

# ECONOMIC COMMENTARY

Federal Reserve Bank of Cleveland

or omission: either the definition of capacity itself is unclear, or no definition is offered. The various reported data series do not appear to use the minimum of a plant's short-run average cost curve to measure capacity; indeed, it is not clear what any of these capacity-utilization estimates actually measure.

In light of these difficulties, the Federal Reserve's eclectic approach may be the most reasonable way of measuring engineering capacity and capacity utilization, because it uses all available information and some informed judgments. Of course, as discussed in the previous *Economic Commentary*, engineering capacity utilization may be a poor indicator of price pressures and future investment.

Furthermore, when employing these measures as signals of future pricing and investment behavior for the economy as a whole, it should be recalled that the reported indexes primarily cover manufacturing, and that

together these sectors represent less than a third of GNP.<sup>5</sup> Even within these sectors, changes in firm technology and behavior, or in government policies, can influence the relationships between capacity utilization, investment, and price changes.

The Census Bureau and the Federal Reserve try to make the best of this imperfect situation. While their estimates are probably effective in tracking long-run shifts in engineering capacity, the user is strongly advised to remember how the indexes are constructed and where these numbers come from "in the first instance."

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*The views stated herein are those of the authors and not necessarily those of the Federal Reserve Bank of Cleveland or of the Board of Governors of the Federal Reserve System.*

## Footnotes

1. Anonymous; quoted in Sir Josiah Stamp, *Some Economic Factors in Modern Life*, London: King and Son, 1929.
2. For more detail on how the Census Bureau constructs its capacity-utilization series, see Elinor J. Champion and Charles O. Thorpe, Jr., "Census Bureau Survey of Capacity Utilization," paper presented at the Second Roundtable Conference on Capacity Utilization, Washington, D.C., December 4, 1987.
3. For a more complete discussion of the Federal Reserve's approach, see Richard D. Raddock, "Federal Reserve Estimates of Capacity and Utilization," paper presented at the Second Roundtable Conference on Capacity Utilization, Washington, D.C., December 4, 1987.
4. Despite these differences, this survey's results appear closely related to the Census Bureau's practical capacity-utilization series, implying that firms are using an engineering definition of capacity.
5. The Federal Reserve also calculates capacity and utilization indexes for mining and utilities.

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## A User's Guide to Capacity-Utilization Measures

by Paul W. Bauer and Mary E. Deily

*The government are very keen on amassing statistics. They collect them, add them, raise them to the nth power, take the cube root and prepare wonderful diagrams. But you must never forget that every one of these figures comes in the first instance from the village watchman, who just puts down what he damn well pleases.<sup>1</sup>*

In the preceding *Economic Commentary*, we examined how capacity utilization measures can be useful in evaluating industry price pressures, investment, and war mobilization capabilities. An engineering definition for capacity utilization is most appropriate for policymakers interested in war mobilization, whereas the minimum of the short-run average cost curve is the best choice if one is interested in price pressures or investment.

In this issue, we evaluate two of the more widely disseminated indexes of capacity utilization, those prepared by the Census Bureau and by the Federal Reserve. The two measures tend to move together (see chart 1), but are constructed quite differently, as we will show.

### ■ Census Bureau Approach

The Census Bureau bases its estimates of capacity utilization on a subsample of the Annual Survey of Manufactures, which covers about 450 manufacturing industries at the four-digit Standard Industrial Classification code level. The survey collects information for the fourth quarter of the year from about 9,000 manufacturing establishments.

The survey is sent to each plant in the sample; thus, firms with more than one plant may fill out more than one survey form. Respondents are asked to report the actual market value of production, the market value of "preferred" operations (defined as the production level the firm would prefer to maintain, at which profits are maximized and where unit price equals marginal cost), and the market value of "practical" operations (defined as the production level that could reasonably be attained using existing work schedules and machinery and equipment in place). The survey further instructs respondents that the preferred output level may not exceed the practical output level.

Two separate capacity-utilization measures are calculated from this data. The *preferred rate* is the market value of actual output divided by the value

The U.S. Census Bureau and the Federal Reserve prepare the two most widely disseminated indexes of capacity utilization. This article, the second of a two-part series on capacity utilization, explains how the indexes are constructed and analyzes the advantages and shortcomings of both approaches.

of preferred output, and the *practical rate* is the value of actual output divided by the value of practical output. These plant-level utilization measures are then aggregated, using value-added weights, to obtain preferred and practical capacity-utilization indexes for each industry and for all of manufacturing.

