Commitment Versus Discretion In Monetary Policy*

BY MICHAEL DOTSEY

Whether policymakers should commit to a certain course of action or have the flexibility to approach each situation as it arises continues to be a central question in the design of monetary policy. A seminal article written by two prominent economists in 1977 analyzed the benefits of carrying out plans based on commitment rather than discretion. Since then, others have joined the debate. In this article, Mike Dotsey elaborates on the merits of commitment versus discretion in setting monetary policy.

The debate over whether it is better for a policymaker to commit to a particular course of action or to approach each situation with perfect flexibility has been and continues to be a central question in the design of monetary policy. In 1977, economists Finn Kydland and Edward Prescott wrote the seminal article analyzing the benefits of carrying out plans based on commitment as opposed to discretion. Since then, the benefits of commitment have been analyzed in many settings and in many economic models. Indeed, in a 2007 speech to the New York Association for Business Economics, Philadelphia Fed President Charles Plosser explained his views on credibility and commitment in monetary policymaking. This article elaborates and expands on some of these ideas.

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To start with, let me first define what we mean by commitment versus discretion. Commitment is the ability to deliver on past promises no matter what the particular current situation is. I should stress that, under commitment, promised behavior is generally contingent on future events. Promises are not typically blanket commitments to be fulfilled irrespective of future situations. The key aspect of commitment is that the policymaker keeps his promise to act in a certain way when a particular future event comes to pass. The absence of this ability is called discretion. Under discretion, a policymaker is allowed to change policy depending on current circumstances and to disregard any past promises. Because the discretionary planner does not make any binding commitments, it would appear that discretion offers more flexibility and it would seem to be preferable to a policy whereby the policymaker must honor past promises.

The idea that it is better for a central bank to follow through on policies promised in the past, rather than being free to respond to conditions as they evolve, is a subtle and perhaps surprising one. Not only are better long-run outcomes achieved under commitment, but monetary policy is also better able to respond to shocks if the central bank is constrained to honor past promises concerning its future behavior. As I'll discuss below, lower inflation, with no adverse effects to economic activity, is obtained under a policy of commitment, and such a policy can achieve less volatility in both inflation and output as well. Indeed, the inability to commit often leads to problems for policymakers.

Comparing policymaking under discretion and under commitment is an analysis of two polar cases. It sidesteps the question of how a central bank can act in a committed fashion even if it desires to do so. Also, how could a central bank convince the public that it is operating in a manner consistent with commitment when the institutional setting places little restriction on future policies? For instance, the members of the policy-

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making boards change over time as do the legislators that monitor the behavior of monetary policy. Commitment requires tying the hands of future policymakers, and in reality, we don't even know who they will be.

Research analyzing ways that policy can come close to the ideal of full commitment has generally proceeded along two lines. One is institutional design. How does one set up institutions that will improve on discretionary outcomes? The other is the role of reputation and the credibility an institution can achieve by behaving like a committed planner over time. While of tremendous interest, investigations into these areas are beyond the scope of this article. But we cannot hope to understand these more advanced investigations without first understanding the different nature of policy under commitment and under discretion.

Economists refer to the desire to alter previously made plans as the time-consistency problem because, at each date, an individual or policymaker finds it tempting to deviate from what an earlier plan dictated. The temptation to alter strategies affects how others view your proposed plan, and it is the interaction between the public's expectations and the policymaker's decisions that leads to problems for a policymaker who cannot commit. Economics has many examples of the time-consistency problem, and although I will primarily focus on monetary policy, I will start with a simpler setting that lays out the basic issues in a fairly transparent way.

THE EXAMPLE OF THE FLOOD PLAIN

Before we delve into monetary policy, it will be helpful to look at the difference between commitment and discretion in a simpler setting. One of the more famous examples used by Kydland and Prescott to illustrate the benefits of commitment over discretion is that of the flood plain. Recently, Robert King provided a detailed description of this example, which highlights the importance of expectations and the role they play in economic outcomes.[1] The role of expectations will also be a central aspect in the analysis of monetary policy.

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In this example, people make a single decision: whether they wish to live near the water. Unfortunately, areas near the water are subject to flooding. The government can prevent flooding by building dams, but doing so is expensive. The government also has a single decision: whether to build a dam. Furthermore, the government wants its policies to conform to individual preferences. It wants to do what makes society as a whole better off. There is no conflict between what individuals think is best and what the government thinks is best. The problem is determining what the best outcome will be, given that people prefer living near the water and the fact that building dams is costly. Of course, the best outcome will depend on how costly dams are relative to the pleasures of living near the water.

The problem is interesting only if we assume that, all things considered, dams are prohibitively expensive, and therefore, the best outcome is for people to live away from water and in areas not subject to flooding. Thus, the best outcome is for people to decide not to build houses in areas subject to floods and for the government to choose not to build dams. If the government can commit to never building a dam, this will be the outcome. Everyone will believe that the government will not build a dam and no one wants a flooded house. As a result, no one chooses to build near the water. The individual's decision about where to build a house is a relatively simple one and does not depend on where other individuals decide to build their houses. If you want to avoid flooding, stay away from the water.

Under discretion the government cannot commit to not building a dam. As King explains, this inability complicates the problem considerably. The government's decision is now based on how many people live near the water. If a sufficient number decide to live near the water, it is now better to build a dam than to subject many people to floods. Now, an individual's decision about where to build is complicated. If he thinks a lot of people will build houses near the water, he should too because a dam will be built, and he will have to pay his share of the dam's cost. If he anticipates that only a few people may build houses near the water, he should not follow their example because he will be subject to the risk of floods. In either instance, if he anticipates correctly, he either lives near the water

[1] See the article by Robert King.

protected by a dam or he lives in safety away from the water. If incorrect, he lives near the water and his house is periodically flooded, or he pays for a dam and lives in a less desirable location.

If we focus on situations where everyone behaves in a similar fashion, there are two potential outcomes. Everyone believes that no one else will build near the water; no one does; and no dam is built. That is the optimal outcome and the one obtained under commitment. If, however, everyone believes that others will build near the water, everyone does build near the water, and a dam is built — a less than desirable outcome. An important thing to note is how complicated an individual's decision-making process is. He must factor in not only what he believes the government will do but what everyone else will do as well. It is precisely this feature of how expectations affect an individual's decision that leads to the less desirable results under discretion. I will return to this aspect of behavior when I discuss monetary policy.

THE LONG-RUN BENEFITS OF COMMITMENT IN MONETARY POLICY

Now let's analyze the benefits that commitment confers on average inflation and average output. As in the example just considered, a key ingredient in the analysis is the forward-looking behavior of individuals. It is people's ability to plan ahead and anticipate the policymaker's actions that makes outcomes under discretion sub-optimal.

In particular, we will analyze the issue using a classical framework in which prices and wages are perfectly flexible. In such a setting, anticipated changes to the money supply have no effect on output. In this environment, if firms believe the central bank is going to increase the money supply, they respond by increasing prices. To be concrete, consider the case where individuals anticipate a doubling of the money supply. In this case firms respond by doubling their prices and workers similarly respond by doubling their wage demands. Workers would like to be able to purchase the same number of goods for a given number of hours worked and firms are willing to pay the higher wages because, in the end, they are paying workers the same amount in terms of goods produced. Thus, a doubling of money and a doubling of prices and wages leaves everyone in the same position as before. Therefore, anticipated changes in money affect only prices, and this is a long-run attribute of every established model in monetary economics.

However, unanticipated changes in money do affect output. For example, if the central bank adopts an expansionary policy by unexpectedly increasing the money stock, output expands and inflation increases. Firms and workers are both surprised by the increase in money and initially do not demand higher prices or higher wages. The increased money stock, which is held by the public, can now be used to purchase more goods and aggregate demand subsequently increases. As firms and workers catch on to what has happened, prices and wages increase, resulting in inflation. Symmetrically, unexpectedly tight monetary policy lowers inflation and causes output to contract.

Furthermore, there is a rate of inflation that everyone prefers, which, for the purposes of this article, need not be specified. I will refer to this rate as pi-star.[2] Inflation above or below this rate is viewed as undesirable. A second feature of the economy is that the central bank and the public desire output to be somewhat greater than potential.[3] The justification for this assumption is that other features of the economy, such as the lack of perfect competition or the presence of distortionary taxes, prevent the economy from operating efficiently, and to some extent, it is desirable for the monetary authority to offset these features.

Under these assumptions the central bank can move output above potential only if it surprises individuals by inflating at a rate greater than pi-star. Under commitment, the central bank would inform the public that it will keep inflation at pi-star. Knowing that the central bank is capable of honoring its promises, the public will believe the central bank and expect the inflation rate to be pi-star. With no surprises, inflation will be pi-star, and output will attain its potential level, which is somewhat below its desired level.

The question then is: Can a policymaker who cannot commit to achieving an inflation rate of pi-star do better? Can that policymaker increase output enough at the expense of some surprise inflation to make everyone better off? Perhaps surprisingly, the answer is no. Suppose the public initially thought that the central bank would target inflation at the rate of pi-star. Knowing this, the central bank is now faced with the opportunity to increase the level of output by creating a bit of surprise inflation through expansionary policy. In other words,

[2] Depending on one's view of the structure of the economy, the optimal rate could be slightly negative, zero, or even perhaps slightly positive.

[3] An economy's potential output is the level that would occur in the absence of any economic distortions. Basically, it is the level that would obtain if prices were free to vary, markets were competitive, and there were no distortionary taxes.

a discretionary policymaker has an incentive to deviate from the policy that would occur under commitment. A small increase in the inflation rate would not be very costly, and the benefit would entail more output. Facing this tradeoff, the central bank will generally find it desirable to initiate additional inflation.

For concreteness, assume it is desirable to generate a 1 percent surprise increase in inflation. In this case, it would be foolish for the public to expect the inflation rate to be pi-star. They should expect it to be pi-star plus 1 percent. If the central bank does not revise its strategy, the outcome will be no surprise: Inflation will be pi-star plus 1 percent, and output will be at its potential level. At this stage we can repeat the reasoning in the previous paragraph. A further attempt to surprise the public, with say 0.5 percent additional inflation, will generate increased output that, in the end, may be worthwhile. If that is the case, the public should anticipate an inflation rate of pi-star plus 1.5 percent.

Again, all that occurs in the end is more inflation and no additional output. At some point additional inflation will be too costly, and the central bank will no longer try to fool the public. The public will expect the higher inflation rate, and output will remain at potential. Forward-looking individuals will not be fooled, but under discretion, there is a temptation to try to fool them. The result is just more inflation. So, under both commitment and discretion, output remains at potential, but commitment achieves this result with lower inflation.

The example above makes clear the long-run benefits of commitment and of devising institutional arrangements that prevent the central bank from using discretionary policy. Some economists have argued that the gold standard was such an arrangement or that currency boards help achieve commitment. Others, such as Kenneth Rogoff, have argued for the benefits of appointing central bankers who have a strong aversion to inflation. Carl Walsh has suggested contracts that penalize central bankers if inflation deviates too much from its target. Currently, there is a good deal of interest in whether explicit forms of inflation targeting help to achieve the better outcomes associated with commitment.[4]

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THE RESPONSE TO SHOCKS UNDER COMMITMENT AND DISCRETION

The ability to respond to economic shocks, such as oil-price shocks or changes in productivity, so as to limit their effects on economic volatility is one of the supreme challenges confronting central banks. It is this aspect of monetary policy that most often elicits arguments touting the benefits of discretion. It is argued by those in favor of discretion that monetary policymakers must be allowed a free hand to respond to each situation as it arises and not be constrained, for example, by promises to keep inflation at some targeted rate. Discretion is needed to adequately guide the economy through turbulent times.

However, the notion that commitment unduly constrains the policymaker from reacting optimally to economic shocks is actually mistaken. The ability to keep promises allows a central bank operating under a policy of commitment to influence expectations in a way that the discretionary planner cannot. In a sense, this gives the policymaker who can commit another tool to work with. In fact, a policy under commitment can achieve all of the outcomes of a policy under discretion and can also achieve outcomes unobtainable under discretion. The committed policymaker cannot do worse than the discretionary planner.

It is precisely because a policymaker who can commit has the ability to follow through on promised actions that he can influence expectations in a desirable way. The discretionary planner, because he makes decisions period by period, makes no promises and, as a result, does not have a similar ability to influence expectations. A planner who can commit to future actions in various situations can affect what people expect will happen in these situations, and these expectations influence current behavior. By making well-designed promises, policymakers can influence expectations in ways that elicit better economic outcomes. However, along with these promises comes the constraint to honor them. Thus, actions today, which affect the future, also affect future policy, and this in turn implies that the history of actions taken will affect current policy. In this sense, the committed policymaker is not free to base today's

[4] For a survey of inflation targeting and its effects, see my 2006 *Business Review* article.

policy only on current economic conditions.

