Business Cycles I: Facts

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So far we have focused on long run trends, i.e. in understanding why some countries like China have had a long run growth rate exceeding 5% per year for a long time while others have had a growth rate of 0% for a long time. Now we will switch gear and focus on short run fluctuations, i.e in understanding the quarter to quarter or month to month fluctuations in a given economy, like for example the 2008-09 recession in the US. These type of aggregate fluctuations are called business cycles.

Defining business cycles

The best definition is the one found in the book by Burns and Mitchell (1946) "Measuring Business Cycles",

"Business Cycles are a type of fluctuation found in the **aggregate economic activity** of nations that organize their work mainly in business enterprises. A cycle consists of **expansions** occurring at about the same time in many economic activities, followed by similarly general **recessions, contractions and revivals** which merge into the expansion phase of the next cycle; this sequence of changes is **recurrent but not periodic**; in **duration** business cycles vary from more than one year to ten or twelve years."

This definition concisely summarizes the four main features of business cycles.

1) Business Cycles are an aggregate phenomenon. That is they involve fluctuations in many economic activities hence in many economic variables, not only in GDP. Also note that fluctuations are in many economic activities but not in all activities. Therefore during a cycle some variables or activities do not follow the cycle or move in opposite directions to the cycle.

2) Business Cycles involve expansion and recessions. This is summarized by figure 1

When economic activity is falling we are in a contraction or recession. The low point of the recession is called the trough. After the trough the economy expands till it reaches a peak. After a peak a new recession starts and so on

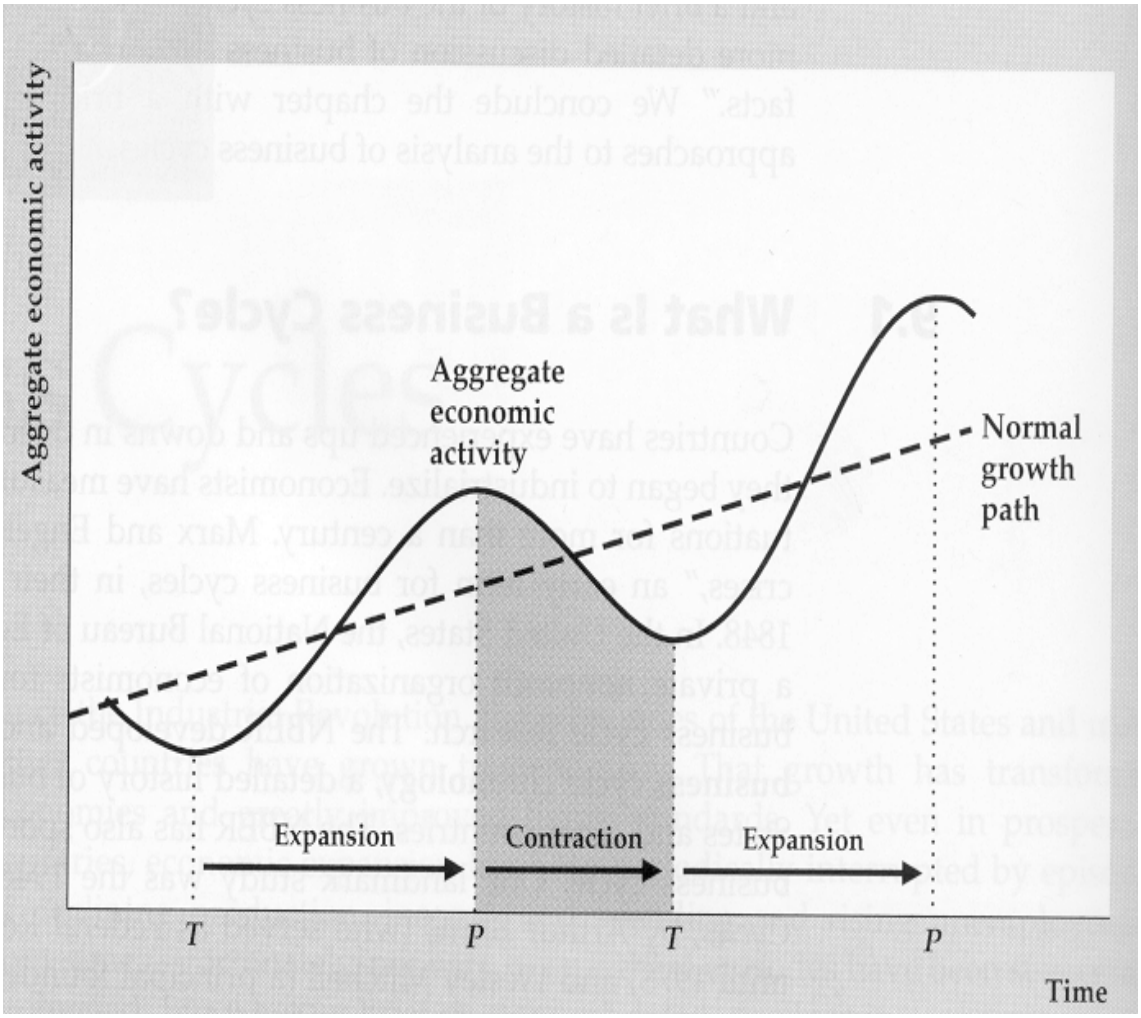

Figure 1: Expansions and Contractions

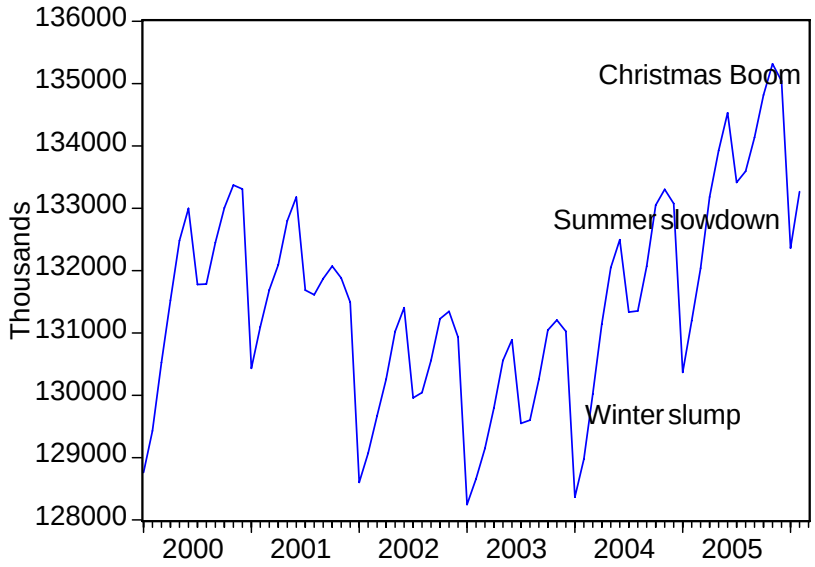

Figure 2: Seasonal Cycles

3) Business cycles are recurrent but not periodic. Cycles are recurrent in the sense that they happen many times but are not periodic in the sense that they do not happen at predictable times and for predictable length of time. An example of recurrent and periodic cycle is the seasonal cycle. Note that the fact that are not periodic makes them harder to predict but also more interesting to analyze in the sense that if you get them right you can take advantage of it (while there is not much advantage in getting the date of Christmas right).

