The Relationship Between Capacity Utilization and Inflation

BY MICHAEL DOTSEY AND THOMAS STARK

A common belief is that when there's slack in the economy — that is, when labor and capital are not fully employed — the economy can expand without an increase in inflation. One measure of the intensity with which labor and capital are used in producing output is the capacity utilization rate. According to some economists, when capacity utilization is low, firms can increase employment and their use of capital without incurring large increases in the costs of production. So firms will not be forced to raise prices in order to make profits on additional output. But this theory is not universally accepted. In this article, Mike Dotsey and Tom Stark investigate some of the problems with what, at first glance, seems a compelling story.

A commonly held view in economics is that when there is slack in the economy — that is, labor and capital are not fully employed — the economy can expand without an increase in inflation. This idea has a long history in economic theory, with its earliest clear exposition dating back to John Maynard Keynes. There is also recent support for this view. For example, earlier this year Goldman Sachs noted in its newsletter that "core inflation has fallen by about one percentage point over the past year…This disinflation is consistent with the view that resource utilization is indeed too low."[1] Likewise, in its February 2004 forecast, Macroeconomic Advisers stated that "over the near term, inflation will be held in check by recently exceptional growth in productivity, slack conditions in labor markets, and global excess capacity in many goods markets."

One measure of the intensity with which labor and capital are used in the production of output is the capacity utilization rate.[2] When the capacity utilization rate is low, implying that there are unemployed workers and idle plant and equipment, it is assumed that firms can increase employment and their use of capital without incurring large increases in the costs of production. Hence, some theories accord with what seems like a very intuitive notion, namely, that firms will not be forced to raise prices in order to make profits on additional output. In that case, output can increase with very little inflation.

However, the above story is not universally accepted, and we shall investigate some of the problems with what, at first glance, seems a compelling story.[3] Further, even if the relationship between capacity utilization and inflation were theoretically sound, the strength of the relationship and its usefulness for monetary policy purposes is an empirical matter.

Our empirical research suggests that up to the mid-1980s, capacity utilization is modestly useful in

[1] Goldman Sachs *Global Economic Research* (newsletter), February 6, 2004.

[2] The capacity utilization rate is not the only measure that conveys whether resources are underutilized. Other common measures are the output gap (which measures the difference between the level of GDP and the level of potential GDP (that is, the level of maximum sustainable GDP), the NAIRU (which is the unemployment rate consistent with stable inflation), and the help-wanted index.

[3] An excellent example of a contrary view is given in the 1996 article by Mary Finn.

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helping to explain the behavior of inflation. However, the relationship between utilization and inflation is not a stable one. As the sample period is extended into the mid-1990s, capacity utilization's predictive power wanes or becomes nonexistent. Further, although the economic theory that underpins the intuition discussed above also indicates that the relationship between capacity utilization and inflation would vary with the rate of capacity utilization — with inflation rising more rapidly as capacity utilization increases — we find no evidence that this is the case.

A FIRST LOOK AT THE DATA

The capacity indexes computed by the Federal Reserve Board attempt to measure the ratio of the actual level of output to sustainable maximum or capacity output. The Board defines sustainable maximum output as "the greatest level of output a plant can maintain within the framework of a realistic work schedule, after factoring in normal downtime and assuming sufficient availability of inputs to operate the capital in place."[4] Thus, it measures output relative to what could reasonably be called normal output when the plant is employing the usual number of workers and using its machinery at a typical intensity. The capacity level of production is estimated from annual surveys of manufacturing capacity utilization conducted by the Bureau of the Census along with data supplied by other government and private-industry sources. The staff at the Board of Governors use this information to construct estimates of capacity and capacity utilization for industries in manufacturing, mining, and electric and gas utilities.[5] Because the survey is yearly, changes in the capacity utilization rate largely reflect actual movements in production.[6]

We begin our investigation of the relationship between capacity utilization and inflation by plotting the two series over the period 1959 to 2003.[7] Examining the relationship between capacity utilization and inflation, we see that there are periods when utilization and inflation move in the same direction and even when the movements in utilization precede movements in inflation (Figure 1). For example, in 1972 manufacturing capacity utilization increased from roughly 77 percent to 88 percent and was followed by an increase in annual inflation of 8 percentage points. Likewise in 1976, manufacturing capacity utilization increased a dramatic 14 percentage points and was followed by an increase in the inflation rate of 4 percentage points. Moreover, the relationship between utilization and inflation has not just involved positive responses. In 1974, utilization declined 16 percentage points, and inflation soon decreased 5 percentage points. On the other hand, we see large increases as well as high levels of utilization throughout the 1990s, and inflation steadily declined during that period. The same overall pattern of behavior is observed in the early 1960s. Thus, from looking at the raw data, we cannot easily discern the presence

[4] See the explanatory notes for the Industrial Production and Capacity Utilization G.17 Federal Reserve Statistical Release at www.federalreserve.gov/releases/G17/cap_notes.htm.

