

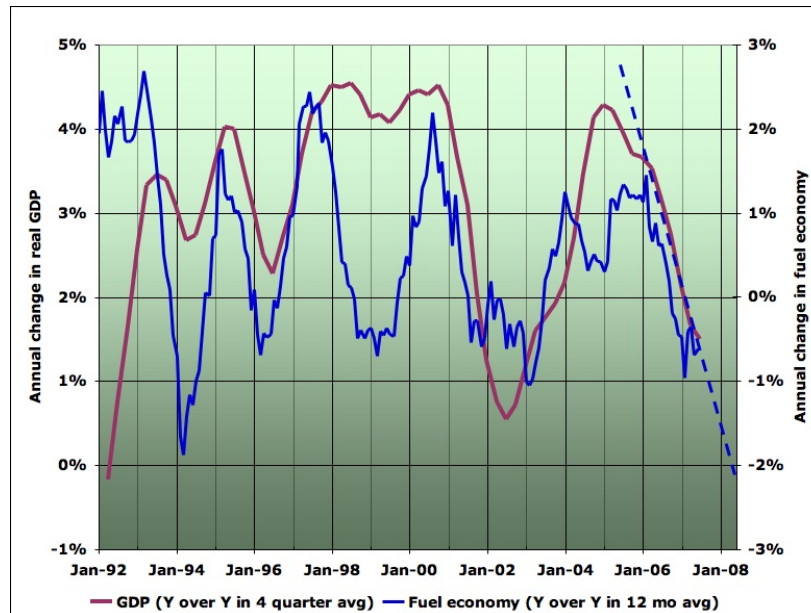


US Peak Oil Adaptation: Prognosis in a Credit Crunch

Posted by [Stuart Staniford](#) on September 2, 2007 - 10:00am

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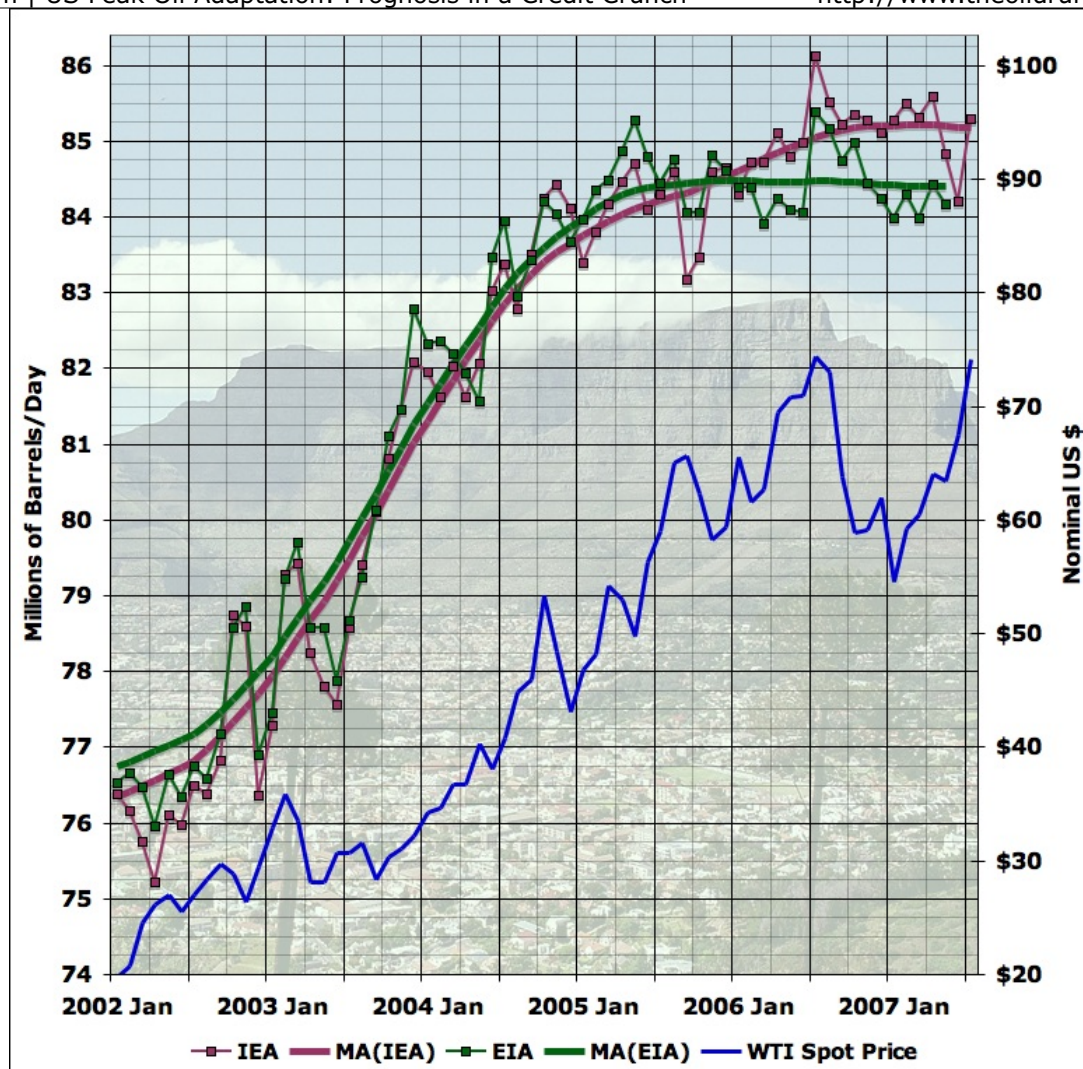


Year on Year change in four quarter average of US GDP (chained 2000 dollars) and 12 month average of US deployed fleet fuel economy. Click to enlarge. Source: [FHWA Blue Book](#) and [FHWA Travel Volume Trends](#) for VMT data, [Bureau of Economic Affairs](#) for GDP, and [EIA](#) for gasoline supplied.

In this post I want to start exploring a hypothesis that is worrying me a lot. Specifically, the possibility that the emerging financial/credit crisis could cause a near-term collapse in demand for energy, energy prices, and investment in energy infrastructure. That in turn could lead to an even poorer failure to adapt to peak oil than we have seen so far, resulting in great difficulties once the economy begins to recover from its credit problems. I'm not claiming to have conclusive evidence for this hypothesis, I am not sure of its truth myself, and this post will only be a beginning of exploring the issues.

