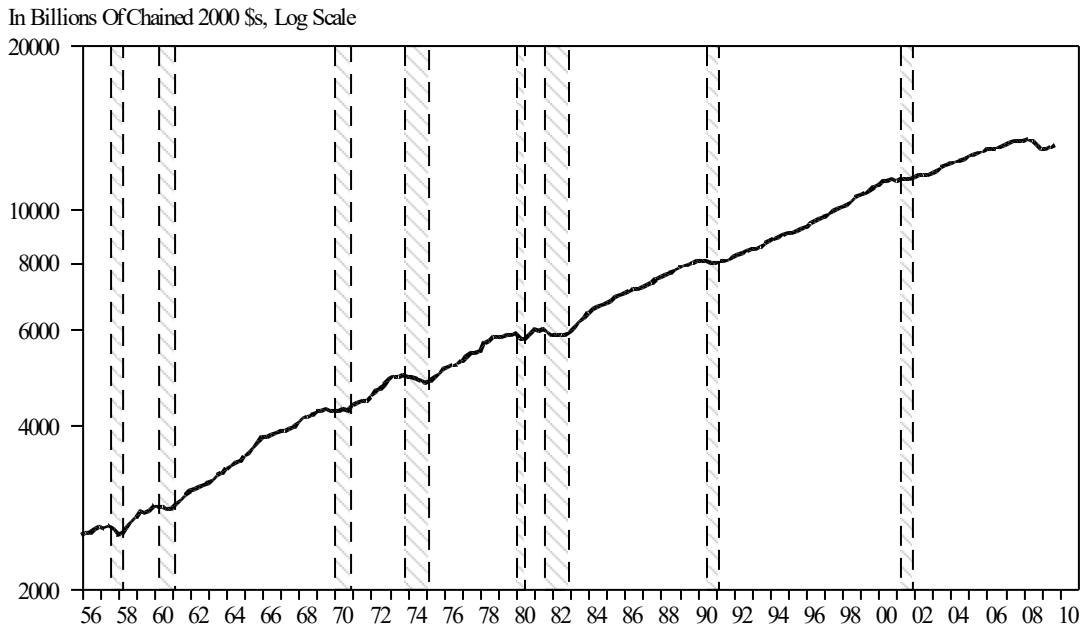


Lecture 4: Long Term Sustainable Growth

As we noted at the outset of this course, two essential sentiments drive our thinking about forecasts. One, growth is the rule. Two, changes in growth rates animate economic discussions.

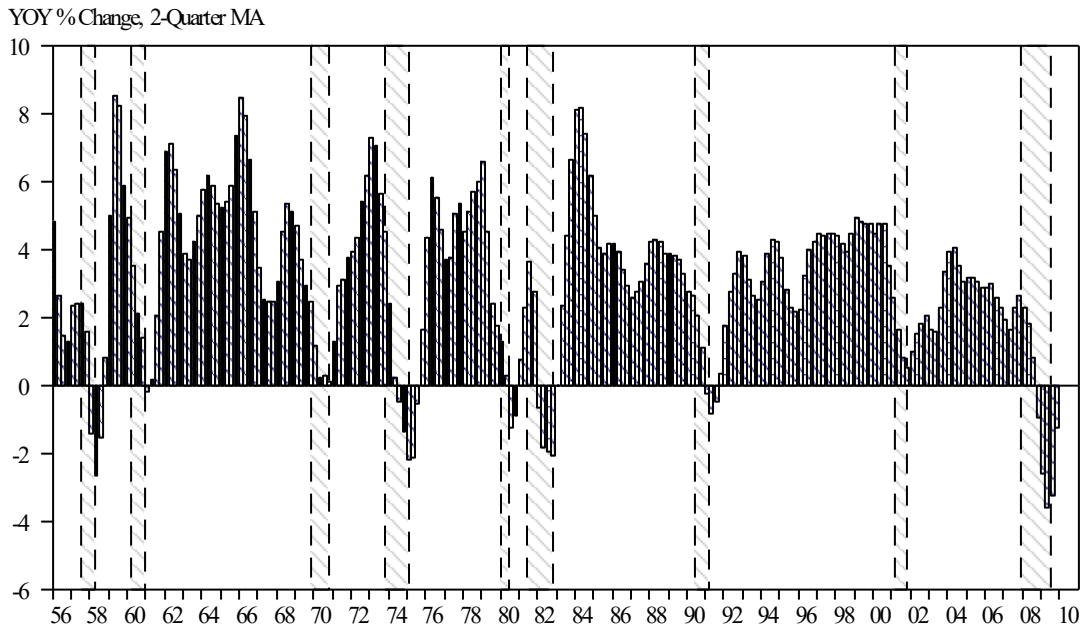
Growth Is The Goal And Growth Is The Rule.

NIPA: Real GDP



Recessions Arrive With Regularity, And Require Explanation.

NIPA: Real GDP



Acknowledging these two rules, economic forecasters generally employ a two-step procedure when they contemplate future growth rates. Step one involves divining an estimate for long term potential growth. Step two delves into the violence of short term cyclical dynamics. Simply put, we start with a projection of the long term possible. We modify this trend trajectory as we reflect upon business cycle considerations.

Economic growth theory trains its eye on the long term. As we will see in the pages that follow, growth theory focuses on labor force changes, rates of investment in capital equipment and the evolution of technological progress. This concentrated focus allows us to build streamlined models that are quite useful tools as we attempt to calculate long-term trajectories.

Sociology/Soft Infrastructure Foundations

But growth theory, to be fair, is silent on a great many key issues. Recall that Keynes believed a good economist needed to be, in part, a sociologist. Over the past few decades, the importance of sociology—the state of soft infrastructure—has been magnified. The collapse of the Soviet Union and its reemergence as a hyper corrupt state, the astonishing rise of China, and China’s potential for disastrous bust, all of these questions require analysis of social systems that stand outside of the items we measure in a neoclassical growth model. Likewise, the permanent disappointments that define many economies in Latin America, and the basket case economies of much of Africa, require much more than a review of population growth and rates of saving and investment.

Indeed, the unspoken first assumption embedded in all of growth theory, that all Nations unabashedly pursue economic growth, overstates political economic reality. Christopher Lasch, a brilliant left wing social commentator, spent nearly 1000 pages arguing that in the 20th century, chasing more economic growth for the U.S. was simply not worth the effort. His central argument? The U.S., in its wild commitment to produce more output, paid no heed to the destruction of psychologically satisfying jobs. The result, according to Lasch? The U.S. increasingly is a nation of people steeped in consumer goods and despairing about their meaningless lives (*The True and Only Heaven: Progress and Its Critics*, Christopher Lasch).

Lasch’s alternative? A commitment to time honored employment traditions, at the expense of economic progress! Preposterous? Visit the south of France. Marvel at the rolling hills of sunflowers. Taste any one of 385 cheeses, 478 wines. France, quite clearly, has fought unfettered progress, in defense of their way of life. Moreover, only the most doctrinaire free market apologists are serene about the prospects of transforming the south of France into Little Rock Arkansas, in the name of progress.

Critics from the right also see deficiencies in economic growth models. Hernando DeSoto in *The Mystery of Capital* identifies property rights as the critical “soft infrastructure” foundation for successful economic growth. DeSoto’s work focuses on the lack of well defined property rights in many Latin American Nations that perpetually under perform. DeSoto documents widespread *extra-legal* transactions throughout these poor Nations. When much of commerce is conducted without the protection of the legal system, DeSoto argues that it severely limits growth prospects.

