

NBER WORKING PAPER SERIES

WHAT'S A RECESSION, ANYWAY?

Edward E. Leamer  
Chauncey J. Medberry

Working Paper 14221  
<http://www.nber.org/papers/w14221>

NATIONAL BUREAU OF ECONOMIC RESEARCH  
1050 Massachusetts Avenue  
Cambridge, MA 02138  
August 2008

I am indebted to Jerry Nickelsburg for thoughtful comments on an earlier draft, and to many conversations regarding forecasting with Vladimir Keilis-Borok. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the National Bureau of Economic Research.

© 2008 by Edward E. Leamer and Chauncey J. Medberry . All rights reserved. Short sections of text, not to exceed two paragraphs, may be quoted without explicit permission provided that full credit, including © notice, is given to the source.

What's a Recession, Anyway?

Edward E. Leamer and Chauncey J. Medberry

NBER Working Paper No. 14221

August 2008

JEL No. E3,E32,E37

**ABSTRACT**

Monthly US data on payroll employment, civilian employment, industrial production and the unemployment rate are used to define a recession-dating algorithm that nearly perfectly reproduces the NBER official peak and trough dates. The only substantial point of disagreement is with respect to the NBER November 1973 peak. The algorithm prefers September 1974. In addition, this algorithm indicates that the data through June 2008 do not yet exceed the recession threshold, and will do so only if things get much worse.

Edward E. Leamer

John E. Anderson Graduate School of Management

University of California, Los Angeles

Box 951481

Los Angeles, CA 90095-1481

and NBER

[edward.leamer@anderson.ucla.edu](mailto:edward.leamer@anderson.ucla.edu)

Chauncey J. Medberry

Department of Economics

University of California, Los Angeles

# What's A Recession, Anyway?

Edward E. Leamer<sup>1</sup>

Chauncey J. Medberry Professor of Management  
Professor of Economics  
Professor of Statistics  
UCLA

Version: July 28, 2008

## Abstract

Monthly US data on payroll employment, civilian employment, industrial production and the unemployment rate are used to define a simple recession-dating algorithm that nearly perfectly reproduces the NBER official peak and trough dates. The only substantial point of disagreement is with respect to the NBER November 1973 peak. The algorithm prefers September 1974. In addition, this algorithm indicates that the data through June 2008 do not yet exceed the recession thresholds, and will do so only if things get much worse.

I offer here an algorithm that perfectly identifies the ten official NBER recessions since WWII and that closely reproduces the official NBER monthly peak and trough dates. In a similar fashion, Harding and Pagan(2002) produce quarterly peak and trough dates based on local extremes of quarterly US GDP, and Harding and Pagan(2006b) produce monthly peak and trough dates based on the synchronization of local extremes of four monthly times series: industrial production, employment, sales and personal income. The algorithm discussed here is a bit different. It imposes a minimal threshold decline in employment and industrial production to qualify for the recession label, and it defines the peaks and troughs in terms of changes in the local trends of the series after the fashion of Gelfand et. al.(1976).

The point of an algorithm is to take the guesswork out of the recession definition. For those who are too busy to read more than one paragraph, here is the punch line: We are not yet in a recession. For those who insist otherwise, I offer a challenge: What's your algorithm?

One reason we need a clear definition is that the media focus intensely on two questions: Is it a bear market? Are we in recession? If the answer is "yes, we are in recession," it seems useful to me if both speaker and listener understand what is being said. The focus on recession is not nearly as silly as the focus on bear markets. It is only somewhat misleading to describe the economy as having two states: healthy and ill. With that as

---

<sup>1</sup> I am indebted to Jerry Nickelsburg for thoughtful comments on an earlier draft, and to many conversations regarding forecasting with Vladimir Keilis-Borok.

the framework, the only things a forecaster/analyst brings to the table are prognostications regarding the transitions between these two states. Indeed, the standard way to disparage a forecaster is to point out that he or she has predicted 18 of the last 10 recessions. But actually, the opposite is the case. Few econometric models and few backs-of-envelopes have the kind of nonlinearities that produce recession forecasts as central tendencies, and the forecast record has been more like the prediction of 1 of the last 10 recessions. The episode that we are currently experiencing has been marked by an unusually large number of very vocal recession pronouncements. That, by itself, provides statistical evidence that we are not in a recession.

Given the importance of having some clear definition of a recession, it is more than a little aggravating that the official recessions are decided by a committee of Ph.D. economists. We can just imagine the committee meeting at which the members pour over data displays to try to decide if there was a recession, and, if so, when it began and when it ended. This brings up fantasies of Justice Potter Stewart<sup>2</sup> and other members of the Supreme Court perusing pictures of naked men and women to decide which pictures are pornographic and which are not.

An alternative to a committee would be a computer algorithm that mimics the committee's decisions but without the whim. That is difficult for pornography since dividing digitized images into pornographic or not is a task that you and I can do pretty well, but this kind of pattern recognition is still far in the future for computers. The point of the Potter Stewart statement, "We know it when we see it" is that the definition of pornography cannot be codified, and therefore is not programmable. Further complicating the task is the fact that pornography standards are explicitly changing as time progresses. For the NBER and recessions, the data are digital, and quite limited, and the standards are fixed, or should be. So why don't we have an algorithm? Since we don't have one, maybe we need to insist that the NBER committee members never change; then at least there is some hope that what was a recession in 1958 is still a recession in 2008, and conversely.

Without a definition, we have to put up with Potter Stewartisms from Warren Buffett:

"By any common sense definition, we are in a recession," Buffett said. "Business is slowing down. We have retail stores in candy, home furnishings and jewelry; across the board, I'm seeing a significant slowdown."

<http://uk.reuters.com/article/gc06/idUKWEN425620080303>, May 3, 2008

Another of my favorites is "It may not be a recession, but it sure feels like one." I am resisting the temptation to write a delicious, salacious, analogous statement for pornography.

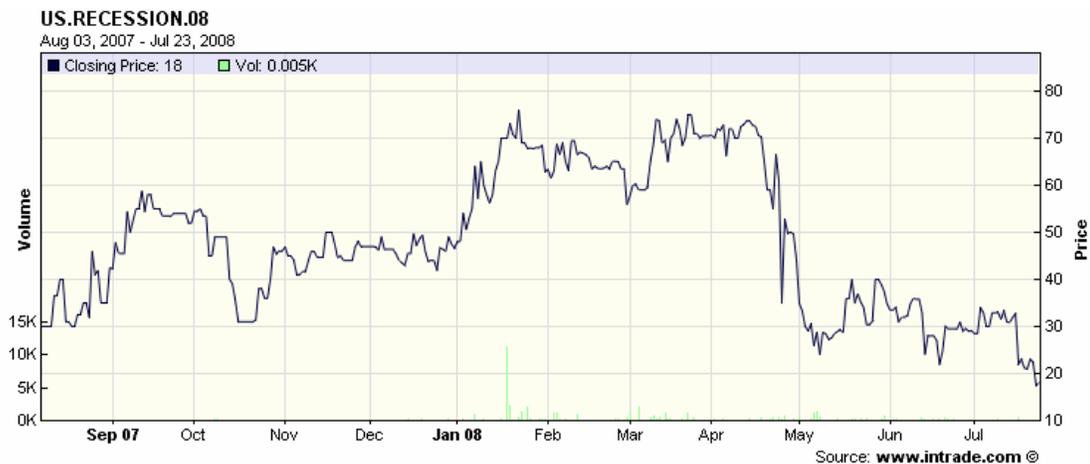
---

<sup>2</sup> [Jacobellis v. Ohio](#) (1964).

## Two Consecutive Quarters of Negative GDP Growth

In great contrast, the unofficial widely-accepted definition is two consecutive quarters of receding real GDP (negative growth). This definition has the great advantage that you can make a book on it, as is done by the prediction market website Intrade.com. When the first quarter GDP came in positive at the end of April, the Intrade probability of recession in 2008 (two negatives in the five quarters commencing 2007Q4) that is illustrated in Figure 1 collapsed from over 70% to 30% and as the second quarter looks more like a positive than a negative, the probability has fallen to below 20%. A little math helps interpret these numbers. If the growth rate has a mean of zero, is symmetrically distributed, and has no serial correlation (well approximating the 2008 circumstances), then we are just flipping a coin to get a negative, and the probability of two consecutive negatives in the last three quarters of 2008 would be 37.5%, a bit higher than the Intrade probability in June and July. The probability of two consecutive negatives in the last two quarters, under the same circumstances is 25%, a bit higher than the Intrade estimate of 18% on July 23<sup>rd</sup>. Thus it seems that the market has a mean growth a bit greater than zero. Meanwhile, there were many economists who persist on explaining with the utmost confidence that we are in the worst downturn since the Great Depression.

**Figure 1** Intrade Probability of Recession in 2008



Though two quarters of negative GDP growth has the appeal of clarity, it misses the 2001 downturn, which features three nonconsecutive negative quarters of GDP growth, two of which preceded the official recession, though when the negatives occurred depends on what GDP release date is relied upon. Quarterly GDP reports come three times: advance, preliminary, and final, and then are subject to further changes at the annual benchmark revisions each July.<sup>3</sup>

According to the Intrade contract rule, the “final” data are the ones relied on. Figure 2 has the growth rates estimated at three different release dates

- (1) The October 31, 2001 data that were available when the NBER announced on November 26, 2001 that the official cycle peak was March 2001.
- (2) The June 26, 2003 data that were available when the NBER announced on July 17, 2003 that the official date of the trough was November 2001.
- (3) The most recent release dated June 2008.

The 2001 recession is most evident in the middle display based on June 2003 data. Here we have negative growth numbers in three consecutive quarters. But the latest data do not have two consecutive negatives, and leave one completely confused by both the NBER choice of peak in 2001Q1, which was a negative quarter, and also by the choice of trough in 2001 Q4, which was a positive quarter. Just to make the confusion complete, Figure 3 displays the GDP levels, which do not show much “receding” at all, just a patch of stumbling forward, not falling down. The really unsettling feature of this picture is that the NBER peak has a GDP less than both adjacent quarters, and the NBER trough has a GDP higher than any other point in the recession, and higher even than the peak value!!