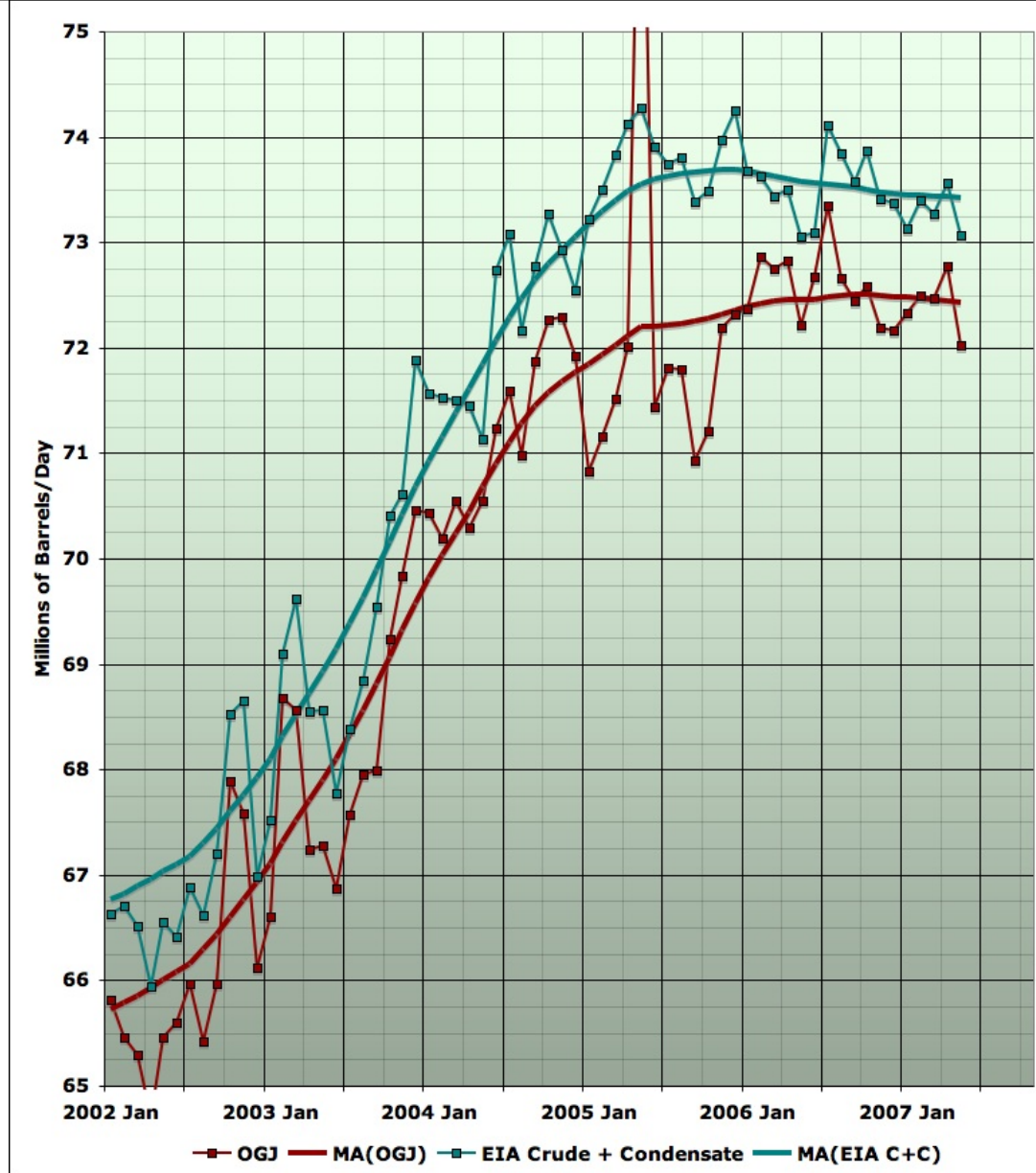
Let's first review the situation to date. I began worrying that we might be essentially at peak oil already [back in November 2005](#). This was the date of [Ken Deffeyes'](#) famous prediction based on [Hubbert Linearization](#), but my concern was based as much on the plateauing of the monthly oil production series in spite of high prices. As more evidence emerged, I firmed in my view that [peak oil is probably about now](#).

A couple more years of data have not changed the picture much:



Average daily total liquid production, by month, from EIA (green) and IEA (plum), together with 13 month centered moving averages of each line, recursed once (LHS). WTI spot price (blue - RHS). Click to enlarge. Graphs are not zero-scaled. Source: [IEA Oil Market Reports](#), and [EIA International Petroleum Monthly Table 1.4](#). The IEA line is taken from Table 3 of the tables section at the back of the OMR in the last issue for which the number for that month is given; last two points in purple are at earlier stages of revision than the rest of the graph. WTI spot price is from the [EIA](#)

The EIA data for total liquid fuels show a plateau since early 2005, while the IEA data increased slowly for a little longer but have shown a plateau for the last year. Looking at narrower definitions of oil produces a broadly similar picture:



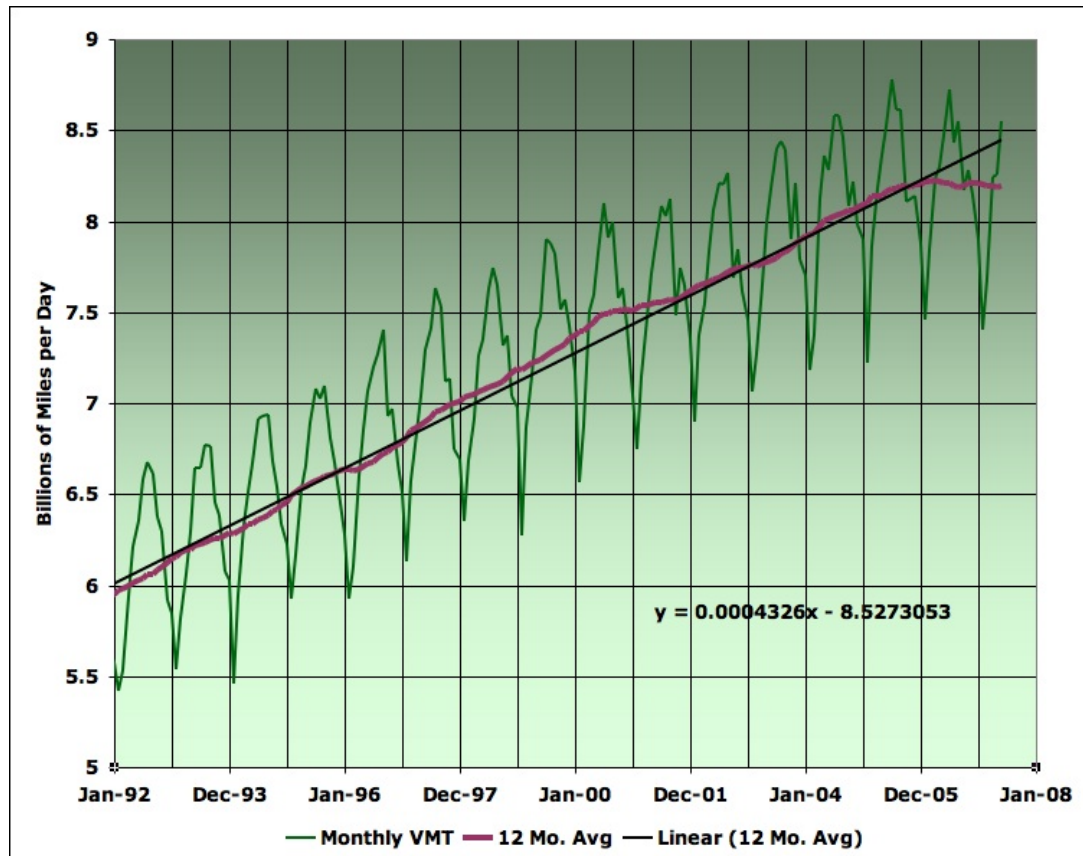
Average daily production of crude oil from Oil and Gas Journal (red), and crude plus condensate from EIA (teal) together with 13 month centered moving averages of each line, recursed once. Graph is not zero scaled to better show changes, click to enlarge. Source: [Oil and Gas Journal](#), and [EIA International Petroleum Monthly Table 1.1d](#).