The critical link Desoto makes is between clear ownership of property and borrowing against that property. A home, restaurant, or piece of machinery is transformed from an object into *Capital* if and only if clear property rights exist. Ownership permits the use of **leverage** and it is the leveraging of capital assets, in DeSoto’s model that distinguishes successful economies from perpetual underperformers.

Consider Desoto's assertion, in light of our initial foray into accounting. Unambiguous rules of the game, property rights, allow both Hilary and Han to borrow money and buy a home. Han, the conservative investor, watched his net worth rise well above the pace that he would have been consigned to had he been compelled to rent throughout his life. Hilary, the speculative sibling, saw major net worth gains, thanks to ownership of her home—that is until the market for housing went bust. Ownership of assets, and use of leverage, Desoto argues—and our simple accounting lecture demonstrated—clearly lifts an economy's potential growth rate. Later in this course we will investigate the question of what constitutes an ideal amount of leverage. But no ability to leverage—the reality when property rights ambiguous—locks a nation into a sub-optimal state of affairs.

DeSoto's work is all the more interesting, over the past 25 years, in light of the collapse of the Soviet Union. As Nations emerged from communism, relative levels of success did appear, in part, to be correlated with the existence or creation of property rights. Thus successes in Poland, the Czech Republic and Slovakia stand in stark contrast to the poor performance of Russia, and in part reflect the property rights provisions put in place.

China, perhaps the most intriguing economy since the U.S. in the late 1800s also offers up lessons about the importance of property rights. In the aftermath of the Mao regime, Deng Chou Peng reflected upon pervasive poverty in China in contrast to spectacular economic advances in many Asian nations. He sought to emulate these other successes, declaring in 1986 that *to get rich is glorious*. China, under Deng's direction, rewrote property rights, enabling manufacturers to build factories and keep profits if their efforts proved successful. The subsequent boom in China has been nothing short of astounding.

Interestingly, however, China did not change property rights for land ownership. Investment in farming, as a consequence, has wildly lagged capital investment in manufacturing. Not surprisingly, real per capita incomes have soared in towns and languished on the farm. Property rights, in both cases can explain the divergent performances.

Long Term Growth Prospects, Malthus and Resource Scarcity

In 1826 Thomas Malthus wrote a treatise that contained within it what many economists consider to be the first macroeconomic model. In *An Essay on Population*, Malthus predicted that unremitting gains in human population would collide with finite earthly resources, ending economic growth and dooming the world's population to a deteriorating standard of living—one in which population ultimately would be controlled by the world living at minimum subsistence levels.

Malthus had a simple model. It contained two supposedly nature-given facts. The first, natural resources are limited. The second, the human population multiplies continuously, subject to the limits of subsistence. Malthus concluded that “when... all the fertile land is occupied. The yearly increase of food must depend upon...the land already in possession. This is a fund... which must be gradually diminishing.” (An Essay on Population, 6th edition, P.4) Ergo, soon enough, the world would be engulfed in a dismal reality, as life would be lived on the edge as starvation controlled world population.

Malthus was adamant about his insight. He wrote, “The main principle [herein] advanced is so incontrovertible, that, if I had confined myself to merely general views, I could have entrenched myself in an impregnable fortress...” (An Essay on Population, 6th edition, P.XXXVI)

Thus Malthus, when he launched the discipline of macroeconomic forecasting, provides us with many lessons. He had a simple model. Its logic, on the face of it seemed compelling. He was cocksure of his forecasting conclusion. And, quite deliciously, his conclusion turned out to be dead wrong!

How might we look at the Malthusian dilemma? In our first lecture we talked of four pursuits that forecasters, simultaneously, needed to pursue. The first two, *think logically, separate signal from noise*, Malthus clearly had covered. What about the second two? *Think outside the box and stay humble?* He painted the world into a box and cavalierly asserted that he was absolutely sure that there was no way out.

Creating boxes and guaranteeing that there is no way out is a time honored tradition among economists—nad in many instances it produces embarrassing results for the box builders.

Where did Malthus Err?

In the long run, Keynes quipped, we are all dead. Malthus, to be sure, has to be right in the very very long run, if population continues to grow at even moderate rates. In 2017 world population looks to be about 7.4 billion. Recent growth rates approximate 1% per year. In 2050 the population extrapolates to 10 billion. But in 3017, after the next millennium, at present growth rates, the population would exceed 138 trillion. So in the very very long run, the globe will most likely not support a continually expanding human population—Mars here we come!

For more reasonable time periods—say the next few hundred years, we simply need to introduce the magic of technological innovation and the constraints of a finite world all but disappear. Simply put, all of economic history, since the industrial revolution, suggests that technological innovation trumps resource scarcity.

Consider U.S. farming, from the end of WWII to the present. From 1948 through 2004 U.S. farm output rose by 1.7% per year, so that the 2004 output level stood at 2.7 times the 1948 total. In a world akin to Malthus, or Mill for that matter, less productive land will lower output per unit of input. But in the U.S. labor employment, 1948-2004, fell by 2% per year, so that the 2004 farm employment figures are 75% lower than the 1948 level. Turns out you not only can't keep them down on the farm, you don't have to.

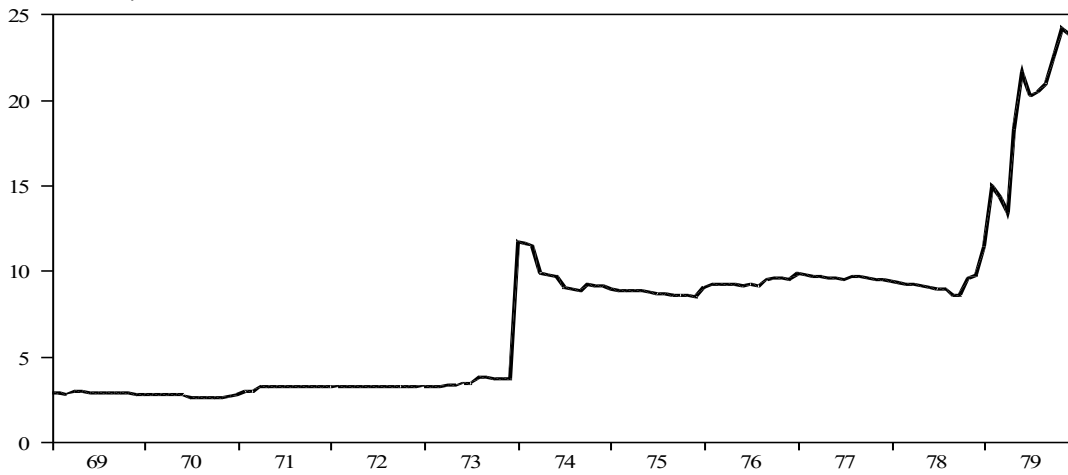
Think about discussions today concerning China, their demand for food and energy, inflation and limits to growth. Again, if we simply imagine property rights in China for farmers, we can envision an explosive rise in Chinese farm output, with a sharp fall in its labor input.

Technology, then, not resource availability, is the binding constraint for long-term growth.

