

Why are the Cycles in Homes and Consumer Durables So Similar?

Edward E. Leamer

October 2008

In this paper I explore more fully the idea in my Jackson Hole paper¹ that the Fed should use a modified Taylor rule with interest rates determined by the level of housing starts and the direction housing starts are moving as well as a long moving average of inflation. Here I will take as a given that inflation is very persistent and needs a persistent policy to combat it. Thus the short-run movements of the Fed Funds rate should be about stabilizing the business cycle, not fighting inflation. I take this to the extreme here, and ignore altogether the inflation target.

The traditional Taylor rule has interest rates a function of inflation and the output gap. There are two problems with the use of the output gap to set monetary policy. One problem is how to measure it. The other problem is that the output gap is a looking-backward measure. Policy should be anticipatory not reactive, and for that purpose there is a big difference between a gap that is growing and a gap that is shrinking.

I will show in this paper the extraordinary historical accuracy of a recession forecast based on high but declining housing starts. The next step is to determine the sensitivity of housing to short-term interest rates under control of the Federal Reserve Board. This is not so easy because of the obvious endogeneity/anticipatory nature of the bond market, both the long-term rates chosen by the market and the short-term rates chosen by the Fed. To put it another way, all we have in the data are temporal orderings. There are no experiments here. The causal conclusions derived from these temporal orderings do not approach scientific truths. So think of the regressions below as rhetorical devices. If you can relax your standards of evidence and allow yourself a pleasant swim in this warm pool of words and regressions, you may find your thinking clarified, and you may even reach a state of blissful enlightenment.

The apparent interest-rate sensitivity of housing makes it seem clear that the Federal Reserve Board could smooth out the cycle in homes. When housing starts are above their normal 1.5-1.6 million range, and rising higher, that is the time to cool the housing passions with higher interest rates. When housing starts crest and start to decline, that is the time for accommodative monetary policy to soften the landing.

This idea was dismissed by Fed officials with the remark: “We don’t do sectors.” Thus the title of this paper: “Why are the Cycles in Homes and Consumer Durables So Similar?” Is it enough to have the proximate target be housing since everything else would just fall in line? Or would the stabilization of housing leave the rest of the cycle intact, or even make it worse? That is question that motivates this paper.

¹ “Housing is the Business Cycle,” in *Housing, Housing Finance and Monetary Policy, A Symposium* Sponsored by the Federal Reserve of Kansas City, August 2007

The focus on consumer durables comes from the fact that we do not have a business cycle, we have a consumer cycle. In the first section of this paper, I show that of the ten recessions that the US has had since WWII, eight have been consumer downturns that began first with problems in housing followed a couple of quarters later with problems in consumer durables. Thus, after homes, it is consumer durables that is most important to smooth out, if the economic cycle is to be attenuated. What would interest rates chosen to smooth the housing volume cycle do to housing prices and to the volume cycle in durables?

To answer this question, I build a simple three-equation econometric model that explains housing starts, housing appreciation and unit sales of light vehicles. Into this model I insert a rate-setting equation designed to stabilize housing starts at 1.55 million units, roughly the historical mean around which starts have been fluctuating for a long time. This rate-setting equation is a solution to a quadratic control problem that correctly allows for uncertainty in the interest rate effects – leaning toward more conservative rate setting as the standard error on the interest rate coefficient increases. The target is to eliminate in a quarter 15% of the difference between starts and 1.55 million. This model is run for two different time periods. The first scenario commences in 2000, when Mr. Greenspan was worried about inflation and was raising rates. Here we explore the wisdom of that year 2000 rate increase, the subsequent very low rates in 2003/4, the rapid jacking up of rates in 2004/5, and the diving down of rates to where we are today. To put it succinctly: what was all that volatility about? How helpful was that?

The next scenario begins in 2006 when Chairman Bernanke replaced Chairman Greenspan at the table. He was obviously dealt a weak hand with housing starts peaking at their stratospheric level of 2.1 million units virtually the day he took over, but what might he have done to help housing achieve a soft landing, and would that have made the problems in automobiles less extreme?

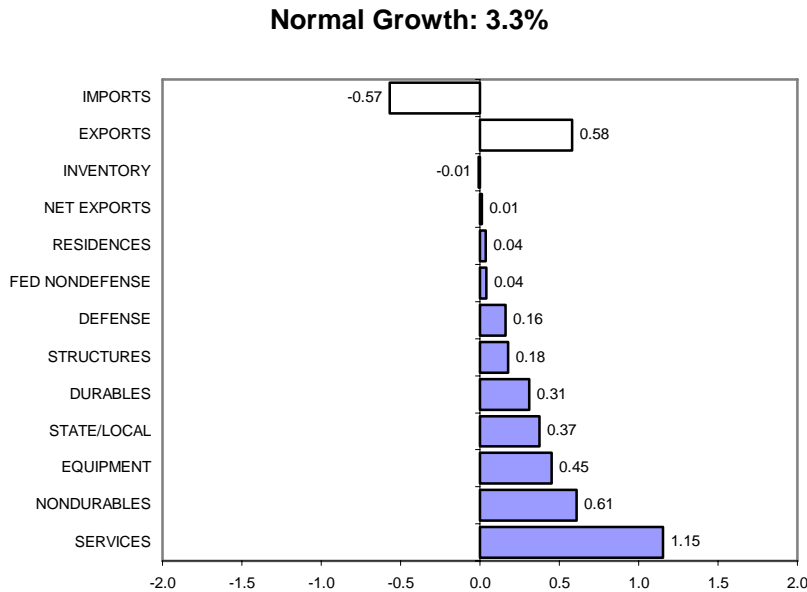
Don't expect definitive answers here. The data sets are not up to the task. But expect to be (mildly) entertained, and maybe even influenced. I really do think the Fed should focus much more on housing. Right now, with housing starts under 900 thousand, the cumulative housing units will be below trend early next year, and if these very low housing starts continue through 2009, the under-building of places to live will lay the foundation for the next housing mania. Unfortunately, the interest rate arrows that the Fed is shooting cannot come close to housing as long as home prices are declining, since the real cost of a home loan is the interest rate plus the home price depreciation. By the way, that's a kind of deflation we should worry about. The rental market for places to live in most parts of the country is strong and calling out for "more building", but with ever declining home prices the asset market that determines who owns the units is saying "no way." Builders sell in the asset market and cannot find customers even though we need more places to live. Ironically, the Fed's commitment to an anti-deflation policy in 2003/4 produced a deflation pathology today that is beyond the reach of the Fed's medicine.

Cycle Facts: Magnitudes and Timing of the Problems

Profiles of Contributions to GDP Growth

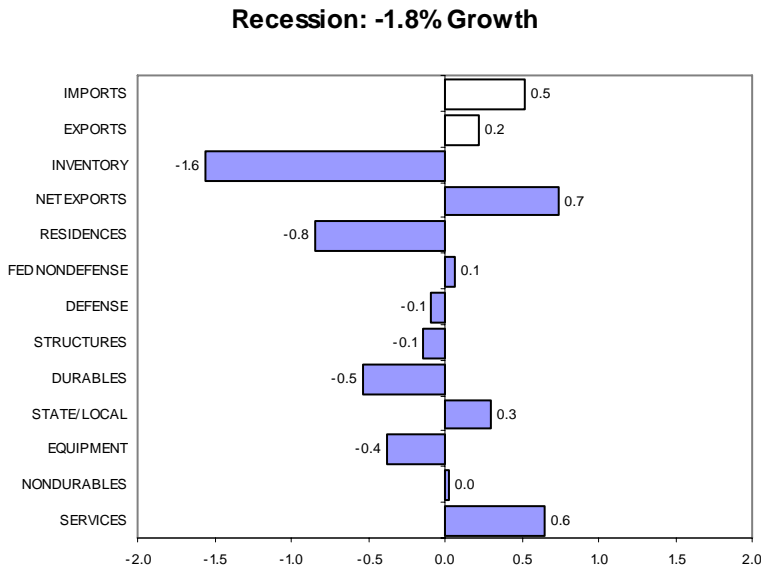
We first start looking for causes of the US recession among the components of GDP. The BEA creates a table of “contributions to GDP growth” that in effect scales the components of GDP by their importance. This information is displayed in the normal growth profile, Figure 1, which is based on historical data only in the “normal” growth phases, not the recessions, recoveries or spurts. At the bottom of this pyramid is the largest contributor to normal growth: consumer services. Services contribute 1.15 to the total normal growth of 3.3. Next comes consumer nondurables, then equipment and software. Moving farther up the chart, we see that defense spending is rather unimportant, while federal nondefense, homes, net exports and inventory hardly matter at all. Incidentally, at the top of this figure I have displayed imports and exports separately, but show them in white bars. Thus the 0.58 contribution of exports is almost perfectly offset by a -0.57 from imports.

Figure 1 Profile of Normal Growth



We are trying to figure out what causes recessions, and a first step is to ask how recessions are different from normal. Compare the recession profile in Figure 2 with the normal profile in Figure 1. They are dramatically different. A recession has a big negative from inventory, while normal growth has virtually none. A recession has a big positive from net exports, while normal growth has virtually none. A recession has a big negative from homes (residences) while normal growth has a very small positive.

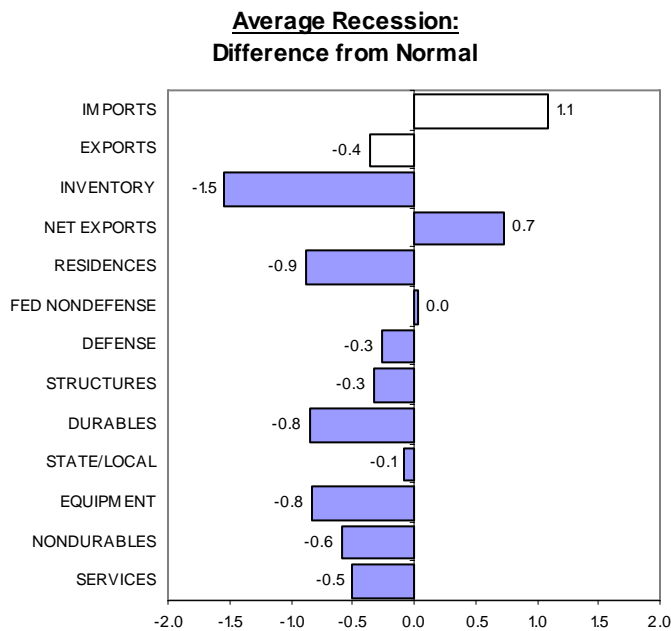
Figure 2 Recession Profile



The comparison of the recession with normal growth is much easier if we look at the difference between the two, illustrated in Figure 3. This tells us very clearly how a recession is different from normal. On the negative side, the biggest problem is inventory. Next comes homes, then consumer durables (cars and washing machines) and business equipment. That's an important clue. Put it in your head. *Inventories, homes, cars and equipment.*

The only bright part of a recession is the positive contribution of net exports. That is mostly due to imports, because we ship our economic softness abroad by purchasing fewer imports.

Figure 3 Recession Profile: Difference from Normal

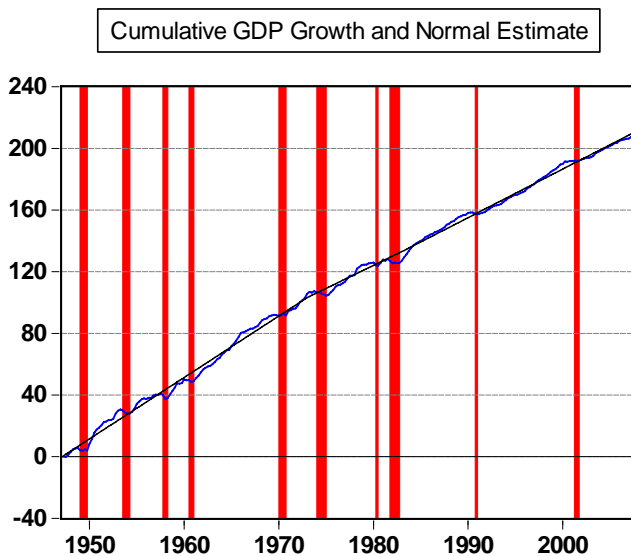


Normal Trend Contributions to GDP Growth

The figures just discussed that contrast the contributions to GDP growth during recessions with the contributions during normal periods do not allow for the possibility that the normal contributions have changed over time. But weakness in a component of GDP in 2001 may be rather different from weakness in 1948 because of potentially substantial changes in the structure of the economy over that half-century.

I have explored many possible ways of allowing the normal contributions to change over time but the one that is simple and seems to do the job is a piece-wise regression of the cumulative contributions on a time trend, allowing for three different trends.² The two break-points in these trend lines have been chosen to maximize the fit of the regression, with the restriction that each episode must be at least ten years in length. The results of this exercise for GDP are displayed in Figure 4 which depicts the cumulative (additive, not compounded) GDP growth figures (divided by 4 to turn the quarterly numbers into annual), and the three-trend line that best captures changes in the trends in this series. You can hardly see it in the figure, but this “normal contribution” has breakpoints in both 1973Q1 and 1983Q3.

Figure 4 GDP Growth Cumulative and “Normal” Cumulative



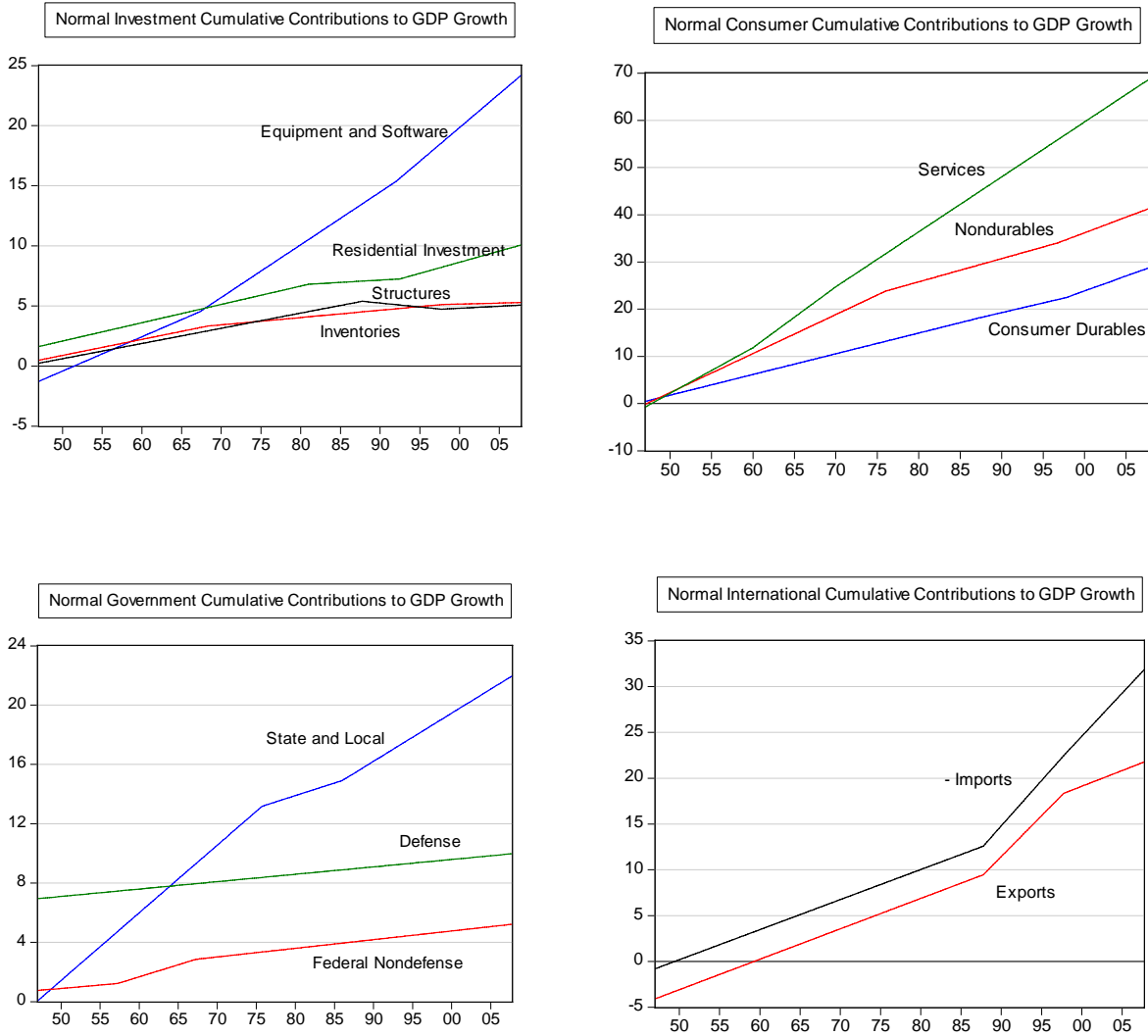
The three-trends “normal” cumulative doesn’t fit so well the defense spending cumulative I have instead chosen a single trend commencing in 1955.

