Capacity Utilization and U.S. Inflation

By C. Alan Garner

Policymakers and economic analysts have recently been concerned about potential inflationary pressures in the U.S. economy. Various economic statistics show the amount of unused productive resources has been diminishing. For example, the civilian unemployment rate has decreased and the capacity utilization rate of the nation's factories has risen. If real output grows rapidly in the future, the competition for scarce productive resources could put upward pressure on wages and other production costs and ultimately could raise consumer price inflation.

Some analysts have challenged the view that productive resources are becoming so scarce that higher inflation is a danger. This challenge partly turns on whether the capacity utilization rate, which measures the percent of manufacturing capacity currently in use, is a reliable indicator of inflationary pressures. Most economic forecasters believe inflationary pressures build after capacity utilization rises above a certain level. Some analysts have claimed, however, this historical relationship is no longer valid because the economy has become more open, allowing imported goods to relieve any shortage of domestic capacity. Some analysts also have argued that manufacturing capacity shortages will not be a problem in the foreseeable future because of rapid technological progress and strong business investment.

This article examines whether the capacity utilization rate for the manufacturing sector is still a reliable indicator of inflationary pressures. The first section describes the capacity utilization rate and summarizes recent arguments about whether the relationship between capacity utilization and inflation has changed. The second section presents empirical evidence testing whether the economy can now operate at a higher utilization rate than in the past without the inflation rate rising. The article concludes that the historical relationship between capacity utilization and inflation still holds, indicating the capacity utilization rate remains a reliable indicator of inflationary pressures.

BACKGROUND ARGUMENTS

Inflationary pressures typically emerge when the overall demand for goods and services grows faster than the supply, causing a decrease in the amount of unused productive resources, or economic slack. Economists measure economic slack in various ways. Perhaps the most common measure is the unemployment rate, which measures unused resources in the labor market. Another measure of slack is the real output gap, the estimated difference between actual real output and the economy's potential output. This section examines a third major measure of economic slack, the capacity utilization rate.

C. Alan Garner is a senior economist at the Federal Reserve Bank of Kansas City. David Hensley, a research associate at the bank, and James O'Toole, a research assistant, helped prepare the article.

Stable-inflation capacity utilization

The capacity utilization rate measures the operating rate of the nation's industrial capacity. This article focuses on capacity utilization in the manufacturing sector and thus excludes mining and utility output. The capacity utilization rate equals the Federal Reserve's index of manufacturing output divided by the index of manufacturing capacity. Capacity is defined as the highest sustainable level of output by the manufacturing sector.[1] Because estimates of capacity evolve slowly over time, short-term movements in the capacity utilization rate primarily reflect changes in manufacturing output. But over longer periods, the growth rate of manufacturing capacity varies in response to technological progress and changing levels of business investment.

Most economic forecasters believe the capacity utilization rate is a useful indicator of inflationary pressures. Historically, capacity utilization in the manufacturing sector has tightened before the rate of consumer price inflation has increased (Chart 1). As the slack in the economy diminishes, firms typically face higher production costs in order to raise their output further. Firms may have to hire inexperienced workers or put older, less efficient plant and equipment back into service. The higher production costs would usually be passed through to the ultimate purchaser as higher prices of finished goods.

Inflationary pressures can be judged by comparing the current capacity utilization rate with an estimated stable-inflation capacity utilization rate. When capacity utilization is at the stable-inflation rate, inflation tends neither to increase nor decrease. The concept is similar to the natural rate of unemployment, the unemployment rate for which inflation neither increases nor decreases, but uses capacity utilization rather than unemployment as the measure of economic slack.[2] In this view, inflation will rise as long as capacity utilization is above the stable-inflation rate. Conversely, inflation will fall whenever capacity utilization is below the stable-inflation rate.

Past economic research found that the stable-inflation capacity utilization rate in the manufacturing sector was about 82 percent. For example, McElhattan (1985) estimated a stable-inflation capacity utilization rate of 81.7 percent for 1959-83. More recent work by Franz and Gordon produced an identical estimate for 1973-90 even though they used a different estimating equation and a different inflation measure.[3] Moreover, these studies found the stable-inflation capacity utilization rate was relatively steady over time. But despite this evidence, some analysts believe the capacity utilization rate has become a less reliable indicator of inflationary pressures.