4) Duration. Expansion and recession phases can have different durations (the time passing from peak to trough) and different amplitudes (the drop or increase in aggregate economic activity relative to the trend).

Identifying a business cycle

When we see a fluctuations in aggregate economic activity how do we know whether it is a long run change (which thus is going to stay) or a cyclical fluctuation (which thus is going to revert)? The first panel of figure 3 shows a measure that is often used to measure aggregate economic activity, that is the log of non farm employment. The first thing you should notice in the series is that there are a lot of so called seasonal cycles (see figure 2).

Since most times we are not really interested in those fluctuations we take them out using a statistical procedure called de-seasonalization (many statistical packages do

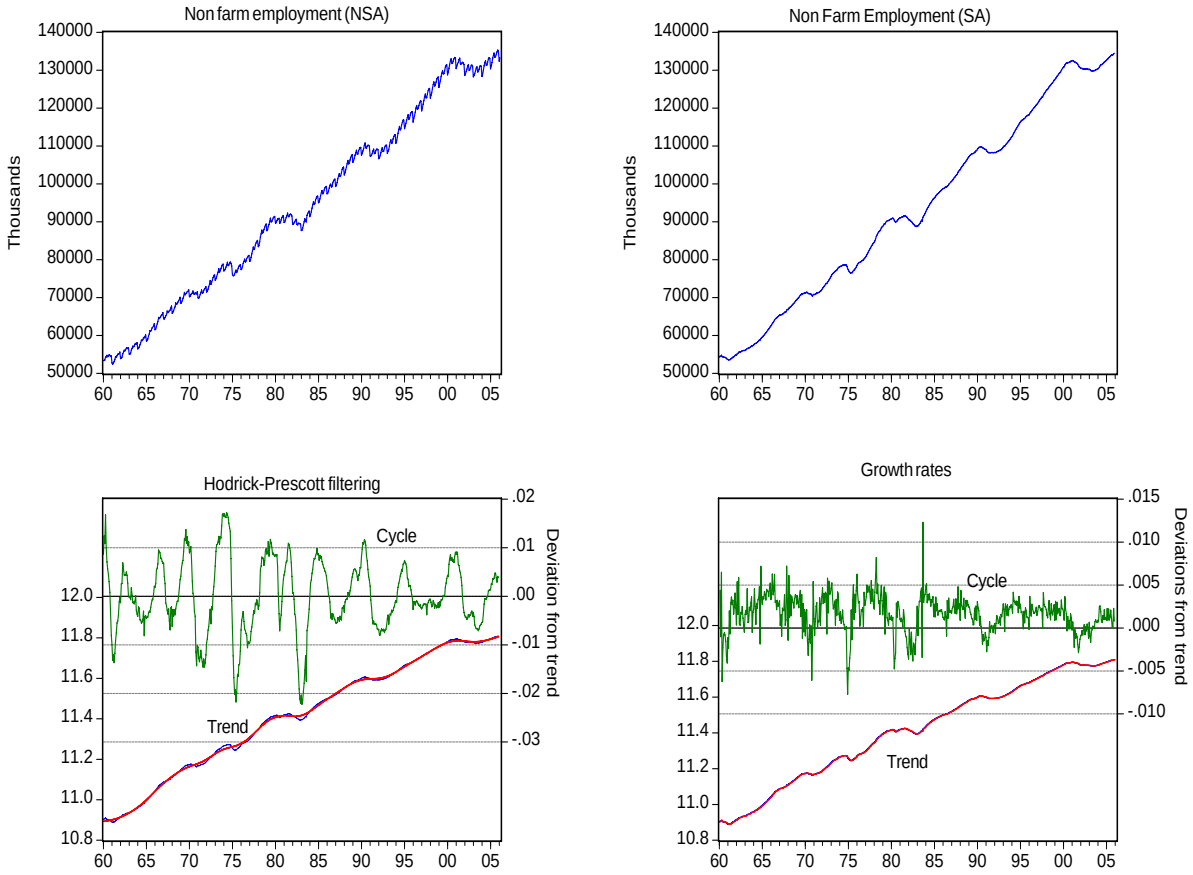

Figure 3: Trends and Cycles

it for you). The second panel show the de-seasonalized series. The third and fourth panel show possible ways of decomposing a (log) series in a trend component and a cycle component. They are both based on the idea that the cycle component y_t^C of a log time series y_t can be written as $y_t - y_t^T$ where y_t^T is the trend component: in other words the cycle component tells us the percentage deviation from the long run trend. The third panel shows the long run trend computed as a special moving average of the actual series and the resulting cycle (this procedure is called Hodrick-Prescott filtering). The fourth assumes that the trend at time t is simply the value of the series at time t-1 so that the cycle is just the growth rate of the series.

Describing a business cycles

Once we have identified the cycle component we want to distinguish the two phases of the cycle.

The NBER (National Bureau of Economic Research) has a committee that studies business cycle dates in United States (http://www.nber.org/cycles/main.html), that is determines when the US Economy is in a recession or expansion. The NBER does not define a recession in terms of two consecutive quarters of decline in real GNP (this definition is known as the Okun's definition of a recession). Rather, a recession is a recurring period of decline in total output, income, employment, and trade, usually lasting from six months to a year, and marked by widespread contractions in many sectors of the economy. A useful way of condensing this definition is the 3D criterion: a slowdown is a recession if it satisfy the following three criterions:

Duration (It lasts at least 6 months)

Depth (It is significant)

Diffusion (It is diffused to many sectors in the economy).

You can read the NBER memo (including the FAQ section) for more information. In figure 4 you can see how the two definitions compare as the bars are GDP growth in a given quarter and the shaded red areas are the NBER recession dates. It is convenient to divide economic variables according to there direction and their synchronization withy the GDP cycle.

Variables that move together with GDP are called pro-cyclical, variables that move in opposite direction are called counter-cyclical while variables that display no clear pattern are called a-cyclical.

Variables that tend to display their peak before the GDP peaks are called leading variables, those that peak at the same time as GDP are called coincident variables, those who peak after GDP are called lagging variables.

