Prediction of the Rise of Unemployment in the U.S.

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Prediction

Strong and lasting rise of unemployment rate in the US civilian labor force is predicted to start by February 2007. It is expected to last for about 20 months. Estimated probability that this is not a false alarm and such a rise will start by that date is above 70%.
This prediction is obtained by the previously published algorithm of pattern recognition type http://www.igpp.ucla.edu/prediction/ref/Unemployment.pdf. It is based on analysis of macroeconomic indicators; depending on their subsequent behavior the alarm might be extended past 2006 for the few more months.

Explanations

Methodology used for that prediction is discussed in detail in [1] and references therein. Here, its basic elements are briefly outlined.

Targets of prediction are schematically illustrated in Fig. 1. The thin curve shows the monthly rate of unemployment. Thick curve shows this rate with seasonal variations smoothed out. Arrow indicates prediction target - the start of a sharp and lasting increase of the smoothed rate. We call this target by the acronym *FAU*, for "Fast Acceleration of Unemployment." Algorithm for determination of FAUs are defined in [1],

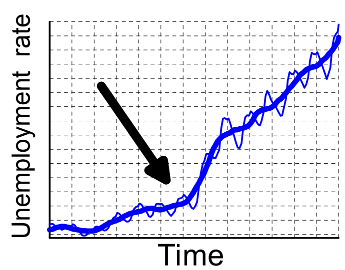

Figure 1. Schematic definition of prediction target.

Three indicators used for prediction: ***IP*** ***- total U.S. industrial production*** in real (constant) dollars. ***S-*** *short-term interest rate on 90-day U.S. treasury bills*, at an annual rate. ***L*** ***-*** *long-term interest rate on 10-year U.S. treasury bonds*, at an annual rate. Time series of these indicators are taken from the CITIBASE, where *IP*, *FYGM3*, and *FYGT10* are their respective mnemonics.
Noteworthy, the prediction algorithm based on these indicators was developed first by analysis of similar indicators for France and then applied to US.

Possible outcomes of prediction. Our prediction targets are rare (extreme) point events. Accordingly, prediction algorithm is of the pattern recognition kind: at each moment it indicates whether *FAU* should or should not be expected within the subsequent τ month; in other words predictor is discrete sequence of "alarms" - the time intervals where a *FAU* is predicted to start. Three possible outcomes of such a prediction are illustrated in Fig. 2. Inevitable probabilistic component of prediction is represented by probability of errors of each kind and total duration of alarms in % to the time period where algorithm was applied.

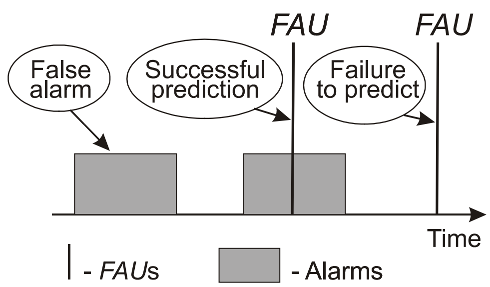

Fig. 2. Possible outcomes of prediction.

Note the difference of our problem from classical Kolmogorov-Wiener problem of predicting continuous function, when predictor is a continuous function too.

Experiment in prediction-in-advance. Algorithm has been developed using the data from January 1964 to August 1999. Since then it is being applied as identifying two alarms so far (Fig. 3). First one happened to be correct: rise of unemployment was predicted to start between March and December 2000; *FAU* has actually started in June 2000. Here, we communicate the current prediction.

