The New Economy and the Challenges for Macroeconomic Policy

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Abstract

The accelerated introduction of information and communications technology into the economy has created numerous challenges for policymakers. This paper describes this *New Economy* and then proceeds to examine difficulties created for policymakers. The increased flexibility of the new economy argues against trying to use fiscal policy for stabilization and creates both immediate and long-term difficulties for monetary policy. Immediate difficulties concern the problems associated with estimating potential output when the productivity trend is shifting. During periods of transition, it is extremely difficult to distinguish permanent from transitory shifts in output growth, and adjust policy correctly. In the long-term, central banks must face the prospect of a significant decline in the demand for their liabilities, and a resulting loss of their primary interest rate policy instrument. The disappearance of the demand for central bank money for interbank settlement seems very unlikely, and so this concern seems unwarranted.

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> "In the new economy, many of the old classical rules of economics no longer apply; over the years, the U.S. has made and learned new rules all its own." *Time Magazine*, December 31, 1958.

1. Introduction

The new economy poses many old challenges. Computers and the internet have reduced the cost of providing and obtaining information, but so did telephones and televisions 50 years ago. The difficulties of integrating new technology into the production of goods and services may be somewhat less than in the past, but the upheaval caused by it does not seem qualitatively different from what we have seen since the beginning of the Industrial Revolution.[1] There are surely many difficult challenges, but they are not new.

For macroeconomic policy the story is similar. The goal of macroeconomic policy is to assure high and stable growth with low and stable inflation. The details of how to do this remain illusive. The job of fiscal and monetary policy makers has always been complex, and it is surely not getting any easier. But again, this is not new. Economists continue to argue about the potential for government tax and expenditure policies to stabilize the economy, and the decades-long debate over the exact nature of the monetary transmission mechanism continues. It is as impossible now to give detailed advice to policymakers about when and by how much to adjust their instruments as it was 30 years ago.

Monetary and fiscal policies share the job of economic management. Unlike most government actions, interest rates can be changed literally overnight. By contrast, changing tax and expenditure policies usually means legislative action, making it very slow. Monetary policy is a much better stabilization tool, while fiscal policy should focus on building solid foundations for long-term growth. The fact that today's economy is more nimble in responding to shocks places these roles into even starker relief than

[1] DeLong and Summers (2001) place the most recent new economy into historical perspective.

they were a decade ago. Ensuring short-term economic stability in today's world is the job of the central bank, and that is where I will focus my attention.

Ever-faster computers and telecommunications equipment have created new challenges for central bankers. Most importantly, the economy has become naturally more resilient over the past decade. We have seen important changes in the structure of goods, labor and financial markets. As the economy has become more nimble in adjusting to external shocks, policymakers must become more agile in their reactions. The central bankers' job has become more difficult, since they need to recognize risks and act more quickly, but at the same time, the costs of inaction may have gone down, as the economy seems to heal itself more rapidly.

Even in the new economy, the primary challenges facing monetary policymakers in their daily work are the same as they have ever been. Stabilizing prices means forecasting inflation, which requires estimates of the sustainable, or potential, growth rate of the economy. As if this isn't a sufficiently daunting task, central bankers would be helpless without some idea of how changes in their interest rate instrument will alter the path of future output and inflation.

Difficulties in estimating potential GDP growth have been with us since the concept was first introduced more than 40 years ago. Over the years, trend productivity growth has undergone occasional periods of transition when estimating future potential output has been very difficult. In the U.S., we entered such a period in the middle 1990s, and things have not stabilized yet. For policymakers, the problem is that it takes time to realize that the trend rate of growth has shifted. Charts 1 and 2, which plot real GDP growth and output per hour for the U.S. from 1980 to 2001, make this point abundantly clear. It is nearly impossible to tell even in hindsight that the growth rate in potential GDP rose markedly in the mid-1990s.

The recent change in the productivity growth rate is not unprecedented. The increase in the sustainable growth rate of the American economy is in many ways just the

mirror image of the slowdown that came in the mid-1970s. Then, the sustainable growth rate of the American economy fell from roughly 4% to a level closer to 2½%. Coming at a time of substantial domestic and international turbulence, it took several years to realize that the change had occurred.

Beyond the difficulties created by shifts in the sustainable growth rate of the economy, the structural underpinnings of the economy are constantly evolving. Over the 1990s we can point to three very important, and probably lasting, changes. Technology has been used to make production more responsive to changes in product demand, thereby reducing the level of inventories. The growth in the proportion of workers hired on a temporary basis had given companies the ability to adjust the size of their workforce rapidly in response to changing business conditions. And finally, innovations in finance have helped to assure that companies and consumers have access to resources even when times are tough.

The evolution of the financial system poses a particularly difficult challenge for central bankers. Since monetary policy acts initially through its impact on the balance sheets of financial firms, the explosion of asset-backed securities has likely changed the mechanism by which interest rate changes affect the real economy. As more borrowers have access to primary capital markets, and fewer need banks, it may become more difficult for the actions of central bankers to alter the future path of output and inflation.

Reduced demand for cash and reserves, the primary liabilities issued by the central bank, poses a second challenge to central bankers. But again, this problem is not new. The metamorphosis of the financial system has been ongoing for decades, if not centuries. And, as a result, the changes in the monetary transmission mechanism have been continuous. One clear sign of this is the constant attempts to broaden the set of financial instruments that are included in a given monetary aggregate, in the belief that the liquidity of the new instruments are somehow equivalent to that of those that were in the previous definition. But the connection between the elements of the central bank

balance sheet and the monetary aggregate has never been that tight anyway, and so it is difficult mourn the further decline in their usefulness as policy guides.

What is new is the widespread belief that the rate of change in the financial system has somehow increased, and so the end game, where demand for cash and reserves have dropped to zero, may be fast approaching. My own view is that the difficulties this poses for central bankers are still several decades off.[2]

In the remainder of this essay, I will discuss both short- and long-term challenges that the evolution of the macroeconomic structure poses for fiscal and monetary policy. In Section II, I present evidence of the changes wrought over the past decade or so. I focus first on the reduced cyclical volatility of U.S. growth, then on the increase in the level of average growth, and finally on the sources of the low inflation of the last half of the 1990s. Section III discusses the implications of these changes for fiscal and monetary policy. In the final section, I provide some comments on my views on how information technology will transform policy in the longer run.

2. Elements of the "New" Economy

The United States economy has evolved significantly from what it was just twenty years ago. Today, information technology is everywhere. Once the preserve of scientific laboratories and the back offices of financial institutions, today semiconductors are buried inside home appliances and automobiles. Computer chips control everything from elevators to airplane traffic.

The internet, initiated several decades ago by the United States Department of Defense in an effort to link research universities together, has now grown into an important part of domestic and international commerce. I no longer have to leave my

[2] This topic has been the subject of heated debate over the past few years. The papers on "The Future of Monetary Policy" by Charles A.E. Goodhart, Michael Woodford, Charles Freedman and Benjamin Freedman that have appeared in the July 2000 issue of the journal *International Finance* provide a comprehensive summary of the issues.

desk to shop for and purchase books, clothes, furniture, or virtually anything else. It is even simple to order wine, cheese and chocolate by clicking. Not only that, but I can place my order 24 hours a day, 7 days a week while sitting in my home wearing nothing but my underwear. This is all truly revolutionary.

As computers became both ubiquitous and increasingly powerful, two things happened. First, in the mid-1980s, the *volatility* of U.S. GDP growth declined, and then, in 1995, the *level* of growth rose. Along with this came a marked fall in average inflation. The goal of this section is to describe these changes and speculate about their sources.

2.1 A More Stable Economy

Using sophisticated statistical procedures, Margaret Mary McConnell and Gabriel Perez Quiros (2000) establish that what our eyes suggest is in Chart 1 is really there. They show that growth has been markedly less volatile since 1984 than it was in the preceding 25 years.

