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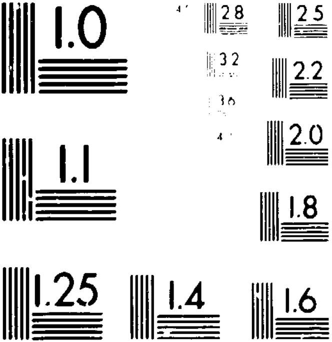

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(ANSI and ISO TEST CHART No. 2)

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Distr.
LIMITED

UNIDO/IS.469
22 May 1984

ENGLISH

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

THE UTILIZATION OF CAPITAL IN DEVELOPING COUNTRIES:

A Survey of Empirical Estimates*

prepared for

Global and Conceptual Studies Branch
Division for Industrial Studies

by

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THE UTILIZATION OF CAPITAL IN DEVELOPING COUNTRIES:
A Survey of Empirical Estimates

This paper provides a comprehensive survey of the existing empirical estimates of industrial capital utilization in the developing countries. It is a response to the persistence of high real interest rates that have sharply increased the costs of capital to developing countries. Real interest rates are a principal component of capital costs[1] so the fact that they have been three times higher thus far in the 1980's than they were in the decade of the 1960's is a fact of considerable moment to economic, and especially to industrial, development.

Over the past decade and more, it has become clear that the level of utilization of existing capital stocks is an important economic and technical variable that does much to determine the productivity of a society's capital stock. Increased levels of utilization serve both to allow existing capital stocks to serve as a substitute for new capital investment and to increase the productivity of new capital as it is installed. Quite simply, a plant that is used more of the time produces more output; a plant that is idle more of the time produces less. Increasing capital utilization, therefore, is a potentially promising way simultaneously to raise the productivity of capital and reduce the need for new investment — a potentially promising way to soften the harsh effects of rising real interest rates.

The primary purpose of this study is to present estimates of the utilization of capital stocks in less developed countries -- comprehensively to survey the data that are available on existing utilization levels. But it is essential to understanding and interpreting those data also to survey what has been learned over the past decade about the role of capital utilization in economic growth -- how it influences economic growth, and is influenced in turn by important economic policy variables. Much has been clarified about these relationships and it directly impinges on the data on utilization -- its definition, method and measurement. The most important such discovery is the difference between "capital utilization" and the older and better known -- but crucially more limited -- measure of "capacity utilization."

Part I presents a review of what is known about capital and capacity utilization and their place in economic development. Most of this is the result of research done during the past decade.[2] This discussion deals with the strengths and limitations of increasing utilization as a device to accelerate growth and it is here that we clarify some of the potentially dangerous confusion between "capital utilization" and "capacity utilization" that often plagues analyses of utilization in development. Part II turns to the practical matter of measuring capital and capacity utilization to describe the major measures that have been used and their strengths and weaknesses. Part III is the heart of the study, which summarizes the available data on capital and capacity utilization in less developed countries. Finally, Part IV presents a brief evaluation of the quality of those data, a summary of their policy implications, and a discussion of future directions for research -- it suggests a research agenda to help further to assess the promise of a "capital utilization policy" for less developed countries.

I. Capital and Capacity Utilization in Economic Development[3]

While the study of capacity utilization goes back to the 1940's, the study of capital utilization began with a book by Robin Marris in 1964, twenty years later. This is understandable in light of the fact that capacity utilization is a subject central to business cycles -- to the depressions and unemployment that dominated thinking in advanced countries from the Great Depression through the 1950's -- while capital utilization is a broader subject, central to the questions of growth and efficiency that have dominated thinking in both advanced and less developed countries since then.

In this part, we will proceed as follows: Section A will describe capacity utilization as a central aspect of business cycles and cyclical behavior in advanced countries; Section B will describe the more recent research on capital utilization; Section C will summarize the five fundamental facts about utilization that have emerged from a decade of research and investigation -- and the relevance of those facts to development.

A. Capacity Utilization

Capacity utilization data are intended to describe how close to its desired, economical level of output a firm, sector or economy operated during a specified period. So when Iron and Steel in India is said to be "operating at 75% of capacity," the impliction is that the industry's output could be increased by roughly a third without overtaxing its available labor, material and capital resources. It is often explicit but always implicit that this increase in readily attainable output would be achieved under "standard and normal" hours of operation and with a "typical" mix of products.

Capacity utilization figures describe the "short-run" variations in aggregate output that occur over a business cycle or in face of other unanticipated changes. In advanced countries, these data are watched intently to reveal turns of the economy toward better or worse conditions. Though complications are admitted, most such variations in capacity utilization are seen to be Keynesian, attributable to variations in demand: firms fail to operate at their desired levels of output because if they did so, they could not sell all of the resulting product. To this analysis of capacity utilization in developing countries has been added restrictions on availability of input supplies as a cause of excess capacity, making the concept applicable, too, to the strong demand conditions often found in developing countries. All this has been summarized in Winston, JEL.

The key fact about capacity utilization is that any "excess capacity" — any departures from 100% capacity utilization — is unintended by the firms: capacity utilization describes firms' responses to undesirable circumstances inflicted upon them.

Perhaps an example will be useful. Consider a plant -- a bicycle producer — that normally operates in times of good, strong, demand at an output rate of 400 bicycles a week, producing a given mix of types, styles, colors and qualities. Normal hours of operation for the plant are from seven in the morning to four in the afternoon, with an hour's shutdown for lunch, Monday through Friday. Now, if orders fall off, the firm will first produce for inventory, but if those low sales persist, it will cut back on production, making fewer than 400 bicycles a week. If the firm were surveyed when its production rate was down to, say, 320 bicycles a week, it would (quite reasonably) report operations at "80% of capacity" -- 320 is 80% of its normal, desired, strong-demand level of output of 400 bicycles a week. If, on the other hand, orders were especially strong so it stepped production up to 440 bikes a week, the firm would report that it was operating at "110% of capacity," presumably by working overtime (more than the normal forty hours a week) or increasing its crew size. If production were reduced to 320 because of bottlenecks in input supplies while facing strong demand, the firm would report operations at "80% of capacity."

Capacity, then, is normal, efficient, desired output for a firm or an economy. Capacity utilization is its actual output expressed always as a percent of that desired level. So capacity utilization figures are statements about how close firms come to producing at the rate they'd like to produce in the short run. Because they are percentages, capacity utilization data are statements about actual output relative to desired output.

So capacity utilization data don't say anything about the firm's or the economy's desired or optimal level of output — about how much firms would like to produce -- or why that desired level of output often leaves the firm's productive capital stock idle as much as three quarters of the time. To address that more central question, we must turn to the more recent research or capital utilization.

B. Capital Utilization

Capital utilization data are intended to tell how much of the time the productive capital stocks of a firm, sector or economy are operated and how much of the time they are idle. So when it is estimated that the industrial capital stock of Pakistan is operated at a capital utilization rate of 25%, the message is that the typical production process in Pakistan industry is run for some 2190 hours of the 8760 hours in a typical year — it is typically idle three out of four hours.

The central issue of the study of capital utilization has been to discover what it is that determines how much of the time a firm desires to operate and how much of the time it wants to be idle. Clearly, grocery stores and gasoline stations have no interest in "100% capital utilization" — in operating day and night every day of the year. Nor do most manufacturing plants or mining and agricultural operations. Indeed, we have discovered that it is most economical — it produces output at lowest average cost — not to operate all the time. There is tremendous variation in observed levels of utilization, both between industries within countries and within industries between countries. The World Bank data (Bautista, et al) reveal that there is just as much variation in capital utilization within an industry between countries as between industries within a country. It has been a major objective of research on capital utilization to discover the causes of those variations -- why one plant considers it desirable, and indeed "normal," to operate virtually all of the 8760 hours of the year while another considers it equally desirable and equally "normal" to operate only 2000 hours or less in a year and shut down for the other 4760 hours or more.

The incentive for this concern, of course, is that capital utilization affects the productivity of a capital stock. A plant that is utilized most of the time produces more output than one that is idle most of the time. More highly utilized capital is more productive capital that contributes more to economic growth.

So capital utilization focuses on why the bicycle plant described above considers a 40-hour week to be the "standard and normal" period of operation, the period that defines its full capacity output. In contrast, there may be a plant next door that produces fine cotton textiles and that considers a 168-hour week to be its standard and normal period of operation -- it operates all the time -- and that firm defines its capacity output on the basis of twenty-four-hour, seven-day-week operation. Why these differences should be found is the question of capital utilization research.

Capital utilization describes how much of the time firms operate their production processes and hence how much of the time they are idle. It includes both intended and unintended departures from full-time operation. So capacity utilization is included in measured capital utilization, but not the other way around: capital utilization is the more inclusive concept and one with an unambiguous denominator.

The first useful insights into the determinants of capital utilization are due to Robin Marris who, in a 1964 study of British industry, discovered that the level of "normal" capital utilization for a firm is typically the result of both economic and technical factors. Before Marris' pioneering empirical study, which was based on extensive interviews with plant managers, it had been conventional wisdom in economic analysis, planning, and policy that a firm's normal hours of operation -- its desired capital utilization -- depended solely on its technology, hence was an issue outside the firm's control and outside the purview of economists. Marris' discovery that firms choose their normal hours of operation and that they do so in significant measure as the result of both the technical and economic circumstances within which they operate was a major breakthrough in understanding the contribution of capital to economic efficiency and growth.

Marris' central discovery was that firms schedule production within the day, the week, and the year so as to minimize costs. Unit capital costs -- as elementary economic theory teaches us -- are indeed reduced by running a plant at maximum output, i.e., all of the time. Maximum capital utilization will always save on unit capital costs.[4] But running a plant all the time often involves higher unit non-capital costs. Maximum capital utilization will usually increase unit variable costs: central to UK manufacturers was the higher unit cost of night-time and weekend labor. Higher labor costs are often the result of a simple preference among most people for working during normal hours. So, to do any given job at an inconvenient hour, a British worker demands (and gets) a premium wage rate -- a higher wage cost attaches to the same job, with the same work effort, when it is done at an inconvenient or distasteful hour. This "night shift wage premium"[5] increases the firm's labor costs of producing at night and on weekends. In a plant that uses a lot of labor and relatively little capital, it may therefore not be "worthwhile" (profit-maximizing) to pay that wage premium: it may be "more sensible" (yield lower unit cost) to shut the plant down every evening and every weekend and start up again the next day or on Monday morning when wage rates are lower. This, of course, is consistent with the behavior of our bicycle plant example.

So Marris described firms that balance two competing forces -- if they operate their plants a greater part of the time, they economize on capital costs, but if they operate their plants a greater part of the time, they also increase their labor costs. The "optimal utilization" of their capital stock is the result of this balancing act. Their optimal utilization is therefore the basis of their "standard and normal" hours of operation that are the basis, in turn, of their judgment of "capacity output."

During the 1970's, much empirical research was done on the determinants of capital utilization. My Pakistan study (Winston, EJ,

1971) first looked at capital utilization in a less developed country and showed very low levels of utilization which suggested both that there was considerable room for increasing capital services by policies that increase utilization and that existing economic policies (especially low interest rate policies) may have contributed to low capital productivity. A pioneering time-series study of South Korean manufacturing over the decade of the 1960's by Kim and Kwon showed dramatic increases in capital service flows got from increased utilization. And the large World Bank study was initiated in the early 1970's to gather data on utilization and idleness in manufacturing plants in four countries (Malaysia, Colombia, Israel and the Philippines) — a study that was published in 1981 as Bautista, et al. The ILO, in the mid 1970's, initiated studies of the employment impact of increasing capital utilization in Sri Lanka, Nigeria and Morocco (Phan-Thuy, et al, 1981). Finally, Betancourt and Clague's study (1982) used published UNIDO data to test the key theoretical propositions on capital utilization.

A clearer understanding of the firm's optimal utilization decision was developing at the same time. Marris' study had not integrated his perceptive observations on firms' incentives with conventional economic production theory so I set out, after the Pakistan study, to develop a coherent and essentially conventional theoretical basis for analysis of capital utilization. The result was a series of formal production models, starting in 1970, that recognized the timing of production within the day or week or year (Winston, 1970, 1974, 1974b). Though somewhat removed from its beginnings as a pressing issue for economic development policy, this "time-specific analysis" of production (and consumption and markets) was published by Cambridge University Press last year. Mary Ann Baily's MIT PhD thesis and Betancourt-Clague's Southern Economic Journal article (1974) added further depth to the model, including consideration of economies of scale, of worker-managed enterprises and of the general equilibrium context of capital utilization decisions. Most of these developments in the theory of capital utilization were summarized in Winston (1974) and they provided the structure for subsequent empirical analyses, including those by the World Bank and ILO.

C. Capital Utilization, Efficiency and Growth: Important Facts

The accumulated research of the past fifteen years has discovered a number of important facts about capital utilization that are central to any economic development policies that hope to increase capital productivity and reduce the need for new investment by inducing more efficient utilization of new and existing capital stocks. They are:

1. Increased capital utilization is a substitute, at least partially, for increased capital stocks — investment — in economic growth.

Output is produced by capital services — by utilizing capital stocks — not simply by the existence of those capital stocks. In a capital-constrained economy, an increase in output must be supported by an increase in capital services. That increase in turn, can be got either from an increase in the size of the capital stock (investment) or from an increase in the proportion of the time an existing capital stock is used (utilization). Or both. While increased utilization is not a perfect substitute for increased capital stocks — a subject to which we return below — it often can and does increase capital services and output just like new investment. Increased (or decreased) utilization, by increasing (decreasing) the flow of capital services from a given capital stock, increases (decreases) the productivity of capital stocks.

Consider again the bicycle plant that is producing 400 bicycles a week while operating what it considers to be a normal, full-capacity, 40-hour week. Let it be confronted by a growth in demand for its product, say a doubling of demand to 800 bicycles a week. The firm now has two options. If technology is unchanged, it can simply invest in twice as much plant and quipment — and buy twice as much labor and materials flows — to double its output rate. Or it can operate an unchanged amount of plant and equipment for sixteen hours a day, instead of eight; it can double its standard and normal hours of operation, and labor services and materials flows. Either way, it will double output to produce 800 bicycles a week. In one case, output growth is achieved entirely by new capital investment and in the other case entirely by increased utilization of existing capital stocks. The relationship between net investment and increased capital utilization has been emphasized in formal models where increased utilization is shown to be a substitute for increased domestic saving (Winston, JEL).

The study by Kim and Kwon cited above showed that in South Korean manufacturing, during the period of dramatic expansion of the decade of the 1960's, approximately half of the total increase in the capital services that fueled that expansion came from increased utilization of capital stocks while about half of it came from increased capital stocks -- from net investment, a dramatic demonstration of the potential for increased utilization.

2. **Capital utilization is an economic variable, the result of a firm's economic decisions, influenced by economic policy.**

The conventional wisdom before the studies of the 1970's was that any firm's capital utilization, or schedules of production and idleness, was dictated by its technology of production. When output demand and input supply were strong, firms were said to "have to" operate the hours we see them operate because of technological necessity. There was no element of choice in their "standard and normal" production schedules, only technological determinism. There might be, it was occasionally suggested, some complications due to sociological causes -- family pressures or fear of the dark or bandits in traditional societies might make it advisable to stick to normal daytime operation -- but that these were not, at their base, economic issues.

In this view of capital utilization, our bicycle plant would be found operating its 40-hour week for technological reasons. It would be assumed that there is something inherent in the way bicycles must be made that requires the plant to shut down for sixteen hours a day --

and for sixty-four hours on the weekends. It would be assumed, too, that there is something inherent in the way textiles must be made that requires that the textile mill next door has to operate without stopping night and day through weekdays and weekends. The bicycle plant's schedule might be attributed, too, to peoples' refusal to work other than weekdays, but there would be no comment on the fact that the textile firm next door managed to run its plant on so different a schedule.

The discovery that firms choose their operating schedules and that they do so under heavy influence of economic variables represented a major advance in our understanding.

3. **The firm's optimal utilization — its schedule of operation and idleness — is responsive to differences in (a) the technology of production, (b) the price of capital, (c) the wage rate, (d) the size of the night shift wage premium, and (e) plant size.**

Undoubtedly, the most important result of the research activity of the 1970's was its identification of the major economic determinants of firms' optimal utilization, identification of those economic variables and technical parameters that influence the operating schedule a firm will consider to be optimal. These are the determinants of the firm's "capacity" and they are variables that are, importantly, amenable to policy manipulation.

Fortunately, the economic variables that are shown by theoretical and empirical study to influence utilization rates make sense — they have both a formal mathematical foundation and an appeal to intuitive good sense of the sort that plant managers can and frequently do enunciate. It is economic theory that fares very well in discussions on the factory floor.

The basic logic of a firm's optimal utilization decision was described above: in the simplest case, the more of the time a firm operates, the lower will be its unit capital costs but the higher will be its unit labor costs. So a profit-maximizing firm will strike a balance in its production schedule, extending its period of operation until on the time margin the reduction in capital costs just equals the increase in labor costs. That first-order condition will define its optimal schedule of operation, its optimal capital utilization rate. So when asked why he runs the plant 40 hours a week instead of 80, the manager of our bicycle factory would probably say "because it costs less -- workers get a higher wage for night work, it's cheaper to increase output by expanding the plant than it is to try to run a night shift with expensive, low productivity labor." He would be, in that statement, nicely verbalizing the mathematical model of optimal utilization (Winston-McCoy, 1974).

The roles of the specific technical and economic variables that influence the firm's optimal utilization decision follow from this balancing act in an appealingly obvious way.

a. **The capital intensity of the production process:** If the plant uses a lot of capital relative to the amount of labor it uses, economizing on capital (the larger part of costs) will be more important than saving on labor (the smaller part of costs). So higher utilization rates will be optimal for a capital-intensive production process and lower utilization rates optimal for a labor-intensive one.

If a comparison of the bicycle plant and the textile plant revealed that bicycles are made with relatively a great deal of labor and a little capital while modern textiles are made with a great deal of capital and only a little labor, we would expect, other things equal, that the manager of the bicycle plant would find it optimal to run fewer hours per day (and week) than the manager of the textile mill. When the bicycle plant avoids night-time operation by shutting down at 4:00, it saves on its relatively large labor costs at the expense of its relatively small capital costs; when the capital-intensive textile mill does not shut down at 4:00 but runs instead night and day, it saves on its relatively large capital costs at the expense of its relatively small labor costs.

b. **The price of capital:** For much the same reason, a firm will be more interested in saving on capital costs under high relative capital prices than it will when capital is cheap: high prices make capital costs relatively more important. This is clearly central to the policy issues involving capital utilization since the price paid for capital by firms is heavily influenced by government policies through interest rates and through tariff and import policies. It is of considerable importance that higher capital prices induce firms to raise capital utilization and lower capital prices induce them to reduce it: policies that keep capital prices low also, through their effect on optimal utilization, keep capital productivity low. This central issue will be addressed again below.