Figure 5 displays the three-part trends for all the cumulative contributions to growth. Keep in mind that what matters here are the slopes and not the levels of the curves. It is

² This “normal” is both backward and forward looking. It might be better to change the trend only when the trend becomes apparent in real time. I don’t think that appropriate change could matter much.

these slopes that are the normal contributions, and it is the difference between the actual contributions and these slopes that is the abnormal contribution. Many of these normal cumulatives are virtually straight lines, meaning that there is only one normal contribution. However, the rapid rise in both imports and exports after 1987 and the more sluggish growth of exports after 1997 are quite evident.

Figure 5 Normal Cumulative Contributions: Three Periods



Cumulative Abnormals

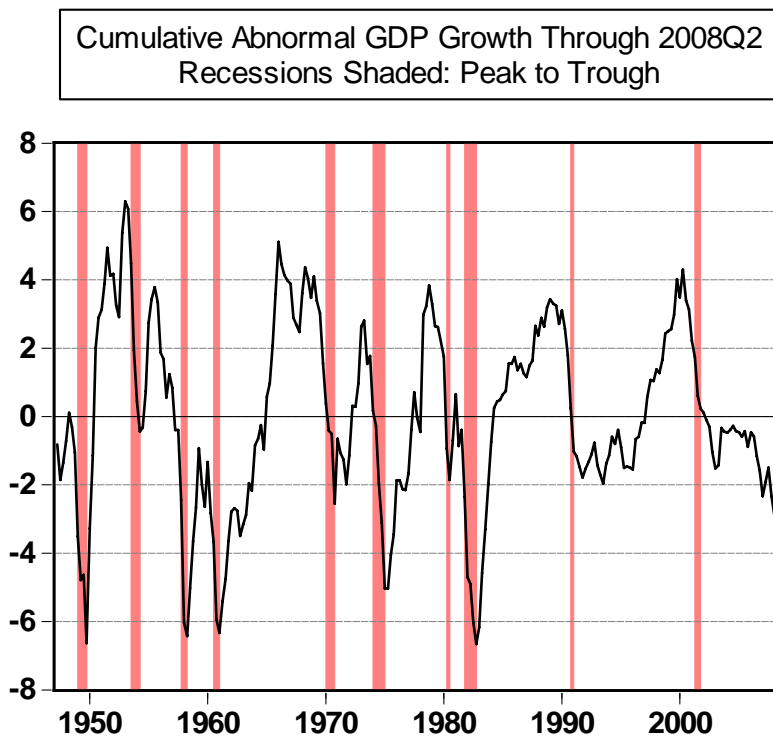
The next step is to subtract from the actual cumulative the “normal” cumulative to get to the abnormal cumulative. For example, the GDP abnormal cumulative, which is the difference between the two lines displayed in Figure 4, is displayed in Figure 6 with the recessions color coded. To understand this figure you need only think: flat, rising or declining. When the line is flat, that means the growth is normal, quarter after quarter, since to get a cumulative abnormal that doesn’t change, it is necessary to have the

abnormal be zero, and thus actual equal to normal, quarter after quarter. When the curve is rising, growth exceeds normal; when the curve is declining, growth is less than normal.

The official recessions are shaded in this figure and the weakness of GDP growth is evident as the curve dives sharply in every one of the recessions. Generally, after a few quarters of diving down, the curve shifts in the other direction and rockets skyward. That is the better-than normal growth recovery. There are hardly any flat segments here, and thus few extended periods of normal growth, but you can see two flat segments near the end of the series: the early 1991-1995 and 2002-2007.

The next step will be to look at these cumulative abnormals to see if they are behaving in some special way immediately before the recessions, and can therefore be used to issue an early warning signal of troubles ahead. Figure 6 reveals that GDP growth softens dramatically in the recessions, but the weakness immediately before recessions is not so distinct that it can be relied upon to predict recessions. That isn't surprising, since the NBER uses declines in GDP to date the start of recessions.

Figure 6 GDP Deviations from Normal Cumulative



Temporal Ordering of Components of GDP

Average Temporal Orderings: It's a Consumer Cycle, not a Business Cycle

We already have some clues about what causes recessions. The big four problems *during* recessions are: *Inventories, homes, cars and business equipment*. The next step is to look at temporal orderings: which comes first? What is soft before recession? Which is a leading indicator?

To explore the temporal orderings, we will first look at the cumulative abnormal contributions to GDP averaged across seven recessions and then look at each of the ten recessions separately. Excluded from the averages are three recessions that are different: the 2001 Internet Comeuppance, the 1953 Department of Defense Downturn and the 1948 ancient consumer downturn which is a typical consumer downturn but with an atypically strong recovery. We will look at each of these recessions separately soon enough.

The *average cumulative abnormal contributions* of the investment components of GDP growth during the seven consumer recessions are illustrated in Figure 7. The corresponding data for the other components of GDP are displayed in Figure 8. These data are computed in the manner discussed in the previous section. This may seem complex, but you only have to remember one thing: when the displayed line is flat, that represents a sequence of normal contributions, since the abnormal must be zero to make the cumulative have no change. FLAT=NORMAL. RISING=GREATER THAN NORMAL. DECLINING=LESS THAN NORMAL.

Take a look at Figure 7 and Figure 8. Can you see flat, or rising, or declining? The horizontal scale in these figures is the number of quarters before and after the official NBER peak. Period 0 is the peak and period 1 is the first quarter of the recession. The period zero data is zero in every case by construction: from the data around each recession we subtract out the value at the cycle peak. The vertical scale indicates the cumulative effect of the item on GDP compared with the cycle peak period.

There are big differences in the timing and the amplitude of each of these average abnormal contributions. The housing peak occurs three quarters before the official cycle peak, and the decline in spending on homes reduces GDP by about 0.6% before the recession officially begins. In the first two quarters of the recession, declines in spending on homes reduce GDP by another 0.5%, but strong growth thereafter has home spending exceeding the value at the cycle peak in the 6th quarter of the recession.

Contrast homes with the pattern of spending on equipment and software. In equipment and software there is just a tiny bit of weakness prior to the onset of the recession- the equipment line is virtually flat to the left of zero. Spending on equipment and software gets very soft immediately at the onset of the recession, and doesn't return to normal

again until the 5th quarter of the recession when the line bottoms out. The cumulative impact of weakness in spending on equipment and software is to knock a full percentage point off of GDP. And even after the seven quarters, the lost growth due to weakness in equipment and software has not been recovered.

So who moves first: businesses or consumers? It's consumers. **It's a consumer cycle, not a business cycle!!** Businesses wait to see what consumers are doing. Businesses are the passenger, not the driver.

What about consumer durables and business structures? They tell a similar story. Spending on consumer durables softens considerably two quarters before the official cycle peak. **The consumer durables downturn is closely aligned with the decline in residential investment, but the total reduction in GDP is greater for consumer durables(1.4) than for residential investment (1.0), and the bottom in consumer durables is one or two quarters after the bottom in residences.** Based on these averages, it appears that weakness in consumer durables is as good a predictor of oncoming recessions as weakness in residential investment, but when we look at all the recessions separately another conclusion emerges – the averaging has masked considerable noise in the consumer durables numbers across recessions. Rely on homes not durables.

The cycle in business spending on structures has the smallest amplitude and is the most delayed of these four, not returning to normal until the 7th quarters of the recession.

The inventories component deserves some special attention since the cumulative abnormal is rising smartly several quarters before recessions. Possibly, prior to recessions, businesses are building up inventories in anticipation of exceptional growth ahead, but more likely the softening economy produces an unexpected and unintended buildup of inventories, and when the recession begins in full measure, these inventories are drawn down and are a substitute for current production, which makes the production swing greater than the swing in demand. Thus it appears as though inventory management, rather than softening the cycle in production, as it should, is actually amplifying it.

The other components of GDP displayed in Figure 8 reveal additional softness before recessions on the consumer side: consumer nondurable and consumer services. Each of these shaves about 0.2 percentage points off of GDP in the three quarters before recessions. Nondurables during the recessions shaves another 0.6 off of GDP and services -0.4.

One thing that really jumps out of Figure 8 is the help during recessions that comes from imports. The weakness in demand for imports in recessions is a plus for GDP because imports subtract from GDP. In other words, we export our troubles by importing less. But we also import troubles too, in the form of weaker exports. Why is that? Why might weakness in the US lead to weakness in our exports? Is that exports of parts made in the US for assembly overseas and later reimport into the United States? Or is that a

general slowdown in the economies that deliver goods to the US because demand in the US is weakening? Or some of both?

Figure 7 Investment Components of GDP during Seven Consumer Downturns

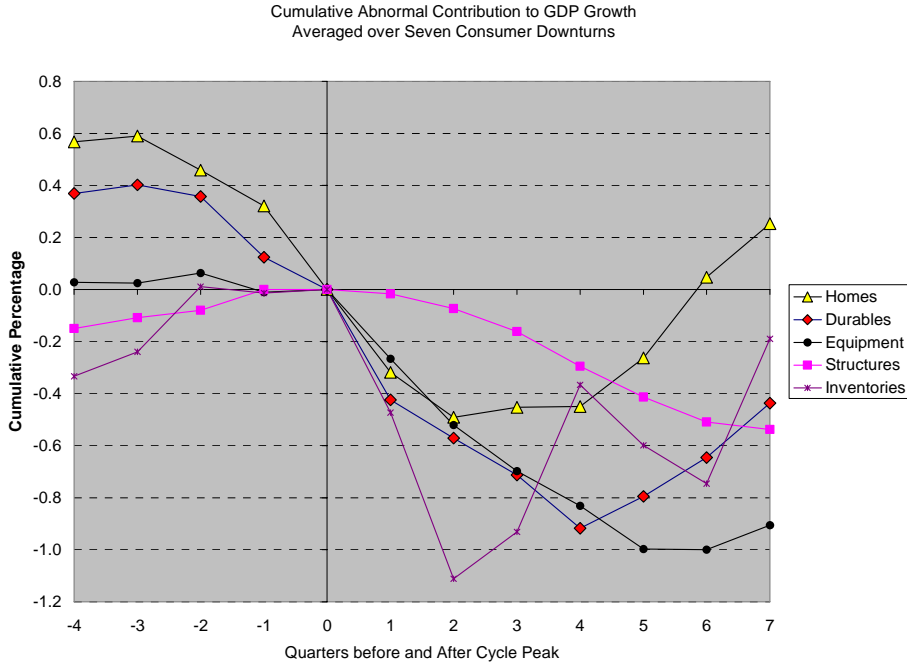
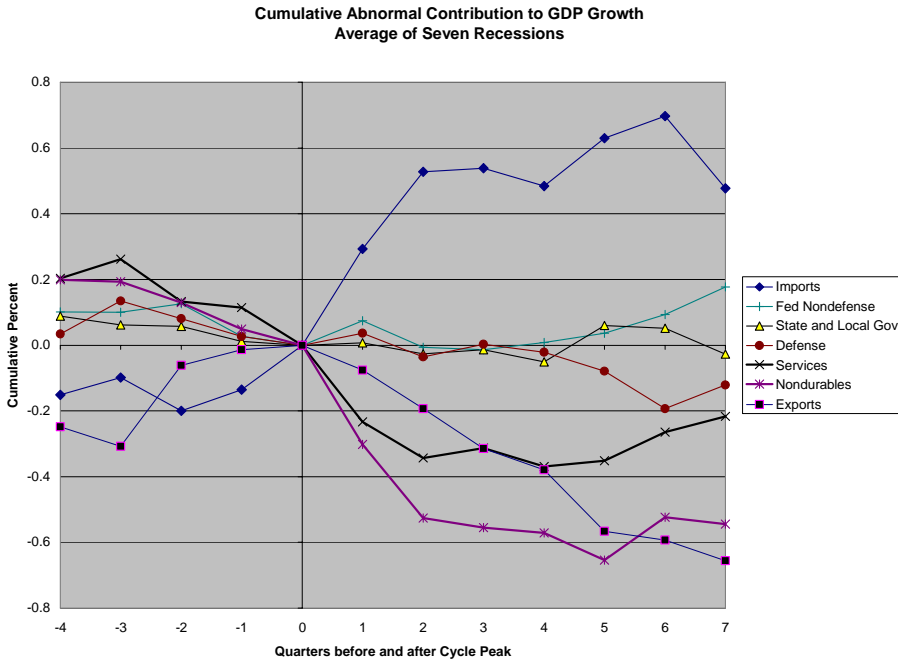


Figure 8 Other Components of GDP during Seven Consumer Downturns



Eight Consumer Cycles, a Disarmament Downturn and an Internet Rush Comeuppance

Though many of the recessions are preceded by significant weakness in houses and consumer durables, all ten recessions have not been the same, and the averaging masks important differences. We need to take a close look at each of the ten events.

Figure 9 displays the cumulative abnormal contribution of residential investment averaged across seven consumer downturns and all ten downturns individually. Here you can see why we have excluded the 1953 and 2001 recessions (no warning from housing) and the 1948 recession (exceptionally strong recovery). The others closely follow the average, though the dip in 1973 was very extreme.

Figure 9 Residential Investment During Ten Recessions

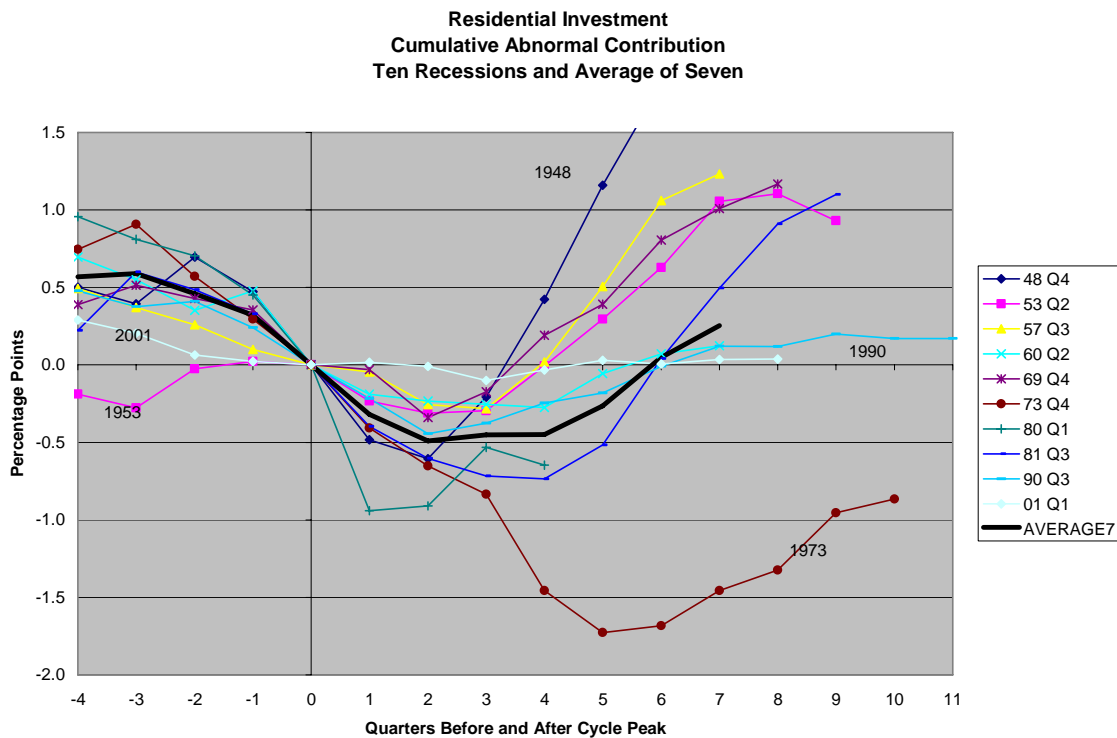


Figure 10, Figure 11, Figure 12, Figure 13 and Figure 14 are similar displays for consumer durables, equipment and software, structure, inventories, and defense. Take a close look at these. There is a lot of information here. Here is what I see:

- There is a lot of noise around the averages for consumer durables and especially for inventories. This noise greatly reduces the reliability of these components of GDP for forecasting recessions.
- Though equipment and software reliably is weak during the recession, prior to the recession it has a mixed outcome- often normal, sometimes weak and sometimes strong.
- Business structures (offices and factories) are late to the recession party and rarely matter very much.
- There was an exceptional negative contribution from equipment and software before and especially during the 2001 recession.
- The 1953 recession was unusual in that there was no weakness prior to the recession in any of these displays. Though normal up until the recession officially began, defense spending subtracted almost 4 percentage points from GDP in 8 quarters. With normal GDP growth of 3 in 4 quarters, that is a huge blow.
- The defense display is dominated by the 1953 event but there was considerable weakness in defense spending also in 1969.