McConnell and Perez Quiros attribute the fall in aggregate volatility to a change in the inventory behavior of durable goods manufacturers. In the past, unintended shifts in inventory levels have been blamed for a significant part of business-cycle fluctuations. When demand fell, manufacturers would find themselves with substantial unsold stock and be forced to cut back on production, reducing employment and leading to an overall economic downturn. Beginning in the mid-1980s, the inventory to sales ratio of these manufacturers began to decline, and it continued to decline steadily through the 1990s. Chart 3 tracks the fall for the goods producing sector from an average of 2.1 prior to 1984 to a level of 1.54 by the end of 2001. (These figures can be interpreted as number of quarters supply on hand.) Technology has enabled companies to keep better track of production and sales, speeding the rate at which they are able to response to changes in demand. Techniques like *just-in-time* inventory control policies have reduced the amplitude of inventory fluctuations and stabilized overall economic activity.

The general resilience and stability of the U.S. economy is nowhere more apparent than in the 2000-2001 episode. This mini-recession, with a peak to trough GDP decline of less than one-quarter of one percent, clearly demonstrates the new recuperative powers of the U.S. economy. Moreover, Chart 3 suggests that inventory policy played an important role. This is the only recession during which the inventory-to-sales ratio has fallen.

The change in inventory control policies is only one of several things contributing to the speedy recovery from the 2001 downturn. Changes in labor and financial markets also played a role in increasing the flexibility of the U.S. economy. On the employment side, there has been a dramatic shift toward temporary help over the past decade. Chart 4 shows that the proportion of employees from temporary help agencies increased from ½% of total nonfarm employment in 1983 to over 2½% by 2000. At its peak in September 2001 over 3½ million workers were temporary. Not only that, but over the subsequent 16 months, the fall in temporary help accounted for 70% of the nonfarm employment decline of 951,000 workers. The recession was concentrated to an extraordinary degree in this most flexible portion of the labor force, leaving "permanent" employees in their jobs.

Turning to financial markets, we have seen significant innovation over the past decade as well. Once upon a time there were two sources for borrowing: direct debt issuance and bank borrowing. Most firms and households cannot issue marketable debt, and so were dependent on banks for financing. Beginning with the creation of mortgage-backed securities in the early 1970s, things started to change. Today the list of asset-backed securities now includes home mortgages, car loans, credit card debt, student loans, equipment leases, movie box-office receipts, and even the future revenues from British pubs.

Chart 5 plots total asset-backed securities (from both private and government issuers) as a percentage of debt that was typically issued by the banking system (this

includes loans, mortgages and consumer credit).[3] Starting at close to zero in 1983, by the end of 2001, asset-backed securities accounted for 40% of what had previously been credit held on the balance sheets of financial intermediaries.[4] This shift from bank to marketable debt is important for two reasons. It makes financing more flexible in response to external shocks, and it makes banks less important. The following example demonstrates what has happened. During the winter of 2001 as the U.S. economy slowed, the credit-rating agencies downgraded the large automobile manufacturers, increasing their borrowing costs. Since the demand for cars was falling, this was potentially disastrous. How were Ford, GM and DaimlerChrysler going to offer the financial incentives needed to move the cars off of the dealers' lots? Without high credit ratings, it was too expensive for them to borrow directly and make the loans that were needed to sell the cars. And yet, in the fall of 2001 automobile sales hit records highs, as buyers were offered very attractive loans to purchase the cars. How did they do it? The answer is that the car companies created pools of car loans and securitized them. These car-loan-backed securities had better credit ratings – they were AAA – than the car companies themselves![5]

This new financial intermediation – through asset-backed securities – gives us all direct access to capital markets. By finding a broker who will put me into a pool, I now have direct access to capital markets, and no longer have to rely on a bank. The broker takes a fee for this service, but I don't need to worry about the availability of bank credit. Not only that, but I don't have to know it is happening to me, nor do I care!

These three changes – improved inventory control policies, the rise in the use of temporary help and the increase in the percentage of lending that is marketable – have

[3] The data are from the Federal Reserve's Flow and Funds. The numerator of the series is Table L125 line 1 plus L126 line 1, financial assets of federally related mortgage pools plus financial assets of private issuers of asset-backed securities. The denominator is the sum of lines 6, 7, 8 and 9 from Table L4, credit market debt included bank loans not elsewhere classified, other loans and advances, mortgages and consumer credit.

[4] Estrella (forthcoming) provides a summary of the increase in asset-backed securities and its likely impact on monetary policy effectiveness.

[5] See Greg Ip and Russell Gold " Shock Absorbers: Lessons of Expansion Are Helping Economy Beat Recession," *Wall Street Journal*, March 4, 2002, pg. A1.

each played a part in the improved performance of the U.S. economy. They have made the economy more flexible in responding to unexpected events.

2.2 A Faster Growing Economy

Turning to the increase in the level of U.S. growth, the first line of Table 1 gives us a sense of what happened over the last quarter of the twentieth century. The table shows raw average annual growth in business nonfarm output for the periods 1974 to 1990, 1991 to 1995, and 1996 to 1999.[6] Growth in the last half of the 1990s was truly extraordinary. The increase over the first five years of the decade is in excess of two full percentage points *at an annual rate*.

By the end of the 1990s a consensus had developed that the sustainable growth rate of the U.S. economy had reached at least 4 percent. That is, with the unemployment rate steady, American GDP could grow at a rate that is now 1½-percentage points higher than it could only five years ago. Labor productivity growth had risen by the same 1½ -percentage points and was rising at a rate of at least 3 % per year.[7]

What were the sources of this astonishing performance of the U.S. economy in the latter half of the 1990s? To get some idea we can turn to the Ohliner and Sichel's (2000) estimates of the sources of growth, reproduced in Table 1. From their accounting we learn that that the 2-percentage point rise in U.S. growth had three primary sources: higher labor inputs, higher investment in information technology capital, and increases in multifactor productivity. The increase in labor inputs mirrored the decline in the U.S. unemployment rate from over 5½% in 1995 to 4% five years later. What is most striking is the importance that Ohliner and Sichel ascribe to the increase in IT investment. By their estimates, IT investment alone accounted for 0.54 of the 2.08 percentage point rise in growth, fully one-quarter of the increase in growth. Increased multifactor productivity growth accounts for 0.7 percentage points of the remaining change. This is the part of the

[6] Table 1 is reproduced from Ohliner and Sichel (2000).

change that is left unexplained by standard growth accounting. There are a number of possible interpretations of this increase, one of which is that it represents the increased productivity arising from the efficient use of technology in production.[8]

It is worth looking at the IT data a bit more closely. Table 2 reports that, between the first and second half of the 1990s, the growth rate in computer hardware inputs increased from an already impressive 29% to a phenomenal average annual growth rate of 46%. As a simple matter of accounting, this acceleration in equipment installation is responsible for all of the increase in productivity growth attributed to information technology.

Digging deeper, we see that the increased growth in computer equipment investment came from the intensification in the U.S. of computer price declines during this period. The deflator for information technology equipment used by the Bureau of Economic Analysis (BEA) to calculate U.S. GDP went from an average of about -15% in the first half of the decade of the 1990s to an average of nearly -25% in the second half. If, from 1995 to 1999, the hardware deflator had continued to decline at the more modest -15% rate, then U.S. growth would have averaged between 0.25 and 0.50 percentage points less than it was.[9] The clear implication is that a significant share of the increase in

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[7] At this writing in early 2002, disagreements had resurfaced and estimates of the sustainable growth rate ranged from 3 to 4 percent.

[8] Before continuing, it is worth pointing out that Robert Gordon has looked at these same numbers and come to somewhat different conclusions. Gordon makes two points. First, he notes that evaluation of the changes in the productivity trend requires careful treatment of cyclical factors. From this he concludes that this accounts for part, but not all of the acceleration of the late 1990s. Second, Gordon's analysis shows that the productivity growth increase is concentrated in the durable manufacturing sector. That is, the improvement in productive efficiency has not been shared across the entire economy, but has been entirely in less than one-tenth of the economy (measured by employment). See Gordon (2000).