When the bicycle plant pays a low price for capital for its plant and equipment, it can be expected to utilize its capital less of the time; increased demand will more likely be met with increased (cheap) investment.

c. **The average wage rate:** The same reasoning implies that when a plant pays high wage rates, the savings on labor costs achieved by low levels of utilization are more important; if it pays low wage rates, those labor cost economies are less important so higher utilization rates will be used. Relatively expensive labor induces lower capital utilization rates and lower capital productivity; cheap labor induces higher capital utilization rates and higher capital productivity.

When the bicycle plant pays a high average wage, it will have less incentive to incur the even higher wage rates that go with night shift operation -- it will be more tempted to expand its plant to meet additional demand, even though that plant will be idle much of the time.

d. **The night time (weekend) wage premium:** If the firm has to pay a much higher wage rate at night (or on the weekend), it will find it optimal to run its plant less of the time than if day and night (weekday and weekend) wages are quite similar. A night (weekend) wage premium is effectively a large penalty levied on the firm that tries to utilize its plant more of the time; a small night wage premium is a small penalty.

It should be noted, quickly, that although it is convenient and conventional (in two-factor production models) to talk only of "capital" and "labor," the logic of optimal capital utilization does not depend on there being a large night-time wage differential. There are two reasons for this. The most important is that a large number of inputs to production can, like labor, have "rhythmic" price patterns like the day-night wage differential. The prices of agricultural inputs vary rhythmically over the year; the prices of products of natural processes -- mining and fishing -- do the same, etc. The optimal utilization analysis depends only on there being one input to production whose price varies rhythmically. The other reason the analysis is more general than it might appear to be is that even where labor does not receive a night-time wage premium, labor costs may nonetheless have the same sort of rhythmicity because of day-night differences in labor productivity. It appears that, especially in less developed countries, productivity differentials rather than explicit money wage differentials act to increase night-time labor costs, discouraging higher levels of capital utilization.

So the manager of the bicycle plant will more likely want to meet expanded demand for bicycles by putting on a night shift, rather than by running an expanded plant only during the day if the difference between day and night labor costs is slight.

e. Size: The larger the plant, the higher the level of capital utilization that will prove optimal (Betancourt and Clague, Southern Economic Journal). This is not, it should be made clear, a matter of measurement, an illusion due to the fact that size is measured by output and plants that operate more of the time produce more, and hence are counted as larger plants. It is more basic than that. It appears to have to do with the divisibility of functions both in organizational space and in time. It was suggested by Marris early on that a larger plant allows more division of labor, hence a finer division of responsibilities for those who work at night: in a large bicycle firm that runs two shifts, the Sales Manager doesn't have to come into the plant at night — only the Night Production Manager does. But in a small plant where the functions of Production and Sales Manager are combined in one person, the Sales Manager does have to come in at night because he is also the Night Production Manager. A large bicycle plant is more likely to find high levels of utilization optimal than a small bicycle plant.

To summarize, these determinants of the firm's optimal capital utilization — factor intensity, the prices of capital and labor, the "wage rhythm," and scale — are both predicted by the theory of optimal utilization and revealed in empirical studies. They provide the basis for a utilization policy.

4. Growth, Aggregation and Obsolescence

But it is important to emphasize not just the promise but also the limitations on changing capital utilization as a way of increasing capital productivity — the limitations on increased capital utilization as a substitute for new investment. That promise is great, but it is limited.

a. Growth: Utilization as a Substitute for Investment

Increased capital utilization substitutes for new investment by increasing the productivity of capital stocks — with higher utilization, more capital services are got from a given capital stock. But increasing capital utilization cannot increase the productivity of existing capital stocks except when output is growing. Existing capital stocks exist. If they are producing output only part of the time, they can increase the output they produce but there has to be a demand for it. So the process of replacing capital stocks with higher utilization cannot take place in a static environment, except by the slow process of depreciation, of replacing gross investment with higher utilization.

The bicycle plant, therefore, gains nothing if it still produces its original 400 bicycles a week but does so on two shifts. The higher utilization and capital productivity in that half of the plant needed to maintain an output of 400 bicycles on two shifts is entirely offset by the zero productivity of the other half of the plant that is shut down. If, on the other hand, the firm were able to sell 800 bicycles, the increased utilization would bring increased productivity for all of the existing capital stock.

It is important that increased capital utilization is a substitute for new investment but increased capital utilization will not save investment or increase aggregate capital productivity without growth.

b. The Specificity of Existing Capital Stocks

Increased utilization of existing capital stocks will increase the flow of capital services, but in a form determined by the composition of the existing capital stock. Only that part of the increase in capital services that can substitute for new investment will actually be useful. At any time, the existing capital stock is embodied in highly specific forms, appropriate to the production of highly specific products. If the demand for all of those products were to increase, higher utilization might substitute completely for new investment. But if the demand for the products of only part of the existing capital stock increases, not all the potential increase in capital services through utilization will be realized. So the distribution of increased output over the existing capital stock affects the ability of increased utilization to increase capital productivity and thereby replace new investment.

This limitation is exacerbated by the upper limit to utilization, by the fact that once a plant is operated as much of the time as its management deems optimal, further increases in output will be got by new investment. Optimal capital utilization is, indeed, seen as defining the minimum investment-inducing level of output (Winston-McCoy).

So doubling the capital utilization in the bicycle plant by going to two-shift operation will double the output of bicycles without any new investment. But doubling capital utilization cannot be expected to increase output of the textile mill next door that is already running three shifts.

Only to the extent that the growth in demand occurs in industries where firms' optimal utilization levels can be increased can that increase in utilization replace new investment. And only to the extent that firms are induced to increase optimal levels of utilization will increased utilization replace new investment and raise capital productivity. This is an important restriction to any policies that are expected to replace new investment with higher utilization of existing capital stocks.

Finally, not all capital services can usefully be increased with higher utilization rates. Technically obsolete capital stocks are often kept as standby equipment to meet brief periods of unusually high demand and a permanent expansion of demand would see them replaced by more technically efficient new investment.

With these caveats, it remains that the evidence of the past decade clearly shows increasing utilization of existing capital stocks to be a highly potential way to get more out of a given capital budget, increasing the productivity of both new investment and existing capital stocks. It is important that this can be achieved, however, only with policies that make firms want to redefine their optimal levels of utilization, hence their ideas of their "output capacity."

D. Capital and Capacity Utilization Once Again

It is useful to end this discussion of the influence of policy variables on capital utilization — and the influence of capital utilization, in turn, on capital productivity and economic growth — by returning to the central matter of the distinction between capacity utilization and capital utilization with which the discussion began: it is crucial to understanding utilization, to using utilization data, and to formulating policies to increase capital productivity through increased utilization. After the discussion of the determinants of a firm's optimal capital utilization, it can now be made clearer.

In essence the issue is simple: Increased capital utilization increases capital productivity. Increased capacity utilization may or may not.

Since an increase in capital productivity — with its reduction in the amount of capital stock needed to produce a given level of output and its more efficient use of existing capital stocks — is the objective of policies to counter the increased real cost of capital stocks, increased capital utilization and not increased capacity utilization is the appropriate objective of policy.

Increased capital utilization means getting more productive capital services and hence more actual output from a given amount of capital stock. By definition it increases the productivity of that capital stock.

Increased capacity utilization means moving a firm's actual output closer to its desired level of output. But that can be the result of either an increase in actual output or a reduction in desired output. If higher capacity utilization is due to an increase in output, capital and capacity utilization will both increase and so, therefore, will capital productivity. But if higher capacity utilization is due to a reduction in desired output, capacity utilization will increase while capital utilization remains unchanged or decreases and so, therefore, will capital productivity decrease.

Policies that increase capacity utilization will increase capital productivity only if they also increase capital utilization. Capital utilization is the determinant of capital productivity; capacity utilization is not.

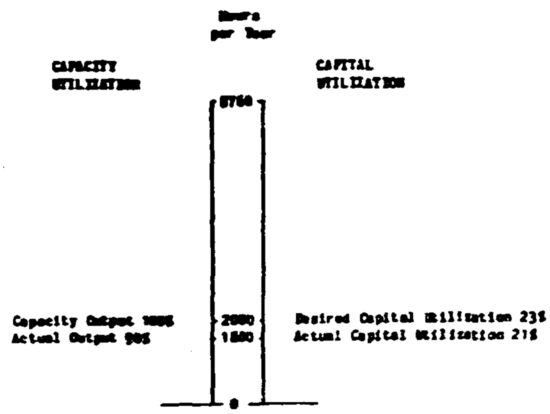

Figure 1

A Firm's Capital and Capacity Utilization

Under the simplifying assumption that the output rate of a plant is constant whenever it operates, a bar graph will make this clear. It depicts the 8760 hours a year a capital stock can be operated. The desired level of utilization — the result of the firm's optimal capital utilization decision -- is shown illustratively as 2000 hours a year; single shift operation, five days a week as determined by the forces described above. The output produced when it operates 2000 hours a year is the firm's capacity output, the output that coincides with its optimal capital utilization. Finally, the firm is shown actually to be producing output for only 1800 hours a year. The firm's capacity utilization, then, is 90% (=1800/2000x100). Its capital utilization is 21% (=1800/8760x100) of the time. Put somewhat differently, the firm in this graph is shown to be operating ten percent below its desired level of operation -- it has ten percent excess capacity — when it operates 21 percent of the time. When, on the other hand, the firm operates at "100% of capacity" (2000 hours a year), it operates its plant 23% of the time — and leaves it idle 77% of the time.

If, for this plant, actual production were to increase from 90% to 95% of capacity, both capacity utilization and capital utilization would increase. But if production remained unchanged while the firm's "capacity" target fell to 1950 hours a year, capacity utilization would rise (to 92.3%) while capital utilization and capital productivity remained the same. Capital utilization, even if expressed as a percent, is measured in terms of an absolute unit — the total amount of time available for production — while capacity utilization is only measured as a percent of a variable unit, the desired, optimal level of output.

To illustrate this with the bicycle plant, the desired level of utilization — eight hours a day, five days a week — defines a capacity output of 400 bicycles a week as 100% of capacity utilization. So its optimal rate of capital utilization is 23% (=40/168x100). If the plant actually operates seven hours a day, five days a week, it will be producing 350 bicycles a week and it will be working at 88% of capacity (=35/40x100). Its capital utilization will be 20% (=35/168x100).

If demand improved for the bicycle factory so it stepped up production to 380 bicycles a week by operating 38 hours a week, its capacity utilization would increase to 95% (380/400x100) while its capital utilization would increase to 22.6% (=38/168x100). But its capacity utilization might increase, instead, because of a decline in its definition of "capacity" -- a decline in its desired utilization (due to a fall in the price of capital, a rise in wage rates or...). If optimal utilization fell to, say, 35 hours a week, with output at 350 bicycles a week, capacity utilization would rise to 100% while capital utilization, and capital productivity, would still be only 21% (35/168x100).

Policies to increase capital productivity must focus on increasing capital utilization, not on increasing capacity utilization.

E. Utilization Policies -- Summary

To summarize what has been learned over the last decade or so about the ability of changing capital utilization to influence capital productivity and thereby the rate of economic growth:

1. Using a capital stock more of the time increases its productivity, contributing to economic growth much like new investment -- increased capital utilization is to some extent a substitute for increased savings.

2. Capital utilization is not the same thing as capacity utilization; the former is relevant to capital productivity and growth, the latter to business cycles and supply shocks.

3. Firms choose their intended levels of capital utilization -- their optimal production schedules that define their output "capacity" -- as an integral aspect of economically efficient production.

4. Firms' efficient capital utilization choices are affected by economic variables that are under the influence of policy-makers. Capital utilization, hence capital productivity, will be higher:

a. the higher are capital prices,
b. the lower are wage rates,
c. the more capital intensive are production processes,
d. the less rhythmic are input prices, and
e. the larger are plants.

An important implication of this catalogue for the question of development under rising real interst rates is that the increase in capital prices they cause will, in itself, tend to induce firms to increase their desired capital utilization and the productivity of their capital stocks. The president of a large US manufacturing firm was recently quoted in a New York Times article on high real interest rates as saying: "For a long time, capacity was figured on a five-day-a-week, two-shift basis" but his company had begun to try to increase its plant utilization because it believes that "the cost of capital is going to remain high by any historical standard, and that corporations are going to have to pay increasing attention to getting more out of their assets and their working capital bases. I don't think too many companies have really faced up to this fact, yet," he said. "This firm," the article noted, "has begun to try to work some of its plants around the clock -- 24 hours a day, seven days a week, without paying time-and-a-half or double-time -- to make better use of its plant and equipment." High real interest rates, in themselves, push firms toward just the sort of increasingly careful use of their capital we would want from any utilization policy.

It is not clear, of course, that higher real interest rates will create enough pressure. So to emphasize the connection between higher interest rates and higher capital utilization is not to defend simply "letting the market work" as an adequate utilization policy. But two things are clear. First is the fact that the higher market prices for capital generated by higher interest rates are pulling in the right direction, forcing firms to increase the utilization and productivity of their increasingly expensive capitel stocks. And, second, that any policies intended to augment this increase must reckon with -- and should harness -- those market forces that affect utilization.

II. The Measures of Utilization

A number of quite different measures have been used to estimate capital and capacity utilization for a sector or economy. Some are based on individual firm data, some rely on aggregates. Measures of capital utilization are, predictably in light of the discussion above, less ambiguous than measures of capacity utilization. The latter drove the Chairman of President Johnson's Council of Economic Advisors to observe, somewhat plaintively, "in principle, 'capacity' has meaning."

In this part, the various measures used to generate the data reported in Part III will be described and evaluated. There are three sections. The first describes the survey technique used in the World Bank and ILO studies that generates data on both capital and capacity utilization based on individual firms. The second section describes the common measures of capital utilization that do not rely on direct survey enumeration -- shift working and electric power consumption -- and comments on their strengths and weaknesses. The third section deals with measures of capacity utilization, most of them inherited, understandably, from the advanced countries where concern with the business cycle has long been dominant.

A. Enterprise Survey: Capital and Capacity Utilization

It is, perhaps, to be expected that the empirical studies done since the theory of capital and capacity utilization was developed and the two integrated should be based on the most sophisticated measurement concepts -- especially since the first of them also marshalled the considerable resources of the World Bank in service of the research. There exists, then, an expensive but very effective measure of capital utilization that has also provided an integrated estimate of capacity utilization. It is based on the operations of the individual firm; with aggregation, it describes the sector or the economy. The quality of this survey measure is due in part to its independence from previously published data and in larger part to its reliance on a coherent conceptual base. That, of course, also explains its expense. What follows is a description of the method of capital and capacity utilization measurement used in the World Bank (Bautista, et al) and ILO (Phan-Thuy, et al) studies.

Actual capital service flows were measured directly, as hours per year, while retaining information on the time-shape of those flows within the year. The data described, for a plant, the typical number of hours of operation per day, the number of days per week and the number of weeks per year, with a description of any significant departure from regularity. In summary form, the data reported the total number of hours of operation out of the 8760 hours of the year. Individual production managers were the usual source of information both on production schedules for the plants as a whole and, where appropriate, on sub-sections of the plants. These were the basic raw data on actual capital utilization: hours of utilization of the plant and equipment per year.

Desired or optimal capital utilization estimates were then got from a manager's response to what he would consider the "best" or "most efficient" schedule of operation for that plant and the number of hours per year that that schedule would imply. The manager's estimate of his "capacity" output was then elicited along with the production schedule -- in hours per year -- that would generate that capacity output. Finally, he was asked at what percent of full capacity operation the plant was currently being run — the typical capacity survey question on which much of the data on capacity utilization is based (see the McGraw-Hill measure of capacity described below).

These questions, in light of the discussion in Part I above, should yield consistent answers — the capital utilization that generated capacity output should also be the level of capital utilization said to be the most efficient. That was, indeed, usually the case. When such consistency was not immediate, the surveyor was instructed to probe further to determine the source of inconsistency.

For each enumerated plant the survey yielded:

a. a measure of actual capital utilization as hours per year of capital services

b. a measure of desired (optimal or most efficient) capital utilization as hours of capital services per year

c. a measure of "full capacity" output and the corresponding capital utilization it implied

d. a measure of capacity utilization and excess capacity comparable to conventional McGraw-Hill survey results.

These data allowed the construction, in effect, of a bar graph of the type shown in Part I above for each plant in the survey, fully accounting for the 8760 hours of the year providing a uniform and integrated basis for the usual utilization concepts. In addition, the survey enumerated those characteristics of the plants that would either allow aggregation of plant observations into industry estimates or inform explanations of the observed variations in utilization. These included: product, value of output, value of capital stocks, employment, hours of labor use, and time-distribution of labor use, as well as things like ethnicity of owners or managers, corporate form, foreign or domestic ownership, etc.

EVALUATION:

Because the issues identified by the theoretical capital utilization analysis -- as well as the need to integrate capacity and capital utilization -- are only now being recognized as important by economists and statistical agencies, it is not surprising that data appropriate to their analysis should not yet exist widely. The expensive business of gathering those data through surveys, therefore, is inevitable if appropriate information is the objective. That was certainly the case with the World Bank and some of the ILO surveys. They did an excellent job of generating the right kind of data -- appropriate to understanding utilization and to formulating policies -- but they were either very expensive (the Bank) or confined to small samples (ILO). It would be easy to overstate the necessary expense of appropriate data, however. The World Bank project covered roughly 1200 firms in four countries and cost roughly $500,000 1973 dollars, as I recall it, but the ILO Nigeria study generated very useful information on 44 firms for not much more than $11,000 1976 dollars. I will return to this issue of costs in Part IV below.

B. Measures of Capital Utilization

Most studies have not had the luxury of being able to generate well-defined survey data on capital utilization so they have had to infer the flow of capital services from information on the measurable flows of other inputs, most notably those of labor services or of electric power. These are the two main measures of capital utilization that have employed existing data.

1. Shift Working -- Capital Utilization Inferred from Labor Utilization

Shift-working data are often reported for an industry or a sector, describing the number of shifts worked in the typical day or (less often) in the typical week. Sometimes, the distribution of the labor force over these shifts is also reported, the percent of the labor force that is found at work on each of the three shifts.

From these data, it is possible to estimate the utilization of the capital stock over the same period. If the typical plant in an industry works two shifts a day, it can be inferred that capital utilization is, for that day, roughly 67%. If the data also report the distribution of workers among shifts, employment weights can be attached to the reported shift distribution for an alternative measure of hours of capital services per day, though the fact that there is typically substitution out of labor for evening and night shifts -- because of the changing relative input prices discussed in Part I -- means that these simple shift-based data will typically understate the level of capital utilization.