The EIA's crude plus condensate actually shows a very slight decline since a peak in late 2005, while the Oil and Gas Journal series for crude alone has a gradual increase to a plateau in 2006 and 2007. For more background on this plateau debate, see [this tutorial post](#) - I used to track this stuff every month but it got boring.

In my view, the immediate cause of this oil supply plateau is that [Saudi Arabian oil production stopped increasing](#), as of [late 2004](#), and then began to decline: at least part of this is likely due to the [depleted state of North Ghawar](#). If [this unsourced graph](#) is to be believed, Ghawar production has declined 1mbd (20%) from 2005 to 2007.

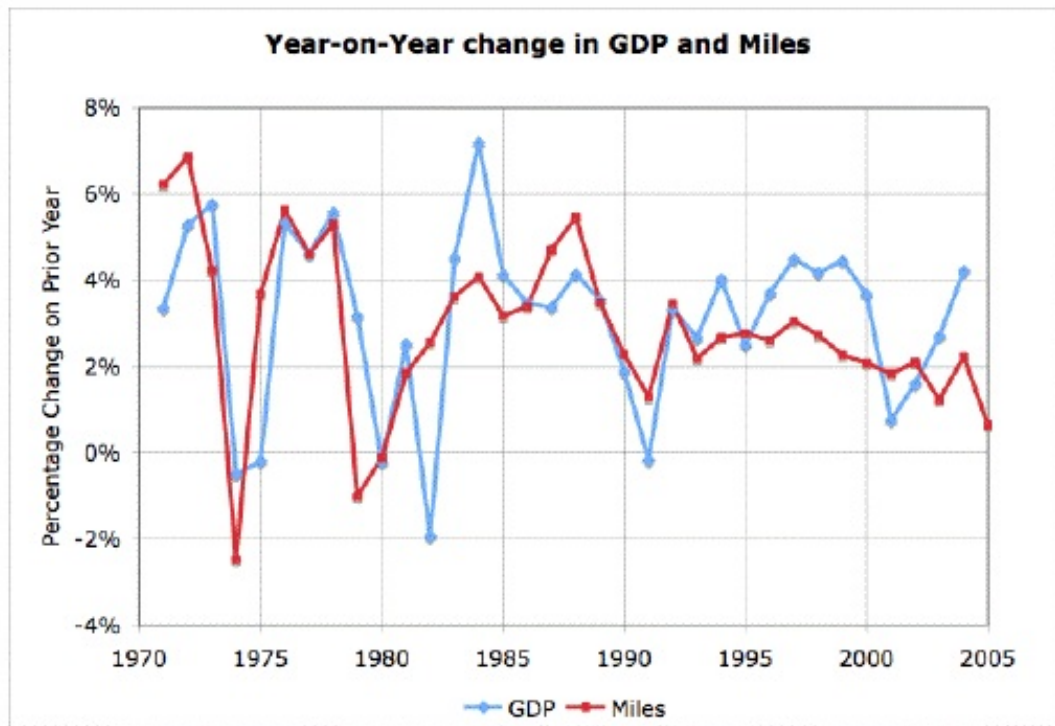
In looking at United States adaptation to the situation, I've primarily focussed on usage in road transport, which represents [about half](#) of total US oil usage (which in turn is about a quarter of global oil usage). And historically, the transportation sector is the [least elastic](#) user of oil in the US.

It's convenient to separate road transport usage of oil into two factors: the total vehicle miles traveled (VMT), and the efficiency with which the vehicle fleet currently uses oil. The recent trends in vehicle miles traveled I've studied in [detail in the past](#), but here's an update:



Monthly vehicle miles traveled in the United States, Jan 1992 - May 2007, together with a twelve month trailing average and a linear fit to the average. Graph is not zero scaled to better show changes. Click to enlarge. Source: [FHWA Travel Volume Trends](#).