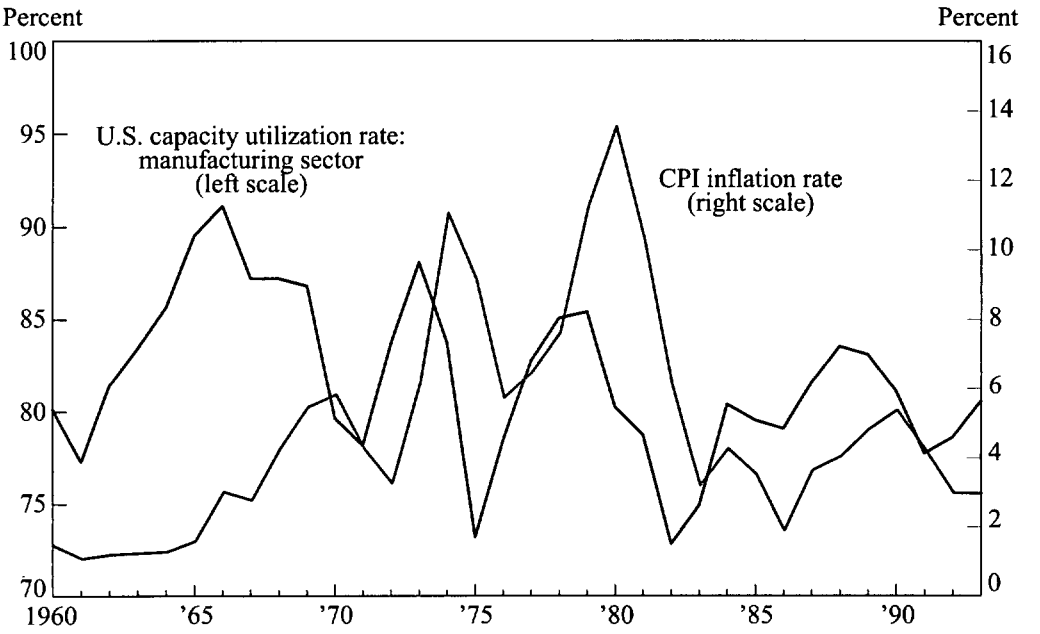
Effects of greater openness

Some analysts contend the capacity utilization rate has become a less dependable indicator of inflationary pressures because the greater openness of the U.S. economy to foreign-produced goods has shifted the stable-inflation capacity utilization rate (Harris). International trade in goods and services has clearly become more important as a share of economic activity. Chart 2 shows that nonoil merchandise imports have risen steadily as a share of gross domestic output, or GDP, over the last three decades. When domestic demand is strong and U.S. factories are operating at a high utilization rate, goods can be purchased from foreign producers with excess capacity. The extra supply of imported goods will, it is argued, moderate inflationary pressures and so weaken the link between domestic capacity utilization and the inflation rate.

Several counterarguments suggest that domestic capacity utilization may remain a reliable indicator of inflationary pressures despite the greater openness of the U.S. economy (Tatom; Krugman). Most domestic output is not traded internationally, including most consumer services and government output. As Krugman noted, large parts of the economy are "effectively insulated" from foreign markets and therefore can experience inflation even

Chart 1

Capacity Utilization and the CPI Inflation Rate



Sources: Board of Governors of the Federal Reserve System and U.S. Department of Labor.

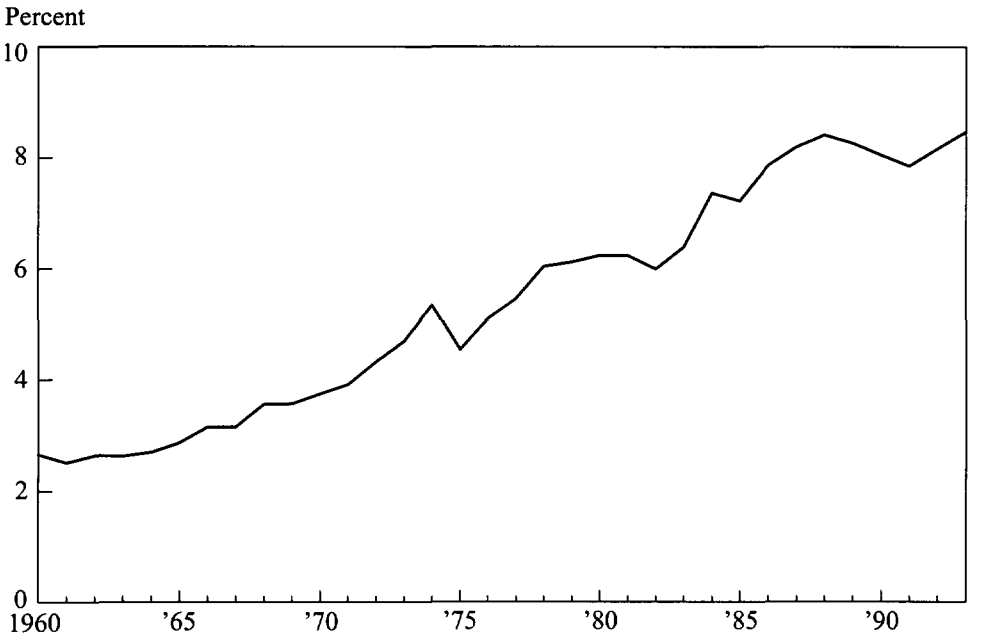
when substantial economic slack exists abroad. And for internationally traded goods, U.S. and foreign products are often not perfect substitutes, implying domestic producers may have some ability to raise their prices relative to foreign producers when aggregate spending is strong.