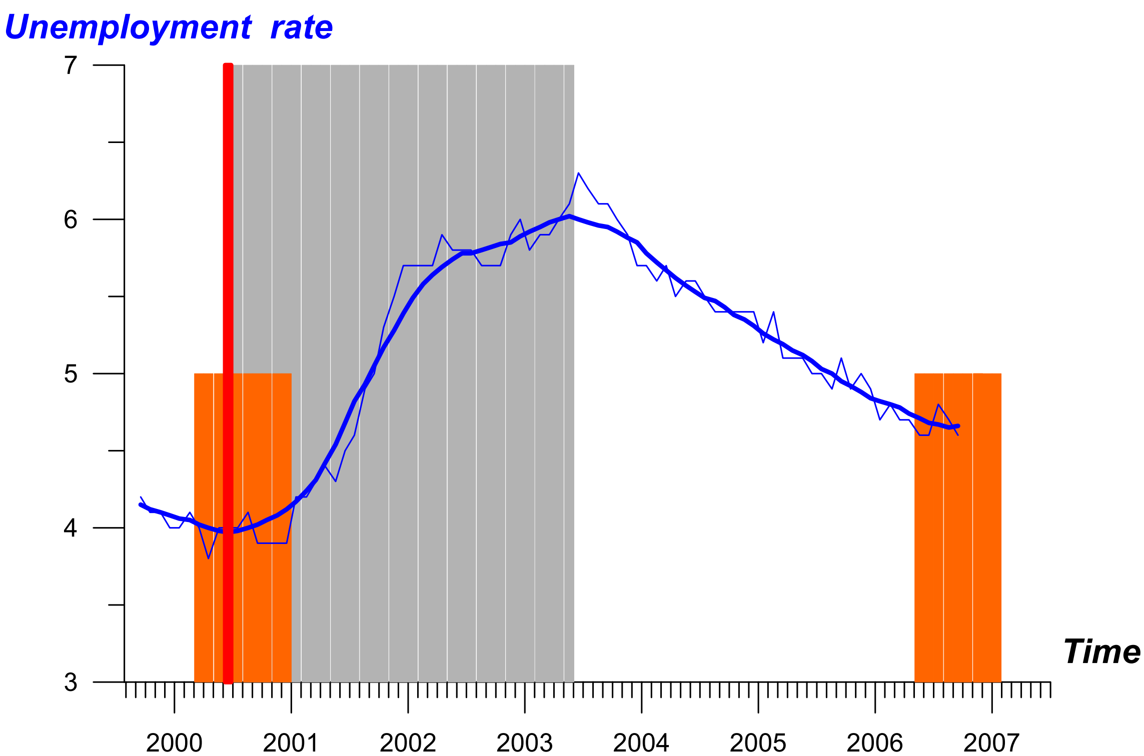

Figure 3. Advance prediction of *FAU*s in the US
Blue curves show monthly rates of unemployment: Thin curve shows original data of Bureau of Labor Statistics, U.S. Department of Labor (http://data.bls.gov); thick curve sows the data with seasonal variations smoothed away. Orange bars – periods of alarms. Grey bars – periods of unemployment rise. Vertical red line – moment of the only *FAU* since the experiment started. This *FAU* confirms the first alarm. Second alarm is current.

Prediction algorithm, unambiguously defined, is based on the trends of macroeconomic indicators. It consists of the following steps.

--*Determination of the trends***.** Let $I(m)$ be a monthly time series of an indicator considered (***IP* or *L* or *S***); time is defined by the integer m - the sequence number of a month. $W^I(m/s)$ is the local linear least-squares regression of $I(m)$ within a sliding time window $(m - s, m)$,

$$W^I(m/s) = K^I(m/s)l + B^I(m/s),\ l = m - s,\ m - s + 1,\ m - s + 2,\ \ldots\ m, \quad (1)$$

We approximate a trend by the regression coefficient $K^I(m/s)$. It may be used for prediction since it does *not* depend on information on the future: its value is attributed to the *end* of the time window where it is determined.

--*Discretization.* On the next step we determine "premonitory" values of each trend, which emerge more frequently as a *FAU* approaches. This is done on the lowest (binary) level of resolution: we distinguish only *large* and *low* values, separated by a certain threshold. Preprecursory values are coded as “1”, opposite values - as “0”.

Thus the description of the unemployment-relevant situation is reduced to a monthly time series of binary vectors. In case of three indicators considered here the *large* values of the trends $\boldsymbol{K^I(m/s)}$ are premonitory in that sense. Fig. 4 shows that different indicators became precursory on different time intervals shown in red.