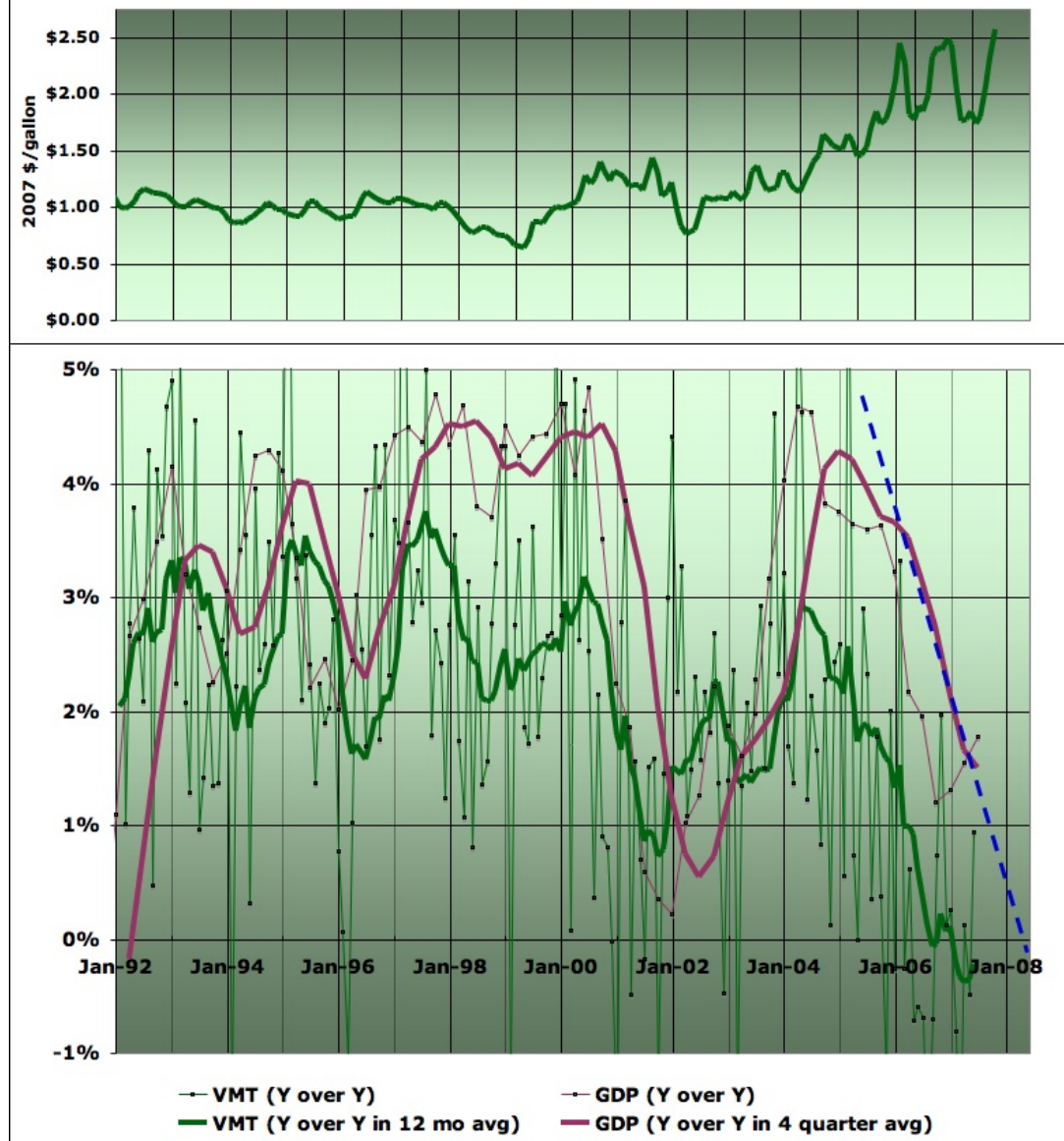
Basically, increases in VMT were fairly steady over the last 15 years until late 2005, when VMT flattened out and began to decline slightly (broadly coincident with the plateauing of global oil supply). This isn't altogether good news. Historically, there's a [decent correlation](#) between changes in US miles travelled and overall economic growth:



Year on Year change in US GDP (chained 2000 dollars) and US VMT. Click to enlarge. Source: [FHWA Blue Book](#) and [FHWA Travel Volume Trends](#) for VMT data, [Bureau of Economic Affairs](#) for GDP.

On this basis, I [suggested in 2005](#) that the (then) drop in VMT growth would presage a drop in economic growth, and refined this at the start of 2006 to a prediction that the US economy would [enter recession in 2007](#) (a prediction based on my perceptions of the bursting of the housing market bubble also). I may have gotten the timing at bit wrong, but basically that still looks close, and we may get there by the end of 2007.

This next graph updates that VMT-GDP connection with the monthly data over the last 15 years (through May 07 in the VMT, and Q2 07 in GDP).



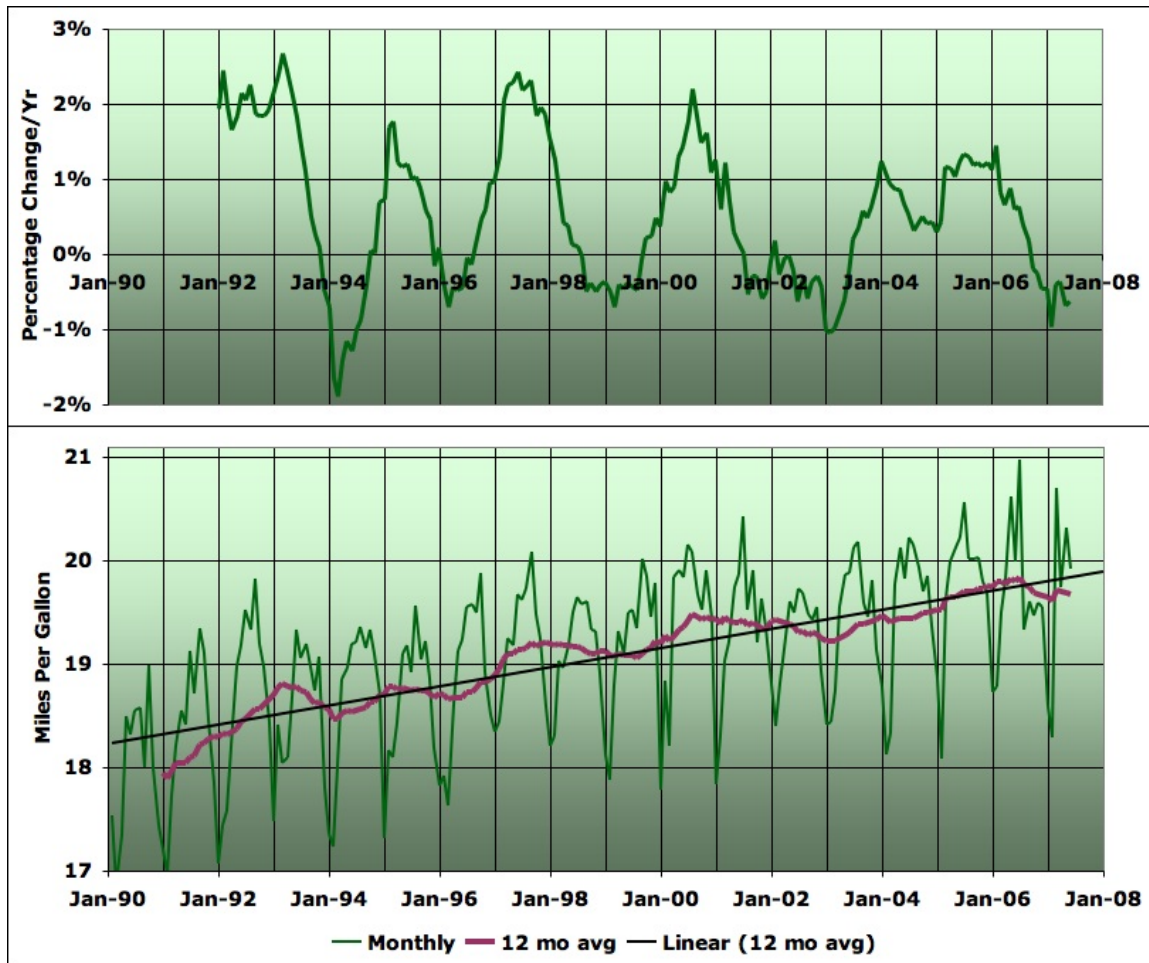
Top panel - inflation adjusted price of a gallon of regular gasoline pre-tax. (Jan 2007 dollars, CPI-U adjusted).