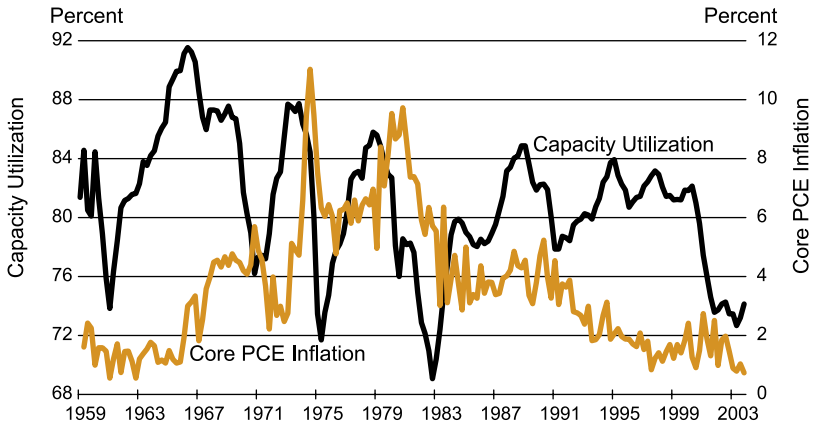
[5] On the basis of these surveys, the Board staff also makes monthly estimates of capacity by assuming that capacity follows a linear trend within the year.

[6] For a more thorough discussion of how capacity utilization is constructed, see the articles by Norman Morin and John Stevens, Carol Corrado and Joe Mattey, and Zolton Kenessey.

[7] To measure capacity utilization, we use the capacity utilization rate in manufacturing. Our measure of inflation is the annualized quarterly change in the price index for personal consumption expenditures less food and energy (core PCE).

FIGURE 1

Core PCE Inflation and Capacity Utilization



Core PCE Inflation is measured as the annualized one-quarter percent change in the core price index for personal consumption expenditures.

Capacity utilization is capacity utilization in manufacturing.

of a significant statistical or predictive link between capacity utilization and inflation.

But can we find a more exact relationship by concentrating on the link between capacity utilization and inflation over the business cycle? Capacity utilization is highly cyclical, and it may be that its primary influence on inflation is over the business cycle as well. Our first empirical examination of the link between the capacity utilization rate and inflation is to look at their correlations once we have removed both the trends and the very short-term noise in the series (Figure 2).[8] As seen in the figure, current capacity utilization is highly positively correlated with future inflation, indicating that when capacity utilization is high, inflation in the future will also be high. Similarly, if capacity utilization is currently low, inflation will be low in the future as well. The current capacity utilization rate shows its highest correlation with inflation five quarters in the future. Thus, over the business cycle, it looks like capacity utilization rates lead inflation.

[8] To do this, we first used a band-pass filter to filter out long-run and very short-term components of the two series. We then computed the correlation between the two series.

A SKETCH OF SOME THEORIES

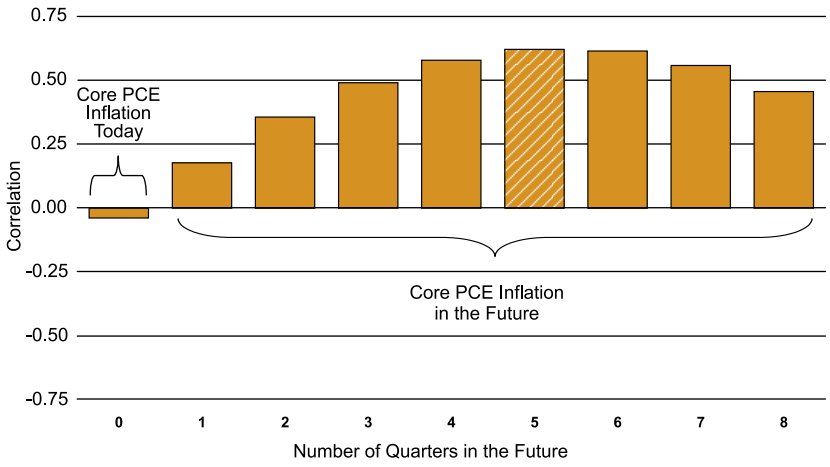
Effects of Increases in Demand Induced by Monetary Policy. The clearest early exposition of the relationship between the intensity with which resources are used in production and changes in the price level is provided in John Maynard Keynes' *General Theory of Employment, Interest, and Money.* In his treatise, Keynes postulated that the price level was tied directly to the cost of production and that production costs, in turn, were linked to the intensity with which factors of production — labor and capital — were used. For example, if employment was well below full employment, Keynes assumed that a monetary-policy-induced increase in aggregate demand would not cause an increase in wages. Additional labor would be readily supplied at the going wage rate. As a result, the cost of producing more output did not require any increase in prices. Thus, when employment was below full employment, monetary policy could stimulate output with very little increase in the price level — that is, the general level of prices in the economy.

