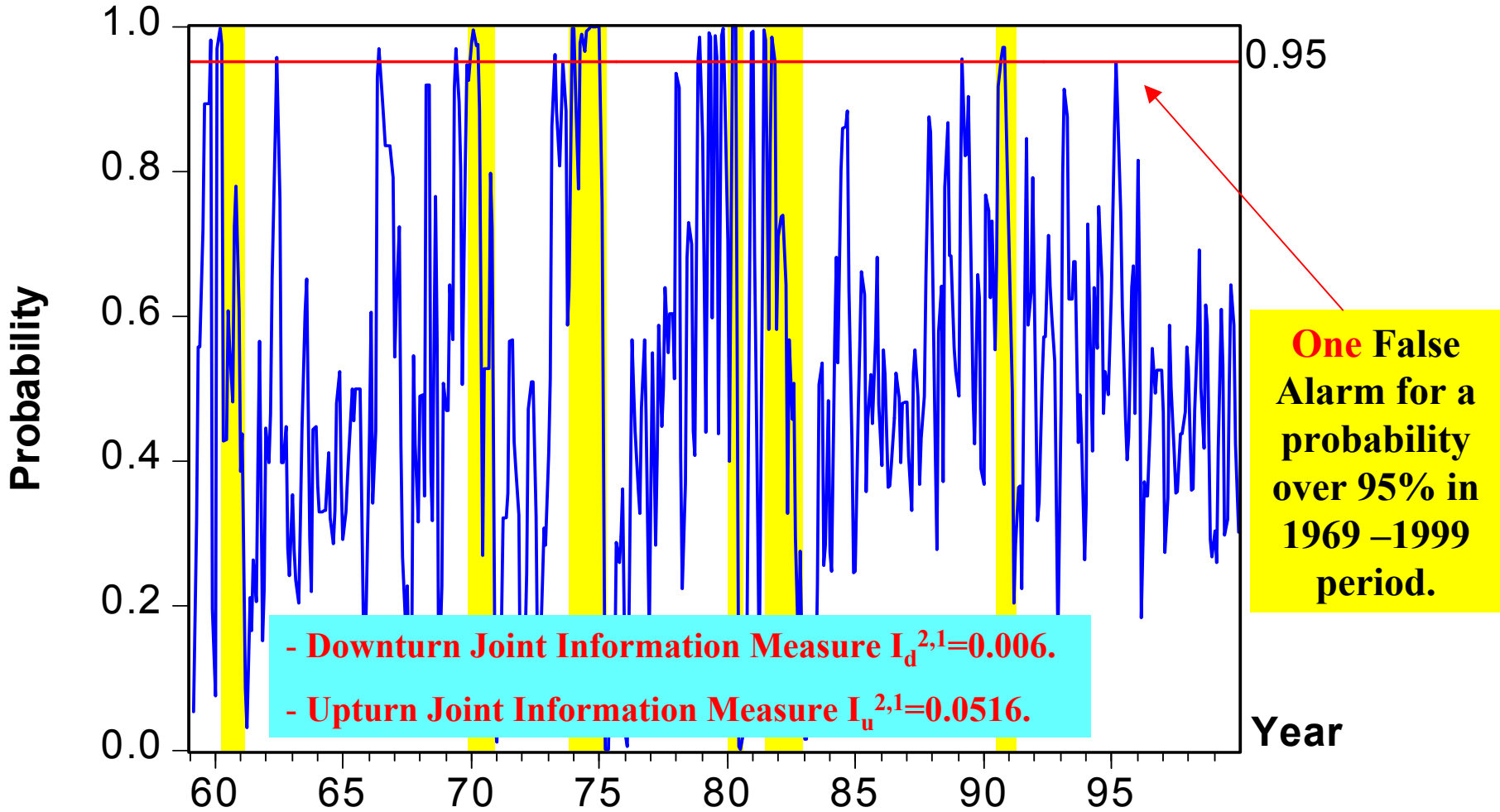
- A good predictor of a turning point must be reliable in accurately identifying a true turning point with no or few false alarms.
- An optimal amount of information is required to develop a good predictor
    - More information is not necessarily better.
- A good property of this methodology is that it will let you decide what number of consecutive CLI's to use.
- The optimal amount of information for predicting a down turning point for this period turned out to be the values of 2 consecutive CLIs, with no autocorrelation is used.

BPFD2_1996: Bayesian Probability Forecast of a Downturn Using 2 Consecutive CLI - CLI1996 = 100



No False Alarm for a probability over 95% in 1969 –1999 period.