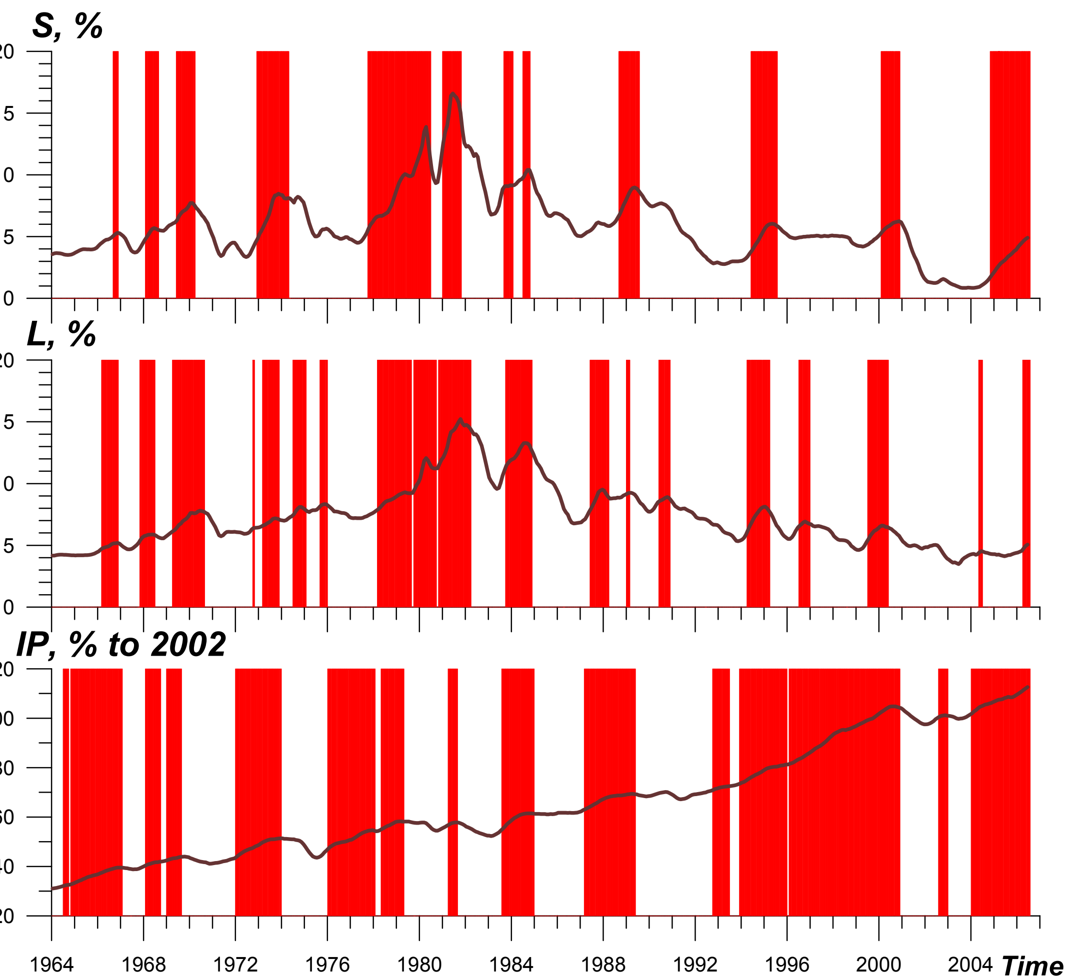

Fig. 4. Precursory trends of indicators

Brown curves show smoothed indicators; *IP* is defined in % to 2002.

Red bars show time intervals when the trend of an indicator was large (i.e. above the respective threshold).

-- *Determination of alarms*. In terms of pattern recognition this is done by “voting”.

Let $\Delta(m)$ be the number of zeros in the binary code of the situation (that is the number of non-precursory indicators) in a month m. *An alarm is declared for 6 months after each month with* $\Delta(m) = 0$ *that is all three indicators are precursory (regardless of whether this month belongs or not to an already determined alarm)*.

Application of the algorithm. Alarms during the period 1964-2006 are shown in and the upper panel Fig. 5 and Table 1. Upper panel of Fig.5 juxtaposes *FAU*s, alarms, and smoothed unemployment rate.

Bottom panel shows contribution of separate indicators to formation of each alarm. We see that the triplet of indicators considered gives much shorter alarms and lower rate of false alarms comparing with each individual indicator.