Figure 10 Consumer Durables during Ten Recessions

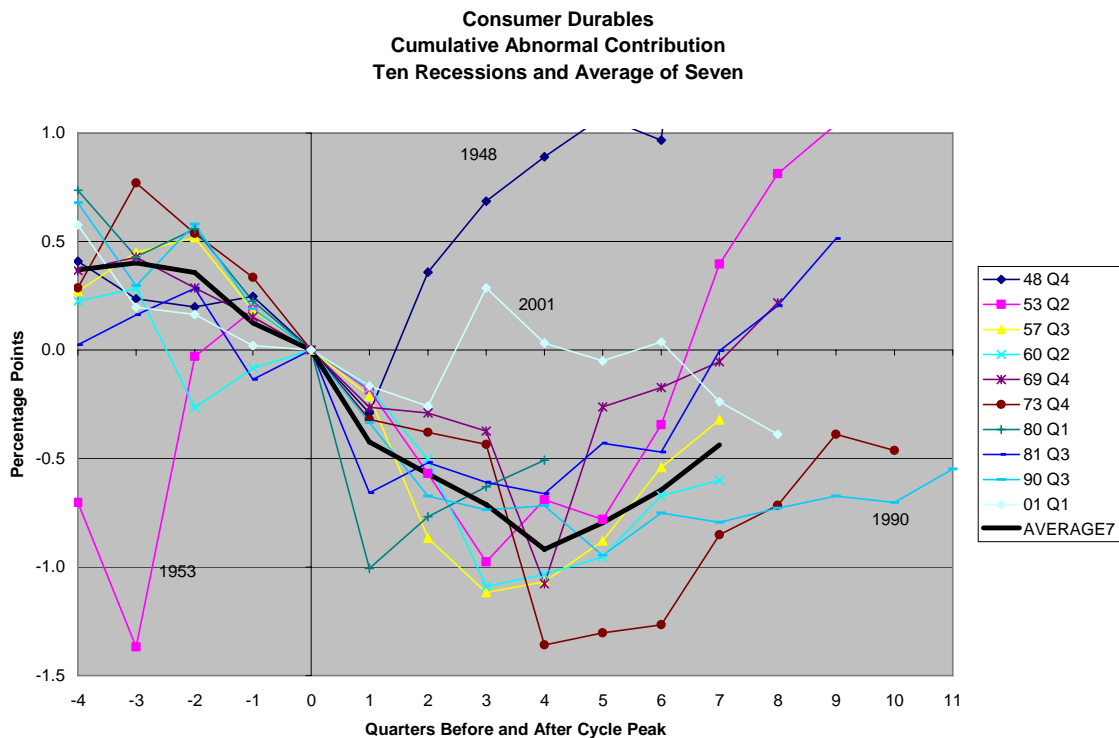


Figure 11 Equipment and Software during Ten Recessions

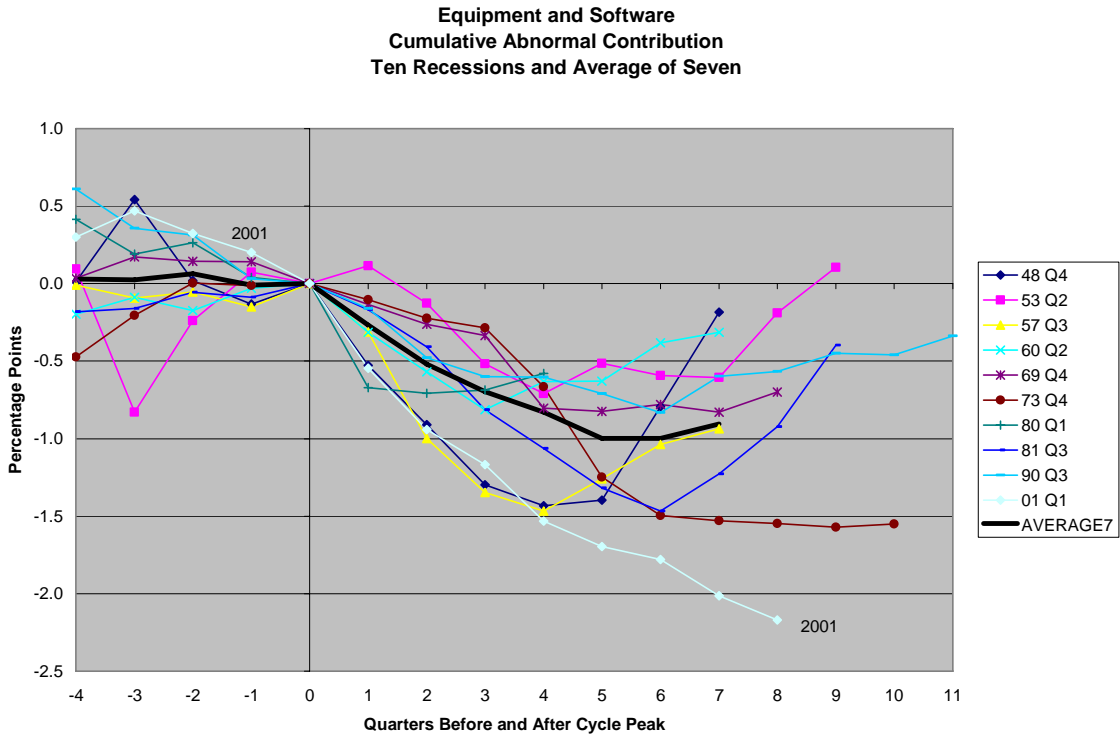


Figure 12 Business Structure during Ten Recessions

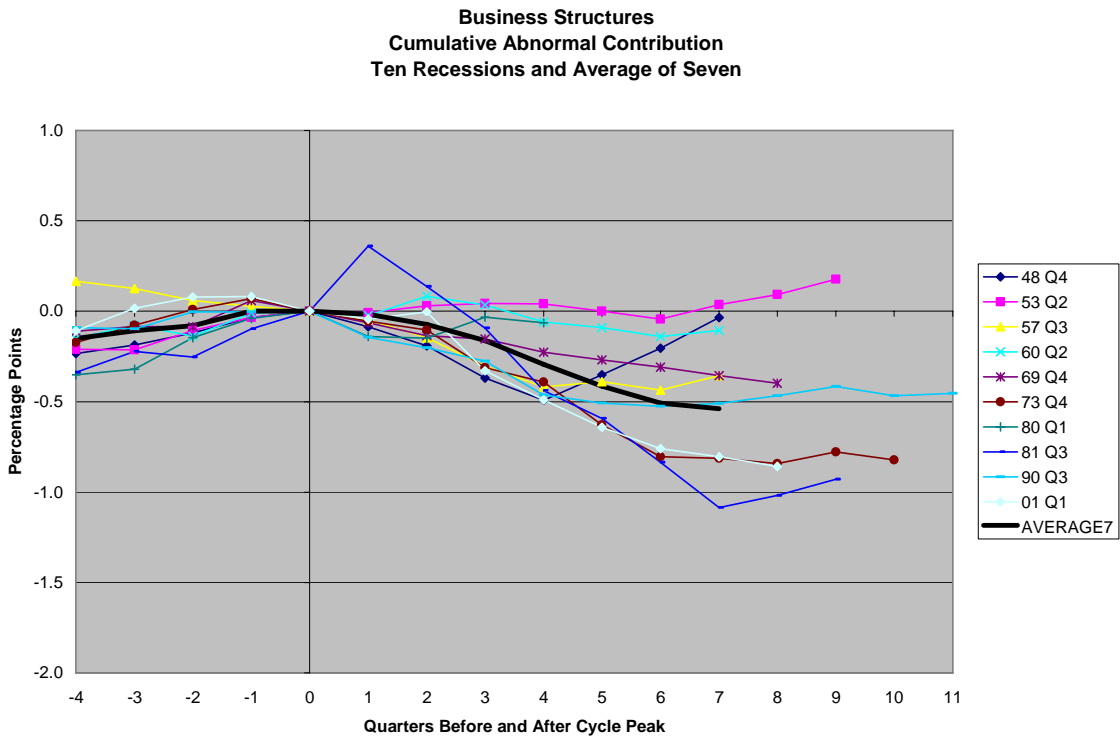


Figure 13 Inventories during Ten Recessions

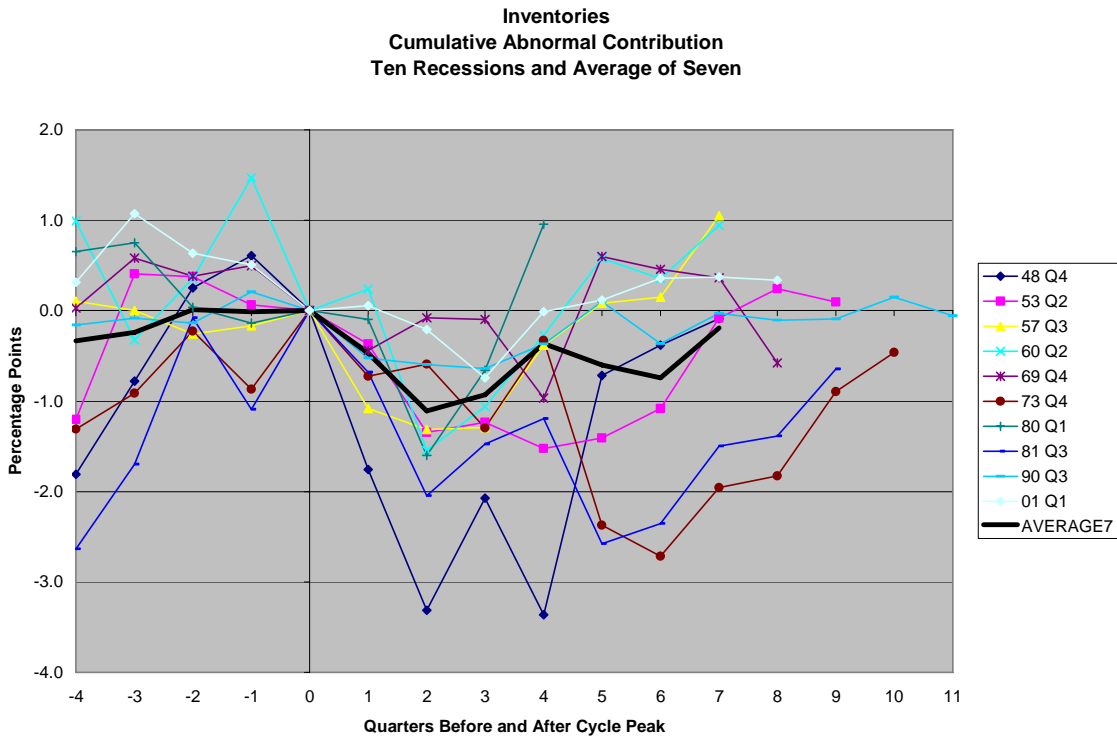


Figure 14 Defense Spending during Ten Recessions

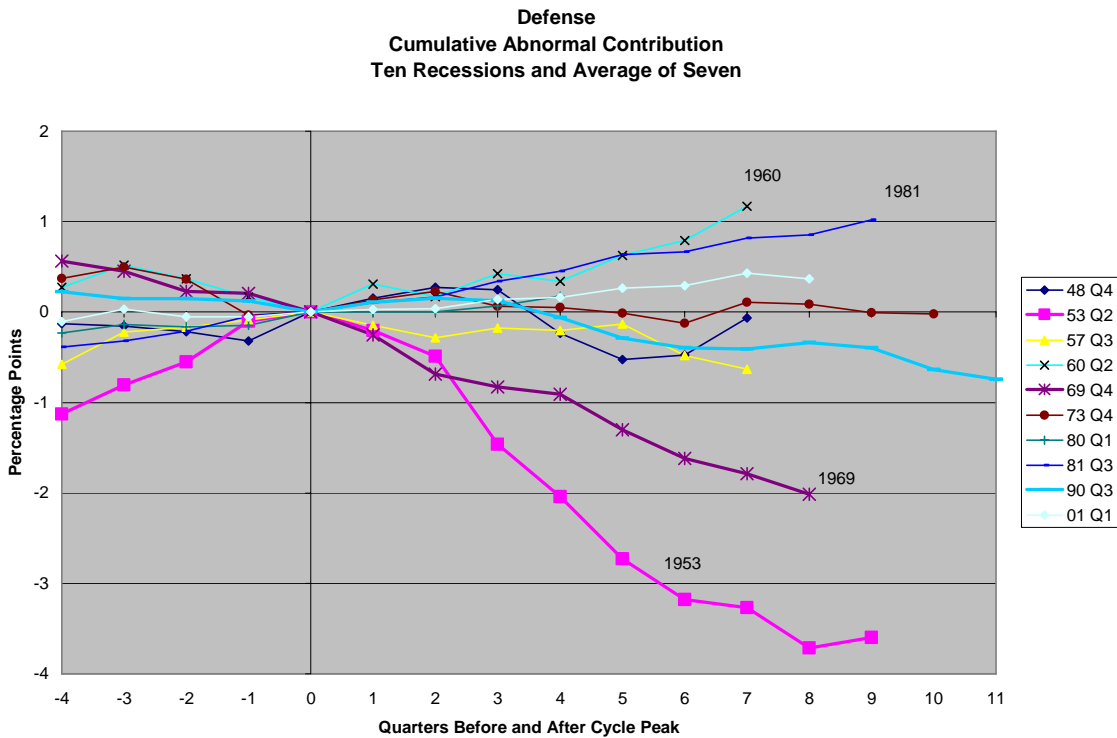
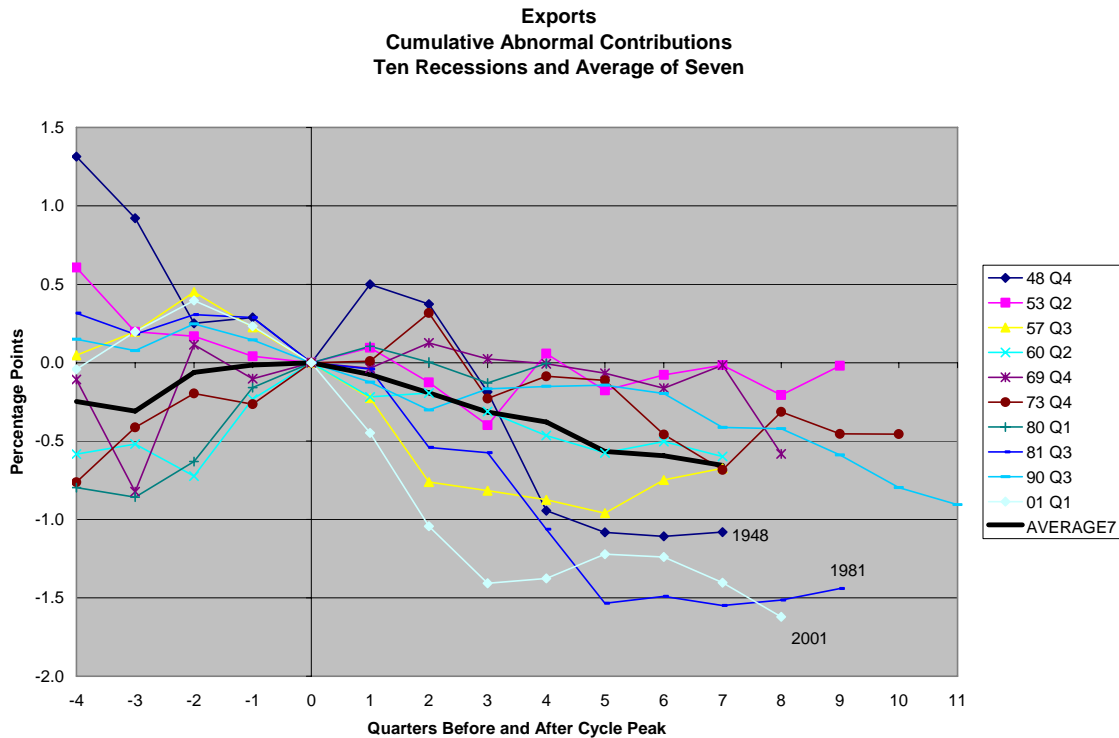