A more serious overstatement of capital utilization, however, is likely to come from the failure of shift-working data to provide information on the variations in utilization that take the form of variations in days of operation per week and variations in weeks of operation per year. So long as only "typical" daily shifts are reported, there is no way to reconstruct these other, and quite significant, sources of variation in capital utilization from shift-working data. That these are significant sources of variation in actual capital utilization is evident from the World Bank data. If most variations in hours of capital utilization per year were accounted for by variations in shifts worked per day, the yearly data would be grouped around utilization rates of 1/3, 2/3 and 1. But they aren't.

EVALUATION:

Capital utilization estimates based on shift-working data are crude but useful, liable to understatement due to capital-labor substitution but to a probably greater overstatement through neglect of non-diurnal production rhythms. The ability to employ available data on shift working clearly reduces the costs of generating capital utilization estimates and therefore makes more such estimates available to us. The cost in data quality, however, can often be considerable. Some shift-working data report only "shifts worked per typical day," and are therefore unable to reflect variations in capital utilization due to variations in days worked per week or in weeks worked per year.

2. Electricity -- Capital Utilization Inferred from Electric Power Consumption Data

The other input flow from which capital utilization data have been inferred is electric power. This was the source of data for Murray Foss' pioneering 1964 study of US capital utilization. As with estimates based on labor input, the assumption of this method is that there is a fixed relationship between the utilization of the measured input and the utilization of capital services. The main difference between labor service- and electricity-based measures is that no information exists on the timing of electric power consumption by sector while it is just that timing that is registered in the shift-working data.

The procedure for estimating capacity utilization from eleectric power data uses two basic pieces of information: (1) the actual consumption of electricity over the year by industrial sector and (2) the "nameplate rating" of the electric motors installed in the plants of that industrial sector. Capital utilization, then, is taken to be the ratio of actual consumption of electric power to the consumption of electric power that would have resulted from running all those motors all the time. Adjustments are made for non-motive use of electricity -- for heating and lights -- and, in the other direction, adjustments are made for self-generated electricity -- since published data usually record only purchases of power.

EVALUATION:

The main strength of the electric power measure of capital utilization is its reliance on information that is cheaply available in a number of countries -- total nameplate capacity and actual sales of electric power, both by industrial sector. What is more, it is information that is routinely collected and therefore usually available over a number of years. This is why it was so clearly appropriate to the long time-series studies of capital utilization trends in the US (Foss) and Korea (Kim and Kwon).

The main weakness of the electric power measure is the fairly heroic assumptions necessary to make cross-section or interindustry comparisons. See Morawetz's effectively critical study for more detail. It is simply not true that the nameplate rated capacity of a motor can be extended over the year to give a reasonable measure of the potential consumption of electricity by the machine to which the motor is attached. A drill press, for instance, might be powered by a five-horsepower motor, capable of a peak consumption of 4.4 KW. Yet installed in an ordinary production process, the press might utilize that full capacity power input for only a small part of its efficient work cycle — the rest of that work cycle involves the positioning of the work piece and the removal of the finished work piece, not to mention routine and productive pauses to change bits and maintain the press. The consumption of power over an hour of sustained and highly efficient operation would fall very far short of that calculated by a simple extension of the nameplate rating for an hour.

Such distortions are bound to be quite serious when the electric power consumption measure is used to make comparisons between industries with their markedly different technologies — the error introduced by the nameplate data in one production process will be significantly different from that introduced in another production process. But over time within a given industry -- with its considerable stability, in the short run at least, of production technology — that sort of error would not be nearly as likely to be serious.

So the electricity measure of capital utilization appears to be (a) cheap, in relying largely on existing and collected data, (b) misleading for interindustry cross section comparisons, and (c) quite useful in measuring changes within a sector (or aggregation of sectors) over time. Kim and Kwon's use of this technique appears to have produced very useful results for South Korea and its promise for other developing countries appears to be considerable — an issue to which we return in Part IV below.

C. Measures of Capacity Utilization

This section presents an expository challenge. The subject of capacity utilization -- as has been made amply clear in the discussion of Part I — is less relevant to issues of the efficient use of capital in developing countries than is the subject of capital utilization. Yet because capacity utilization has so long been of importance to aggregate business cycle behavior in the advanced countries that spawn world statistical techniques and set standards, there are far more varieties of measures of capacity utilization and there is far more nuance in their design and analysis. The challenge, then, is to present a sense of their measurement and its variety without telling far more than is relevant to the subject of this study. Fortunately, that task is made easier by an excellent recent summary of capacity measures in the IMF Staff Papers by Lawrence Christiano: the existence of that survey lets me be efficiently brief while directing the interested reader to a far more thorough discussion of capacity measures.

There are two broad sources of data on capacity utilization: (1) capacity use surveys of firms and (2) inference from other reported industrial data.

1. Survey Measures of Capacity.

Broadly, two approaches are taken to capacity utilization surveys. In one — often called the "McGraw-Hill" method after the publisher of Business Week, who started it, though it is also used in US Department of Commerce, BEA, the MITI index of operating ratios in Japan, *inter alia* — firms are asked at what percent of full capacity they are currently operating. This survey generates a continuous variable with a logically possible range from zero to 100 percent (or more, depending on the definition of capacity). The alternative survey approach simply asks firms whether or not they are currently operating at full capacity. Its data are the proportion of firms surveyed that do report full capacity operation. This alternative approach is used in the Swedish Business Tendency Survey, in the INSEE in Paris and in one variant of the Bureau of Economic Analysis survey in the US, *inter alia*. None of the studies reported in Part III below uses this alternative survey measure.

Capacity measures are highly sensitive to the definition of "capacity" the respondent uses. This is true of surveys. On the one hand, it can be assumed that complex and imprecise though it is, the idea of "capacity" does have meaning and therefore useful responses will be got from managers without instructing them on how to interpret the word. On the other hand, it can be assumed that on its interpretation explicit guidelines are necessary to help the manager think of the meaning of "capacity" and to get meaningful results. But appealing though it is, this latter approach is often felt to create a too-complex question for preoccupied plant managers to answer accurately. Among the difficulties inherent in defining "capacity" -- that either are or are not swept under the rug -- are product mix, the relevant time period, and, of course, the "normal schedule of operation" that is at the core of capital utilization decisions.

EVALUATION:

As measures of capital productivity, survey measures are inadequate because they cannot describe "full capacity" in other than highly elastic and unmeasured terms. As measures of business confidence and optimism or Keynes' "animal spirits" -- the use to which they are often put in advanced country studies of investment behavior -- they are far more useful, but then they are less relevant to the study of capital productivity. The ability of surveys to include a richer set of questions than the data-based studies described below can, of course, be useful.

2. Data-Based Measures of Capacity Utilization

The alternative to asking firms about their capacity utilization is to infer it from industrial data collected for other purposes. The method is simple in principle. Actual output estimates for a sector or other aggregate[6] are compared to "capacity output" estimates and the ratio is reported as capacity utilization. "Excess capacity" is then one minus the capacity utilization ratio. The difficulties, of course, again come in estimating "capacity output." There are two methods for making capacity estimates -- and a third that combines them.

a. Trend-through-the-peaks. This is the "Wharton method" based on a historical output series by industrial sector. It identifies output peaks (arbitrarily) and assumes that they represent full-capacity operation. Then capacity output for intervening periods is estimated simply by a linear connection (or projection) of the peak trend output. Contemporary actual output is compared with the projected trend to establish the capacity utilization estimate.

b. Production functions are estimated as descriptive of the long-term relationships (for a sector) between "capacity output" and measured capital stock and labor inputs. For any period, then, estimates of actual output are compared to the capacity output estimated at full employment of resources to determine capacity utilization.

c. Trend-through-the-peak, modified by other information on input flows merges these two methods, retaining information on capital or labor variations between peaks while still depending on those historical peaks to define capacity output.

EVALUATION:

Much the same thing can be said about production function and Wharton trend estimates of capacity utilization as was said about the survey based estimates. In this method, it is clearer, perhaps, that the interest and purpose of these devices is to measure cyclical variations in economic activity and not to assess the efficiency of utilization of capital resources. At the same time, by using aggregated data that cannot be expanded to include the less formal information that often emerges in surveys, data-based capacity measures seem less likely to lead to insights into issues of optimal capital productivity.

3. Merged Survey and Data-Based Measures of Capacity Utilization

Though nothing like it shows up in studies of capacity utilization in a developing country, it is worth noting in conclusion that the Federal Reserve Bank's capacity utilization measure tempers McGraw-Hill survey results with information from its Survey of Industrial Production -- in order to generate an amalgated measure of capacity utilization -- one that decreases the volatility of the McGraw-Hill survey results.

D. Weighting in Aggregation

Brief note should be made of the variations in weighting when utilization data are aggregated to industry or sectoral estimates because the choice of weighting scheme has a significant influence on the resulting estimate and because the different weighting schemes serve different analytical purposes. These issues are discussed at some length in the World Bank study (Bautista, et al).

The weights most frequently used are (a) value of the capital stock, (b) number of employees and (c) sales or value added. The alternative is an unweighted average. Each of these answers a different question for the sector or economy. (a) Weighted by value of capital, an aggregate utilization estimate describes the utilization rate of the average piece of capital in that sector. This is the measure most relevant to analyses of capital productivity. (b) Weighted by number of employees, an estimate describes the utilization of the plant in which the average worker works. This is the measure most relevant to analysis of working conditions. (c) Weighted by sales or value added, the estimate measures the utilization of the plant in which the average unit of product is made. It is not clear what purpose this measure might serve. Finally, an unweighted estimate describes the utilization of the average plant where plant level data are used. The choice of weights, it was shown in World Bank data, has a considerable effect on the values of the utilization estimates produced -- they are higher with capital weights than unweighted and higher unweighted than with labor weights, reflecting the higher utilization rates typically found in capital-intensive operations.

III. A Survey of Empirical Estimates of Capital and Capacity Utilization

This part describes those empirical studies that have generated data on capital and capacity utilization in developing countries and reports the data on utilization generated by each. The emphasis is on work done since 1970 when concepts were clarified sufficiently that meaningful data could emerge. The extensive discussion of the preceding two sections of the data on capital and capacity utilization, its measures and meaning, allows the use of an efficiently brief format in this section without the need for extensive repetition. Except where translation was necessary, all data are presented as Xeroxed copies of the original sources to avoid introduction of errors in copying. Interpretive notes are added where relevant.

The project used DIALOG On Line Bibliographical Search to access all major US libraries to discover published studies of utilization in developing countries. The search for unpublished studies was done by personal correspondence with the eighteen leading researchers around the world who have in the past been most directly involved in studies of capital utilization — at the World Bank, in Europe, the US, Australia and in a number of developing countries. It is evident from the published material, however, that with the introduction of these issues into the general literature a decade ago this is no longer a wholly reliable way of locating new studies: none of my correspondents identified new current studies being done, yet correspondence from those following up on my work in the literature have revealed three, one of them an extensive study of Indian manufacturing (the others described Italy and Hungary and hence are not relevant).

Twenty-one studies are summarized in this section involving twelve countries. Fifteen of those studies report information on capital utilization while the remaining six describe studies of capacity utilization. Four of the capital utilization studies used shift-working data as the basis of measurement; two used electric power; and the remaining nine used survey data of hours worked, including the World Bank (three developing countries) and ILO (three countries) studies discussed at length above. One of the capacity studies used a Wharton index, three used production function (or capital output) estimates, and three did not describe their methodology. Studies that reported data on shift working -- for Brazil, Chile and five Latin American Countries (Schydlowsky) — are noted in the bibliography but not included in the summary of research since those data have not been used to estimate capital utilization levels. Two other omissions are less fortunate: the working papers of the "UNIDO Expert Group on the Use of Excess Capacity for Exports" (Rio de Janeiro, 1969) were not available to me and neither was Abusada-Salah's 1978 Cornell University PhD thesis on capital utilization in Peruvian manufacturing. These should be consulted in any further study.

A guide to the contents of this section — the studies summarized here — follows:

A. Capital Utilization

A1. The World Bank Project
- A1.1 Colombia -- Thoumi
- A1.2 Malaysia -- Lim
- A1.3 Philippines -- Bautista

A2. The ILO Studies
- A2.1 Nigeria -- Winston
- A2.2 Sri Lanka -- Betancourt
- A2.3 Morocco -- Phan-Thuy

A3. Other Country Studies
- A3.1 Malaysia -- Lim
- A3.2 Korea -- Kim and Kwon
- A3.3 Nigeria -- Mrs. Osaba
- A3.4 Brazil -- de Almeida
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- A3.6 Bangladesh -- Islam
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B. Capacity Utilization

B1.1 Bangladesh -- Afroz and Roy
B1.2 India -- Sastry
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C. Other Studies

C1. Utilization Estimates Omitted
C1.1 Kenya -- Baily
C1.2 India -- Betancourt-Clague
C2. Studies Unavailable or Inappropriate
C2.1 India
C2.2 Brazil
C2.3 Peru
C2.4 Nigeria
C2.5 Capacity Studies -- Various Countries
C2.6 India

A. Capital Utilization Studies

A1. The World Bank Project

The first three studies are part of the World Bank's Capital Utilization Project reported in Bautista, et al.... A fourth country -- Israel -- was included in that project but since it does not qualify as a developing country, it is omitted here.

The data reported in these studies are based on surveys of stratified (by industrial sector) random samples of establishments. Enumerations were done by survey teams. For each establishment, hours per year of operation were reported without (U_1) and with (U_2) recognition of variations in the intensity of use of capital equipment during periods of operation. Then these data on hours of operation per year per establishment were aggregated into four- and three-digit sectors using a variety of weighting schemes: unweighted averages (reporting utilization in the average plant), capital weights (reporting utilization of the average piece of equipment), employment weights (reporting utilization in the plant in which the average worker works), and value added weights (reporting utilization in the plant in which the average dollar of value added is produced). Clearly, in a study of capital utilization, the capital weights were most appropriate. The desired level of utilization (analogous to theoretically optimal utilization) was reported by each establishment (U_5). U_4 is an indirect estimate of desired capital utilization. In addition to capital utilization, a McGraw-Hill capacity utilization estimate was got from each establishment (U_3) and they, too, were aggregated. Furthermore, an independent estimate of capacity is reported as actual relative to desired utilization (U_6).

A1.1 Colombia

Thoumi, Francisco E., Chapter 5, "Colombia," in Bautista, et al, Capital Utilization in Manufacturing: Colombia, Israel, Malaysia, and the Philippines, A World Bank Research Publication (New York: Oxford University Press; 1981), pp. 99-140.

Data: Capital Utilization

Method/measure: Direct survey enumeration of establishments as described above including both capital and capacity utilization estimates.

Date/sample: 1973. 347 establishments. Reported at the three- and four-digit levels.

Table 5-7. *Colombia—Capital Utilization in Manufacturing, ISIC Three-digit Level, 1973*
(percent)

ISIC	Branch	Number of plants	U_1 UW	U_1 K	U_2 UW	U_2 K	U_3 UW	U_3 K	U_4 UW	U_4 K	U_5 UW	U_5 K	U_6 UW	U_6 K
311	Food manufacturing	51	49.2	75.4	42.5	73.1	68.9	88.3	61.7	82.8	69.0	81.7	71.3	92.3
312	Food manufacturing, n.e.c.	7	57.6	77.4	49.6	71.3	75.7	81.7	65.5	87.3	62.3	81.1	92.5	95.4
313	Beverages	10	48.1	88.4	40.1	71.3	69.6	71.4	57.6	99.9	50.7	93.6	94.9	94.4
314	Tobacco products	3	39.5	53.5	38.0	53.5	75.7	99.5	50.2	53.8	38.1	53.3	103.7	100.4
321	Textiles	24	52.2	83.5	48.5	83.0	78.6	92.7	61.7	89.5	72.5	92.6	72.0	90.2
322	Wearing apparel except footwear	29	30.3	27.3	25.1	23.8	74.1	65.8	33.9	36.2	46.8	46.3	64.7	59.0
323	Leather and products except footwear	5	41.1	68.5	32.0	49.7	79.0	74.4	40.5	66.8	49.5	76.8	83.0	89.2
324	Leather footwear	6	24.5	25.6	18.8	23.0	65.0	63.3	28.9	36.3	34.9	29.6	70.2	86.5
331	Wood and products except furniture	4	25.2	26.2	16.2	14.0	63.8	52.6	25.4	26.6	26.9	27.4	93.7	95.6
332	Furniture and fixtures	15	23.5	24.2	16.5	13.6	60.5	45.1	27.3	30.2	44.6	41.8	52.7	57.9
341	Paper and products	13	59.4	85.4	50.4	85.6	81.4	92.9	61.9	92.1	77.5	87.1	76.6	98.0
342	Printing and publishing	10	41.1	55.2	35.3	46.9	72.0	72.2	49.0	65.0	58.9	62.0	69.8	89.0
351	Industrial chemicals	16	72.9	91.2	70.0	91.0	87.1	98.5	80.4	92.4	87.4	94.8	83.4	96.2
352	Other chemical products	24	30.1	42.2	24.2	41.2	64.2	70.0					70.4	85.6
355	Rubber products	9	36.9	44.1	30.4	38.0	73.7	67.5	41.2	56.3	54.1	62.0	66.2	71.1
356	Plastic products, n.e.c.	6	48.1	79.3	37.4	65.0	67.5	79.9	55.4	81.4	63.5	85.6	75.7	92.6
361	Pottery, etc.	4	40.0	93.2	40.0	93.2	85.0	100.0	47.1	93.2	58.3	99.9	68.6	93.3
362	Glass and products	6	47.4	96.9	44.5	98.9	84.7	99.7	52.5	99.2	75.4	99.5	62.9	99.4
369	Other nonmetallic mineral products	20	43.2	84.2	38.7	81.5	74.5	91.6	51.9	89.0	56.9	94.9	75.9	88.7
371	Iron and steel	4	64.7	98.5	57.1	98.0	66.0	98.0	86.5	100.0	80.0	98.8	86.9	99.7
372	Nonferrous metal industries	2	42.5	46.7	33.8	37.5	92.5	94.3	36.5	39.8	71.4	78.3	66.9	59.6
381	Fabricated metal products	31	38.9	60.8	32.1	55.8	75.1	71.5	42.7	78.0	53.3	74.7	73.0	81.4
382	Nonelectrical machinery	16	39.3	57.4	31.3	45.5	69.0	68.0	45.4	66.9	60.1	66.9	65.4	85.8
383	Electrical machinery	19	28.3	32.1	21.6	25.6	55.3	55.0	39.1	46.5	46.8	40.0	60.5	80.3
384	Transport equipment	6	38.8	49.0	30.1	41.2	64.5	56.2	46.7	73.3	55.0	60.8	70.5	80.6
390	Other manufacturing	7	33.7	47.2	26.3	35.7	55.7	64.3	47.2	55.5	66.8	89.1	50.4	53.0
	All manufacturing, average	347	42.6	81.4	36.3	78.9	71.7	89.6	50.6	88.1	59.3	87.8	71.8	92.7
	Standard deviation		24.1	19.7	24.6	22.0	22.7	15.6	19.6	25.1	28.7	17.6	15.1	19.2