A sharp increase in U.S. spending on imported goods also might have inflationary exchange rate effects. Tatom noted that an increased demand for foreign goods as domestic inflationary pressures rise would likely increase the demand for foreign currencies. The resulting decrease in the foreign exchange value of the dollar would tend to raise import prices and so worsen the U.S. inflation rate. A booming U.S. economy therefore may raise the inflation rate even if domestic demand can, to some extent, spill over into foreign markets with excess capacity.[4]

Recent history provides clear examples of open economies that developed inflationary problems when growth was too fast. For example, Krugman pointed to the British experience in the late 1980s. A boom in the British economy produced a sharp increase in inflation even though the United Kingdom has a much more open economy than the United States. Similarly, Tatom noted that strong monetary growth associated with German reunification in 1991 caused inflation to rise even though Germany has a more open economy than the United States, and substantial excess capacity existed at the

Chart 2

Nonoil Merchandise Imports as a Share of GDP



Source: U.S. Department of Commerce.

time in the United States, Canada, and the United Kingdom.

Effects of productivity growth

Some analysts believe the capacity utilization rate is not a reliable indicator of inflationary pressures because the U.S. economy is currently experiencing rapid productivity gains (Farrell). In this view, the economy is undergoing major structural changes such as corporate reengineering, adoption of new computer and telecommunications technologies, and high levels of business equipment investment. The extreme version of this argument is that capacity is unlikely to be a constraint on economic growth in the near future because of these improvements in industrial productivity. In this extreme case, there is virtually no limit to how fast the economy can grow with stable inflation.

Policymakers and forecasters should be skeptical of any claim that the economy is departing dramatically from the historical relationship between capacity utilization and inflation. At this point in the recovery, the evidence does not support the extreme view that business productivity has improved radically. Business spending on plant and equipment has been strong recently, and labor productivity has grown faster in the current expansion. But these variables typically grow faster

in an economic recovery. Moreover, the growth of business fixed investment and labor productivity in the current recovery is not dramatically different than in other postwar recoveries of the same duration (Chart 3). For example, productivity rose 6.6 percent—not annualized—over the first 13 quarters of the current expansion, but productivity also rose 7.9 percent over the first 13 quarters of expansion in 1975-78 and 6.6 percent over the similar period in 1982-86. Thus, the recent strength in business investment and productivity growth appear to primarily reflect cyclical fluctuations rather than a break with longer term economic trends.

A less extreme view is that current statistics may overstate the capacity utilization rate somewhat because of problems in measuring manufacturing capacity (Epstein). In particular, official capacity estimates are based partly on a biennial survey by the U.S. Department of Commerce. The most recent data from this survey are for the end of 1992, and the next survey will provide end-of-year capacity use data for 1993 and 1994. If the official statistics have not fully captured recent capacity gains resulting from technological progress and strong business investment, the figures on manufacturing capacity might be revised upward, and the corresponding capacity utilization rates might be revised downward.

But revisions to the capacity utilization statistics might not change the conclusion that the manufacturing sector is operating at or somewhat above its stable-inflation capacity utilization rate. Because capacity utilization is currently well above McElhattan's estimated stable-inflation rate, the capacity utilization rate could be revised downward without changing the conclusion that the economy is operating at or above the stable-inflation rate. Revisions to past capacity utilization rates also might have a small effect on the estimated stable-inflation capacity utilization rate. Large changes in the estimated stable-inflation rate are unlikely, however, because the capacity utilization statistics will be revised for only a small part of the sample period.

EMPIRICAL EVIDENCE

The arguments against using capacity utilization as an indicator of inflationary pressures are not particularly compelling in light of the previous discussion. Moreover, the open economy arguments could have been made over much of the last 30 years, yet empirical evidence shows the stable-inflation capacity utilization rate has been surprisingly steady. This section presents additional estimates confirming the steadiness of the stable-inflation capacity utilization rate.