Bottom panel - year on year change in monthly vehicle miles traveled in the United States, Jan 1992 - May 2007, together with year on year change in 12 month trailing average. Also, year on year change in real GDP (chained 2000 dollars), and year on year change in 4 quarter average. The two moving averages are constructed so as to be comparable, but trail the underlying quantities by 6 months in addition to smoothing noise. Click to enlarge. Source: [FHWA Travel Volume Trends](#) for VMT and [Bureau of Economic Affairs](#) for GDP. Blue line extrapolates recent trend in GDP trailing average.

I've also put the increase in gas prices in the top panel for context. However, I think it's important to stress that I'm not suggesting high gas prices are the sole cause of the drop in VMT (and GDP). On the contrary, I think those movements are likely multiply caused by both the oil supply constraint (which required some drop in vehicle usage somewhere), and the housing bubble bursting and resulting economic slowdown (which has been a major control on who has had to do the conserving). More on this in a moment, but let's turn to the other factor in road transportation oil usage - average fuel economy.

The news here is pretty bad - progress is essentially non-existent. I've discussed my methodology in detail [before](#), but essentially I'm dividing the total number of vehicle miles by the amount of gasoline consumed, with an approximate correction for diesel vehicles. So this next graph represents the average fuel economy achieved by the entire gasoline powered fleet **on the**

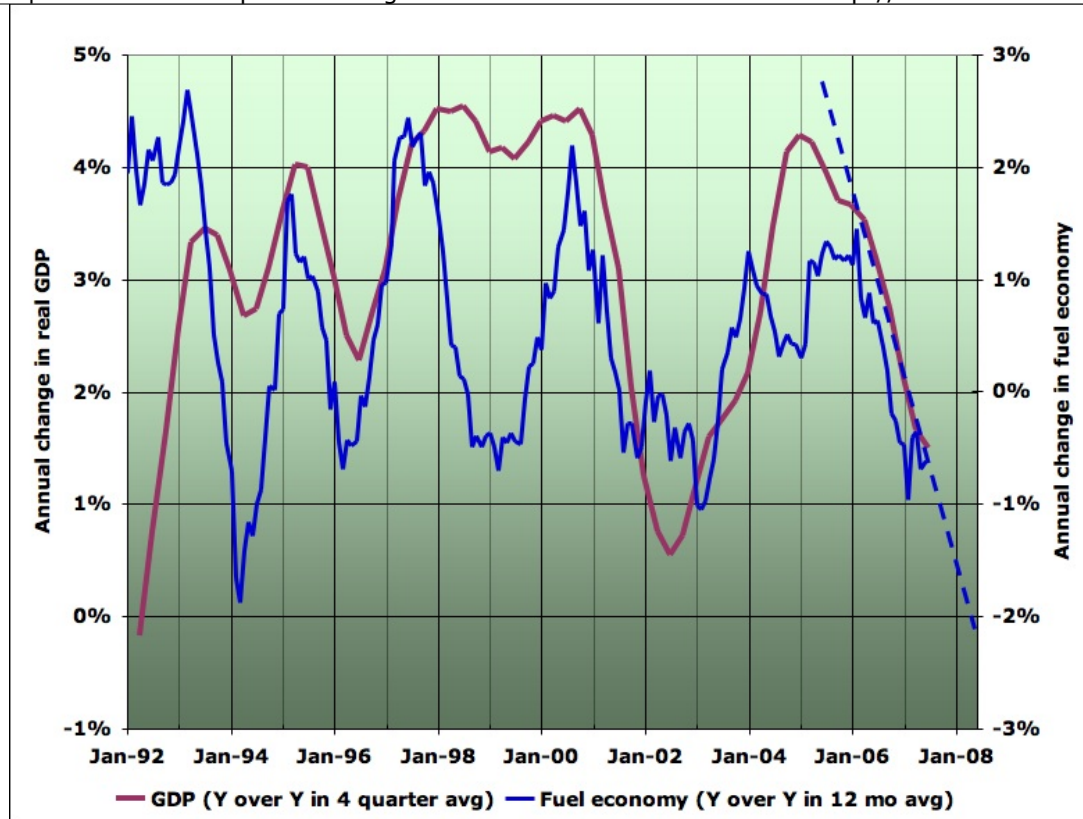
road (ie **not** just the fuel economy of new vehicles).



Bottom panel: Estimate of US deployed gasoline fuel economy by month, Jan 1990-May 2007, with 12 month trailing average and linear trend. Graph is not zero-scaled. Top panel: year-on-year change in 12 month average. Click to enlarge. Source: [FHWA for VMT stats](#), [EIA for gasoline supplied](#), and [Transportation Energy Data Book for diesel vehicle correction](#). See text for details.

As you can see, fuel economy has been getting very gradually better over the last 15 years, but the trend in the last couple of years is actually getting **poorer** not better as one might hope. This is in contrast to the reaction to the seventies oil shocks, where, once things got under way, deployed fleet fuel economy improved by [several percent per year](#). People really have not gotten the message yet - in part, they may still be treating the high gas prices as a temporary situation, rather than perceiving it as an important long-term need.