**Oil Prices, Adjusted For Overall Price Changes,
Rose From \$3.50/BBL To \$24.75/BBL, In The 1970s.**

Real Oil Prices: CPI Inflation Adjusted, 1972 Base Year

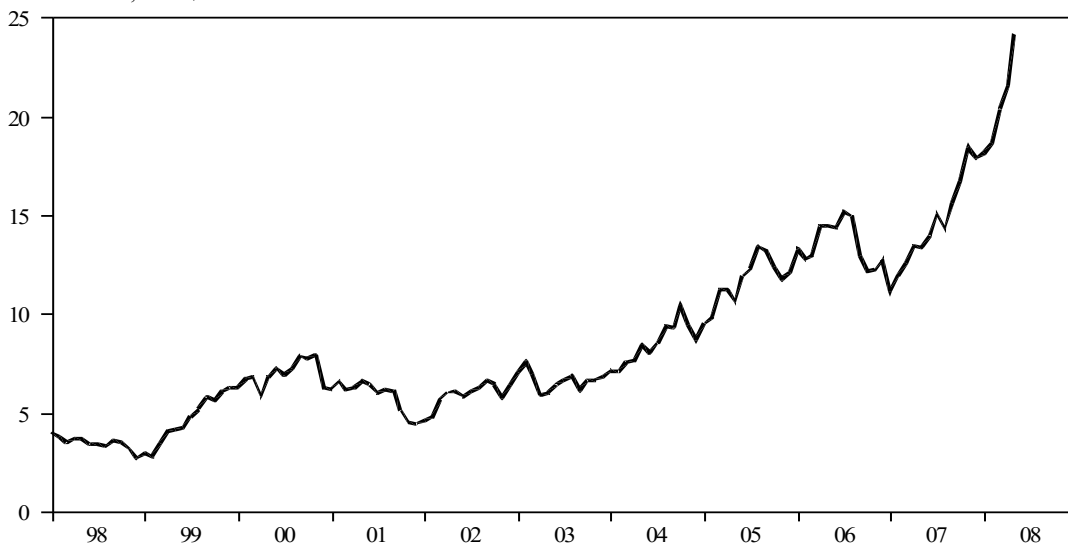
Real Oil Prices, 1972 \$s



**Oil Prices, Adjusted for Overall Price Changes,
Rose From \$3.50/BBL To \$24.75/BBL, Over The Past Ten Years.**

Real Oil Prices: CPI Inflation Adjusted, 1972 Base Year

Real Oil Prices, 1972 \$s



Energy Supply, Energy Demand, Crisis Prices and Technological Breakthroughs

Energy resource scarcity, with great regularity, is offered up as a reason that growth will stagnate in the not too distant future. I have lived through two installments of this story. In the 1970s the world was in the midst of a surge in crude oil prices and a generalized rise for non-energy commodity prices. Two resource analyses bound the period. In 1972, *The Limits to Growth* was published by the Club of Rome. The book presented a set of extrapolations for world population, industrialization, pollution, food production, and resource depletion. The extrapolations assumed that resource usage grew exponentially. Oil supplies, according to these extrapolations, would be exhausted by 1992.

Late in the period, after the second energy shock, a report was commissioned by the Ford Foundation to evaluate the global energy question. A group of scholars, under the auspices of Resources for the Future (RFF), was assembled — including several Nobel Prize winners — and a book, *Energy: The Next Twenty Years* was published in late 1979. The RFF book dismissed the simple-minded extrapolations of *The Limits To Growth* study, pointing out that energy resources were “huge at prices not much more than about double those that prevail today”. The book concluded that “*higher energy costs cannot be avoided, but can be contained by letting prices rise to reflect them.*”

The assertions embedded in *The Limits to Growth*, as we all now know, turned out to be just as wrong as those contained in the essay by Thomas Malthus. Of more interest, however, is the fate of the conclusions of the Ford Foundation study. As it turned out, the assembled academics were right as rain about the power of rising energy prices. Nonetheless, they were terribly wrong about the need for additional energy price increases — given the surge in prices already in place by 1979.

Markets and Technology: The Right Stuff for the Long Haul

What happened to derail forecasts by Malthus, the Club of Rome, and RFF? Clearly, resource scarcity as the key limitation to economic growth, the *Malthusian Dilemma*, captivated the globe in the late 1970s. But market price signals and technological innovation, all of economic history since the industrial revolution makes clear, over the long run, trump resource scarcity and allow for impressive global economic growth. Simply put, a big jump in prices elicits a search for more output, a scramble for substitute products, and a mad dash to reduce the use of any product whose price is rising rapidly. Thus the right long-run bet, over the past several hundred years has been to dismiss *Malthusian Dilemma/Club of Rome* extrapolations, depend upon markets and technology, and wager on healthy global growth.

What about the RFF study? Like comedy, good forecasting requires good timing. The RFF study had all the right linkages in place. They asserted, quite correctly, that a sharp rise in the real price of energy was the critical ingredient needed to elicit necessary changes in the use and provision of energy resources. They were confident that higher real prices would radically reduce energy usage and substantially increase energy field yields without derailing long-term U.S./worldwide growth prospects. They acknowledged that in the short run, recession was a genuine risk. But they expected healthy growth over much of their 1979-2000 forecast horizon alongside radically different energy supply and demand dynamics, all a consequence of signals higher real prices deliver.

The only thing they got completely wrong? Their oil price forecast. They expected “the real world oil price (...the inflation-adjusted, long-term contract price) to increase in fits and starts over the next twenty years, about doubling from mid-1979...to the year 2000.” At the time of the book’s publication, oil was trading at \$36 per barrel. As it turned out, the peak nominal price was near at hand and oil prices fell irregularly for the next five years. Moreover, from the mid-1980s through the mid-1990s oil prices generally hovered in a \$15 to \$25 range. And, of course, the modest rise for other prices drove the real price of oil steadily lower. Quite incredibly, in early 1999, the real price of crude oil had not only not risen, it had erased the entirety of its 1972 through 1979 climb.

How could a group of learned men have been so right about the workings of the energy markets and so wrong about the implications for energy prices? Simple. All of the secular changes that they promised higher prices would deliver had been put in train by the run-up in prices from 1972 through 1979. In other words, the climb for oil prices from \$3.50 per barrel to \$36 per barrel was plenty powerful enough to work the market magic that they were betting on. Their blind spot, we would submit, was to confuse the supply/demand situation in place in 1979 with the 1979 oil price. Late-1970s supply/demand fundamentals reflected mid-1970s oil prices. The late-1970s spike for oil prices simply needed time to work its magic.

Violent Energy Price Shocks:

Recession First, Secular Solutions Thereafter

Here is the bad news. Recessions, in the short run, stem the oil price spike until such time as the secular shifts come to the fore. A sharp jump for the real price of energy acts as a tax on consumer purchasing power, it swells the coffers of energy producers too quickly to be spent — and their saving rate goes up. In addition, rising inflationary risks limit central bank flexibility. Recession, as a consequence, followed energy price spikes in 1974, 1980, and 1990.

Contracting economic activity, in turn, sharply reduces energy demands and energy prices swoon. And it is at this point that cyclical forces pass the baton to secular shifts. The lesson of the 1970s is that long-run responses to sharply higher energy prices require five to ten years to come into play. That means that these secular shifts occur too slowly to prevent recession, but come into play in the next expansion. Suppose a recession unfolds, after a three-year surge in energy prices. Assume the recession lasts a year. Assume further that it takes two years of economic recovery to return activity to its previous cycle peak. Importantly, that means by the time the economy returns to its previous peak performance, it is six years into its scramble to reshape energy supply and demand. In other words, on the other side of the recession, long-run solutions begin to bear fruit. Most importantly, it means that a rebound for economic activity does not elicit a return to previous peak energy prices — secular forces, at that juncture, take over.