He also considered how intensively capital was being used when thinking about how much prices would need to adjust when demand increased. He postulated that all factors of production would generally not reach their full employment levels simultaneously, nor would all industries simultaneously reach full production. As demand increased, more and more industries would find themselves at full employment, and any further increase in demand would merely cause an increase in the prices they charged. Thus, as the economy as a whole got closer to fully employing labor and capital, prices would increase at an accelerated pace as aggregate demand increased. In other words, higher levels of capacity utilization would imply an increasingly higher price level.

Although the original theory was postulated as a relationship between the price level and utilization, the modern view links inflation with utilization. This theory suggests that prices increase at a faster rate when utilization rates are high and that we should, therefore, see a stronger relationship between inflation and utilization when utilization rates are high. Importantly, the rate of utilization will influence the inflationary consequences of monetary

FIGURE 2

Business-Cycle Correlations Between Capacity Utilization Today and Core PCE Inflation Today and in the Future



A correlation of one indicates that the series move together perfectly, while a correlation of zero indicates that the two series are unrelated. A correlation of minus one indicates that the series moves in opposite directions perfectly.

policy. For example, accommodative policy might be more inflationary when capacity utilization is high.

Long-Run Implications. Keynes' theory, like many modern macroeconomic theories, implies that monetary policy can affect economic activity in the short run. However, unlike any respectable modern theory, his theory also implied that output was affected in the long run as well. An increase in output back to its capacity level, which was caused by a monetary-policy-induced increase in demand, was permanent. In modern models, monetary policy's only long-run effect is on prices.

Thus, according to the modern view, an increase in demand induced by monetary policy will initially cause output and utilization rates to rise. But as time passes, prices will begin to adjust and inflation will increase. As a consequence of rising prices, output and utilization rates will fall back to their initial levels. In this case, inflation and utilization rates might be negatively correlated, depending on the specific path of inflation and utilization. For example, typically, in response to expansionary monetary policy, inflation rises quite slowly at first, then picks up steam, and finally reverts to its average rate. Measured capacity utilization, on the other hand, rises quite quickly and declines much more quickly than inflation. Thus, along part of their joint trajectory — when inflation is still rising but capacity utilization rates have already begun to decline — the two series are negatively correlated.[9] The dynamic relationship between these two variables is entirely missing from the basic Keynesian theory.

Including the Effects of Other Types of Shocks. Up to this point, we have focused on changes in demand primarily induced by monetary policy. However, changes in monetary policy account for only a part of the disturbances that affect economic activity. Changes in productivity (i.e., the output produced by an hour of work) are also a primary source of economic fluctuations, and the early Keynesian theory offers little in the way of understanding how changes in productivity affect both utilization rates and inflation. Increases in productivity lead to increases in output, but they also lead to an increase in the level of capacity;[10] that is, the economy is simply capable of producing more goods. So, at first glance, productivity's effect on capacity utilization is ambiguous.

But it takes time for firms to add new capacity. Initially, firms will use their more productive workers more intensively, thereby increasing output. Thus, in the short run, increases in productivity should lead to increases in capacity utilization. In the long run, additional capital will be built up through increased investment, and capacity output and actual output will move one-for-one.

Thus, increases in productivity can lead to a short-run increase in capacity utilization. However, it is the way in which monetary policy reacts to the increase in productivity that determines whether the increase in utilization will be associated with an increase or decrease in inflation.[11] Therefore, the relationship between inflation and changes in capacity utilization brought about by changes in productivity could vary over time, depending on how monetary policy responds to the increase in productivity.

CONFRONTING THE THEORY WITH THE DATA

The preceding discussion suggests that inflation could be influenced by capacity utilization rates, but at the same time, it indicated that the relationship might not be very exact. The simple Keynesian theory suggested a strong relationship between changes in capacity utilization and inflation when these changes were demand driven, while long-run considerations and the consideration of other types of disturbances indicated that the link might not be very strong at all.