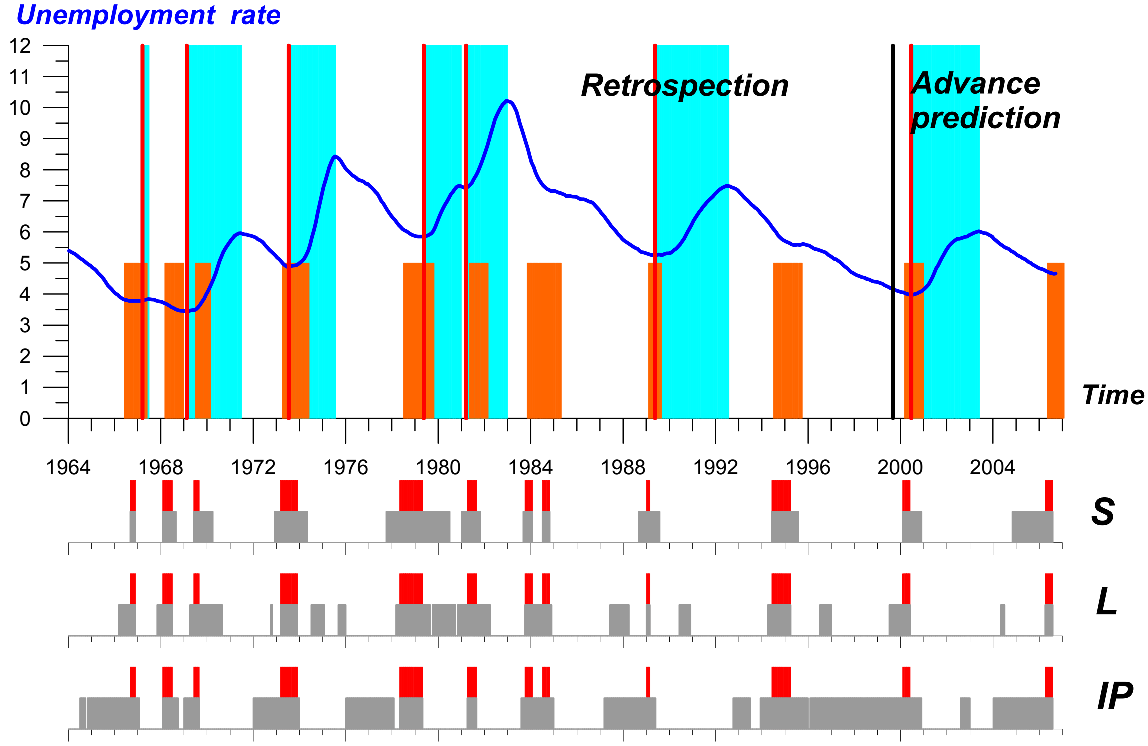

Figure 5. Alarms and *FAU*s

Top panel: Blue curve shows monthly unemployment rate data smoothed over one year. Red vertical lines show moments of the *FAU*s, cyan bars – periods of unemployment acceleration, orange bars – periods of alarms.

Bottom panel: Grey bars indicate the months when the trend of an indicator was premonitory. Red bars indicate months when all three indicators have premonitory trends ($\Delta(m) = 0$).

Table 1 shows the same data in digital form for the time period from 1999 onwards. Similar table for 1964 onwards is available on request.

Table 1. Binary vectors that code trends of indexes *IP*, *L*, and *S*
(1 – large trend, 0 – low trend)
The period of the unemployment rate growth is marked by grey color.
Months when all tree Δ(*m*) = 0 are marked by "+".