The 2008 Energy Shock: Recession Worsens, Secular Solutions Emerge In 2009

What about the most recent episode? The spike for oil prices, 2001-2008, is small by comparison to the 1970s experience. But it occurred in a low, rather than high inflation environment. Once we adjust for this, the real rise for oil prices, 2001-2008 matched the rise witnessed in the 1970s.

Truth in advertising, in 2007 I asserted that the world would avoid a sharp energy spike. My expectations about the bust for U.S. housing and the U.S. consumer were correct. But my timing concerning oil prices was way off the mark. The violence of the last leg up for oil prices, however, put an all too familiar dynamic

in place. A year-on-year doubling of energy prices superimposed upon the burst U.S. housing bubble guaranteed a protracted U.S. and rest-of-world economic decline. Thus generalized economic retrenchment for the world, once again, followed a big energy shock.

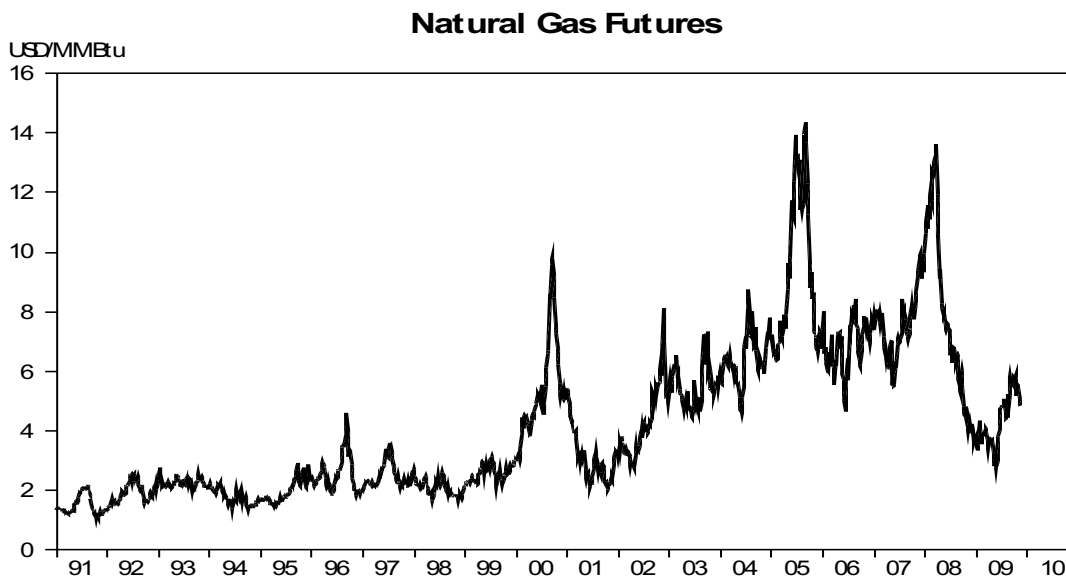
But the 1979 RFF study and the dynamics of supply, demand and price need to be kept in mind. To repeat, the lesson from the 1970s was that in the short run, deteriorating global growth breaks surging oil prices. Much more importantly, however, on the upside for the global economy the world will be in the midst of adopting radical changes for energy use and provision. Supply and demand will shift dramatically. And if the late 1970s are a guide, the peak prices witnessed in 2009, will not return.

Natural Gas Fracking: A Clear Sign of Technology Coming to the Rescue

How much oil is left in the ground? How much natural gas? Economists rephrase these two questions. How much *economically exploitable* oil and gas remains? To answer that question we need three general pieces of information. Petroleum engineers will give us information about oil and gas deposits around the world. They also provide us with information about technologies available to extract oil and gas from these deposits and the costs associated with the technologies in question. For a given price, we identify which resources can be exploited *profitably*. And we then tally up a measure of global oil and natural gas supplies.

A surge in prices, however, elicits new techniques for energy extraction. This, in turn, expands the measure of resource supplies. And from 2002 to 2009 that is precisely what happened to our estimates of natural gas supplies around the globe.

For decades natural gas prices were locked in a range of \$1 to \$3 per million BTUs. All of that changed in 2000. Emerging evidence of a developing world boom, shrinking conventional natural gas supplies and climbing oil prices drove natural gas prices into anew much higher zone (see chart). Gas prices now were trading between \$4 and \$8 per million BTUs, and they spiked in 2005 and again in 2008 to over \$13 per million BTUs!



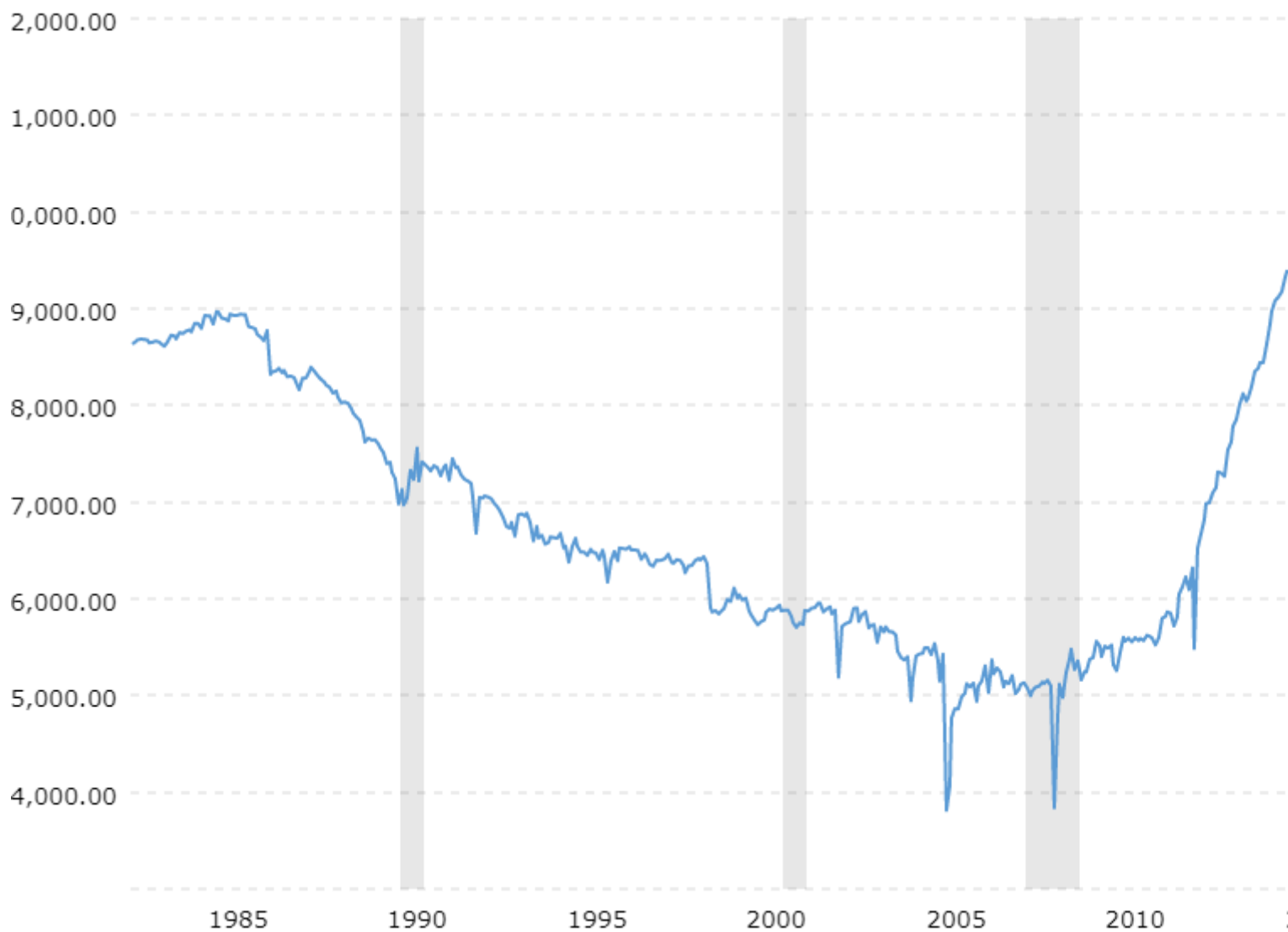
All economists are supposed to know that price matters. Savvy economists also know that sometimes the effects of price changes take time. The new regime for natural gas prices, over several years, spawned a new technology. Fracking appeared, a two-step technique that shatters shale and shattered conventional estimates of U.S. and rest-of-world natural gas supplies. Step one involves drilling several miles down, into shale formations. Step two requires the drill bit to make a right hand turn, allowing drilling to go horizontal for about a mile. Step three involves pumping water and nasty chemical into the hole at super high pressure, fracturing the shale, which releases the natural gas. And it turns out that the process is spectacularly successful. Initial calculations suggested an \$8 breakeven for the newfound approach. But much higher gas yields from the wells now coming on line imply a break even closer to \$5.5! And this *shale play* involves enormous acreage.