---

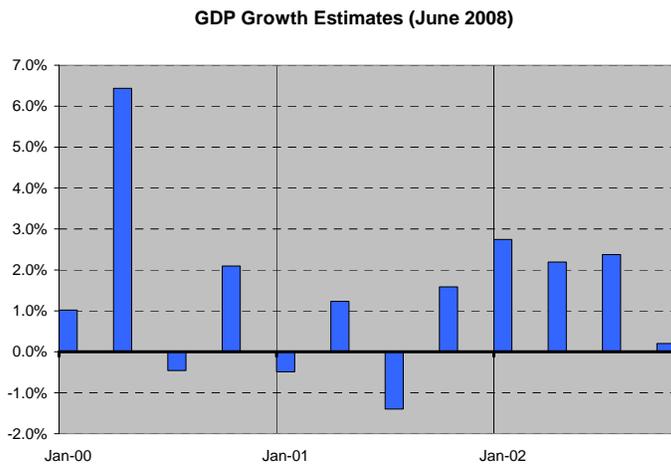
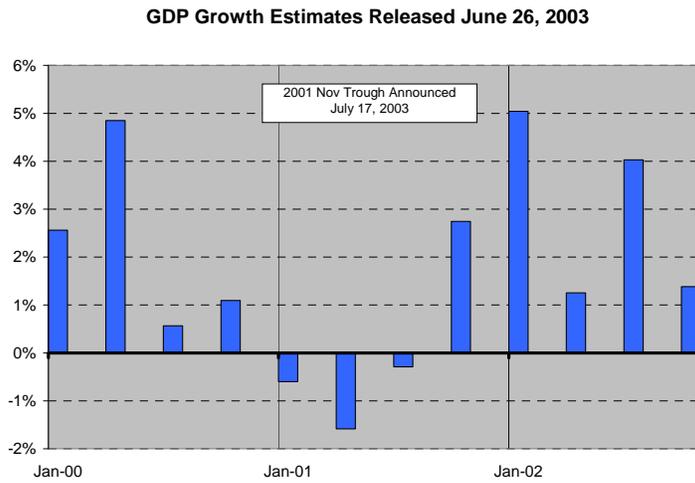
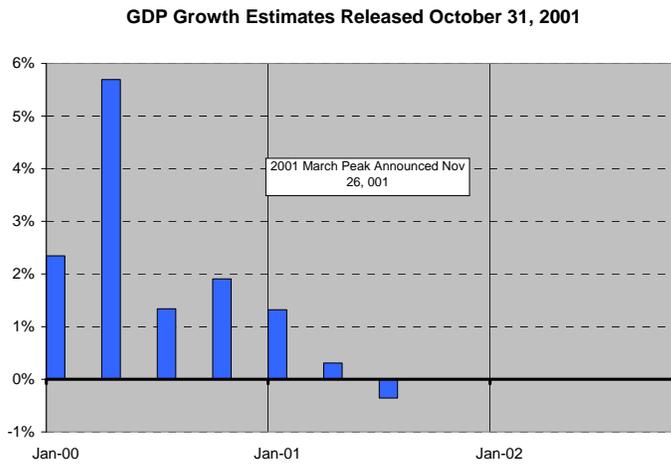
<sup>3</sup> From <http://www.bea.gov/national/pdf/NIPAhandbookch1-4.pdf>, page 10:

For GDP and most other NIPA series, the set of three current quarterly estimates are released on the following schedule. “Advance” estimates are released near the end of the first month after the end of the quarter. Most of these estimates are based on initial data from monthly surveys; where source data are not yet available, the estimates are generally based on previous trends and judgment. “Preliminary” and “final” quarterly estimates are released near the end of the second and third months, respectively; these estimates incorporate new and revised data from the monthly surveys and other monthly and quarterly source data that have subsequently become available. The current quarterly estimates provide the first look at the path of U.S. economic activity.

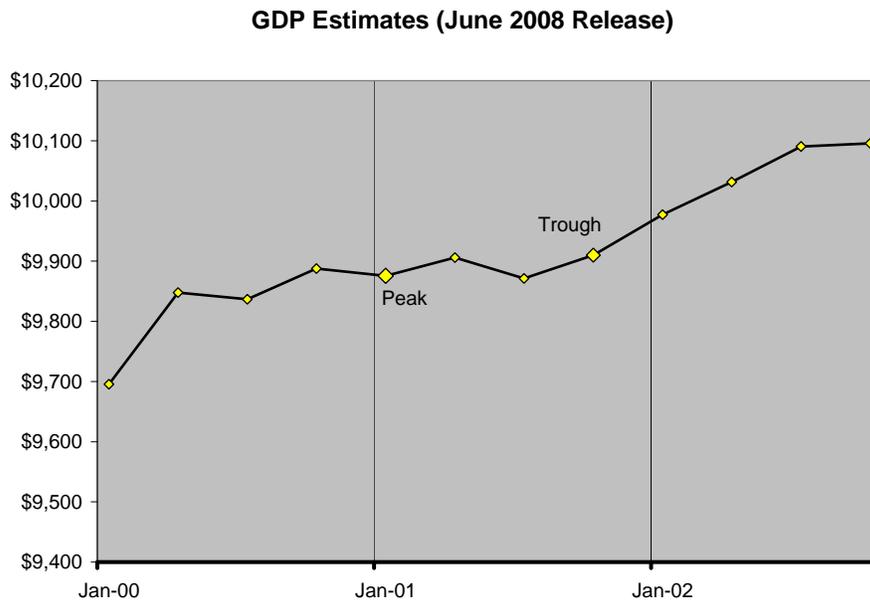
Annual revisions of the NIPAs are usually carried out each summer and cover the 3 previous calendar years. These estimates incorporate source data that are based on more extensive annual surveys, on annual data from other sources, and on later revisions to the monthly and quarterly source data. These revised NIPA estimates improve the quality of the picture of U.S. economic activity, though the overall picture is generally similar to that shown by the current quarterly estimates.

Comprehensive revisions are carried out at about 5-year intervals and may result in revisions that extend back for many years. These estimates incorporate all of the best available source data, such as data from the quinquennial U.S. Economic Census. Comprehensive revisions also provide the opportunity to make definitional, statistical, and presentational changes that improve and modernize the accounts to keep pace with the ever-changing U.S. economy. Thus, these NIPA estimates represent the most accurate and relevant picture of U.S. economic activity.

**Figure 2 Growth Estimates at Different Release Dates**



**Figure 3** GDP levels in 2000-2003 per data in June 2008



## The NBER Definition

Actually, the wise economists at the NBER report that they do not rely much on the GDP data because the data are quarterly, not monthly, and subject to substantial revision, as we have just seen. Here is what the NBER committee have said about the recession definitions in their report dated November 26, 2001 (*italics added*).

<http://www.nber.org/cycles.html>

### **Business Cycle Dating Committee, National Bureau of Economic Research**

Robert Hall, Chair

Martin Feldstein, President, NBER

Ben Bernanke

Jeffrey Frankel

Robert Gordon

Victor Zarnowitz

A recession is a significant decline in activity spread across the economy, lasting more than a few months, visible in industrial production, employment, real income, and wholesale-retail trade.

Because a recession influences the economy broadly and is not confined to one sector, the committee emphasizes economy-wide measures of economic activity. The traditional role of the committee is to maintain a monthly chronology, so the committee refers almost exclusively to monthly indicators. *The committee gives*

*relatively little weight to real GDP because it is only measured quarterly and it is subject to continuing, large revisions.*

The broadest monthly indicator is *employment* in the entire economy. The committee generally also studies another monthly indicator of economy-wide activity, *personal income less transfer payments*, in real terms, adjusted for price changes. In addition, the committee refers to two indicators with coverage of manufacturing and goods: (1) *the volume of sales of the manufacturing and trade sectors* stated in real terms, adjusted for price changes, and (2) *industrial production*. The Bureau of Economic Analysis of the Commerce Department compiles the first and the Federal Reserve Board the second. Because manufacturing is a relatively small part of the economy, the movements of these indicators often differ from those reflecting other sectors.

Although the four indicators described above are the most important measures considered by the NBER in developing its business cycle chronology, *there is no fixed rule about which other measures contribute information to the process.*

A recession involves a substantial decline in output and employment. In the past 6 recessions, industrial production fell by an average of 4.6 percent and employment by 1.1 percent. The Bureau waits until the data show whether or not a decline is large enough to qualify as a recession before declaring that a turning point in the economy is a true peak marking the onset of a recession.

This statement begins with a vague Potter Stewart definition of recession but edges toward an algorithm by identifying four specific monthly series, and even suggesting limits like a 1.1 per cent decline in employment. But in the midst of that hopeful development, the committee slaps us back to reality by advising that “there is no fixed rule.”

Well, what they say and what they do may not be the same. The NBER committee may be using a fixed rule, but may not be aware of it. That would be a natural consequence of a committee decision – there can be a predictable collective intelligence, even though none of the individuals is aware of it. If there is a fixed rule, a statistician ought to be able to uncover it. If the rule isn't fixed, a statistician may be able to uncover that too and even predict it, provided that the changes are small enough and smooth enough to allow the effective sample size per rule to be greater than one. So let's see if we can make some progress on this question. What is the rule that the NBER relies on?

## Business Cycle Dates Based on Payroll Employment, Industrial Production and the Unemployment Rate

In seeking to automate the definition of recession, we need to find variables that allow us to mimic the NBER choices. Most monthly time series are too noisy to serve this function, but three do the job rather well: the level of payroll employment, the level of industrial production and the rate of unemployment. The NBER dates conform closely to periods of falling payroll employment, falling industrial production and rising unemployment. It will prove easy to mimic quite accurately the NBER recession periods based on these three series.

The NBER suggests using four series to define recessions: (1) “employment,” (2) industrial production, (3) real personal income less transfer payments, and (4) the “volume” of sales of the manufacturing and trade sectors. In using the word “employment” the NBER does not distinguish between the household survey and the payroll survey. I will use both. I will also use industrial production, but not the other two series suggested by the NBER. These two are too hard for me to find to suggest using them in a publically available recession-dating algorithm. If you dig deep enough into the BEA website, you can find sales of manufacturing and trade on a monthly basis, but I couldn’t find a deflator for that series. Real disposable (net of taxes) personal income is reported on the FRED website, but not transfer payments. Furthermore, the year-over-year growth of real disposable personal income illustrated below is a wildly up-down series that misses many recessions and finds many that are not there.