In the following table we analyze the behavior of the most important economic variables in terms of the cycle

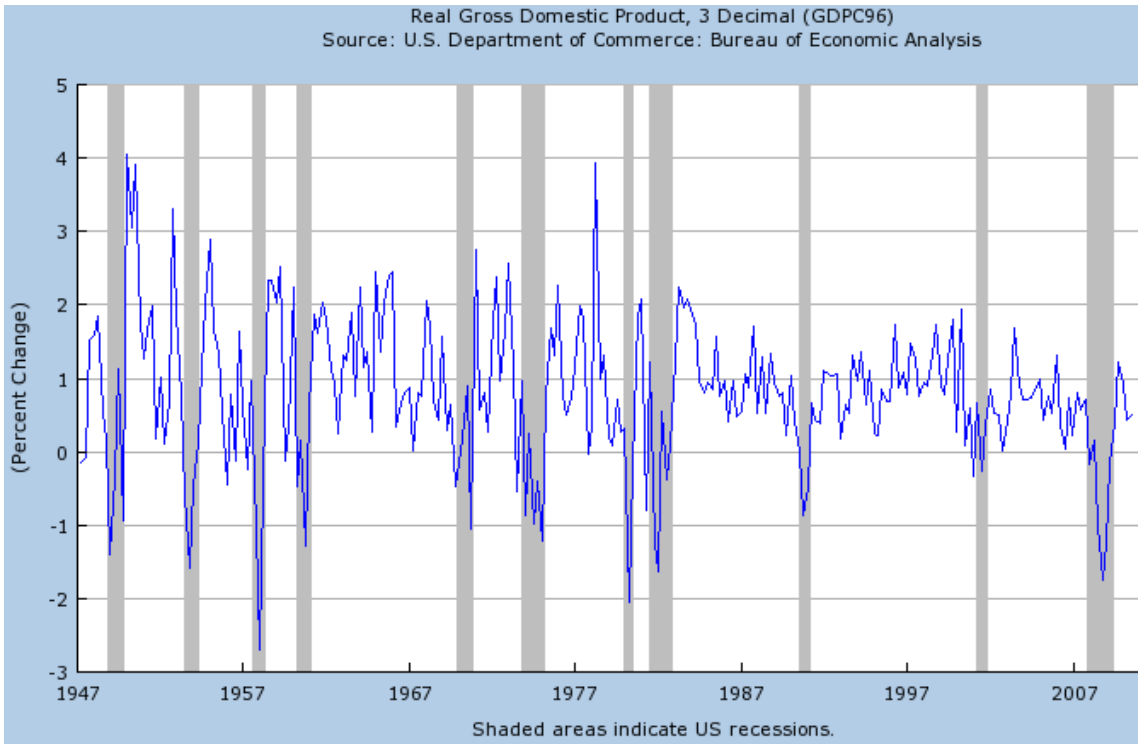

Figure 4: GDP growth and NBER recession dates

	Direction	**Timing**
Industrial production	ProCyclical	Coincident
Consumption	ProCyclical	Coincident
Business Fixed Investment	ProCyclical	Coincident
Residential Investment	ProCyclical	Leading
Inventories	ProCyclical	Leading
Government Spending	ProCyclical	—
Imports	ProCyclical	Leading
Exports	ProCyclical	Lagging
Net Exports	Countercyclical	Leading
Employment	Pro Cyclical	Coincident
Unemployment	CounterCyclical	Lagging
Labor Productivity	ProCyclical	Leading
Real Wage	ProCyclical	—
Money growth	ProCyclical	Leading
Inflation	ProCyclical	Lagging
Stock prices	ProCyclical	Leading
Nominal Interest rates	ProCyclical	Lagging
Real interest rates	Acyclical	–

Also figures 5 and 6 show the patterns of several of these variables in the US business cycle. Figure 7 instead focuses on the 2009 recession and shows the patterns of several component of GDP before, during and after he recession. Note a few things:

1) Investment is more volatile than consumption, residential investment is more volatile than business investment and durable consumption is much more volatile than non durable consumption. Can you guess why?

2) Note that in most recessions durable purchases and investment fall considerably. Notice though how the 2001 and 2008-09 recession are very different in the sense that in the in the 2001 recession residential investment barely moves but in the 2008-9 recession residential investment collapses.

3) Unemployment rate is highly counter-cyclical i.e. goes up in recessions. In the early recessions (70s and 80s) unemployment falls rather quickly after the recession is over. In the late recessions (90s, 00s) and in particular in the 2008-2009 unemployment remains high well after the recession is over. This charactersistic of recest recession has been referred as "jobless recovery",

4) In the 2008-2009 recession government spending went up rather substantially (Obama stimulus plan), imports fell much more than exports.