[9] It is important to note that in the U.S., the Bureau of Economic Analysis (BEA) employs hedonic adjustments, which incorporate improvements in processing speed and memory, for example, directly into the construction of price indices. Furthermore, because these adjustments have become more important in recent years and they are not made in most European countries, the differences have increased. During the first half of the 1990s German and U.S. computer price deflators showed roughly equivalent declines. It is over the past five years that the two have diverged significantly, with the German deflator showing a decline of less than 10% on average.

the American productivity growth rate is a consequence of measured improvements in the *quality* of computer hardware installed by businesses.[10]

Before turning to the recent inflation record, it is worth digressing briefly to bring up the possibility that we are overinvesting in information technology equipment. After the Nasdaq finished its slow motion crash in mid-2001, newspapers and magazines were cluttered with pictures of surplus computers piled in warehouses. This "refuse" came from bankrupt internet companies that had been able to obtain financing because of the bubble in the Nasdaq. Because it was too cheap to obtain financing, the economy invested too heavily in computers. Since investment in IT equipment was so big a part of the new economy productivity acceleration, if it was unjustified then the measured increase in growth was a mirage.

Overinvestment in IT equipment may be more than just a one-time problem arising from a stock "bubble". The possibility comes from what I think of as the dark side of network externalities. A network externality arises when the usefulness of a product to you depends on how many other people have it. If you have the only fax machine, it is useless. But if everyone has a fax machine, that is a different story. The same is true of computer software. I am typing this document using Microsoft Word 2000 version 9.0.3821 SR-1. I don't really know what all of that means, but I do know that if I send the document to someone using a sufficiently antiquated version of Microsoft Word that this document will not display or print properly. In other words, to take advantage of the network externality that comes from using this word processing software, we all have to keep our software sufficiently up to date. This means more than buying updates. As we have all learned, updates are designed to run on the newest, fastest, more memory-intensive, machines and so the upgrading of the software often forces us to buy new hardware quite frequently – probably more frequently than we really need!

[10] I have argued elsewhere that the computers generate monopoly rents for the producers that need not be shared with the users, and so the economic benefits generally may accrue to the individuals (and countries) that are making chips and IT hardware. This has two implications. First, aggregate improvements in

I believe the GDP numbers produced by the Bureau of Economic Analysis, but if we are replacing our computers too frequently investment and growth may be overestimated. This will show up mainly in the price deflator, as the true quality of computers may not be increasing as fast as the official estimates suggest.

2.3 Lower Inflation

Beyond the increase in productivity growth, a second important aspect of recent experience in the U.S. has been the behavior of inflation. Through the latter half of the 1990s, inflation in the U.S. was both low and falling.

Chart 6 plots the 12-month changes in headline inflation as measured by the All-Items Consumer Price Index (CPI) and two measures of core inflation, the CPI excluding food and energy, and the Median CPI.[11] Inflation in the U.S. dropped steadily throughout the 1980s and into the 1990s, hitting a low in 1999. But the most striking fact about this picture is the pattern over the latter part of the 1990s. Here we see that both the headline CPI and the two core measures actually fell as growth was rising. During this entire period, the vast majority of analysts inside and outside of the government were forecasting that inflation would be one-half to one percentage point higher than it turned out to be. Only in the last 12 to 18 months has inflation begun to rise to levels in excess of 2½%.

How can we account for the recent inflation experience? There are several explanations. The most obvious is that in the late 1990s, the U.S. economy experienced two beneficial supply shocks that reduced inflation. These came in the form of the restructuring of the system for the delivery of medical care and the reduction of oil prices. Chart 7 reports the 12-month change in the consumer price index for medical care commodities and services. As the data clearly show, inflation in medical costs declined

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productivity will flow to the computer makers, and second that the productivity growth increases will accrue to the countries that produce computers.

[11] The Median CPI is computed by the Federal Reserve Bank of Cleveland, and is available on their web site, http://www.clev.frb.org/Research/index.htm#cpi. The computation is based on work that first appeared in Bryan and Cecchetti (1994).

significantly throughout the 1990s, falling from nearly 10% at the beginning of the decade to a low of 2½% in late 1997. But through the latter half of the 1990s, medical care cost inflation remained below 4% per year.

Turning to oil prices, Chart 8 reports the price *level* of West Texas Intermediate crude oil. Through 1998, oil prices fell from $25 per barrel at the beginning of the year, to a low of just over $10 by the end of the year. This significant reduction in energy prices had a clearly beneficial effect on the U.S. economy, helping to both raise growth and lower inflation.

Has the advance of information technology changed the inflation process itself? While its possible to argue that the product markets have become more competitive, as it is now easier to sample the prices of many suppliers at lower cost, there is no reason to believe that inflation has changed in any material way. The internet, and the low cost of communicating prices to potential customers has certainly improved the efficient operation of the price system in allocating resources, but it has not changed the way in which overall price inflation occurs. The new economy has affected inflation in the same way that it has influenced output – by making short- and medium-term forecasting more difficult. The difficulty in forecasting inflation and growth over the medium term is the primary challenge for policymakers posed by the new economy for monetary policymakers, and I take that up next.

3. Macroeconomic Policy in the New Economy

The two pillars of modern macroeconomic policy are the government's tax and expenditure decisions and the determination of short-term interest rates by the central bank. In the past we have thought of fiscal and monetary policy as sharing responsibility for short-term stabilization and having somewhat different roles in insuring long-term growth. Does the new economy imply a new macroeconomic policy as well? Things have certainly changed. Let's see how.

3.1 Fiscal Policy

Over the past 50 years we have come to think of fiscal policy as an important source of stimulus during a general slowdown. People turn to their elected officials for help, demanding that they set things right with new programs that bring some combination of lower taxes and higher government spending. Payments to the unemployed and lower income tax bills create a social safety net that automatically stabilizes modern market-based economics. We believe that this reduces the overall amplitude of cyclical downturns while at the same time insuring that the burden is not overly concentrated on the unlucky few.

But when things start going bad, the natural reaction is to want to do something, and in the fiscal arena that means discretionary tax and expenditure programs tailor-made for the problem at hand. These can work. But just because something can work, it does not follow automatically that it will or that it is the right thing to do. There have always been flaws with discretionary fiscal policy, and the more flexible goods, labor and financial markets of the new economy have only made these worse. The problem is that fiscal policy is both slow and hard to do sensibly. Look at a few facts.

Most recessions are short, lasting a year or less. The longest recession in the US after the Second World War lasted 16 months. Furthermore, because data are only available with several months lag, a recession is often half way through before there is consensus that a recession has started.

Timing presents a considerable challenge. I know of no government that has an agreed-upon economic stimulus legislation waiting to be implemented. In fact, given both the shifting environment and the changing cast of characters, such a thing is both economically undesirable and politically inconceivable. Instead, someone has to write new legislation every time a recession comes along. This takes several months even under the best of circumstances. The most recent example is instructive. Serious

Congressional efforts to pass stimulus legislation in 2001 began only after September 11, six months after the recession "officially" started, [12] and were completed in early March 2002, when economic recovery was already underway.[13]

As if that were not enough, policies take time to have any impact. Even after legislative action is complete, changes in taxes do not increase individual consumption or corporate investment immediately. By the time the spending starts, the chances are the coming boom will be in full swing.

The main problem is with the substance of economic stimulus packages. Economists do not write economic stimulus packages, politicians do! And fiscal stimulus is one place where economics and politics collide. Economists prefer policies that focus attention on getting a few important people to do something they were not planning to do while avoiding paying for others to do what they would have done anyway. Temporary incentives to spur investment and income tax reductions for the less well off who will spend what they get are good examples. Politicians, by contrast, look for programs that reward the largest number of people possible in order to win support and ensure re-election.