To shed light on the theoretical uncertainty, we now explore the statistical relationship between capacity utilization and inflation along a number of dimensions.[12] First, how well does capacity utilization predict inflation?

The relationship between inflation and changes in capacity utilization brought about by changes in productivity could vary over time, depending on how monetary policy responds to the increase in productivity.

[9] The description of the behavior of capacity utilization and inflation is based on the empirical work of David Altig, Lawrence Christiano, Martin Eichenbaum, and Jesper Linde.

[10] This effect would be picked up in the Federal Reserve's survey-based measure of capacity.

[11] For a more complete explanation of the role monetary policy plays in how productivity improvements affect the economy, see Mike Dotsey's previous *Business Review* article.

[12] We investigate a particular measure of inflation, inflation in the core PCE; a particular measure of resource utilization, the capacity utilization rate; and a particular simple specification of the relationship between the two, one that doesn't include other variables that might influence the relationship, e.g., the unemployment rate or productivity growth. A more thorough analysis would include more complicated specifications and other measures of inflation and resource utilization.

In the simple theories outlined above, it is possible that utilization will begin to change before inflation changes, and we wish to see if we can confirm this behavior. So we will test whether the past and current behavior of utilization rates helps predict future rates of inflation. Second, when the capacity utilization rate is low, some theories predict that inflation may not be very responsive to an increase in demand. At the same time, when utilization rates are high, inflation will be very responsive to demand. Thus, utilization's effect on inflation may vary with the level of utilization, and we will test to see if this is the case as well.

In particular, we want to see if utilization rates can tell us anything more about the behavior of inflation than we could learn just by looking at the behavior of inflation itself.[13] For instance, our look at simple correlations indicated that past utilization rates are positively correlated with current inflation. We would like to know, however, if utilization rates help to predict future inflation over the period 1959-2003, taking into account the behavior of current and past inflation.

To test whether capacity utilization aids our ability to predict core PCE inflation over and above what we could have done by just using inflation itself, we ran two regressions: a regression of average inflation over the past year on a constant, past capacity utilization, and on past quarterly inflation rates, and a regression of average inflation over the past year on past quarterly inflation rates alone (see *Empirical Specification*).

The top panel of Figure 3 shows the actual year-over-year inflation rates (blue line) for the core PCE and the predicted values of inflation from the two regressions. The predictive values that use capacity utilization are shown by the black line and those that use only past inflation are shown by the orange line. For our entire sample period covering 1959 to 2003, we find that past rates of capacity utilization are statistically significant — that is, they help predict future inflation — but that their effect on the actual forecast is quite small.[14] The predictions of inflation do not appear to be very different whether we include capacity utilization or not — the orange line tracks the blue line about as well as the black line does. This is seen more clearly in the bottom panel when we look at the difference between the predicted values and actual values (called forecast errors). The average absolute value of the forecast error falls from 0.66 percent when capacity utilization is not included to 0.60 percent when capacity utilization is included. Moreover, the ability of capacity utilization to forecast inflation has fallen over time. Over the period 1984-2003 our estimations indicate that capacity utilization no longer statistically helps predict inflation. This result is consistent with the graphs in Figure 1, which suggest that the relationship between capacity utilization and inflation is less strong over the latter half of the sample period. For example,

Empirical Specification

Our basic regression is
$100[P(t) - P(t\text{-}4)] = a + b_0*[400(P(t\text{-}4)\text{-}P(t\text{-}5)] + b_1*[400(P(t\text{-}5)\text{-}P(t\text{-}6)] + \ldots + b_n*[400(P(t\text{-}4\text{-}n)\text{-}P(t\text{-}5\text{-}n)] + c_0*CU(t\text{-}4) + \ldots. + c_m*CU(t\text{-}4\text{-}m) + e(t)$,
where P(t) is the log of the quarterly average of the monthly chain-weighted price index for core personal consumption expenditures at time t and CU(t) is the rate of capacity utilization in manufacturing at time t. The number of lags was chosen by minimizing the Bayesian information criteria, and standard errors are corrected for heteroscedasticity and serial correlation using the methodology of Newey and West. For the sample period covering 1959:Q1 to 2003:Q4, our Granger-causality results are based on the parameter estimates in the table below. The coefficient, c_0, on capacity utilization is significant at the 1 percent level, indicating that capacity utilization helps forecast core PCE inflation over the entire sample.