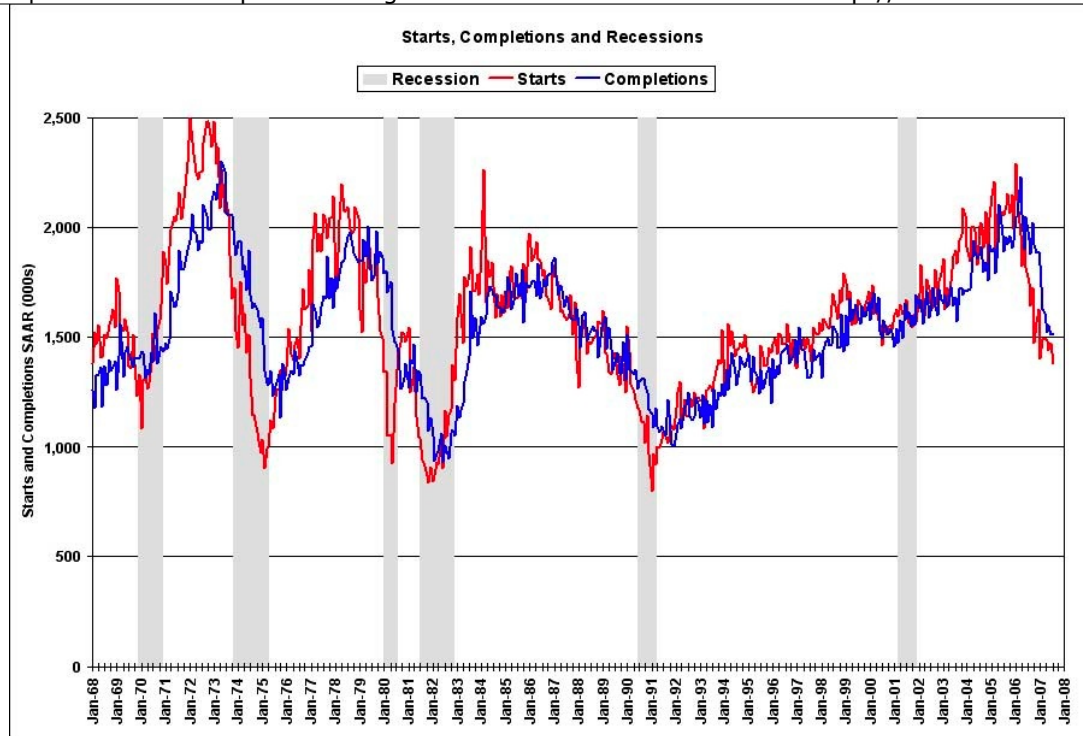
However, I also hypothesize that part of what is going on is as follows. There seems to be a decent rough correlation between fuel economy changes and economic growth:



Year on Year change in four quarter average of US GDP (chained 2000 dollars) and 12 month average of US deployed fleet fuel economy. Click to enlarge. Source: [FHWA Blue Book](#) and [FHWA Travel Volume Trends](#) for VMT data, [Bureau of Economic Affairs](#) for GDP, and [EIA for gasoline supplied](#).

The recent poor fuel economy growth fits into this pattern. I assume that what is happening is that as the economy slows, people buy fewer cars, and thus are less prone to replace older less efficient vehicles with newer more efficient ones. This is probably particularly true of lower income consumers who are particularly likely to be driving older vehicles (and now struggling to pay their subprime mortgages). This hypothesis should be confirmed more deeply (and I welcome any data or studies anyone is aware of which bear on this point). But for now, let's just keep going, noting the strong possibility that this correlation may continue to hold in the future.

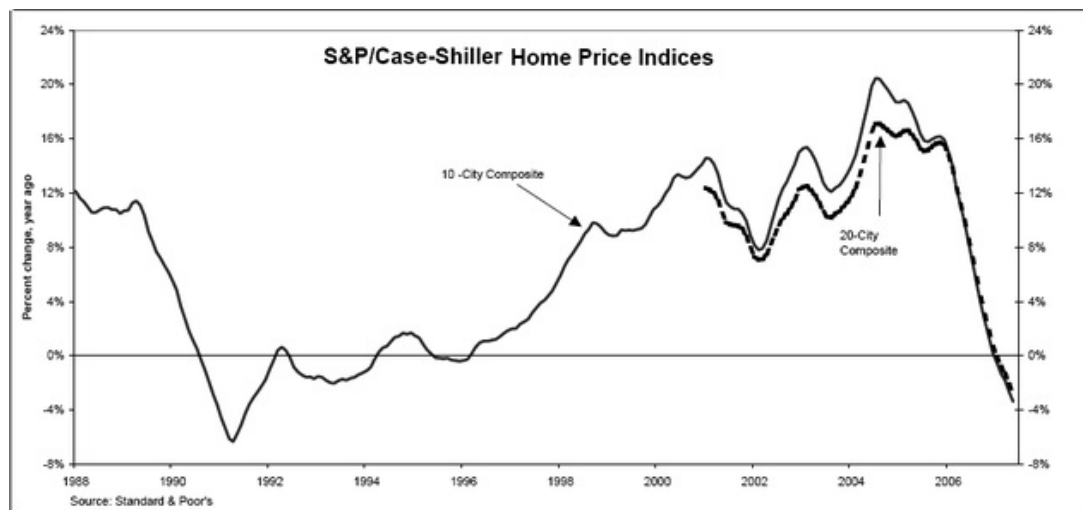
I have not blogged extensively on the US housing bubble and crash. This is not because I haven't considered it very important and followed it closely, but rather because [Calculated Risk](#) does such a stellar job. He makes most of the graphs I would tend to make, and I think has generally excellent judgement in interpreting them. Thus up till now I've been largely content to read that blog every day and feel like I know what's going on. To summarize a few salient stats now though, here's new housing starts and completions.



US housing starts and completions, together with recessions (gray bars). Source [Calculated Risk](#).

As you can see, new housing starts are a decent leading indicator of recessions, and peaked about the beginning of 2006 and have been falling sharply since. I take this as further evidence for the "recession around the end of 2007" hypothesis.

Prices of existing homes reached a maximum rate of acceleration in mid-to-late 2004 - at a staggering 15-20% in major metro areas - and then began to decelerate sharply:



Year-on-year change in Case-Shiller Index of home prices for 10 and 20 major US cities. Source [Big Picture](#).

Prices are now falling in this index (which I prefer to median home price indices as it is constructed based on comparing sales of the same house over time, and thus it not subject to problems of the sample changing significantly between up and down markets). For more on the housing bubble, I recommend [this nice summary](#).

The major driver of the extremely high rate of acceleration in house prices was a combination of

very low interest rates (engendered by the Federal Reserve attempting to mitigate the effects of the 2000-2002 tech crash) and a near complete collapse in lending standards in recent years, allowing all manner of exotic and imprudent mortgages to be passed off on people who could ill afford them. This has all come to a grinding halt in recent months, and now appears to be giving rise to a massive credit crunch. I refer you to [Stoneleigh's excellent primer](#) and [Jerome's comments](#) for more details.

So the question of the hour is: how bad is this credit crunch going to be?

I don't claim to have a methodology that I believe in to answer that question. Obviously, the mainstream economic consensus is that there is nothing to worry about. However, the mainstream economic consensus has been retreating one step at a time, which is not confidence-inspiring. As part of my research for this post, I read a sample of the Federal Open Market Committee minutes for the last few years, and it's somewhat like being in a parallel universe. Clearly, it's related to my universe, in that energy prices, housing activity, etc, are discussed. However, the discussion always seems to be about what happened in the last quarter, and projections about the future invariably assume that whatever is wrong now will moderate or not get much worse. Since the trend of events in the housing market has been to get steadily worse, this gives an impression of unreality: the committee invariably seems to fail to anticipate major negative developments. A sample from the [March 2007 meeting](#) will give you the idea. This is just after major disruptions in the subprime mortgage sector in February.