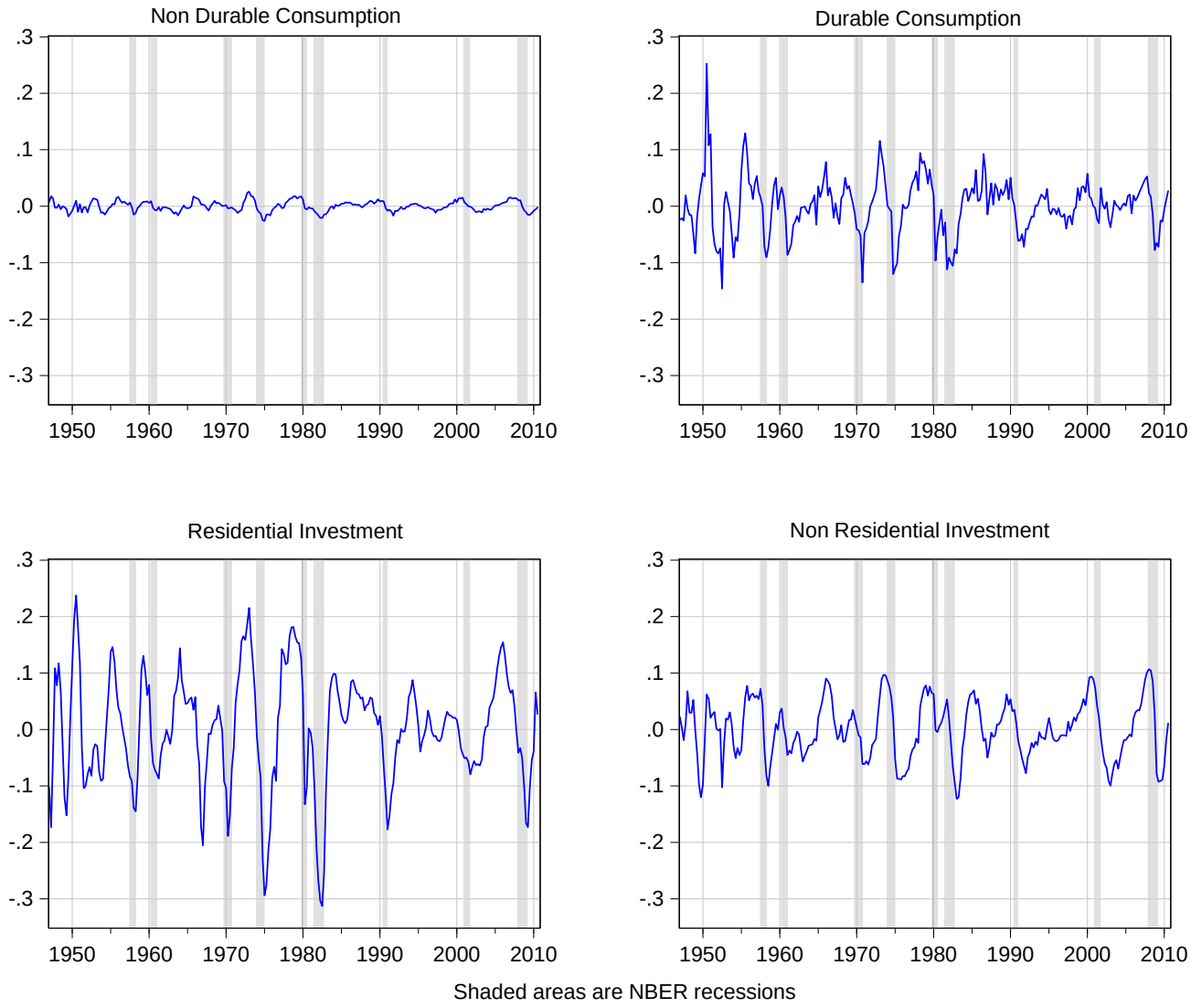

Figure 5: Consumption and Investment cycles

Business Cycles in the US

In figure 8 you can see all the US Business Cycles since 1854 and all the periods that were classified as recessions.

Note that the expansion of the 1990s was the longest ever. Notice also that there is a clear trend in the duration of business cycles: expansions are getting longer, contractions are getting shorter and the overall cycles are getting longer (because the change in the duration of expansions dominates). Notice for example that the record setting contractions are all pretty far back in time. For example the longest

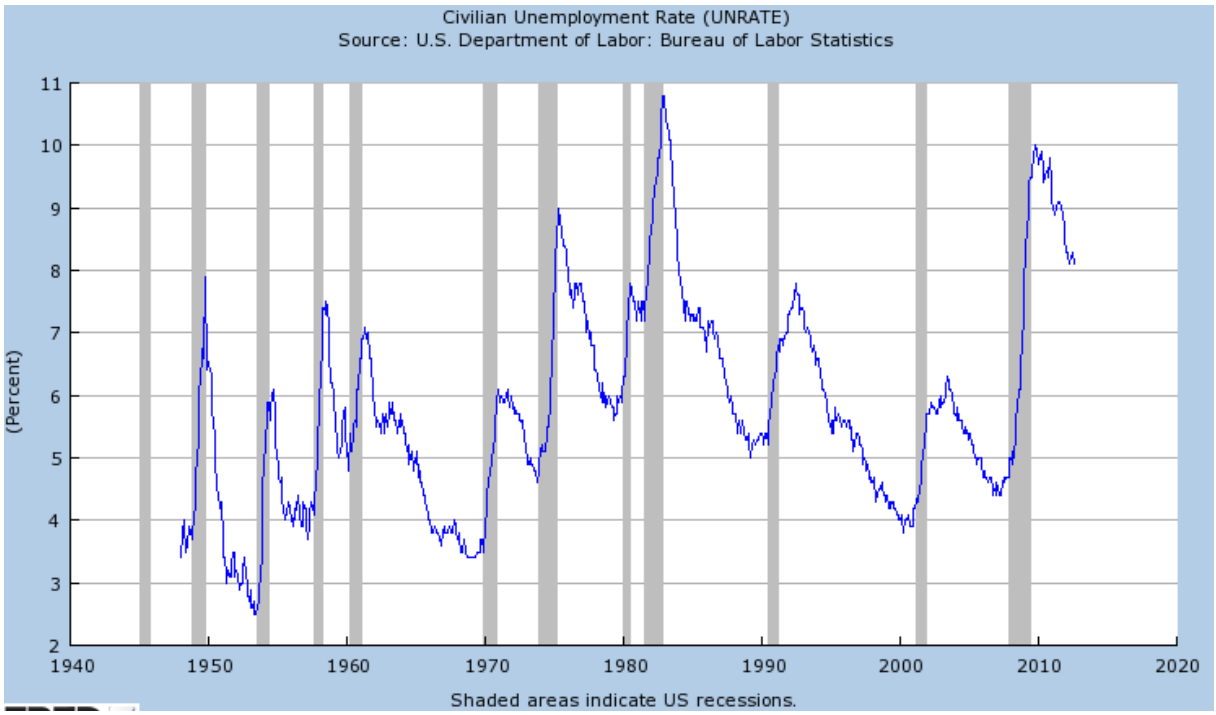

Figure 6: Unemployment rate

US contraction is from 1873 to 1879 and it lasted 65 months (there was no Federal reserve back then!) and the great depression that was a contraction that lasted for 43 months but in which GDP fell by more than 40% relative to its trend (almost 30% in absolute terms!). Clearly in comparison to recessionary episodes of the past the current recession seems mild, pretty much like the common flu in comparison with the Black death. You can see also these facts also by looking at figure 9 that shows the annual growth rates of US real GDP since 1870.

A very useful resources for looking more at features of the US business cycles in the post war is the Minneapolis Fed web site Recession in Perspective.