Source: Survey data

Table 5-8. *Colombia—Capital Utilization in Manufacturing, ISIC Four-digit Level, 1973*
(percent)

ISIC	Branch	Number of plants	U_1		U_2		U_3		U_4		U_5		U_6	
			UW	K	UW	K	UW	K	UW	K	UW	K	UW	K
3111	Meat processing	4	55.8	48.3	42.4	34.9	65.8	66.3	64.4	74.1	85.7	89.5	164.3	54.0
3112	Dairy products	4	62.9	72.4	48.6	59.5	63.8	61.8	76.2	96.3	56.1	58.0	112.1	127.0
3113	Fruit and vegetable canning	3	46.3	66.5	44.0	65.7	75.0	86.8	58.7	75.7	69.1	89.1	67.0	74.6
3115	Oils and fats	4	88.4	92.4	82.7	82.1	73.0	80.2	113.3	99.3	100.0	100.0	88.0	92.4
3116	Grain mill products	9	35.3	29.3	33.8	27.5	59.6	46.8	56.7	58.8	74.9	70.5	47.1	41.8
3117	Bakery products	15	43.9	60.7	34.8	58.9	64.7	61.8	53.8	95.3	63.9	71.0	68.7	85.5
3118	Sugar products	4	75.6	82.1	69.3	81.2	87.5	98.0	79.2	82.9	84.5	85.2	89.5	96.4
3119	Cocoa and confectionary	8	33.2	43.3	29.6	39.0	78.0	74.7	37.9	52.2	46.7	50.5	71.7	85.7
3121	Food products, n.e.c.	5	53.5	79.7	46.8	76.3	77.0	83.6	60.8	91.3	56.2	81.4	95.2	97.9
3122	Animal feed products	2	67.9	65.8	56.5	55.8	72.5	72.1	77.9	77.4	77.7	79.5	87.4	82.8
3131	Distilled beverages	2	43.8	76.0	36.1	62.8	48.5	86.2	74.4	72.9	64.4	63.9	94.4	118.9
3132	Wine	2	25.0	25.5	21.3	22.3	62.5	67.9	34.1	32.8	30.7	31.6	81.4	71.2
3133	Malt liquors	2	75.9	91.2	59.3	72.9	75.0	70.3	79.1	103.7	76.2	98.5	99.6	92.6
3134	Soft drinks	4	47.9	56.3	41.9	54.9	81.0	76.8	51.7	71.5	50.2	43.4	95.4	129.9
3140	Tobacco products	3	39.5	53.5	38.0	53.5	75.7	99.5	50.2	53.8	38.1	53.3	103.7	100.4
3211	Spinning, weaving, finishing	18	61.0	84.2	57.3	83.7	84.0	92.9	68.2	90.1	81.2	92.6	75.1	90.9
3212	Made-up textiles	3	27.0	24.0	23.2	24.0	68.3	78.3	34.0	30.7	57.1	94.1	47.1	25.5
3213	Knitting mills	1	24.7	24.7	24.7	24.7	80.0	80.0	30.9	30.9	28.6	28.6	86.4	86.4
3214	Carpets and rugs	2	24.6	25.8	18.3	18.7	45.0	54.8	40.7	34.1	39.3	43.5	62.6	59.3
3220	Wearing apparel except footwear	29	30.3	27.3	25.1	23.8	74.1	85.8	33.9	36.2	46.8	46.3	64.7	59.0
3231	Tanneries	2	50.8	68.8	39.1	49.9	75.0	74.3	53.1	67.2	63.1	77.2	80.5	89.1
3233	Leather products	3	26.5	26.8	21.2	19.3	85.0	92.9	24.9	20.8	29.2	29.6	90.8	90.5
3240	Leather footwear	6	24.5	25.6	18.8	23.0	65.0	63.3	28.9	36.3	34.9	29.6	70.2	86.5
3311	Sawmills and woodmills	2	25.2	25.9	11.2	8.3	45.0	32.4	24.9	25.6	27.7	26.9	91.0	96.3
3312	Wood and cane containers	2	25.2	27.0	21.2	26.5	82.5	97.9	25.7	27.1	26.2	28.3	96.2	95.4
3320	Furniture and fixtures	15	23.5	24.2	16.5	13.6	60.5	45.1	27.3	30.2	44.6	41.8	52.7	57.9
3411	Pulp, paper, paperboard	1	50.0	50.0	50.0	50.0	100.0	100.0	50.0	50.0	85.7	85.7	58.7	58.3
3412	Paper containers and boxes	9	54.8	86.6	45.8	86.0	81.4	94.9	56.3	90.6	69.1	85.2	79.3	101.6
3419	Pulp, paper, paperboard, n.e.c.	3	76.4	77.7	64.3	67.4	75.0	79.4	85.7	84.9	100.0	100.0	76.4	77.7
3420	Printing and publishing	10	41.1	55.2	35.3	46.9	72.0	72.2	49.0	65.0	58.9	62.0	69.8	89.0
3511	Basic industrial chemicals	7	82.6	88.2	82.6	88.2	94.3	93.2	87.6	94.6	95.9	99.3	86.1	88.8
3512	Fertilizers and pesticides	3	25.9	25.7	19.7	17.1	65.0	80.0	30.3	21.4	50.8	34.5	51.0	74.5
3513	Synthetic fibers	6	85.1	92.1	80.6	92.0	89.7	99.0	89.9	92.9	95.8	95.2	88.8	96.6
3521	Paints, varnishes, lacquers	3	36.4	43.7	24.7	32.4	67.7	68.8	36.5	47.1	41.9	48.8	86.9	89.5
3522	Drugs and medicines	11	31.3	26.5	22.2	19.1	63.0	65.0	35.2	29.2	46.4	55.7	67.5	51.2
3523	Soap and cosmetics	6	34.0	36.3	29.1	32.1	66.5	62.8	43.8	51.1	54.4	53.8	62.5	67.5
3529	Chemical products, n.e.c.	4	32.7	38.7	28.7	35.7	78.8	87.2	36.4	40.9	49.9	43.8	65.5	87.2
3551	Tires and tubes	1	33.0	33.0	33.0	33.0	100.0	100.0	33.0	33.0	64.3	64.3	51.3	51.3
3559	Rubber products, n.e.c.	8	37.4	44.0	30.0	38.1	70.4	66.5	42.6	57.3	52.8	61.9	70.8	71.7
3560	Plastic products, n.e.c.	6	48.1	79.3	37.4	65.0	67.5	79.9	55.4	81.4	63.5	85.6	75.7	92.6
3610	Pottery and china	4	40.0	93.2	40.0	93.2	85.0	100.0	47.1	93.2	58.2	99.9	68.6	93.3
3620	Glass and products	6	47.4	98.9	44.5	98.9	84.7	99.7	52.5	99.2	75.4	99.5	62.9	99.4
3691	Structural clay products	13	37.6	70.9	31.7	49.6	70.0	65.7	45.3	75.5	48.7	74.5	77.2	95.2
3692	Cement, lime, plaster	2	85.5	87.2	85.5	87.2	97.5	95.6	87.7	91.2	92.9	98.4	92.0	88.2
3699	Nonmetallic minerals, n.e.c.	5	40.8	45.5	38.2	42.7	77.0	83.7	49.6	57.0	63.6	74.8	64.2	60.8
3710	Iron and steel	4	64.7	98.5	57.1	98.0	66.0	98.0	86.5	100.0	80.0	98.8	80.9	99.7
3720	Nonferrous metals	2	42.5	46.7	33.8	37.5	92.5	94.3	36.5	39.8	71.4	78.3	59.5	59.6
3811	Cutlery and hand tools	3	43.2	39.0	38.1	35.2	71.7	72.8	53.1	48.4	58.3	52.9	74.1	73.7
3812	Metal furniture and fixtures	11	34.3	50.3	26.4	38.5	76.4	69.3	34.6	55.6	47.5	70.9	72.2	63.5
3813	Structural metal products	4	57.2	74.4	53.5	73.7	68.3	71.2	78.3	96.7	71.4	85.4	80.1	87.1
3819	Metal products, n.e.c.	13	37.5	44.3	30.7	36.1	76.4	76.5	40.2	47.2	52.8	55.8	71.0	79.4
3821	Engines and turbines	1	49.4	49.4	49.4	49.4	80.0	80.0	61.8	61.8	85.7	85.7	57.6	57.6
3822	Agricultural machinery	5	38.2	68.9	32.4	64.5	72.0	62.7	45.0	102.9	65.4	93.2	58.4	73.9
3823	Metal and woodworking machinery	2	25.4	25.4	15.2	15.2	40.0	40.0	38.0	38.0	28.6	28.6	88.8	88.8

(Table continues on the following page.)

Table 5-8 (*Continued*)

ISIC	Branch	Number of plants	U_1 UW	U_1 K	U_2 UW	U_2 K	U_3 UW	U_3 K	U_4 UW	U_4 K	U_5 UW	U_5 K	U_6 UW	U_6 K
3824	Other industrial machinery	2	52.6	55.6	23.5	22.5	55.0	40.5	51.8	55.6	78.6	57.9	66.9	96.0
3825	Office machines	1	25.3	25.3	25.3	25.3	100.0	100.0	25.3	25.3	26.8	26.8	94.4	94.4
3829	Nonelectrical machinery, n.e.c.	5	38.6	74.2	32.2	62.9	69.0	78.4	46.7	80.2	55.2	80.0	69.9	92.8
3831	Electrical industrial machinery	2	43.4	51.9	39.7	49.8	75.0	81.7	52.9	61.0	59.5	64.8	72.9	80.1
3832	Radio, TV, communications	4	23.8	23.6	20.7	22.0	52.5	68.0	39.4	32.4	31.7	30	75.1	76.4
3833	Electrical appliances	7	27.7	32.1	21.3	25.2	53.8	49.5	39.6	50.9	41.8	35.0	66.3	91.7
3839	Electrical apparatus, n.e.c.	6	26.8	39.2	16.6	29.2	52.5	74.1	31.6	39.4	59.1	70.8	45.3	55.4
3843	Motor vehicles	6	38.8	49.0	30.1	41.2	64.5	56.2	46.7	73.3	55.0	60.8	70.5	80.6
3909	Manufacturing industries, n.e.c.	7	33.7	47.2	26.3	35.7	55.7	64.3	47.2	55.5	66.8	89.1	50.4	53.0
	All manufacturing, average	347	42.6	81.4	36.3	78.9	71.7	89.6	50.6	88.6	59.3	87.8	71.8	92.7
	Standard deviation		24.1	19.7	24.6	22.0	22.7	15.2	19.6	25.1	28.7	17.6	15.1	19.2

Source: Survey data

NOTES:

U_1: hours per year of operation, expressed as a percent of total time

U_2: " " " " " " " " " , adjusted for intensity of capital utilization during operation

U_3: McGraw-Hill capacity utilization response

U_4: Estimated desired utilization, U_1/U_3

U_5: Desired (optimal) hours of operation response, as a percent of total time

U_6: Actual hours of operation as percent of desired hours

UW: Unweighted average

KW: Capital weighted average

A 1.2 Malaysia

Lim, David, Chapter 7, "Malaysia," in Bautista, et al, Capital Utilization in Manufacturing: Colombia, Israel, Malaysia, and the Philippines. A World Bank Research Publication. (New York: Oxford University Press; 1981), pp. 184-213.

Data: Capital and Capacity Utilization

Method/measure: Direct survey enumeration of establishments as described above including both capital and capacity utilization estimates.

Date/sample: 1972. 350 establishments. Reported at the three- and four-digit levels.

Table 7-3. *Malaysia—Capital Utilization in Manufacturing, MIC/ISIC Three-digit Level, 1972*
(percent)

MIC/ ISIC	Branch	Number of plants	U_1		U_2		U_3		U_4		U_5	
			K	UW	K	UW	K	UW	K	UW	K	UW
311	Food manufacturing	42	62.5	50.5	58.0	46.4	74.4	76.6	78.0	60.6	70.2	57.1
312	Food manufacturing, n.e.c.	9	52.1	48.7	46.3	41.3	80.7	81.1	57.4	53.4	59.9	51.3
313	Beverages	10	64.5	46.8	60.9	[illegible]	82.1	81.0	74.2	55.2	73.0	51.4
314	Tobacco products	13	50.4	39.7	49.5	35.7	98.9	83.0	50.1	43.0	48.5	49.3
321	Textiles	18	84.9	79.4	80.3	73.7	86.2	86.0	93.2	85.7	79.4	80.0
322	Wearing apparel except footwear	4	44.8	46.7	44.8	46.7	100.0	100.0	44.8	46.7	44.9	47.3
323	Leather and products except footwear	3	26.4	26.5	18.7	20.4	78.1	78.3	23.9	26.1	39.3	52.4
324	Leather footwear	3	28.6	45.3	24.3	34.5	64.7	66.6	37.6	51.8	28.2	46.0
331	Wood and products except furniture	31	53.1	44.6	45.9	40.1	84.6	84.7	54.2	47.3	57.8	49.6
332	Furniture and fixtures	3	46.2	36.3	44.4	32.8	99.6	93.3	44.6	35.2	37.6	47.6
341	Paper and products	4	55.3	59.0	47.3	51.9	82.7	82.5	57.2	62.9	60.8	65.5
342	Printing and publishing	20	53.5	44.7	52.6	42.2	89.7	80.3	58.6	52.6	45.6	55.7
351	Industrial chemicals	7	86.4	64.8	84.2	61.8	80.6	74.5	104.5	82.9	93.8	72.5
352	Other chemical products	18	42.5	35.8	38.6	33.6	73.9	77.7	52.2	43.2	42.7	38.5
353	Petroleum refineries	5	87.2	82.2	83.9	78.1	96.1	93.0	87.3	84.0	79.9	77.6
355	Rubber products	48	78.2	70.6	72.5	64.1	84.9	85.7	85.4	74.8	81.0	76.4
356	Plastic products, n.e.c.	10	73.3	71.3	67.8	66.1	82.2	81.8	82.5	80.8	74.0	71.2
361	Pottery, etc	3	35.9	30.7	33.4	29.8	100.0	100.0	33.4	29.8	26.9	28.0
362	Glass and products	3	93.9	72.4	92.9	71.4	87.1	91.6	95.2	77.9	100.0	100.0
369	Other nonmetallic mineral products	23	90.7	65.4	87.7	61.4	95.6	83.7	91.7	73.3	92.7	63.2
371	Iron and steel	11	89.3	57.6	80.4	51.4	91.0	76.1	88.4	67.5	90.5	61.7
372	Nonferrous metals	3	87.6	69.0	86.1	67.6	80.7	83.6	106.7	80.9	82.7	68.3
381	Fabricated metal products	16	57.5	46.9	43.8	39.3	73.7	73.9	59.4	53.2	68.2	56.5
382	Nonelectrical machinery	12	32.1	35.9	25.1	30.3	78.9	81.2	31.8	37.3	28.4	34.7
383	Electrical machinery	13	70.9	62.7	70.0	61.4	71.4	75.2	98.0	81.6	54.0	48.0
384	Transport equipment	12	34.7	34.0	33.4	31.1	80.8	76.2	41.3	40.8	25.6	26.8
385	Scientific equipment	3	75.7	66.8	65.0	58.4	86.2	86.6	75.4	67.4	28.6	28.6
390	Other manufacturing	3	84.9	82.1	70.1	71.3	100.0	100.0	70.1	71.3	74.9	76.2
	All manufacturing, average	350	74.9	54.6	70.8	50.1	88.7	81.9	79.8	61.2	72.7	57.9
	Standard deviation		26.1	24.2	27.2	25.2	12.3	13.4	23.5	17.7	27.5	30.0

Source: Survey data

Table 7-4. *Malaysia—Capital Utilization in Manufacturing, MIC/ISIC Four-digit Level, 1972*
(percent)