How much? The U.S. Potential Gas Committee gives revised estimates once each two years. In June of 2009 they raised their estimate of gas resources by 35%, by far the largest increase on record. U.S. natural gas supplies exploded as this new technology led to a boom in drilling for gas. And natural gas prices? The U.S., as a consequence, is awash in natural gas at prices well below the peaks seen when oil and gas prices spiked. Once again, technology is trumping simple minded notions about resource scarcity.

Oil Supply and Fracking, the Next Shoe to Drop.

Fracking worked so well for natural gas that it has been used to free oil from shale. The results here have remarkable too. Ten years ago, much was made of the notion of Hubbert's Peak. The name comes from a geologist who drew log linear lines on production rates in the early 1900s and conjectured that the U.S.

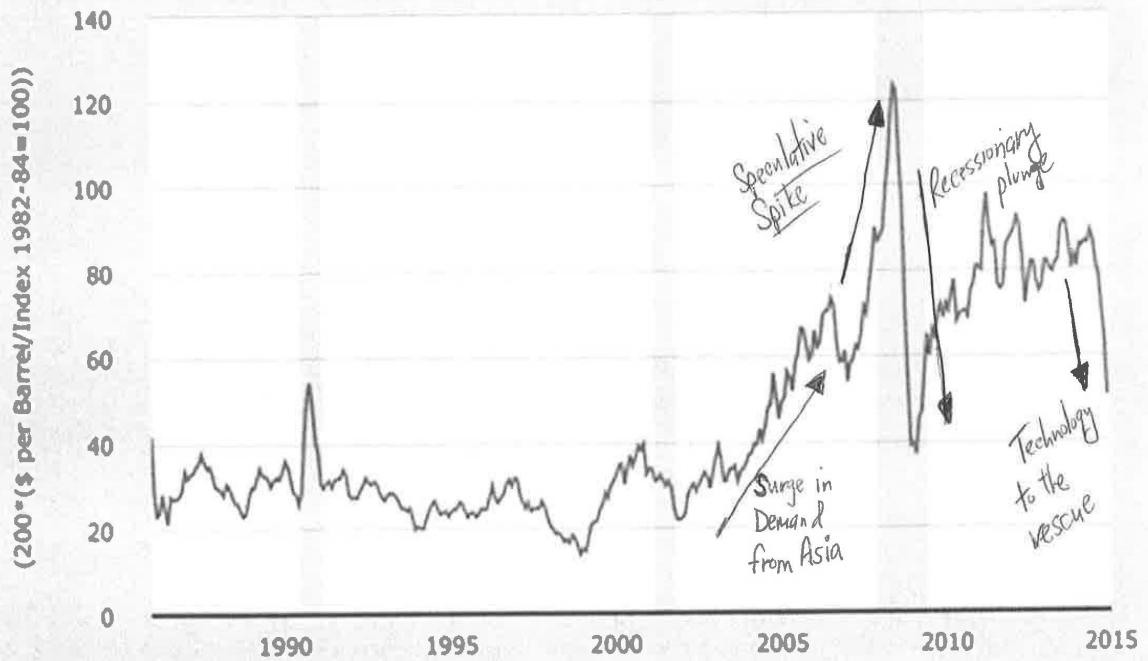
would “run out of oil early in the 2000s”.



Shale oil production rose from 111,000 barrels per day in 2004 to 553,000 barrels per day in 2011. Conservative estimates by the U.S. Energy Information Administration (EIA) suggest that number will reach 1.2 million barrels per day by 2035. Industry sources are forecasting a rise to 3.8 million barrels per day. Split the difference and a 2.5 million barrel per day production for shale oil would amount to shale oil providing 25% of total oil consumption in the U.S. in 2035. In short, technology wins again.

FRED 

— 200*(Crude Oil Prices: West Texas Intermediate (WTI) - Cushing, Oklahoma/Consumer Price Index for All Urban Consumers: All Items)



Shaded areas indicate US recessions - 2015 research.stlouisfed.org

Fracking as the Devil Incarnate: The Market Price versus the Social Cost

In the 1973-1979 and 2003-2012, resource scarcity generated a spike in oil prices and market forces, over time, delivered major responses. Estimates of economically viable oil supply leapt. Measures of per unit usage of oil fell sharply. In sum, the *invisible hand* of the price system exploded the Malthusian notion of resource constraints weighing on the long-term global growth trajectory.

Climate change, in stark contrast, is a brutal example of a problem that *invisible hand* forces will not solve on their own. Scientists now overwhelmingly conclude that burning fossil fuels produces CO₂ in amounts that are rapidly lifting average global temperature. The increasing temperatures, in turn are delivering growing welfare losses—*islands are sinking, fires are burning, coral reefs are dying...* Nonetheless, the users of fossil fuels are not required to pay for these costs, as they occur outside the workings of the market system.

Fracking in the U.S. delivered a surge in U.S. oil production. This lifted global supply and reduced global prices, leading to a higher use of oil. If your goal was slowing climate change, by reducing use of fossil fuels, you can look at fracking as a disaster, not a panacea.

Economic Growth: Labor Force Gains and U.S. Productivity Performance

How do we derive an estimate for long-term sustainable growth (LTSG)?

We begin by splitting the question into two parts. Economic growth will reflect growth in labor input in combination with advances in the productivity of that labor:

$$\frac{\partial y}{\partial t} = F\left(\frac{\partial l}{\partial t}, \frac{\partial LP}{\partial t}\right)$$

Growth in the Labor Force:

Up until recently, debate about the trajectories for labor input, over the long haul, tended to be very small. Now, however, debate about both population and labor force projections is much more heated.