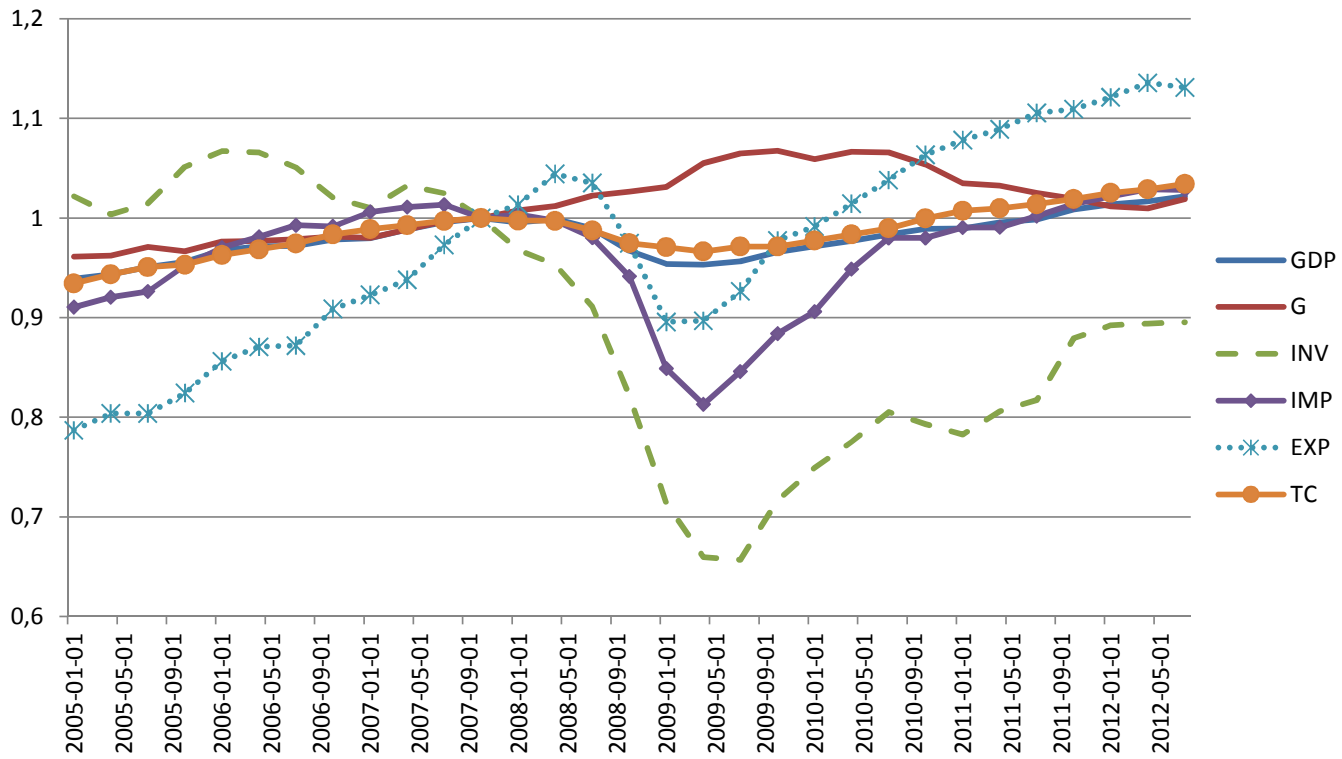

Figure 7: Anatomy of the 2008-2009 Recession

Business Cycles in Emerging Countries

In terms of many features (for example the high volatility of investment relative to consumption, the strong pro-cyclicality of employment) business cycles in other countries are similar to those observed in the US. Emerging and poor countries though have markedly more volatile and persistent business cycles: i.e. recession tend to be larger and to last longer. Figure 10 show this difference by plotting the difference in GDP fluctuations in US and in Argentina. Figure 11 shows how business cycles volatility is related in a negative way to income per capita. That is poor countries also tend to have much more volatile cycles. Why is that? This is an issue economists are still debating and which we will come back to. One leading explanation is that the same bad policies and institutional factors that lead to low per capita income also lead to high volatility.

BUSINESS CYCLE REFERENCE DATES		DURATION IN MONTHS			
Peak	**Trough**	**Contraction**	**Expansion**	**Cycle**	
Quarterly dates are in parentheses		*Peak to Trough*	*Previous trough to this peak*	*Trough from Previous Trough*	*Peak from Previous Peak*
	December 1854 (IV)	--	--	--	--
June 1857(II)	December 1858 (IV)	18	30	48	--
October 1860(III)	June 1861 (III)	8	22	30	40
April 1865(I)	December 1867 (I)	32	46	78	54
June 1869(II)	December 1870 (IV)	18	18	36	50
October 1873(III)	March 1879 (I)	65	34	99	52
March 1882(I)	May 1885 (II)	38	36	74	101
March 1887(II)	April 1888 (I)	13	22	35	60
July 1890(III)	May 1891 (II)	10	27	37	40
January 1893(I)	June 1894 (II)	17	20	37	30
December 1895(IV)	June 1897 (II)	18	18	36	35
June 1899(III)	December 1900 (IV)	18	24	42	42
September 1902(IV)	August 1904 (III)	23	21	44	39
May 1907(II)	June 1908 (II)	13	33	46	56
January 1910(I)	January 1912 (IV)	24	19	43	32
January 1913(I)	December 1914 (IV)	23	12	35	36
August 1918(III)	March 1919 (I)	7	44	51	67
January 1920(I)	July 1921 (III)	18	10	28	17
May 1923(II)	July 1924 (III)	14	22	36	40
October 1926(III)	November 1927 (IV)	13	27	40	41
August 1929(III)	March 1933 (I)	43	21	64	34
May 1937(II)	June 1938 (II)	13	50	63	93
February 1945(I)	October 1945 (IV)	8	80	88	93
November 1948(IV)	October 1949 (IV)	11	37	48	45
July 1953(II)	May 1954 (II)	10	45	55	56
August 1957(III)	April 1958 (II)	8	39	47	49
April 1960(II)	February 1961 (I)	10	24	34	32
December 1969(IV)	November 1970 (IV)	11	106	117	116
November 1973(IV)	March 1975 (I)	16	36	52	47
January 1980(I)	July 1980 (III)	6	58	64	74
July 1981(III)	November 1982 (IV)	16	12	28	18
July 1990(III)	March 1991(I)	8	92	100	108
March 2001(I)	November 2001 (IV)	8	120	128	128
December 2007 (IV)	June 2009 (II)	18	73	91	81
Average, all cycles:					
1854-2009 (33 cycles)		16	42	56	55*
1854-1919 (16 cycles)		22	27	48	49**
1919-1945 (6 cycles)		18	35	53	53
1945-2009 (11 cycles)		11	59	73	66

Figure 8: Business Cycle Dates

Predicting Business Cycles

Predicting growth rate of GDP is quite hard as, contrary to some other variables like employment growth, it displays very modest serial correlation over time. Since there