The estimating equation

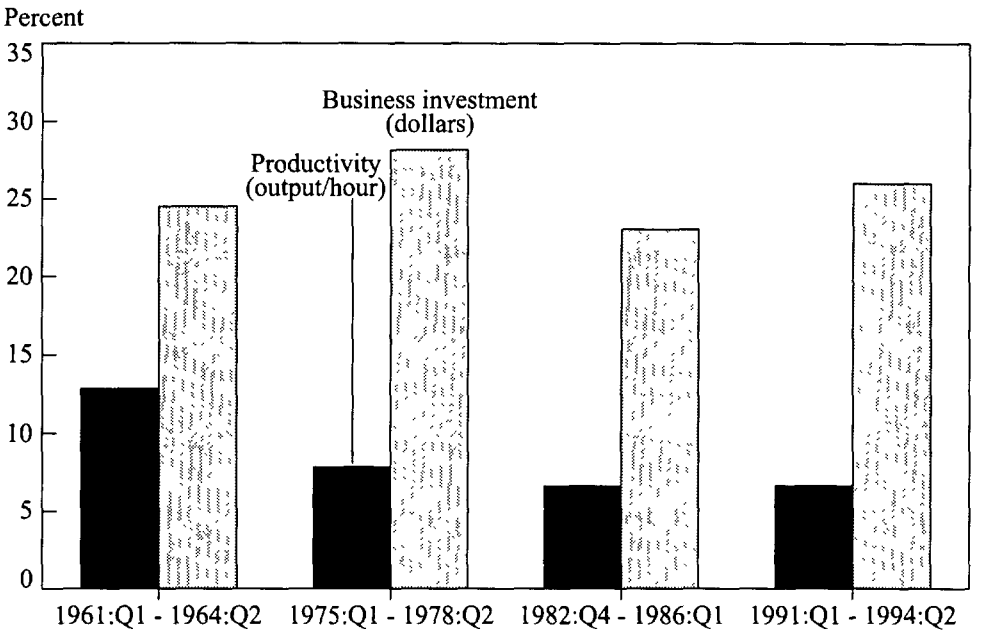
An estimate of the stable-inflation capacity utilization rate can be obtained from a short-run Phillips curve, a statistical equation describing the short-run tradeoff between inflation and a measure of economic slack. Slack is measured by the capacity utilization rate for the manufacturing sector. Other determinants of inflation also are included to ensure the equation adequately describes the inflationary process. After setting the effects of these other determinants to zero, the short-run Phillips curve can be solved for the capacity utilization rate that keeps the overall inflation rate stable.

The other determinants of inflation are aggregate supply variables, which affect the price level by changing the cost of producing goods and services. Perhaps the best example of such a variable is the price of crude petroleum products. Because petroleum is used to produce and transport a wide range of goods and services, large increases in crude oil prices have had a major impact on inflation during the last 30 years. Other supply-side variables included in the short-run Phillips curve represent the Nixon administration's wage-price controls and changes in the foreign exchange value of the dollar.

This section focuses on a short-run Phillips curve explaining changes in the consumer price index, or CPI, in terms of capacity utilization and the supply-side variables. The CPI is an important

Chart 3

Changes in Productivity and Business Investment



Note: The changes in productivity and business investment are 13-month nonannualized percentage changes calculated from the beginning of an expansionary period.

Sources: U.S. Department of Labor and U.S. Department of Commerce.

price index for policymakers and economic analysts because it measures changes in the cost of living. Other inflation measures are considered briefly at the end of this section. The equations were estimated with annual data for 1964-93 or selected subperiods. The appendix provides a further description of the short-run Phillips curve and more detailed empirical results.

Results with the CPI

Estimates of the stable-inflation capacity utilization rate change little when the short-run Phillips curve is estimated over different time periods. Table 1 contains estimates of the stable-inflation rate for five different periods. As the end of the period gradually moves from 1983 to 1993 in the first four columns, the estimated stable-inflation rate is surprisingly steady at slightly below 82 percent. In the fifth column, the first ten years of the sample are dropped while keeping the 1993 endpoint. This change actually reduces the estimated stable-inflation rate slightly to 80.8 percent, exactly the opposite from what one would expect based on the openness and productivity arguments. But given the uncertainty about such statistical estimates and the problems in measuring capacity utilization, this evidence of a downward shift in the stable-inflation rate is not convincing. The major conclusion from

Table 1

Estimates of the Stable-Inflation Rate

(in percent)

	Sample period				
	1964-83	1964-86	1964-89	1964-93	1974-93
Stable-inflation rate of capacity utilization	81.9	81.6	81.8	81.8	80.8

Note: These estimates are based on regressions with the CPI as the dependent variable.

Table 1 is simply that the estimates do not support the claimed upward shift in the stable-inflation capacity utilization rate.[5]

To test further for shifts in the stable-inflation capacity utilization rate, equations were estimated including an interaction variable equal to the capacity utilization rate multiplied by another variable representing the presumed openness or productivity effects. For example, a time trend was included because the openness and productivity arguments imply the relationship between capacity utilization and inflation has changed with the passage of time. But empirical estimates over 1964-93 found the interaction term involving capacity utilization and time was not statistically significant. A variable allowing a one-time shift in the stable-inflation capacity utilization rate also was not statistically significant when included in an interaction term.

Interaction variables related more directly to the growing openness of the economy also did not reveal a shift in the stable-inflation capacity utilization rate. Nonoil merchandise imports as a share of GDP (Chart 2) were not statistically significant when included in an interaction term. Traded goods as a share of GDP, which equals exports plus imports divided by GDP, were statistically significant in an interaction term, but the coefficient of this term implied that the stable-inflation capacity utilization rate has decreased as the economy has become more open, exactly the opposite of what has been claimed.