The Bush administration's decision in 2001-2002 to try to sell a capital gains tax reduction as part of their anti-recession program is a particularly egregious example of an expensive proposal that will have virtually no impact on the problem at hand. I guess reducing the tax burden on some wealthy people when they chose to sell appreciated stock might lead them to buy a few more Mercedes and BMWs, but I'm not exactly sure what it has to do improving the prospects for short-run economic growth. The proposal to cut the taxes big companies pay on past profits is another example. I do not hold opportunism against elected public officials, but we all need to recognize that it exists. We elect politicians to do things that are popular. Economic slowdowns, when some people are suffering and the rest are worried, play to their worst instincts.

[12] The official arbiter of recessions, the NBER Business Cycle Dating Committee, could have easily picked an early beginning for the recession, as employment and production seem to have peaked in late 2000.

The fact that the economy has become more flexible in adjusting to shocks has made all of these problems worse. To the extent the economy's natural recuperative powers are improved, there is now even less time to get the job done. This increases the odds that any legislatively-based stimulus program will come on line too late to do what was intended. Add to this the fact that markets, through mechanisms like asset-backed-securities and temporary help, have made it easier to circumvent roadblocks put up by governments trying to distort economic incentives, and many things look even more pointless.

All of this means that discretionary fiscal policy is a poor stabilization tool. While it might be possible to design economically sensible stimulus legislation, we need to realize that it will not be enacted. Instead, legislators should focus their attention on building solid foundations for long-term growth. This means creating structural tax and spending policies that encourage investment, innovation and hard work. Eliminating the corporate income tax and the individual tax on capital gains may be good long-term policy actions, but that is what should be debated. In the meantime, the new economy has made fiscal policy an even worse stabilization tool than it was a decade ago.

3.2 Central Bank Policy

The changes wrought by the advances of the last decade pose both immediate and long-run challenges for the operations of central banks. In the short term, these are really just the same old problems that monetary policymakers have faced for decades: stabilization requires distinguishing transitory from permanent shifts in productivity growth. The long-term threat is rather different. There, central banks are threatened by the possibility that the disappearance of the demand for the monetary base – the thing only they can supply – will render their policy tools impotent. We will consider each of these in turn.

[13] At this writing, the dating of the end of the recession was not yet official.

Immediate Challenges

The objective of most of the central banks of the world is to stabilize inflation about some low level while maintaining growth at near its sustainable rate. One way of expressing this is that monetary policy seeks to minimize a weighted average of inflation and output variability. Variability is usually measured as the squared deviation from the target. In the case of inflation, there is general agreement that target levels should be in the range of zero to two percent per year. The exact value depends on a number of considerations that are likely to be unique to the conditions within the region that the central bank operates as well as the manner in which inflation is measured.[14] The problem is the target for output, where policymakers require an estimate of the sustainable rate of growth, or potential output.

In practical terms, the difficulty is that central bankers should react differently to *transitory* movements in productivity than to *permanent* ones. If a productivity shock is transitory, then policymakers will attempt to stabilize output about its permanent growth path, allowing prices to deviate somewhat from their long-run target path. By contrast, if productivity growth shifts permanently, then the appropriate policy response is to stabilize inflation while allowing output to move to its new long-run growth path.

Telling the difference between changes in productivity growth that are temporary and those that are not has proven to be extremely difficult. To see the point, first look back to Chart 2 where I have plotted output per hour in the nonfarm business sector and ask how long it would take to tell that the second half of the 1990s is different from the first half. In hindsight we can see it. But to do their job, the FOMC needed to divine this change in 1997! Our good fortune is that they were able to see the productivity acceleration in its early stages.

Private sector economists as a group failed to realize that the sustainable growth rate of the economy had risen. Chart 9 is a plot of the log of GDP together with a series

[14] See Cecchetti (2001b), for a detailed discussion of this, and other issues regarding policy objectives.

of consensus forecasts from the Blue Chip survey. For each quarter, the chart shows the forecast out several years. For example, for the first quarter of 1996, I plot the actual data point, plus the forecast for the next few years. The actual level of GDP follows a path that is steeper than the forecasts throughout the period, meaning that the forecasters consistently underestimated growth. The systematic underestimates of the growth rates were a clear sign that forecasters were slow to learn that a significant part of the productivity acceleration was permanent.

The continuous underestimates of GDP growth were accompanied by a series of overestimates of future inflation. Chart 10 plots the log of the consumer price index together with the series of forecasts. Until oil prices began to rise in early 1999, professional forecasters were consistently overestimating future levels of inflation. (Core inflation forecast errors continued to be positive through the end of the decade.) Interestingly, the combination of the real GDP and inflation forecast errors suggest that forecasts of *nominal* GDP were approximately correct.

It is interesting to note that if we were to collect data for the latter half of the 1970s, we would be able to produce very similar charts, although the labels would be switched. That is, forecasts of GDP would have been consistently too high, and forecasts of inflation would have been systematically too low.

But the problem of estimating trend growth extends beyond the tumultuous periods of the late 1970s and late 1990s. Athanasios Orphanides (1998) has compared real time estimates (i.e. those used by a putative inflation forecaster) for 1980 to 1992 of the output gap in the United States with subsequent revisions, and arrives at astonishing conclusions. During this period, the real time estimates of the gap (measured as output minus potential output divided by potential) averaged -3.99 % with a standard deviation of 3.46. Subsequent revisions in measures of both actual and potential output led to changes in the estimated gap such that by 1994 the revised figures for the 1980-1992 period implied a gap of only -1.64 % with a standard deviation of 2.44! In other words the revised gap was on average 2.35 percentage points lower than the real time estimates,

which presumably were used in the preparation of inflation forecasts and as inputs into the formulation of monetary policy at the time.

Turning to monetary policy, we can look to the work of Jordi Galí to help us to understand the challenges posed by shifts in trend productivity. Galí (2000) compares the behavior of inflation following a move in productivity in the Volcker-Greenspan period (1979-1999) with that in the pre-Volcker (1954-1979) period. He finds that during the 1980s and 1990s, a negative productivity shock left inflation unchanged, while in the earlier period, inflation rose significantly. The explanation for this is that the FOMC of the 1960s and 1970s did a poor job of distinguishing transitory from permanent changes in growth, and tried to keep a decline in productivity from affecting output. The result was inflation. In the more recent period, with an increased focus on inflation, the FOMC has not made the same mistakes.

Overall, the message is clear. During periods when the productivity growth trend is changing, central bankers face challenges that are more daunting than the usual ones. Failing to react to a decline in productivity growth, as the U.S. did in the 1970s, can result in an extended episode of higher than desired inflation, which is then costly to eliminate. Alternatively, a central bank that tightens policy when faced with a permanent increase in its economy's sustainable rate of growth risks not allowing the growth to occur in the first place. In the end, though, the challenge is to figure out as quickly and accurately as possible the trend growth rate of productivity.[15]

Long-term Challenges

While technological progress poses clear short-run and medium-run challenges for monetary policy, they can all be studied and discussed using the now common

[15] It is interesting to note that the debate over the distribution of increased U.S. growth between its permanent and transitory components continues in the form of trying to cyclically adjust productivity. Robert Gordon (2000) suggested that a significant part of the acceleration has been cyclical. As we emerge from the 2000 mini-recession we are on the verge of knowing.

vocabulary of central bankers. We talk about the impact of the change in an interest rate instrument on output and inflation as transmitted through the financial system.

But when we think about the long-run challenges posed by technological advance, we must think critically about the nature in which the transmission mechanism will change. Will the central bank continue to be able to control an interest rate? How will they do it? What will the consequences of changes in the system of financial intermediation be for system stability?[16]

These are all difficult questions, and they have elicited a variety of answers over the past few years. At the heart of the issue is whether technological advance will ultimately eliminate completely the private sector demand for central bank liabilities. Today, this demand is split between two groups. First, there is the demand for currency to be used in daily transactions by individuals, and second, financial intermediaries demand reserves for their daily clearing operations through the payments system that is maintained by the central bank. In some countries, intermediaries hold reserves to meet regulatory requirements, but in most instances, this demand is being eliminated by technological advance and so I will ignore it here.[17]

Monetary policy operates by adjusting the level of the central bank's liabilities. If the demand for these liabilities goes to zero, then the leverage of policymakers will disappear as well. But is the time approaching when individuals will no longer hold currency and financial firms will no longer hold central bank reserves? Let us take each of these in turn.