But having policy constrained in this way should not be viewed as a negative attribute of commitment. These constraints, if designed appropriately, can actually lead to better outcomes through their influence on expectations that allow for better economic decisions. These last points have been persuasively illustrated by economists Richard Clarida, Jordi Gali, and Mark Gertler and by economist Michael Woodford.

To make these points more concretely, I will use a simple benchmark New Keynesian model of the economy.[5] That model has two basic components. One is a description of aggregate demand, commonly referred to as an IS curve, that essentially relates current output demand to the level of the real interest rate (the interest rate adjusted for inflation) and to future levels of output.[6] Basically, high real interest rates imply lower demand for consumption and investment. A high real interest rate implies a greater return to saving and induces people to consume less and save more. It also means that firms must earn a higher rate of return on each project in order for those projects to be cost effective. Thus, only relatively profitable projects will be undertaken, and consequently, there will be less investment.

Alternatively, greater future economic activity implies both an increase in current consumption through a wealth effect and more investment because future economic prospects appear rosy. The important feature to note is that higher interest rates reduce aggregate demand and lower output.

The model's other component is a Phillips curve that relates current inflation to future expected inflation and to the level of output. This is the supply part of the model. If future inflation is expected to be high, firms will want to raise prices more aggressively today so that their prices do not get too far out of line with the behavior of prices in general. This leads to greater inflation today. Thus, higher expected future inflation leads to higher inflation today. Also, when the level of output is high, firms' costs of production rise, and as a result, firms pass on some of these additional costs to consumers. The result is higher inflation. The economy will be in equilibrium when the level of the real interest rate and inflation implies that output demand is equal to output supply.

Importantly, in the model, monetary policy can affect the level of output. Underpinning this model of the economy is the feature that prices and wages are costly to adjust. These costs may involve the resources used in acquiring information, the resources employed in figuring out exactly what the correct price or wage is, and the resources needed to change prices. These costs imply that firms and workers will not immediately and fully react to changes in monetary policy. As in our previous example, in which unanticipated changes in policy affected the economy, here anticipated changes in policy affect the economy as well. They do so because it takes time for the price system to fully respond to changes in policy. Thus, the central bank can move output and inflation around in response to an economic shock.

The question I now address is: Who does it better — a discretionary policymaker or a committed policymaker?

To answer this question, I examine how both types of policymakers and the economy respond to an aggregate supply shock. Figure 1 displays the model economic responses to a 1 percent shock to the inflation rate.[7] Because the public does not like inflation above target and the central bank is trying to maximize the public's welfare, policy responds by tightening: The central bank raises the nominal interest rate (panel a). Note that, under discretion, the interest rate must be raised by approximately 50 basis points more than under commitment. As a result, output declines by more under discretionary policy (panel b), but the effect of this more aggressive tightening under discretion has less of an effect on inflation (panel c). Inflation moves up more in response to the shock to inflation and declines more slowly. Policy under commitment experiences a smaller rise in inflation and a more rapid return of inflation to target, with less loss of output. Policy also does not need to be as aggressive because inflation doesn't rise as much.

How does the committed policymaker achieve the best of both worlds: less inflation as a result of the shock and less loss of output while at the same time acting less aggressively? The answer is that expectations of future inflation affect current inflation. Under commitment, individuals take into account the policymaker's promise to bring inflation down and not exploit the output gains arising from inflation. As a result, expectations of inflation do not increase as much under commitment (panel d), implying

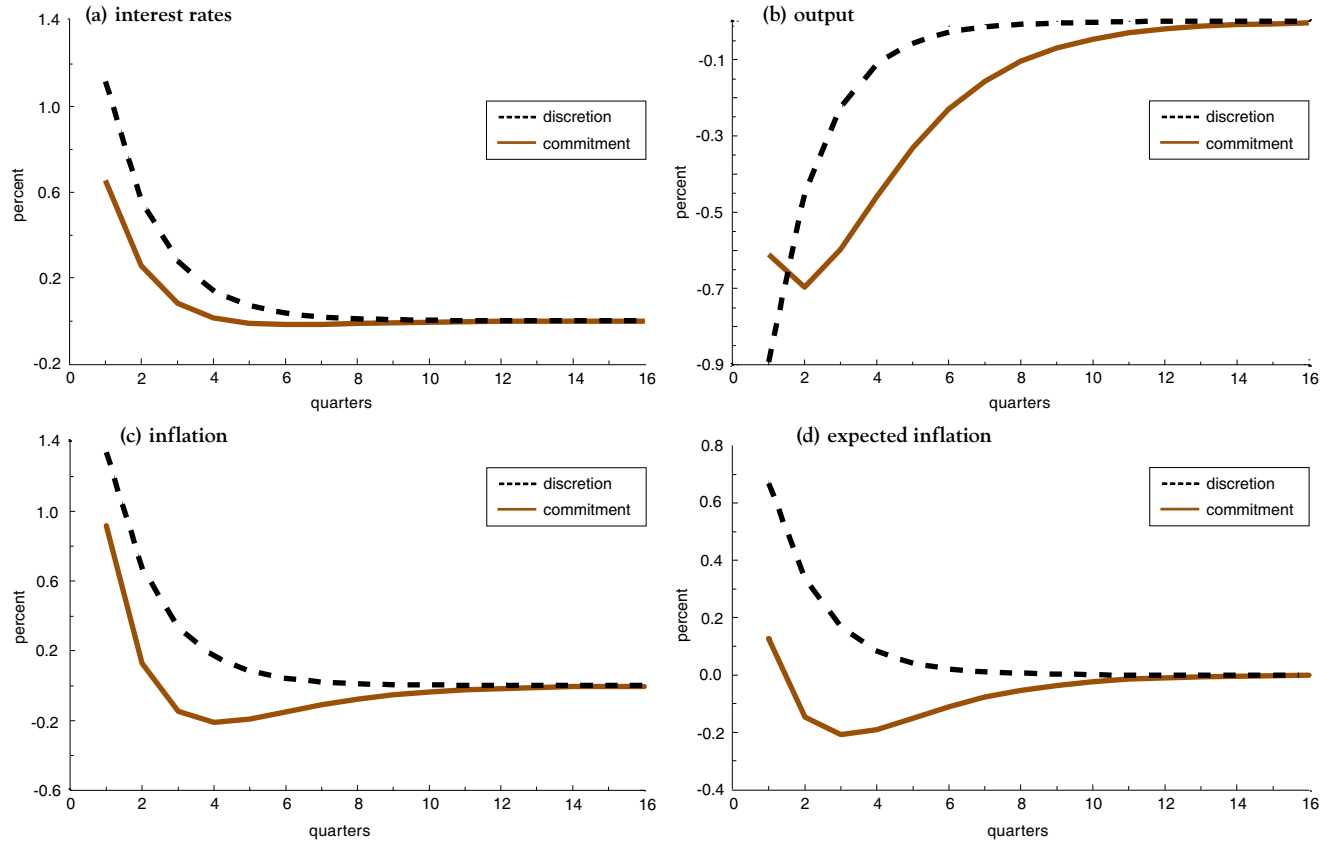
[5] For a more detailed description of the model economy used in this section, see the article by Richard Clarida, Jordi Gali, and Mark Gertler.

[6] It is also common to describe the IS and Phillips curves in terms of output relative to its potential level, which is referred to as an output gap.

[7] In these simulations the monetary authority places only half as much weight on output fluctuations as it does on inflation fluctuations.

FIGURE 1

Economic Responses Under Commitment and Discretion



that firms do not raise their current prices as aggressively as they would in an environment characterized by discretion. The stability of inflation expectations under commitment implies that policy does not have to be as aggressive in order to bring down inflation, and as a result, output does not have to decline by as much. Contrary to intuition, the constraint of having to abide by past promises actually allows the committed policymaker to achieve superior economic outcomes in response to economic disturbances.[8]

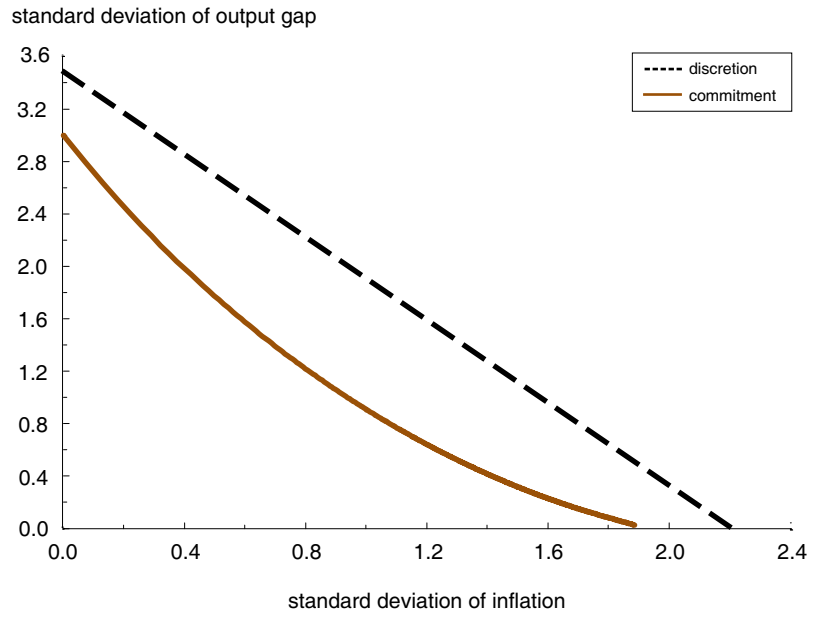
Commitment's superiority to discretion can be further characterized by investigating what kind of inflation and output tradeoffs confront the economy under the two different types of policy. In this model of the economy, decreasing the variability of inflation can be achieved only by allowing output to be more variable. If, in order to combat inflation or disinflation, the policymaker responds more aggressively to inflationary shocks, output will end up varying more because of the more aggressive policy response. Therefore, the more the policymaker tries to limit the volatility of inflation, the greater the volatility of output will be. Symmetrically, the policymaker can lower the volatility of output only by accepting more volatility in inflation. Thus, the policymaker will have a whole menu of attainable combinations of output variability and inflation variability to choose from. The particular choice will depend on the public's preferences.

Figure 2 graphs the choices available to each type of policymaker. Because people dislike volatility in both output and inflation, points that lie closer to the origin are preferred. It is obvious that under commitment the economy can achieve better outcomes than under discretion because the curve depicting the tradeoff under

[8] In this simple model, the committed and discretionary policymakers achieve the same outcomes in response to a shock to aggregate demand. However, this is not generally true in more sophisticated models.

FIGURE 2

Output and Inflation Tradeoffs



commitment lies everywhere below the curve under discretion. This means that for any given level of variability in inflation, the committed policymaker can obtain less variability in output than the discretionary planner. Similarly, for any degree of volatility in output, the committed planner can generate less volatility in inflation. Thus, not only will the economy achieve a lower average rate of inflation under commitment, it will also experience less volatile inflation. This depiction along with the discussion in the previous section highlights the observation made earlier: Under commitment, policy can achieve outcomes that cannot be achieved under discretion.

AN EXAMPLE: OIL-PRICE SHOCKS

There are many examples of the benefits of commitment — or, in U.S. monetary policy, at least examples in which the Federal Reserve has had sufficient credibility that the public believed that monetary policy would behave in a manner that approximates commitment. I will contrast two episodes, both involving oil-price shocks.

Although I cannot give definitive proof for the following argument, one can view the differential economic impact of oil-price shocks in the 1970s and 2000s through the lens of commitment.[9] In one instance, the Fed lacked credibility for maintaining low inflation and in the other the Fed had that credibility. The theoretical material covered suggests that the effects of the oil shocks on economic activity and inflation could be different under these two different settings. In actuality, they were quite different.

The two episodes are the oil-price shock of the late 1970s and a more recent oil-price shock in the early 2000s.[10] By the time the oil-price shock of 1979 hit, more than doubling oil prices over the course of the year, inflation had already reached 9 percent. These historically high inflation rates were caused by overly easy monetary policy. It is fair to say the Federal Reserve had, by the time of the oil shock, lost credibility for maintaining low inflation. The rise in oil prices further ignited inflationary pressures, and without credibility for maintaining low inflation, the Fed was put in the situation of ratifying the higher expected inflation or trying to contain inflation with a large subsequent loss of output. It chose the first option, and by the first quarter of 1980, inflation had increased to more than 15 percent.