We face two issues. At what pace will the population grow? How will demographics affect the percent of the working age population that is going into the work force?

Interestingly, USA population in the past, and based upon pre-Trump election projections, depended in part on net immigration. Estimates suggest the USA population would have grown by 17% less, 1965 to 2015, if we subtract immigrants and their progeny from the total. Looking ahead, the U.S. Census, in 2014 projected population growth of 0.8% per year, with half of that population expansion due to net immigration. If Trump efforts successfully shut this inflow down, one would have to scale back forecasts for population, the labor force and the sustainable pace for employment growth.

<u>CALENDAR</u>	<u>TOTAL</u>	<u>TOTAL</u>	<u>NET IMMIGRATION</u>	<u>IMMIGRATION</u>
<u>YEAR</u>	<u>POPULATION</u>	<u>YEARLY GROWTH</u>	<u>YEARLY GROWTH</u>	<u>SHARE OF GROWTH</u>
2016	323,996	2,627	1,250	48%
2017	326,626	2,630	1,256	48%
2018	329,256	2,631	1,262	48%
2019	331,884	2,628	1,267	48%
2020	334,503	2,619	1,271	49%
2021	337,109	2,606	1,275	49%
2022	339,698	2,589	1,282	50%
2023	342,267	2,569	1,291	50%
2024	344,814	2,547	1,301	51%
2025	347,335	2,521	1,310	52%
2026	349,826	2,491	1,320	53%

Table 1. Projections of the Population and Components of Change for the United States: 2015 to 2060 (NP2014-T1)
Source: U.S. Census Bureau, Population Division
Release Date: December 2014

Labor Force Growth over the Next 10 Years

Long-term sustainable growth is an estimate of the growth rate we can achieve without putting upward pressure on inflation. Assume the economy is at full employment. How fast can the economy add jobs? It can add jobs at the pace at which the labor force grows. How fast will the labor force grow?

$$\Delta \text{LF} = \Delta \text{Population} + \Delta \text{Labor Force Participation Rate}$$

$$\Delta \text{Population} = (\text{Birth} - \text{Death}) + (\text{Immigration} - \text{Emigration})$$

$$\Delta \text{Labor Force Participation Rate} = f(\text{new entrants minus newly retired})$$

To repeat, population growth is the first issue. The consensus and BLS experts agree with growth of 0.8% initially, slowing to 0.7% over the last few years. We can embrace Trump logic and cut this number. If we do we cut our forecast for potential entrants to the labor force.

What will happen to the Labor Force Participation Rate? We noted last week that there is some room for a pop, over the next year or two, if prime age workers return. But further out we will see decline as the working age population ages.

Labor Productivity Performance: Secular and Cyclical Swings

What we can expect for labor productivity over a long period turns out to be devilishly difficult to project.

	Average Annual Productivity Growth	Percent Due To Technological Advance	
(Percent %)			
1800-1855	0.4	51	
1855-1890	1.1	35	Industrial
1890-1929	2.1	69	Revolution
1929-1966	2.5	83	Motor Vehicle Age
1966-1989	1.2	54	
1990-1995	1.6	33	
1995-2007	2.7	54	Information Age
2007-2011	2.0	25	Big Cyclical Squeeze

As the table above reveals, the pace of advance for labor productivity, over the past 150 years, has lurched several times. Economic historians with an eye toward innovations that lead to secular jumps in productivity explain the past century and a half in terms of epochal changes in economic organization. These analysts label the *industrial revolution* the *motor vehicle age* and the *information age* as critical periods in which productivity registered clear multi-decade jumps.

Sadly, the only definitive proof of a secular shift in productivity performance is an ex-post calculation of its existence. Economic growth theory, like much of economics, lacks precision. Thus during the first decade of higher productivity that arrived in the U.S. from the early 1990s, experts debated furiously about whether or not the newly emerging trend was a sustainable phenomenon:

(See: http://www.aeaweb.org/annual_mtg_papers/2007/0106_1430_1901.pdf).

To repeat, the analyst charged with estimating future productivity performance confronts a daunting task. From 1966 through 1989 labor productivity crept ahead at only at only a 1.3% annual pace, a sad performance relative to the 2.5% rate in place in the decades before. The resounding resurgence, 1995-2007, with productivity gains of 2.7% per year was very impressive—and quite difficult to anticipate. In the midst of these gains, many enthusiasts championed the notion of a “Brave New World” of enduring high productivity and rapid inflation free growth.

In the years following the Great Recession, labor productivity performance has been abysmal:

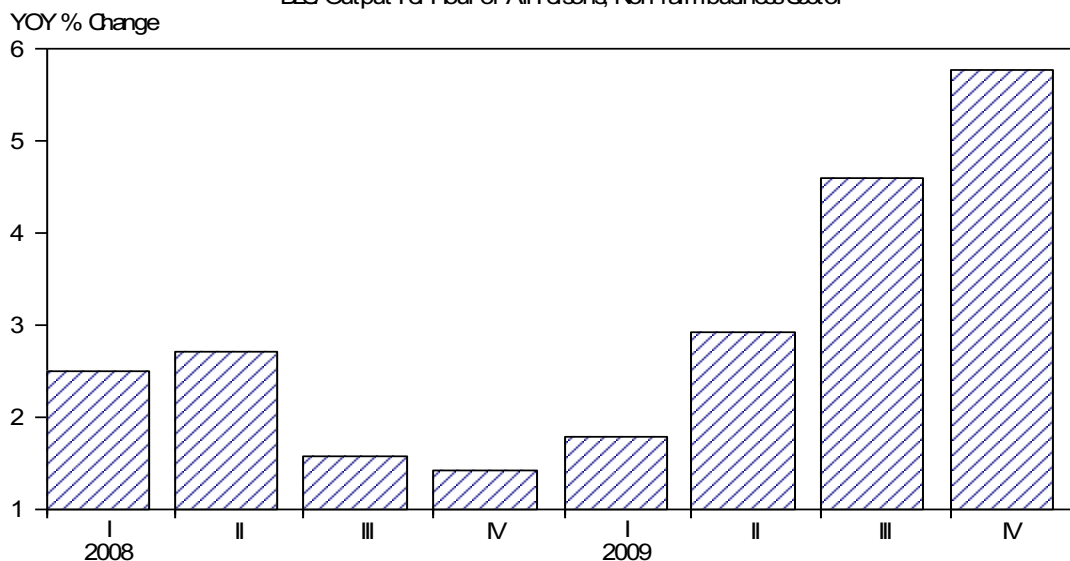
	1987-1995	1995-2007	2007	2008	2009	2010	2011-2016
Labor Productivity (private non-farm)	1.6%	2.7%	1.7%	0.8%	3.4%	3.2%	0.5%

The 2009-2010 surge in productivity surge reflected the wild pace of firing, as the jobless rate doubled, climbing to 10% by mid-2010.

That certainly characterizes the Great Recession dynamics of 2008-2009 (see chart below).