First, consider the demand for currency. The claim is that privately issued store-value cards and the like will replace the functions of officially issued paper money.

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[16] These questions are in addition to the ones raised by the change in the financial intermediation system. Estrella (forthcoming) discusses how the increase in securitization has decreased the effectiveness of monetary policy. He estimates a rather dramatic decline in the interest elasticity of GDP growth.

[17] The U.S. is a case in point, where very few banks are bound by their reserve requirements. Regional banks hold ATM cash and money center banks hold clearing balances in the Federal Reserve accounts that both exceed their respective required reserve levels.

Currency provides finality, security, and anonymity in transactions. Surely, we will want all of these and so any adequate substitutes will need to have all of these characteristics. It is difficult to conceive of privately issued substitutes with all of these. Specifically, the risk-free nature of central bank liabilities is something that private money will have a very difficult time emulating.

To see the point, think of the example of stored-value cards issued by a telephone company. These exist in many countries, are easy to purchase, and convenient to use. The cards have value because they can be exchanged for phone-company provided services, something that is in nearly universal demand.

Can we imagine the cards, or their electronic equivalent, replacing central bank liabilities in the payment and settlement of transactions? There are several reasons to be skeptical. First, there is the fact that the government is unlikely to accept payment of taxes in telephone company liabilities. This alone is probably enough to sustain the existence of central bank money. But beyond that, there is the fact that the probability of phone company default is likely substantially higher than that of the central bank.

But even in the absence of actual default, the phone company can partially default by inflating the price of its services. This possibility means that it is unlikely that phone company "money" will always trade at par.[18] Central bank money has no such problem. The central bank can always guarantee that a dollar is one dollar.

In fact, the private issuer need not actually threaten bankruptcy to partially default on its liabilities. If, as in the case of the phone company, the "money" is backed by services rendered by the issuer, then raising the price of the services is partial default on the nominal value of the money. While central banks surely have defaulted on the value of their liabilities through aggregate inflation, a credible commitment to price stability is now the norm.

Information technology may well eliminate demand for central bank issued *paper* currency. But if the central bank adapts and issues e-money, then the official e-money seems very likely to dominate that of all private issuers.

It is worth pausing to comment on the demand for cash for illegal and underground transactions. Some people have noted that so long as this demand remains, monetary policy will retain its efficacy. But if the only remaining demand for currency were to come from drug dealers and the Mafia, surely we would all agree that the proper policy response would be to eliminate its issuance.

This brings us to the demand for central bank reserves used in the payments system. We have already reached the point in most central bank systems where the intra-day demand far exceeds the overnight demand for these balances. In the U.S., for example, the overnight level of clearing balances is now well below $10 billion. Meanwhile, the gross level of *daily* transactions on the Fedwire exceeds $2 trillion. During any given day, cumulative overdrafts of banks that are executing these clearings can easily exceed $40 billion at any given instant. The overdrafts arise from the timing mismatch of incoming and outgoing payments at the largest banks, and attract a charge of less than 50 basis points at an annual rate (measured by the minute). But the point is that this system is very heavily used, and it runs largely on intra-day credit.

The details of these payments systems, including charges for intra-day credit and remuneration for overnight balances, differ. But several things look as if they are similar. In particular, the payments system run by the central bank usually entails some form of subsidization. This can be in the form of the provision of intra-day credit, or the implicit guarantees, or the network externalities of letting everyone connect for a nominal (or zero) charge. Given the existence of the central bank's payment system and the use of central bank liabilities in clearing, it seems that the demand for reserves is likely to continue long into the future. Since the leverage of monetary policy is a consequence of

[18] If you believe that this is far-fetched, consider the example of the California energy utility Pacific, Gas and Electric during the year 2000. At the beginning of the year, PG&E bonds were very high grade. By

the central bank being the monopoly supplier of these reserves, my prediction is that the leverage to influence economic activity will continue long into the future.

4. Conclusion

The rapid advance of information and communication technology has brought with it changes in virtually every sector of the economy. This new economy is growing more quickly and is more stable than the old one. I have argued that these changes have been the result of a series of changes to the structure of production, labor markets and financial intermediation. Using new ideas and technologies, firms are now able to manage their inventories of goods more accurately and so need less of them, temporary workers increase the flexibility of the labor force, and the increased reliance on asset-backed securities to finance credit has made us less dependent on banks.

The improved recuperative powers of the new economy mean that policymakers must change the way that they do their jobs. I have argued that fiscal policy, never a particularly good stabilization tool, should now focus exclusively on providing a foundation for long-term stable growth. The job of short-term policy adjustments should be left to central bankers. They are not only independent from the political considerations that make it difficult for legislators to do the right thing, but they can respond quickly to changed economic conditions. But I have emphasized that the New Economy poses particularly difficult challenges for monetary policymakers for several reasons. First, the changes in the financial sector may well have blunted the impact of monetary policy. Interest rate changes affect growth and inflation through the banking system. As banks have become less relevant to credit creation, monetary policy may well have become less effective. The second challenge comes from the fact that it appears to have become more difficult to differentiate between transitory and permanent shifts in productivity growth. When the trend is shifting around, as it has been for some years now, historical patterns are a poor guide to the future making a central banker's job even more difficult. It is worth noting that to the extent that structural changes have made the

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the end of the year, the firm was nearly bankrupt.

economy more stable, monetary policy is less important than it once was – and the risks from policy mistakes are also smaller.

In considering the long-run impact of information and communication technology on monetary policy, the concern is over the potential disappearance of the demand for central bank liabilities. Since monetary policy acts through changes in the quantity and interest rate charged for central bank liabilities, if the demand evaporates, monetary policy goes with it. My conclusion is that perfect substitutes for all of the functions of central bank money are extremely unlikely to arise, and so the central bank will retain some leverage.

We can only hope that each new day continues to bring with it a new economy and that the challenges of the future are as pleasant as those of the recent past have been.

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Table 1: Contributions to Growth of Real Nonfarm Business Output, 1974 to 1999

	1974-90	1991-95	1996-99
Growth of Output	3.13	2.82	4.90
Contributions from			
Information Technology	0.51	0.54	1.08
Hardware	0.28	0.24	0.62
Software	0.11	0.23	0.31
Communications Equipment	0.12	0.07	0.15
Other Capital	0.85	0.44	0.76
Labor Hours	1.15	0.82	1.51
Labor Quality	0.22	0.44	0.31
Multifactor Productivity	0.44	0.57	1.25
Growth Rate of Inputs			
Hardware	31.4	17.5	36.0
Software	13.2	12.8	13.1
Communications Equipment	7.7	3.6	7.1

Source: Ohliner, Stephen D. and Daniel E. Sichel, "The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?" February 2000.

Table 2
The Change in the 1990s
(Average Annual Percentage Growth)

	1991-1995	1996-1999
Nonfinancial Corporate Business		
Labor Productivity	1.61	3.55
Unit Labor Costs	1.36	0.52
Unit Non-Labor Costs	0.75	-0.50
Real Investment in Computer Hardware*	29.0	45.9
Prices of Computer Hardware	-14.8	-23.4

*National Income and Product Accounts Basis.
Source: U.S. Bureau of Economic Analysis, National Income and Product Accounts