In contrast, from the end of 2003 to the end of 2005 oil prices more than doubled, yet inflation remained contained without any significant adverse effect on output. The main difference between these two episodes is the credibility that the Federal Reserve now enjoys for maintaining low and stable inflation. This credibility is portrayed by the stability of various measures of inflation expectations over this period. For example, the 10-year expected

[9] Recent evidence outlined in the article by Sylvain Leduc, Keith Sill, and Tom Stark is consistent with the interpretation of events described here.

[10] There are many other documented episodes. Some are discussed in President Plosser's speech, and the history of inflation scares is documented in the article by Marvin Goodfriend. Also, for a more detailed analysis of appropriate monetary policy in the face of shocks to oil prices, see the article by Sylvain Leduc and Keith Sill.

inflation rate in the Philadelphia Fed's Survey of Professional Forecasters hardly moves over this period, and expected inflation as represented by the difference between the yield on 10-year nominal and indexed Treasury bonds is quite stable. Therefore, as in Figure 1, the more recent oil-price shock had very little impact on inflation expectations, and as a result, there has been no need for exceedingly aggressive policy. In turn, there has been very little impact on output. The current FOMC is committed to low and stable inflation and is perceived in that light. Acting as a committed policymaker has its benefits both in theory and in practice.

SUMMARY

This article has explored the benefits of policy under commitment versus discretion. In particular, it has discussed the added benefits policymakers derive from fulfilling past promises. Rather than constraining policy, adhering to honoring policy promises enables monetary policy to attain outcomes that cannot be attained by a policy arrived at anew at each point in time. Committed policy generates lower long-run inflation without any adverse effects on economic activity and ameliorates the effects of economic disturbances.

In practice, achieving and maintaining the credibility that allows a central bank to follow policies consistent with the assumption of full commitment is not easy or straightforward. The credibility the Fed has achieved is due, in no small part, to the leadership of the two previous Fed Chairmen, Paul Volcker and Alan Greenspan. The current Chairman, Ben Bernanke, is maintaining their example of commitment to low and stable inflation. The benefits of following a committed plan are now so entrenched in policy-making circles that most central banks aggressively strive to maintain their credibility. The loss of credibility presents grave problems for monetary policymakers, problems that have been highlighted in this article.

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The Mismeasured Personal Saving Rate Is Still Useful:

Using Real-Time Data to Improve Forecasting*

BY LEONARD NAKAMURA

People make decisions based on information. Often, with hindsight, they could have made better choices. Economics faces a similar problem: Economic data, when first released, are often inaccurate and may subsequently be revised. In this article, Leonard Nakamura uses the U.S. personal saving rate — a statistic that has often been initially low, then substantially revised upward — to discuss how modern economic statistical techniques can improve forecasting.

People make decisions based on information. A quarterback scanning receivers or a corporate executive concluding a merger must usually make decisions with inadequate information. With hindsight, they often could have made a better choice. A similar problem holds true for economics: Initial economic statistics are often inaccurate and may be subsequently revised as better data become available. One consequence of this process of initial data releases that are later revised is that economists now realize that the quality of economic forecasts needs to be judged against the data available at the time. A second consequence is that when economists make forecasts, they should be aware that the statistics will be revised and incorporate this information into their forecasts.

The U.S. personal saving rate, which has been averaging less than 1 percent of after-tax personal income for the past three years, has often been initially low and then substantially revised upward. I will take this statistic as an example and discuss how modern economic statistical techniques can improve forecasting, by taking into account the difficulties of measuring saving in the short run.

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USING THE SAVING RATE AS A FORECASTING TOOL

Households often make decisions about how much to spend or how much to save based not just on their current income but also on their expectations of future income. To the extent that households base such decisions on expected future income, economists may draw inferences from that behavior and use them to make forecasts about households' income. For example, households may save more when they expect their future income to decline, such as in retirement, and they may save less when they expect their future income to rise. If so, an economist might be able to infer that households expect to retire — and therefore suffer a fall in income — from their saving behavior.

However, understanding the economic behavior in question is only part of the difficulty of forecasting. In practice, economic forecasting suffers from the problem that at the moment a forecast is made, current data on the economy may be imperfect. So the forecaster must try to estimate what will happen tomorrow, not knowing fully what is happening today. As time passes, the data will be improved, but that fact is cold comfort to the forecaster. In the case of data on saving, the personal saving rate is often not measured well initially, making forecasting more difficult.

Averaging across all households in the U.S. economy, we expect household saving to be positive. After all, positive saving supports a rising stock of capital that will make workers more productive. From 1946 to 1992, the personal saving rate was generally stable (Figure 1). If the personal saving rate has been generally stable over time, then whenever the personal saving rate is low, it should tend to rise

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back to its average rate, and vice versa, a process called mean reversion. Since personal saving is defined as after-tax personal income minus personal outlays, a low saving rate seemingly must have one of two implications: Either consumption is expected to fall, or income is expected to rise. The often-expressed view that if saving is low, consumers are overspending and must soon cut back is a tempting one. But as this article will show, the evidence strongly favors the view that if saving is low, it's more likely the case that income is expected to rise.

The saving rate may change for other reasons, as well. For example, households save not only for retirement but also for a rainy day. This "precautionary saving" stems from households' concern that they may suffer a loss of income due to layoffs or ill health. In recent years, financial innovations and the moderation of the severity and frequency of U.S. recessions in recent years may have reduced households' fears of the consequences of income loss. To the extent that changes such as these influence the saving rate, the saving rate will not accurately predict changes in income.

Recently, the measured U.S. saving rate has been very low: under 1 percent of after-tax income in 2005, 2006, and 2007. This stands in contrast to a saving rate of 8.5 percent over the 46 years from 1946 to 1992. Does the fact that the U.S. is experiencing a low saving rate imply swiftly rising income?

It turns out that the current low level of the personal saving rate may well be due to mismeasurement. As I argued in a 2001 *Business Review* article, personal saving is hard to measure and may be understated, particularly over the past 20 years or so, as a result of changes in the way the economy behaves and is measured. In particular, we appear to have systematically undercounted U.S. investment in developing new products, which has resulted in uncounted income and saving. In this situation, is it possible to still use the saving rate to make forecasts?

In our working paper, Tom Stark and I point out that, in the past, initial reports of low saving rates have repeatedly been revised upward. That is, there is a historical tendency to initially undermeasure the personal saving rate. One reason may be that income is harder to count, and thus easier to underestimate, than is spending, but over time we solve the underestimation problem. So the current situation, in which we are likely undercounting income and saving, is similar to past episodes.

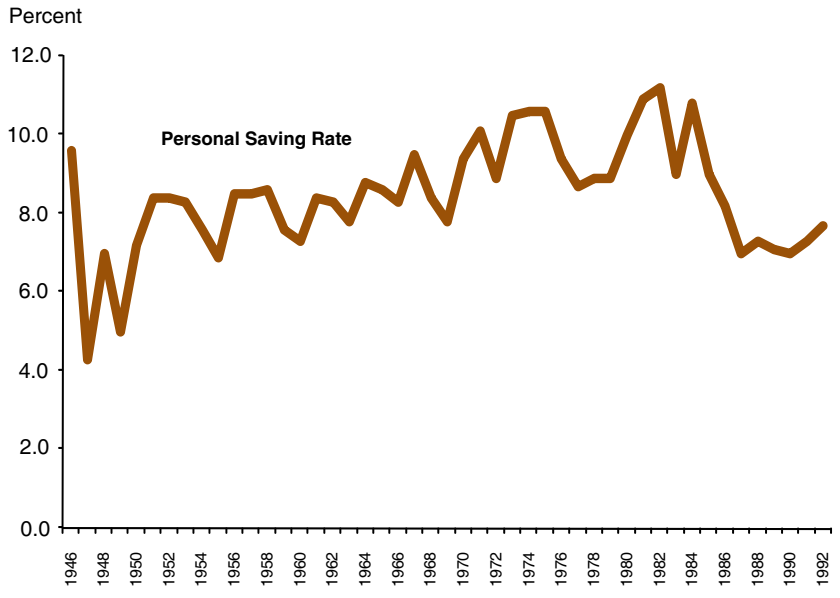
If the personal saving rate is typically understated when first reported, a low level of personal saving may not be very useful for forecasting. Nevertheless, this article will present evidence that *changes* in the saving rate can be used for forecasting movements in income.[1]

First, we need to go back in time to recover the pattern of past reports of income, consumption, and saving, before and after revision. In doing so, we must remember that many initial economic reports rely on data based on surveys that are incomplete and that may contain errors, and the surveys may only imperfectly capture the economic activity they are supposed to target. Over time, more complete data become available as does additional information that helps place each survey in context, making possible a more accurate view of economic activity. As a consequence, economic reports may be revised and may become more accurate. As we shall see, the data on

[1] Here, and elsewhere in the article, income means real income, that is, income adjusted for inflation.

FIGURE 1

(Reasonably) Stable Personal Saving Rate, 1946 to 1992



personal saving are particularly vulnerable to changing relationships between initial data and economic activity as a whole. Yet recognizing that the data on saving are imperfect does not exempt us from doing our best to see what information we can extract from the imperfect series.

The inaccuracy of initial economic reports matters because forecasters, and the decision-makers who rely on their forecasts, do not have the luxury of waiting for more accurate measures. They must use the reports available to make their decisions. Economists cannot avoid being concerned about saving and consumption because consumption constitutes a large proportion of demand for output: Personal consumption expenditures have averaged about two-thirds of gross domestic product (GDP) over the last quarter century. To use these data as well as we can, we turn to economic theory, on the one hand, and empirical analysis on the other.

CONSUMPTION THEORY AND FORECASTING

The modern theory of consumption dates back to the 1950s and the work of Milton Friedman. Friedman showed, in the work for which he received the Nobel Prize in 1976, that when our income falls temporarily, we — consumers — are unlikely to reduce our consumption as much as income falls. This argument is called the permanent income hypothesis.

The fundamental argument is that we generally prefer not to consume a lot one year and a little the next; we prefer more equal consumption over the two years. Economists say that consumers prefer a smooth path of consumption rather than one that bounces up and down. In particular, suppose we know that in one year we will have a lot of income and in the following year much less. The preference for smooth consumption means that we will consume about the same each year. So we will save much of our income the first year in order to spend it in the next.[2]

John Campbell, building on sophisticated theories of Friedman's permanent income hypothesis developed by Robert Hall and Marjorie Flavin, has argued that if personal saving fell for consumers as a whole, this would likely forecast an expected increase in income.

The underlying logic can be seen as follows. Suppose consumers raise their consumption while their income remains the same, so their saving falls. Saving can return to normal in one of two ways. Consumers could be intending to reduce their consumption in the future. But that would involve an uneven, rather than a smooth, path for consumption. More likely, consumers have raised their consumption because they expect their incomes to rise in the future.

The Greek fable of the Ant and the Grasshopper, in which a grasshopper who sings all summer starves in the winter, while an ant who saves during the summer is well provided for, serves as a reminder of the possibility that not all households may do a good job of forecasting. Thinking about household behavior raises an important empirical question: How much forethought does the average consumer have? If a large number of households are like the grasshopper, an alternative view of the historically low personal saving rate that the U.S. (and other countries) currently suffers from is that we must inevitably experience a decline in consumption and a recession (Figure 2).

The permanent income theory says that if consumption will be kept the same when income goes up, consumers should expect their future incomes to rise and all of the rise in income to go into saving.

For example, the minutes to the September 2004 meeting of the U.S. Federal Open Market Committee state, "Members perceived several possible sources of downside risk to household spending. In particular, households might hold back on spending in an attempt to increase their saving, which had fallen to a very low level relative to income." In this view, this "downside risk" to spending could trigger a slowdown in economic growth and possibly a recession.