### ■ Advantages and Shortcomings of the Census Bureau Approach

The Census Bureau bases its estimates of capacity utilization on the most extensive and statistically sound

sample of any reported capacity or capacity-utilization measures. Two obvious limitations are that the Census Bureau's estimates represent only manufacturing (which is only 20 to 22 percent of GNP), and that the estimates cover only the fourth quarter of the year. But there are other, less obvious, problems with the reported measures as well.

The quality of the data may be suspect, since it is unclear who responds to the survey and how they interpret its questions. The respondent may be a plant manager, a government-reports unit, an accountant, a personnel officer, or a plant owner, among others. While someone actually based at the plant may be best informed about its operations, such individuals are unlikely to spend their days filling out government reports. Those who do fill out these reports may not have the best information, nor the incentive to obtain it.

In addition, the definitions of the survey's two measures of capacity suffer from a variety of problems. Preferred capacity is intended to be closest to an economic concept of capacity, but it is not measured as output at the minimum of the short-run average cost function—the measure we advocate. If plants are maximizing their profits, then they are always producing where unit price equals marginal cost. But preferred output is then always equal to actual output, and the measure of capacity contains no information. Also, because this definition makes capacity dependent on unit prices, it causes capacity to vary procyclically, even if there is no underlying change in the plant's or industry's capital stock or other fixed factors.

Since the preferred capacity-utilization rate is usually reported to be in the range of 70 to 80 percent for most manufacturing industries, it appears

unlikely that the survey respondents are reporting exactly what the Census Bureau defines as preferred operations. In many cases, the reported figures are likely to represent output levels at which costs start to rise sharply. This interpretation is supported by the similarity of reported preferred and practical output levels: about half of the respondents state their preferred level of capacity as equal to their practical capacity, and three-fourths report values for the two measures that are within 10 percent of each other.<sup>2</sup> Given this apparent duplication, perhaps the Census Bureau might try to elicit information about the level of output at which short-run unit costs are minimized, instead of plants' preferred rate of output.

The practical capacity measure is closest to the engineering definition of capacity, and is probably closer to the layman's idea of capacity than the preferred measure. While the practical measure is more readily understandable, it is still somewhat vague. It is also inherently difficult to measure, since plants rarely operate at practical capacity. In addition, this capacity-utilization measure is more useful for assessing the nation's industrial base for war mobilization than for providing information to policymakers about future investments or price changes.

Finally, because the Census Bureau data are collected at the plant level, potential bottlenecks at the firm, industry, or economy level may not be taken into account. For example, if two plants, both operating at less than full capacity, rely on inputs from a third plant that is operating at full capacity, then the Census Bureau's aggregate measure of capacity utilization would indicate some unused capacity, whereas in fact, the three firms taken together are operating at full capacity. This effect tends to bias

both measures of capacity utilization downward. In fact, the Census Bureau's estimates are consistently lower than those based on survey data obtained from the entire firm (such as McGraw-Hill's).

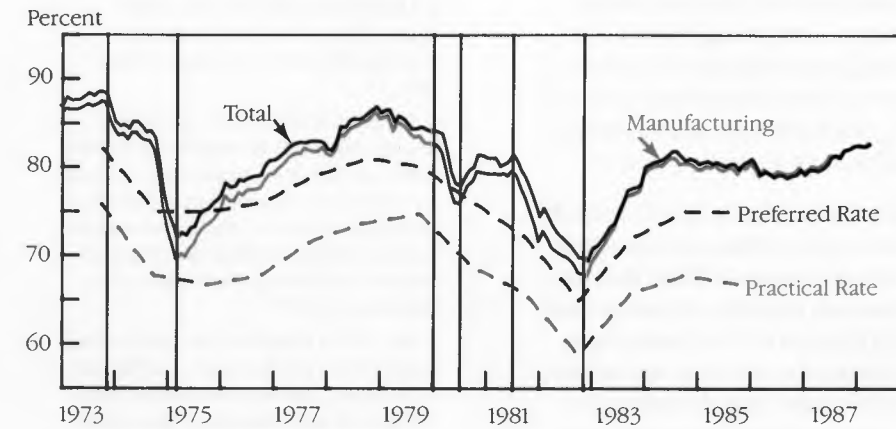
#### ■ Federal Reserve Approach

The Federal Reserve collects no primary data of its own, relying instead on capacity-utilization surveys compiled by McGraw-Hill and by the Census Bureau, and on various industry sources. In combining these disparate data, the Federal Reserve seeks to provide consistent estimates, so that a given capacity-utilization rate reflects the same degree of "tightness" over time.