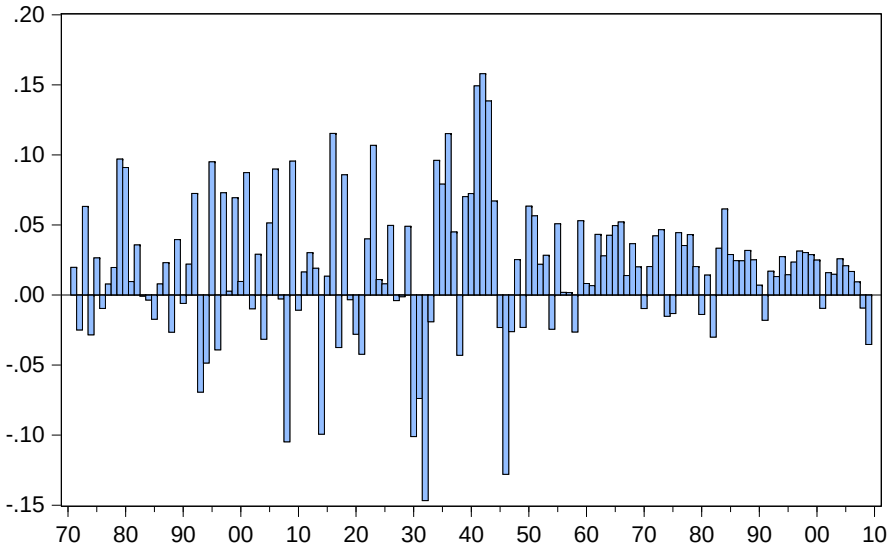

Figure 9: Annual growth rate of US GDP: 1870-2009

are some variables that consistently peak before the cycle economists have tried to construct an index that is an aggregate of all these variables that can be used to predict the business cycle; this index is called index of leading indicators. Some of the variables included in the index change from time to time but most of them are fixed. As of now they are

(1) Average weekly hours, manufacturing

(2) Average weekly initial claims for unemployment insurance

(3) Manifacturers' new orders, consumer goods and materials

(4) Vendor performance, slower deliveries diffusion index

(5) Manifacturers' new orders, non-defense capital goods

(6) Permits, new private housing units

(7) Stock prices, 500 common stocks

(8) Money Supply, M2

(9) Interest Rate spread, 10-year Treasury bonds less federal funds

(10) Index of consumer expectations

Notice that most variables are there because they are good predictors of future economic activity. Some variables (such as residential investment) would be a good

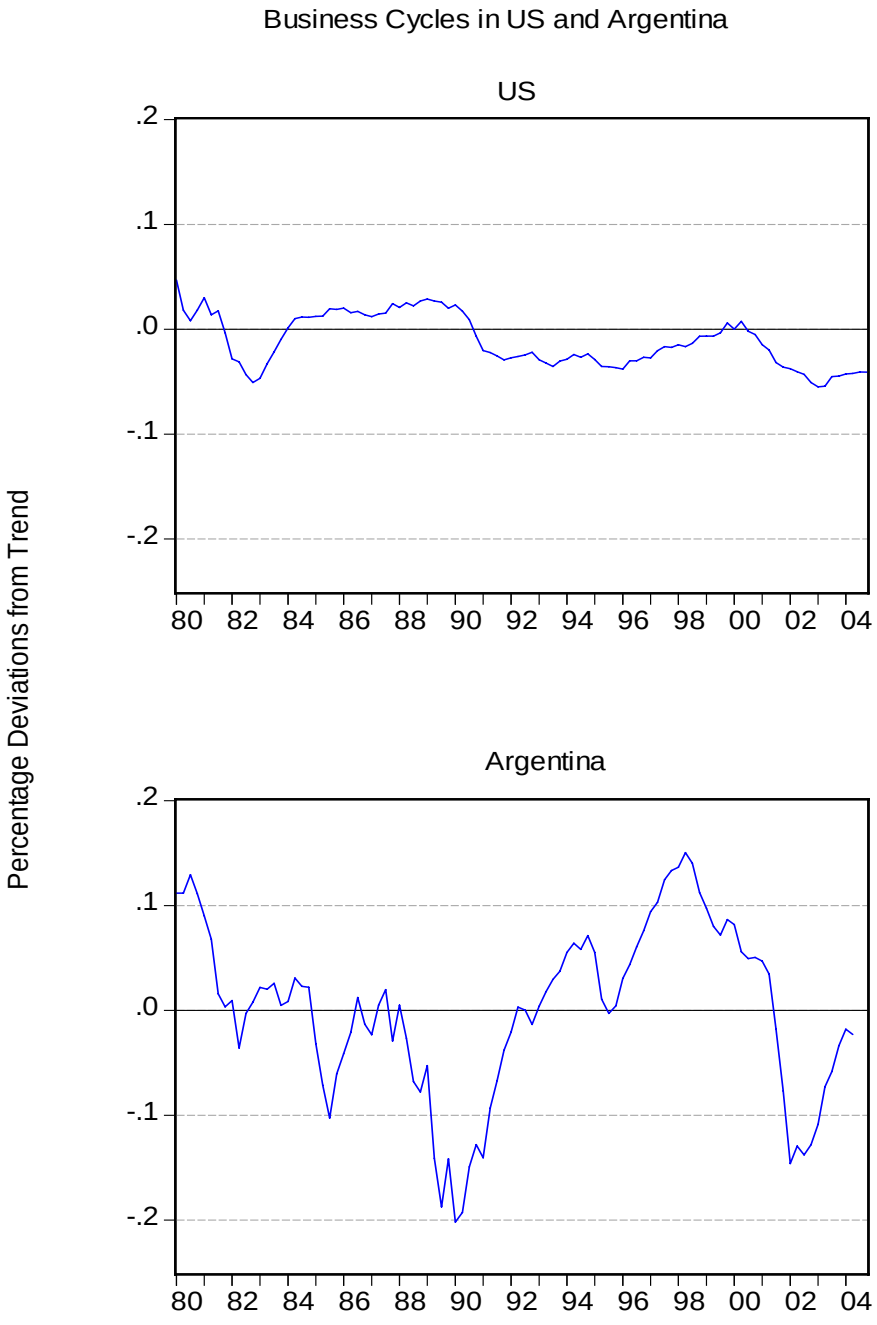

Figure 10: Business Cycles in US and Argentina

predictor of future economic activity are not there because they are not promptly available and therefore they cannot be used to predict a coming recession. An interesting indicator (that is also one of the more effective) is the interest rate spread, that is the difference between the interest rate on 10yrs bonds and the federal funds