Month	*IP*	*L*	*S*	Δ		
1999:09	1	1	0	1		
1999:10	1	1	0	1		
1999:11	1	1	0	1		
1999:12	1	1	0	1		
2000:01	1	1	0	1		
2000:02	1	1	1	0	+	
2000:03	1	1	1	0	+	
2000:04	1	1	1	0	+	
2000:05	1	1	1	0	+	
2000:06	1	1	1	0	+	*FAU*
2000:07	1	0	1	1		
2000:08	1	0	1	1		
2000:09	1	0	1	1		
2000:10	1	0	1	1		
2000:11	0	0	0	3		
2000:12	0	0	0	3		
2001:01	0	0	0	3		
2001:02	0	0	0	3		
2001:03	0	0	0	3		
2001:04	0	0	0	3		
2001:05	0	0	0	3		
2001:06	0	0	0	3		
2001:07	0	0	0	3		
2001:08	0	0	0	3		
2001:09	0	0	0	3		
2001:10	0	0	0	3		
2001:11	0	0	0	3		
2001:12	0	0	0	3		
2002:01	0	0	0	3		
2002:02	0	0	0	3		
2002:03	0	0	0	3		
2002:04	0	0	0	3		
2002:05	0	0	0	3		
2002:06	0	0	0	3		
2002:07	0	0	0	3		
2002:08	1	0	0	2		
2002:09	1	0	0	2		
2002:10	1	0	0	2		
2002:11	1	0	0	2		
2002:12	1	0	0	2		
2003:01	0	0	0	3		
2003:02	0	0	0	3		
2003:03	0	0	0	3		
2003:04	0	0	0	3		
2003:05	0	0	0	3		
2003:06	0	0	0	3		
2003:07	0	0	0	3		
2003:08	0	0	0	3		
2003:09	0	0	0	3		
2003:10	0	0	0	3		
2003:11	0	0	0	3		
2003:12	0	0	0	3		
2004:01	1	1	0	1		
2004:02	1	1	0	1		
2004:03	1	0	0	2		
2004:04	1	0	0	2		
2004:05	1	1	0	1		
2004:06	1	1	0	1		
2004:07	1	0	0	2		
2004:08	1	0	0	2		
2004:09	1	0	0	2		
2004:10	1	0	0	2		
2004:11	1	0	1	1		
2004:12	1	0	1	1		
2005:01	1	0	1	1		
2005:02	1	0	1	1		
2005:03	1	0	1	1		
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2005:05	1	0	1	1		
2005:06	1	0	1	1		
2005:07	1	0	1	1		
2005:08	1	0	1	1		
2005:09	1	0	1	1		
2005:10	1	0	1	1		
2005:11	1	0	1	1		
2005:12	1	0	1	1		
2006:01	1	0	1	1		
2006:02	1	0	1	1		
2006:03	1	0	1	1		
2006:04	1	1	1	0	+	
2006:05	1	1	1	0	+	
2006:06	1	1	1	0	+	
2006:07	1	1	1	0	+	

**RELATION BETWEEN PRECURSORS
TO UNEMPLOYMENT'S ACCELERATON AND TO RECESSIONS**

This problem, raised by Prof. E. Leamer, is illustrated in Fig. 6. It shows that all American recessions after 1964 lay within periods of unemployment's acceleration and only one such period (in 1967) does not include recession too.

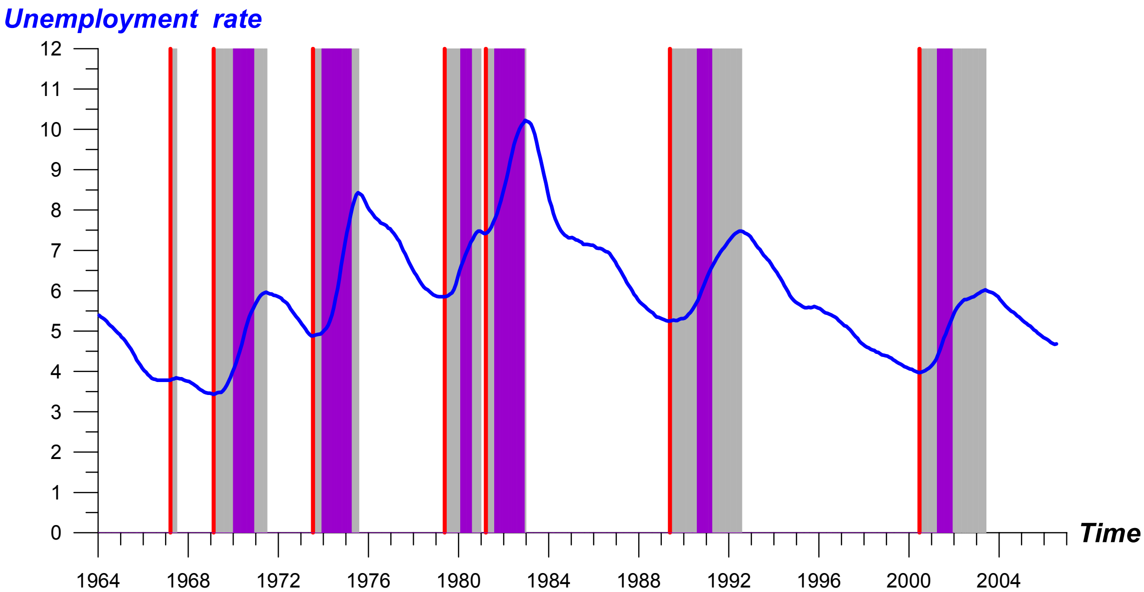

Figure 6. *FAU*s and recessions in the U.S.
Blue curve shows monthly unemployment rate data smoothed over one year, red vertical lines – moments of the *FAU*s, grey bars – periods of unemployment acceleration, purple bars – recessions.