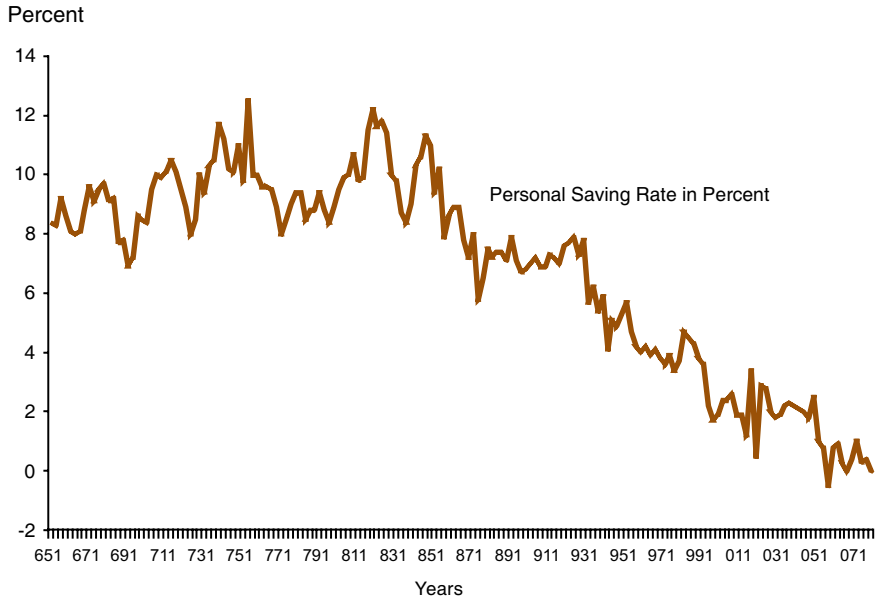
Thus, there are two conflicting notions about how a low saving rate can return to normal. One, the "grasshopper theory," says that consumers will simply consume less and save more. The other, the permanent income hypothesis, says that income will rise while consumption remains stable.

The permanent income theory actually says something more. It says that if consumption will be kept the same when income goes up, consumers should expect their future incomes to rise and all of the rise in income to go into saving. So forecasts of income and saving should tend to mirror one another. To achieve this goal, the forecasting equation for saving must be

[2] A fuller discussion of consumption and the permanent income hypothesis can be found in Satyajit Chatterjee's forthcoming article.

FIGURE 2

Twenty Years of Profligacy? Measured U.S. Personal Saving Rate* As Reported in 2008 Q1



* Seasonally adjusted.

quite similar to the forecasting equation for income. If this tight relationship between the forecasts holds, the two forecasts together should perform better than either separately.[3]

Campbell found evidence for the idea that a low saving rate does imply future growth in income but not for the stronger claim that income growth is exactly related to the size of the drop in the saving rate. However, such exact tests of hypotheses typically fail because hypotheses are necessarily overly simple in their formulation. A statistical rejection can occur because the simple hypothesis is only approximately true, and the data are sufficiently precise to reject the approximation. In fact, Campbell was testing the notion that all consumers are ants, and none are grasshoppers. And that was rejected.

Peter Ireland has pointed out that if Campbell's theory is true, the personal saving rate should be useful in forecasting income, in particular, labor income. He argued that forecasting ability was a good test of an economic theory; indeed, it shows that the economic theory can be useful in a very practical way. That is, the theory says that saving should help us improve our forecasts of income. Because this is true, according to Ireland's argument, the economic significance of the hypothesis is validated, even though statistics may have rejected its narrow implications. For example, when Galileo tested whether two objects of different weight fell at the same speed, he ignored the effect of air resistance. His test, in fact, rejected the hypothesis that the two fell at exactly the same speed. But his test did show that the prediction that they would fall at the same speed was much more accurate than the prediction that they would fall at a speed proportional to their weight. Similarly, although Campbell's estimation showed that forecasted saving did not move with income exactly as the permanent income hypothesis predicts, Ireland's results, as we shall see, showed that when saving and income were assumed to follow the permanent income hypothesis, the forecast was better than if that assumption had not been made. To put it another way, Ireland showed that most consumers were ants rather than grasshoppers, and so, on balance, for practical purposes, there are enough ants that the grasshoppers don't matter.

Before we get to Ireland's evidence, however, we shall first discuss the measurement of saving.

SAVING: INITIAL MEASUREMENT AND REVISION

In a previous *Business Review* article, I argued that the personal saving rate may be mismeasured. The main evidence is that if U.S. personal saving is unusually low, U.S. wealth should be falling. However, the opposite has been true. It is useful to be more precise about how the personal saving rate is measured in the U.S.

The personal saving rate is personal saving as a percentage of disposable (after-tax) personal income. Personal saving, in turn, is disposable personal income minus personal outlays. Disposable personal income includes some easily measured items, such as social insurance contributions

[3] The relationship between the two forecasts is achieved technically through what are called cross-equation restrictions. In this example, a low saving rate forecasts a higher rate of income growth. The low saving rate also forecasts an increase in the saving rate of about the same amount. So the coefficient on the low saving rate should be approximately the same for the two. For details, see the Appendix, and my working paper with Tom Stark.

and benefits. Other parts of labor income, such as other (that is, non-Social Security) benefits and transfers, are subject to measurement and conceptual problems. (For example, is a pension considered income when it is earned or when it is paid to a worker?) Wages and proprietors' income are subject to underreporting in government records as a result of tax evasion. Rental income and proprietors' income are net income measures that require estimates of depreciation and other expenses that are hard to measure well. Capital gains on equity (other than from qualified equity stock options) and real estate are not included in personal income.

Under the current method of measuring income, we may not be capturing all of the sources of household income, and this may result in the appearance of low saving. In that case, if, in the future, we figure out a better way to measure income, we will revise our current estimates of saving upward.[4]

How are data revised? Data on a given quarter's economic activity are first published in an advance estimate, late in the first month of the next quarter. The revised estimate is published in the second month of a quarter, followed a month later by a final estimate. These data are then generally left unchanged until the following summer, when the latest three years of national account data are revised. Initial estimates thus undergo three summer revisions. Thereafter, the estimates are changed only in benchmark revisions, which now occur every four years. Benchmark revisions provide an opportunity for the Bureau of Economic Analysis (BEA) to make discretionary choices in defining the items it considers to be part of personal income. For example, government pension income is now considered income when it is earned, rather than when it is paid out.[5] In addition, more complete data from economic censuses are included at this time. Most of the revisions to the saving rate that turn initially low rates into higher ones occur during benchmark revisions.

Real-Time Data Collected by the Philadelphia Fed. Researchers Dean Croushore and Tom Stark pioneered the collection of data sets in vintages that capture the data as they were available on a particular date. These data can be used to show how revisions change our view of economic processes. (The real-time data used here as well as a number of other statistical series can be downloaded at the following address: http://www.philadelphiafed.org/research-and-data/real-time-center/real-time-data/.)

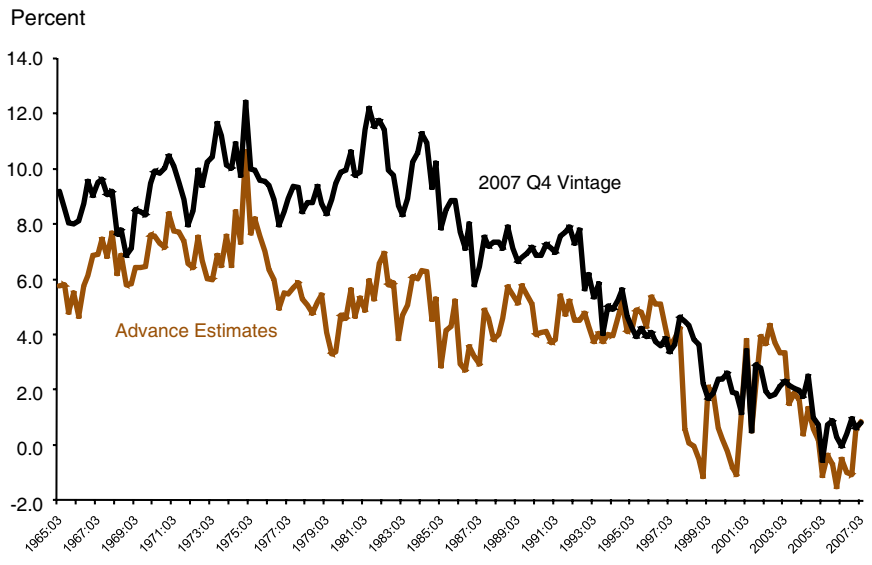
These data show that adjustments to the measurement of personal saving have occurred repeatedly in the past. For example, the average saving rate from 1980 to 1985 was initially reported as 6.5 percent and is now reported as 10.4 percent, the highest saving rate in our current data series. The advance estimates of the personal saving rate from the third quarter of 1965 to the second quarter of 1999 averaged 5.3 percent. But after revisions, as reported in September 2007, the personal saving rate over the same period averaged 8.1 percent. Figure 3 shows the advance

[4] In particular, it's possible that we will eventually adjust our treatment of capital gains, which have become an important contributor to the increase in household wealth.

[5] When government pensions were mainly federal pensions, they were treated this way because the federal government did not set aside income at the time the pension obligations were incurred. However, now most government pensions are state and local government pensions, and these governments generally set aside pension funds when their employees earn the pensions.

FIGURE 3

Before and After: Measured Personal Saving Rate as First Published and as of 2007 Q4



estimates of the personal saving rate as they were reported when first published, and the latest vintage data, as we would have seen them last year. For example, in the fourth quarter of 1985, when the advance report for the personal saving rate in the third quarter of 1985 became available, it was reported as 2.9 percent. (See the table in *Understanding and Using Real-Time Data*.) But if we go to the BEA's website today, we will find that we now believe that the personal saving rate in the third quarter of 1985 was 7.9 percent.

What is the problem in measuring saving? It turns out that complete data on income are hard to measure. As the economy evolves, new types of income come about. Initially, the new income may not be reported or may not be considered income. Over time, as new sources of data become available and as old data come to be viewed in a new light, more income is reported.

These changes in income are usually recorded in the benchmark revisions. In our working paper, Tom Stark and I show that almost all of the upward revisions to the personal saving rate occur in benchmark revisions.

Which data should we use for our tests of the permanent income hypothesis? Peter Ireland and Tom Stark and I simulated forecast exercises. Ireland's test focused on how consumers actually behave, to test whether the underlying consumer behavior was primarily driven by households that conform to the permanent income hypothesis. To do this test, we want to use the data that best reflect the underlying behavior, that is, the most accurate available data. And those are the latest revised data, in the most recent vintage.

Forecasting well is not necessarily the same as understanding consumer behavior. For understanding consumer behavior, how poor our latest statistics are is irrelevant — what we care about is the underlying behavior revealed by the best statistics, which may be available only in historical data that have been revised. Ireland used the right data from the perspective of understanding consumer behavior — the best and latest available statistics — but those data are not the best guide for understanding how to forecast with the data the forecaster actually has available.

Forecasting well is not necessarily the same as understanding consumer behavior.

If we want to test how useful the saving rate is to an economic forecaster, we should use real-time data, which will repeatedly put us into the situation of the forecaster: using data that have not yet been revised.

FORECASTING WITH MISMEASURED PERSONAL SAVING

One way economists analyze statistical relationships in economic data is to perform an in-sample data analysis called a regression analysis. In our case, we want to examine whether in periods when saving is low, income rises faster than usual in later periods. This statistical relationship can then be used to forecast the behavior of the consumer.

Peter Ireland's insight was to argue that even if not all consumers behave according to the permanent income hypothesis, if most of them do so, it may be better to assume than not assume the hypothesis that saving and income will rise together and that assumption will produce better forecasts.

The method Ireland used for his test is called *recursive* out-of-sample testing. This method basically asks over and over (recursively) whether the relationship in past data successfully forecasts the next piece of data. This analysis is out-of-sample because the next piece of data is never in the sample.

To use a specific example, we take a base period, say, from the first quarter of 1959 to the fourth quarter of 1970, and do a regression analysis. We then use this regression analysis to forecast the next quarter's income — the first quarter of 1971. We then compare this to the actual income for the first quarter of 1971 and measure the error in this forecast. We then add the first quarter of 1971 to our data, lengthening our data one period, and undertake a new regression based on data from the first quarter of 1959 to the first quarter of 1971. We then forecast the new next period: we forecast income in the second quarter of 1971 and again measure the error in this forecast.

Continuing to the present, we can accumulate a long series of forecasts, the actual data, and the forecast errors.[6] We square the errors, sum them up, and divide by the number of forecasts to obtain the mean square error of the forecasts. We then take the square root to obtain the root mean square error, a number conceptually similar to the standard deviation. The smaller the root mean square error, the more accurate the average forecast. When we make forecasts of income using past income and saving, we will compare the root mean square error with the root mean square error when only past income is used in the

[6] The forecast error is the difference between the actual value and the predicted (forecast) value of a time series.