MIC/ISIC	Branch	Number of plants	U_1 K	U_1 UW	U_2 K	U_2 UW	U_3 K	U_3 UW	U_4 K	U_4 UW	U_5 K	U_5 UW
3111	Meat processing	2	43.7	37.0	43.7	37.0	59.3	50.0	73.7	74.0	67.0	56.0
3112	Dairy products	6	45.5	41.1	43.6	39.7	77.9	76.7	56.0	51.8	53.9	46.4
3113	Fruit and vegetable canning	6	66.2	52.8	60.0	46.6	62.7	75.0	95.6	62.1	30.3	31.7
3114	Fish processing	2	86.5	82.4	86.5	82.4	93.2	92.5	92.8	89.1	43.1	48.2
3115	Oils and fats	5	75.4	68.8	73.9	65.4	81.0	84.0	91.2	77.9	76.8	54.6
3116	Grain mill products	12	61.5	46.0	57.1	40.8	68.3	74.3	83.6	54.9	81.6	58.3
3117	Bakery products	5	48.0	42.6	38.9	36.0	82.9	77.0	46.9	46.8	64.8	57.1
3118	Sugar products	2	76.5	78.1	70.5	73.8	86.1	90.0	81.9	82.0	100.0	100.0
3119	Cocoa and confectionary	2	31.0	27.0	26.8	24.7	61.4	73.0	43.6	33.8	44.0	39.0
3121	Food products, n.e.c.	6	51.6	47.3	42.7	40.0	73.6	75.8	58.0	52.8	74.2	52.1
3122	Animal feed products	3	52.9	51.7	51.6	50.2	91.4	91.7	56.4	54.7	38.3	33.7
3133	Malt liquors	2	77.3	76.6	72.4	72.6	80.9	75.0	89.5	96.8	95.5	88.1
3134	Soft drinks	8	48.5	39.4	46.6	37.7	83.6	82.5	55.7	45.7	44.9	32.3
3140	Tobacco products	13	50.4	39.8	49.5	35.7	98.9	83.1	50.0	43.0	48.5	45.0
3211	Spinning, weaving, finishing	15	84.1	78.4	79.5	72.2	85.8	84.5	93.0	85.4	75.2	47.8
3213	Knitting mills	1	98.1	98.1	98.1	98.1	90.0	90.0	109.0	109.0	100.0	100.0
3214	Carpets and rugs	1	59.2	59.2	59.2	59.2	100.0	100.0	59.2	59.2	64.3	64.3
3215	Cordage and rope	1	96.2	96.2	86.5	86.6	90.0	90.0	96.1	96.2	88.1	88.1
3220	Wearing apparel except footwear	4	44.8	46.8	44.8	46.8	100.0	100.0	44.8	46.8	44.9	29.8
3231	Tanneries	2	26.7	26.7	19.1	21.4	76.4	77.5	25.0	27.6	49.0	28.6
3233	Leather products	1	26.1	26.1	18.3	18.3	80.0	80.0	22.9	22.9	28.6	28.6
3240	Leather footwear	3	28.6	45.3	24.4	34.4	64.7	66.7	37.7	51.6	28.2	46.0
3311	Sawmills and woodmills	31	53.1	44.6	45.9	40.1	84.6	84.7	54.2	47.3	57.8	44.2
3320	Furniture and fixtures	3	46.2	36.4	44.4	37.8	99.6	93.3	44.6	40.5	37.6	47.6
3410	Paper and products	1	55.7	55.7	44.6	44.6	95.0	95.0	46.9	46.9	66.7	66.7
3412	Paper containers and boxes	3	55.0	60.2	48.6	54.4	78.6	78.3	63.3	69.5	58.0	65.1
3420	Printing and publishing	20	53.5	44.7	52.7	42.2	89.7	80.4	58.8	52.5	45.6	41.0
3511	Basic industrial chemicals	4	88.3	81.2	86.4	78.9	80.8	68.0	106.9	116.0	95.4	53.0
3512	Fertilizers and pesticides	3	60.8	43.1	55.3	39.1	77.4	83.3	71.4	46.9	73.4	27.4
3521	Paints, varnishes, lacquers	5	33.1	27.6	32.6	26.8	85.7	82.6	38.0	32.4	25.3	26.1
3522	Drugs and medicines	3	24.2	23.6	20.8	20.8	86.1	88.7	24.1	23.4	26.5	26.6
3523	Soap and cosmetics	7	62.7	48.9	56.2	45.7	68.6	75.7	81.9	60.4	63.2	52.2
3529	Chemical products, n.e.c.	3	30.0	31.0	26.2	29.2	65.6	63.3	39.9	46.1	35.4	38.9
3530	Petroleum refining	5	87.1	82.2	83.9	78.1	96.1	93.0	87.3	84.0	79.9	62.7
3551	Tires and tubes	4	70.0	61.0	69.3	53.9	91.2	90.0	76.0	59.9	80.3	77.2
3559	Rubber products, n.e.c.	44	79.4	71.5	72.9	65.1	84.1	85.4	86.7	76.2	81.1	65.3
3560	Plastic products, n.e.c.	10	73.3	71.4	67.8	66.2	82.2	81.8	82.5	80.9	74.0	52.0
3610	Pottery and china	3	36.0	30.7	33.4	29.8	100.0	100.0	33.4	29.8	26.9	28.0
3620	Glass and products	3	94.0	72.4	92.8	71.5	87.1	91.7	106.5	78.0	100.0	100.0
3691	Structural clay products	8	65.0	55.9	53.4	48.3	81.7	84.4	65.4	57.2	67.0	28.8
3692	Cement, lime, plaster	5	94.8	95.3	92.6	93.3	98.1	98.2	94.4	95.0	100.0	100.0
3699	Nonmetallic minerals, n.e.c.	10	83.0	58.3	82.7	56.0	90.1	87.5	92.0	64.0	63.0	45.4
3710	Iron and steel	11	89.2	57.6	80.4	51.5	91.0	76.2	88.3	67.6	90.5	57.9
3720	Nonferrous metals	3	87.6	69.0	86.1	67.7	80.7	81.7	106.6	82.9	82.7	68.2
3811	Cutlery and hand tools	1	82.2	82.2	77.3	77.3	100.0	100.0	77.3	77.3	83.9	83.9
3812	Metal furniture and fixtures	3	29.3	29.7	25.2	26.6	82.0	85.0	30.7	31.3	52.6	51.2
3813	Structural metal products	4	61.5	51.2	41.3	39.2	70.5	70.0	58.6	56.0	68.5	47.9
3819	Metal products, n.e.c.	8	56.9	47.0	42.7	39.4	69.7	68.5	61.3	57.5	68.3	53.6
3821	Engines and turbines	6	30.8	32.0	23.8	26.8	78.7	83.3	30.2	32.2	26.3	26.9
3822	Agricultural machinery	1	32.2	32.2	29.0	29.0	100.0	100.0	29.0	29.0	28.6	28.6
3823	Metal and woodworking machinery	1	30.3	30.3	30.3	30.3	50.0	50.0	60.6	60.6	33.3	33.3
3829	Nonelectrical machinery, n.e.c.	4	51.5	44.0	40.2	36.1	81.1	81.3	49.6	44.4	56.7	48.2
3832	Radio, TV, communications	5	49.9	48.9	47.9	46.1	57.8	60.2	82.9	76.6	26.2	26.3
3839	Electrical apparatus, n.e.c.	8	81.7	71.4	81.5	71.1	78.4	84.6	104.0	84.0	65.3	48.7
3841	Shipbuilding and repair	1	32.4	32.4	32.4	32.4	100.0	100.0	32.4	32.4	23.8	23.8
3843	Motor vehicles	7	38.1	38.5	37.0	36.2	65.3	65.7	56.7	55.1	26.5	27.2
3844	Motorcycles and bicycles	4	26.9	26.8	21.2	22.1	87.6	88.8	24.2	24.9	27.0	26.9
3851	Professional and scientific equipment	3	75.7	66.9	65.0	58.4	86.3	86.7	75.3	67.3	28.6	28.6
3909	Manufacturing industries, n.e.c.	3	84.9	82.1	70.1	71.3	100.0	100.0	70.1	71.3	74.9	28.5
	All manufacturing, average	348	74.9	54.6	70.8	50.1	88.7	82.0	79.8	50.1	72.7	47.0
	Standard deviation		18.4	16.7	18.8	16.3	9.6	8.4	23.5	17.7	27.5	23.5

Source: Survey data

NOTES:

U_1: hours per year of operation, expressed as a percent of total time

U_2: " " " " " " " " " , adjusted for intensity of capital utilization during operation

U_3: McGraw-Hill capacity utilization response

U_4: Estimated desired utilization, U_1/U_3

U_5: Desired (optimal) hours of operation response, as a percent of total time

UW: Unweighted average

K: Capital weighted average

A 1.3 Philippines

Bautista, Romeo M., Chapter 8, "Philippines," in Bautista, et al, Capital Utilization in Manufacturing: Colombia, Israel, Malaysia, and the Philippines. A World Bank Research Publication. (New York: Oxford University Press; 1981), pp. 184-213.

Data: Capital and Capacity Utilization

Method/measure: Direct survey enumeration of establishments as described above including both capital and capacity utilization estimates.

Date/sample: 1972. 400 establishments. Reported at the three- and four-digit levels.

Table 8-7. *Philippines—Capital Utilization in Manufacturing, ISIC Three-digit Level, 1972*
(percent)

ISIC	Branch	Number of plants	U_1		U_2		U_3		U_4	
			UW	K	UW	K	UW	K	UW	K
311	Food manufacturing	76	46.3	52.9	43.0	51.2	72.6	79.7	59.2	64.2
312	Food manufacturing, n.e.c.	20	50.8	66.9	47.3	65.6	69.0	71.6	48.6	91.6
313	Beverages	21	44.8	56.5	40.0	49.5	80.0	92.0	50.0	53.8
314	Tobacco products	20	32.2	51.3	26.4	46.7	60.8	76.8	43.4	60.8
321	Textiles	33	63.8	78.2	57.9	70.9	77.8	83.4	74.4	85.0
322	Wearing apparel except footwear	10	46.7	68.1	38.5	63.0	[illegible]	[illegible]	46.8	72.8
323	Leather and products except footwear	3	28.9	29.6	24.4	26.0	70.0	57.8	34.7	48.4
324	Leather footwear	5	26.7	24.2	15.0	17.5	61.0	74.7	24.5	23.4
331	Wood and products except furniture	26	40.2	68.7	35.3	62.5	71.1	78.2	49.6	79.9
332	Furniture and fixtures	7	36.8	37.0	35.7	35.6	80.9	79.9	44.1	44.6
341	Paper and products	11	56.6	72.0	51.8	67.8	72.3	74.6	71.6	90.9
342	Printing and publishing	11	49.1	65.8	40.9	53.4	76.4	72.9	53.5	73.3
351	Industrial chemicals	13	57.7	75.3	53.6	67.3	70.5	63.2	76.0	106.5
352	Other chemical products	30	37.2	51.4	32.3	47.5	58.4	68.4	55.3	69.4
353	Petroleum refineries	3	68.5	66.3	67.5	65.2	71.0	70.0	95.1	93.1
355	Rubber products	11	45.3	63.7	37.7	59.8	73.2	84.7	51.5	70.6
356	Plastic products, n.e.c.	4	56.8	69.9	37.9	38.4	73.8	56.0	51.4	68.6
361	Pottery, etc.	3	56.4	60.5	39.0	49.7	86.7	91.7	45.9	54.2
362	Glass and products	6	52.9	81.9	46.1	64.3	70.0	76.4	65.9	82.0
369	Other nonmetallic mineral products	21	60.3	76.4	57.7	77.6	69.6	77.7	82.9	99.9
371	Iron and steel	7	49.5	43.4	50.2	55.3	75.7	75.4	66.3	73.3
372	Nonferrous metal industries	4	41.3	43.3	34.9	34.9	67.5	35.7	51.7	97.8
381	Fabricated metal products	18	43.8	50.5	36.2	36.4	67.7	62.2	53.5	58.5
382	Nonelectrical machinery	8	34.4	62.1	31.4	56.9	65.0	84.3	48.3	66.4
383	Electrical machinery	11	42.9	46.8	38.0	42.2	67.0	68.2	56.7	61.9
384	Transport equipment	9	24.4	27.2	23.9	26.5	74.4	88.0	32.1	30.1
385	Scientific equipment	3	64.2	70.9	63.6	70.1	81.7	82.4	77.8	85.1
390	Other manufacturing	6	32.2	41.0	29.1	39.4	47.0	38.4	61.9	102.6
	All manufacturing, average	400	46.3	63.3	41.6	60.6	70.8	78.1	58.9	77.6
	Standard deviation		24.8	20.5	24.6	20.1	21.7	15.8	21.4	27.8

Source: Survey data

Table 8-9. *Philippines—Capital Utilization in Manufacturing, ISIC Four-digit Level, 1972*
(percent)

ISIC	Branch	Number of plants	U_1		U_2		U_3		U_4	
			UW	K	UW	K	UW	K	UW	K
3111	Meat processing	6	27.5	40.3	23.9	39.8	66.3	93.1	36.0	42.7
3112	Dairy products	8	48.0	53.3	42.0	47.6	61.4	64.7	68.4	73.6
3113	Fruit and vegetable canning	6	31.2	55.4	31.5	52.7	59.2	74.3	53.2	70.9
3114	Fish processing	4	21.5	15.8	13.9	11.4	71.3	76.9	19.4	14.8
3115	Oils and fats	8	76.2	83.2	72.0	77.8	74.0	60.9	97.3	127.8
3116	Grain mill products	10	46.6	47.7	39.2	47.6	72.2	60.3	54.3	78.9
3117	Bakery products	3	42.5	47.7	24.0	31.1	56.0	71.5	42.9	43.5
3118	Sugar products	25	50.3	52.4	48.6	51.1	82.0	82.9	59.3	61.6
3119	Cocoa and confectionary	6	48.7	57.7	48.1	56.2	75.8	70.2	63.5	80.1
3121	Food products, n.e.c.	17	53.9	68.4	50.9	67.2	68.8	71.8	74.0	93.6
3122	Animal feed products	3	32.8	36.5	26.5	32.5	70.0	68.2	37.9	47.7
3131	Distilled beverages	4	53.5	51.3	33.4	51.2	90.0	98.2	37.1	52.1
3132	Wine	5	20.7	20.5	19.6	19.4	78.0	78.5	25.1	24.7
3134	Soft drinks	12	58.7	77.0	50.8	59.4	76.8	89.7	66.1	66.2
3140	Tobacco products	20	32.2	51.3	26.4	46.7	60.8	76.8	43.4	60.8
3211	Spinning, weaving, finishing	24	71.7	81.0	62.0	71.9	78.3	82.2	79.2	87.5
3212	Made-up textiles	2	57.0	48.8	57.0	48.8	75.0	53.8	76.0	90.0
3213	Knitting mills	4	44.6	65.7	40.1	65.7	75.0	90.4	53.5	72.7
3214	Carpets and rugs	1	27.7	27.7	27.7	27.7	80.0	80.0	34.6	34.6
3215	Cordage and rope	2	73.0	76.8	60.4	70.5	80.0	90.5	75.5	78.2
3220	Wearing apparel except footwear	10	46.7	68.0	38.5	63.0	80.1	86.5	48.1	72.8
3231	Tanneries	3	28.9	29.6	24.3	28.0	70.0	57.8	34.7	48.4
3240	Leather footwear	5	26.7	24.2	15.0	17.5	61.0	74.7	24.6	23.4
3311	Sawmills and woodmills	17	47.8	69.1	42.6	63.0	75.0	78.3	56.8	86.5
3312	Wood and cane containers	2	18.7	21.0	18.7	21.0	60.0	57.6	31.2	36.5
3319	Wood and cork products, n.e.c.	1	27.8	27.3	22.3	22.3	65.0	66.8	34.3	33.4
3320	Furniture and fixtures	7	36.8	37.0	35.7	35.6	80.9	79.9	44.1	44.6
3411	Pulp, paper, paperboard	6	57.1	72.5	53.1	70.9	70.0	76.3	75.9	92.9
3412	Paper containers and boxes	7	56.3	71.3	51.1	63.9	73.6	72.3	69.4	88.4
3420	Printing and publishing	11	49.1	65.8	40.9	53.4	76.4	72.9	53.5	73.1
3511	Basic industrial chemicals	5	60.6	75.5	55.0	74.2	74.4	52.9	73.9	140.3
3512	Fertilizers and pesticides	1	83.6	83.6	83.6	83.6	70.0	70.0	119.4	119.4
3513	Synthetic fibers	7	52.8	66.3	48.4	57.8	76.3	69.0	63.3	83.8
3521	Paints, varnishes, lacquers	5	31.9	35.0	25.5	27.7	56.8	65.5	44.9	42.4
3522	Drugs and medicines	14	32.3	42.5	26.0	36.8	53.3	58.6	48.8	62.8
3523	Soap and cosmetics	7	42.3	78.9	42.3	78.8	63.0	79.4	67.1	99.2
3529	Chemical products, n.e.c.	4	51.9	52.6	45.5	40.2	70.3	75.6	64.7	53.2
3530	Petroleum refining	3	68.5	66.3	67.5	65.2	71.0	70.0	95.1	93.1
3551	Tires and tubes	5	59.6	80.6	57.6	80.2	69.0	88.3	83.5	90.8
3559	Rubber products, n.e.c.	6	33.4	26.6	21.1	14.9	76.7	76.6	27.5	19.5
3560	Plastic products, n.e.c.	4	56.8	69.9	37.9	38.4	73.8	56.0	51.4	68.6
3610	Pottery and china	3	56.4	60.5	39.0	49.6	86.7	91.7	45.0	54.1
3620	Glass and products	6	52.9	81.9	46.1	64.3	70.0	78.4	59.4	82.0
3691	Structural clay products	5	33.9	31.0	39.4	78.5	52.0	93.0	75.8	86.9
3692	Cement, lime, plaster	11	82.3	81.3	77.1	77.5	75.6	76.1	102.0	101.7
3699	Nonmetallic minerals, n.e.c.	5	38.5	82.9	33.4	74.9	74.0	98.5	[illegible]	[illegible]
3710	Iron and steel	7	49.5	43.4	50.2	55.3	75.7	75.4	66.3	73.3
3720	Nonferrous metals	7	41.3	43.3	34.9	34.9	67.5	35.7	51.7	97.8
3811	Cutlery and hand tools	1	27.2	27.2	27.2	27.2	80.0	80.0	34.0	34.0
3812	Metal furniture and fixtures	2	27.9	28.0	27.9	28.0	70.0	70.0	39.9	40.3
3813	Structural metal products	8	44.9	49.6	40.0	38.4	69.9	67.2	57.2	57.1
3819	Metal products, n.e.c.	7	49.5	52.8	35.5	34.2	62.7	55.5	56.6	61.6

(Table continues on the following page.)

Table 8-9 *(continued)*

ISIC	Branch	Number of plants	U_1 UW	U_1 K	U_2 UW	U_2 K	U_3 UW	U_3 K	U_4 UW	U_4 K
3822	Agricultural machinery	1	27.7	27.7	27.7	27.7	75.0	75.0	36.9	36.9
3829	Nonelectrical machinery, n.e.c.	7	35.3	67.3	31.9	60.3	63.6	85.7	50.2	70.4
3831	Electrical industrial machinery	1	27.5	27.5	19.6	19.6	85.0	85.0	23.1	23.1
3832	Radio, TV, communications	1	25.8	25.8	7.7	7.7	30.0	30.0	25.7	25.7
3833	Electrical appliances	3	29.2	33.8	23.2	28.5	53.3	55.2	43.5	51.3
3839	Electrical apparatus, n.e.c.	6	55.1	71.0	53.5	70.0	77.0	77.2	69.5	90.7
3843	Motor vehicles	8	24.7	27.2	24.1	26.5	77.5	88.3	31.1	30.0
3844	Motorcycles and bicycles	1	22.4	22.4	22.4	22.4	50.0	50.0	44.8	44.8
3851	Professional and scientific equipment	1	87.7	87.7	85.9	85.9	85.0	85.0	101.0	101.1
3852	Photo and optical goods	2	52.5	55.9	52.5	55.9	80.0	80.0	65.6	69.9
3902	Musical instruments	1	27.5	27.5	16.5	16.5	60.0	60.0	27.5	27.5
3909	Manufacturing industries, n.e.c.	5	33.2	41.1	31.7	39.7	44.4	38.2	71.4	103.9
	All manufacturing, average	400	45.7	63.8	41.6	60.6	70.6	78.1	58.9	77.6
	Standard deviation		24.8	20.5	24.6	20.1	22.0	15.8	21.4	27.8

Source Survey data

NOTES: U_1: hours per year of operation, expressed as a percent of total time

U_2: " " " " " " " " " , adjusted for intensity of capital utilization during operation

U_3: McGraw-Hill capacity utilization response

U_4: Estimated desired utilization, U_1/U_3

UW: Unweighted average

K: Capital weighted average

A.2. The ILO Studies

The following three studies were included in the International Labour Office World Employment Programme Study and reported in Phan-Thuy, et al. It should be noted that, unlike the World Bank Studies reported above, there was no uniform methodology imposed on the three country studies in the ILO project. Therefore rather different data with rather different conceptual bases emerge. It should be noted too that because I designed the World Bank questionnaire and was pleased with its success there, the Nigerian study for the ILO is in all respects but sample size comparable to those of the World Bank.