**Figure 4** Year over Year Growth in Real Disposable Personal Income

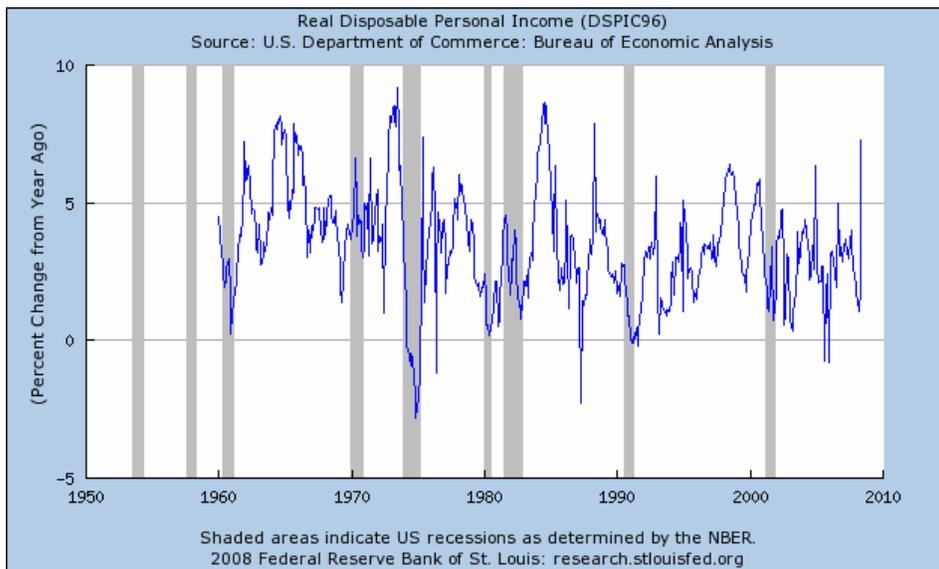
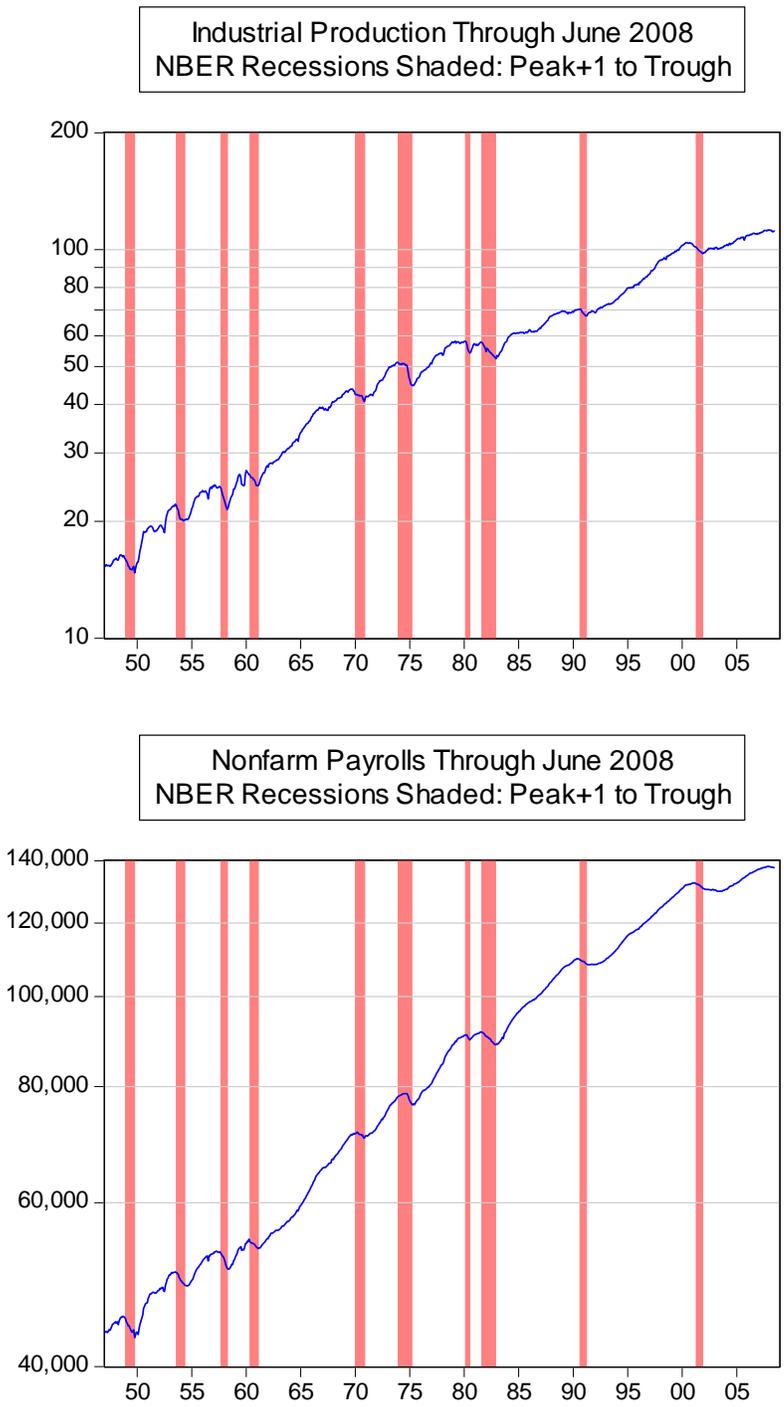


Figure 5 depicts industrial production and nonfarm payrolls from January 1947 to June 2008 with the official NBER recessions shaded, peak+1 to trough.<sup>4</sup> Clearly, declines in industrial production and payroll jobs are features of our official recessions. Figure 6 depicts the data collected from the Household Survey: Employment and Labor Force and also the implied unemployment rate:  $100*(1 - (\text{Employment}/\text{Labor Force}))$ . A reason to be sensitive to the difference in the employment and labor force data is that the most recent rise in the unemployment rate is a consequence of stable employment with rising labor force, depicted in Figure 7. One might imagine that in a recession, labor force growth is weak or negative while employment is substantially falling. If that were the case, the recent rise in the unemployment rate would not be indicative of recessions. To explore this possibility, Figure 8 depicts the employment and labor force data for all ten recessions plus the 2008 data. As it turns out, 2008 does not seem all that unusual, so perhaps this concern is unfounded. I will explore this more below by using both the unemployment rate and the household employment level as alternative variables to form a recession-dating algorithm. As it turns out, the employment level is quite inferior to the unemployment rate. To make the point pointedly: don't quickly dismiss the importance of the recent rise in the unemployment rate because so much of it comes from strong labor force participation.

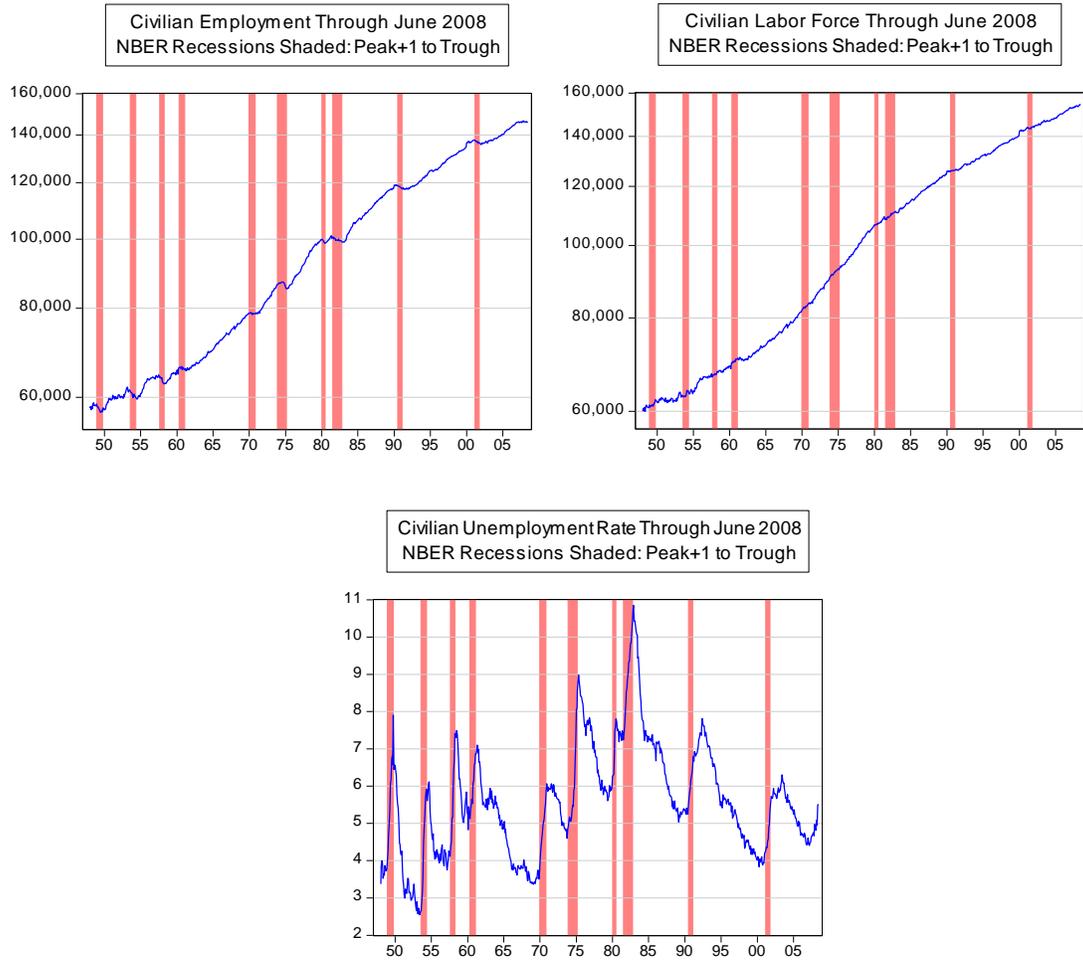
---

<sup>4</sup> These recession shadings often go from peak to trough, but the peak month is part of the expansion not part of the recession. The usual shading incorrectly suggests that the unshaded expansions go from trough+1 to peak-1. Regardless of what choice is made, it is important to know which was chosen.

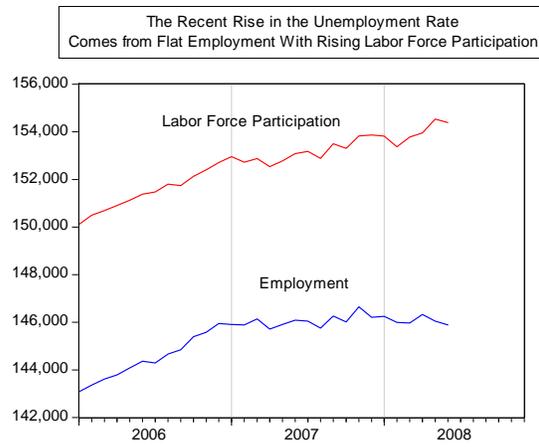
**Figure 5 Industrial Production and Nonfarm Payrolls**



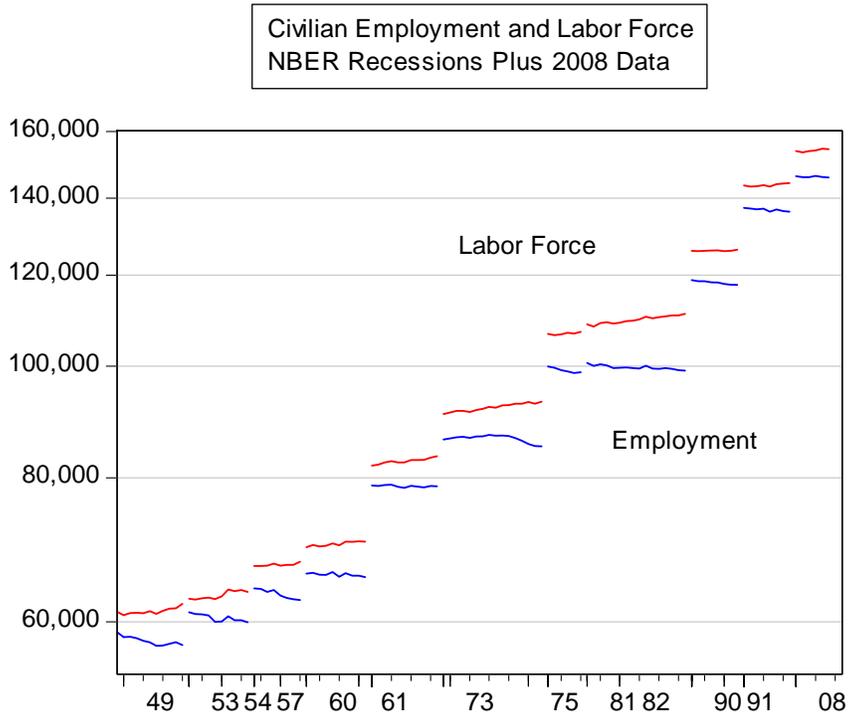
**Figure 6** Data from the Household Survey



**Figure 7 Employment and Labor Force in 2008**



**Figure 8 Employment and Labor Force in Recessions**



## Recession Dating Algorithms

Cycle peak and trough dates have been suggested in the literature on stochastic regime-switching that has emanated from Hamilton(1989). Papers include Chauvet and Hamilton (2005 ), Durland and McCurdy (1994), and Layton(1996). This econometric analysis is part of a search for a model that best approximates how the economy operates. My goal here is not to approximate the economy but rather to mimic the NBER committee, in process as well as outcome, a process that presumably follows the lead of Burns and Mitchell(1946). In that attempt, I will use a non-probabilistic data-analytic approach rather than an econometric probabilistic approach, as has been done by Harding and Pagan(2002) which compares econometric and data analytic approaches and Harding and Pagan(2006a, 2006b) which offer non-probabilistic algorithms.