Understanding and Using Real-Time Data

Ordinarily, data used in economic analysis are what real-time data users call the latest available vintage. It reflects the data that were published by the statistical agency (in the case of the U.S. personal saving rate, the Bureau of Economic Analysis, or BEA) at the time the economic analysis was performed. As we have stressed, these data may look very different from those that were available to a forecaster at some earlier time.

The table on page 16 contains selected portions of a real-time data matrix. Each column in the full matrix represents a "vintage." Each vintage contains the data from the first quarter of 1947 to the quarter before the vintage date, as it was published at the vintage date.

A forecaster in the fourth quarter of 1985 would have had available the data in column 2 of the table presented here and would have thought that the personal saving rate in the third quarter of 1985 was 2.9 percent. A forecast of real income in the fourth quarter of 1985 would have been based on this estimate.

In the next quarter, the BEA published a benchmark revision, and the personal saving rate for the third quarter of 1985 then appeared to be 3.7 percent. This is shown in column 3. Because this is a benchmark revision, the entire history of the personal saving rate has been revised. Note that even the data from 1947 have been revised. This would presumably have caused a forecaster using the personal saving rate in forecasting to redo the regression analysis on which the forecast was based. Again, in the third quarter of 1986, a summer revision changed the data for the past three years, and the estimate of the personal saving rate for the third quarter of 1985 was reported to be higher yet, 4.2 percent (column 5).

The data that Peter Ireland used in his paper were those published by the BEA in the fourth quarter of 1994 (column 6). In Ireland's work, the estimate of personal saving for the third quarter of 1985 was 5.4 percent. For all of his forecasts, Ireland would have used column 6 data. In our real-time forecast analyses, presented here, we use a different column of data for each forecast. Thus, we would assume that the forecaster in the fourth quarter of 1985 would use the data in column 1 to estimate the forecast equation and to make the forecast. In the first quarter of 1986, the forecaster would use the data in column 2. By contrast, Ireland's forecaster in the fourth quarter of 1985 uses the data in column 6, up to the row that says third quarter of 1985, to make a forecast.

Remarkably, the data change further in the latest vintage used in our study, the third quarter of 2005, which shows a personal saving rate of 7.9 percent in the third quarter of 1985 (that's the number still being reported as of the first quarter of 2008).

An interesting contrast is to look at changes in the personal saving rate, which changes much less across vintages compared with the level. In both the real-time vintage of the fourth quarter of 1985 (column 2), and in the "latest" vintage of the third quarter of 2005 (column 7), we observe that the personal saving rate in the third quarter of 1985 is low relative to its neighbors in the quarter before and the quarter after. In our working paper, Tom Stark and I present additional evidence that changes in the personal saving rate are more stable over time than the level, which is an important reason why changes in the saving rate have better predictive power than the level of the saving rate.

forecast. If saving does help to forecast income, it will lower the root mean square error.

Peter Ireland used this "recursive regression" method to forecast income using the personal saving rate.[7] Using data from 1959 to 1994, he showed that the personal saving rate was a good forecaster of income from 1970 to 1994.

To create a benchmark for his forecasts, he began by using past values of income growth to forecast future income growth. There is good evidence that — in part because economies tend to go through booms and busts — when income growth is high, it tends to remain high, and when income growth is low, it tends to remain low, a pattern called persistence. Ireland made recursive out-of-sample forecasts of income growth using past values

[7] When the regressions are formed by continually enlarging the data set, so that, as in the example, we always begin from 1959, the regressions are called recursive. An alternative technique is "rolling regressions," where, as we add more recent data, we drop off the oldest data, so that the period under consideration is always the same length.

TABLE

Example of Real-Time Data Personal Saving Rates in Six Vintages, Selected Observations

1	2	3	4	5	6	7
	Vintage 85:Q4	Vintage 86:Q1	Vintage 86:Q2	Vintage 86:Q3	Vintage 94:Q4	Vintage 05:Q3
Date						
1947:Q1	5.0%	4.9%	4.9%	4.9%	4.8%	6.1%
1947:Q2	1.4%	1.3%	1.3%	1.3%	1.2%	2.6%
1976:Q1	7.7%	8.2%	8.2%	8.2%	7.9%	9.6%
1976:Q2	7.3%	8.0%	8.0%	8.0%	7.7%	9.6%
1976:Q3	6.7%	7.6%	7.6%	7.6%	7.3%	9.5%
1976:Q4	5.9%	6.9%	6.9%	6.9%	6.6%	8.9%
1984:Q1	6.1%	7.0%	7.0%	6.9%	8.1%	10.3%
1984:Q2	5.7%	6.1%	6.1%	6.0%	7.8%	10.6%
1984:Q3	6.3%	6.7%	6.7%	6.4%	8.4%	11.3%
1984:Q4	6.2%	6.0%	6.0%	6.0%	7.9%	11.0%
1985:Q1	4.5%	4.8%	4.8%	5.2%	6.7%	9.4%
1985:Q2	5.1%	5.9%	5.9%	6.5%	7.8%	10.2%
1985:Q3	2.9%	3.7%	3.7%	4.2%	5.4%	7.9%
1985:Q4	#N/A	4.1%	4.0%	4.4%	6.0%	8.6%
1986:Q1	#N/A	#N/A	4.3%	5.0%	6.5%	8.9%
1986:Q2	#N/A	#N/A	#N/A	5.2%	7.2%	8.9%
		Benchmark Revision		Summer Revision	Ireland Data	Nakamura-Stark Latest Available Vintage

of income growth and then measured the forecast error. He repeated this over the period from 1970 to 1994 and calculated the root mean square error.

He then made similar forecasts of future income growth using past values of income growth and adding past values of saving. He found that the root mean square error was lower than when only past values of income were used. Moreover, he found that the forecast error was even lower when he accounted for the restrictions imposed by the permanent income hypothesis: that predicted savings and income have parallel movements. He took this to be good evidence that the permanent income hypothesis is true.

However, Ireland used the data as they were available in 1994. This is not really a true test of personal saving's usefulness in forecasting because we know that the personal saving rate as it was available in 1994 differed substantially from what it looked like in, say, 1980. So Ireland, making his forecasts in 1994, used an estimate of the personal saving rate for the third quarter of 1985, for example, that was 5.4 percent, while the forecaster in the fourth quarter of 1985 would have thought it was 2.9 percent (and, as we now know, it was later revised to 7.9 percent).

FORECASTING WITH REAL-TIME DATA

Using real-time data from the Philadelphia Fed's data set, we can make real-time forecasts that use the data as they were available to an economist on a series of dates. (To see how these data are organized, see *Understanding and Using Real-Time Data*. Further information can be found in the 2000 article by Croushore and Stark.) Real-time data enable us to ask: Given that personal saving has historically been dramatically mismeasured, would it be a useful forecasting tool?

Forecasting Income with Saving, with Latest Available Data, and in Real Time. With data that have been revised over many years, the relationship between the level of saving and future income growth is just as the permanent income hypothesis shows, as Peter Ireland also showed.

However, if we try to do the same exercise in real time, the level of the saving rate is not predictive. I will show that, in particular, from 1981 to 2005, the level of the saving rate does not improve forecasts of income growth. All is not lost, however, because I will show that changes in the saving rate can be used in real time to forecast income growth.

Forecasting in Real Time. Let's look at the forecasts using real-time data, shown in the first row of the table on page 18. If we look at the period before 1982 (the first quarter of 1971 to the fourth quarter of 1981), before the saving rate started trending downward, even in real time there is value to these forecasts, although the improvement shrinks to 3.7 percent. There is even a small improvement from imposing the restrictions of the permanent income hypothesis.

But when we look at the data after 1981, the level of the saving rate is much less helpful in forecasting. Looking at row 2, from the first quarter of 1982 to the second quarter of 2005, we see that when the level of the saving rate has been falling, it has been much less useful in forecasting. In real time during this period, the level of the saving rate worsens forecasts, with or without the restrictions. As we see in row 2, the forecasts are 4 percent worse using the level of the saving rate and 1 percent worse adding the restrictions.

An Alternative: Forecasting with the Change in the Saving Rate. Thus far, I have focused on the level of the saving rate as a measure of future income expectations because the underlying theory and the data suggest that the level of the saving rate should generally be stable. Therefore, when the saving rate is below average, we expect it to rise toward the average. A below-average level of the saving rate, according to the permanent income hypothesis, implies that income is expected to rise, causing saving to rise. But, as we have seen, the most recent level is typically too low and likely to be revised higher. Thus, the level might be misleading. Perhaps we should try the change in the saving rate. Even if the level is low because of mismeasurement, a downward change might be telling us that income is expected to increase.

It is true that in the absence of substantial measurement error, the change in the saving rate is unlikely to be as informative as the level of the saving rate. If we look at the latest revised data, in the heavily revised period from 1971 to 1981, we see that the level of the saving rate reduces the root mean square error 12 percent. When

Using real-time data from the Philadelphia Fed's data set, we can make real-time forecasts that use the data as they were available to an economist on a series of dates.

TABLE

Forecasting Real Disposable Income Growth with Real-Time Data:
Ratios of Forecast Errors, Forecasts with Saving Relative to Forecasts with Only Past Income Growth*

	(1) Level of Saving	(2) Permanent Income Hypothesis Restrictions on Level of Saving	(3) Change in Saving	(4) Permanent Income Hypothesis Restrictions on Change in Saving
1971:Q1 – 1981:Q4				
1. Real time	0.963	0.954	0.950	0.944
1982:Q1 – 2005:Q2				
2. Real time	1.040	1.010	0.943	0.935

* Lags chosen using the Akaike information criterion.

we add the restrictions of the permanent income hypothesis, we reduce the root mean square error 16 percent. With the latest revised data, the change in the saving rate does not do as well in this period, reducing the root mean square error 10 to 12 percent, depending on whether we impose the restrictions of the permanent income hypothesis.

Thus, with good revised data, the change in the saving rate is not as informative about future changes in income as is the level of the saving rate. The theory points us to the right form for the data.

But as noted before, this does not tell us about the situation a forecaster faces. If we look at that same period but make forecasts using real-time data, we see that the level of the saving rate reduces the root mean square error only 3.7 percent, and the permanent income hypothesis restrictions add only a small improvement, reducing the root mean square error 4.6 percent. We make better forecasts with the change in the saving rate, which produces a 5 percent improvement without the restrictions of the permanent income hypothesis and 5.6 percent with them.

If we look at the more recent period, from 1982 to 2005, the level of the saving rate performs quite poorly in forecasting. In real time in this period, the level of the saving rate worsens forecasts with or without the permanent income hypothesis restrictions, as we have seen. By contrast, the change in the saving rate performs well, reducing the root mean square error 5.7 percent without the permanent income hypothesis restrictions and 6.5 percent with it.

Thus, using changes in the saving rate in real time, a forecaster could have made a better forecast of future income than using only past data on income. This is true whether or not the permanent income hypothesis restrictions are imposed. By contrast, the level of the saving rate, despite attractive theoretical properties and despite the fact that the level of the saving rate does well with the latest revised data overall, would not have been a good choice in a forecasting equation over the past 20 years.

Why might the change in the saving rate be better in real time than the level of the saving rate? It turns out that the change in the saving rate is subject to smaller revisions than the level of the saving rate. Technically, this is because revisions tend to have a cumulative impact on the levels. Consequently, the changes are more reliable than are the levels.

CONCLUSION

I have made three points in this article. First, I argued that when the saving rate falls, it is more likely to be evidence that households expect faster real income growth in the future, rather than evidence that they are spending too much and will have to cut back on consumption.

Second, I showed that the personal saving rate has typically been substantially revised and usually upward. The Philadelphia Fed's real-time data set gives us the data we need to show this. Since a low personal saving rate can occur because of mismeasurement and may well be revised upward, in practice, the level of the personal saving rate does not help us forecast real income growth.

Finally, I showed that, guided by this insight, forecasters can use the change in the saving rate rather than the level as a forecasting tool. Although this technique does not work as well as having better data would, it does enable economists to improve their forecasts.

So I have shown that real-time data can be quite useful for improving forecasting when revisions are large. By using real-time data, economists can sometimes figure out how current data can be valuably employed, even when poorly measured.

TECHNICAL APPENDIX

Permanent Income Hypothesis Restrictions

Campbell's version of the permanent income hypothesis that we are testing is a two-equation system that predicts changes in income and the level of the saving rate. The system relates these to past values of income and the level of the saving rate.