**Productivity In The 2008-2009 Recession And Early Recovery.
A Sag In 2008 And A Surge In The Second-Half Of 2009.**

ELS Output Per Hour of All Persons, Non-farmbusiness Sector

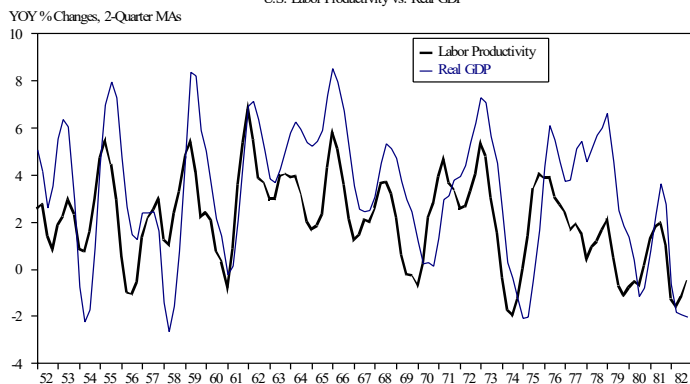


Productivity, as Gordon noted in his paper on Okun’s law, traditionally led business cycle swings. In the current experience, we had a pop and then inexplicably went dead.

The chart below depicts labor productivity performance, relative to real GDP growth, 1952-1982. The chart uses two quarter averages, year on year percent change. The chart makes it abundantly clear that, big quarter-to-quarter swings in productivity nearly entirely reflected short-term business cycle dynamics. But in the weak world we have recently been in, no such pop has occurred.

**The Cyclical Story: Productivity Leads, And Swings
With Real GDP Cyclical Swings (1952-1982).**

U.S. Labor Productivity vs. Real GDP



Long Term Growth Theory: A Brief History

Early discussions of growth potential dwelled on capital labor ratios. Per capita growth was deemed to be a function of the capital labor ratio.

$$Y \div L = f(K \div L)$$

Using a barebones macro model, assuming no government and no external sector, we have:

$$Y = c + i$$

$$C = (1 - s)y$$

$$Y = (1 - s)y + i$$

$$Sy = I$$

Thus the bare bones result, saving equals investment.

This leads, quickly, to the absurd assertion that a rising saving rate guarantees a rising real growth rate. Recall that our initial premise was that per capita output depended upon the capital output ratio. Given that rising saving, in our model above, leads to rising investment, which in turn leads to rising per capita output, we are led to the notion that additional saving, in any amount, can raise the economy's growth rate. We need only step away from long run questions for a moment, to remind ourselves of the problem with this logic. One form of investment, in reality in any economy, is inventory investment. And as we learned in lecture 4, swings in inventory investment dominate business cycle swings. A sharp rise for saving, will leave consumption quite low, axiomatically driving inventory investment sharply higher. Unintended inventory investment in a world with sticky prices, leads to production cutbacks, falling wage incomes, and falling EX-POSTE saving. Thus with a little light lifting we remind ourselves of the dangers of a high and rising intended saving rate and the Keynesian paradox of thrift.

The Harrod/Domar Knife Edge

This potential mismatch between saving and investment desires would play a central role in early economic growth models. Harrod and Domar explored these ideas in the first notable growth models. They viewed growth as a function of the saving rate, the growth in the labor force, and the capital output ratio:

$$Y \div T = (S, dL \div dT, K \div L)$$

Both Harrod and Domar asserted that these three key parameters were independently established. Households had a predetermined saving rate in mind. The labor force inexorably grew with population. Companies were locked into one capital labor ratio. With the Harrod/Domar insistence that these three parameters were constants, the model all but guaranteed long periods of disastrous disequilibrium. Why? For steady growth at a constant rate the following had to be true:

$$S = (K \div Y) \times (dL \div dT)$$

The odds that the saving rate would magically equal the product of the capital output ratio and the growth in the labor force were infinitesimal. Thus was borne the Harrod/Domar knife edge, and the early model threat of extensive periods of high and rising unemployment. In other words, long term sustainable growth was

almost a fleeting fancy because small deviations from the knife edge led to extended periods of distress—these growth models implied that the business cycle overwhelmed economic potential because the economic system was not self-correcting.

What might have prompted such a dismal view? Harrod in 1939 and Domar in 1945 published their models in the aftermath of the Great Depression. Recall that in the United States over the Depression decade of the 1930s the unemployment rate rose to 26%, industrial production fell by 40% and 9,600 banks failed. It was reflecting upon that overwhelming episode, that Harrod and Domar developed their dismal growth models.

Professor Solow and Neo-Classical Growth Model

Robert Solow in the late 1950's, concluded that the Harrod/Domar formulation was much too dour. As he put it:

Economic history was indeed a record of fluctuations as well as of growth, but most business cycles seemed to be self-limiting. Sustained though disturbed growth was not a rarity (Growth Theory and After, Solow Prize Lecture, 12/87).

Solow created a growth model that allowed for the substitutability of capital and labor. Because Solow's model permits shifts in factor usage (i.e., the K/L ratio can change), this allows for convergence, over time, and a long run equilibrium growth rate is established. Solow also posited that capital can grow in its usefulness. This observation, that the *efficiency of capital* changes, added a term to growth accounting. Some in deference to its creator call it the *Solow residual*.

Solow's model took the following essential form:

$$dY \div dt = f(dL \div dt, K \div L, d(\text{efficiency of capital}) \div dt)$$

The model posits that an economy's long term growth rate reflects its labor force growth, its capital output ratio and the rate of technological progress. Solow's arithmetic also shows that the capital output ratio only changes the economy's trajectory in the short run. Once the economy adjusts to a new ratio, its growth rate settles back. Only changes in technological progress produce enduring changes in long run trajectories.

Simply put, in the Solow formulation, technological progress changes the power of investment, and it is the only change that delivers an enduring shift in the economy's growth rate.

Growth Accounting and Multifactor Productivity

Solow's model provided the theoretical construct that today is embedded in growth accounting statistics. The Bureau of Labor Statistics, each year, deconstructs labor productivity estimates, detailing their best guesses on the extent to which the factors identified by Solow contributed to U.S. productivity performance. Consider the table below, derived from the most recent BLS Multifactor Productivity report revised annual productivity reports and revised annual payroll documents.

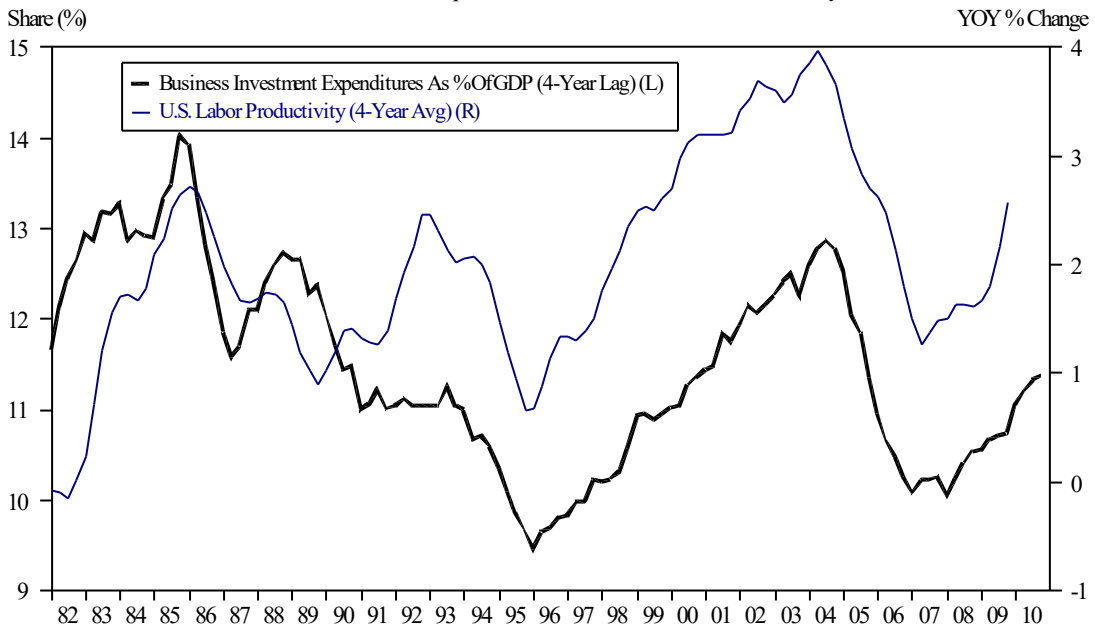
	1987-1995	1995-2007	2007-2014
Solow residual	0.5	1.5	0.5
Labor composition	0.5	0.2	0.3
Capital Intensity	0.7	1.1	0.6
Labor productivity	1.7	2.8	1.4