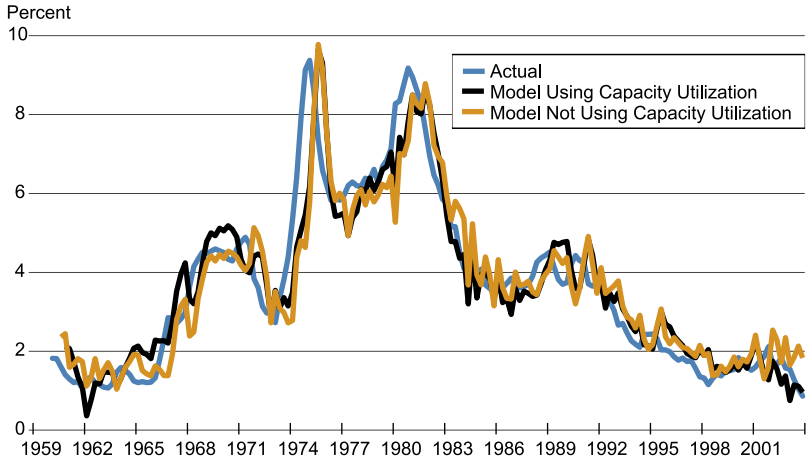
Coefficient	Estimate	HAC Standard Error
a	-8.455	2.032
b_0	0.516	0.074
b_1	0.219	0.105
b_2	0.200	0.069
c_0	0.107	0.025
R^2	0.85	
SEE	0.84	

[13] The statistical name for this procedure is a Granger causality test. In all of the regressions, we chose the number of lags that gave the best specification as determined by that which minimized the Bayesian information criterion.

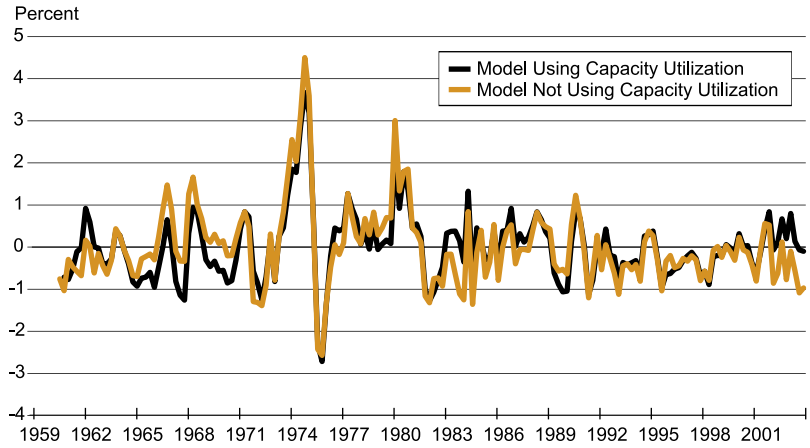
[14] Specifically, our results are significant at the 1 percent level. A 1-percentage-point increase in the utilization rate leads to an increase in yearly inflation of only 0.107 percentage point. These results are consistent with those reported in the paper by Stephen Cecchetti and the one by Kenneth Emery and Chih-Ping Chang.

FIGURE 3

Actual and Predicted Core PCE Inflation: In-Sample



Difference Between Actual Value and Predicted Value of Core PCE Inflation



The mean absolute error is 0.66 percent in the model not using capacity utilization and 0.60 percent in the model using capacity utilization.

capacity utilization rates are moving up throughout most of the 1990s while core PCE inflation is falling.[15]

Explaining the Empirical Findings. Why might the relationship be significant in some periods and not in others? One possible explanation may be related to the different types of shocks that have hit the economy over the sample period and the different responses that utilization and inflation have to these shocks.

Another explanation revolves around the changing nature of monetary policy itself. Recall that the theoretical link between capacity utilization and inflation is most precise when the predominant economic disturbances are shocks to demand brought about by changes in monetary policy. Expansionary monetary policy in the presence of economic slack leads to increases in output with little upward pressure on inflation. During times when labor and capital markets are tight, it leads mostly to rising prices and inflation.

With respect to productivity disturbances, the implications are less clear. Depending on how monetary policy reacts, there could be little relationship between utilization and inflation. Indeed, recent theoretical work indicates that it is optimal for monetary policy to insulate the price level and inflation from productivity disturbances.[16] Doing so maximizes the economy's ability to react efficiently to changes in productivity. If we look at the data over the 1990s, monetary policy appears to have done that. So if much of the economic activity in the 1990s was driven by changes in productivity, and if the central bank was operating in an optimal manner, we would not expect to see a strong link between inflation and capacity utilization rates over this sample period.