Chart 1: Real GDP Growth

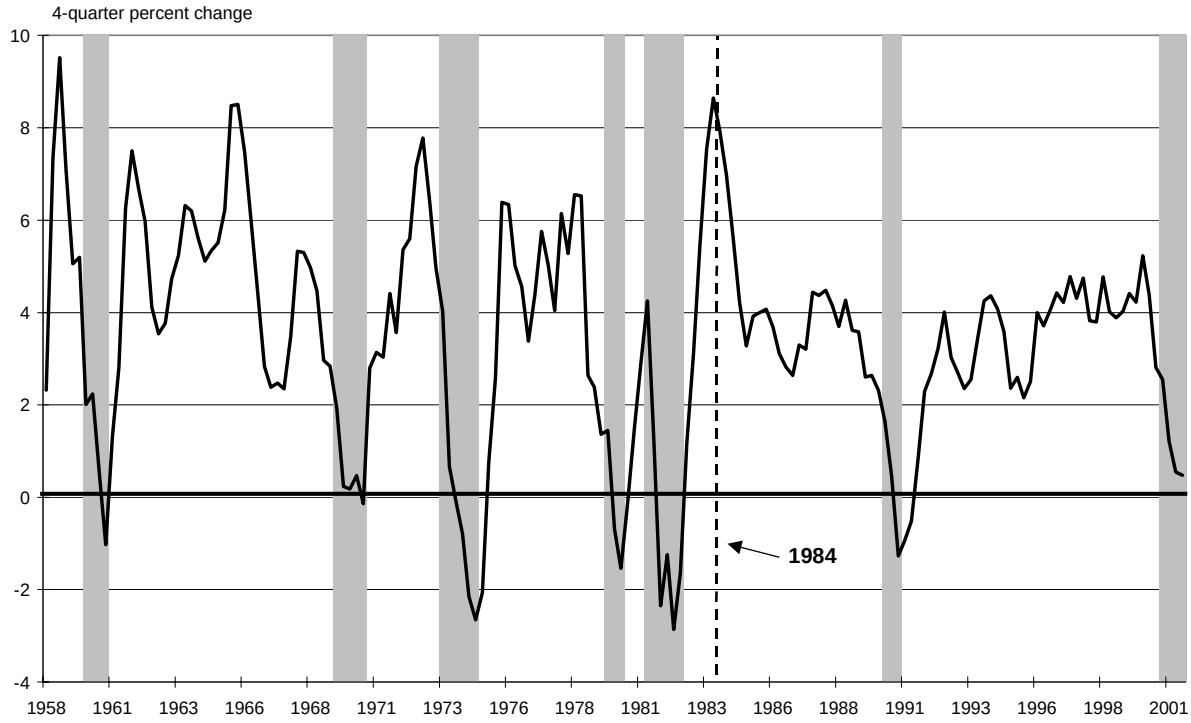


Chart 2: Growth in U.S. Real Output per Hour, Nonfarm Business Sector

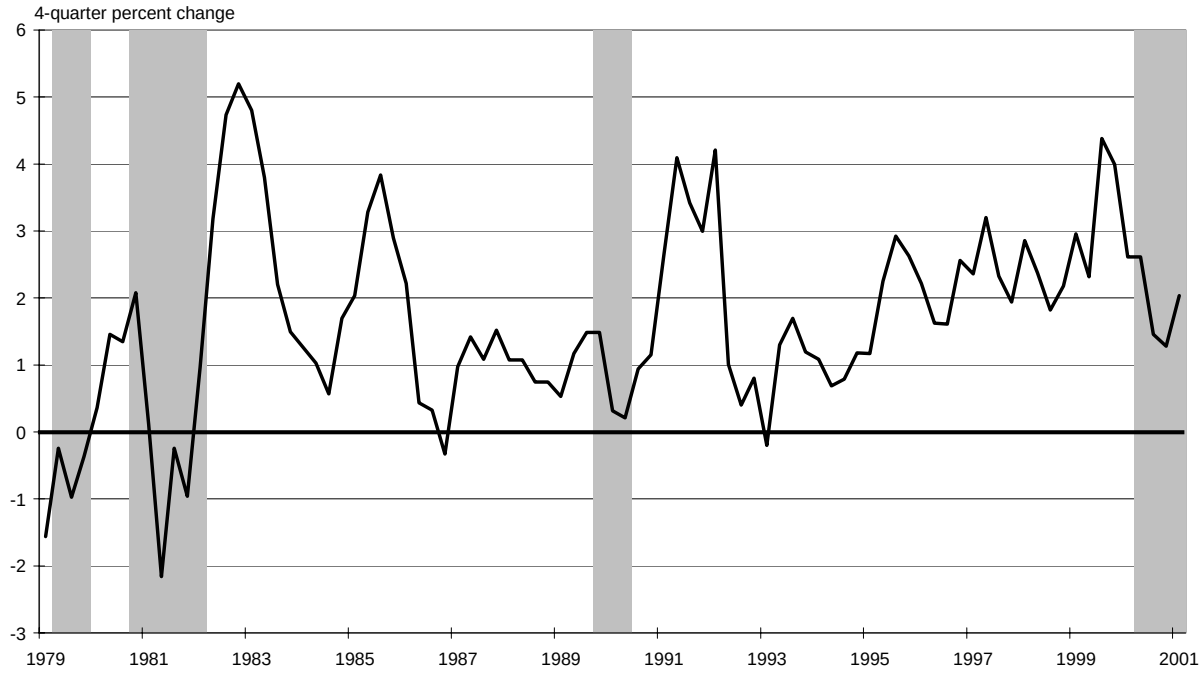


Chart 3: Inventory-to-Sales Ratio: Goods Sector

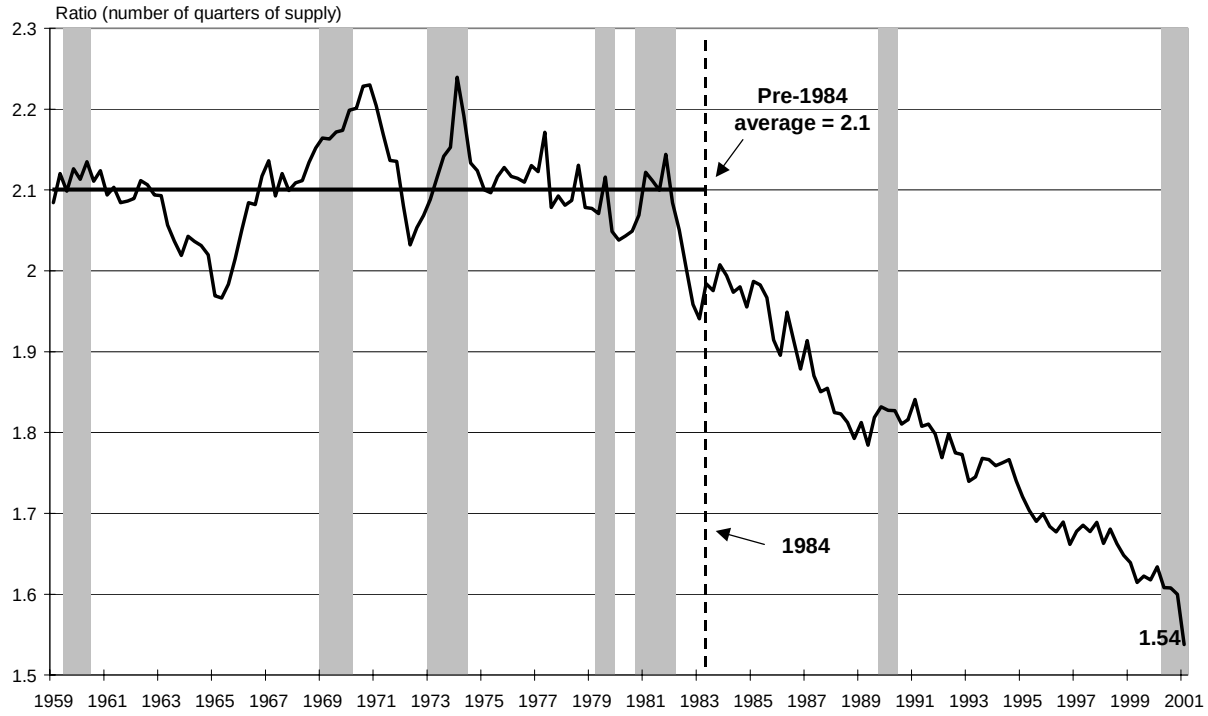