A 2.1 Nigeria

Winston, Gordon C. "Increasing Manufacturing Employment through Fuller Utilisation of Capacity in Nigeria," Chapter Three in Phan-Thuy, N., Roger R. Betancourt, Gordon C. Winston and Mieczyslaw Kabaj, Industrial Capacity and Employment Promotion: Case studies of Sri Lanka, Nigeria, Morocco and over-all survey of other developing countries. Published on behalf of the International Labour Office (Farnborough, Hants: Gower Publishing Company, Limited; 1981), pp. 92-170.

Data: Capital and Capacity Utilization

Method/measure: Used survey directly to measure capital utilization and firm's capacity estimates. Method similar to World Bank Study A1 above.

Date/sample: 1976. 44 manufacturing firms in Nigeria, semi-randomly selected (biased toward large firms but geographically and industrially dispersed). Small sample prevented individual industrial sector estimates. Data reported as representative of manufacturing sector as a whole.

Table 11.1 - Utilization rates

	Utilization time u_t		Utilization time, Section adjusted u_{ts}		Utilization time section and intensity adjusted u	
	hours/year	% of time	hours/year	% of time	hours/year	% of time
Average firm	3 810	43.5	3 364	38.4	3 187	36.4
Typical plant and equipment(capital weights)	7 323	83.6	6 377	72.8	6 185	70.6
Plant employing typical worker (employment weights)	5 825	66.5	5 098	58.2	4 897	55.9

NOTES: U_t: hours of operation per year -- same as Bank's U_1

U: hours of operation per year adjusted for partial plant operation and intensity of capital use during operation -- same as Bank's U_2

U_{ts}: an intermediate step with adjustment for sectional operation but not intensity

Table IV.1

Firms' Full Capacity Targets and Private Excess Capacity

	Firms' Full Capacity Targets (u^*)		Capacity Utilization		Firms' Excess Capacity			Time & Output
			Time (u/u^*)	Output (Mc-Graw-Hill)	(u^*-u)	$\left[\frac{u^*-u}{u^*}\right]$	(1-McG)	$\left[\frac{\text{Col (4)}}{\text{Col (3)}}\right]$
	hours (1)	% of time (2)	% (3)	% (4)	hours (5)	% (6)	% (7)	(8)
Average Firm	4152	47.4	76.8	68.8	965	23.2	31.2	89.6
Typical Plant and Equipment (Capital Weights)	6719	76.7	92.0	83.0	534	7.9	17.0	90.2
Plant Employing Typical Worker (Employment Weights)	5186	59.2	94.4	83.1	289	5.6	16.9	88.0

NOTES: This table relates capital and capacity utilization estimates.

TABLE V.1

Capacity Utilization and Excess Capacity

	Firms' Average Utilization Time			Firms' Capacity Utilization		Firms' Excess Capacity		Total Social Excess Capacity	
	Actual	Hours (%)	Target	McG-H (Output)	u/u* (Time)	(Output)	(Time)	(Output)	(Time)
Current Levels	4897 (56%)		5186 (59%)	83%	94%	8%	1%	16-21%	7-12%
At Firms' Aggregate Full Capacity Targets	4946 (56%)		5186 (59%)	90%	95%	0	0	7-12%	7-12%
At Social Full Capacity	5289 - 5583 (60-64%)		5549 - 5860 (63-67%)	90%	95%	0	0	0	0

NOTES: This table relates privately optimal utilization targets to socially optimal rates.

A 2.2 Sri Lanka

Betancourt, Roger R., "The Utilisation of Industrial Capital and Employment Promotion in Developing Countries: Multiple Shifting as an Emergency Employment Scheme in Sri Lanka," Chapter Two in Phan-Thuy, N., Roger R. Betancourt, Gordon C. Winston and Mieczyslaw Kabaj, Industrial Capacity and Employment Promotion: Case studies of Sri Lanka, Nigeria, Morocco and over-all survey of other developing countries. Published on behalf of the International Labour Office (Farnborough, Hants: Gower Publishing Company, Limited; 1981), pp. 26-91.

Data: Capital and Capacity Utilization

Method/measure: Used published shift-working data to estimate capacity utilization (Tables 1 and 2) and a small survey directly to measure capital and capacity utilization.

Date/sample: 1977. Emphasis on differentiation between public and private sector manufacturing firms. Shift working and capacity data from official Sri Lanka statistics; capital utilization data from survey (mail and interview) of 10 plants, fully enumerated in Table 3. Eight sectors reported in capacity survey. Small size of capital utilization survey prevented individual sector estimates: data reported as representative of manufacturing sector as a whole.

Table 1

Indirect measures of capital utilisation in Sri Lanka[1]

Industrial group	1968-70[2] Private (1)	(2)	Public (3)	1974 Public[3] (4)	Private and public (5)
I. Food and beverages and tobacco	69 (15)	28	67 (4)	69 (4)	65 (91)
II. Textiles, wearing apparel and leather industries	55 (95)	22	50 (2)	50 (2)	46 (410)
III. Wood and wood products	(0)		62 (1)	75 (1)	32 (10)
IV. Paper and paper products	63 (5)	25	72 (1)	77 (1)	46 (29)
V. Chemicals, petroleum, coal, rubber and plastics	83 (55)	33	36 (2)	76 (2)	9 (136)
VI. Non-metallic mineral products (except petroleum and coal)	63 (12)	25	85 (4)	80 (3)	78 (42)
VII. Basic metal products	(0)		33 (1)	44 (1)	44 (1)
VIII. Fabricated metal products metal products and machinery	45 (100)	18	22 (1)	19 (1)	33 (210)
IX. Manufactured products not elsewhere specified	(0)		(0)	(0)	7 (16)

[1] The number in parentheses in the body of the table is either the number of firms or the number of public sector corporations included in the calculations.

[2] These figures are calculated from Annexes I and II of ESCAP Sri Lanka: Industrial Excess Capacity, March 1975, IET/Cons.Grp/UEII/1. The "capacity" figures for public enterprise were reported on a threeshift basis; those for private enterprises on a single shift basis; column (2) attempts to put both sets of figures on a comparable basis by dividing column (1) by 2.5.

[3] These figures are calculated from table II(D)4 of the Annual Report (1974), Central Bank of Ceylon. The figures for those units also included in column (3) were the only ones used here.

[4] This column is reproduced from table II(C)2 (3) of the Annual Report (1974), Central Bank of Ceylon. This column is not strictly comparable to the others because the Central Bank seems to add the units of capacity output and actual output first and then divide one by the other rather than calculating capacity for each unit first and then an average for all the firms. An even better summary measure would be a weighted average with, for example, relative value added as the weighting factor. Moreover, the coverage of both public and private sector firms is different from that in the other columns.

Table 2

Utilisation and its determinants in the short run: Sri Lanka's industrial corporations (public), 1972-74

Industrial[1] group	Utilisation index[2] 1972 (1)	1974	Inverse of value added price index[3] 1972 (2)	1974	Wage per man-day[4] 1972 (3)	1974	Share of public corporations in sectors output[5] 1972 (4)	1974	Share of industrial group in industrial output[6] 1972 (5)	1974
I. Food and beverages*	79	62	55	71	10.5	18.7	29	36	32.7	30.5
II. Textiles	65	50	45	52	8.5	14.4	25	28	16.1	13.9
III. Wood products	73	75	90	34	12.1	14.5	58	93	1.3	1.3
IV. Paper products	75	77	60	49	11.5	21.2	43	63	3.2	3.3
V. Chemicals*	93	88	68	79	18.4	17.6	55	80	23.1	33.1
VI. Non-metallic minerals*	79	86	36	23	16.0	25.0	58	78	7.1	5.8
VII. Basic metals	88	44	73	44	12.7	34.7	100	100	2.8	3.2
VIII. Fabricated metals	10	19	61	41	10.9	16.5	4	6	12.5	8.5

[1] These groups are the same as in table 1.

[2] The index was constructed using the capacity utilisation figures of the state industrial corporations for each year. When reported capacity changed between the two years, the capacity figure for 1974 was used as the base in both years. In addition, when no capacity figure was available for either year, as in the case of the petroleum corporation, the output in 1974 was used as the base on which to construct the index. Therefore, the levels of utilisation are not comparable to those in table 1, and the asterisk indicates the main sectors affected by these differences. The changes between years, however, reflect the focus of our interest whether output increased or decreased.

[3] This is the ratio of the value of raw materials to the value of production for each sector calculated from the data provided by the Annual Reports of the Central Bank for 1972 and 1974.

[4] From table II(C)1, Annual Report, 1974.

[5] Calculated from table II(C)2 and II(D), Annual Report, 1974. Only the same units as in column (1) were used.

[6] From table II(C)2, Annual Report, 1974.

Table 3

Utilisation measures in the private sector

	Actual/planned (1)	Planned/ capacity output (2)	Actual/ capacity output[1] (3)	Percentage of hours equipment is in operation[2] (4)	 (5)
1.	.94	.83	.78	.26	(.39)
2.	.58	.81	.47	.23	(.35)
3.	.58	.80	.46	.20	(.30)
4.	1.14	.70	.80	.21	(.32)
5.	1.07	.58	.62	.20	(.30)
6.	.92	.35	.32	.26	(.39)
7.	.82	.82	.67	.27	(.41)
8.	.75	.60	.45	.22	(.34)
9.	.78	.80	.62	.21	(.32)
10.	.99	.83	.82	.27	(.41)
Average	.86	.71	.60	.23	(.35)

[1] This column is the product of columns (1) and (2).

[2] Column (4) gives the number of hours the equipment is in operation relative to the total number of hours available in the year. Column (5) gives the number of hours the equipment is in operation relative to the total number of hours available in the year after correcting for the number of hours in official holidays, Saturdays and Sundays.

NOTES: Col. 1 identification number of individual firm.

A 2.3 Morocco

Phan-Thuy, N., "Employment Promotion in Morocco through Fuller Utilisation of Installed Industrial Capital," Chapter Four in Phan-Thuy, N., Roger R. Betancourt, Gordon C. Winston and Mieczyslaw Kabaj, Industrial Capacity and Employment Promotion: Case studies of Sri Lanka, Nigeria, Morocco and over-all survey of other developing countries. Published on behalf of the International Labour Office (Farnborough, Hants: Gower Publishing Company, Limited; 1981), pp. 171-217.

Data: Capital and Capacity Utilization

Method/measure: Survey established capital utilization as hours of operation per year with sectional and intensity adjustments; capacity utilization based on reported "normal" hours of operation per year. Hours of operation data collected only for hours-per-day and days-per-week, therefore no accommodation of adjustments through variations in weeks of operation per year.

Date/sample: 1977. 47 enterprises representing 54 establishments distributed by size.

Table III.2

Number of hours of operation and rate of utilisation of capital invested

	Without adjustment (A)		With section adjusted (A.)		With section and intensity adjusted (A..)	
	Hrs per year	% of 8,760 hours	Hrs per year	% of 8,760 hours	Hrs per year	% of 8,760 hours
Arithmetical average	3 415	39.0	3 234	36.9	2 765	31.6
Average weighted by assets[1]	4 586	52.3	4 296	49.0	4 096	46.7
Average weighted by employment[1]	3 283	37.5	2 945	33.6	2 572	29.4

[1] The weighted average is defined as being: $\sum x_i f_i$, where x_i is the number of hours of operation in plant i and f_i is its weighting coefficient.

Where the average is weighted by assets, f_i is the proportion of the assets of plant i in the total assets of the plants covered by the survey. Where the average is weighted by employment, f_i is the proportion of the number of workers of plant i in the total number of workers of the sample covered by the survey.

NOTES: These data are comparable to those in Winston, Table II.1 above

Table IV.1

Business capacity and excess of business capacity

	Business capacity (C)		Rate of utilisation of business capacity		Excess of business capacity			Ratio between time and production
	Hours	% of 8,760 h	Time (A_{S1}/C)	McGraw-Hill production rate (MG)	Time		Production 1 - MG	$\frac{(4)}{(3)}$
					$C-A_{S1}$	$\frac{C-A_{S1}}{C}$		
	(1)	(2)	% (3)	% (4)	Hours (5)	% (6)	% (7)	(8)
Arithmetical average	3 709	42.3	78.5	60.6	944	25.5	39.4	81.3
Average weighted by assets	4 786	54.6	85.6	58.2	690	14.4	41.8	68.0
Average weighted by employment	3 569	40.7	72.1	66.7	997	27.9	33.3	92.5

NOTES: These data are comparable to those in Winston, Table IV.1 above

A. 3. Other Country Studies

A3.1 Malaysia

Lim, David, "Effects of Separating Management from Ownership on Capital Utilization: A Study of Malaysian Manufacturing," Weltwirtshaftliches Archiv., vol 116, no. 2, 1980, pp. 330-40.

Data: Capital and Capacity Utilization (World Bank data expanded)

Method/measure: Same data as World Bank study except for disaggregation by ownership structure, estimating capital and capacity utilization rates separately for incorporated and unincorporated firms.

Date/source: See World Bank study above.

Table 1 — *Capital Utilization of Incorporated (I) and Unincorporated (NI) Establishments in West Malaysian Manufacturing*, 1972 (per cent)

MIC/ ISIC	Industry	Number		U_t		U_{ti}		U_{am}		U_{dt}		U_{fm}	
		I	NI	I	NI	I	NI	I	NI	I	NI	I	NI
311	Food	36	6	63	30	58	29	74	78	72	35	87	38
312	Other food	9	0	52	—	46	—	81	—	60	—	65	—
313	Beverages	10	0	65	—	60	—	82	—	73	—	83	—
314	Tobacco	8	5	51	43	49	32	100	70	48	71	51	61
321	Textiles	17	2	65	59	60	50	86	80	79	57	100	74
322	Wearing apparel	4	0	45	—	44	—	100	—	45	—	45	—
323	Leather and leather products	1	2	26	17	18	19	80	76	29	40	33	35
324	Footwear	2	1	30	17	21	27	70	60	28	29	43	46
331	Wood and rattan products	22	9	59	33	49	34	82	93	56	62	71	38
332	Furniture	3	0	46	—	44	—	100	—	58	—	46	—
341	Paper and paper products	4	0	55	—	47	—	83	—	62	—	69	—
342	Printing and publishing	12	8	79	43	78	42	69	90	89	27	100	43
351	Industrial chemicals	7	0	86	—	84	—	81	—	94	—	100	—
352	Other chemical products	17	1	44	25	39	21	74	80	44	26	62	32
353	Petroleum and coal products	3	0	87	—	83	—	96	—	40	—	91	—
355	Rubber products	42	6	79	59	74	50	85	81	84	46	95	70
356	Plastic products	9	1	74	54	68	49	82	80	76	33	92	63
361	Pottery, china, etc.	1	1	37	28	33	28	100	100	27	27	36	38
362	Glass and glass products	2	1	94	31	92	31	87	100	100	100	100	31
369	Non-metallic mineral products	20	3	93	82	89	80	97	90	96	89	96	91
371	Iron and steel products	9	2	91	46	81	38	92	63	91	57	98	73
372	Non-ferrous metal products	3	0	88	—	86	—	81	—	83	—	100	—
381	Fabricated metal products	14	2	61	31	45	28	72	89	72	37	90	35
382	Machinery	8	4	32	29	23	26	60	65	28	30	40	45
383	Electrical machinery	12	1	67	99	66	99	88	100	39	29	100	100
384	Transport equipment	9	3	37	32	34	32	70	97	26	84	96	33
385	Professional equipment etc.	1	1	55	86	47	70	88	85	29	29	62	98
390	Other manufacturing	3	0	85	—	30	—	100	—	73	—	85	—
3	Total for common industry-groups	243	30	73	31	60	40	84	93	74	48	89	38

NOTES: These classifications follow those reported above for the Bank study with $U_t = U_1$; $U_{ti} = U_2$; $U_{am} = U_3$; $U_{dt} = U_4$; $U_{fm} = U_5$.

A3.2 Korea

Kim, Young Chin and Jene K. Kwon, "The Utilization of Capital Equipment in a Developing Economy: Case of S. Korean Manufacturing, 1962-1971," Working Papers in Economics, Northern Illinois University, DeKalb, Illinois, undated.

Data: Capital Utilization

Method/measure: Electric power based estimates.

Date/sample: Time series, 1962 to 1971 for three-digit SIC sectors. Two sources of installed electric motor capacity were used: government figures (U_1) and authors' mail survey of 194 firms (U_2).

Table 3

UTILIZATION RATES IN KOREA (1971) AND THE U.S. (1962) BY SECTOR

Industries	Classification Codes		Korea (1971)		U.S. (1962)
	Korea[a]	U.S.[b]	U_1	U_2	
Food and kindred products	1-5	20, 21	19.8	13.6	24.3
Textiles	6-9	22, 23	38.0	32.3	41.7
Chemicals	10-13 15, 16	28	54.5	46.9	44.6
Paper	14	26	53.5	37.3	38.6
Rubber products	17	30	29.8	22.3	23.8
Wood products	18	24, 25	21.5	14.7	13.8
Stone, clay, glass products	19-21	32	49.1	46.5	29.2
Basic metals	22	33	20.5	17.8	20.6
Other metal products	23	34	11.1	10.0	n.a.
Machinery, except electrical	24	35	17.1	7.7	11.2
Electrical machinery	25	36	13.7	15.1	17.1
Transport equipment	26	37	7.1	8.0	15.2
Petroleum and coal products	27	29	18.1	29.8	43.0
Printing and publishing	28	27	16.4	12.3	24.3
Leather products	29	31	22.3	20.0	20.7
Others	30	19,38,39	9.6	10.3	n.a.

[a]KECO's classification numbers.

[b]U.S. SIC code numbers

Sources: U.S.--1963 Census of Manufacturers, and Foss.

NOTES: U_1: Installed electric motor capacity based on government data

U_2: Installed electric motor capacity based on mail survey

TABLE 4
Average Annual Growth Rates of Utilization Rates by Sector
1962 - 1971

Sector	% Growth Rate (U_1)	% Growth Rate (U_2)
1	5.40%	5.38%
2	10.78	10.79
3	0.65	0.66
4	9.70	9.69
5	7.05	7.04
6	2.72	2.68
7	9.02	8.99
8	10.00	10.19
9	13.16	13.08
10*	-17.39 (22.53)	-17.39 (22.59)
11	5.78	5.75
12	4.40	4.33
13	10.66	10.66
14	1.33	1.31
15	4.53	4.58
16	11.48	11.83
17	8.26	8.12
18	18.34	18.29
19**	-7.50 (0.81)	-10.08 (3.06)
20	3.38	3.26
21	4.81	4.72
22	10.56	10.70
23	8.77	8.78
24	6.84	6.82
25	8.53	8.62
26	5.83	5.82
27	18.08	17.91
28	12.32	12.28
29	19.58	19.63
30	6.50	7.55
Total manufacturing	(A) 7.17% (B) 7.71 (C) 8.78 (D) 9.94	(A) 8.50% (B) 8.34 (C) 9.29 (D) 10.71

*The growth rates in parentheses refer to a subperiod of 1967-1971. (See Appendix for explanation.)