Does Utilization's Effect Vary with Its Level? Another reason that capacity utilization's effect on inflation might vary over time is that its effect may depend on its level. This would be the case if, as suggested by basic Keynesian theory, the weakest link between capacity utilization and inflation occurred at very low utilization rates,

[15] The vanishing predictive content of utilization found here matches results reported in Emery and Chang (1997). This means that over the later sample, past capacity utilization has no statistically significant independent effect on inflation other than its possible effect on past inflation rates themselves.

[16] The intuition for this result is discussed more fully in Mike Dotsey's previous *Business Review* article. More detailed theoretical analysis can be found in the papers by Robert King and Alexander Wolman; Aubhik Khan, Robert King, and Alexander Wolman; and Michael Woodford.

while the strongest link occurred at very high utilization rates. For the former, we would expect that when utilization was below some threshold, utilization rates would rise with no change in inflation. For the latter, we would expect that when utilization rates were above some threshold, changes in aggregate demand would bring about big changes in inflation.

To test this implication, we ran a regression where we separately considered the effects of very high utilization rates, average utilization rates, and very low utilization rates.[17] We found that the relationship between utilization rates and core PCE inflation does not vary with the level of utilization. This result rejects one of the implications of the Keynesian theory[18] and indicates that, in our specification, changes in utilization, whether starting from a level of slack or a level of tightness, imply the same future effect on core PCE inflation, namely, a 1-percentage-point increase in manufacturing capacity utilization implies a 0.107-percentage-point increase in core PCE inflation.

[17] We do this by dividing the utilization rates into three roughly equal portions: u-low, u-middle, and u-high. For a normally distributed variable the boundaries determining u-middle are the mean of u ±0.43 times the standard deviation of u. Thus, the groups are formed by defining u-low = u if u is less than the mean of u minus 0.43 times the standard deviation of u and zero otherwise. Similarly, u-high=u if u is greater than the mean of u plus 0.43 times the standard deviation of u and zero otherwise. U-middle = u if u falls in between these two bounds and zero otherwise. We find that it works well and that it approximately divides the utilization series into three equally represented orthogonal components. We computed 56 nonzero observations that fall into the u-high category, 60 in the u-low category, and 64 in the u-middle category for the period 1959 to 2003. The mean of the nonzero observations falling into u-high is 86.05, 76.08 for u-low, and 81.32 for u-middle.

[18] These results are consistent with those reported in Mary Finn's 1995 article. Finn uses a slightly different specification over a different sample period.

FORECASTING USING ONLY SOME OF THE AVAILABLE DATA

If a policymaker were to rely on the relationship between capacity utilization and inflation when setting policy, he could only use available data. A policymaker in 1983 would have had no knowledge of the statistical relationship between these two variables in the 1990s because that data had not yet been generated. Further, it is not clear that the policymaker would even want to use all the data available to him at the moment. We just discussed our analysis of the statistical relationship between capacity utilization and core PCE inflation over the entire sample period, which is the correct procedure if the statistical relationship is stable. However, the relationship may not be stable, implying that it is different in different periods. For example, if the relationship between capacity utilization and inflation differs between the 1960s and the 1980s, we would not want to use data from the 1960s to help us predict inflation in the 1980s. To address this issue, we would need to look at so-called out-of-sample prediction, that is, predicting future inflation at any point in time by using only data that were available at that time, and perhaps only some portion of the available data.[19]

Over some periods including utilization helps to predict core PCE inflation, but at other times, including it actually makes the forecasts worse.

[19] We do, however, use final revised data rather than real-time data in this exercise.

Our statistical analysis (discussed in *The Changing Relationship Between Inflation and Utilization Rates*) suggests that the relationship between core PCE inflation and capacity utilization is not stable, implying that additional tests for analyzing whether capacity utilization helps predict inflation are required. Therefore, we re-estimated our model using only the most recent 60 quarters of data, starting from the first quarter of 1961 through the fourth quarter of 1975, and then successively updating our 60-quarter sample. For example, the prediction of inflation for 1983 is based on data over the sample 1968-1982.