The Federal Reserve follows six basic steps in constructing each of its capacity-utilization series.<sup>3</sup> First, it calculates a preliminary implied, end-of-year index of industrial capacity for a sector by dividing the sector's index of industrial production by the corresponding utilization rate from a survey for that end-of-year period. Although the Federal Reserve has traditionally relied primarily on McGraw-Hill's survey, it is increasingly using the Census Bureau's survey because of its larger sample and finer classification of manufacturing industries. These preliminary capacity estimates are checked against production indexes (which provide lower bounds and suggest upper bounds for the capacity index, particularly at major cyclical peaks) and against any available estimates of capacity utilization published by industry associations.

In the second step, the annual movements of the preliminary capacity index are adjusted because these initial indexes tend to fluctuate more than movements in the capital stock would suggest, rising in expansions and dropping in recessions. The Federal Reserve smooths the indexes using data from estimates of industry

CHART 1 CAPACITY UTILIZATION



NOTE: Solid lines indicate Federal Reserve measures; dotted lines indicate Census Bureau measures.  
SOURCES: U.S. Census Bureau; and Board of Governors of the Federal Reserve System.

capacity based on physical units, from estimates of an industry's capital stock, and from businesses' direct estimates of the annual percentage change in their capacity. If none of this information is available, a time trend is estimated from the preliminary capacity indexes.

Third, the Federal Reserve uses straight-line interpolation to obtain monthly estimates of capacity from its adjusted estimates of year-end capacity. Adjustments to the capacity figures may be made during an ongoing year if new information becomes available.

The fourth step is to adjust the capacity measures for certain sectors (materials, mining, utilities, and certain manufacturing areas) to remove short-term peak capacity, so that capacity figures will reflect the maximum sustainable capacity.

The fifth step uses value-added weights to sum the individual series to obtain sector estimates; these are

the same weights used in constructing the Federal Reserve's industrial production indexes.

In the sixth and final step, the Fed calculates monthly capacity-utilization rates by dividing its monthly production index by the capacity index it has constructed.

■ Advantages and Shortcomings of the Federal Reserve Approach  
A major advantage of this measure is its eclectic nature. The Federal Reserve tries to include all relevant data when constructing its capacity indexes. Smoothing excess volatility from the capacity series is particularly appropriate, because this volatility cannot be explained by movements in capital stocks or investment. Using observed production levels to adjust capacity figures is also reasonable, since actual output contains some information, albeit imperfect, about capacity.

Of course, because the Census Bureau and McGraw-Hill surveys are the two main sources of data, the Federal Reserve series incorporates their

biases. Problems with the Census Bureau figures have already been discussed. An advantage of the McGraw-Hill survey is that it is based on firm-level data, and thus picks up bottlenecks that do not show up at the plant level. The main drawbacks of this survey are its relatively small sample and the lack of a definition for capacity utilization (respondents can interpret it as they wish).<sup>4</sup>

The Federal Reserve insulates itself from some of these problems by relying on more than one source of information and by further refining the data in calculating its capacity and capacity-utilization series. Ultimately, however, the measure appears closer to an engineering definition of capacity than to a cost-based measure because of biases in the McGraw-Hill and Census surveys and because the Federal Reserve adjusts the series using output and capital-stock measures.

Finally, even though the Federal Reserve strives to construct capacity-utilization series that are consistent over time, such consistency is difficult to achieve. Major institutional and technological changes have occurred in the past and are certain to continue in the future, possibly affecting the degree of tightness a given capacity-utilization rate represents. For example, a plant using a just-in-time inventory process will be much more dependent on its outside suppliers than a plant using a more traditional inventory process. Capacity restrictions at these suppliers would not necessarily show up in either the Census Bureau or McGraw-Hill surveys, and could cause a shift in tightness represented by the Federal Reserve's capacity-utilization series.

#### ■ Conclusions

Month-to-month and even year-to-year movements in capacity utilization should be used with caution. Each series is flawed by commission