**The growth rates in parentheses refer to a subperiod of 1965-1971. (See Appendix for explanation.)

Notes:
(A)--totals. (B)--totals less nos. 10 and 19. (C)--totals less nos. 10, 19, and 14. (D)--totals less nos. 10, 19, 14, and 22.

NOTES: U_1: Installed electric motor capacity based on government data

U_2: Installed electric motor capacity based on mail survey

A3.3 Nigeria

Osoba, Mrs. A. M., An Economic Study of Shiftwork and Capacity Utilization in Some Selected Nigerian Manufacturing Industries, typescript, N.I.S.E.R., University of Ibadan, undated (1974?)

Data: Capital Utilization (interpreted as capacity utilization)

Method/measure: hours per year of operation with "full capacity" defined as operating 100% of the time (!).

Date/sample: 1973. Five industries selected to represent large, important sectors with a variety of capital-output ratios in intermediate and consumption goods. An interview survey of all 84 firms officially listed as manufacturing in those sectors -- interviews of both firm officials and workers (1300 of them).

"Capacity utilization rates of one hundred percent [see definition above] were observed in four establishments. Two of these were cement manufacturing firms, one soft drink and one textile manufacturing establishments. In all the remaining sixty-four establishments, the rate of utilization ranged between 3.81 and 84.86 percent. The average annual percentage rates of capacity utilization for the industries were tobacco (46.79), cement (79.46), beer and stout (72.52), soft drinks (43.27) and textiles (49.24). The overall annual rate of capacity utilization in the manufacturing establishments covered was 52.22 percent." (p. 125)

NOTES: these figures are actually capital utilization figures, not capacity utilization, but they are expressed as percentages of 8400 hours per year to allow for an arbitrary fifteen days' maintenence time. No other data were reported.

A3.4 Brazil

de Almeida, Manoel Bosco, "Estimativas da Utilizacao de Capital -- Brazil -- 1970," Revista Economica Noreste, 11(1), 1980, pp. 35-55

Data: Capital utilization

Method/measure: Electric power measure.

Date/sample: 1970. Industrial Census of Brazil.

Table IV

Numbers of Hours Worked Yearly and Level of Capital Utilization in Manufacturing Sector

Industries	Hours Worked (of Work)	Level of Capital Utilization Hypothesis (a)	(b)	(c)
Non-Metallic Minerals	2,532	0.29	1.22	0.61
Basic Metals	2,863	0.33	1.39	0.69
Metal Product	1,063	0.12	0.50	0.25
Electrical Machinery	724	0.08	0.34	0.17
Transportation Machinery	1,223	0.14	0.59	0.29
Wood	970	0.11	0.45	0.23
Furniture	473	0.05	0.21	0.11
Paper and Cardboard	2,339	0.27	1.13	0.57
Rubber	1,829	0.21	0.88	0.44
Leather and Pelts	799	0.09	0.38	0.19
Chemicals	3,609	0.41	1.72	0.85
Pharmaceuticals	2,710	0.31	1.30	0.65
Perfumes, Soaps	1,546	0.18	0.76	0.38
Plastics	1,755	0.20	0.84	0.42
Textiles	1,846	0.21	0.88	0.44
Clothes, Shoes	762	0.09	0.38	0.19
Food	1,741	0.20	0.84	0.42
Beverages	1,691	0.19	0.80	0.40
Tobacco Products	2,463	0.28	1.18	0.59
Publishing and Graphics	633	0.07	0.29	0.15
Miscellaneous	1,299	0.15	0.63	0.32
TOTAL	1,993	0.23	0.97	0.48

NOTES: Translation of Table by Mara Bun.

A3.5 Pakistan

Winston, Gordon C., "Capital Utilisation in Economic Development," The Economic Journal, vol. 81 (March, 1971), pp. 36-60.

Data: Capital and Capacity Utilization

Method/measure: Capital utilization measured as actual output relative to output that would be produced on 2.5 shift operation or actual operation. Capacity utilization measured as actual output relative to reported capacity output.

Date/source: 1965-66. Unpublished Census of Manufacturing Industries, Provincial Ministry of Industries of West Pakistan. 247 observations analysed as 26 industrial sectors (organized on Pakistan Standard Industrial Classification).

Table III

Utilisation Data

P.S.I.C.	Industry.	Utilisation rates. Unadjusted.	Utilisation rates. Adjusted.	Reporting units.	Average size.	Imported Raw material.	Labour productivity.	Competing imports. 1959/60.	Exports 1959/60.	Rate of growth.	Capital–income ratio.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
2070	Sugar	50·28	50·28	11	299·90	8·71	8·30	0·10	2·36	293·37	1·19
2091	Edible oils	66·73	38·11	131	28·55	0	1·49	3·40	0	523·05	1·72
2092	Tea	91·09	36·44	5	308·57	1·18	—	0·60	23·99	38·47	—
2099	Miscellaneous food	49·43	22·32	57	16·43	25·46	1·09	26·20	18·14	230·44	1·34
2100	Beverages	44·40	17·76	24	10·47	23·96	3·25	37·80	0·01	45·25	1·34
2200	Tobacco	49·66	19·86	45	77·55	9·77	14·33	0·40	0·10	456·76	0·85
2311	Cotton textiles	94·32	69·73	668	24·08	16·10	1·28	2·70	21·73	218·23	4·87
2314	Silk and art silk	72·00	28·93	201	7·62	78·88	1·80	49·00	0·01	199·27	2·34
2420	Footwear	44·36	17·75	57	6·46	55·56	—	0·20	—	109·50	—
2500	Wood, cork and furniture	60·19	24·07	46	4·36	19·32	1·32	17·30	2·07	508·02	−0·93
2700	Paper	44·48	20·87	11	2·90	63·46	3·16	33·40	1·16	420·38	2·88
2800	Printing/publishing	52·00	20·80	149	4·97	41·10	1·74	11·10	1·70	220·63	1·67
2900	Leather	65·48	62·75	55	6·26	22·06	1·37	1·10	98·34	413·03	0·52
3000	Rubber	47·41	18·97	42	8·60	63·41	—	66·10	1·44	218·43	2·12
3114	Fertilisers	79·77	79·77	3	296·72	7·58	1·35	58·10	54·66	2728·97	13·56
3150	Soaps/perfumes	43·57	22·85	86	18·37	51·10	—	5·80	0·95	365·98	—
3191	Matches	142·44	56·97	1	105·81	25·77	—	0	0	71·55	—
3199	Miscellaneous chemicals	45·26	18·68	124	26·92	29·89	4·80	60·70	10·28	621·25	1·45
3200	Petroleum	45·41	45·41	5	973·06	49·12	—	67·20	14·96	209·95	1·97
3300	Non-metallic minerals	67·16	42·52	80	16·21	25·79	2·67	22·00	0·59	291·28	3·60
3400	Basic metals	40·40	16·16	97	19·15	85·74	1·90	56·00	1·22	705·87	3·09
3500	Metal products	48·71	19·48	295	3·72	71·34	1·46	56·00	4·66	437·64	1·17
3600	Non-electrical machinery	35·82	14·33	252	3·32	30·53	1·48	87·30	1·57	876·83	1·97
3700	Electrical machinery	40·33	16·13	173	12·35	74·46	2·13	69·70	0·09	1325·77	1·91
3800	Transport	53·37	21·35	183	8·49	78·19	1·67	65·50	10·04	1013·69	5·82
3900	Miscellaneous manufacturing	49·82	20·81	197	3·60	42·07	1·83	67·60	68·54	627·41	2·08

Column — *Notes for Table III*

(3) *Utilisation rates, unadjusted.* These aggregated rates are a weighted (by capacity) average of industry utilisation rates computed from annual production (value) and annual production capacity reported in 1965–66 C.M.I. [5].

(4) *Utilisation rates, adjusted.* Computed as in Column 3, except that annual production capacity for each industry has adjusted to a 2½ shift level if the industry worked less than that as reported by C.M.I. [5].

(5) *Number of reporting units.* Summed for each sector from reported C.M.I. enumeration [5].

(6) *Average size unit.* Annual production per reporting unit computed from C.M.I. [5].

(7) *Imported raw material.* The proportion of the value of total raw-material inputs purchased from abroad. Both figures from C.M.I. [5].

(8) *Labour productivity.* Computed as gross value added per man-hour from C.M.I., 1959–60 [4].

(9) *Competing imports.* Imports as a proportion of total supply from Lewis and Soligo [13, Table B-3, col. 3].

(10) *Exports.* Exports, f.o.b., as a proportion of gross output at factor cost [13, Table A-3].

(11) *Rate of growth* of output at factor cost computed from [13, Table A-1].

(12) *Capital–Income ratios* as ratios of real value of assets to value added for West Pakistan, unadjusted for capacity use reported in Khan–MacEwan [11, Table 1-B] and correspondence with MacEwan to correct the paper sector entry.

NOTES: "Unadjusted utilization rates" correspond to capacity utilization estimates

"Adjusted utilization rates" correspond (roughly) to capital utilization estimates

A3.6 Bangladesh

Islam, Rizwanul, "Reasons for Idle Capital: The Case of Bangladesh Manufacturing," Bangladesh Development Studies, 6(1), Winter 1978, pp 27-54.

Data: Capital and Capacity Utilization

Method/measure: Capital utilization measured as actual output relative to output that would be produced on 2.5 shift operation (expressed as 900 shifts per year). Capacity utilization measured as actual output relative to reported capacity output.

Date/source: 1968-9. Unpublished Census of Manufacturing Industries, Bangladesh Bureau of Statistics. 15 industrial sectors, selected on the basis of high value added (hence accounting for 90% of value added in manufacturing.)

TABLE A-I

UTILIZATION DATA

Sectors	U	S	C/V	L	E	M	N
Sugar	31.33	100.89	7.87	6.74	0.01	14.38	12
Edible Oils	45.55	19.87	1.51	8.72	0	30.49	53
Tea	34.44	32.32	1.04	26.10	76.00	1.00	97
Cigarettes	60.00	276.60	0.39	59.56	0.18	20.17	15
Cotton Textiles	98.44	105.14	2.14	7.25	0.84	60.29	42
Jute Textiles	71.88	219.19	3.41	4.45	93.21	0	50
Rayon	100.00	610.96	5.53	18.22	0	0	1
Paper	74.44	108.32	22.59	59.51	70.86	15.55	5
Printing & Publishing	34.66	3.51	1.07	7.63	0.43	18.36	107
Leather	31.55	15.01	1.34	8.13	91.92	4.99	84
Fertilizers	47.55	103.44	8.85	22.57	0.03	4.89	5
Matches	39.00	45.97	0.92	5.19	51.32	0.02	17
Cement	100.00	60.92	4.96	6.07	0	75.83	1
Iron & Steel	28.33	47.32	2.73	15.53	0	64.17	27
Shipbuilding	37.89	21.92	3.43	5.76	0	31.33	17

NOTES:
- U: same as "adjusted utilization" rate above -- equivalent to capital utilization
- S: Firm size
- C/V: Capital/Value Added ratio
- L: Labor productivity
- E: Exports as a percent of domestic production
- M: Imports as a percent of domestic production
- N: Number of firms in sector

A3.7 Philippines

Diokno, Benjamin, "Capital Utilization in Government 'Favored' Export-Oriented Firms," The Philippine Economic Journal, vol xiii (2), Second Trimester, 1974. pp. 148-88.

Data: Capital and Capacity Utilization

Method/measure: Capital utilization as hours of operation per year (patterned after World Bank study). Capacity utilization, McGraw-Hill questionnaire.

Date/source: 1972. Survey (mail and interview) of 91 firms from the government's list of favored export-oriented firms. The purpose of the study was to compare the utilization performance of these export firms with that of other firms, based on the World Bank data so I have included that comparative table.

TABLE 3
CAPITAL UTILIZATION IN GFEO FIRMS
(Summary of Data by 4-Digit ISIC Industry Code)

ISIC Code	*No. of Plants*	*Mean CUR**	*Standard Deviation of CUR**	*Coefficient of Variation*	*Weighted Mean of CUR* By Assets*	*Weighted Mean of CUR* By Assets*
3113	1	43.55	0.0	0.0	43.55	43.55
3114	2	21.55	0.78	3.61	21.63	21.81
3115	1	68.50	0.0	0.0	68.50	68.50
3116	1	45.62	0.0	0.0	45.62	45.62
3119	4	43.37	21.49	48.87	39.74	40.21
3121	3	63.06	4.82	7.64	64.45	66.12
3131	1	56.37	0.0	0.0	56.37	56.37
3211	8	71.93	15.53	21.59	73.39	76.37
3312	1	47.28	0.0	0.0	47.28	47.28
3214	1	27.67	0.0	0.0	27.67	27.67
3215	2	58.10	31.35	53.96	60.12	57.80
3220	8	51.58	21.72	42.11	60.44	58.94
3311	6	62.85	19.54	31.09	71.68	71.40
3312	1	28.22	0.0	0.0	28.22	28.22
3319	1	9.22	0.0	0.0	9.22	9.22
3320	3	43.52	8.03	18.44	40.17	43.45
3513	5	54.96	24.70	44.94	58.25	53.30

(table continues on next page)

Table 3 *(Continued)*

ISIC Code	*No. of Plants*	*Mean CUR**	*Standard Deviation of CUR**	*Coefficient of Variation*	*Weighted Mean of CUR* By Assets*	*Weighted Mean of CUR* By Assets*
3521	4	29.41	24.51	83.33	40.33	29.76
3522	2	34.00	11.65	24.27	40.93	42.02
3529	2	63.41	23.62	37.25	73.59	62.36
3551	2	71.07	20.89	29.40	84.19	84.28
3560	1	35.72	0.0	0.0	35.72	35.72
3620	3	59.64	36.08	60.49	80.25	80.82
3691	1	88.13	0.0	0.0	88.13	88.13
3692	8	76.68	13.39	17.46	77.78	78.98
3699	2	65.66	33.37	50.82	76.38	58.71
3710	1	42.57	0.0	0.0	42.57	42.57
3720	1	34.97	0.0	0.0	34.97	34.97
3819	2	26.32	17.32	65.82	26.56	26.63
3829	3	37.68	29.87	79.28	40.16	41.87
3832	1	7.72	0.0	0.0	7.73	7.73
3833	2	25.76	17.56	68.19	21.55	21.66
3839	3	60.16	12.31	20.46	61.72	57.36
3852	1	76.96	0.0	0.0	76.96	76.96
3902	1	16.49	0.0	0.0	16.49	16.49
3909	2	46.50	27.01	58.09	64.96	65.24
	91	52.67	23.98	45.53	69.20	62.49

NOTES: CUR*: hours of operation per year, adjusted for variations in plant sections and intensity -- comparable to World Bank's U_2.

TABLE 15

COMPARATIVE CURI OF BOI AND NON-BOI FIRMS
(Per Cent)

ISIC	*Industry*	*Capital Utilization Rates* BOI-EPP Firms	Non-BOI Firms	Computed t-value	*d.f.*
3119	Cocoa, chocolate and sugar confectionery	43.97	53.74	−0.4959	4
3121	Food products, not elsewhere classified	63.06	52.73	0.5637	13
3211	Spinning, weaving and finishing textiles	71.93	45.99	2.5138[a]	18
3220	Wearing apparel, except footwear	51.56	23.26	2.5590[a]	10
3311	Sawmills, planing and other wood mills	62.85	31.56	2.9871[a]	15
3320	Furnitures and fixtures, except primarily of metal	43.52	29.74	1.4219[b]	10
3513	Synthetic resins, plastic materials	54.96	36.54	1.1474[c]	6
3521	Paints, varnishes and lacquers	29.41	17.24	0.6394	4
3522	Drugs and medicines	34.00	31.71	0.2121	12
3551	Tyre and tube industries	71.07	51.94	1.0794[c]	3
3620	Glass and glass products	59.64	32.53	1.0412[c]	9
3692	Cement, lime and plaster	76.68	76.43	0.0256	9
3699	Non-metallic mineral products, n.e.c.	65.66	26.12	2.3199[a]	6
3839	Electrical apparatus and supplies, n.e.c.	60.16	36.96	1.6249[b]	4

[a]Significant at 5 per cent level or better.
[b]Significant at 10 per cent level.
[c]Significant at 20 per cent level.

TABLE 8

ALTERNATIVE ESTIMATES OF UTILIZATION IN GOVERNMENT FAVORED EXPORT-ORIENTED FIRMS

	Utilization Rates (%)		
	CUR	*CUR**	*CUR^m*
3113	53.60	43.55	100.00
3114	21.55	21.55	n.c.
3115	68.50	68.50	n.c.
3116	45.62	45.62	57.00
3119	43.97	43.97	77.36
3121	66.48	63.06	n.c.
3131	72.10	56.37	100.00
3211	82.79	71.93	93.39
3212	47.48	47.28	66.67
3214	27.67	27.67	100.00
3215	78.76	58.10	87.50
3220	55.97	51.58	90.09
3311	71.33	62.85	90.42
3312	28.22	28.22	50.00
3319	18.44	9.22	70.00
3320	45.18	43.52	75.15
3513	62.38	54.96	89.80**
3521	33.20	29.41	68.27
3522	37.81	34.00	90.00
3529	63.46	63.41	82.72
3551	74.48	71.07	81.43
3560	51.03	35.72	76.47
3620	66.56	59.64	76.67
3691	100.00	88.13	102.04**
3692	81.13	76.68	85.42
3699	70.62	65.66	96.88**
3710	60.82	42.57	70.00
3720	50.59	34.97	37.50
3819	57.88	26.32	65.20
3829	44.52	37.68	63.48
3832	25.75	7.73	35.29
3833	39.12	25.76	57.50
3839	71.87	60.16	73.63
3852	99.73	76.96	80.00
3902	27.49	16.49	70.59
3909	54.40	46.50	61.43

Notes: *CUR** – refers to capital utilization adjusted for sectional and intensity use.
CUR^m – refers to "subjective" measure of capital utilization.
n.c. – not computable, data incomplete.
** At least one firm considered actual capacity to be greater than desired "standard" or "normal" capacity level.

NOTES: CUR: hours of operation, unadjusted for variations in plant sections or intensity -- comparable to World Bank's U_1

CUR^m: capacity utilization estimates based on McGraw-Hill type survey question

A3.8 India

National Productivity Council of India, Productivity Trends in Cotton Textile Industry in India, 1976 quoted in Sastry, D. U., "Capacity Utilization in the Cotton Mill Industry in India," Indian Economic Review, vol. XV, No.1 (January/March 1980), pp.1-28.