We begin here with an examination of data series in comparison with thresholds. This is clearly how the NBER process begins, since a meeting of the NBER committee is triggered by data exceeding some thresholds, like a decline in GDP or jobs. After it has been determined that a recession has occurred because the data exceed certain thresholds, the next step is to select the peak and trough months. This, I imagine, is done by the NBER using “eyeball” estimation. To find the peaks and troughs, the eyeball would likely be drawn to local minima and maxima. Rather than local maxima and minima as used by Burns and Mitchell(1946) and Harding and Pagan(2006 and b), I will search for changes in the local trends of the data, thus ignoring local maxima and minima that are similar to the surrounding data (e.g. very gradual increases in unemployment above some local long-standing minimum don’t count) and also allowing for the possibility that for some data the recession dates reflect substantial changes in the growth rates, not necessarily a complete reversal of the sign of the growth rate.<sup>5</sup>

### ***Recession Thresholds***

The first step in the recession-dating algorithm is to select periods that satisfy recession thresholds. Figure 9 to Figure 12 illustrate the 6-month growth of jobs and industrial production and the 6-month increase in the unemployment rate confined to periods of falling jobs and industrial production and rising unemployment. Each of these graphs has a line representing a recession threshold that is selected to discriminate best between recessions and non-recessions, by picking months in all ten recessions but no month outside these recessions.

The payroll jobs threshold  $\log(\text{payroll}/\text{payroll}(-6)) < -0.005$  perfectly identifies all ten recessions and only these recessions. If the threshold is lowered enough to include the

---

<sup>5</sup> Birchenhall et.al.(1999) use a logistic regression to “predict” the NBER recession periods. This also approximates the NBER choices in outcome, but not in process.

most recent data, then the 2001 recession has a second dip and another recession pops out in the 1950s.

The industrial production threshold  $\log(ip/ip(-6)) < -0.03$  picks up the ten official recessions plus three more in the 1950s. If the threshold is increased to get rid of these extra downturns, then we lose the 2001 and 1970 recessions. If the threshold is lowered to the point where the most recent data are included, several other suggested recessions emerge.

The  $u-u(-6) > 0.8$  threshold for the rise in unemployment is just high enough to allow it to perfectly identify all ten recessions and just low enough to capture the most recent data. A somewhat lower threshold would find another recession in 1959.

Though the unemployment data seem to identify recessions accurately, the unemployment rate is a function of both civilian employment and also civilian labor force participation. Employment is a measurement of a physical reality – getting up in the morning and going to work. But unemployment is partly psychological, and can vary downward because job-seekers get discouraged or upward because of favorable expectations about finding a good job. The movement in the unemployment rate that is due to rapid changes in labor force participation may or may not be relevant for defining recessions. An alternative to using the unemployment rate to define recessions is to use civilian employment.

The six-month declines in civilian employment are illustrated in Figure 12. The civilian employment threshold  $\log(emp/emp(-6)) < -0.004$  identifies all the official recessions and also picks November 2007 as a cycle peak. This cutoff also selects two additional recessions in 1951 and 1952, and turns the 1981 recession into a double dip. A more extreme cutoff of  $-0.005$  would get rid of many of these, but would also get rid of the official 1970 recession.

If the diagrams are not so clear, the results are summarized numerically in Table 1 which indicates various thresholds and the corresponding number of extra recessions beyond the NBER 10. The minimal threshold is the level needed to pick up all ten of the NBER recessions. The other thresholds are all lower and thus select these ten recessions, and sometimes more. For industrial production, the minimal threshold of  $-0.032$  selects 3 additional straggling recessions, as does the somewhat lower threshold that I am using:  $-0.030$ . If the threshold were lowered so that the 2008 data satisfied it, we would identify an additional 10 unwanted recessions. The unemployment rate does much better, and does not identify additional recessions with my threshold  $+0.8$  or with the 2008 value. Payroll employment is good at identify just the 10 recessions, though with my threshold we get one straggler month, and with the 2008 limit we get 3 additional unwanted recessions. Finally, the performance of civilian employment is substandard, since even for the minimal threshold needed to select the 10 NBER recessions, it finds 9 additional sequences of months that satisfy the threshold.

**Table 1                  Recession Thresholds and Extra Recessions**

**6 Month Growth of Industrial Production**

	Minimal	Leamer	Other	2008
Threshold	-0.032	-0.030	-0.020	-0.010
Extra Recessions	3	3	4	10

**6 Month Growth of Payroll Employment**

	Minimal	Leamer	Other	2008
Threshold	-0.0087	-0.0050	-0.0040	-0.0032
Extra Recessions	0	1	1	3

**6 Month Change in Unemployment Rate**

	Minimal	Leamer	Other	2008
Threshold	1.02	0.80	0.70	0.82
Extra Recessions	0	0	1	0

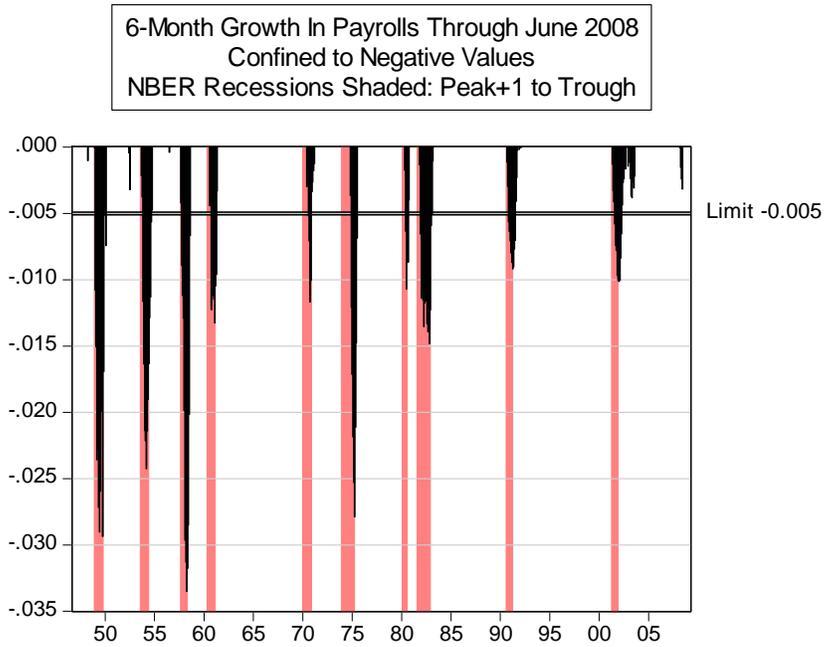
**6 Month Growth of Civilian Employment**

	Minimal	Leamer	Other	2008
Threshold	-0.005	-0.004	-0.005	-0.004
Extra Recessions	9	9	7	9

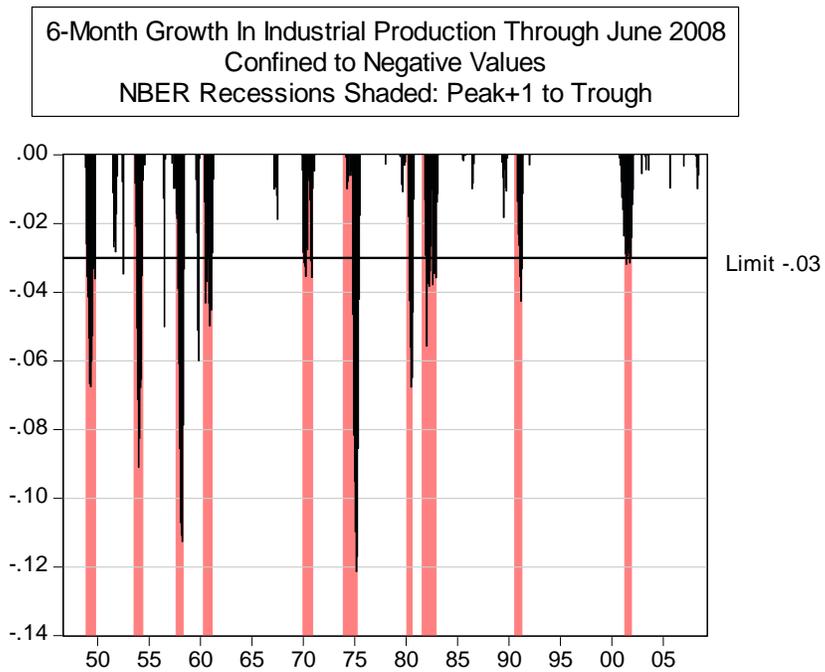
The Minimal Threshold is the Level Just Exceeded by all 10 Recessions

An Extra Recession is a Contiguous Sequence of One or More Months Satisfying the Threshold

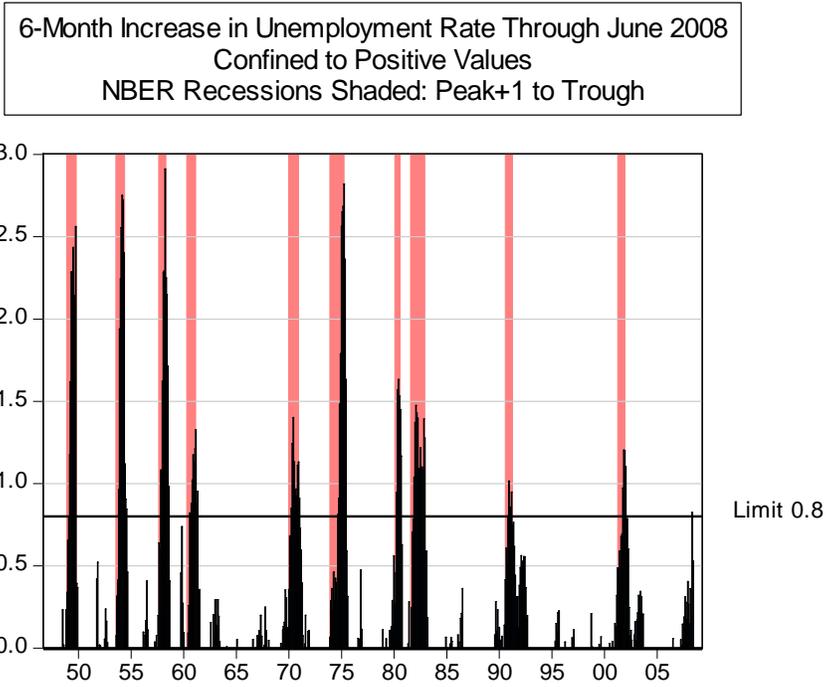
**Figure 9** 6-Month Negative Growth of Payroll Jobs