BPFDc2_1996: Bayesian Probability Forecast of a Downturn Using 2 Consecutive CLI - CLI1996 = 100



Evaluation of BPFD2-1996 versus BPFDc2-1996 at 95%: 1959 -1999

Both Models Have Performed Well with BPFD2-1996's Performance Is Marginally Better.

NBER Peaks	BPFD2-1996 Signal Dates	BPFD2-1996 Lead (-) Lag(+)	BPFD2-1996 NCDS	BPFDc2-1996 Signal Dates	BPFDc2-1996 Lead (-) Lag(+)	BPFDc2-1996 NCDS
60/04	59/11	-5	1	59/11	-5	1
	60/02	-2	3	60/02	-2	3
	62/06		1	62/06		1
	66/06		1	66/05		2
69/12	69/06	-6	1	69/06	-6	1
	70/01	+1	4	70/01	+1	4
73/11	73/04	-7	1	73/04	-7	1
	73/12	+1	2	73/08	-3	1
	74/04	+5	10	73/12	+1	2
				74/04	+5	10
80/01	78/11	-14	2	78/11	-14	2
	79/04	-10	2	79/04	-10	2
	79/07	-6	2	79/07	-6	2
	79/10	-3	2	79/10	-3	2
	80/03	+2	3	80/03	+2	3
81/07	80/12	-7	2	80/12	-7	2
	81/06	-1	2	81/06	-1	2
	81/10	+3	1	81/10	+3	2
90/07	89/03	-16	1	89/03	-16	1
	90/09	+2	3	90/09	+2	3
				95/03		1