Figure 4 is similar to Figure 3 in showing both the predicted inflation from these rolling regressions when capacity utilization is either included or excluded and the resulting forecast errors of the two specifications. Our results indicate that up to about 1990, it matters whether utilization rates are included. Over some periods — for example, during the early 1980s — including utilization helps to predict core PCE inflation, but at other times, such as the late 1980s, including it actually makes the forecasts worse. The forecast errors actually become larger when capacity utilization is included. Over the entire period, we find virtually no difference in forecast accuracy. As the sample progresses, capacity utilization neither hurts nor helps our ability to forecast core PCE inflation, reflecting the fact that over the past 13 years, capacity utilization has not proven very useful for forecasting core PCE inflation.[20]

[20] The waning usefulness of capacity utilization as a predictor of core PCE inflation is consistent with recent work by Stephen Cecchetti, Rita Chu, and Charles Steindel. However, James Stock and Mark Watson find that capacity utilization continues to help predict inflation over the period 1984-1996 using a recursive forecasting method. Because we find some evidence of parameter instability, we used the alternative procedure of rolling regressions.

The Changing Relationship Between Core PCE Inflation and Capacity Utilization Rates

A monetary policymaker who wanted to formulate policy relying on the relationship between capacity utilization and inflation would need to know if that relationship would continue to hold. But how stable is the empirical relationship between capacity utilization and inflation?

To explore the stability of the relationship between capacity utilization rates and core PCE inflation, we looked at the behavior of the estimated regression coefficients over time. To do this, we ran a number of regressions, each on 60 quarters of data. We started with a sample period beginning in the first quarter of 1961 and ending in the fourth quarter of 1975 and then updated the starting and ending dates by one quarter. Our last regression covered the period from the first quarter of 1989 through the fourth quarter of 2003. For each of these rolling regressions, the top and bottom panels of the figure show the coefficients on the first lag of inflation and the first lag of capacity utilization as well as the 95 percent confidence interval for each of the coefficient estimates. These confidence intervals indicate that the true value of the coefficient lies within the range with 95 percent probability. When the interval includes zero, the coefficient is not statistically different from zero.

It is easy to see that the coefficients describing the behavior of core PCE inflation (i.e., the coefficients on $(P_{t-4} - P_{t-5})$ and CU_{t-4}) are changing over time. The coefficient on capacity utilization is positive and generally significantly different from zero over the early part of the sample. As time goes forward, however, it becomes insignificantly different from zero. This experiment gives further credence to the assertion that the relationship between capacity utilization rates and inflation has changed over time.

FIGURE

Rolling Coefficient Estimates for Core Inflation

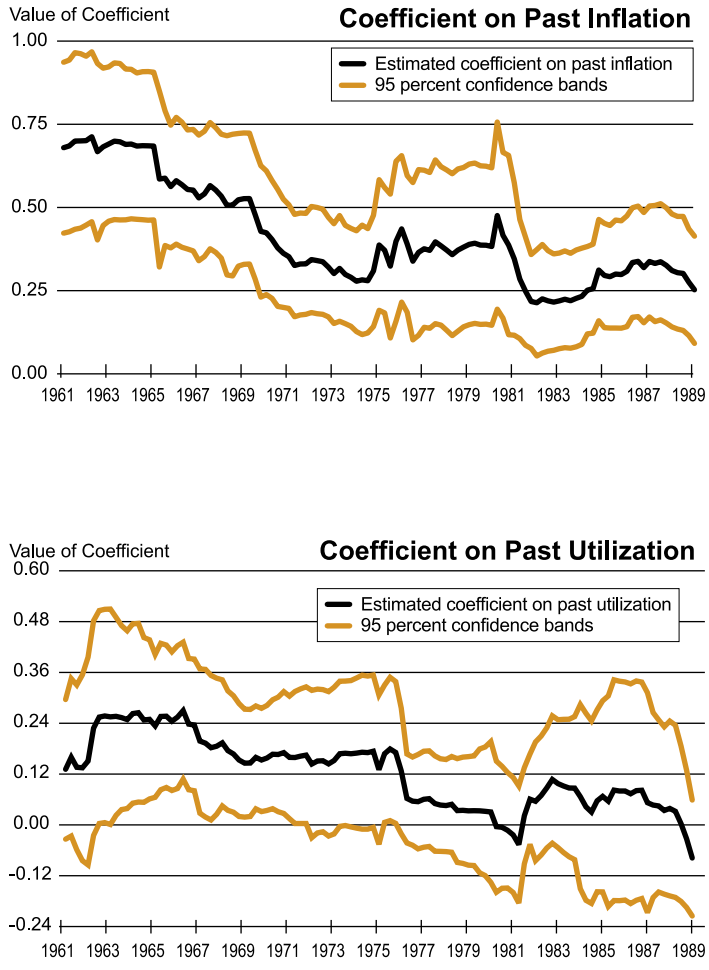
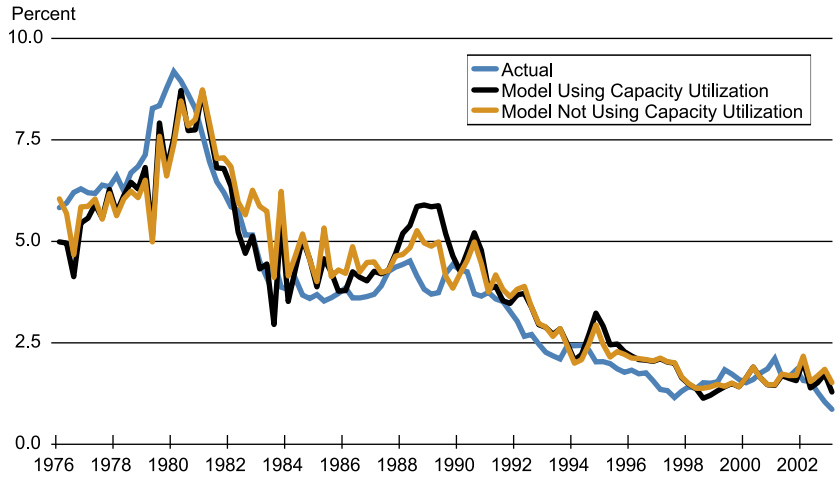