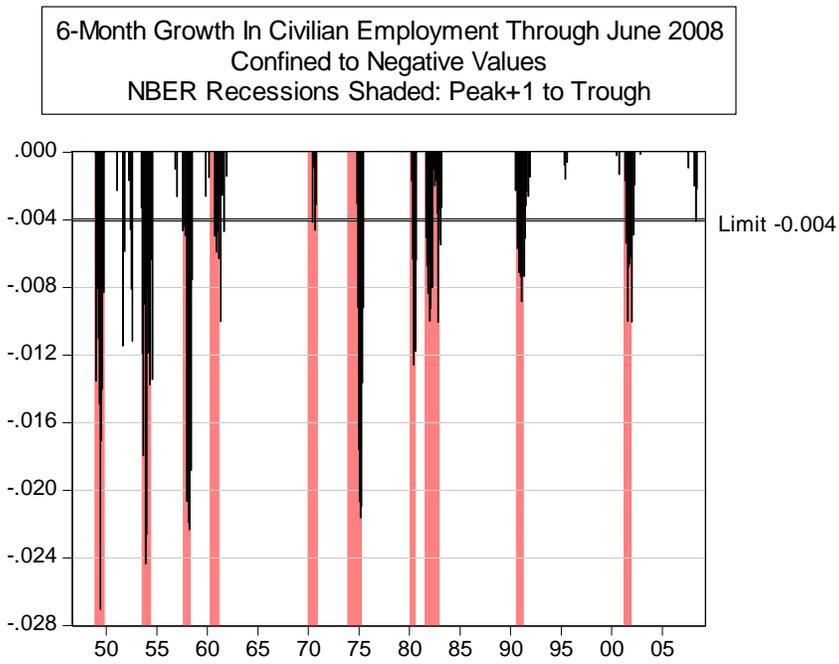
**Figure 10** 6-Month Negative Growth of Industrial Production



**Figure 11**                      **6-Month Increase in the Unemployment Rate**



**Figure 12**                      **6-Month Negative Growth of Civilian Employment**



## **Peak and Trough Dates**

Having identified thresholds that can be used to determine the approximate recession periods, the next step is to select an algorithm for picking the exact peak and trough dates. To do this, I use the second derivatives of each series, with cycle peaks when a second derivative is maximally negative and cycle troughs when the second derivative is maximally positive. With  $y(t)$  referring to industrial production or employment, the logarithmic 6-month second derivative is

$$\log(y(t+6)/y(t)) - \log(y(t)/y(t-6))$$

which is the difference in the growth over the next six months compared with the last six months. Thus in looking for local extremes of this second derivative, we are searching for transition points between periods of high and low growth – the kind of nonlinearity that a recession is all about. A recession is beginning when this second derivative is negative – in other words when a period of healthy growth is followed by a period of weak or negative growth. A recession is ending when this second derivative is positive, in other words when a period of weak or negative growth is followed by a period of healthy growth. This is after the fashion of forecasts produced by V.I. Keilis-Borok and coauthors who use changes in local trends to identify events that are accumulated into alarms of forthcoming rises in unemployment and recessions.<sup>6</sup>

Figure 13 depicts the second derivative of the log of payroll employment, plotted twice depending on whether the following six months or the preceding six months satisfies the recession threshold:

$$\begin{aligned} \text{Recession ahead: } & \log(\log(y(t+6)/y(t))) < -0.005 \\ \text{Recession behind: } & \log(\log(y(t)/y(t-6))) < -0.005 \end{aligned}$$

A cycle peak occurs when the second derivative is maximally negative for the recession ahead subperiods and a cycle trough occurs when the second derivative is maximally positive for the recession behind periods.

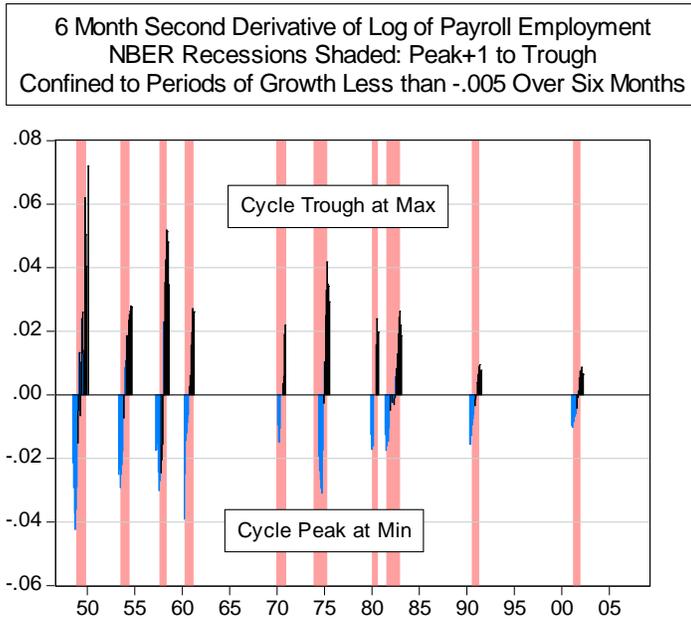
The 6-month second derivatives subject to these forward and backward thresholds for industrial production, unemployment and civilian employment are illustrated in Figure 14 Figure 15 and Figure 16. The suggested peaks and troughs, which are the local maxima and minima of these second derivatives, are reported in Table 2.<sup>7</sup>

---

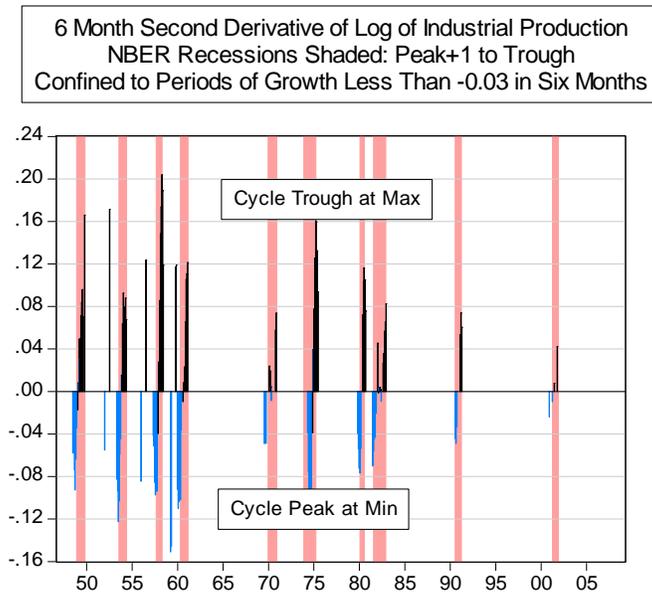
<sup>6</sup> Gelfand et.al., (1976) , Keilis-Borok et.al. (1990), V. Keilis-Borok et.al. (2000).

<sup>7</sup> Notice, by the way, that a positive second derivative is associated with the cycle peak, because the downturn has rising unemployment, while a negative second derivative is associated with a cycle trough.

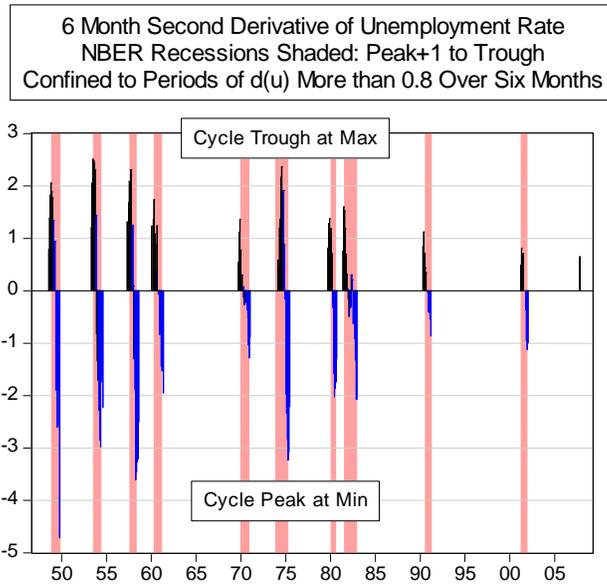
**Figure 13 Payroll Peaks and Troughs Around Periods of Loss exceeding 1% per year**



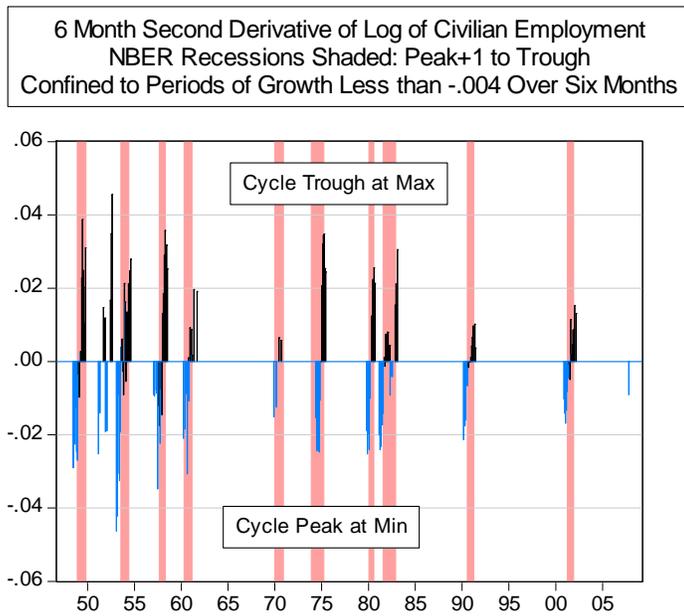
**Figure 14 Second Derivatives of Log Change in Industrial Production**



**Figure 15**                      **Second Derivative of the Unemployment Rate**



**Figure 16**                      **Second Derivative of Civilian Employment**



## ***Table of Results and Recession-Dating Algorithm***

The NBER peak and trough months are compared with the peak and trough months suggested by the extreme second derivatives of the payroll data, industrial production, the unemployment rate and the civilian employment data in Table 2. The number of months between the data-suggested peaks and troughs and the NBER peaks and troughs are also reported. There are a lot of zeroes and ones here, meaning that the NBER and these dating methods to a large extent conform.

The employment data provides the largest disagreements with the NBER dates, including turning the 1981 recession into a double dip affair, and adding two more recessions in the early 1950s. The unemployment rate does a much better job and apparently my concern about the role of the changes in labor force participation in determining the unemployment rate doesn't much matter. Or maybe to put it differently, it appears as though the NBER historically has relied on the unemployment rate, not the level of household employment to pick the peak and trough dates. So let's just drop the employment data and work with payroll jobs, industrial production and the unemployment rate.