Another test of the openness argument is to include foreign capacity utilization in the interaction term. If this argument is true, the relationship between inflation and domestic capacity utilization should vary depending on whether excess productive capacity exists abroad. A world capacity utilization rate would be preferable for this test, but capacity utilization rates are not available for many countries over the 1964-93 period. Instead, the test used the capacity utilization rate for Canada, the largest trading partner of the United States. The Canadian capacity utilization rate was not statistically significant when included in an interaction term.[6] Therefore, the empirical results do not support the view that the stable-inflation capacity utilization rate has risen as a result of growing openness or rapid productivity change.

Results with other inflation measures

Policymakers and forecasters would probably

Table 2

Estimates with Various Inflation Measures

(in percent)

	Dependent variable			
	CPI	PPI	Core CPI	Core PPI
Stable-inflation rate of capacity utilization	81.8	81.8	82.1	81.6

Note: The sample period for the CPI, PPI, and core CPI estimates is 1964-93. The sample period for the core PPI estimate is 1976-93.

feel more confident about using capacity utilization as an indicator of inflationary pressures if the estimated stable-inflation rate is not sensitive to the choice of an inflation measure. Three alternatives to the CPI are considered here. The first is the producer price index for finished goods, or PPI. The PPI is an interesting alternative because prices at the producer level might be more closely related to manufacturing capacity utilization than the CPI, which has a large services component. The second alternative is core consumer price inflation, measured by the CPI excluding food and energy prices. The core CPI is an interesting alternative because food and energy prices are subject to unpredictable supply shocks that are not easily controlled by monetary or fiscal policy. The core CPI, therefore, may be a better measure of the underlying inflationary pressures that should be the focus of policymakers. The third alternative is core producer price inflation, measured by the PPI excluding food and energy prices.

Similar estimates of the stable-inflation capacity utilization rate are obtained with these alternative measures of inflation (Table 2). The estimated stable-inflation rate using the PPI is 81.8 percent, exactly the same as was obtained with the CPI. The estimated stable-inflation rate using the core CPI is slightly higher at 82.1 percent. But given the uncertainties surrounding such statistical estimates, this higher number is probably not meaningfully different from the 81.8 percent estimate obtained with the CPI or PPI. Finally, the estimated stable-inflation rate using the core PPI is 81.6 percent.

Using alternative inflation measures does not change the results of any of the tests reported previously for the CPI.[7] When the short-run Phillips curves were estimated over the same periods as in Table 1, the stable-inflation rate was again relatively steady. Tests using interaction terms also provided no evidence the stable-inflation rate has shifted because of increasing openness or faster productivity growth.

CONCLUSION

The preceding sections imply the capacity utilization rate in the manufacturing sector remains a reliable indicator of inflationary pressures. The stable-inflation capacity utilization rate has apparently been steady at about 82 percent. The increasing openness of the U.S. economy has not produced an

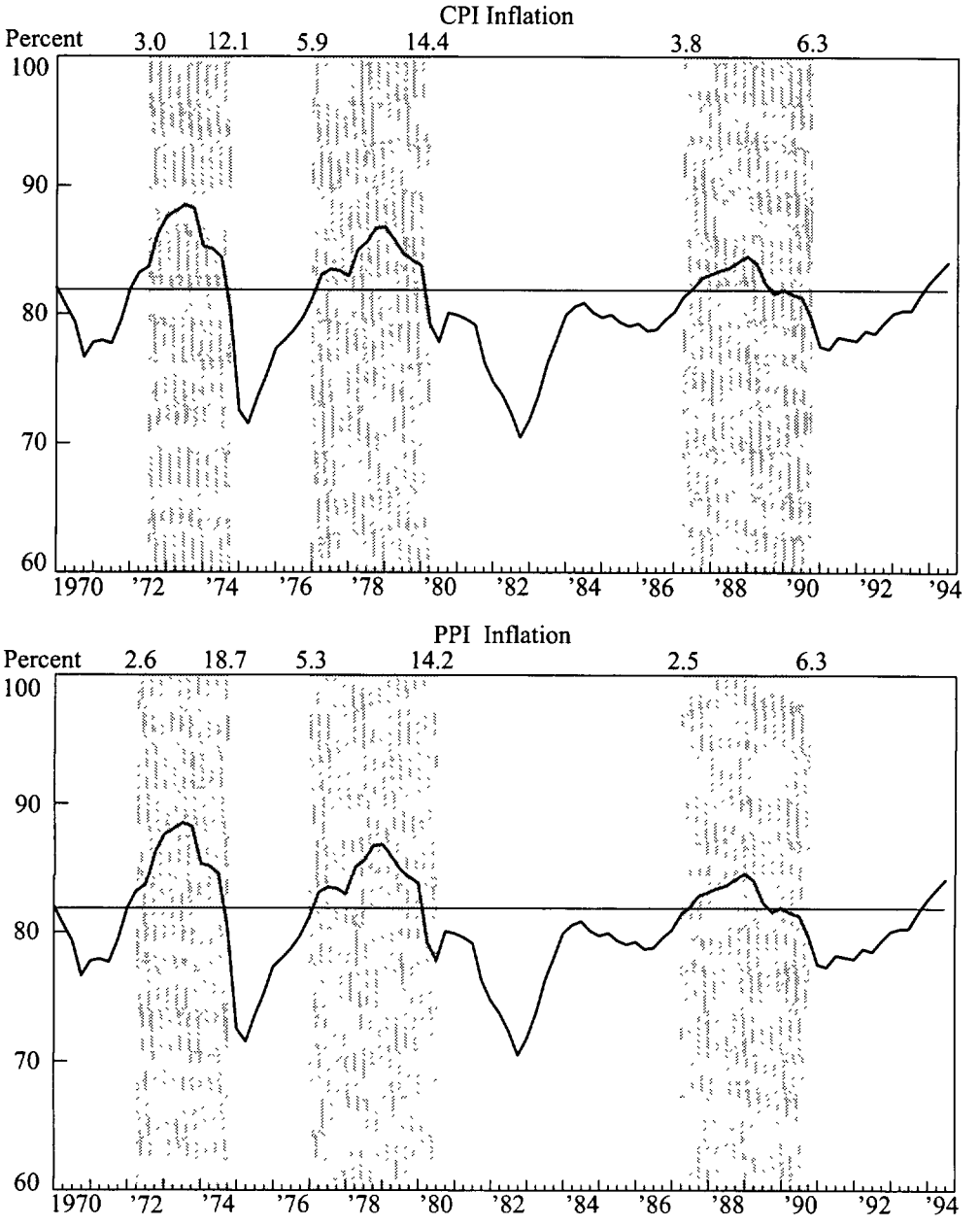
upward shift in the stable-inflation capacity utilization rate that would allow the economy to operate at higher utilization rates than in the past without worsening inflation. Also, there is no evidence the relationship between capacity utilization and inflation has weakened because of rapid technological change or strong business investment.