Figure 15 Exports During Ten Recessions



The 1953 Department of Defense Downturn

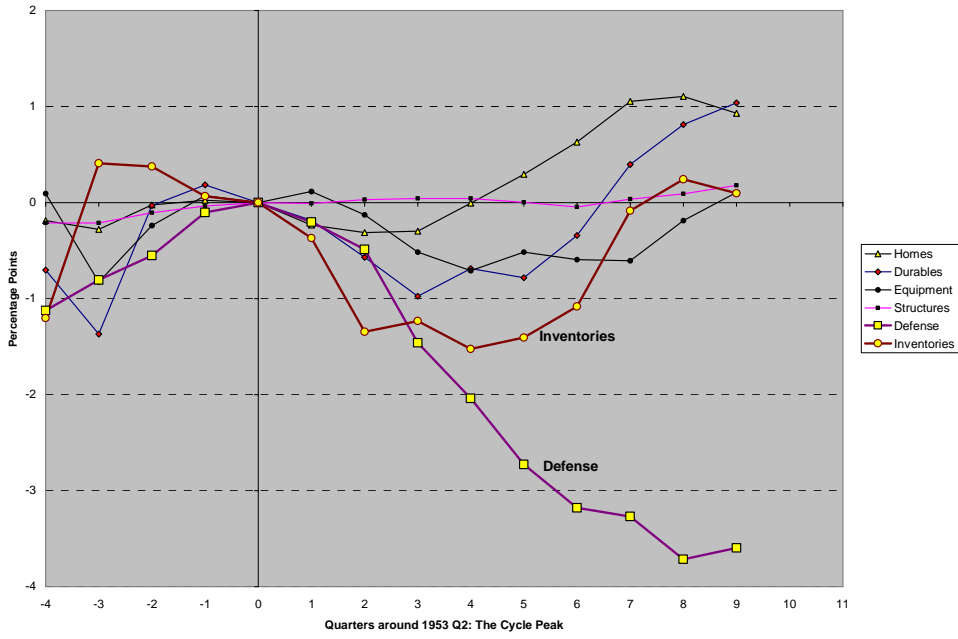
The cumulative abnormal contributions of the volatile components of GDP during the 1953 recession are displayed in Figure 16. Notice that there were no alarm bells rung out in any of the spending items prior to the onset of the recession. The Korean Armistice was signed on June 27, 1953, and the official recession began in the very next quarter, 1953 Q3. Prior to that quarter, defense spending was powering the economy forward with abnormally high positive contributions to GDP growth, but that turned around on a dime with the armistice and defense spending became as strong a drag on the economy at it had been a driver. Most of the action initially came from a drawdown in inventories which had been building up earlier in the year in anticipation of continued hostilities. Once the armistice was signed, inventories subtracted almost 1.5 percentage points from GDP in only two quarters, presumably in anticipation of the defense cutback that was sure to come in the months ahead. Through eight quarters the defense cutback reduced GDP by almost 4 percentage points. At an annual rate that is 3 percentage points, that is almost all of normal growth. The multiplier effect of this fiscal cutback is evident in the weakness during the recession in homes, durables and business equipment.

This 1953 DOD downturn was a great reverse test of “Keynesian” reliance on government spending to pull the economy out of recession, complete with an apparent multiplier effect on consumer spending and also an accelerator effect on inventories and business equipment.

Figure 16

The 1953 DOD Downturn

Cumulative Abnormal Contributions
1953 Q2 Recession: The End of the Korean War

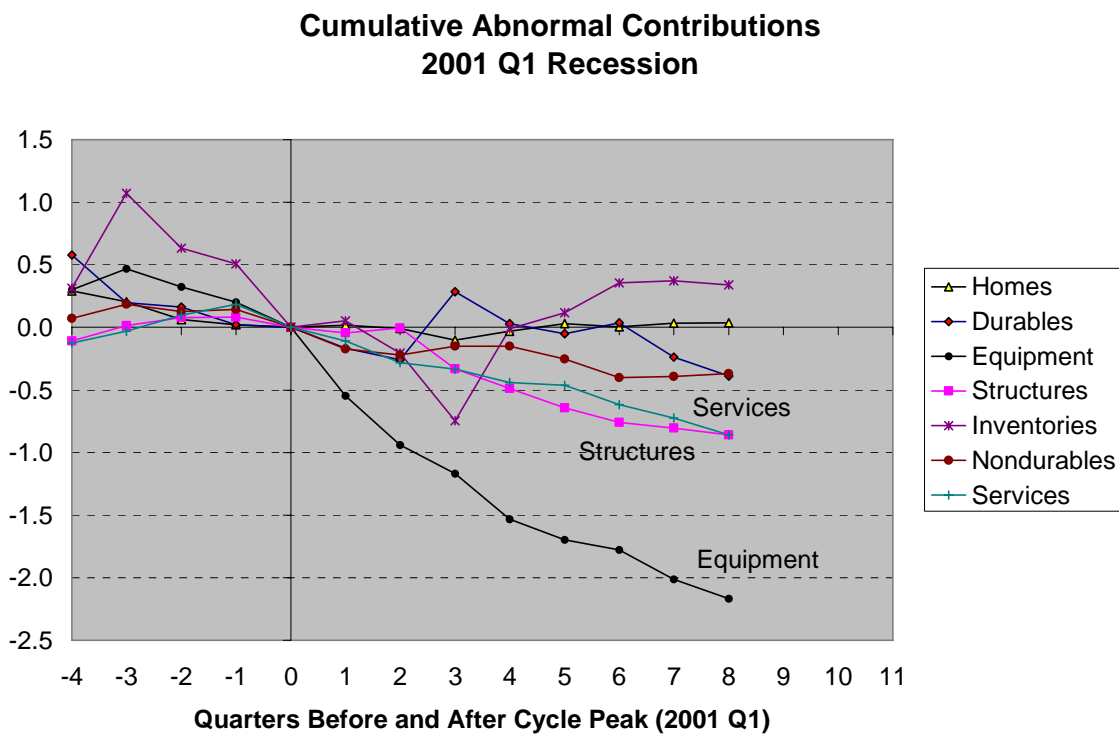


The 2001 Internet Comeuppance

The cumulative abnormal contributions of the volatile components of GDP during the 2001 recession are illustrated in Figure 17. Here you can see how much drag came from equipment and software both before and during the recession and from a drawdown of inventories prior to the recession. You can also see problems in business structures starting three quarters into the downturn. There is no weakness in either residential investment or in consumer durables.

This 2001 event was our only business downturn.

Figure 17 Cumulative Abnormals: The 2001 Internet Comeuppance



Recession or Structural Adjustment?

We call it a business cycle but usually it hasn't been. Since World War II we have had eight consumer recessions, one DOD downturn, and one business downturn. Notice that I wrote eight "recessions" and two "downturns." That is foreshadowing a point that I will now get to. A recession is a V-shaped pathology. During the first stroke of the V there are massive layoffs. That lasts only a few quarters. During the second stroke of the V, most of these folks get rehired doing the same thing they did before. When the illness is over, the economy looks pretty much like it did prior to the recession.

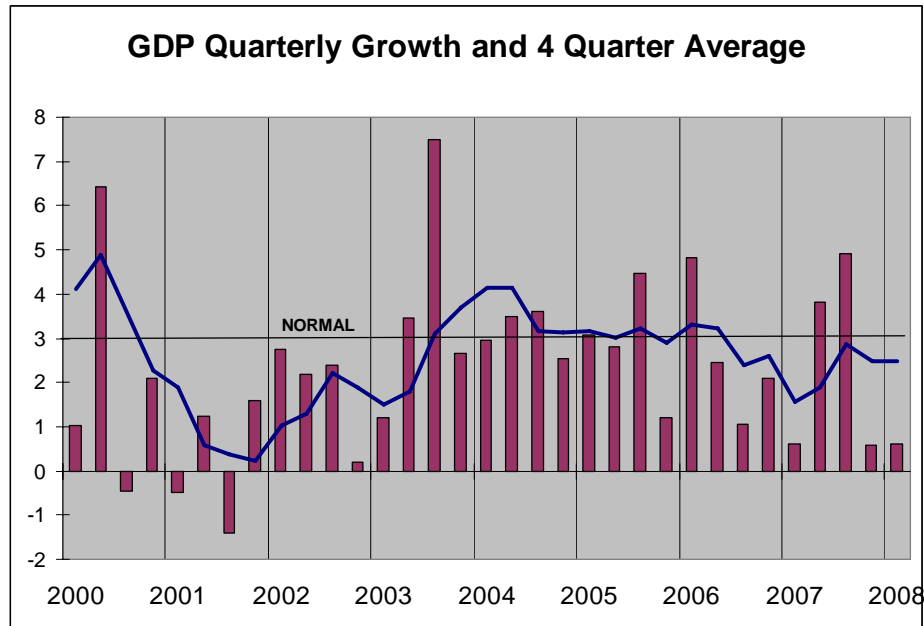
But in addition to V-shaped recessions, there are structural adjustments that entail a fundamental change in the GDP mix, and no return to the pre-downturn economy. The Korean War disarmament is an obvious example. Members of the Army who got “laid off” didn’t get “rehired.” Defense contractors didn’t experience a filling up of their order books soon after the 1953 recession. This was a structural adjustment from a wartime economy to a peacetime economy.

The 2001 downturn was also partly a structural adjustment. I call it the 2001 “Comeuppance” referring to the exuberance that drove the Internet Rush from 1996 to 2000 when every business in the United States had to have the coolest website, or advertise on one.

You can see in Figure 17 that nondurables and services were a bit weak during the 2001 Comeuppance but homes and durables were not. Weakness in nondurables and services isn’t surprising in light of the job loss that occurred, but it is surprising that neither consumer durables nor residential investment was weak at the same time. What kept two consumer spending items (homes and cars) strong, while the other two consumer spending items were weak (services and nondurables)? The answer might be very low interest rates, courtesy of Mr. Greenspan.

The uniqueness of the 2001 Comeuppance is important because it greatly reduces the relevance of the historical evidence for forecasting what was likely to have happened in 2002/3/4. You can see from the normal cycles illustrated in Figure 7 that during the recovery quarters 5 to 7, homes and consumer durables are usually making a greater-than-normal contribution to GDP growth – they are climbing out of the trough into which they had fallen during the recession. During this recovery period, GDP growth is exceptional (5%), the job market is improving and profitability is strong. But the 2001 comeuppance could have no recovery in consumer durables or homes since there was no consumer dip. If there were a “recovery” on the business side in 2002 or 2003, it would have required someone in a Palo Alto garage to figure out how to squeeze profits off the Internet. That didn’t happen. Bottom line: in 2001 we didn’t think there could have been the usual high-growth recovery from the 2001 recession. Indeed, that is exactly what happened, as you can see in Figure 18. Growth in 2002 and the first half of 2003 was below the normal rate of 3%. But in 2004 and 2005, the US economy kicked into a higher gear with growth averaging above normal. I wonder why??? Think interest rates. Think housing. (For another view of the weakness in GDP growth after the 2001 downturn look at Figure 4.)

Figure 18 GDP Growth, 2000-2008



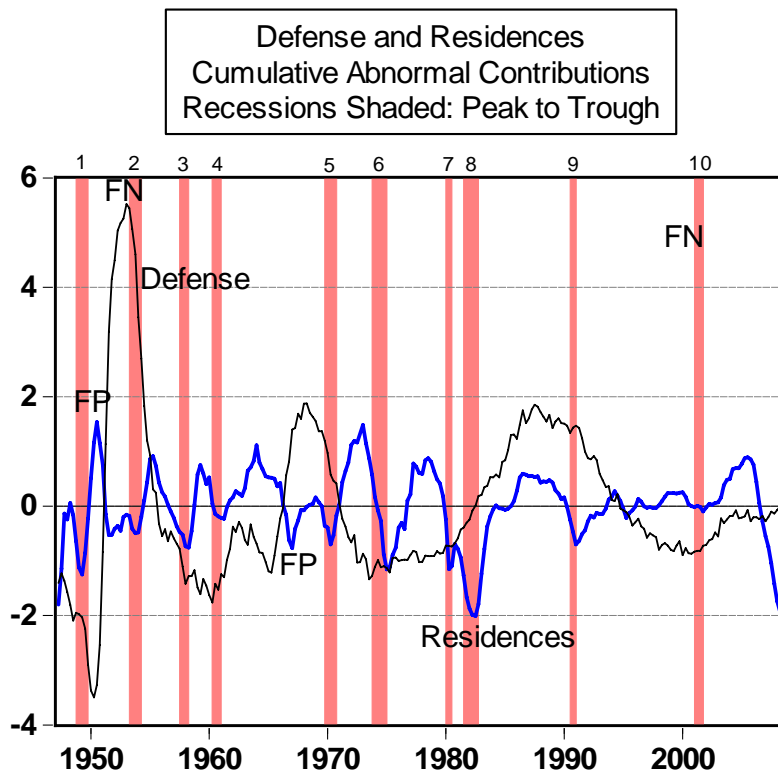
The uniqueness of the 2001 Comeuppance raises issues for monetary policy as well as for forecasting. A different disease requires a different treatment. Stimulating consumer spending by low interest rates and income tax reductions in 2001 was treating a disease from which the economy was not suffering. Listen up, Drs. Greenspan and Bush. You need to understand that interest rates affect the timing of homes and autos, but not the totals. In a normal consumer recession, weakness in spending on homes and autos creates pent-up demand, and the low interest rates in the aftermath of a recession move sales *forward* in time, capturing sales that had not been made during the recession. But there were no lost sales of homes and autos during the 2001 Comeuppance. So where do you suppose the sales in 2003-2005 came from? They came from the future. Dr. Greenspan was moving sales backward in time, not forward. That created economic strength in 2003-2005, but inevitable weakness later when there would be fewer potential home and auto buyers. To put this another way, monetary policy needs to be conceived explicitly as an intertemporal control problem, with the decisions made today affecting the options later on. You can stimulate now or later, but not both.

Housing False Positives and False Negatives

We have already learned that declines in spending on homes preceded eight of the 10 recessions since WWII and contributed substantially to the 1953 decline as well. But how many other times did problems in housing suggest that a recession was imminent? Figure 19 answers this question by displaying the cumulative abnormal contribution to GDP growth of both residences and defense, with the recessions highlighted. Indeed eight of the ten recessions were preceded by declines in housing. The two false negatives labeled FN in the figure were the disarmament downturn of 1953 and the Internet Comeuppance of 2001 – the two structural adjustments.

There were only two false positives. Housing was very weak late in 1951 but there was no recession. Why? That was the Korean War, which broke out in June 1950. Take a look at the huge contribution of defense spending at that time, completely offsetting the weakness in housing. Housing was also weak in 1966 and 1967. Again it was the Department of Defense that came to the rescue, this time to fight the Vietnam War.

Figure 19 Investment in Residences



A Story of the Consumer Cycle: Our Collective Bipolar Disease

It's homes. We need a good story now to memorialize this finding. Here is one.

As far as homes are concerned we suffer from a collective bi-polar disease, swinging back and forth between manic buying and depressed waiting.

In both the manias and depressions, the housing market doesn't work right. The economists' model of the efficiency of the market hinges in a critical way on "downward sloping demand curves": when the price is reduced, more is sold. If demand curves are downward sloping, and builders experience an unwanted increase in unsold homes, they can cut the price and sell more. When builders are having a hard time keeping up with the demand, they can raise the price and reduce the sales rate. But in both the manias and the depressions, demand is upward sloping not downward sloping. When the price is rising in a mania, a higher price suggests even higher prices later on, and buyers rush in before it is too late. Thus higher prices lead to more buyers, not fewer. When the price is falling during the depressions, a price cut suggests more cuts are on the way, and buyers decide to wait to get a better deal. Thus lower prices lead to fewer buyers, not more

From these upward sloping demand curves, we suffer terrible overshooting, with prices rising high enough to shock buyers out of their manias, and prices falling low enough to coax the buyers out of their depressions.

Home buyers do not suffer from manias and depressions without the support of the enablers who issue the mortgages. When homes are appreciating in value, home loans are self-collateralizing and anyone who can crawl off the street can get a loan and buy a home. But when home prices are flat or declining, the loans are not self-collateralizing and lenders are forced to look at default risks much more carefully, and to screen out suspicious borrowers.

This creates an inevitable boom and bust cycle in residential real estate. This cycle affects the whole economy since during the boom, there are substantial income accruals to everyone involved in the building homes or selling homes, including brokers and bankers. The increase in home values also puts phantom assets onto the personal balance sheets of homeowners who use that paper wealth to finance the purchase of cars and other durables. The income and the phantom assets disappear when the real estate bust occurs, precipitating some serious belt-tightening.