These three series do not always suggest the same peak and trough dates. To resolve the differences use the median date, indicated in the last two columns. Another way to say this is that a cycle peak occurs when two of the three series so indicate and likewise for a trough. *With these median dates we replicate the NBER results almost perfectly!* By the way, this does a much better job picking identifying the NBER peaks than does the Harding and Pagan(2006b) algorithm which averages 2.7 months early in the seven recessions from 1960-2001.

So that's the algorithm:

### **Recession Dating Algorithm**

#### **1. Pick probable recessions based on the following thresholds:**

**A decline in industrial production for 6 Months at the rate of -6% per year or more.**

**A decline in payroll employment for 6 Months at the rate of -1% per year or more.**

**An increase in the unemployment rate in a 6 month period by at least +0.8 percentage points.**

Every recession since World War II has included months that satisfied all three of these limits. And there has never been a time in the expansions during which all three of these limits were satisfied. (The extra recessions come only from the industrial production limits.)

- 2. From the periods identified in step 1 for each of the three variables separately identify suggested peak and trough dates as the months when 6-month second derivatives are maximally negative (peak) and maximally positive (troughs).**

The second derivative of the series  $y$  is defined as  $(y(t+6)-y(t)) - (y(t)-y(t-6))$  with logarithmic transformation for series with demonstrable time trends (industrial production and employment.)

- 3. Reconcile differences in the peak and trough dates by using the median of the three dates.**

**Table 2 Peaks and Troughs Per Payroll Data**

Business Cycle Peaks and Troughs per NBER and Three Monthly Indicators  
 Plus Median Month of Payroll, Industrial Production and Unemployment  
 Dif = Difference in Months from NBER dates

		<b>NBER</b>	<b>Payroll</b>	<b>Dif</b>	<b>IP</b>	<b>Dif</b>	<b>U</b>	<b>Dif</b>	<b>Emp</b>	<b>Dif</b>	<b>Median</b>	<b>Dif</b>
1	Peak	Nov-48	Oct-48	-1	Oct-48	-1	Nov-48	0	Jul-48	-4	Oct-48	-1
	Trough	Oct-49	Feb-50	4	Oct-49	0	Oct-49	0	Jun-49	-4	Oct-49	0
2	Peak	Jul-53	Jul-53	0	Jul-53	0	Jul-53	0	Feb-53	-5	Jul-53	0
	Trough	May-54	Aug-54	3	Jan-54	-4	May-54	0	Aug-54	3	May-54	0
3	Peak	Aug-57	Aug-57	0	Aug-57	0	Oct-57	2	Jul-57	-1	Aug-57	0
	Trough	Apr-58	May-58	1	Apr-58	0	Apr-58	0	Apr-58	0	Apr-58	0
4	Peak	Apr-60	Apr-60	0	Feb-60	-2	May-60	1	Sep-60	5	Apr-60	0
	Trough	Feb-61	Feb-61	0	Feb-61	0	May-61	3	May-61	3	Feb-61	0
5	Peak	Dec-69	Apr-70	4	Aug-69	-4	Dec-69	0	Dec-69	0	Dec-69	0
	Trough	Nov-70	Nov-70	0	Nov-70	0	Dec-70	1	Jun-70	-5	Nov-70	0
6	Peak	Nov-73	Oct-74	11	Sep-74	10	Aug-74	9	Oct-74	11	Sep-74	10
	Trough	Mar-75	Apr-75	1	Mar-75	0	Apr-75	1	Apr-75	1	Apr-75	1
7	Peak	Jan-80	Jan-80	0	Feb-80	1	Dec-79	-1	Dec-79	-1	Jan-80	0
	Trough	Jul-80	Jul-80	0	Jul-80	0	Jun-80	-1	Aug-80	1	Jul-80	0
8	Peak	Jul-81	Jul-81	0	Jul-81	0	Jul-81	0			Jul-81	0
	Trough	Nov-82	Dec-82	1	Dec-82	1	Nov-82	0			Dec-82	1
9	Peak	Jul-90	May-90	-2	Sep-90	2	Jun-90	-1	Mar-90	-4	Jun-90	-1
	Trough	Mar-91	May-91	2	Mar-91	0	Mar-91	0	May-91	2	Mar-91	0
10	Peak	Mar-01	Mar-01	0	Dec-00	-3	May-01	2	Feb-01	-1	Mar-01	0
	Trough	Nov-01	Feb-02	3	Oct-01	-1	Dec-01	1	Jan-02	2	Dec-01	1
11	Peak						Nov-07		Nov-07			

Peak	Jan-52	Mar-51
Trough	Jul-52	Sep-51
Peak	Jan-56	Dec-51
Trough	Jul-56	Aug-52
Peak	Apr-59	Apr-81
Trough	Nov-59	Jan-82
Peak		May-82
Trough	Jan-82	Feb-83

Expansion Peak Conditions  
 (LOG(PAYROLL(+6)/PAYROLL)<-0.005)  
 (LOG(IP(+6)/IP)<-0.03)  
 (U(+6)-U>0.8)  
 (LOG(EMP\_CIV(+6)/EMP\_CIV)<-0.004)

## 1974

The only question mark about this algorithm is raised by recession 6 which has an NBER peak in November 1973 but peaks for the four series reported in Table 2 at 11, 10, 9 and 11 months later. What was the NBER thinking, anyway?

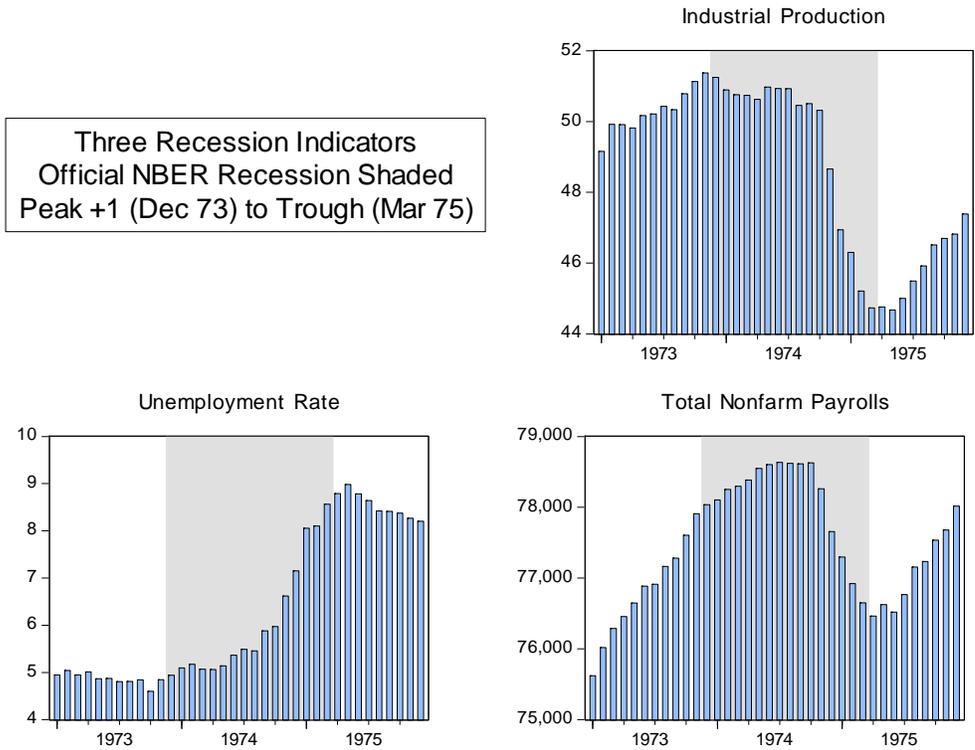
Figure 17 and Figure 18 contrast the official NBER recession in 1974 with the recession suggested by my recession-dating algorithm. The NBER has begun their 1973/4 recession in a period of economic weakness in which industrial production is decaying a bit and the unemployment rate is elevating but payroll employment is still rising. What the NBER dates ignore altogether is the late peak of the payroll data and the dramatic change in the slope of the industrial production data in the middle of the official recession. This point, where both industrial production and payroll employment begin a precipitous decline, is what my algorithm selects. It may not be so clear, but the unemployment rate also has a maximal derivative at about the same point: the rate was rising slowly until August 1974 when it really took off.

So which do you like? I like mine. Remember that mine is selected to be consistent with the choices that the NBER has made in the 60 years covered by this data set. I particularly cannot see the validity of the NBER peak given the payroll data that not only has a maximal derivative in October 1974, but has the largest value locally as well. That's a "peak" isn't it?

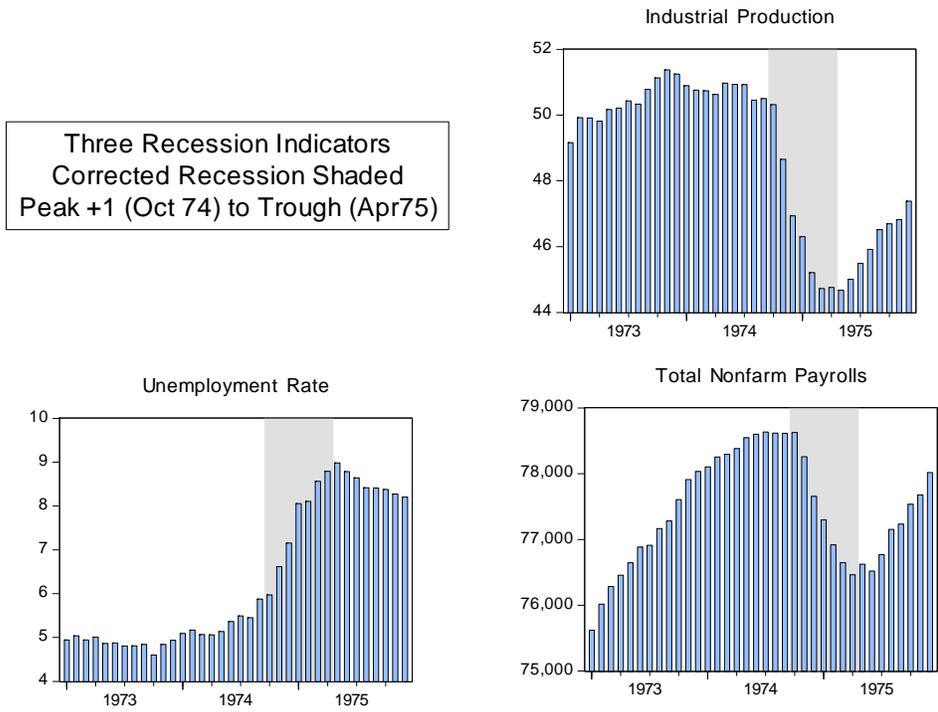
This argument in favor of my choices is clouded by the GDP growth data displayed in Figure 19. For those of you who like negative growth numbers, there are plenty here in both 1973 and 1974. If you need consecutive negatives, however, they occur in 1974q3 – 1975q1, which is pretty close to the quarters selected by my rule. Looking through the right glasses at the level of real GDP depicted in Figure 20 further supports my choice. since it appears as though the second derivative thinking would select 1974q2 as the peak because 1974q2 is above the levels of both 1973q3 and 1974q1, and because the half-year decline in real GDP is very great after 1974q2. But, if you don't work so hard at it, and if you move Figure 20 far from your eyes so you can see only the "big picture", you cannot miss the GDP peak in the 1973Q3 and the trough in 1974q4, which is exactly the way the NBER "sees" it. Moreover, the results of the second derivative algorithm reported in Table 3 agree with the NBER, even though I first "saw" it differently. In other words, we have a problem here with GDP.