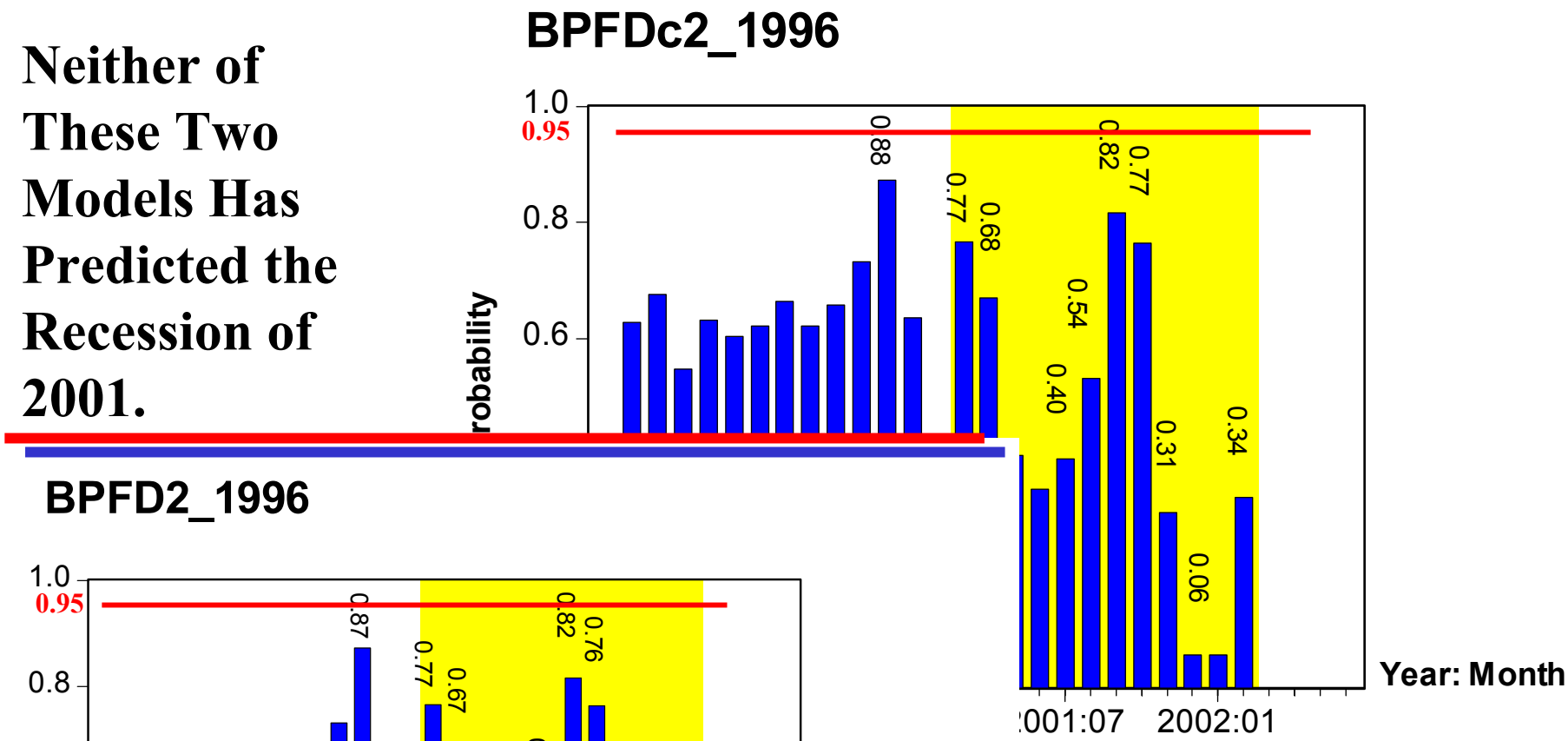
False Alarms

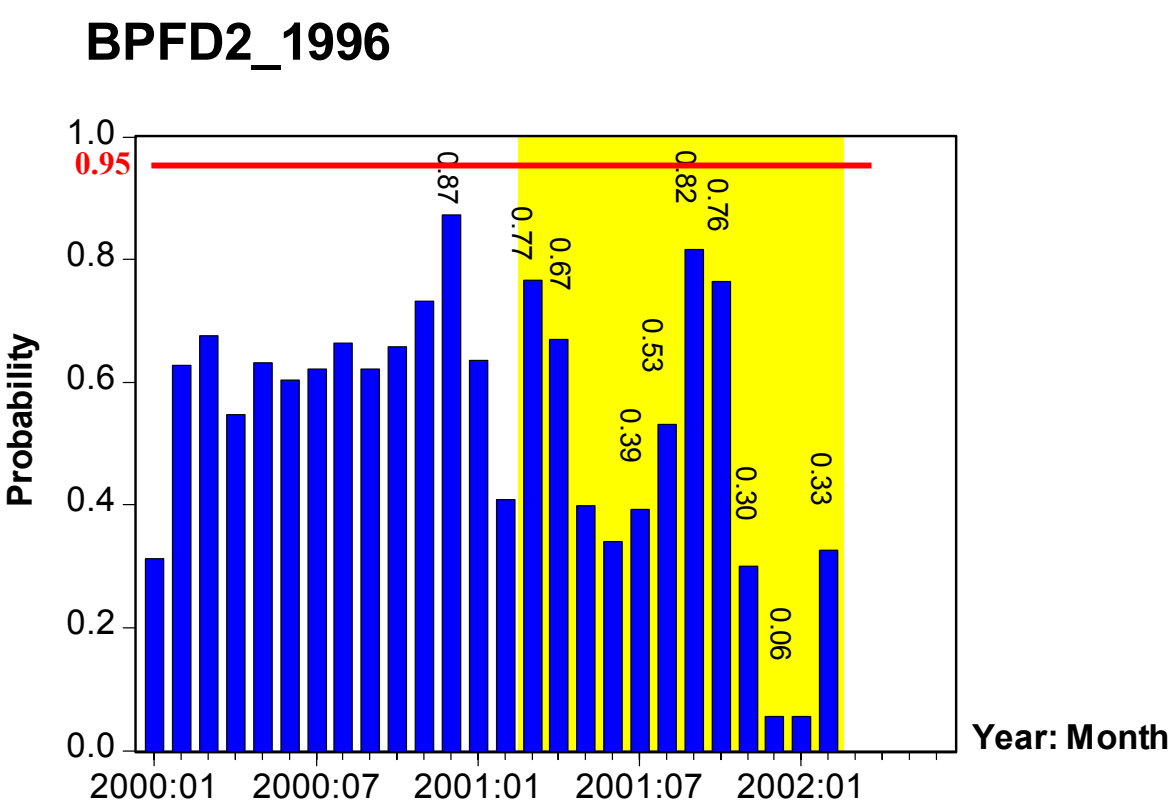
Differences

- In 1969 – 1999 Period, BPFD2-1996 had predicted all the recessions with no False Alarm.

- BPFDc2-1996 had only 1 False Alarm.

Neither of These Two Models Has Predicted the Recession of 2001.





BPFDc2_1996 probabilities are generally higher (by up to 2%) due to lower autocorrelations in downturn periods.

Is the U.S. Economy in a Recession?

Two Views:

I. There are good evidence, especially in the manufacturing sector and in unemployment rate, to indicate that the economy has possibly contracted enough to be in a recession.

- The CLI performance is distorted by too much influence of the Federal Reserve System's expansionary Monetary Policy of cutting interest rate and increasing money supply (65%).

II. The economy has slowed down, but not contract to a level to be in a recession; as evidenced by only a one-quarter negative growth rate in Real Growth Domestic Products.

- CLI has performed well providing accurate information about the near future state of the economy.