Formally, the system is

$$\Delta Y_{lt} = a(L)\Delta Y_{lt-1} + b(L)S_{t-1} + u_{1t}$$
$$S_t = c(L)\Delta Y_{lt-1} + d(L)S_{t-1} + u_{2t}$$

where Y_{lt} is real labor income per capita at time t, S_t is real saving per capita, and Δ is the first-difference operator. The terms $a(L)$, $b(L)$, $c(L)$, and $d(L)$ are polynomials in the lag operator, given by, for example, $a(L) = \sum_{i=1}^{p} a_i L^i$, p is the lag length, and the u_t are forecast error terms.

Whenever the expected permanent increase in real labor income occurs, the saving rate is expected to rise at the same time. The permanent income hypothesis says that these two expected increases are closely related; econometrically, this relationship is called a cross-equation restriction because it relates coefficients across the two equations. The intuition behind these cross-equation restrictions is that a current decrease in saving must imply a future predictable permanent increase in real labor income and a future predictable saving increase. The 2p restrictions on the coefficients of the lag operators are

$$c_i = a_i, i = 1, \ldots, p$$
$$d_1 = b_1 + (1 + r)$$
$$d_i = b_i, i \geq 2,$$

where r represents a constant real interest rate. See Peter Ireland's article for a more detailed description.

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Growing Slowly, Getting Older:*
Demographic Trends in the Third District States

BY TIMOTHY SCHILLER

National trends such as slower population growth, an aging population, and immigrants as a larger component of the population are mirrored in the Third District states (Pennsylvania, New Jersey, and Delaware). These trends are likely to persist and perhaps even accelerate well into the future. In this article, Tim Schiller reviews these trends and their possible interaction with health-care and retirement benefit programs nationally and in the Third District states.

Since the last census in 2000, estimates suggest that U.S. population growth has slowed, the population has aged, and immigrants have become a larger component of the population. These national trends have also been evident in the three states of the Third Federal Reserve District: Pennsylvania, New Jersey, and Delaware. These trends are likely to persist — and even accelerate — well into the future. The major economic consequence of these demographic changes is a slowdown in the rate of employment growth. Coupled with an aging population, slow growth in the working population will present challenges for government budgets, particularly public retirement and health-care programs. The magnitude of these challenges cannot be determined exactly; it will depend on actual demographic developments and on how the benefit programs evolve. Nevertheless, estimates can be made based on current demographic trends and existing benefit programs. This article will review these trends and their possible interaction with benefit programs nationally and in the Third District states.

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THIRD DISTRICT POPULATION: SLOWER GROWTH AND OLDER

Population Growth Has Slowed. Annual estimates of the national population and the population of the Third District states indicate that growth since 2000 has been slower than growth between the census years 1990 and 2000.[1] As of 2007, the U.S. population was about 7 percent larger than it was in 2000, the result of an annual growth rate of about 1 percent. This was slower growth than the annual rate of about 1.2 percent between 1990 and 2000. In the region, the increase in population from 2000 to 2007 was 1.2 percent in Pennsylvania, 3.2 percent in New Jersey, and 10.4 percent in Delaware. Among the three states, only Delaware's population growth was faster than the nation's (Table 1). Delaware ranked 10th among the 50 states and the District of Columbia in population growth since 2000, and it was the only state in the northeastern region of the country to have population growth above the national rate.

Population growth in the nation is the result of two factors: natural increase (births minus deaths) and net international migration (people moving into the country minus people moving out). Since 2000, growth in the national population has been due to natural increase and net international migration in the same

*The views expressed here are those of the author and do not necessarily represent the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

[1] The Census Bureau makes annual estimates of the national and state populations. See the U. S. Bureau of the Census citation in the References for website information. The bureau's analysis of its estimates of current population and projections of future population indicates that both tend to be lower than actual population counts. Nevertheless, the estimates and projections give a fair picture of the trend in actual population over time, which is the subject of this article. For a discussion of the accuracy of projections, see the working paper by Ching-li Wang.

TABLE 1

Population Change 2000 - 2007

	Percent	Population 2007
Nevada	28.4	2,565,382
Arizona	23.5	6,338,755
Utah	18.5	2,645,330
Georgia	16.6	9,544,750
Idaho	15.9	1,499,402
Texas	14.6	23,904,380
Florida	14.2	18,251,243
Colorado	13.0	4,861,515
North Carolina	12.6	9,061,032
Delaware	10.4	864,764
South Carolina	9.9	4,407,709
Washington	9.7	6,468,424
Oregon	9.5	3,747,455
Alaska	9.0	683,478
Virginia	8.9	7,712,091
New Mexico	8.3	1,969,915
Tennessee	8.2	6,156,719
California	7.9	36,553,215
United States	7.2	301,621,157
New Hampshire	6.5	1,315,828
Montana	6.2	957,861
Maryland	6.1	5,618,344
Arkansas	6.0	2,834,797
Hawaii	5.9	1,283,388
Wyoming	5.9	522,830
Minnesota	5.7	5,197,621
South Dakota	5.5	796,214
Missouri	5.0	5,878,415
Kentucky	4.9	4,241,474
Oklahoma	4.8	3,617,316
Wisconsin	4.4	5,601,640
Indiana	4.4	6,345,289
Alabama	4.1	4,627,851
Nebraska	3.7	1,774,571
Illinois	3.5	12,852,548
Maine	3.3	1,317,207
Kansas	3.2	2,775,997
New Jersey	3.2	8,685,920
Connecticut	2.8	3,502,309
District of Columbia	2.8	588,292
Mississippi	2.6	2,918,785
Iowa	2.1	2,988,046
Vermont	2.0	621,254
New York	1.7	19,297,729
Massachusetts	1.6	6,449,755
Michigan	1.3	10,071,822
Pennsylvania	1.2	12,432,792
Ohio	1.0	11,466,917
Rhode Island	0.9	1,057,832
West Virginia	0.2	1,812,035
North Dakota	-0.4	639,715
Louisiana	-3.9	4,293,204

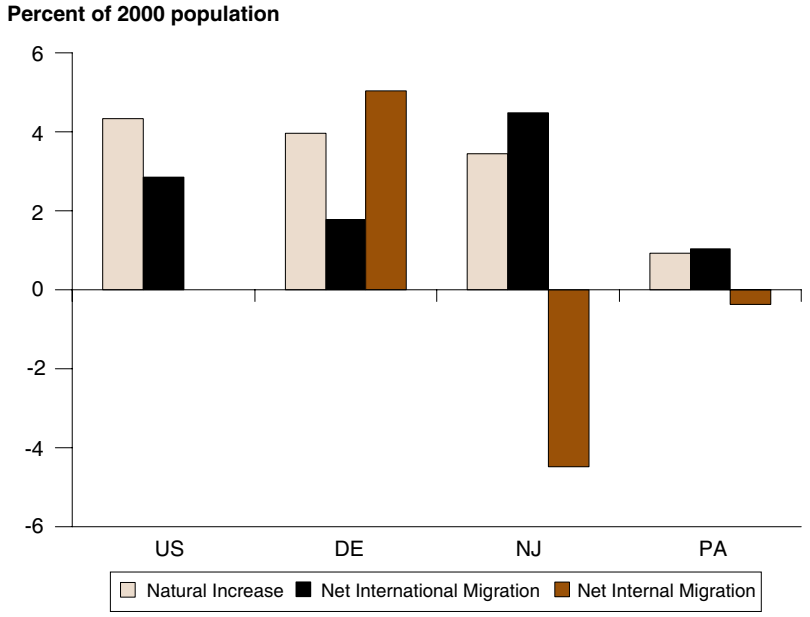
Source: U.S. Census Bureau.

proportions as growth from 1990 to 2000: 60 percent of the growth in population was from natural increase and 40 percent from net international migration. For the states, there is the additional component of population change: movement of people from one state to another, called internal migration.

A look at all of the components of population change since 2000 in the three Third District states reveals that natural increase has been an important factor, but the other factors have had different effects in each state. (See the Figure.) In Pennsylvania, net international migration was the component that contributed the most to growth. Natural increase was much less in the state than it was in the nation, but it contributed 75 percent of the total increase, a greater share than in the nation. Pennsylvania has the third lowest natural increase (among the 50 states and District of Columbia) in population; West Virginia had an actual decrease (deaths exceeded births); and Maine's natural increase was less than Pennsylvania's. The two components contributing to an increase in Pennsylvania's population — natural increase and net international migration — were offset

FIGURE

Components of Population Change 2000-2007



Source: U.S. Census Bureau

to some extent by negative net internal migration (more people moved out to other states than moved in), which subtracted from the state's population between 2000 and 2007. Another way to look at this effect is to note that net internal migration offset 33 percent of the total population growth from 2000 to 2007. For the years since 2000 compared with the 1990s, international migration became a more important positive factor and internal migration became a less important negative factor in Pennsylvania's population growth.

In New Jersey, net international migration added to the state's population between 2000 and 2007, but it was offset by a virtually equal amount of negative net internal migration (more people moved out to other states than moved in from other states). Consequently, on net, New Jersey's population growth was almost equivalent to its natural increase. The offsetting effects of international and internal migration in New Jersey for the years since 2000 were similar to their effects during the 1990s.

Delaware had a natural increase that nearly matched the nation's, net international migration that was less than the national gain, and significant net internal migration. Both net international and net internal migration have been somewhat more important for Delaware's population growth in the years since 2000 than they were in the 1990s. Compared with the average of other states, natural increase and net international migration contributed proportionately more to growth in Pennsylvania and New Jersey and less in Delaware. Net internal migration contributed proportionately more to growth in Delaware and subtracted from growth in Pennsylvania and New Jersey.

Increase in Foreign-Born Percentage of Population and an Older Population. The percentage of the population that is foreign-born has increased, and the population has gotten older. Both of these developments represent the continuation of long-term trends in the nation as well as in the Third District states. With international migration accounting for nearly half of the increase in the national population since 2000, it is not surprising that the foreign-born percentage of the national population increased to about 13 percent from 11 percent. The percentage-point increase was smaller in Pennsylvania (from 4.1 percent to 5.1 percent), which has long had a smaller percentage of foreign-born population than the nation. The percentage-point increase was somewhat larger in Delaware (from 5.7 percent to 8.1 percent). Like Pennsylvania, Delaware has long had a smaller percentage of foreign-born population than the nation, but also like Pennsylvania, Delaware has seen an increasing share of its population growth come from an increase in foreign-born residents. The percentage-point increase in the foreign-born population of New Jersey (from 17.5 percent to 20.1 percent) was greater than the national increase. New Jersey has long had a larger percentage of foreign-born population than the nation.

The national birth rate, which has been declining for many years, has continued to do so at a slow pace in the years since the start of this century. With the slowdown in the birth rate, the median age of the national population rose, as did the median age of the population in each of the Third District states. Although the median age of people immigrating into the country each year is younger than the median age of the current total population, the numbers of immigrants and the difference in

median age have not been sufficient to keep the median age from rising nationally or in the three states.

Since 2000, the median age nationally has increased from 35.3 to 36.6 (Table 2). The median age in each of the Third District states is above the national median. Among the three states, it is highest in Pennsylvania, 39.7 years, making the state the sixth highest for median age among all the states and the District of Columbia. The median age in New Jersey is 38.4 years (11th highest), and in Delaware it's 37.9 years (13th highest).

Another measure of the population's age is the percentage at or above certain ages. A common cutoff for this measure is 65. The percentage of the population 65 years and over in the nation has not changed much since 2000, rising from 12.4 percent to 12.6 percent. In the region, the percentage of the population 65 years and over has increased since 2000 in Delaware but declined slightly in Pennsylvania and New Jersey. Nevertheless, the percentage is greater in each state than in the nation (15.2 percent in Pennsylvania. 13.1 percent in New Jersey, and 13.6 percent in Delaware).

Besides the population age 65 and over as a share of the total population, another key measure of this age group's significance is its size in relation to the population age 20 to 64. This is because the 65 and over population is much more likely not to be in the workforce, while the 20 to 64 population largely makes up the workforce. The nonworking older population relies, in part, on the younger working population for its support. This is true to the extent that future social obligations toward the elderly — such as Social Security payments and public medical expenditures — are not fully funded by past savings. (It is mitigated to the extent that savings have been set aside either by the individual or on his or her behalf in public trust funds.) For this reason, the ratio of the population 65 and over to the population 20 to 64 is called the old-age dependency ratio. For the national population, this ratio has decreased slightly since 2000, from 21.1 percent to 20.9 percent. This decline is due, at least in part, to the rising immigrant population, which has added to the 20 to 64 population. Our region has seen a similar decline in the old-age dependency ratio. However, the ratio in each state remains above the national ratio (Table 3).