I am tempted to do what the NBER committee has done and simply discount the GDP numbers, but I think I can plant a seed of doubt about the validity of the real GDP numbers in 1973 and 1974. There was a three-fold increase in the price of oil in 1973 and 1974, illustrated in Figure 21. I wonder if that caused problems in measuring the price level? The year 1974 was not all that unusual in terms of the growth of nominal GDP, illustrated in Figure 22, but there was a real surge in the measured rate of inflation, illustrated in Figure 23. I wonder if they got that right.....

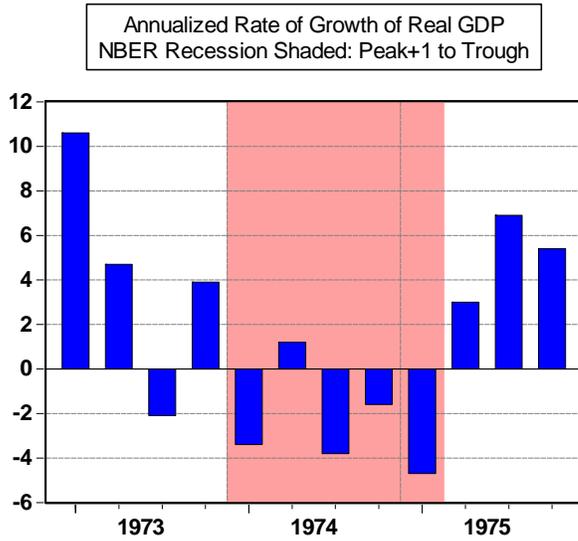
**Figure 17 Three Indicators in 1974, NBER Recession**



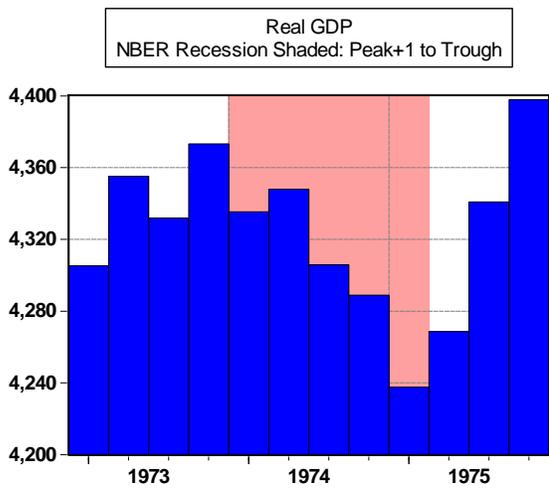
**Figure 18 Three Indicators in 1974, Corrected Recession Dates**



**Figure 19**      **Growth of Real GDP in 1974**



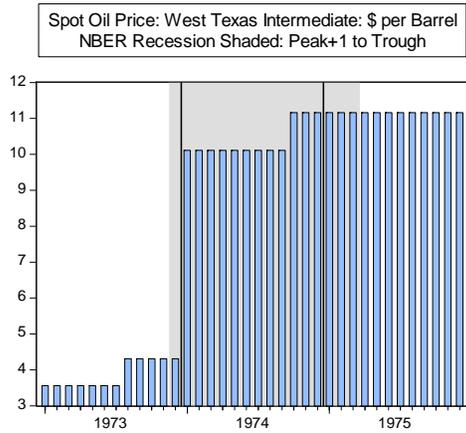
**Figure 20**      **Level of Real GDP in 1974**



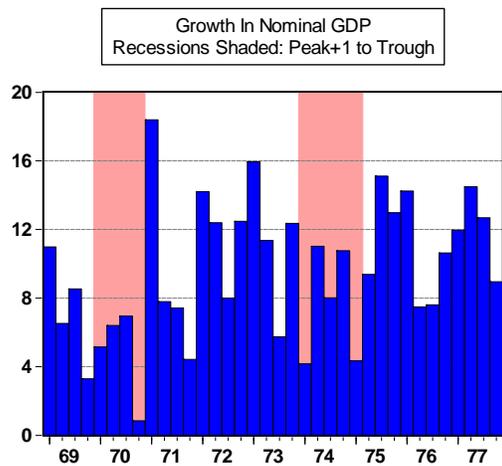
**Table 3** Peaks and Troughs from Real GDP data using 2Q Second Derivatives

	NBER	RGDP	dif
Peak	1948Q4	1948Q3	-1
Trough	1949Q4	1949Q1	-3
Peak	1953Q2	1953Q2	0
Trough	1954Q2	1954Q2	0
Peak	1957Q3	1957Q3	0
Trough	1958Q2	1958Q2	0
Peak	1960Q2	1960Q1	0
Trough	1961Q1	1961Q1	0
Peak	1969Q4	1969Q3	-1
Trough	1970Q4	1970Q4	0
Peak	1973Q4	1973Q4	0
Trough	1975Q1	1975Q1	0
Peak	1980Q1	1980Q1	0
Trough	1980Q3	1980Q3	0
Peak	1981Q3	1981Q3	0
Trough	1982Q4	1982Q4	0
Peak	1990Q3	1990Q2	-1
Trough	1991Q1	1991Q1	0
Peak	2001Q1	2001Q1	0
Trough	2001Q4	2001Q3	-1

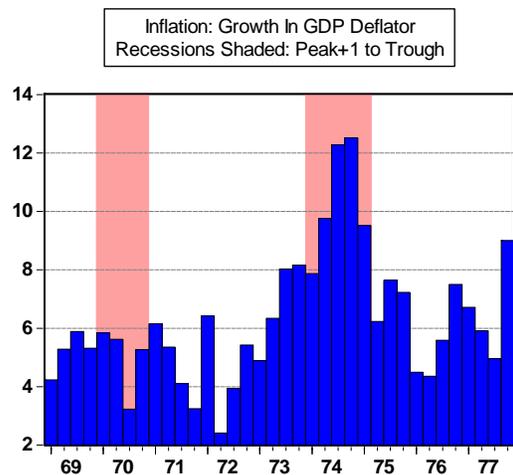
**Figure 21 Oil Price Spikes in August 73, Jan 74, Oct 74**



**Figure 22 Growth of Nominal GDP**



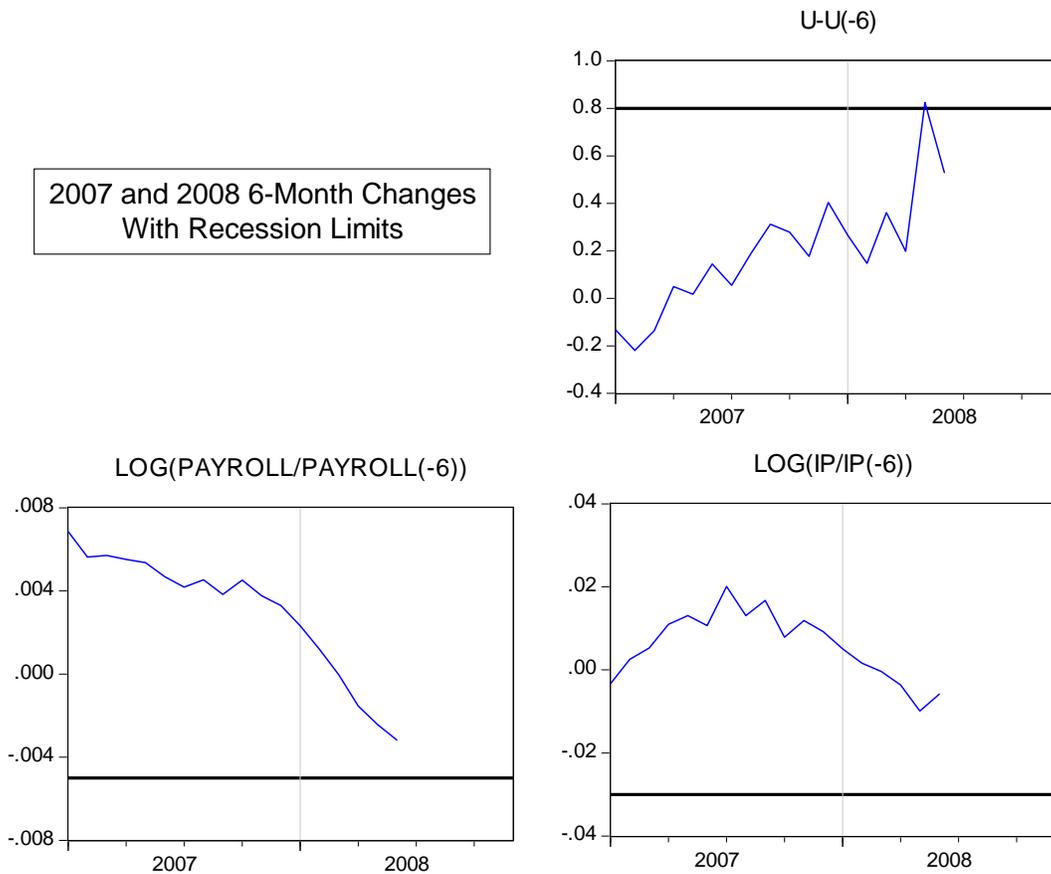
**Figure 23 Inflation: Growth of GDP Deflator**



# 2008

Figure 24 illustrates the recent data and the proposed recession cut-offs. The unemployment rate satisfies the cutoff in one month, just barely, because of that sharp increase in May, but when June held steady the six-month change backed off a bit. The payroll data look like they are going to cross the threshold soon enough, but actually the rate of decline of payroll jobs has been very steady over the last six months at the six-month rate of  $-.03$ , well short of the cutoff of  $-.05$ . And the problems in industrial production are nowhere close to the limit. Bottom line: things have to get much worse to pass the recession threshold.

**Figure 24** The Recent Data with Recession Thresholds



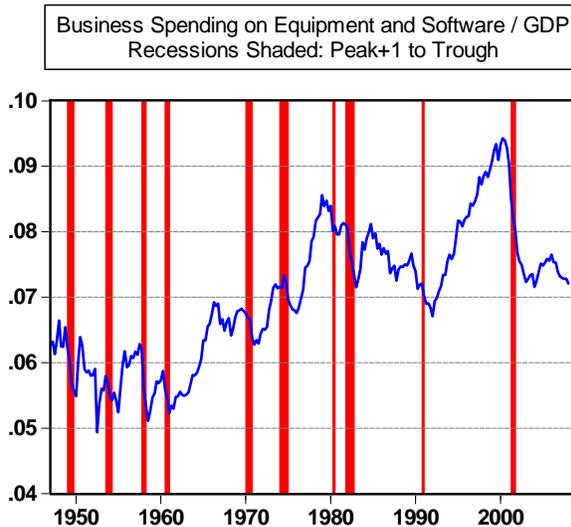
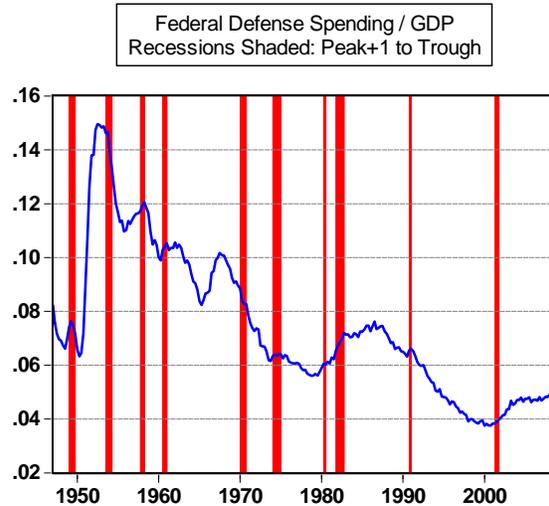
OK, I admit it; I have a stake in this. The UCLA Anderson Forecast has maintained since December 2005, that the housing adjustment would be extreme, but, unlike all other such housing adjustments in the historical data, this time we would not have a recession because the manufacturing employment numbers have been favorably positioned. With my neck sticking so far out, if my algorithm identified a recession using the 2008 data, you may suspect that I would suppress it. You would be wrong, I think, but don't just dismiss my effort for that reason; offer an algorithm of your own. Let's have your recession definition.