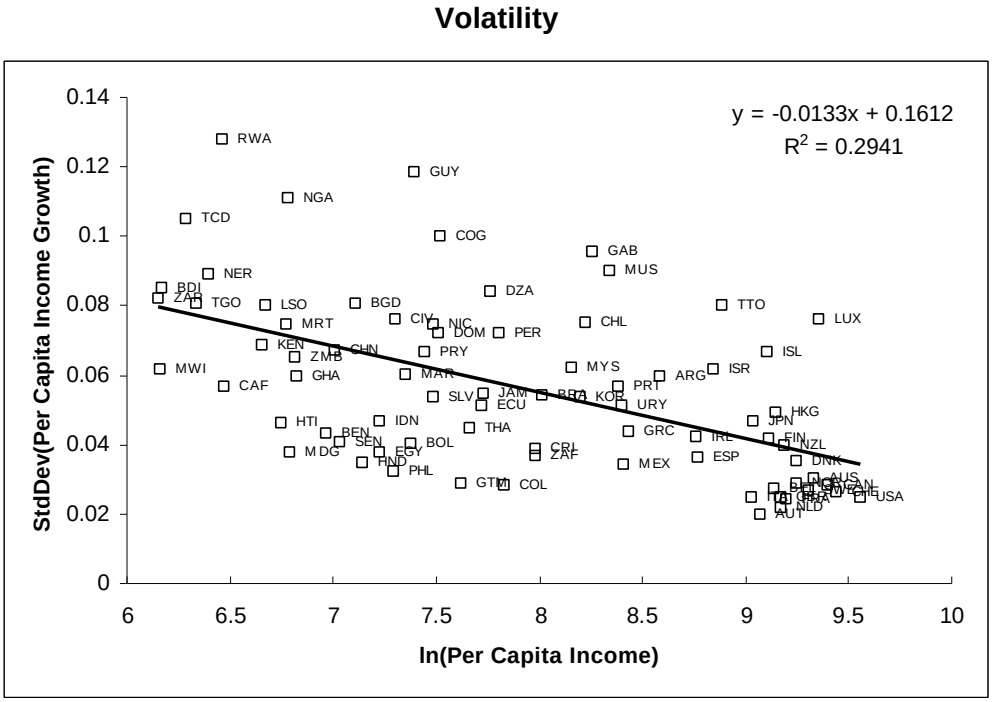

Figure 11: When it rains it pours: poverty and volatility

rate (that is a measure of how steep is the yield curve). A series for the term spread is plotted in figure 12.

The figure shows that indeed many US recessions are anticipated by a fall in the spread. Why is this spread a good predictor of future business cycles? The reason is fairly simple and can be understood introducing the simple "expectation hypothesis". This hypothesis states that the long term interest rate (say the interest rate on a 10 year bond in period t, call it i_{Lt}) should be approximately equal to

$$i_{Lt} = \frac{1}{10} i_{St} + \frac{1}{10} E_t(i_{St+1}) + ... \frac{1}{10} E_t(i_{St+10})$$

where i_{St} is the short run interest rate (say 1 year) in period t and the symbol $E_t()$ denotes expectation of a certain variabl at time t. Why should the equality above hold? If it didn't (suppose for example that $i_{Lt} > ..$) then it would be convenient for investors to buy long term bond and borrow short term; but that would increase the price of long term bond, reducing the yield and making the above equality hold. Now suppose that the equality holds and that at the same time $i_{Lt} >> i_{St}$. This tell us quite obviously that the markets expect future interest rates $E_t(i_{St+1})$ above current short, i.e. expect short rates to increase. But short term rates are increasing

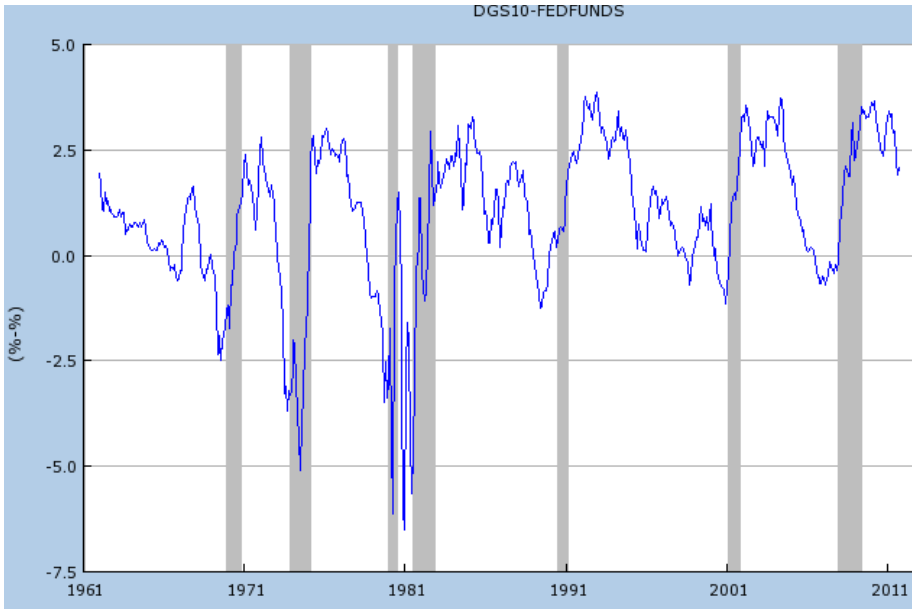

Figure 12: The term spread and US recessions

when the the economy does well and the FED tries to cool off inflation increasing the Federal Funds Rate. Hence seeing $i_{Lt} >> i_{St}$ (i.e. a high term spread) tells you that the markets are expecting good economic times. Conversely seeing $i_{Lt} < i_{St}$ (this situation is called an inverted yield curve) signals an expectation of bad times. Guided from this intuition, many have found that you can predict GDP growth with the slope of the yield curve. To get an idea of the predictive power of the term spread we can run a regression of GDP growth on the term spread at different lags.

Root Mean Square Errors of GDP growth forecasts

	R^2	RMSE
Forecast Horizon		
1 quarter	0.13	3.2%
2 quarters	0.17	3.1%
3 quarters	0.10	3.2%

The R^2 of such regression is decent but not too high and a root mean square error of around 3.2% means that if predicted growth in the next quarter is 4%, growth in the next quarter is only bound by be 4%-6.4%=-2.4% and by 4+6.4%=10.4%. Figure 13 the predicted growth two quarters ahead versus the realized growth. See that the predicted growth does pick up only a small variation of GDP growth and that there are periods (for example the late 1990s) in which the prediction error is systematic and large.

Figure 14 plots the series for a composite index of leading indicators (For details on