FIGURE 4

Actual and Predicted Core PCE Inflation: Out-of Sample



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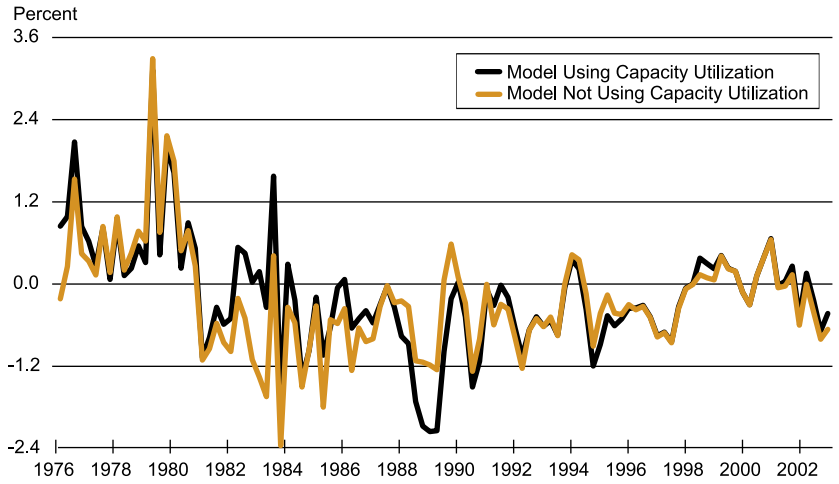

CONCLUSION

Various theories suggest that the intensity of resource use could be an important determinant of inflation. At first glance, it appeared that an economy with lots of spare capacity was less likely to experience an increase in inflation than one that was fully employing all of its resources.

However, the theories describing the causal relationship between utilization and inflation are not universally accepted, and it is quite possible that both inflation and capacity utilization are driven by more fundamental factors, such as changes in productivity or monetary policy. Moreover, the relationship between utilization and inflation could be sensitive to which fundamental factor is driving the economy and the way in which monetary policy responds to those fundamentals, making the relationship quite complex and conditional on economic circumstances. Therefore, drawing inferences about how capacity utilization will affect inflation is a bit tricky. It depends on both the types of shocks hitting the economy and the central bank's response to those shocks. Thus, the joint behavior of utilization and inflation could vary over time for a number of reasons.

Our empirical investigation of one specification of the statistical relationship between capacity utilization and core PCE inflation suggests that the relationship is not robust. Over different sample periods, capacity utilization's ability to help explain or predict the behavior of core PCE inflation varies quite a bit. Sometimes utilization rates are modestly useful, and at other times, especially over the past 15 years or so, they have been unhelpful.

This lack of robustness could be due to changing policy responses to productivity shocks. A well-run monetary policy will allow changes in productivity to influence economic activity without changing inflation. If changes in productivity have been the prevailing driving force behind the economic activity of the last 15 years, and if monetary policy has been conducted in an optimal manner,[21] changes in utilization should not be correlated with changes in inflation. That evidence would not necessarily imply that in response to some other type of economic disturbance, the utilization rate would be uninformative about the likely path of inflation. But our empirical results, using linear forecasting equations, suggest that one should be cautious in predicting core PCE inflation using a simple model of capacity utilization rates.

[21] See Mike Dotsey's previous *Business Review* article for suggestive evidence that this has indeed been the case.

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