Participants reported signs of stabilization in housing demand in most regions of the country. At the national level, sales of new and existing homes, while fluctuating in recent months, did not display declining trends. The inventory of new homes for sale reportedly had fallen further from its recently elevated level. Participants noted, however, that such inventories likely would need to be worked down appreciably more before growth in housing construction would resume. The increase in delinquencies on subprime adjustable-rate mortgage loans and the ensuing increase in interest rates and tightening of credit standards in the subprime mortgage market likely would constrain home purchases by some borrowers, perhaps retarding the recovery in the housing sector. However, there was no sign of spillovers from the subprime market to the overall mortgage market; indeed, interest rates on prime mortgage loans had declined somewhat in recent weeks, along with yields on U.S. Treasury securities. Moreover, home-buying attitudes had improved and continuing job growth could be expected to support home sales.

There's not the slightest hint of concern here that within a few months the Federal Reserve would need to be engaged in massive injections of liquidity to stabilize the financial system during a panic.

For another, now famous example, consider this April 2005 statement from then Chairman Greenspan:

"With these advances in technology, lenders have taken advantage of credit-scoring models and other techniques for efficiently extending credit to a broader spectrum of consumers. The widespread adoption of these models has reduced the costs of evaluating the creditworthiness of borrowers, and in competitive markets, cost reductions tend to be passed through to borrowers. Where once more-marginal applicants would simply have been denied credit, lenders are now able to quite

efficiently judge the risk posed by individual applicants and to price that risk appropriately. These improvements have led to rapid growth in subprime mortgage lending; indeed, today subprime mortgages account for roughly 10 percent of the number of all mortgages outstanding, up from just 1 or 2 percent in the early 1990s.

Oops.

The FOMC comes across to me in their minutes as completely complacent as to the risks of speculative bubbles and the fact that unrestrained credit-creation has caused house prices to get seriously out of sync with incomes. No meeting minutes I read showed any deep discussion about the systemic risks of the kind of risk transference engaged in due to the creation of asset backed securities and CDOs. A search found no mention whatsoever of "peak oil" in any minutes of any Federal Reserve body, or any staff report, though there is regular discussion of "energy prices", treated as an essentially mysterious exogenous factor.

In general, there's an excessive reliance on the assumption that whatever markets are currently doing must be fairly optimal, and a failure to recognize (or at least discuss) that market systems, being collections of fairly imperfect human beings acting under uncertainty, are subject to certain well known pathologies and occasionally get into speculative spirals that can end in very abrupt dislocations. There's no mention of a "housing bubble" in any recent minutes or statements: one has to go back to 2003 to find Alan Greenspan downplaying the idea:

The very large flows of mortgage funds over the past two years have been described by some analysts as possibly symptomatic of an emerging housing bubble, not unlike the stock market bubble whose bursting wreaked considerable distress in recent years. Existing home prices (as measured by the repeat-sales index) rose by 7 percent during 2002, and by a third during the past four years. Such a pace cannot reasonably be expected to be maintained. And recently, price increases have clearly slowed.

It is, of course, possible for home prices to fall as they did in a couple of quarters in 1990. But any analogy to stock market pricing behavior and bubbles is a rather large stretch. First, to sell a home, one almost invariably must move out and in the process confront substantial transaction costs in the form of brokerage fees and taxes. These transaction costs greatly discourage the type of buying and selling frenzy that often characterizes bubbles in financial markets. Second, there is no national housing market in the United States. Local conditions dominate, even though mortgage interest rates are similar throughout the country. Home prices in Portland, Maine, do not arbitrage those in Portland, Oregon. Thus, any bubbles that might emerge would tend to be local, not national, in scope.

Third, there is little indication of a supply overhang in newly constructed homes. The level of overall new home construction, including manufactured homes, appears to be well supported by steady household formation and not dependent on high and variable replacement needs or second-home demand. Census Bureau data suggest that one-third to one-half of new household formations in recent years result directly from immigration.

My confidence is thus low that the FOMC has an adequate understanding of what it is up against, or that its reassurances can be relied on. It will do its best, but it is fundamentally complacent and reactive in its outlook and can be relied on to fail to anticipate new developments, especially

negative ones, ahead of time. I'm willing to revise this conclusion with more data - in particular, Fed Reserve chairman Ben Bernanke has left a large trail of very influential academic papers that I'm now digging into, and hope to report further on.

On the other side, one has a variety of fans of [Austrian economics](#) and the gold standard who tend to the view that the expansion of credit due to recent Fed easing has fueled the debt boom and make a contraction now inevitable. On the whole, they appear somewhat more in touch with reality than the FOMC. I read [Mike Shedlock](#) pretty regularly as the most quantitative and rational exponent of this viewpoint that I've come across in the blogosphere. He has been predicting a financial meltdown due to the credit bubble for some time, but I've still yet to see something that gave me a solid belief that we can estimate how bad this credit crunch could get.

Let me set aside that concern, and just lay out what has spooked me over the last couple of weeks, which is the whiff of financial panic. The events that caused the Fed and the European Central Bank (the ECB) to have to inject such massive amounts of liquidity into markets to maintain target interest rates were described by Paul Krugman in his Op-Ed [Very Scary Things](#) as follows:

Everyone knows now about the explosion in subprime loans, which allowed people without the usual financial qualifications to buy houses, and the eagerness with which investors bought securities backed by these loans. But investors also snapped up high-yield corporate debt, a.k.a. junk bonds, driving the spread between junk bond yields and U.S. Treasuries down to record lows.

Then reality hit — not all at once, but in a series of blows. First, the housing bubble popped. Then subprime melted down. Then there was a surge in investor nervousness about junk bonds: two months ago the yield on corporate bonds rated B was only 2.45 percent higher than that on government bonds; now the spread is well over 4 percent.

Investors were rattled recently when the subprime meltdown caused the collapse of two hedge funds operated by Bear Stearns, the investment bank. Since then, markets have been manic-depressive, with triple-digit gains or losses in the Dow Jones industrial average — the rule rather than the exception for the past two weeks.

But yesterday's announcement by BNP Paribas, a large French bank, that it was suspending the operations of three of its own funds was, if anything, the most ominous news yet. The suspension was necessary, the bank said, because of "the complete evaporation of liquidity in certain market segments" — that is, there are no buyers.

When liquidity dries up, as I said, it can produce a chain reaction of defaults. Financial institution A can't sell its mortgage-backed securities, so it can't raise enough cash to make the payment it owes to institution B, which then doesn't have the cash to pay institution C — and those who do have cash sit on it, because they don't trust anyone else to repay a loan, which makes things even worse.

And here's the truly scary thing about liquidity crises: it's very hard for policy makers to do anything about them.