Chart 4: Help Supply Services Employment

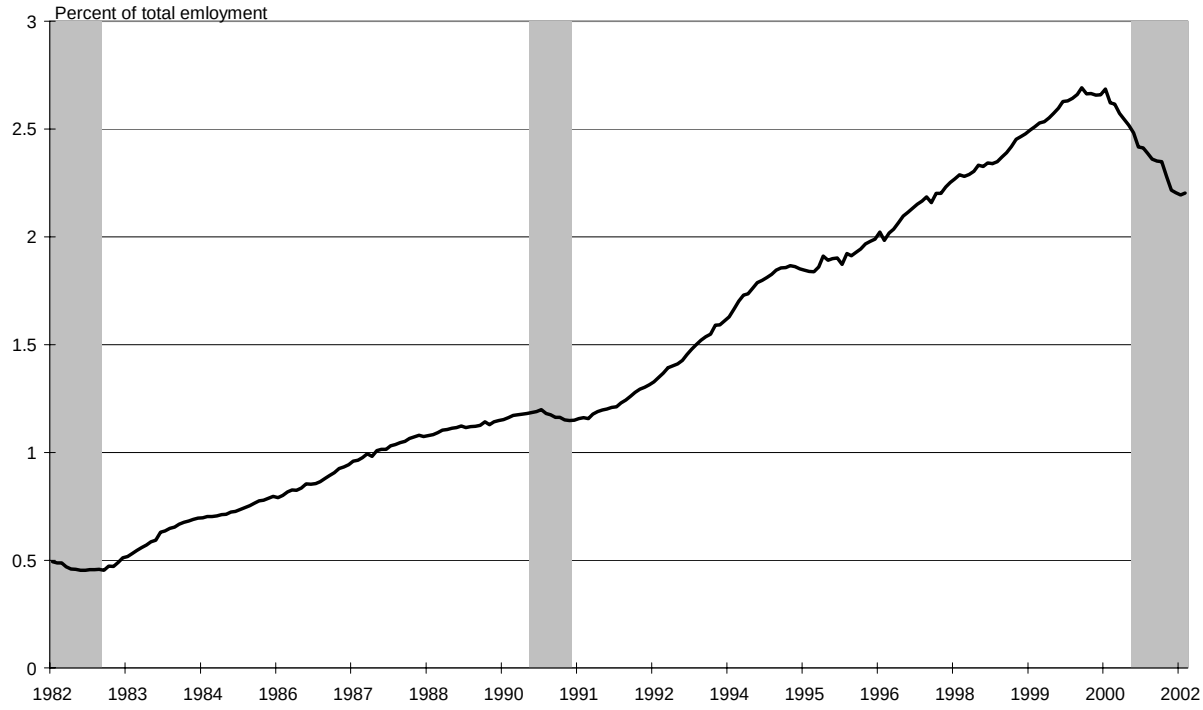


Chart 5: Asset-Backed Securities as a Percentage of Total Liabilities

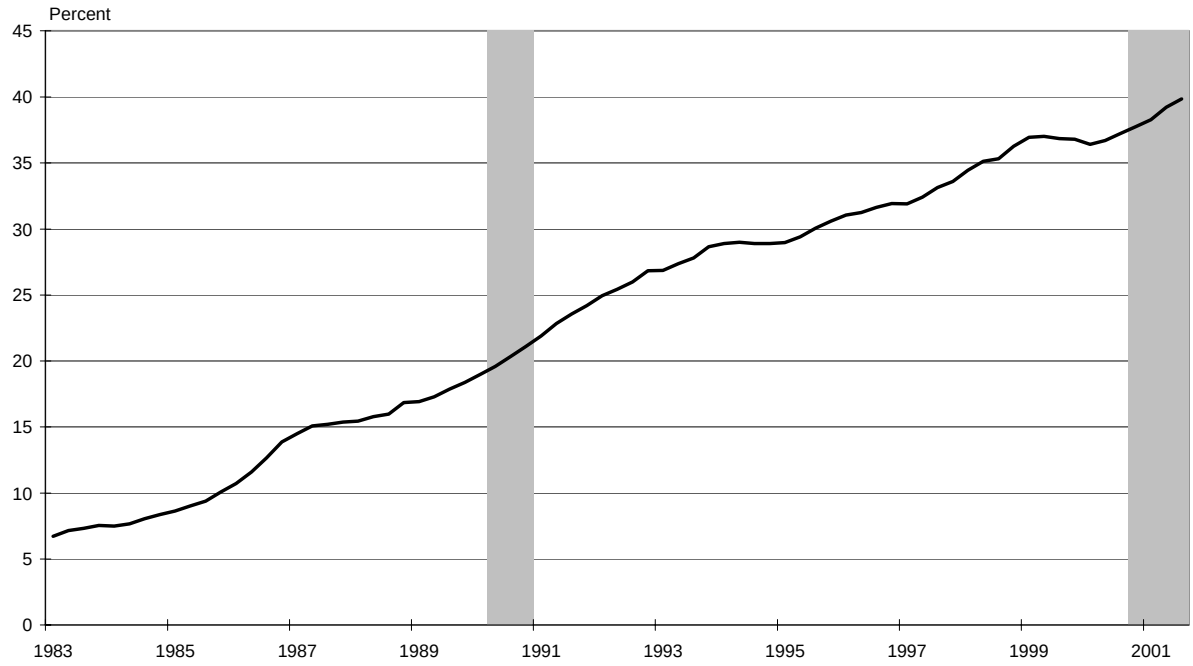
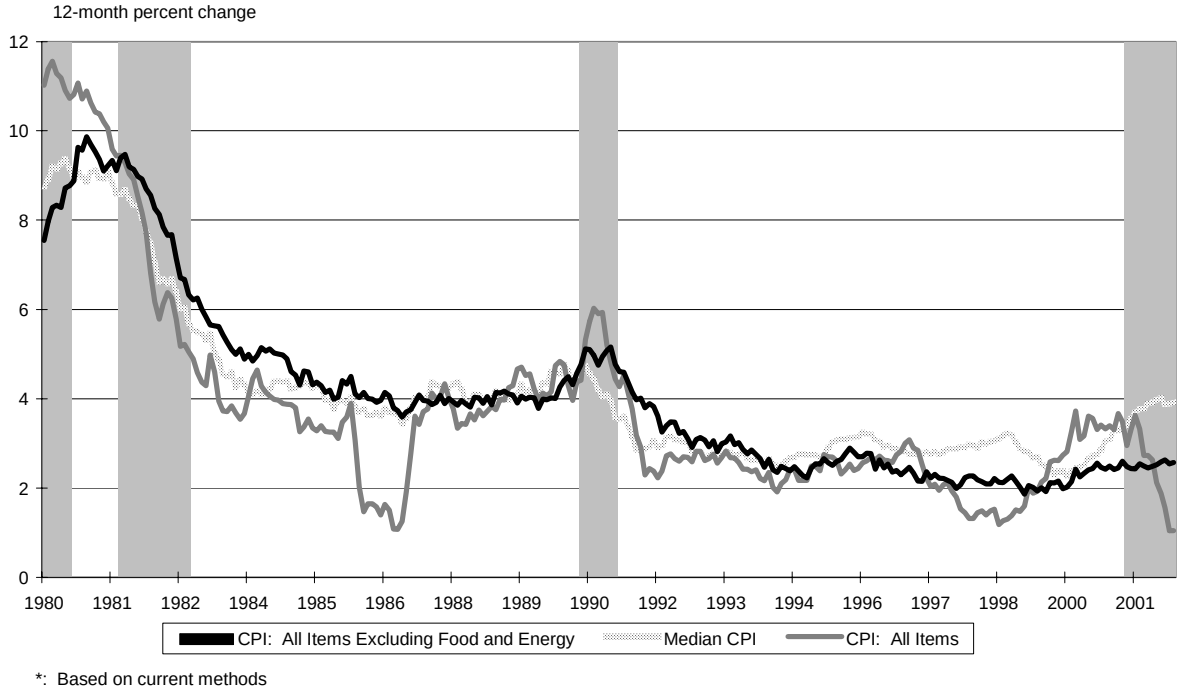