Currently, capacity utilization in the U.S. manufacturing sector is somewhat above the level that has historically been associated with stable inflation. Chart 4 shows capacity utilization with shaded areas representing periods of rising CPI inflation (top panel) or rising PPI inflation (bottom panel). In the late 1970s and the late 1980s, inflation rose at about the same time that capacity utilization crossed the stable-inflation rate of 81.8 percent estimated for the 1964-93 period. But inflation rose with a short lag after capacity utilization reached the stable-inflation rate in the early 1970s. Capacity utilization in manufacturing averaged 84.1 percent in the third quarter of 1994, 2.3 percentage points above the estimated stable-inflation rate.

Capacity utilization and the unemployment rate are presently giving consistent signals about U.S. inflationary pressures. Most estimates of the natural rate of unemployment are in the range from 5.5 percent to 6.5 percent. If we take the 6.0 percent midpoint of that range as a rough estimate of the natural rate, the economy currently is operating slightly below the natural rate of unemployment. And recent credible estimates by Weiner and Phelps put the natural rate of unemployment somewhat above 6.0 percent. Thus, both measures of economic slack are currently giving similar signals about potential inflationary pressures.

Chart 4

Capacity Utilization and Inflation



Notes: Shaded areas represent periods of rising inflation as measured by the CPI or PPI; beginning and ending inflation rates are noted along the top edge. Inflation is measured by the percentage change from four quarters earlier.

Source: Board of Governors of the Federal Reserve System and the U.S. Department of Labor.

APPENDIX

This appendix provides a more detailed description of the basic estimating equation and reports the empirical results in greater detail.

The basic equation

McElhattan (1985) showed that the stable-inflation capacity utilization rate can be estimated from a short-run Phillips equation of the form

$$IR_t = a_0 + a_1 IR_t^* + a_2 CU_t,$$

where IR is the inflation rate, IR* is the expected inflation rate, and CU is capacity utilization in manufacturing. McElhattan found that $a_1 = 1$ and IR_t^* could be replaced by last year's inflation rate, IR_{t-1}. Adding a supply shock variable, Z, McElhattan estimated the regression equation

$$DIR_t = b_0 + b_1 CU_t + b_2 Z_t + e_t,$$

where $DIR_t = IR_t - IR_{t-1}$ and e_t is a random disturbance. Setting the supply shock term and the random disturbance to zero, the equation can be solved for the stable-inflation capacity utilization rate by setting $DIR_t = 0$, or

$$0 = b_0 + b_1 CU_t,$$

implying that the stable-inflation capacity utilization rate is $CU^* = -b_0/b_1$.