At the other end of the age spectrum, there is the youth-dependency ratio: the ratio of the population under 20 to the population 20 to 64. This ratio has also declined since 2000. The decline in the youth-dependency ratio is a consequence of a declining birth rate and of immigration of 20 to 64 year olds. In our region, the youth-dependency ratio declined in each state, and it has remained below the national ratio, reflecting the region's older population.

Labor Force Growth Slower in Nation, But Mixed in Region. Labor force growth in the nation since 2000 has been slower than it was in the 1990s, but in the region, the trends have been mixed. The labor force is the number of persons working or available for work. Although the age group most likely to be employed is the 20- to 64-year-old group, the labor force includes all workers or potential workers regardless of age. For the nation, labor force growth was 1.3 percent annually during the 1990s

TABLE 2

Age Measures

	Actual		Projected		
	2000	2007	2010	2020	2030
US					
Median age	35.3	36.6	37.0	38.0	39.0
Percent 65 and over	12.4	12.6	13.0	16.3	19.7
Pennsylvania					
Median age	38.0	39.7	40.0	40.6	42.1
Percent 65 and over	15.6	15.2	15.5	18.8	22.6
New Jersey					
Median age	36.7	38.4	38.9	39.6	40.8
Percent 65 and over	13.2	13.1	13.7	16.4	20.0
Delaware					
Median age	36.0	37.9	39.4	41.5	43.6
Percent 65 and over	13.0	13.6	14.1	18.3	23.5

Source: U.S. Census Bureau. 2000 Census, 2007 Population Estimates, and State Interim Population Projections

TABLE 3

Dependency Ratios

	Actual		Projected		
	2000	2007	2010	2020	2030
US					
Youth	48.5	45.4	44.9	46.2	48.3
Old Age	21.1	20.9	21.7	28.4	36.3
Pennsylvania					
Youth	46.1	35.9	41.1	42.0	44.8
Old Age	27.1	24.4	26.0	32.9	42.4
New Jersey					
Youth	45.5	37.6	42.2	42.2	43.8
Old Age	22.2	20.7	22.5	27.9	35.9
Delaware					
Youth	47.1	38.0	42.3	43.4	45.5
Old Age	21.9	21.7	23.4	32.1	44.7

Notes: Youth dependency ratio is population under 20 years old as a percent of population 20-64 years old. Old-age dependency ratio is population 65 years old and over as a percent of population 20-64 years old.

Source: U.S. Census Bureau

but only 1.0 percent in the years since 2000.[2] In Delaware, labor force growth has been slower since 2000 than in the 1990s: 0.9 percent versus 1.4 percent. In contrast, recent labor force growth in both Pennsylvania and New Jersey has been slightly faster than growth in the 1990s: 0.5 percent versus 0.4 percent in Pennsylvania, and 0.7 percent versus 0.5 percent in New Jersey. Nevertheless, these growth rates remain below those of Delaware and the nation.

However, many factors other than demography affect the size of the labor force, both nationally and in the states. These factors include public policies and economic developments that can have positive or negative effects on labor markets at the national, state, and local levels. Regardless of the origin of the factors influencing the size of the labor force, these factors have important implications, both nationally and at the state and local levels. Perhaps the most imperative of these is the effect of labor force size on government fiscal conditions because the size of the labor force relative to the total population is the major factor determining government revenues in relation to government spending capacity. This is why the dependency ratio, described above, is a demographic measure of significant interest. The implications of future labor force growth and changes in the dependency ratio for the Third District states are discussed below in light of demographic and economic projections.

POPULATION PROJECTIONS: EVEN SLOWER GROWTH AND MORE AGING

Slower Projected Population Growth in Nation and Region. The Census Bureau projects slower population growth in the nation and in the Third District states for the decades ahead, compared with population growth from 1990 to 2000. National population growth of around 1.3 percent annually in the 1990s has slowed to around 1 percent and is projected to slow to just under 1 percent for the 10 years to 2010 and to continue at around that rate until 2030, the horizon for the census projections.[3]

The Census Bureau projects that Pennsylvania's population will grow at around its current rate of 0.2 percent a year until 2020 and then at a slower rate from 2020 to 2030. Projections for New Jersey's rate of growth show that it will stay around its current rate of approximately 0.5 percent, or slightly faster, to 2030. Projections indicate that Delaware will continue to be the fastest-growing of the three states, although the Census Bureau projects that Delaware's current growth rate of around 1.5 percent a year will fall below 1 percent by 2030. Pennsylvania was the sixth most populous state in 2000 and is projected to still hold that rank in 2030. New Jersey is projected to move from ninth to 13th, and Delaware is projected to remain in 45th

[2] Labor force and employment data for the nation and the states are produced by the Bureau of Labor Statistics. See the U.S. Bureau of Labor Statistics website information in the References.

[3] See the U.S. Bureau of the Census website for projections. The website address is in the References. The website includes both national and state population projections.

place. States in the West and South are projected to be the fastest growing, as they were from 1990 to 2000.

Projections indicate that international immigration will continue to play a large role in the national population's increase and in the population growth of Pennsylvania and New Jersey. Delaware's population growth is projected to result mostly from natural increase and net inward internal migration. Pennsylvania and New Jersey are projected to experience net outward internal migration. While population projections made in the past have done fairly well in comparisons with eventual census counts, they have tended to under-predict growth, especially for fast-growing states.[4] For example, in the Third District, the population in 2000 was projected to be around 12.2 million in Pennsylvania and the actual census count was 12.3 million (an under-projection of around 0.6 percent); the New Jersey projection was around 8.2 million versus an actual count of 8.4 million (a 2.9 percent under-projection); and the Delaware projection was around 760,000 versus an actual count of around 780,000 (an under-projection of around 2.3 percent).[5]

Older Population Nationally and Third District States Among the Oldest. The national population is projected to get older, on average, and the Third District states are projected to be among those with the oldest populations. The national median age is projected to rise, and the percentage of the population 65 and older is projected to increase (Table 2). The old-age dependency ratio is projected to increase (Table 3). The median age in each of the Third District states is projected to increase through the 30 years from 2000 to 2030, and the percentage of the population 65 and older and the old-age dependency ratio will increase in each state. Delaware is projected to overtake Pennsylvania in measures of age. This will be at least partially the result of low international immigration into Delaware, since immigrants tend to be younger than the current population.

Economic Significance of Population Trends. The economic significance of the trends of slower population growth and an aging population will be seen in the effects those trends have on labor force growth, which is projected to be slower in the years immediately ahead than in the past. Demographic factors alone determine the dependency ratio, as described earlier, but other factors influence the actual size of the labor force. Taking all factors into consideration, the most recent Bureau of Labor Statistics (BLS) projections indicate that growth in the labor force from 2006 to 2016 will be slower than growth from 1996 to 2006 (a projected annual rate of 0.8 percent versus 1.2 percent).[6]

The slower projected labor force growth is primarily the result of the aging of the population, a process that will move more potential workers into the age groups that have had lower labor force participation rates historically.[7] Although the BLS projects an increase in the labor force participation rate of the older population, this will not be sufficient to offset the drop in the overall participation rate that occurs as potential workers move to and beyond the traditional retirement age of 65, when the participation rate is expected to fall by half (in 2016).

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With slower labor force growth ahead, employment growth will be slower as well, even if the economy is at full employment (as assumed for the purpose of the BLS projections). The BLS projects payroll employment growth of 1 percent a year from 2006 to 2016, slower than the 1.3 percent

[4] Census Bureau projections have tended to under-predict state population growth, especially in fast-growing states, because annual state population estimates have tended to be too low, and state-to-state migration has been greater than expected. For a discussion of the accuracy of projections, see the working paper by Ching-li Wang.

[5] The Census Bureau's high growth projections for each state were used to compute the percentage under-projection versus the actual count in each state.

[6] The Bureau of Labor Statistics makes national labor force and employment projections every two years. For the latest projections, consult the Bureau's *Monthly Labor Review*, November 2007. Projections are summarized in the article by James C. Franklin.

[7] The labor force participation rate is the number of people in a given age category who are in the labor force — as defined above — as a percent of the total number of people in that age category.

annual rate from 1996 to 2006.[8]

Employment growth in the three Third District states is also projected to be slower in the future. State labor departments project declines in the growth rate of employment.[9] For Pennsylvania, employment growth from 2004 to 2014 is projected to be 0.7 percent per year versus 0.8 percent a year from 1994 to 2004. For New Jersey, growth is projected to be 1 percent a year versus 1.2 percent. For Delaware, growth is projected to be 1.2 percent a year versus 1.8 percent.

Adverse Effects of Increased Dependency Ratio and Slower Labor Force Growth. Slower labor force and employment growth and an increasing old-age dependency ratio have adverse economic implications for the nation and for the states. The increase in the dependency ratio and the slowing labor force growth in the nation are the reasons that the currently projected level of Social Security benefits will soon outstrip the taxes required to pay them. (Social Security refers to the Federal Old-Age and Survivors Insurance — OASI—and the Federal Disability Insurance Trust Funds — DI — collectively referred to as OASDI.) It is projected that the annual cost of OASDI will exceed OASDI annual tax revenue beginning in 2017, after which the shortfall will be covered by redemptions of special obligations of the Treasury that make up the trust fund assets. The assets of the DI fund are projected to be exhausted in 2026 and the assets of the OASI fund in 2042.[10] Other federal government benefits, such as Medicare and Medicaid, are similarly in jeopardy. For example, the Federal Hospital Insurance Trust Fund is projected to be exhausted in 2019.[11] Other parts of the Medicare program (collectively known as Supplemental Medical Insurance) do not use trust funds; instead, this program requires that revenue be matched to costs annually. The cost of this portion of Medicare is also projected to increase rapidly. Consequently, total Medicare expenditures are projected to increase from 3 percent of GDP in 2006 to 11 percent by 2081. Thus, even aside from trust fund issues, federal social welfare programs are projected to become a much larger portion of the federal budget and to grow in relation to gross domestic product, portending an increasing burden on the economy regardless of whether these programs are financed by dedicated taxes or general revenues.

State government financial obligations vary, but many states also face future difficulties paying for benefits, especially state portions of Medicaid payments and payments for health-care benefits for state and local government employees and retirees.[12] For some states, government retiree pensions will also present fiscal challenges. The GAO projects the sum of all state and local government operating budgets to be in deficit by 2015. However, most states and local governments are required to maintain balanced budgets in most years, so future fiscal difficulties could necessitate urgent action at that time.

Among the Third District states, New Jersey appears to be the least prepared to make future payments, although none of the three states has fully funded future obligations. Analysis by the Pew Center on the States estimates that the New Jersey state employee pension system is slightly less than 80 percent funded (one of 20 states below that level) and

Federal social welfare programs are projected to become a much larger portion of the federal budget and to grow in relation to gross domestic product, portending an increasing burden on the economy regardless of whether these programs are financed by dedicated taxes or general revenues.

[8] The projection for household survey employment is 0.8 percent from 2006 to 2016, slower than the 1.3 percent annual rate from 1996 to 2006. The household survey of employment includes farm workers and the self-employed. Employment among these groups is projected to grow more slowly than employment of workers at business firms, which is measured in the payroll survey.

[9] State employment projections are made by state labor and industry departments. These projections are made after the national projections are issued. Consequently, the most recent state projections do not extend as far as the most recent national projections. See the References for website information for projections for Pennsylvania, New Jersey, and Delaware.

[10] See the annual report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance.

[11] See the annual report of the Board of Trustees of the Federal Hospital Insurance and Federal Supplemental Medical Insurance.

[12] See the report by the Government Accountability Office (GAO).

that the provision for state employee-retiree health benefits is practically unfunded. Pennsylvania and Delaware state employee pension systems are estimated to have greater funding, but neither state has full funding for state employee-retiree health benefits.[13]

SUMMARY

Recent demographic trends are likely to continue and even accelerate in years after 2010. That means slower population growth, an older population, and an increasing percentage of foreign-born residents. Both slower population growth and an aging population will tend to limit employment growth in the future. Slower employment growth, in turn, will tend to limit economic growth.

While the issue is a national one, some regions, states, and local areas will face more difficulty than others. Future population growth is projected to be stronger in parts of the country that have already experienced relatively strong population growth, namely, the South and West, and less strong elsewhere. So regions in the North and East, including the three states of our region, are more likely than other parts of the country to face difficulty as a result of demographic trends.

Slower growth in the number of workers will necessitate faster growth in productivity per worker to maintain or improve the growth in total income that will be required to finance growing obligations. A key to higher productivity is greater human capital, which improves individual earning power and is important for regional economic improvement as well. Human capital appears to boost regional economic growth by attracting more and better-educated workers to areas that already have large concentrations of workers with higher-level educations.[14]

[13] See the report by the Pew Center on the States.