Businesses, meanwhile, merely react to what is happening on the consumer side. They are the passengers, not the drivers. They, like the rest of us, cannot tell when the Ponzi scheme will collapse, and they wait until they are sure to react. The amount of delay on the business side depends on the longevity of the business asset. Shorter-lived assets like equipment and software adjust most rapidly. The long planning process and the long

building process and the long lives of factories and offices make these structures the component of GDP that has the most delayed adjustment to the consumer cycle swings.

Numbers, if the pictures are not enough

Regression analyses to support what the pictures say

These images promise that movements in the components of GDP can presage an oncoming recession, but we need to confirm these impressions with some numerical analysis. Let's first try to find out how well we can predict GDP growth from its own past behavior. Is there momentum? Does one weak quarter portend another? Or is GDP growth more like the flips of a coin – a couple of heads in a row having no effect on the probability of another head? The answer is that GDP growth is pretty much like flips of a coin. The fraction of the quarter-to-quarter variability of GDP growth from 1948 Q2 to 2004 Q4 that can be explained by the previous four quarterly numbers is only 14.1%, which is reported at the top of Table 1. An R^2 statistic of 14.1% is going to lead to such terrible prediction errors, and anger your clients so much, that you might as well treat it as a zero and conclude that GDP growth cannot be predicted from its past. There is no momentum, no coming due. It's a random variable. Like flips of a coin.

Also reported in Table 1 are R^2 statistics for explaining GDP growth as function of past behavior of the components of GDP. Next quarter's GDP is predicted from six variables: this quarter's component contribution, the square and cube thereof, and also from the previous three quarters. This allows us to pick up long lags and also nonlinearities, like threshold effects in which small values don't matter much but big ones matter a lot.

The message of this Table 1 is: ***It's HOMES***, stupid.³ What's good for KB Homes is good for the country.

The past spending on homes can explain 30% of the variability of GDP growth. That is getting big enough to make the frown on your client's face fade a bit. It's a long way from 100%, but a lot better than 14.1%. The next best number is for consumer services, but it's only 17.4%, not much better than GDP itself. Everything else is a dismal failure. *Residential investment, and only residential investment, helps to predict GDP growth consistently over this long period from 1948 to 2004.*

In summary, although spending on residences makes a rather unimportant contribution to *normal* growth, it is spending on residences that is the most important of the GDP components for predicting the highs and lows: the recessions and the recoveries.

So say it again: homes, cars, machines and factories. That's the order of the downturn. That's the order of the recovery. Homes, cars, machinery, factories.

³ For what might be the first discovery of this, see Green, Richard K. "Follow the Leader: How Changes in Residential and Non-residential Investment Predict Changes in GDP", *Real Estate Economics*, V. 25, 1997, 253-270.

And if you are interested in GDP prediction, just say HOMES. Or, in the rhetoric of my Jackson Hole paper: Housing is the Business Cycle.⁴

Table 1

Percent of Variance of GDP Growth Explained by Previous Contributions to Growth

Quarterly Data - Four Lagged Values of all Variables, Cubic Equations for first lag
1948 Q2 to 2004 Q4

	R-squared
<u>GDP predicted from Itself</u>	14.1%
<u>GDP Predicted from Components</u>	
<u>Consumption</u>	
Nondurables	15.0%
Durables	9.1%
Services	17.4%
<u>Investment</u>	
Equipment and Software	14.1%
Inventory	5.1%
Residences	30.2%
Structures	6.6%
<u>Net Exports</u>	
Exports	6.2%
Imports	7.5%
<u>Government</u>	1.6%

A Summary Table

With all these images filtering into our consciousness, it is time to do some numerical summaries just to make sure that we have seen all there is to see, and we have not seen things that aren't really there. Table 2 has summaries of the cumulative abnormal contributions to GDP of each of the components before and during the ten recessions. A component that is contributing to the onset of the recession has the cumulative abnormal contribution to GDP declining prior to the official start date of the recession. The amount of this decline from the previous peak is recorded in the *top* panel of Table 2. The components that are contributing negatively *during and after* the recession are noted in the *bottom* panel. The numbers reported here are the largest cumulative amount that the component subtracted from growth since the onset of the recession. The blank

⁴ "Housing and the Business Cycle," in Housing, Housing Finance and Monetary Policy, A Symposium Sponsored by the Federal Reserve of Kansas City, August 2007

components in this table are making an abnormal positive contribution to GDP growth. You can't find many of these during the recessions, when softness was very widespread.

I have separated inventories from the other components in this table because weakness in inventories is a symptom of weakness elsewhere in the economy and shouldn't be treated as a driver. Imports are also separated from the other components for the same reasons: a rise in imports that might look like a negative contribution to GDP growth is a symptom of something else going on in one of the other components of GDP.

In both of the panels, the biggest negative for each recession is shaded in dark red and items close to this extreme are shaded in light yellow. The column in this table at the far right reports the seven quarter average of the table entries, with the first two recessions and the last one excluded, for reasons already explained.

Looking at the averages column of the top panel we discover something we saw in the charts: weakness in spending on homes precedes the official onset of the recessions. On average, declines in home building have been the most important reason for economic weakness prior to the official start of the recession, reducing real GDP to 0.66 per cent. Next come inventories (-0.62) and consumer durables (-0.53).

The details in this table leave an impression that is sometimes at odds with our look at the graphs. Maybe that 1969 recession should be called a defense downturn like the 1953 event! Maybe the classification of eight consumer recessions, one DOD downturn and one Internet Comeuppance isn't so clear! Maybe exports need to be understood better.

The table reveals that declines in spending on homes was the greatest contributor to prior weakness in three of the ten downturns. Consumer durables were most important in three more. The other largest contributions to weakness prior to the recessions were services (1981), exports (1948 and 1953), and defense (1969). Inventories contribute negatively prior to eight of the recessions and were bigger than the other components in three of them.

Turning now to the averages column of the bottom panel, we see that these recessions involve significant negatives from almost all the components of GDP, though equipment and durables are slightly ahead of the others, except inventories. Three times durables was the biggest problem in recessions, three times equipment and software, twice defense, once exports and once residences.

At the bottom of Table 2 are two rows that indicate the components of GDP that drove us into the recessions and the components that contributed the most during recessions. In the "Prior" row, there are six R's, meaning residences. In the "During" row, there are eight E's meaning equipment and software.

Summary Words

To get a recession, one or more components of spending has to plummet rapidly and subtract about a full percentage from GDP growth. Then this problem has to continue and infect other segments of the economy.

Not all recessions have begun in the same way. The pictures suggest that we had eight consumer recessions, a disarmament downturn and an Internet comeuppance. The numbers offer a more nuanced story.

Since World War II the US has had six pure consumer downturns that got started with troubles in housing, consumer durables and services. (1957, 1960, 1973, 1980, 1981, 1990)

The 1969 recession had a big disarmament contribution as well as a big consumer contribution.

We have had one Disarmament Downturn (1953), and one Business Comeuppance (2001).

The 1948 recession was a general malaise, with a big contribution from exports. (What is that, anyway? What were we exporting in 1947?)

Table 2

Abnormal Contributions to Economic Growth

Largest Negative in Red

Close to largest in Yellow

Prior to the Recession

Negative of maximum cumulative prior to period 0, if negative

	48 Q4	53 Q2	57 Q3	60 Q2	69 Q4	73 Q4	80 Q1	81 Q3	90 Q3	01 Q1	Avg 7
Durables	-0.41	-0.18	-0.52	-0.28	-0.43	-0.77	-0.74	-0.28	-0.68	-0.58	-0.53
Nondurables	-0.25	-0.07		-0.14	-0.30	-0.79	-0.21	-0.17	-0.20	-0.18	-0.30
Services	-0.11	-0.02	-0.30	-0.07	-0.09	-0.28	-0.52	-0.79	-0.03	-0.18	-0.30
Residences	-0.70	-0.02	-0.49	-0.69	-0.51	-0.91	-0.95	-0.60	-0.48	-0.29	-0.66
Equipment	-0.54	-0.10			-0.17	0.00	-0.41		-0.61	-0.47	-0.30
Structures			-0.17		-0.06	-0.07				-0.08	-0.10
Defense				-0.52	-0.56	-0.49			-0.22	-0.03	-0.45
Exports	-1.31	-0.61	-0.45		-0.11			-0.31	-0.25	-0.40	-0.28
Other components shaded if less than minimum of first eight											
Inventories	-0.61	-0.41	-0.10	-1.47	-0.58		-0.75		-0.21	-1.07	-0.62
Imports	-0.33	-0.40	-0.05	-0.01	-0.52		-0.03	-0.54			-0.23

During the Recession

Minimum cumulative after onset of the recession, if negative

	48 Q4	53 Q2	57 Q3	60 Q2	69 Q4	73 Q4	80 Q1	81 Q3	90 Q3	01 Q1	Avg
Durables	-0.29	-0.98	-1.12	-1.09	-1.08	-1.36	-1.00	-0.66	-0.95	-0.39	-1.04
Nondurables	-0.73	-0.99	-0.89	-0.68	-0.54	-1.65	-0.61	-0.26	-0.84	-0.40	-0.78
Services	-0.78	-0.51	-0.16	-0.45	-0.28	-0.45	-0.66	-0.53	-0.77	-0.86	-0.47
Residences	-0.61	-0.31	-0.28	-0.27	-0.34	-1.73	-0.94	-0.74	-0.44	-0.10	-0.68
Equipment	-1.43	-0.71	-1.47	-0.81	-0.83	-1.55	-0.71	-1.47	-0.83	-2.17	-1.09
Structures	-0.49	-0.04	-0.44	-0.14	-0.40	-0.84	-0.15	-1.09	-0.53	-0.86	-0.51
Defense	-0.52	-3.71	-0.63		-2.01	-0.12			-0.41		-0.79
Exports	-1.11	-0.40	-0.96	-0.60	-0.58	-0.68	-0.13	-1.55	-0.42	-1.62	-0.70
Other components shaded if less than minimum of first eight											
Inventories	-3.36	-1.52	-1.31	-1.55	-0.97	-2.71	-1.60	-2.58	-0.64	-0.75	-1.62
Imports	-0.24		-0.22		-0.03	-0.01		-0.78			-0.26

Cycle Driver

	48 Q4	53 Q2	57 Q3	60 Q2	69 Q4	73 Q4	80 Q1	81 Q3	90 Q3	01 Q1
Prior	X	X	D/R/X	R	W/R/D	R/D/N	R	S/R	D/E	D/E
During	E	W	E	D/E	W/D	R/N/E	D/R/E	X/E	D/N/E	E

D= Durables E=Equipment, N=Nondurables, R=Residences, S= Services, X = Exports, W=War

Homes and Durables

How important are Homes and Durables?

The message that should come from the previous section is that the early warning of an oncoming recession comes principally from two component of GDP: residences, most reliably and then consumer durables. Table 3 reports summary statistics for the contributions to GDP growth of residential investment and consumer durables as well as the three subcomponents of consumer durables: motor vehicles and parts, furniture and appliances and other durables.

These data are divided into three subgroups: the quarters that comprise the eight consumer recessions, the quarters that comprise the 1953 and 2001 recessions and, at the top, the quarters during which the US economy was not in an official recession.

From the numbers at the top of this table, we discover that durables contribute on average almost three times as much as residential investment. (Keep in mind that all the components of GDP add up to slightly more than 3.0. Thus residential investment comprises about $.2/3 = 0.06$ of GDP and consumer durable comprise $0.6/3 = 0.20$ of GDP.) Within the durables category, the average contributions of autos and furniture are about the same, but the standard deviation of autos is much greater.

Table 3

Contributions to GDP Growth During and Not During Recessions 1947q2 2007q4

Normal: Other Than Recession Quarters (208 Quarters)

	Res. Invest.	Durables	Autos	Furn.	Other
Mean	0.21	0.57	0.25	0.24	0.08
Std. Dev.	0.94	1.40	1.01	0.63	0.13

Eight Consumer Recessions (28 Quarters)

	Res. Invest.	Durables	Autos	Furn.	Other
Mean	-0.38	-0.36	-0.32	-0.01	-0.02
Std. Dev.	1.26	1.52	1.29	0.46	0.14

Two Structural Adjustments (7 quarters: 1953 and 2001)

	Res. Invest.	Durables	Autos	Furn.	Other
Mean	0.10	0.29	0.22	0.05	0.01
Std. Dev.	0.64	1.45	1.20	0.19	0.14

The data for the eight consumer recessions tell a different story: it is homes and autos that matter. In other words, the negative contribution for residential investment exceeds the negative for consumer durables, and within the durables category, *the biggest problem is autos, where most of the negative comes from and most of the volatility too*. Thus our focus soon on auto sales.

Finally, the two structural adjustments (the 1953 Department of Defense downturn and the 2001 Internet Comeuppance) do not have negative contributions from these two critical consumer components of GDP. These were different kinds of episodes.

How similar are the Cycles in Homes and Durables?

The cumulative contributions of homes and durables to GDP are illustrated in Figure 20 and the cumulative abnormal contributions in Figure 21.

The cycles in homes and durables are quite evident in these figures, more so for homes than for durables. The official NBER recessions are shaded, starting with the peak quarter and ending with the trough.

Table 4 records the information in the figures numerically. This table includes the peak and trough quarters for the home and durables cycles, the total contribution to growth in that downturn, the length of the downturn in quarters from peak to trough, the rate per year drag on growth, the in the last two columns, the peak and trough quarters in comparison with the NBER peak.

The first box in this table indicates that homes peaked three quarters before the NBER cycle peak of 1949Q1, and durables peaked two quarters before the NBER cycle peak. The trough of homes occurred in the first quarter of the recession, and the trough in durables was the NBER peak, one quarter before the recession commenced.

The next box contains the threatened recession of 1951 during which spending on both homes and consumer durables was weakening significantly. That weakening was more than offset by a big run-up in spending by the Department of Defense for the Korean War.

Let your eyes scan up down the next-to-last column that indicates the relationship between the housing and durables peaks and the official NBER peak. The negatives in this column indicate that these two spending components peak and were softening prior to the official recessions. Usually it has been residential investment that peaked first, followed by the housing peak in a quarter or two. Twice the peak in homes and durables was the same quarter. Twice durables peaked the quarter before the housing peak: before the 1978 recession and before the 1953 DOD downturn.

Thus the questions:

- Why are the cycles in homes and consumer durables so closely aligned?
- Why does housing tend to peak before durables?

- Why has the peak in consumer durables lagged so much after the housing peak in 2005Q4?