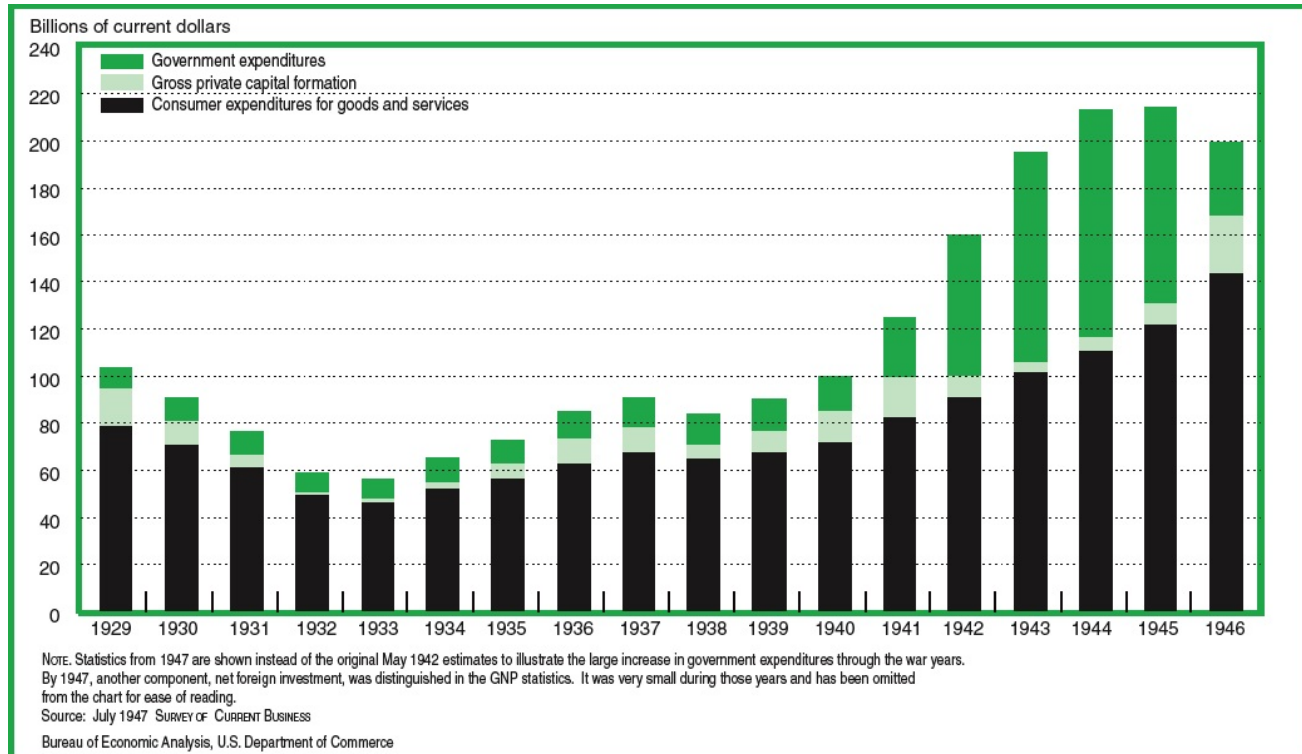
The Fed normally responds to economic problems by cutting interest rates — and as of yesterday morning the futures markets put the probability of a rate cut by the Fed before the end of next month at almost 100 percent. It can also lend money to banks that are short of cash: yesterday the European Central Bank, the Fed's trans-Atlantic

counterpart, lent banks \$130 billion, saying that it would provide unlimited cash if necessary, and the Fed pumped in \$24 billion.

But when liquidity dries up, the normal tools of policy lose much of their effectiveness. Reducing the cost of money doesn't do much for borrowers if nobody is willing to make loans. Ensuring that banks have plenty of cash doesn't do much if the cash stays in the banks' vaults.

Clearly, we have a situation in which financial system players have started to lose confidence in each other. The public has not lost confidence in financial institutions, but they are losing confidence in each other. They are probably better informed than we are, suggesting that as the chain of bad debt and overpriced assets continues to unwind, we could see more institutional failures, and more public loss of confidence in the financial system.

The last financial panic of major significance in the US was the Great Depression, which was essentially the result of a large debt fueled bubble that crashed in 1929. This led to a series of bank failures and panics and large-scale public loss of confidence in the financial system. That in turn led to a major contraction in the amount of money in circulation (since so many banks disappeared), and a drop in the velocity of money as people and institutions tried to improve their balance sheets and hold more cash. This didn't happen all at once, but as a rolling collapse over a period of four years. The Fed did more or less what you would expect (drop interest rates fairly rapidly beginning in 1929), which didn't really work. Then they were obliged to raise them again to counteract a run on Federal gold reserves by foreign governments, which greatly exacerbated the domestic difficulties. Prices dropped dramatically, as did real output. The data are chilling:



US GNP by use of product, 1929-1946. Source [U.S. National Income and Product Statistics: Born of the Great Depression and World War II](#), Feb 2007 Bureau of Economic Analysis Article.

Now, this is probably a worst case for what we might face in the next few years, and there are

some reasons to think things will be much milder. But let's just explore it as a worst case. There are two points I want to draw from it. One is obviously to note the sharp contraction in GNP generally from 1929 to 1933. It almost halved in nominal terms, and even in real terms, it dropped by a third. A contraction in GDP of that order of magnitude today would likely produce a very dramatic drop in oil usage (recall the correlation between GDP and VMT growth), which would without doubt collapse energy prices to pre-peak levels for a number of years. In the great depression, the unemployment rate rose from 3% to over 20%. With no income, and likely very restricted ability to borrow, that's a lot of people who wouldn't be doing too much driving.

Furthermore, consider the "Gross Private Capital Formation" element of GNP. That is private investment, and it dropped to almost nothing in 1932 or 1933. Now private investment today includes things like research and development in alternative technologies, venture capital funding of clean-tech startups, installation of wind power or solar power sites, laying down of new railroads, new nuclear power plants, coal-to-liquids plants, development of new oilfields, etc. Recall also the correlation I pointed out between fuel economy changes and economic growth - in a depression, it's a safe bet that average fuel economy of the fleet would simply degrade as few people bought cars and the existing fleet got older and less efficient. In short, whatever your preferred method of mitigating or adapting to peak oil, you can pretty much kiss it goodbye during a major meltdown of the financial system.

This, of course, will not make peak oil go away. Credit crunches and even depressions, as [extremely painful](#) as they may be, are inherently temporary. After a suitable time, the offending debt somehow gets written off and offending assets are repriced and the economy resumes growing. However, when this one passes, peak oil will still be there waiting for us. And whatever time we lose in investing in all the things we need to do is an opportunity lost forever.

So, I would really like to get a better handle on how bad this credit crunch is likely to get before it's done.



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