[14] See my *Business Review* article.

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FILING FOR BANKRUPTCY: HOW DO HOMEOWNERS FARE?

This paper provides the first in-depth analysis of the homeownership experience of households in bankruptcy. The authors consider households who are homeowners at the time of filing. These households are typically seriously delinquent on their mortgages at the time of filing. The authors measure how often they end up losing their houses in foreclosure, the time between bankruptcy filing and foreclosure sale, and the foreclosure sale price. In particular, they follow homeowners who filed for Chapter 13 bankruptcy between 2001 and 2002 in New Castle County, Delaware, through October 2007. They present three main findings. First, close to 30 percent of the filers lost their houses in foreclosure despite filing for bankruptcy. The rate rose to over 40 percent for those who were 12 months or more behind on their mortgage payment, about the same fraction as among those who entered into foreclosure directly. Second, filing for bankruptcy allowed those who eventually lost their houses to foreclosure to remain in their houses for, on average, an additional year. Third, although the average final sale price exceeded borrowers' own estimates at the time of filing, the majority of the lenders suffered losses. These findings are pertinent to the recent debate over the bankruptcy code on mortgage modification. Finally, the paper also reports circumstances related to the loan, borrower, and lender that make it more or less likely that a certain result will take place.

Working Paper 08-14, "The Homeownership Experience of Households in Bankruptcy," Sarah W. Carroll, formerly Federal Reserve Bank of Philadelphia, and Wenli Li, Federal Reserve Bank of Philadelphia

UNEMPLOYMENT: A RIGHT-TO-MANAGE BARGAINING SCHEME

If the Mortensen and Pissarides model with efficient bargaining is calibrated to replicate the fluctuations of unemployment over the business cycle, it implies a far too strong rise of the unemployment rate when unemployment benefits rise. This paper explores an alternative right-to-manage bargaining scheme. This also generates the right degree of fluctuations of unemployment but at the same time implies a reasonable elasticity of unemployment with respect to benefits.

Working Paper 08-15, "The Elasticity of the Unemployment Rate with Respect to Benefits," Kai Christoffel, European Central Bank, Frankfurt, and Keith Kuester, Federal Reserve Bank of Philadelphia

EVIDENCE OF DIVERGENT BEHAVIOR IN RETURN AND VOLATILITY SPILLOVERS

The authors provide a simple and intuitive measure of interdependence of asset returns and/or volatilities. In

particular, they formulate and examine precise and separate measures of return spillovers and volatility spillovers. The authors' framework facilitates study of both noncrisis and crisis episodes, including trends and bursts in spillovers, and both turn out to be empirically important. In particular, in an analysis of 19 global equity markets from the early 1990s to the present, they find striking evidence of divergent behavior in the dynamics of return spillovers vs. volatility spillovers: Return spillovers display a gently increasing trend but no bursts, whereas volatility spillovers display no trend but clear bursts.

Working Paper 08-16, "Measuring Financial Asset Return and Volatility Spillovers, with Application to Global Equity Markets," Francis X. Diebold, University of Pennsylvania, and Visiting Scholar, Federal Reserve Bank of Philadelphia, and Kamil Yilmaz, Koc University, Istanbul

GENERATING FORECASTS FOR NONCORE VARIABLES

This paper develops and illustrates a simple method to generate a DSGE model-based forecast for variables that do not explicitly appear in the model (noncore variables). The authors use auxiliary regressions that resemble measurement equations in a dynamic factor model to link the noncore variables to the state variables of the DSGE model. Predictions for the noncore variables are obtained by applying their measurement equations to DSGE model-generated forecasts of the state variables. Using a medium-scale New Keynesian DSGE model, the authors apply their approach to generate and evaluate recursive forecasts for PCE inflation, core PCE inflation, and the unemployment rate along with predictions for the seven variables that have been used to estimate the DSGE model.

Working Paper 08-17, "DSGE Model-Based Forecasting of Non-Modelled Variables," Frank Schorfheide, University of Pennsylvania, and Visiting Scholar, Federal Reserve Bank of Philadelphia; Keith Sill, Federal Reserve Bank of Philadelphia; and Maxym Kryshko, University of Pennsylvania

PAYDAY LENDING AND PERSONNEL PERFORMANCE

Does borrowing at 400 percent APR do more harm than good? The Pentagon asserts that payday loans harm military readiness and successfully lobbied for a binding 36 percent APR cap on loans to military members and their families (effective October 1, 2007). But existing evidence on how access to high-interest debt affects borrower behavior is inconclusive. The authors use within-state variation in state lending laws and exogenous variation in the assignment of Air Force personnel to bases in different states to estimate the effect of payday loan access on personnel outcomes. They find significant average declines in overall job performance and retention and significant increases in severely poor readiness. These results provide some ammunition for the private optimality of the Pentagon's position. The welfare implications for military members are less clear-cut, but the authors' results are consistent with the interpretation that payday loan access causes financial distress and severe misbehavior for relatively young, inexperienced, and financially unsophisticated airmen. Overall job performance declines are also concentrated in these groups, and several pieces of evidence suggest that these declines are welfare-reducing (and not the result of airmen optimally reducing effort given an expanded opportunity set); for example, performance declines are larger in high unemployment areas with payday lending.

Working Paper 08-18, "In Harm's Way? Payday Loan Access and Military Personnel Performance," Scott Carrell, University of California, Davis; and Jonathan Zinman, Dartmouth College, and Visiting Scholar, Federal Reserve Bank of Philadelphia

MEASURING BUSINESS CONDITIONS: ESTIMATING THE STATE OF REAL ACTIVITY

The authors construct a framework for measuring economic activity at high frequency, potentially in real time. They use a variety of stock and flow data observed at mixed frequencies (including very high frequencies), and they use a dynamic factor model that permits exact filtering. They illustrate the framework in a prototype empirical example and a simulation study calibrated to the example.

Working Paper 08-19, "Real-Time Measurement of Business Conditions," S. Boragan Aruoba, University of Maryland, and Visiting Scholar, Federal Reserve Bank of Philadelphia; Francis X. Diebold, University of Pennsylvania, and Visiting Scholar, Federal Reserve Bank of Philadelphia; and Chiara Scotti, Federal Reserve Board

TRANSMITTING MONETARY POLICY THROUGH THE BANK LENDING CHANNEL

This study shows that during Paul Volcker's drastic monetary tightening in the early 1980s, local banks operating in only one county reduced loan supply much more sharply than local subsidiaries of multi-county bank holding companies in similar markets, after controlling for bank (and holding company) size, liquidity, capital conditions, and, most important, local credit demand. The study allows cleaner identification by examining 18 U.S. "county-banking states" where a bank's local lending volume at the county level was observable because no one was allowed to branch across county borders. The local nature of lending allows us to approximate and control for the exogenous component of local loan demand using the prediction that counties with a higher share of manufacturing employment exhibit weaker loan demand during tightening (which is consistent with the interest rate channel and the balance-sheet channel of monetary policy transmission). The study sheds light on the working of the bank lending channel of monetary policy transmission.

Working Paper 08-20, "The Effect of Monetary Tightening on Local Banks," Rocco Huang, Federal Reserve Bank of Philadelphia

MACROECONOMIC FLUCTUATIONS AND CORPORATE DEFAULT

This paper studies the relation between macroeconomic fluctuations and corporate defaults while conditioning on industry affiliation and an extensive set of firm-specific factors. Using a logit approach on a panel data set for all incorporated Swedish businesses over 1990-2002, the authors find strong evidence for a substantial and stable impact of aggregate fluctuations. Macro-effects differ across industries in an economically intuitive way. Out-of-sample evaluations show their approach is superior to both models that exclude macro information and best fitting naive forecasting models. While firm-specific factors are useful in ranking firms' relative riskiness, macroeconomic factors capture fluctuations in the absolute risk level.

Working Paper 08-21, "Firm Default and Aggregate Fluctuations," Tor Jacobson, Sveriges Riksbank; Rikard Kindell, Svenska Handelsbanken; Jesper Linde, Sveriges Riksbank and CEPR; and Kasper Roszbach, Sveriges Riksbank, and Visiting Scholar, Federal Reserve Bank of Philadelphia

LEISURE AMENITIES AND URBAN DEVELOPMENT

The City Beautiful movement, which in the early 20th century advocated city beautification as a way to improve the living conditions and civic virtues of the urban dweller, had languished by the Great Depression. Today, new urban economic theorists and policymakers are coming to see the provision of consumer leisure amenities as a way to attract population, especially the highly skilled and their employers. However, past studies have provided only indirect evidence of the importance of leisure amenities for urban development. In this paper the authors propose and validate the number of leisure trips to metropolitan statistical areas (MSAs) as a measure of consumers' revealed preferences for local leisure-oriented amenities. Population and employment growth in the 1990s was about 2 percent higher in an MSA with twice as many leisure visits: the third most important predictor of recent population growth in standardized terms. Moreover, this variable does a good job of forecasting out-of-sample growth for the period 2000-2006. "Beautiful cities" disproportionally attracted highly educated individuals and experienced faster housing price appreciation, especially in supply-inelastic markets. Investment by local government in new public recreational areas within an MSA was positively associated with higher subsequent city attractiveness. In contrast to the generally declining trends in the American central city, neighborhoods that were close to "central recreational districts" have experienced economic growth, albeit at the cost of minority displacement.

Working Paper 08-22, "City Beautiful," Gerald A. Carlino, Federal Reserve Bank of Philadelphia, and Albert Saiz, The Wharton School, University of Pennsylvania, and Visiting Scholar, Federal Reserve Bank of Philadelphia

MEASURING GROWTH AND INTANGIBLE INVESTMENT IN THE CHANGING U.S. ECONOMY

In this paper the author focuses on three related and difficult areas of the measurement of national income. He argues that the economic theory underlying measurement of these items is currently controversial and incomplete.

Working Paper 08-23, "Intangible Assets and National Income Accounting," Leonard I. Nakamura, Federal Reserve Bank of Philadelphia

MODELING PREDATORY LENDING WITH AND WITHOUT COMPETITION

Regulators express growing concern over predatory loans, which the authors take to mean loans that borrowers should decline. Using a model of consumer credit in which such lending is possible, they identify the circumstances in which it arises both with and without competition. The authors find that predatory lending is associated with highly collateralized loans, inefficient refinancing of subprime loans, lending without due regard to ability to pay, prepayment penalties, balloon payments, and poorly informed borrowers. Under most circumstances competition among lenders attenuates predatory lending. They use their model to analyze the effects of legislative interventions.

Working Paper 08-24, "Predatory Mortgage Lending," Philip Bond, The Wharton School, University of Pennsylvania, and Visiting Scholar, Federal Reserve Bank of Philadelphia; David K. Musto, The Wharton School, University of Pennsylvania; and Bilge Yilmaz, Graduate School of Business Stanford University

SELECTING FACTOR PROXIES

In economics, common factors are often assumed to underlie the co-movements of a set of macroeconomic variables. For this reason, many authors have used estimated factors in the construction of prediction models. In this paper, the authors begin by surveying the extant literature on diffusion indexes. They then outline a number of approaches to the selection of factor proxies (observed variables that proxy unobserved estimated factors) using the statistics developed in Bai and Ng (2006a,b). The authors' approach to factor proxy selection is examined via a small Monte Carlo experiment, where evidence supporting their proposed methodology is presented, and via a large set of prediction experiments using the panel data set of Stock and Watson (2005). One of their main empirical findings is that their "smoothed" approaches to factor proxy selection appear to yield predictions that are often superior not only to a benchmark factor model, but also to simple linear time series models, which are generally difficult to beat in forecasting competitions. In some sense, by using the authors' approach to predictive factor proxy selection, one is able to open up the "black box" often associated with factor analysis, and to identify actual variables that can serve as primitive building blocks for (prediction) models of a host of macroeconomic variables, and that can also serve as policy instruments, for example. The authors' findings suggest that important observable variables include various S&P500 variables, including stock price indices and dividend series; a one-year Treasury bond rate; various housing activity variables; industrial production; and exchange rates.

Working Paper 08-25, "Seeing Inside the Black Box: Using Diffusion Index Methodology to Construct Factor Proxies in Large Scale Macroeconomic Time Series Environments," Nii Ayi Armah, Rutgers University, and Norman R. Swanson, Rutgers University, and Visiting Scholar, Federal Reserve Bank of Philadelphia.