Adding the supply variables described in the text, the basic estimating equation for this article was specified as follows:

$$DIR_t = c_0 + c_1 CU_t + c_2 WPON_t + c_3 WPOFF_t + c_4 DDIPE_t + c_5 DDIPE_{t-1} + c_6 DDREX_t + c_7 DDREX_{t-1} + e_t,$$

where $WPON_t$ = a dummy variable that represents the start of the Nixon wage-price controls and equals one in 1972 and zero otherwise;

$WPOFF_t$ = a dummy variable that represents the removal of the wage-price controls and equals one in 1974-75 and zero otherwise;

$DDIPE_t$ = the acceleration in the relative price of crude petroleum, which equals $DIPE_t - DIPE_{t-1}$, where DIPE is the annual percentage change in the relative price of crude petroleum;

$DDREX_t$ = the acceleration in the real exchange rate, which equals $DREX_t - DREX_{t-1}$, where DREX is the annual percentage change in the real trade-weighted value of the dollar.

Empirical results

The statistical results in Table A1 were used to calculate the stable-inflation capacity utilization rates in Table 1 of the text. In most cases, the Durbin-Watson test does not indicate first-order serial correlation of the regression residuals.

But in cases where this statistic fell in the indeterminate region of the Durbin-Watson test, Q-statistics for serial correlation were inspected and did not suggest a serial correlation problem. The Cochrane-Orcutt iterative method was also used to estimate a first-order serial correlation coefficient, and these coefficients were always statistically insignificant.

Table A2 reports the tests for a shift in the coefficient of the capacity utilization variable. In particular, let X be the variable reflecting growing openness or faster productivity growth. The interaction term is $CU_t * X_t$, where the * represents multiplication. The estimated regressions take the form

$$DIR_t = d_0 + d_1\, CU_t + d_2\, (CU_t * X_t) + \cdots .$$

Alternatively, this equation could be written as

$$DIR_t = d_0 + (d_1 + d_2\, X_t)\, CU_t + \cdots .$$

If d_2 were statistically significant and negative, and if X_t were increasing over time, the effect of capacity utilization on inflation would be decreasing over time. A decreasing coefficient on capacity utilization would suggest an increasing stable-inflation capacity utilization rate, consistent with the arguments that the economy can today operate at a higher utilization rate than in the past without serious inflationary pressures.

In Table A2, CU*TREND is the capacity utilization rate multiplied by a linear time trend. CU*DUMMY is capacity utilization multiplied by a dummy variable equal to zero for 1964-78 and one for 1979-93. CU*IMP is capacity utilization multiplied by nonoil merchandise imports. CU*TRADED is capacity utilization multiplied by the share of traded goods in GDP, which equals the sum of nominal exports and imports divided by nominal GDP. CU*CAN is the U.S. capacity utilization rate multiplied by the Canadian capacity utilization rate.

Table A3 presents estimates of the short-run Phillips curve with the alternative inflation measures. The PPI and core CPI equations were estimated for 1964-93. These equations explain slightly less of the variation in the inflation rate than does the comparable CPI equation in Table A1, but the capacity utilization measure is statistically significant in each case. The core PPI equation was estimated for 1974-93 because of limited data availability. As a result, this equation also excludes the dummy variables representing the Nixon administration's wage-price controls. The equations in Table A3 were used to calculate the stable-inflation capacity utilization rates in Table 2 of the text.

Table A1

Results Over Various Sample Periods

	Sample period				
	1964-83	1964-86	1964-89	1964-93	1974-93
Independent variable					
Constant	-16.21	-15.58	-17.73	-18.26	-31.55
	(-2.73)	(-3.03)	(-3.96)	(-4.29)	(-4.05)
CU	.20	.19	.22	.22	.39
	(2.80)	(3.09)	(4.02)	(4.32)	(4.04)
WPON	-1.45	-1.71	-1.66	-1.56	—
	(-1.04)	(-1.39)	(-1.44)	(-1.36)	
WPOFF	1.43	1.41	1.36	1.67	2.04
	(1.21)	(1.34)	(1.45)	(1.88)	(2.26)
DDIPE(t)	.09	.08	.07	.05	.03
	(3.21)	(3.59)	(3.91)	(3.65)	(2.17)
DDIPE(t-1)	.04	.04	.04	.03	.02
	(1.49)	(1.92)	(2.88)	(2.58)	(1.40)
DDREX(t)	-.09	-.09	-.08	-.03	-.03
	(-1.64)	(-2.23)	(-2.16)	(-1.16)	(-1.03)
DDREX(t-1)	-.01	-.04	-.01	-.04	-.02
	(-.22)	(-.81)	(-.39)	(-1.46)	(-.86)
R^2	.81	.80	.79	.75	.84
Durbin-Watson	2.33	2.46	2.19	2.11	2.53

Note: The t-statistics are in parentheses.