Chart 6: U.S. Consumer Prices, Headline and Core Measures*



*: Based on current methods

Chart 7: U.S. Consumer Prices: Medical Care

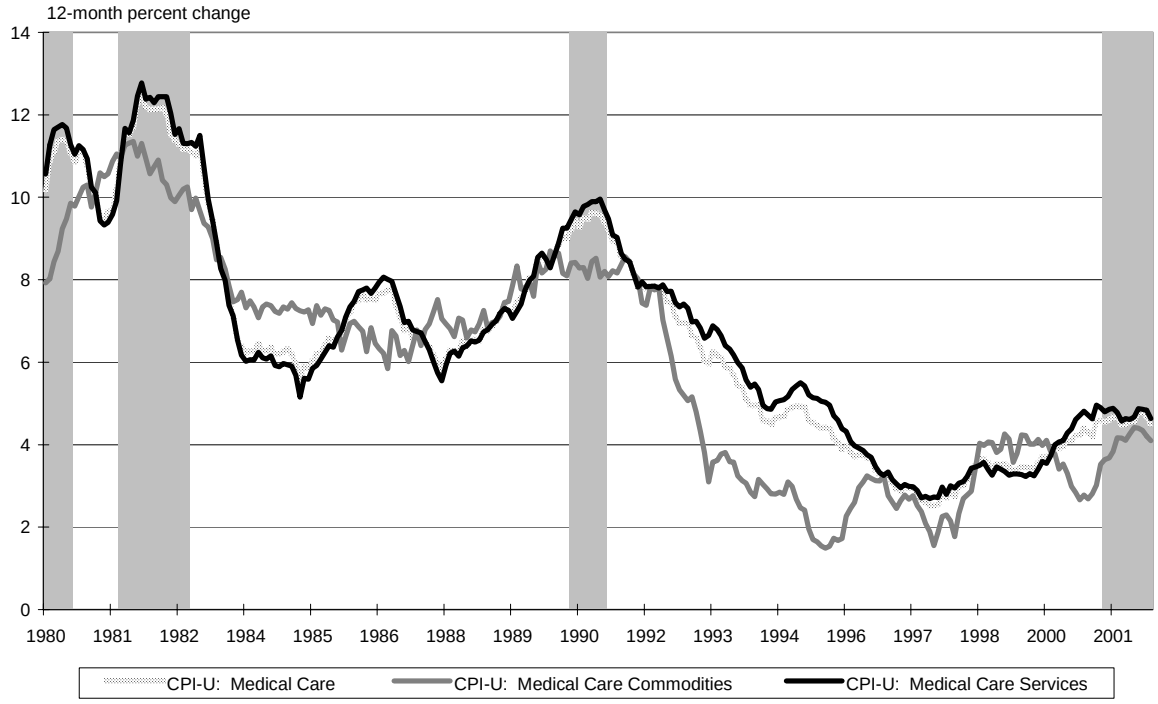


Chart 8: Domestic U.S. Spot Oil Prices: West Texas Intermediate Crude Oil

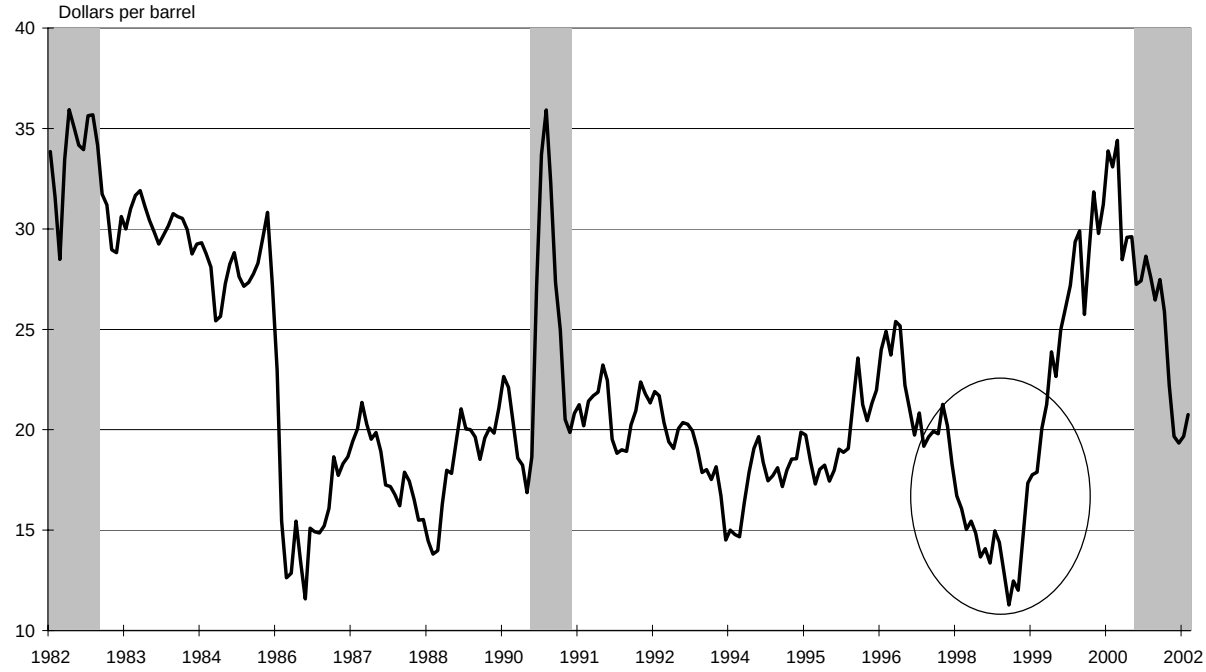


Chart 9: Blue Chip Forecasts of Real GDP Relative to Actual

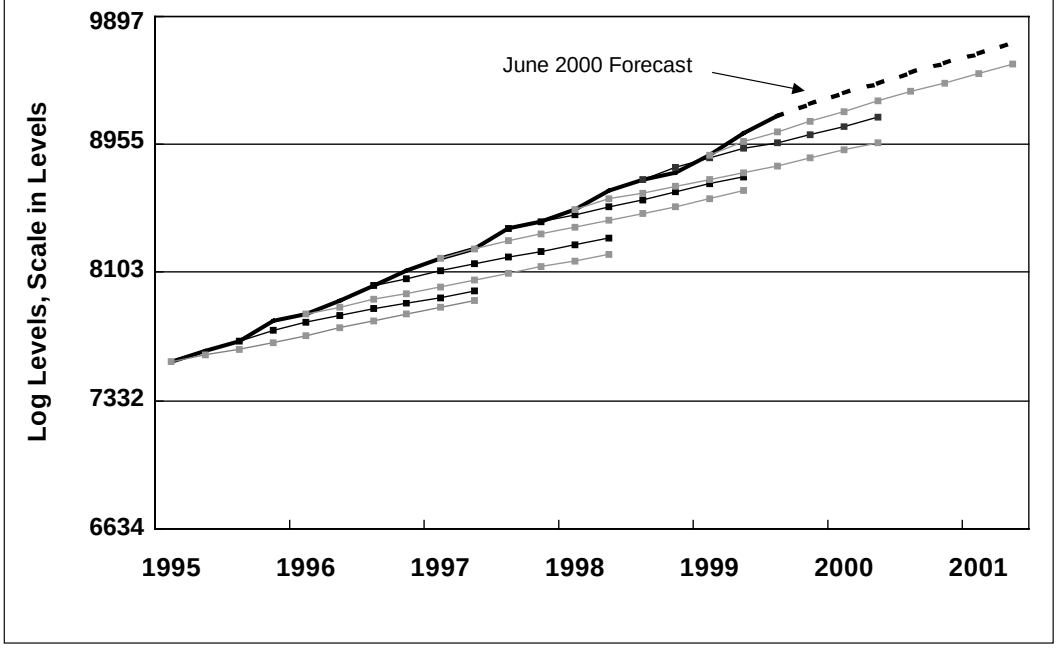


Chart 10: Blue Chip Forecasts of the CPI Relative to Actual