A natural question is whether recession can be predicted by the occurrence of a *FAU*. However, by definition *FAU* coincides with a local minimum of unemployment rate only if is followed by at least 10 months long rise of unemployment rate. So, *FAUs'* can be detected from the data on unemployment only with 10 months delay, while their precursors can be detected immediately. That would cause failures to predict.

Furthermore, it is worth to explore is whether an alarm for a *FAU* is precursory to a subsequent recession. Another pattern recognition algorithm based on 6 macroeconomic indicators is suggested in {2}, http://www.igpp.ucla.edu/prediction/ref/Pre-recession.pdf. Predictions by these algorithms are juxtaposed in Fig. 7.

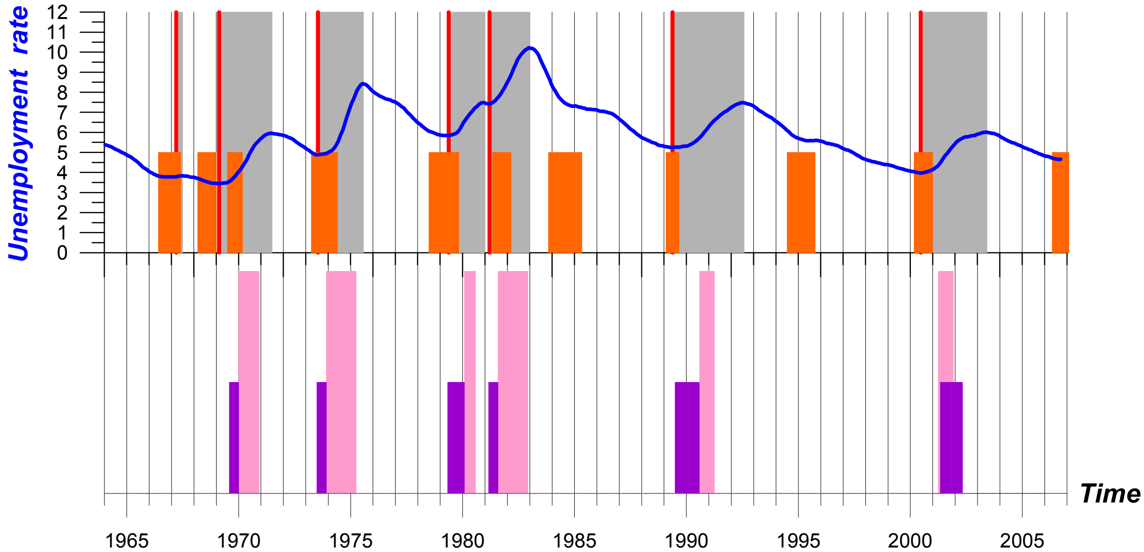

Figure 7. ***Prediction of FAU*****s (top) and recessions (bottom) in the U.S.**
Top panel is the same as in Fig. 5.
Bottom panel: Purple bars show alarms predicting recessions; pink bars show actual recessions. After [2].

Algorithm suggested in [2] is obviously more promising for predicting recessions. However Fig. 7 strongly supports the Dr. Leaner's suggestion to explore interplay between dynamics of unemployment and recessions' development. That seems to open new possibilities not only for prediction per se but for predictive understanding of economy.

References

1. V.I. Keilis-Borok, A.A. Soloviev, C.B. Allègre, A.N. Sobolevskii, and M.D. Intriligator, Patterns of macroeconomic indicators preceding the unemployment rise in Western Europe and the USA, Pattern Recognition 38 (3) (2005) 423-435.
2. V. Keilis-Borok, J.H. Stock, A. Soloviev, P. Mikhalev, Pre-recession pattern of six economic indicators in the USA, J. Forecast. 19 (2000) 65-80.