Table A2

Results with Interaction Terms

	Capacity utilization interacted with				
	Linear trend	Shift dummy	Nonoil import share	Traded goods share	Canadian capacity utilization
Constant	-24.58 (-4.64)	-24.54 (-4.61)	-24.06 (-4.79)	-25.95 (-5.10)	-20.39 (-2.43)
CU	.28 (4.83)	.29 (4.69)	.28 (4.94)	.29 (5.26)	.28 (1.38)
CU*TREND	.0007 (1.85)	—	—	—	—
CU*DUMMY	—	.01 (1.81)	—	—	—
CU*IMP	—	—	.003 (1.93)	—	—
CU*TRADED	—	—	—	.002 (2.33)	—
CU*CAN	—	—	—	—	-.0004 (-.30)
WPON	-1.31 (-1.20)	-1.16 (-1.05)	-1.28 (-1.17)	-1.12 (-1.05)	-1.59 (-1.36)
WPOFF	2.30 (2.52)	2.63 (2.63)	2.28 (2.54)	2.18 (2.59)	1.80 (1.78)
DDIPE(t)	.04 (3.19)	.04 (3.11)	.04 (3.04)	.04 (3.06)	.05 (3.58)
DDIPE(t-1)	.03 (2.10)	.02 (1.98)	.02 (1.98)	.02 (1.99)	.03 (2.53)
DDREX(t)	-.03 (-1.29)	-.04 (-1.41)	-.03 (-1.24)	-.04 (-1.61)	-.03 (-1.17)
DDREX(t-1)	-.03 (-1.35)	-.04 (-1.45)	-.03 (-1.25)	-.04 (-1.57)	-.04 (-1.43)
R^2	.79	.79	.79	.81	.76
Durbin-Watson	2.21	2.08	2.17	2.28	2.08

Note: The sample period is 1964-93. The t-statistics are in parentheses.

Table A3

Results with Alternative Measures of Inflation

	Dependent variable		
	PPI	Core CPI	Core PPI
Independent variable			
Constant	-24.33	-13.53	-25.52
	(-3.63)	(-3.58)	(-2.17)
CU	.30	.16	.31
	(3.65)	(3.59)	(2.14)
WPON	-.50	-2.06	
	(-.28)	(-2.03)	—
WPOFF	1.30	2.83	—
	(.93)	(3.57)	
DDIPE(t)	.07	.03	.02
	(3.74)	(2.23)	(.74)
DDIPE(t-1)	.03	.03	.02
	(1.54)	(2.82)	(.91)
DDREX(t)	-.06	-.02	-.04
	(-1.38)	(-.92)	(-1.14)
DDREX(t-1)	-.03	-.03	-.01
	(-.67)	(-1.24)	(-.17)
R^2	.70	.72	.54
Durbin-Watson	2.04	2.23	2.11

Note: The sample period for the core CPI and PPI estimates is 1964-93. The sample period for the core PPI estimates is 1976-93. The t-statistics are in parentheses.

ENDNOTES

[1] Kenessey defined capacity more precisely as "the greatest level of output that a plant can maintain within the framework of a realistic work pattern, taking account of normal downtime and assuming the availability of inputs to operate the machinery in place." The Federal Reserve's concept of capacity tries to take into account both economic and engineering factors that determine capacity. An important limitation of the Federal Reserve's capacity utilization rate is that it does not take into account the large service and government sectors of the economy. Shapiro presents a more detailed discussion of the statistical and conceptual problems in measuring industrial production and capacity utilization.

[2] See Weiner for an explanation of the natural unemployment rate and recent estimates for the U.S. economy. McElhattan (1978, 1985) sketches the theoretical underpinnings of the stable-inflation capacity utilization rate in a mark-up pricing model.

[3] McElhattan used the GNP implicit deflator to measure the aggregate price level, whereas Franz and Gordon used the fixed-weight GDP deflator. This article will focus on the consumer price index, or CPI.

[4] Krugman noted that the traditional view of international economists has been that an open economy with floating exchange rates faces a steeper tradeoff between unemployment and inflation than a closed economy. Thus, he concluded "it is hard to see why this view should suddenly be abandoned in favor of the idea that an open economy faces no tradeoff at all."

Holding the exchange rate constant, however, there is a small amount of evidence that foreign capacity utilization affects U.S. import prices. Hooper and Mann included foreign capacity utilization measures in equations explaining U.S. manufactured import prices. In an equation for bilateral trade between Japan and the United States, Japanese capacity utilization had a statistically significant effect on import prices. But in an equation explaining the prices of manufactured imports from all countries, foreign capacity utilization did not affect U.S. import prices.

[5] Another test of the stability of the relationship between inflation and capacity utilization is to test whether the regression coefficients are equal across a split in the sample. For this purpose, the sample was split into two subperiods, 1964-78 and 1979-93. The F-statistic for testing the null hypothesis that the regression coefficients are equal in the two subperiods is 1.26. The null hypothesis of stable coefficients cannot be rejected at the 5 percent significance level because $F^{.05}(8,22)$ equals 2.40.

[6] Similar results were obtained when U.S. and German capacity utilization rates were interacted in an equation covering 1965-93. The Canadian and German capacity utilization rates were also not statistically significant when added as separate regressors (that is, not interacted with capacity utilization).

[7] Because core PPI data are not available before 1974, some tests of the steadiness of the stable-inflation capacity utilization rate in the previous section could not be conducted for the core PPI.

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