Figure 20 Durables and Residences: Cumulative Contribution to GDP growth

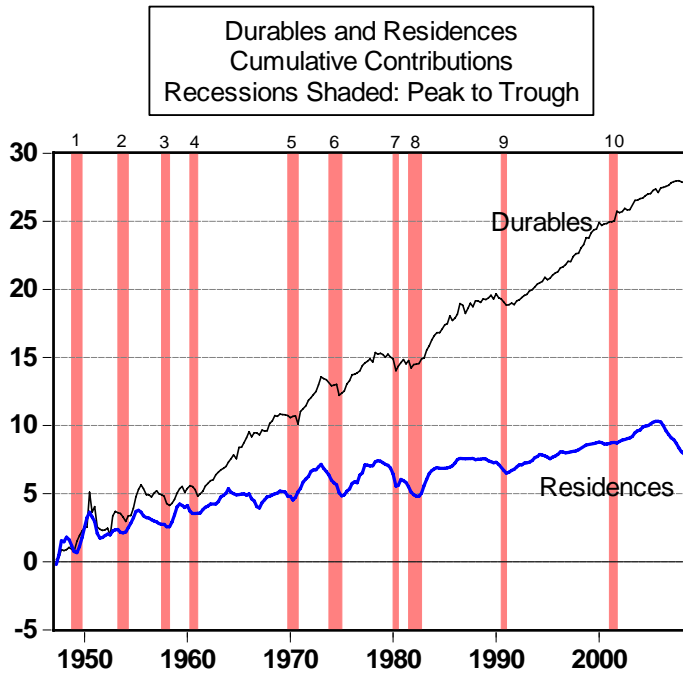


Figure 21 Durables and Residences: Cumulative Abnormal Contribution to GDP growth

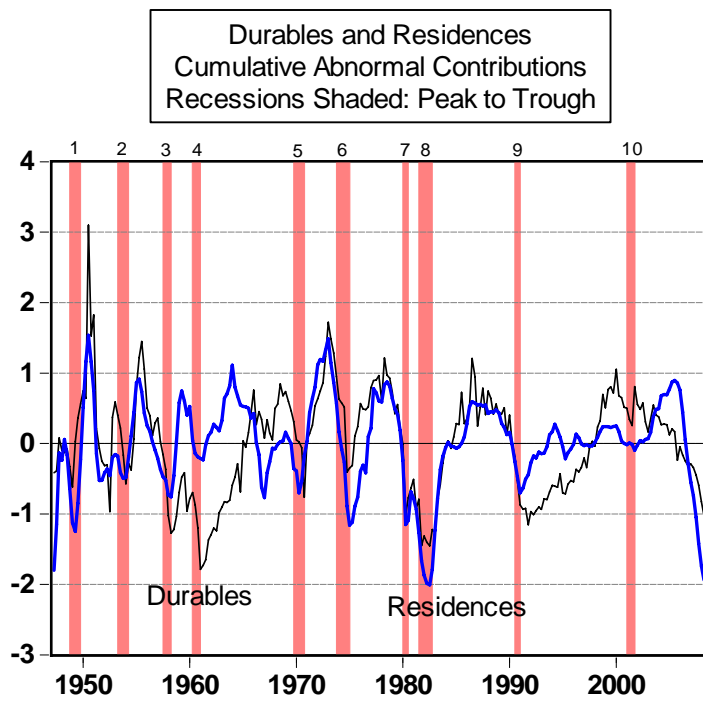


Table 4 Timing of Homes and Durables Cycles

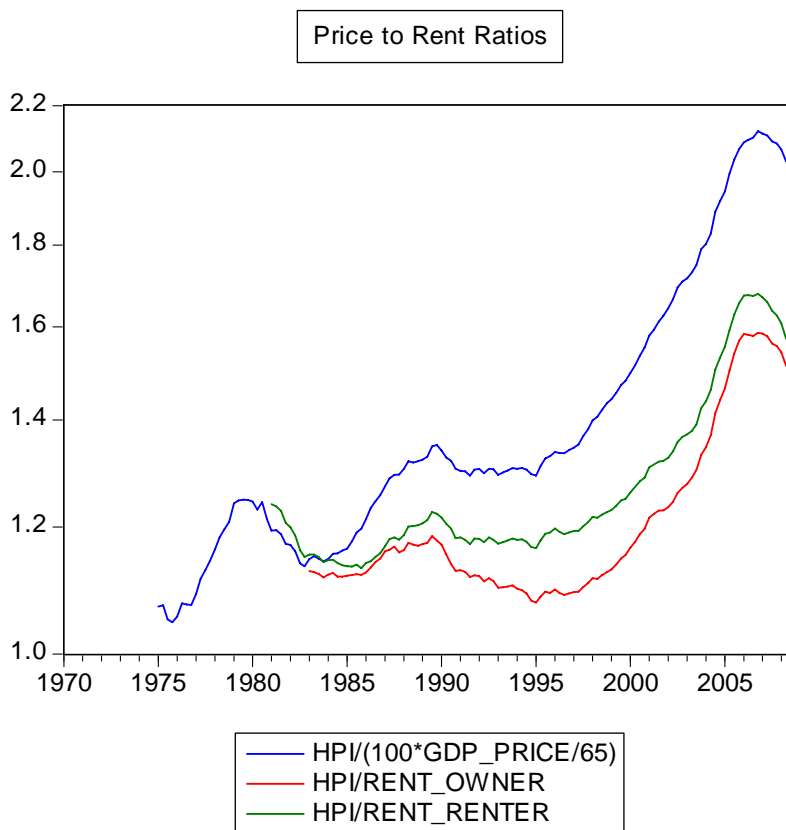
Sector	Peak	Trough	Change	Quarters	Rate	Timing vis-a-vis NBER Peak	
						Peak	Trough
Homes	1948Q2	1949Q2	-1.15	4	-1.15	-3	1
Durables	1948Q3	1949Q1	-0.32	2	-0.64	-2	0
NBER	1949Q1					0	
Homes	1950Q3	1951Q3	-1.91	4	-1.91		
Durables	1950Q3	1952Q3	-3.19	8	-1.60		
Threatened Recession							
Durables	1953Q1	1954Q1	-0.72	4	-0.72	-2	2
Homes	1953Q2	1953Q4	-0.24	2	-0.47	-1	1
NBER	1953Q3					0	
Homes	1955Q2	1958Q1	-1.21	11	-0.44	-10	1
Durables	1955Q3	1956Q3	-0.90	4	-0.90	-9	-5
Durables	1957Q1	1958Q2	-1.09	5	-0.87	-3	2
NBER	1957Q4					0	
Homes	1959Q2	1960Q4	-0.70	6	-0.47	-5	1
Durables	1960Q2	1961Q1	-0.76	3	-1.01	-1	2
NBER	1960Q3					0	
Homes	1964Q1	1964Q4	-0.45	3	-0.60		
Homes	1966Q1	1967Q1	-1.04	4	-1.04		
Threatened Recession							
Homes	1969Q1	1970Q2	-0.66	5	-0.53	-4	1
Durables	1969Q1	1970Q4	-0.73	7	-0.42	-4	3
NBER	1970Q1					0	
Homes	1973Q1	1975Q1	-2.33	8	-1.16	-4	4
Durables	1973Q1	1974Q4	-1.36	7	-0.78	-4	3
NBER	1974Q1					0	
Durables	1978Q2	1980Q2	-1.35	8	-0.67	-8	0
Homes	1978Q3	1980Q2	-1.86	7	-1.06	-7	0
NBER	1980Q2					0	
Homes	1980Q4	1982Q3	-1.24	7	-0.71	-4	3
Durables	1981Q1	1981Q4	-0.61	3	-0.82	-3	0
NBER	1981Q4					0	
Homes	1984Q2	1985Q1	-0.05	3	-0.07		
Threatened Recession							
Homes	1988Q4	1991Q1	-1.08	9	-0.48	-7	2
Durables	1990Q1	1991Q1	-0.84	4	-0.84	-2	2
NBER	1990Q3					0	
Homes	1994Q2	1995Q2	-0.33	4	-0.33		
Threatened Recession							
NBER	2001Q2						
Homes	2005Q4	2008Q1+	-2.06	9	-0.91	-9?	?
Durables	2007Q4	?				-1?	?
Threat	2008Q1?					0	

Controlling the Cycle in Housing Starts

The subject of this section is the choice of interest rates to control the cycle in housing starts.

One variable that seems likely to affect housing starts is the price of homes. Figure 22 illustrates price-to-rent ratios that compare the OFHEO Home Price Index with two rental components of the CPI (rent and owner-equivalent rent) and also the GDP deflator, adjusted by .65 to make the CPI and GDP deflator have the same base year. The relative rise in rents compared with the GDP deflator suppresses the growth in the home price to rent ratio compared with the home price to GDP deflator, but the GDP deflator has the very attractive feature that it extends back to the beginning of the HPI data in 1975.

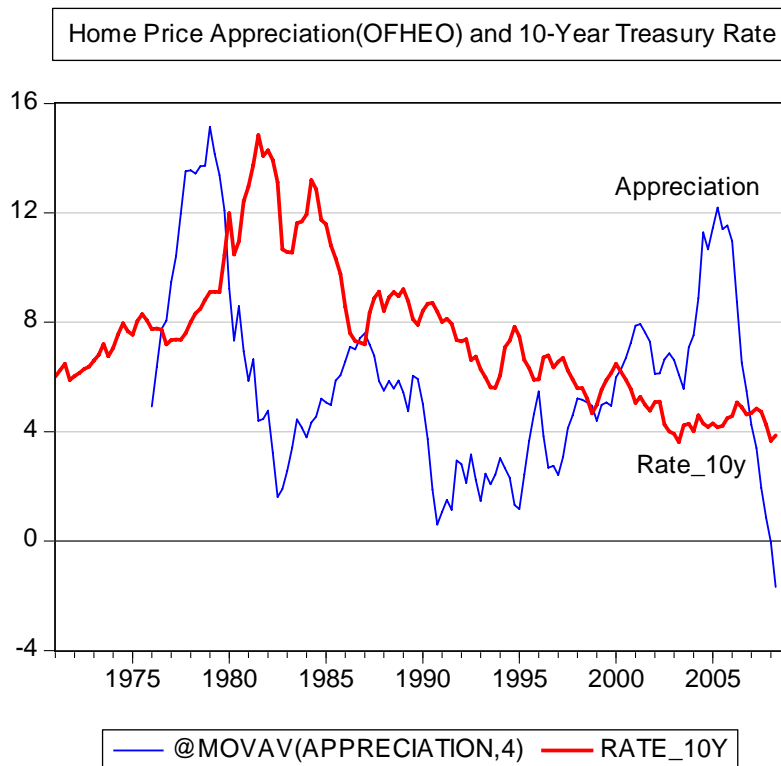
Figure 22



Although this nationwide price to rent ratio elevated by about 30% from 2000 to 2006, that by itself doesn't mean a bubble since a higher p/r ratio can be justified by a lower rate of interest or by higher expected rates of appreciation in home prices. The realized

appreciation and the ten-year Treasury rates are illustrated in Figure 23, where we see the steady march downward of the interest rate from 1980 to the present, and the burst of home price appreciation in 2003-4, that gave back borrowers all their out-of-pocket mortgage expenses, and more.

Figure 23 Ten-Year Treasury and HPI Appreciation



Using the notation

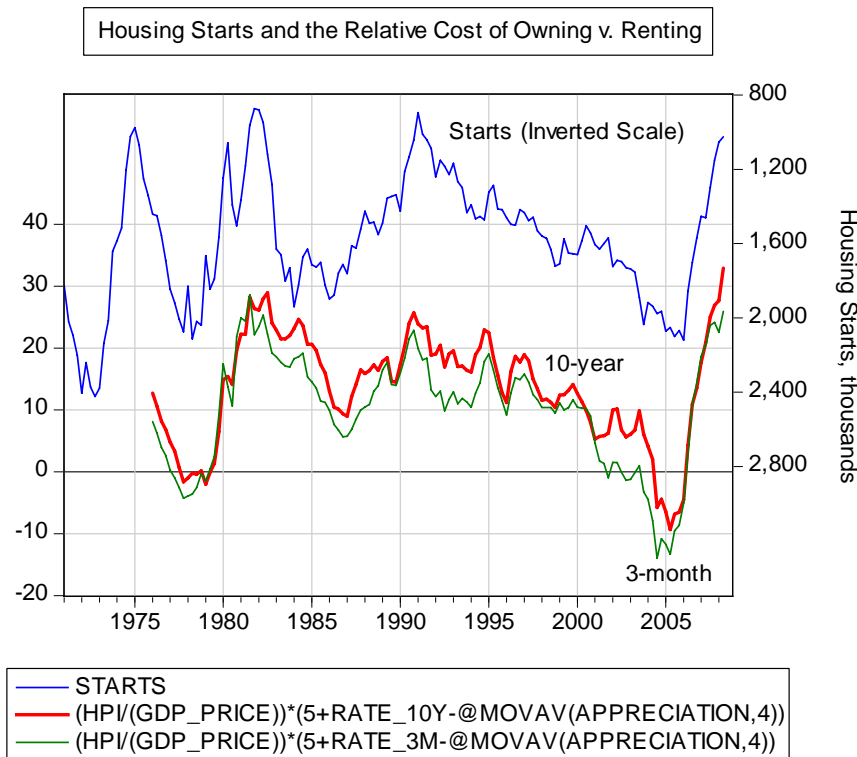
PRICE = price of a home
 r = rate of interest
 RENT = rental income from the asset
 a = rate of appreciation/maintenance
 d = rate of depreciation

the out-of-pocket expense for a an owner-occupied home is the price times the sum of the depreciation rate, the interest rate minus the appreciation rate , $PRICE*(d+r-a)$. This needs to be compared with the rental rate: $PRICE(d+r-a)/RENT$, which is the price to rent ratio times the sum of the rates of depreciation, interest minus appreciation. This adjusted price to rent ratio is illustrated in Figure 24 together with housing starts using an inverted scale. Here the depreciation rate is set to 5% per year, and the tax benefits from

homeownership are ignored. These two series closely parallel each other: building is great when home ownership is cheap compared with renting, and conversely. In fact the association seems astoundingly close.

This figure displays the adjusted price-to-rent ratio using two interest rates – the 10-year Treasury and the 3-month Treasury. The 3-month rate was especially attractive in the period 2001-2005 when the Fed provided very low interest rates. It does not seem surprising that many homeowners opted for variable rate loans tied to short-term rates like LIBOR.

Figure 24 Housing starts and Relative Out-of-Pocket Expense



It is difficult not to conclude from Figure 24 that the Fed has the ability to ameliorate the cycle in housing starts, directly by altering interest rates and indirectly by slowing the rate of appreciation of homes. To think more precisely how this might be done, we need some equations that link housing starts and appreciation rates to Fed behavior. An equation suggested by Figure 24 is reported in Table 5. Here housing starts around the historical mean of 1550 thousand are explained by housing starts in the previous quarter, the change in starts over the previous year and the two components of the housing cost: the price to rent ratio times the ten-year Treasury and the price to rent ratio times the previous year's appreciation, as if that were the forecast for the following year. The coefficients on the interest rate and the appreciation are roughly equal and opposite in sign, supporting the idea that the cost of capital is the interest rate minus the appreciation. For the rent index I am using the GDP deflator not the rental components of the CPI because the time series for the GDP deflator is longer, and because the GDP deflator moves in a way very similar to the CPI rental values.

Also in this equation is the slope of the yield curve, the ten-year Treasury rate minus the 3-month rate. The slope of the yield curve can cause weakness in housing or can only predict it. I will be adopting the causal interpretation based on the idea that it is not only the price of credit that matters; lending standards also matter. When the yield curve is steep banks make intermediation profits by taking deposits at low rates of interest and making loans at high rates. With a steep yield curve (and high rates of home price appreciation) lending standards can be very lax, and anyone who can fog a mirror can get a loan. But when the yield curve flattens, or even inverts, the intermediation profits disappear, and banks are forced to change their lending standards. They shift from pushing loans onto weakly qualified buyers to minimizing delinquency and default risk by lending only to well-qualified buyers. (Feel free to object to treating the spread as a causal variable and to ignore what comes next.)

This equation has statistically significant coefficients for persistence, appreciation and the interest rate spread, and almost significant coefficients for momentum and the ten-year rate of interest. The coefficients are all as expected.

Table 5 Starts Regression

Dependent Variable: STARTS-1550
 Method: Least Squares
 Date: 10/21/08 Time: 06:13
 Sample: 1976Q3 2008Q2
 Included observations: 128

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-58.12770	56.37052	-1.031172	0.3045
STARTS(-1)-1550	0.768759	0.061116	12.57877	0.0000
STARTS(-1)-STARTS(-5)	0.079431	0.048043	1.653318	0.1008
RATE_10Y(-1)*HPI(-1)/GDP_PRICE(-1)	-4.888242	2.657172	-1.839641	0.0683
400*@MOVAV(DLOG(HPI(-1)),4)*HPI(-1)/GDP_PRICE(-1)	5.445701	2.149559	2.533403	0.0126
RATE_3M(-1)-RATE_10Y(-1)	-38.56077	8.531812	-4.519646	0.0000
R-squared	0.883694	Mean dependent var		0.864583
Adjusted R-squared	0.878928	S.D. dependent var		301.7248
S.E. of regression	104.9866	Akaike info criterion		12.19128
Sum squared resid	1344706.	Schwarz criterion		12.32497
Log likelihood	-774.2421	Hannan-Quinn criter.		12.24560
F-statistic	185.3917	Durbin-Watson stat		1.943923
Prob(F-statistic)	0.000000			

This housing starts regression equation has the rate of appreciation as one of its explanatory variables, and we will need explicitly to allow monetary policy to affect home price appreciation. An equation for home price appreciation is reported in Table 6. The dependent variable, $4 \cdot \text{dlog}(\text{HPI})$ is the annualized rate of appreciation. This variable has a highly statistically significant and very large persistence effect, with 99.9% of the previous year's appreciation passed on to the next quarter. Rising long-term rates, high short-term rates and high home prices all reduce the rate of home price appreciation in statistically significant ways. Overall inflation contributes to high home price appreciation though not one-for-one, quarter by quarter. (The time trend in this equation allows for the steady rise in the real home price, with the last two variables offsetting each other over time.)