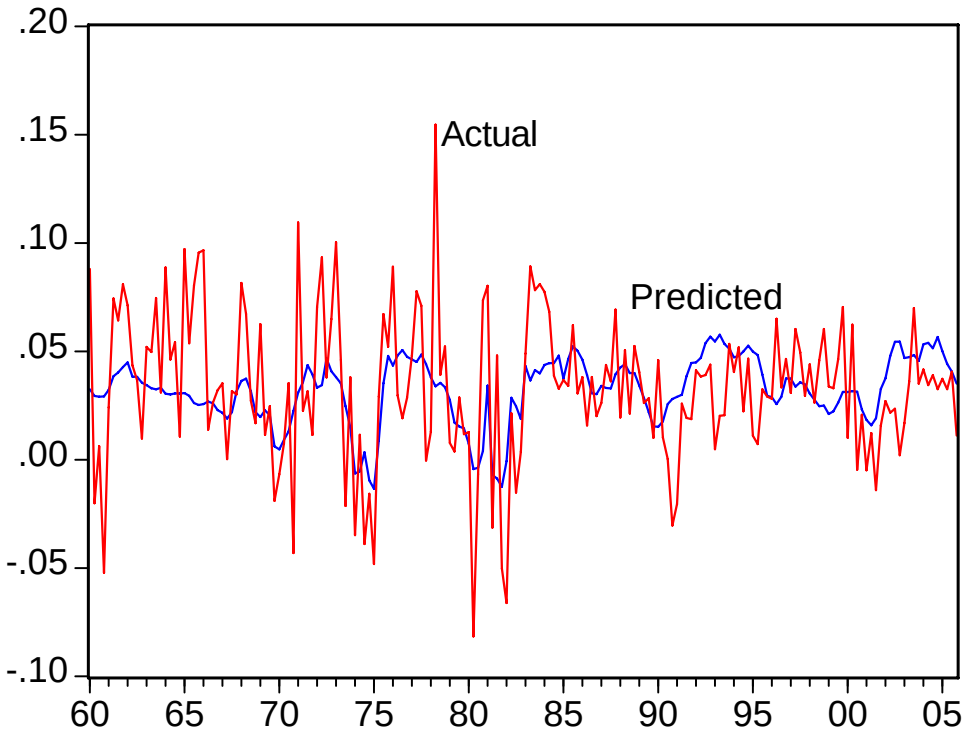

Figure 13: Forecasted GDP growth using term spread

how this series is constructed see here). The shaded areas are NBER recessions in the last 40 years. Notice that most recessions were anticipated by a decline in the leading indicators but that it would be still hard to make accurate predictions on when the next recession is going to come. Notice, for example, that there have been false alarms (66 and 95) and that the onset of the depression has followed the leading indicators with different lags (in 1970 and 1973 the depression has come quickly after the decline in the leading indicators while in 80 and 90 the leading indicators have declined for a long time before the depression has actually happened).

In forecasting future GDP growth the percentage change in leading indicators does better than the simple term spread but not by a lot as the table below and the figure 15 show

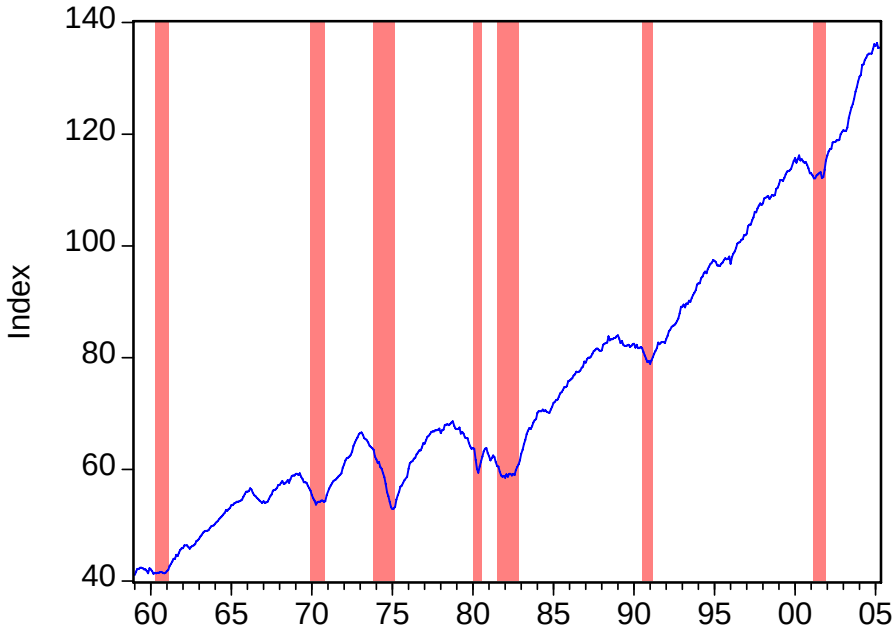

Figure 14: Leading indicators and recessions

Root Mean Square Errors of GDP growth forecasts

	R^2	RMSE
Forecast Horizon		
1 quarter	0.32	2.8%
2 quarters	0.18	3.0%
3 quarters	0.08	3.2%

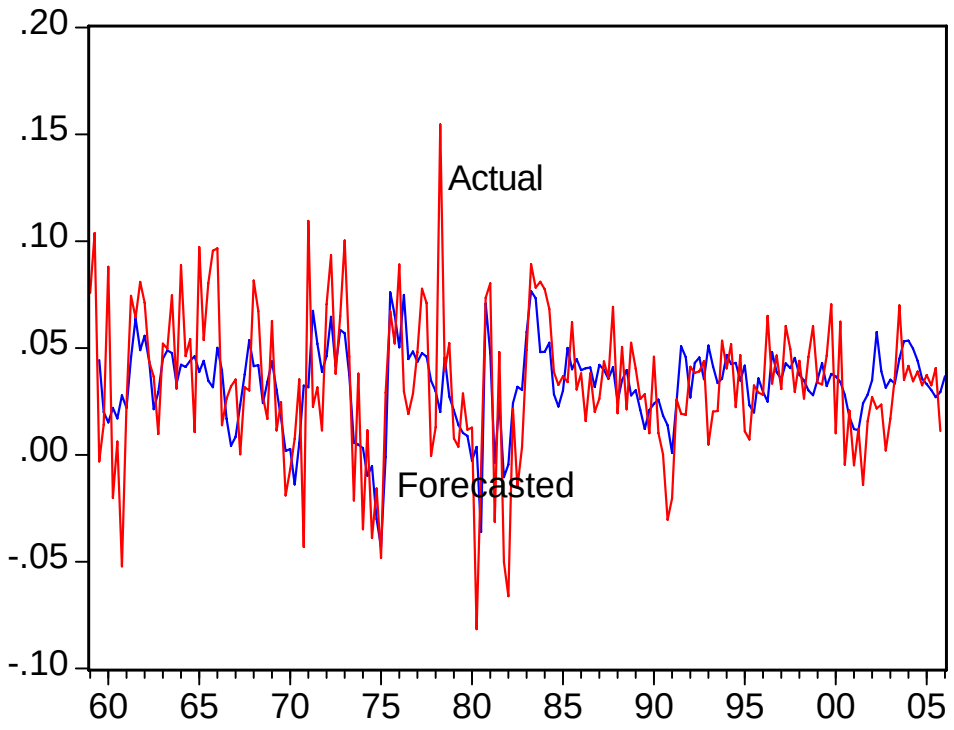

Figure 15: Forecasted GDP growth using leading indicators

Concepts you should know

1. Business cycle
2. Seasonal cycle and trend
3. Recessions
4. 3D criterion
5. Leading and Lagging indicators
6. Pro-cyclical and counter-cyclical variables
7. Expectation hypothesis
8. Business cycles in emerging and developed countries