I know that at any moment we could fall into the recession abyss. I know that the payroll and household data might be revised, and leave me with a bright red face. In the meantime, we need to recognize that if this doesn't qualify as a recession, it surely isn't normal growth. Since this is something very different from anything in the recorded history, we need a name for what we are experiencing. That's obvious. It's a severe Buffeting.

# Postscript: Structural Adjustments Ahead

There is another problem with the recession definition – it is binary. The two categories of expansion and contraction do not do justice to a variegated reality. We surely need to distinguish between temporary “dips” in which the economy returns to where it was after a year or two, versus structural adjustments in which there was no return to those old days anytime soon.<sup>8</sup> One structural adjustment was the **1953 Korean War Disarmament Downturn**– shifting from a wartime to a peacetime economy. Defense spending illustrated in the figure on the right that had ramped up to 15% of GDP in 1953 during the hostilities crashed back to 11% in 1955, producing an official NBER recession that began the very month that the armistice was signed when defense spending began its precipitous decline. Another structural adjustment was the **2001 Internet Comeupance**. During the Internet Rush, spending on equipment and software as a fraction of GDP, illustrated on the right, rose to an historic high of 9.4% but has since retreated to more normal levels a bit over 7%.

These structural shifts were accompanied by a reduction in jobs and industrial production and an increase in the unemployment rate, but when the total jobs and industrial production recovered, what we produced and who produced it were substantially different. The weakness in jobs and production during a structural adjustment is not a symptom of a diseased economy with poorly functioning markets; it is only a symptom of the rapid but efficient transition from one mix of output to another. This is not the kind of problem that should be treated with stimulative monetary or fiscal policy, except as these policies keep the pathology confined to the sector from which it originates.



<sup>8</sup> My Forecast colleague Ryan Ratcliff has studied the structural adjustment idea within California and subregions.

The problem that really needs the right kind of preventative and curative fiscal and monetary policy are the **Consumer Durables Cycles (Homes and Appliances and Cars)**, of which we have had eight since World War II. We have cycles in these items because owning a palatial home and a cool car are fundamental to the American pecking order, and because during expansions these durables can seem eminently affordable while in recessions the acquisition of homes and cars is easily postponable. When circumstances require, we can make do with the homes and cars we already have and reduce maintenance spending too, even it means crowding into ramshackle homes and driving old heaps. We can also do without those expensive cups of coffee from Starbucks and if things get really bad we can postpone the purchase of those Louis Vuitton designer purses that retail for \$2,000. That's a consumer downturn.<sup>9</sup> The right medicine for this bipolar consumer disease is high interest rates and tax rates during expansions to make the durables less affordable and low interest rates and tax rates during recessions to make them more affordable.

We may be on the cusp of a consumer durables downturn but there is a very real possibility that we are in the early stages of a major structural adjustment. Figure 25 illustrates the component shares of GDP: consumption plus investment plus government plus net exports. The scales are chosen so that all vary by 12 percentage points, making the pictures directly comparable. This is where you can see the structural adjustments that have occurred and the structural adjustments that lie ahead.

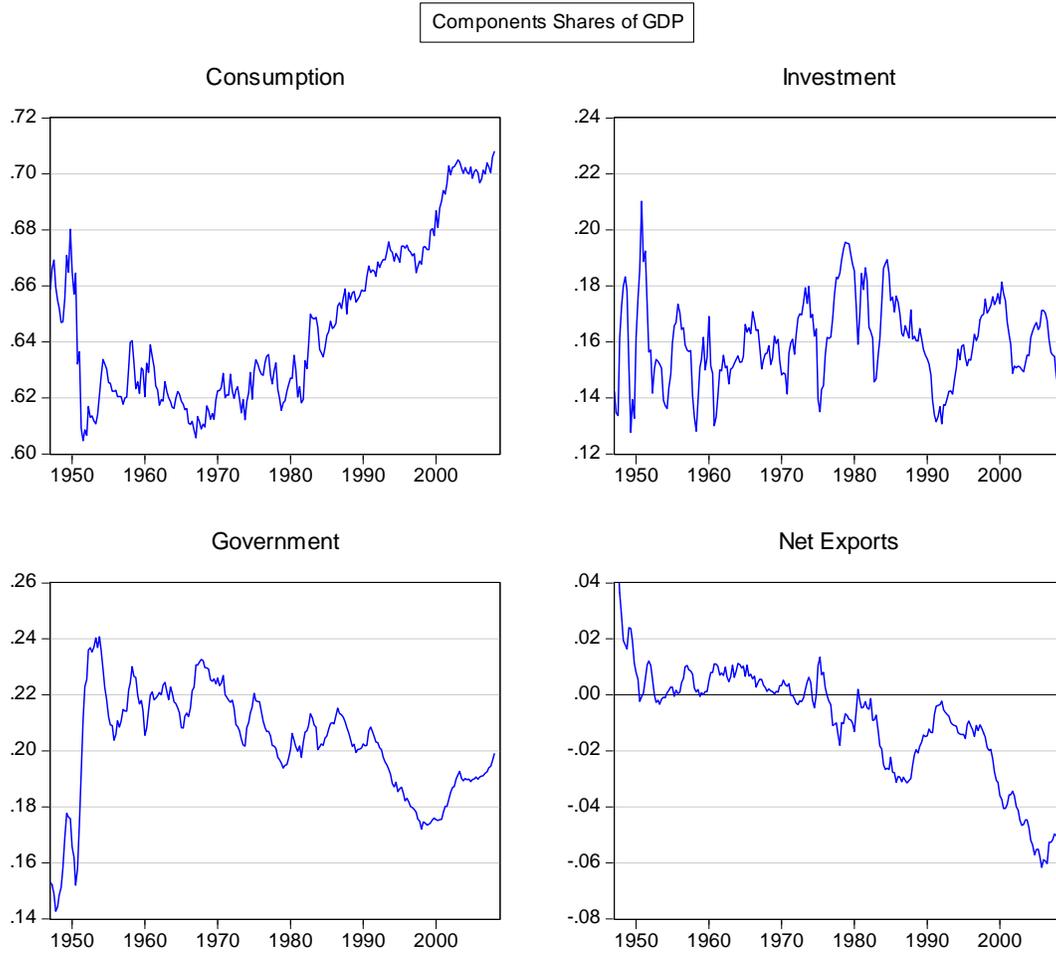
Notice that the investment share of GDP has plenty of ups and downs but no discernable trends. The low real rates of interest that we have been experiencing, the innovations in the financial markets and the tax cuts have not had a discernible affect on the investment share of GDP. That's disappointing. But it is hard even to look at the investment figure while the consumption picture to the left is shouting out: look at me! The consumption share of GDP began a steady march upward from 62% of GDP in 1980 to 70% today. We are not an ownership society, we are a consumption society. That rise by 8 percentage points in the consumption share of GDP had to be offset by a fall in some other shares. About 2 percentage points come from a decline in government spending as a share of GDP. That seems like a good thing, though the potholes in the road are starting to bother me. The other 6 percentage point reduction came from the trade imbalance: exports minus imports. So that's the story. The low rates of interest, the innovations in the financial markets and the tax cuts have turned us into a consumption-loving debt-ridden foreign-depending society.

The slaps in the face each time we fill up our SUVs are carrying the rude message: things have to change. You cannot maintain that profligate life style. The structural adjustment that lies ahead seem certain to come with unbalanced sluggish growth and weak labor markets for a considerable period of time. Misery, but no recession.

---

<sup>9</sup> A consumer cycle is driven by a Minsky cycle in lending standards that makes the financing for homes and cars cheap and available to anyone who can fog a mirror when home prices are appreciating because the loans are self-collateralizing. Inevitably, price appreciation slows and lending standards rise dramatically.

**Figure 25**      **Shares of GDP**



## References

Burns, Arthur F., and Wesley C. Mitchell (1946), *Measuring Business Cycles*, (National Bureau of Economic Research, New York).

Birchenhall, Chris R., Hans Jessen, Denise R. Osborn and Paul Simpson (1999), "Predicting U.S. Business-Cycle Regimes," *Journal of Business & Economic Statistics*, Vol. 17, No. 3 (Jul., 1999), pp. 313-323.

Chauvet, Marcelle and James D. Hamilton (2005 ), "Dating Business Cycle Turning Points," draft

Durland, J. Michael and Thomas H. McCurdy(1994), "Duration-Dependent Transitions in a Markov Model of U.S. GNP Growth," *Journal of Business & Economic Statistics*, Vol. 12, No. 3 (July), pp. 279-288.

Gelfand, I., Keilis-Borok, V. I., Knopoff, L., Press, F., Rantsman, E., Rotwain, I. and Sadovsky, A., (1976) "Pattern recognition applied to earthquake epicenters in California", *Phys. Earth Planet. Inter.*, 11), 227-83.

Hamilton, James D. (1989), A new approach to the economic analysis of nonstationary time series and the business cycle, *Econometrica* 57:357-384.

Harding, Don and Adrian Pagan, 2002. "A Comparison of two Business Cycle Dating Methods," *Journal of Economics Dynamics and Control*, Vol. 27 pp. 1681-1690.

Harding, Don and Adrian Pagan, 2006a, "Measurement of Business Cycles," The University of Melbourne, Research Paper No. 966.

Harding, Don and Adrian Pagan, 2006b, "Synchronization of Cycles," *Journal of Econometrics*, Vol 132, Issue 1, 59-79

Keilis-Borok, V. I. and Kossobokov, V. G., (1990) "Premonitory activation of seismic flow: algorithm M8", *Physics of the Earth and Planetary Interiors*, 61, 73-83.

Keilis-Borok, V., J. H. Stock, A. Soloviev and P. Mikhalev (2000), "Pre-recession Pattern of Six Economic Indicators in the USA" *Journal of Forecasting*, 19, 65-80

Layton Allan P.(1996), "Dating and predicting phase changes in the U.S. Business Cycle," *International Journal of Forecasting* Volume 12, Issue 3, September, Pages 417-428