Table 6 Regression Explaining the Appreciation of Home Prices

Dependent Variable: $4 \cdot \text{DLOG}(\text{HPI})$

Method: Least Squares

Date: 10/15/08 Time: 05:56

Sample (adjusted): 1976Q2 2008Q2

Included observations: 129 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.022677	0.029331	0.773139	0.4409
LOG(HPI(-1)/HPI(-5))	0.998385	0.098319	10.15458	0.0000
D(RATE_10Y(-1))	-0.014586	0.004137	-3.525541	0.0006
RATE_3M(-1)	-0.003649	0.001145	-3.186007	0.0018
$4 \cdot \text{DLOG}(\text{GDP_PRICE}(-1))$	0.406645	0.208290	1.952309	0.0532
LOG(HPI(-1)/GDP_PRICE(-1))	-0.133628	0.044595	-2.996514	0.0033
@TREND	0.000461	0.000269	1.713746	0.0891
R-squared	0.626345	Mean dependent var		0.055286
Adjusted R-squared	0.607968	S.D. dependent var		0.039174
S.E. of regression	0.024528	Akaike info criterion		-4.525299
Sum squared resid	0.073396	Schwarz criterion		-4.370116
Log likelihood	298.8818	Hannan-Quinn criter.		-4.462245
F-statistic	34.08404	Durbin-Watson stat		1.728283
Prob(F-statistic)	0.000000			

Table 7 has the third equation in our simple model that explains sales of autos and light trucks. The most statistically significant variable is the four-year moving average of past sales – this is the comeuppance effect: persistent high levels of sales produce low levels of sales later on. Rising new car prices seem to choke off sales, but the effect of the price of gasoline is hard to detect. The short-run interest rate controlled by the Fed is no measureable effect on auto sales, but the ten-year rate does better. There is a statistically significant housing wealth effect, with a short-run elasticity of unit sales with respect to home price equal to one. For the simulations now to be discussed, the Fed is controlling sales of autos primarily through its control of home price appreciation.

Table 7 Regression Explaining Sales of Autos and Light Trucks

Dependent Variable: LOG(UNITS)

Method: Least Squares

Date: 10/18/08 Time: 18:40

Sample (adjusted): 1980Q4 2008Q3

Included observations: 112 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.908764	0.323925	5.892621	0.0000
LOG(UNITS(-1))	0.223410	0.093321	2.393987	0.0185
LOG(UNITS(-2))	0.338286	0.083155	4.068153	0.0001
LOG(UNITS(-3))	0.142773	0.083432	1.711250	0.0901
RATE_3M(-1)	-0.002311	0.004157	-0.555874	0.5795
RATE_10Y(-1)	-0.009499	0.006055	-1.568892	0.1198
LOG(HPI(-1)/HPI(-5))	0.995255	0.233549	4.261441	0.0000
LOG(@MOVAV(UNITS(-4),16))	-0.393184	0.076704	-5.125992	0.0000
LOG(PRICE_GASOLINE(-1)/PRICE_GASOLINE(-2))	-0.107135	0.075116	-1.426267	0.1568
LOG(PRICE_NEW_CARS/PRICE_NEW_CARS(-5))	-1.142180	0.319082	-3.579581	0.0005
R-squared	0.897021	Mean dependent var		2.689685
Adjusted R-squared	0.887935	S.D. dependent var		0.145252
S.E. of regression	0.048625	Akaike info criterion		-3.124327
Sum squared resid	0.241164	Schwarz criterion		-2.881604
Log likelihood	184.9623	Hannan-Quinn criter.		-3.025846
F-statistic	98.72187	Durbin-Watson stat		2.073588
Prob(F-statistic)	0.000000			

Optimal Control

The next step is to choose a hypothetical target for housing starts and to invert the housing starts estimated equation to solve for the path of interest rates to achieve the target. This inversion should depend on the uncertainty in the coefficients in the equation. Suppose that a variable y is expressible as a linear function of a control variable x and some other variables z , which are known when x is selected:

$$y = \theta' z + \beta x$$

Given the target t for the variable y , with quadratic loss for deviations from the target, the goal is to select x to minimize the expected loss:

$$E(y - t)^2 = E((\theta' z + \beta x - t)^2)$$

The optimal x can be selected by setting to zero the derivative of this expression with respect to x :

$$0 = 2E(\beta(\theta' z + \beta x - t))$$

which can be solved for the optimal x :

$$x = \frac{\bar{\beta}t - Cov(\beta, \theta')z - \bar{\beta}\bar{\theta}'z}{\bar{\beta}^2 + Var(\beta)}$$

where $\bar{\beta} = E(\beta)$. Note that if there is no uncertainty in β this is the certainty equivalent rule:

$$x_c = \frac{t - \bar{\theta}'z}{\bar{\beta}}$$

Scenarios: What If Monetary Policy Had Been Different?

For the scenarios described below the target for STARTS-1550 is $0.85*(STARTS(-1)-1550)$ meaning that interest rates are selected to shrink the gap between starts and their historical average of 1,550,000 per year by 15%, using a rate-setting rule that adjusts for the uncertainty in the interest rate effect on housing starts. Interest rates are chosen with this rule for two different starting points. Scenario 1 chooses short-term rates during the Greenspan era from 2000 to the present and Scenario 2 chooses rates beginning in 2006 when Ben Bernanke took over the Chairmanship. Incidentally, I am taking the 10-year Treasury and the overall inflation as exogenous to all of this, on the assumption that the real 10-year rate is determined in global bond markets and the rate of inflation is not much altered by the suggested changes in short-term rates.

Figure 25 has the results displayed in six different figures depicting interest rates, the spread, housing starts, home prices, home price appreciation and sales of automobiles. The two columns depict two different kinds of solutions to the model. Both have the same rule for setting the short-term interest rate and both use the same set of equations except in one sense. In the images on the left, the residuals in the equations are set to zero, thus in a sense attributing to the new interest rate policies the ability to eliminate the residuals. In the images on the right, the residuals are added to the equations, thus in a sense assuming that the “shocks” remain exactly the same, even though the policy has changed. The truth may lie somewhere between these two.

Look at the zero-residual case on the left. The “housing-optimized” interest rates beginning in 2000 do not have the rate jump in 2000/2001, nor the extremely aggressive rate reductions in 2001 and 2002, nor the complete reversal of course in 2004 and 2005. Targeting houses beginning in 2000 calls for a slow return to a short-term interest rate around 3% and then a rate cut in 2007, chasing the 10 year rate downward, allowing for some steepening of the yield curve to maintain housing starts at the target level in the face of weakening home price appreciation. This has the effect (by design) of keeping housing starts almost perfectly flat at 1550. Coincidentally, the excessive appreciation of homes in 2005 and 2005 is eliminated. Sales of light vehicles are little affected until late in 2004 when they begin a slow decline from 17 million units to 15 million, and then there is no collapse in 2008. This looks pretty good, don’t you think? Targeting housing has completely eliminated the housing cycle and softened the autos cycle too.

The message: That inverted yield curve in 2000 wasn’t helpful to housing starts which were close to normal in 2000 and didn’t need to be reined in. Then in 2001 and 2002 a steep yield curve created by substantial rate reductions helped an already healthy housing market to attain new and unsustainable levels of building and appreciation. The 2001 downturn was our only business downturn and those low rates in its aftermath primarily stimulated something that didn’t need stimulation: consumer spending on homes and cars. Normally, in the aftermath of a recession, sales of homes and cars are transferred forward in time, as low interest rates help recapture sales that did not occur in the recession. This time, with no decline of homes and cars, those low interest rates were transferring sales backward in time, making 2003/4/5 stronger at the expense of 2007/8/9.

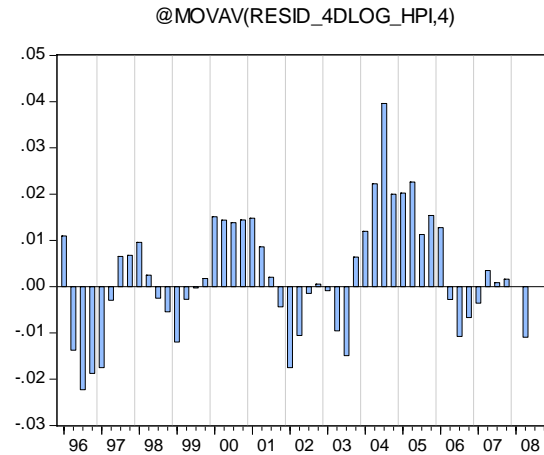
Next take a look at scenario 2 beginning in 2006 when Chairman Bernanke assumed control. What would Chairman Bernanke have done differently beginning in 2006 had he been targeting housing starts? The model calls for an immediate termination of Greenspan’s rate increases, immediate rate reductions and a rapid steepening of the yield curve, much as what actually happened a year later in 2007. During the period of rate decline, the optimal rule has rates about 100 basis points lower than the ones chosen by Chairman Bernanke. This would have created a rapid and substantial increase in the spread, thus stimulating housing even though housing starts were still well above the target level of 1.55 million. Why stimulate housing when we are already producing too much? The reason for this is that housing starts have a very powerful momentum effect. Once they start to fall, they tend to continue to fall. The right time to have tight monetary policy is when starts are above their target levels and increasing. When starts begin to fall, that is the time to ease off to soften the landing and prevent overshooting.⁵ Per the model, this would have allowed a slow decline in housing starts back to the target level of 1550. This would not have prevented the negative appreciation of home prices, nor the sharp decline in auto sales in 2007. In other words, too much damage had already been done for monetary policy to work well in 2006/7/8.

In case you missed it, here are the two points. Eliminating the housing cycle requires preemptive action that prevents a mountain of homes from being built. Monetary policy

⁵ A lower target level for starts would be appropriate at this point to eliminate the overbuilding that occurred in 2004-5.

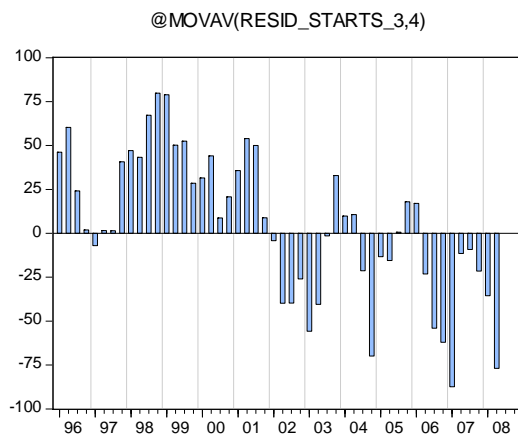
needs to be tight when housing starts are above normal and growing. If you have already built a mountain of homes, the system is very fragile and needs a gentle nudge not a slap in the face. Monetary policy needs to loosen up as soon as housing starts begin to fall.

A somewhat different interpretation of history applies if the regression residuals are included in the equations. These results are displayed in the second column of Figure 25. A very important difference between the two columns is the home price appreciation display. The spike in appreciation in 2004 and 2005 is not explainable by the home price model and if the residuals displayed in the figure on the right are retained, most of the spike in appreciation is retained.



A way to think about the two alternative treatments of the residuals is that setting the residuals to zero eliminates the excesses of the subprime mortgages in 2004 and 2005, which produced that very high home price appreciation, while retaining the residuals keeps the overheated subprime market operating at full blast. It is not at all clear which is the more likely but-for outcome. How much of the excesses of the subprime market in 2004/5 are a consequence of the teaser rates from the Fed in 2002/3/4 and how much a consequence of the innovations in securitization? I am inclined to hold the Fed accountable, but understand that the alternative is viable. Thus I have offered results that apply to both alternatives.

To keep housing cool in the face of that appreciation required a sharp rise in interest rates at about the same time in 2004 as the Greenspan increases and an inverted yield curve about two years before Bernanke's inverted yield curve. But this tight monetary policy is reversed in 2006 with the housing-friendly rates, instead of 2007 per Chairman Bernanke.



Likewise, the sharp decline in housing starts in 2006/7/8 is not explainable by the model, and if these residuals are included in the model, housing starts decline sharply even in the face of a steep yield curve, though the steep descent of starts is softened by earlier steepening of the yield curve, in 2006, not 2007.

Bottom line here: the Greenspan increase in rates and the inversion of the yield curve in 2000 was not a housing-friendly choice, but if appreciation took off because of the

innovations in the subprime market that are not explainable by the normal relationship between home prices and interest rates, a Fed targeting housing would have offset that abnormal appreciation with an inverted yield curve in 2004/5. In other words, either the Fed should have prevented that overheated subprime market with higher interest rates in 2002/3/4, but if that didn't work, needed higher rates in 2004/5. This would have largely eliminated the housing volume cycle and helped make the adjustment in autos earlier and less extreme.

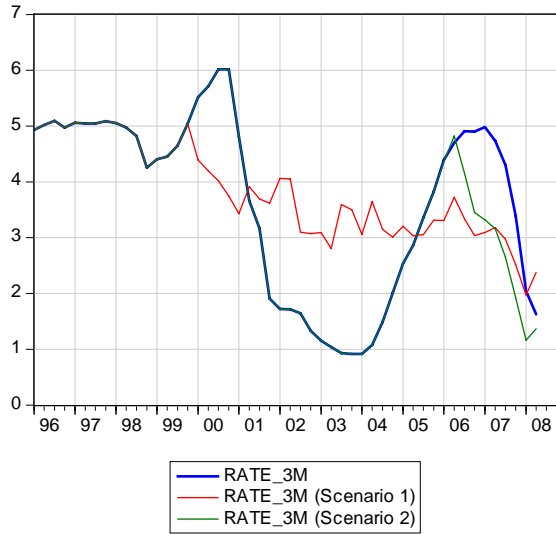
Conclusion

The Fed should pay more attention to housing starts.

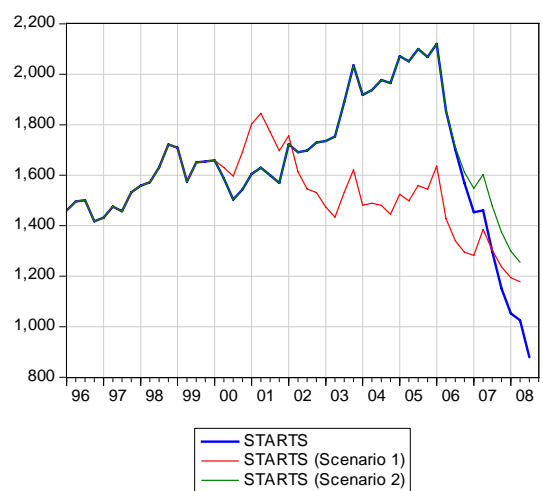
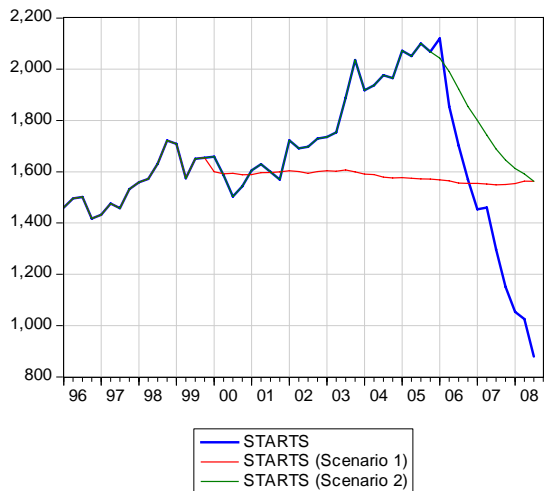
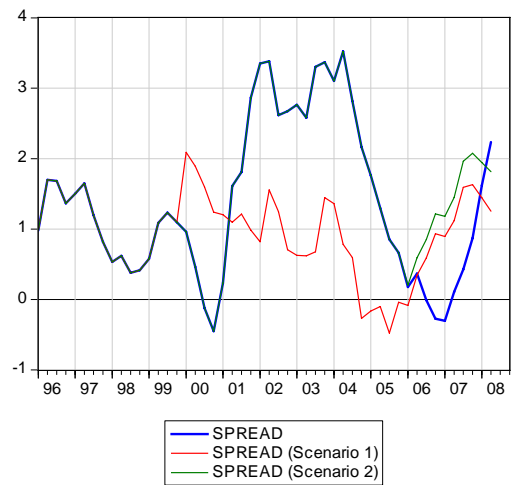
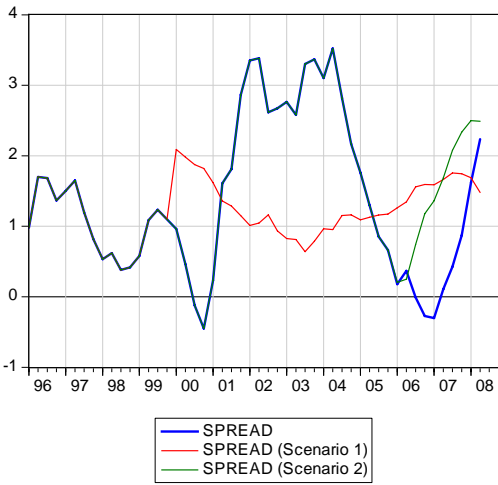
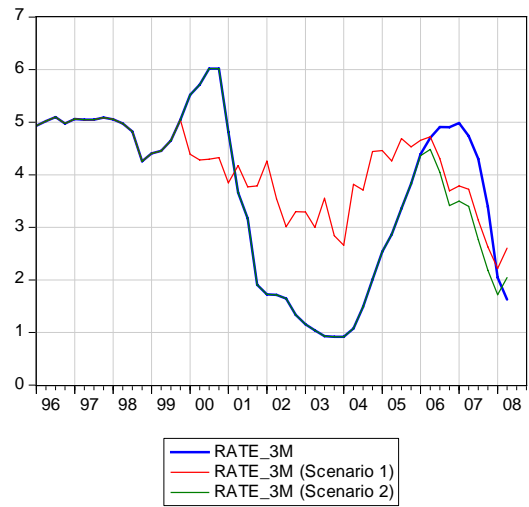
Figure 25