The table allows us to think about past performance for U.S. labor productivity using accounting that owes its derivation from the Solow growth model. The table reminds us that output per hour, in the late 1980s and early 1990s grew very modestly. In stark contrast, from the late 1990s to the eve of the Great Recession it registered a remarkable turnaround. And then we see the plunge for productivity in the aftermath of the Great Recession.

But the table has more to offer. We see that the rebound for productivity established in the Technology boom, in part reflected a substantial increase in investment. Capital deepening, in other words, provided a big increase in output per hour gains (see chart on below).

Capital Deepening Explained Some Of The Late 1990s/Early 2000s Productivity Surge.

Business Investment Expenditures As A % GDP vs. Labor Productivity



But the story does not stop there. Multifactor productivity gains, gains in the efficiency of capital—Solow’s residual—leapt relative to the previous period. Thus the late 1990s though the first half this decade now appear to have been blessed with the effects of a capital spending boom *and a surge in the power of that capital*. In contrast, in the Post-Great Recession world, investment is weak, and so is the Solow residual.

Back to Bad Times?

So one of the many victims of the Great Recession appears to be good gains for labor productivity. The table above gauges a 1.4% average labor productivity performance, 2007-2014. This masks an even worse recent performance. The **Great Recession** created panic and wild cash hoarding. This drove companies to fire with reckless abandon. Labor productivity was quite strong in 2009-2010, almost EXCLUSIVELY reflecting these powerful cyclical effects. After the cyclical pop for productivity, 2009-2010, productivity gains have been very disappointing.

Are we destined to witness meager gains going forward?

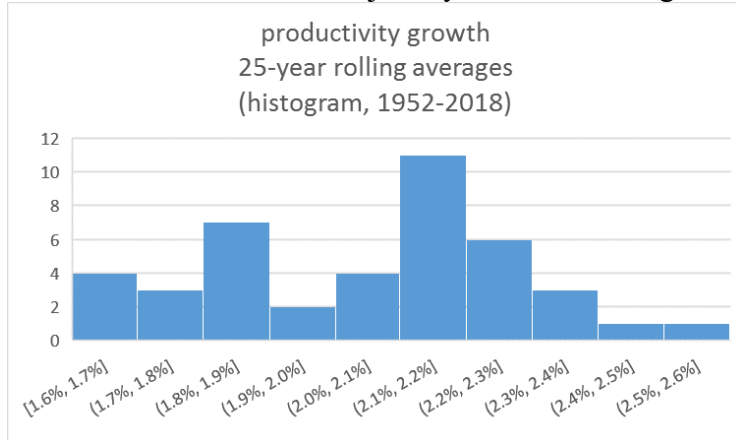
Productivity Parameters: Secular vs. Cyclical Conclusions

We now have an accounting framework that documents a deconstructed version of recent productivity performance. We also are acutely aware of the violence, year-to-year that productivity experiences, over the course of the business cycle. The forecaster, therefore, needs to reflect upon incoming news about early productivity trends, adjusting for best guess assessments about business cycle influences. The result? The analyst makes modest adjustments to revealed long run productivity trends, given emerging developments.

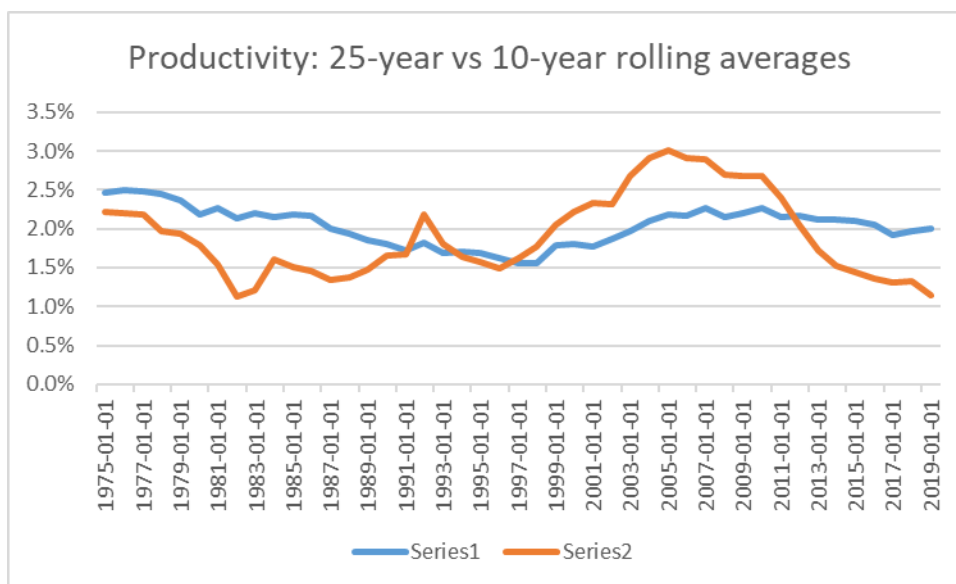
What does this mean in today's circumstances? We have to make judgments about three dynamics. Over 1995-2007 productivity averaged 2.7% per year. That phenomenal performance reflected violent capital deepening and impressive multifactor gains, both of which were driven by the boom in innovation of information technology. In stark contrast, over the five years ending 2016 productivity gains slowed sharply. BLS decomposes the poor performance and sees limited investment and weak technological change.

This has led, in turn to a **Great Reduction** in optimism about almost everything. The Congressional Budget Office, reflecting this diminished enthusiasm, estimates that U.S.A. potential real GDP growth has ground down to around 2.1%. Why such a low number? They assume demographic changes will contain labor force growth, so they assume a 0.6% percent pace is sustainable. They look for limited investment and less of a Solow residual. Accordingly, their estimate for productivity growth is low, around 1.5%/year.

The honest truth is we don't understand the ups and downs, and 5 years of a particular performance does not mean we locked into that trajectory. Here is a histogram of 25-year rolling average performances:



And, below, is a graph of 10-year average LP performances, superimposed upon 25-year averages:



Long Term Sustainable Growth?

Wind your way back in this lecture, and you will remember that we spoke of long-term sustainable growth as a function of two things, growth in the labor force and growth in labor productivity:

$$\frac{\partial y}{\partial t} = F\left(\frac{\partial l}{\partial t}, \frac{\partial LP}{\partial t}\right)$$

OUR LONG TERM SUSTAINABLE GROWTH TRAJECTORY?

0.5% GROWTH IN LABOR FORCE + 1.5% GROWTH IN LABOR PRODUCTIVITY

We conclude that long-term growth of 2.1% is the consensus expectation.