Scenarios

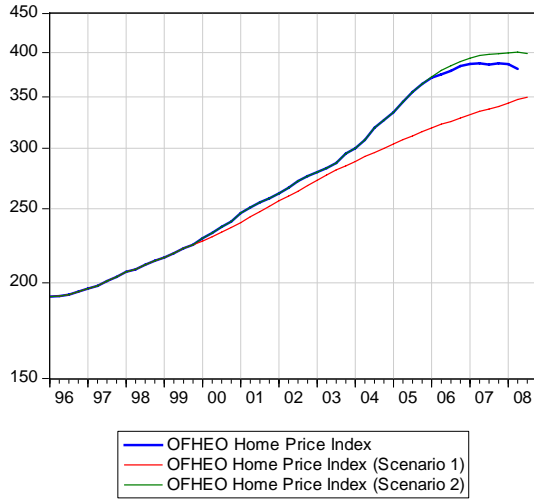
Scenarios with residuals zeroed out



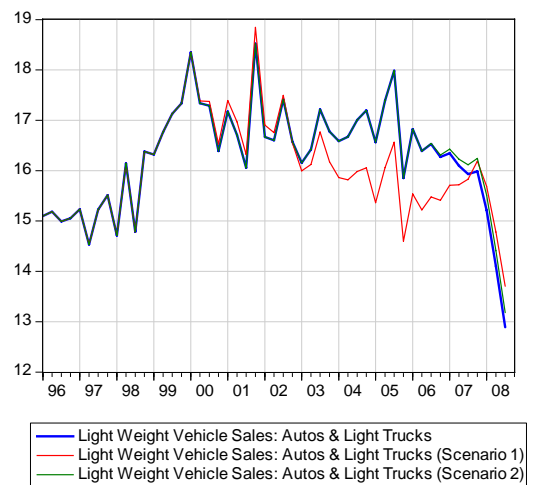
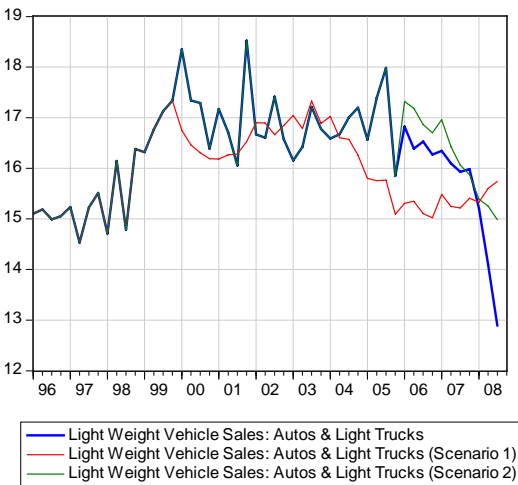
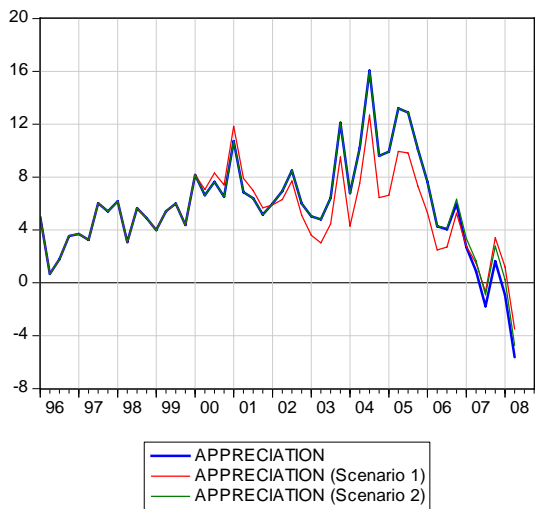
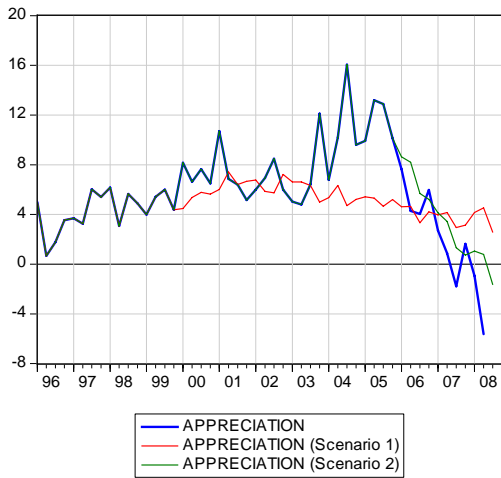
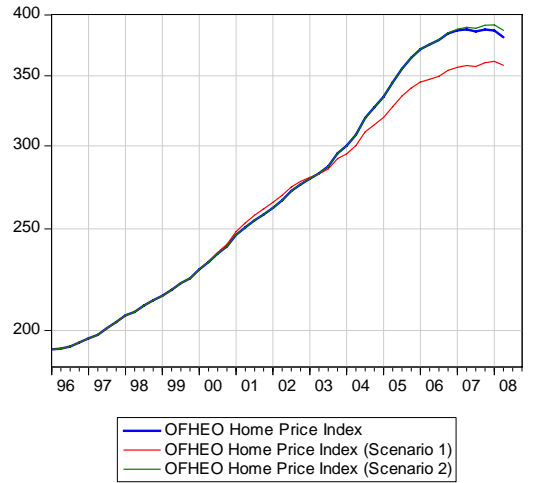
Scenarios with residuals included



Scenarios with residuals zeroed out



Scenarios with residuals included



References

- Abramovitz, Moses, *Evidence of Long Swings in Construction since the Civil War*, New York, NY: National Bureau of Economic Research, 1964.
- Ahearn, A., J. Ammer, B. Doyle, L. Kole, and R. Martin (2005) "House Prices and Monetary Policy: A Cross-Country Study," International Finance Discussion Paper Series No. 841 Federal Reserve Board.
- Alberts, William W. "Business Cycles, Residential Construction Cycles, and the Mortgage Market" *The Journal of Political Economy*, Vol. 70, No. 3. (Jun., 1962), pp. 263-281.
- Bernanke, Ben S. *Essays on the Great Depression*, Princeton University Press, 2000.
- Bernanke; Ben S. and Mark Gertler "Should Central Banks Respond to Movements in Asset Prices?" *The American Economic Review*, Vol. 91, No. 2, Papers and Proceedings of the Hundred Thirteenth Annual Meeting of the American Economic Association. (May, 2001), pp. 253-257.
- Bach, G.L. and James B. Stephenson. 1974. "Inflation and the Redistribution of Wealth." *Review of Economics and Statistics*. 56 (February): 1-13
- Blank, David M. *The Volume of Residential Construction, 1889-1950*, New York, NY: National Bureau of Economic Research, 1954.
- Bostic, Raphael, Stuart Gabriel, and Gary Painter (2005) "Housing Wealth, Financial Wealth and Consumption: New Evidence from Micro Data," Lusk Center for Real Estate, Working Paper, December.
- Brady, Eugene A. (1967) "A Sectoral Econometric Study of the Postwar Residential-Housing Market," *The Journal of Political Economy*, Vol. 75, No. 2. (April), 147-158.
- Campbell, J.Y. and J. Cocco (2005) "How Do House Prices Affect Consumption? Evidence from Micro Data." NBER Working Paper 11534
- Case, Karl E. (2006) "The Value of Land in the United States: 1975-2005" Urban Economics and Public Finance sponsored by the Lincoln Institute of Land Policy, Cambridge, Massachusetts, April 21, 2006.
- Case, Karl E., 1986. The Market for Single Family Homes in Boston, 1979-1985," *New England Economic Review*, May/June 1986.
- Case, K.E., J.M. Quigley and R. J. Shiller (2005) "Comparing Wealth Effects: The Stock Market versus the Housing Market." *Advances in Macroeconomics*, 5(1).1-32
- Case, Karl E. and John M. Quigley "How Housing Booms Unwind: Income Effects, Wealth Effects, and Sticky Prices"
- Case, Karl E. and Robert J. Shiller, "The Behavior of Home Buyers in Boom and Post Boom Markets, *New England Economic Review*, November/December 1988: 29-46.
- Case, Karl E. and Robert J. Shiller (1987) Prices of Single-Family Homes Since 1970: New Indexes for Four Cities," *New England Economic Review*, Sept-Oct, 45-56.
- Case, Karl E. and Robert J. Shiller, "Is There a Bubble in the Housing Market?" *Brookings Papers on Economic Activity*, 2, 2003: 299-362.
- Catte, Pietro, Nathalie Girouard, Robert Price and Christophe André (2004), "Housing Markets, Wealth and the Business Cycle," OECD Economics Department Working Papers No. 394

- Cauley, S. D. and Pavlov, A. "Rational Delay: the Case of Real Estate." *The Journal of Real Estate Finance and Economics*, (Winter 2002:143:165).
- Cauley, Stephen Day and Andrey D. Pavlov, "Why Real Estate Prices Don't Decline Following Demand Shocks," April 2007.
- Cecchetti, Stephen G., Alfonso Flores-Lagunes, and Stefan Krause, "Assessing the Sources of Changes in the Volatility of Real Growth" NBER Working Paper No. 11946, January 2006.
- Cuikerman, A., K. Lennan and F. Papadia. 1985. "Inflation-Induced Redistributions via Monetary Assets in Five European Countries: 1974-1982.
- Cunningham, Rose and Ilan Kolet (2007), "Housing Market Cycles and Duration Dependence in the United States and Canada, Bank of Canada, Working Paper 2007-2.
- Davis, Morris A. and Jonathan Heathcote. 2005 "Housing and the Business Cycle." *International Economic Review*, 46 (August) 751-84.
- de Leeuw, Frank and Edward M. Gramlich, "The Channels of Monetary Policy: A Further Report on the Federal Reserve--M.I.T. Model," *The Journal of Finance*, Vol. 24, No. 2, Papers and Proceedings of the Twenty-Seventh Annual Meeting of the American Finance Association Chicago, Illinois December 28-30, 1968. (May, 1969), pp. 265-290.
- Doepke, Matthias and Martin Schneider (2006) "Inflation and the Redistribution of Nominal Wealth," *Journal of Political Economy*, V 114, No. 6, December, 1069-1097.
- Fair, Ray C. "Disequilibrium in Housing Models," *The Journal of Finance*, Vol. 27, No. 2, Papers and Proceedings of the Thirtieth Annual Meeting of the American Finance Association, New Orleans, Louisiana, December 27-29, 1971. (May, 1972), pp. 207-221.
- Fisher, Jonas D.(2007) "Why Does Household Investment Lead Business Investment over the Business Cycle?" *Journal of Political Economy*, No.1, V 115, Feb 2007, 141-169.
- Genevose, David and Christopher Mayer , Loss Aversion and Seller Behavior: Evidence from the Housing Market, *Quarterly Journal of Economics*, November 2001, 1233-1269.
- Girouard, Nathalie, Mike Kennedy, Paul van den Noord and Christophe André (2006), "Recent House Price Developments: The Role of Fundamentals," OECD Economics Department Working Papers No. 475.
- Granger, C.W. J. (1969), "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods," *Econometrica*, Vol. 37, No.3 (July 1969), 424-438.
- Grebler Leo, "Stabilizing Residential Construction--A Review of the Postwar Test" *The American Economic Review*, Vol. 39, No. 5. (Sep., 1949), pp. 898-910.
- Greenspan, Alan and James Kennedy (2005), "Estimates of Home Mortgage Originations, Repayments, and Debt on One-to-Four-Family Residences", Finance and Economics Discussion Series 2005-41, Board of Governors of the Federal Reserve System, Washington, D.C.
- Helbling, Thomas and Marco Terrones."ChapterII: When Bubbles Burst", World Economic Outlook, IMF, April 2003.

- Herring, Richard and Susan Wachter (2002) "Bubbles in Real Estate Markets," Federal Reserve Bank of Chicago and World Bank Conference, Chicago, April 22-24.
- Himmelberg, C., C. Mayer and T. Sinai (2005) "Assessing High House Prices: Bubbles, Fundamentals and Misperceptions," NBER Working Paper No. 11643.
- Hoeller, Peter and David Rae (2007) "Housing Markets and Adjustments in Monetary Union," OECD Economics Department Working Paper No. 550.
- Ketchum, Marshall D., "Forecasting Capital Formation in Residential Housing," *The Journal of Business*, Vol. 27, No. 1, Forecasting. (Jan., 1954), pp. 32-40.
- Kydland, Finn E. and Edward C. Prescott. 1982. "Time to Build and Aggregate Fluctuations." *Econometrica* 50 (November): 1345-70.
- Leamer, Edward E. (2007) "Is a Recession Ahead? The Models Say Yes, but the Mind Says No" Berkeley Electronic Press, January.
- Lettau, Martin (2001), "Consumption, Aggregate Wealth, and Expected Stock Returns," *The Journal of Finance*, Vol. IVY, No.3, June 2001.
- Lettau, Martin and Sydney C. Ludvigson (2004). "Understanding Trend and Cycle in Asset Values: Reevaluating the Wealth Effect on Consumption," *American Economic Review*, 94(1), 276-299.
- Ludvigson, Sydney, Charles Steindel and Martin Lettau (2002) "Monetary Policy Transmission through the Consumption- Wealth Channel, FRBNY Economic Policy Review (May), 117-133.
- Maisel, Sherman J. "The Effects of Monetary Policy on Expenditures in Specific Sectors of the Economy," *The Journal of Political Economy*, Vol. 76, No. 4, Part 2: Issues in Monetary Research, 1967. (Jul. - Aug., 1968), pp. 796-814.
- McConnell, Margaret Mary and Gabriel Perez-Quiros (2000), "Output fluctuations in the United States: what has changed since the early 1980s?" *American Economic Review*, 90(5), pp 1464-1476
- McCully, Paul, "The Plankton Theory Meets Minsky", PIMCO Newsletter, March 2007.
- Minsky, Hyman P., *Stabilizing an Unstable Economy*. Twentieth Century Fund Report, New Haven and London: Yale University Press, 1986.
- Muelbauer, John (2007), Housing, Credit and Consumer Expenditure, Presented at the Jackson Hole Symposium, Sept. 2007.
- Pavlov, Andrey and Susan Wachter (2001), "Robbing the Bank: The Option Value of Non-recourse Lending and Inflated Asset Prices," Wharton Real Estate Center Working Paper, December.
- Peek, Joe and James A. Wilcox (2006), "Housing, Credit Constraints and Macro Stability: The Secondary Mortgage Market and Reduced Cyclicalities of Residential Investment," AEA Papers and Proceedings, May, 135-140.
- Shefrin, Hersh and Richard Thaler, 1988, "The behavioral life-cycle hypothesis," *Economic Inquiry*, 26, 609-643.
- Stock James H. and Mark W. Watson, eds.(1993) *Business Cycles, Indicators and Forecasting*, National Bureau of Economic Research. Chicago: The University of Chicago Press.
- Smith, Margaret Hwang and Gary Smith, (2006) "Bubble, Bubble, Where's the Housing Bubble?" Brookings Panel on Economic Activity, March 30-31.

- Smith; Lawrence B., Kenneth T. Rosen; George Fallis, "Recent Developments in Economic Models of Housing Markets," *Journal of Economic Literature*, Vol. 26, No. 1. (Mar., 1988), pp. 29-64.
- Thaler, Richard (1990): "Anomalies: Saving, Fungability, and Mental Accounts," *Journal of Economic Perspectives*, 4, 193-206
- Topel, Robert and Sherwin Rosen Housing Investment in the United States *Journal of Political Economy*,. 1988, vol 96, no 41. 718-740.
- van den Noord, Paul (2004), "Modeling Cyclical Divergence in the Euro Area: The Housing Channel", OECD Economics Department Working Papers No. 400
- Van den Noord, Paul,(2006) "Are House Prices Nearing a Peak? A Probit Analysis for 17 OECD Countries, OECD Economics Department Working Paper No. 488.
- Zarnowitz, Victor, *Business Cycles: Theory, History, Indicators, and Forecasting*, New York, NY: National Bureau of Economic Research, 1992.