Data: Capital Utilization

Method/measure: Machine hours per year.

Date/source: Not reported. Cotton textiles only.

TABLE 1

CAPACITY UTILISATION BY ALTERNATIVE MEASURES IN COTTON MILL INDUSTRIES

(in percentages)

Year	Cotton spinning: Wharton measure Variant 1	Cotton spinning: Wharton measure Variant 2	Cotton spinning: Wharton measure Variant 3	Cotton spinning: Index of potential utilisation	Cotton spinning: Max. output per spindle	Cotton spinning: Machine hours	Cotton weaving: Wharton measure	Cotton weaving: Index of potential utilisation	Cotton weaving: Max. output per loom	Cotton weaving: Machine hours
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1950	—	—	—	—	80.97	—	—	—	72.19	—
1951	96.18	96.18	96.15	—	84.27	—	94.20	—	78.24	—
1952	93.37	93.87	93.21	—	92.24	—	93.98	—	88.26	—
1953	94.65	94.65	93.44	—	93.94	—	97.60	—	90.85	—
1954	95.98	95.98	94.27	—	96.61	—	96.21	—	93.07	—
1955	95.39	95.39	93.18	—	97.78	—	95.87	—	94.84	—
1956	95.83	95.83	93.37	—	100.00	71.28	98.21	—	98.34	65.94
1957	96.61	96.34	93.66	—	99.11	70.00	96.77	—	100.00	66.80
1958	90.28	89.35	87.29	—	93.85	65.50	94.09	—	94.87	63.35
1959	91.25	89.69	88.00	—	95.96	67.70	96.49	—	94.84	63.56
1960	93.22	91.04	89.70	91.0	93.23	72.62	96.75	94.2	97.70	64.40
1961	98.01	95.14	94.09	93.0	100.00	76.52	96.88	94.4	100.00	68.13
1962	94.87	92.56	91.86	93.8	94.10	78.61	94.86	92.5	97.00	68.27
1963	93.79	92.52	92.13	91.1	96.09	79.94	92.53	92.2	93.61	65.83
1964	96.92	96.54	96.47	91.1	100.00	82.67	97.36	93.4	97.03	69.40
1965	94.01	94.01	93.68	90.0	92.48	79.19	96.49	92.6	94.26	69.35
1966	90.54	90.54	89.81	87.3	85.59	75.45	89.63	86.0	85.85	67.80
1967	89.41	89.41	88.27	86.9	81.68	78.00	86.86	83.4	83.38	68.55
1968	94.50	94.50	92.86	92.4	82.25	74.39	92.82	89.1	100.00	68.21
1969	95.76	95.76	93.67	85.8	84.14	73.54	90.04	86.5	95.48	67.47
1970	95.42	95.42	92.92	86.0	81.78	75.24	89.48	85.8	89.98	67.60
1971	87.76	87.56	84.98	79.7	74.07	71.56	86.40	82.9	90.62	65.34
1972	95.30	95.30	92.46	86.5	80.54	74.02	90.86	86.4	97.68	69.14
1973	92.67	92.67	94.11	—	—	73.30	89.67	—	—	72.98
Mean	94.00	93.48	92.15	88.41	90.46	74.41	93.65	89.03	92.52	67.39
S.D.	2.55	2.62	2.79	3.75	7.61	4.25	3.49	3.95	6.92	2.27
C.V.	2.71	2.80	3.02	4.22	8.41	5.71	3.72	4.43	7.47	3.37

(table continues on next page)

TABLE I (contd.)

COTTON TEXTILES

(in percentages)

Year	*Wharton measure*	*Index of potential utilisation*	*Maximum output per loom/spindle*	*Machine hours*	*Minimum capital output ratio*	*Two shifts*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1950	—	—	74.63	—	100.00	—
1951	94.74	—	79.91	—	96.20	—
1952	93.77	—	89.36	—	79.77	—
1953	96.44	—	91.71	—	86.11	—
1954	95.67	—	94.05	—	78.76	—
1955	95.12	—	95.66	—	84.13	—
1956	96.87	—	98.80	68.14	71.49	—
1957	95.91	—	99.75	67.69	56.66	—
1958	92.20	—	94.59	63.95	58.01	—
1959	94.13	—	95.15	64.71	60.16	—
1960	92.82	92.4	95.21	68.98	60.85	—
1961	95.32	93.6	100.00	72.80	60.71	41.3
1962	93.19	93.2	95.39	74.03	51.01	—
1963	92.31	90.7	94.99	73.68	50.38	45.8
1964	96.86	92.1	98.68	76.79	51.53	—
1965	94.93	91.2	93.27	74.83	55.78	50.1
1966	89.73	86.7	85.71	72.06	64.63	46.8
1967	87.64	85.3	82.43	73.81	61.21	50.1
1968	92.84	90.9	90.12	73.66	61.59	50.2
1969	92.06	86.1	89.17	70.85	62.97	52.5
1970	91.39	85.9	85.42	70.91	60.28	55.6
1971	85.60	81.1	81.41	68.80	—	53.6
1972	91.75	86.5	88.14	71.86	—	—
1973	92.14	—	—	73.16	—	—
Mean	93.19	88.90	91.02	71.15	67.24	49.56
S.D.	2.76	3.68	6.68	3.38	14.21	4.06
C.V.	2.96	4.14	7.34	4.75	21.17	8.19

NOTE: S.D. Standard Deviation. C.V.: Coefficient of Variation.

FOOTNOTE: The combined rate for Wharton is based on variant 3 of spinning with weaving. In combining both in the case of Wharton Measure and Machine Hours and Maximum Output per Spindle/Loom the following relative weights of spinning and weaving have been used:

Period	*Weights*		*Base year*
	Spinning	Weaving	
1950-59	8.91	23.19	(1956=100)
1960-73	11.79	9.39	(1960=100)

NOTES: Column (7) reports capital utilization estimates.

A3.9 Colombia

Census Data Capital Utilization Estimates, reported by Thoumi in the World Bank Study cited in A1.1 above.

An estimate of capital utilization in manufacturing industry at the three-digit level based on official census figures on number of eight-hour shifts worked per year. These data are used by Thoumi to describe changes in utilization between 1945 and the 1973 World Bank data. Little detailed information is given on the comparability of the data with those from the World Bank study, beyond their reporting the same measure of capital utilization as percent hours of operation per year.

Table 5-14. *Colombia—Capital Utilization, 1945*

	Number of eight-hour-shift plants			*Percentage of plants in sector working*			*Average number of hours worked during the year*[b]	*Percentage of hours worked during the year*	*Average number of blue-collar workers per plant*
Branch[a]	*One shift*	*Two shifts*	*Three shifts*	*One shift*	*Two shifts*	*Three shifts*			
Industrial oils	2	—	—	100.0	—	—	2,316	26.4	5
Food	1,861	78	81	92.1	3.9	4.0	2,344	26.8	12
Paper and cardboard	37	—	1	97.4	—	2.6	2,152	24.6	14
Printing	283	6	6	96.0	2.0	2.0	2,398	27.4	1
Rubber	36	3	3	85.6	7.2	7.2	2,275	26.0	19
Beverages	386	21	15	91.5	5.0	3.5	2,631	30.0	18
Leather and products	915	3	1	99.6	0.3	0.1	2,207	25.2	9
Mineral fuel derivatives	1	—	1	50.0	—	50.0	4,744	54.2	297
Jewelry	161	1	—	99.4	0.6	—	2,224	25.4	7
Wood and products	817	4	—	99.5	0.5	—	2,215	25.3	9
Metals and machinery	541	4	1	99.1	0.7	0.2	2,243	25.6	14
Nonmetallic minerals	540	6	10	97.9	1.1	1.8	2,274	26.0	18
Chemical and pharmaceutical	371	5	5	97.4	1.3	1.3	2,186	25.0	11
Tobacco	289	4	—	98.6	1.4	—	2,145	24.5	25
Textiles	275	46	16	81.7	13.6	4.7	2,684	30.6	78
Clothing	957	5	1	95.4	0.5	0.1	2,251	25.7	9
Miscellaneous industries	51	1	2	94.5	1.8	3.7	2,308	26.3	13
Total	7,523	187	143	95.8	2.4	1.8	2,305	26.3	[illegible]

— Means zero

a Colombian classification

b Estimated by multiplying the number of eight-hour shifts worked during the year by 8 and dividing into the number of establishments in the industrial branch

Source: Calculated from Colombia, *Primer Censo Industrial* (Bogotá, 1945).

B. Capacity Utilization Studies

B1.1 Bangladesh

Afroz, Gul and Dilip Kumar Roy, "Capacity Utilization in Selected Manufacturing Industries of Bangladesh," The Bangladesh Development Studies, vol IV, No. 2 (April, 1976), pp. 275-88.

Data: Capacity Utilization

Method/measure: Six alternative measures are discussed involving various specifications of full capacity annual output. Not based on plant responses. Unclear which one(s) are used in empirical estimates though few are operational. Relation of "shift coefficient" (total employment/employment on single shift) to capacity estimates unclear.

Dates/sources: 1973/74 (Sugar) and 1972/73 (Jute) 1973/74 (Engineering and Shipbuilding). Three industries examined: sugar, jute manufacture, and engineering and shipbuilding. Sugar: fifteen firms included. Unclear whether survey or data provided by trade association. Jute: sixteen firms included. Again, source of data unclear. Separate tables for Hessian cloth and sacking cloth. Engineering and Shipbuilding: thirteen firms. Data not explicitly related to previous discussion of definitions so difficult to explain following tables.

TABLE I

CAPACITY UTILISATION IN SUGAR INDUSTRY

Name of the Enterprise	Actual Shift-Coefficient	Capacity Utilisation (percentages)		
		Existing Shift-Coefficient (1973/74)	Desirable Shift-Coefficient	
			2.94	2.875
North Bengal	2.28	100	77.55	79.30
Setabgonj	1.83	27	16.81	17.19
Deshbandhu	1.73	32	18.83	19.26
National	1.56	22	11.67	11.94
Carew and Co.	2.35	65	51.96	53.13
Rangpur	1.75	37	22.02	22.52
Thakurgaon	2.33	38	30.12	30.80
Zeal Bangla	2.06	50	35.03	35.83
Jaipurhat	1.91	65	42.23	43.18
Kushtia	1.83	61	37.97	38.83
Rajshahi	1.26	61	26.14	26.73
Mobarakgonj	0.89	66	15.49	20.43
Shympur	0.85	55	15.90	16.26
Panchagarh	1.10	12	4.49	4.59
Kaliachapara	0.73	24	5.96	6.09
Average	1.63	47.67	27.48	28.41

Source : Bangladesh Sugar Mills Corporation.

NOTES: The meaning of this table is not clear from the text of the study

TABLE II

PRODUCTION AND CAPACITY UTILISATION (PERCENTAGES) OF JUTE MANUFACTURING INDUSTRIES OF BANGLADESH (HESSIAN) 1972/73

Name of the Jute Mills	Actual Production (tons)	Actual Shift Coefficient	Capacity Utilisation on the Basis of Actual Days Worked, Existing Shift and Loom Actually Operating		Capacity Utilisation on the Basis of Desirable Days (300 days), Desirable Shifts (3 shifts, 23·50 hours) and Installed Looms		Output on the Basis of 300 days 3 Shifts and Installed Looms (tons)
			65% eff. norm	75% eff. norm	65% eff. norm	75% eff. norm	75% eff. norm
Sonali	3951.06	1.88	104.49	90.56	52.99	45.92	8603.98
Janata	2740.92	2.00	91.88	79.62	58.38	50.60	5417.32
Pubali	1532.29	1.84	78.46	68.00	36.99	32.06	4779.99
Fauzi	2431.64	2.63	80.08	69.40	50.31	43.60	5576.66
Jessore	4678.55	2.94	76.68	66.45	56.47	48.94	9559.38
Star	4191.77	2.00	60.14	52.12	27.10	23.49	1,7845.31
Afil	929.81	2.94	48.05	41.64	26.93	23.43	3983.32
Aleem	1071.40	1.59	82.64	71.62	31.04	27.00	3983.32
Eastern	2414.55	2.88	76.82	63.58	67.24	58.00	4142.66
Nowapara	1247.93	1.78	66.09	57.28	31.33	21.26	4779.99
Platinum	5814.04	2.00	65.47	56.74	37.59	32.70	1,7845.31
A.R.Hawlader	1533.67	2.00	57.82	50.11	37.02	32.21	4779.99
Crescent	9565.00	2.94	65.79	56.15	49.48	43.05	2,2306.64
Peoples	5236.34	2.38	64.55	55.94	27.24	23.70	2,2179.17
Quami	2354.60	2.00	67.90	58.84	33.30	27.97	8157.85
Ashraf	2466.35	2.50	55.29	47.91	46.51	40.46	6118.39
Average	3260.06	2.14	71.39	61.62	47.87	35.92	9378.74

Source : Bangladesh Jute Industries Corporation.

NOTES: The meaning of this table is not clear from the text of the study

TABLE III

PRODUCTION AND CAPACITY UTILISATION (PERCENTAGES) IN JUTE MANUFACTURING INDUSTRY OF BANGLADESH (SACKING), 1972/73

Name of the Jute Mills	Actual Production (tons)	Actual Shift Coefficient	Capacity Utilisation on the Basis of Actual Days Worked, Existing Shift and Looms Actually Operating		Capacity Utilisation on the Basis of Desirable Days (300), Desirable Shift (3 shifts, 23.50 hours) and Installed Looms		Output on the Basis of 300 Days, 3 Shifts and Installed Looms (tons)
			65% eff. norm	75% eff. norm	65% eff. norm	75% eff. norm	75% eff. norm
Sonali	3676.12	1.88	108.53	94.06	49.57	42.96	8556.78
Janata	2628.46	2.00	95.54	82.80	59.59	51.64	5476.34
Pubali	2823.98	1.84	101.36	87.85	47.60	41.25	6845.42
Fauji	2259.70	2.63	88.35	76.57	50.78	44.01	5134.07
Jessore	3534.29	2.94	81.24	70.40	59.37	52.11	6782.48
Star	4774.09	2.00	90.76	78.66	40.23	34.87	1,3690.85
Afil	2630.89	2.94	65.85	57.07	35.47	30.24	8556.70
Aleem	3052.73	1.59	100.64	87.23	41.16	35.67	8556.78
Eastern	2706.80	2.88	102.29	88.65	36.21	31.38	8625.23
Nowpara	840.61	2.56	72.99	65.45	56.67	40.11	1711.36
Platinum	7023.26	2.00	85.15	73.79	37.58	32.57	2,1563.09
A.R. Hawlader	2681.62	2.00	75.27	65.23	45.20	39.17	6845.42
Peoples	8713.23	2.38	75.89	65.97	41.48	35.95	2,4232.80
Quami	6826.07	2.00	95.91	83.12	47.15	40.86	1,6702.83
Ashraf	2281.30	2.00	79.56	65.95	46.89	40.64	5613.25
Average	3624.80	2.29	87.95	76.17	46.34	40.19	9926.23

Source : Bangladesh Jute Industries Corporation.

NOTES: The meaning of this table is not clear from the text of the study

TABLE IV

PRODUCTION AND CAPACITY UTILISATION (PERCENTAGES) OF BANGLADESH ENGINEERING AND SHIPBUILDING CORPORATION, 1972/73

Name of the Enterprise	Products	Production Unit	Actual Production	Actual Shift Co-efficient	Capacity Utilisation on the Basis of Actual Days Worked		Capacity Utilisation on the Basis of Desirable Days (300) Desirable Shift (2 shifts)	Capacity on the Basis of 300 Days and 2 Shifts
					Existing Shift (1 shift) 75 % eff. norm	Desirable Shift (2shifts) 75 % eff. norm	75 % eff. norm	75 % eff. norm
Khulna Shipyard	Inland & Sea Going vessel	Ton	1,331	.99	66.97	33.23	33.01	4,034
Eastern Cables	Cables	Ton	348	.99	12.02	7.41	7.16	4,860
Bangladesh Diesel Plant	Diesel Engine	No	1,353	.94	64.09	30.04	27.84	4,860
Atlas Bangladesh Ltd.	Honda Motor Cycle	No	1,729	.96	61.80	24.77	23.78	7,272
Eastern Tubes Ltd.	Tube Light/Jute Loom	No	42,397	.57	36.28	10.41	5.24	809,353
Gulfra Habib Ltd.	Carding Machineries	No	217	.94	53.37	26.88	23.18	936
Hashim Can Co. Ltd.	Decorated can Lac	Ton	115	.98	52.24	25.60	24.57	468
National Tubes Ltd.	G.I. & M. S. Pipe	Ton	2,800	.94	63.27	29.66	27.48	10,188
Progoti Industries Ltd.	Bus, Truck, Car	No	1,218	.94	57.69	27.05	25.06	4,860
Bangladesh Cycle Tube Ltd.	By-Cycle	No	7,448	.94	35.31	16.55	15.34	48,564
Dacca Radio Electric Ltd.	Radio P A. Equipped	No	5,000	.94	71.05	33.31	30.86	16,200
[illegible] Corporation Ltd	Electric Fans	No	7,939	.97	53.69	26.00	24.53	32,364
Average				.93	52.31	24.24	22.32	

Source : [illegible]

NOTES: The meaning of this table is not clear from the text of the study

B1.2 India

Sastry, D. U., "Capacity Utilization in the Cotton Mill Industry in India," Indian Economic Review, vol. XV, No.1 (January/March 1980), pp.1-28.

Data: Capacity Utilization -- time series, 1950-70

Methods/measures: Four methods of estimation of capacity output reported, three original to this study: (1) Wharton trend-through-the-peaks; (2) Reserve Bank of India (RBI), a stepwise version of the Wharton index; (3) Maximum output per spindle/loom; (4) Maximum output per unit value of installed fixed capital.

Date/source: 1950-70. Estimated for spinning, for weaving, and combined. Date/source was published government output statistics (see note, p.11).

TABLE 1

CAPACITY UTILISATION BY ALTERNATIVE MEASURES IN COTTON MILL INDUSTRIES

(in percentages)

Year	Cotton spinning						Cotton weaving			
	Wharton measure			Index of potential utilisation	Max. output per spindle	Machine hours	Wharton measure	Index of potential utilisation	Max. output per loom	Machine hours
	Variant 1	Variant 2	Variant 3							
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1950	—	—	—	—	80.97	—	—	—	72.19	—
1951	96.18	96.18	96.15	—	84.27	—	94.20	—	78.24	—
1952	93.37	93.87	93.21	—	92.24	—	93.98	—	88.26	—
1953	94.65	94.65	93.44	—	93.94	—	97.60	—	90.85	—
1954	95.98	95.98	94.27	—	96.61	—	96.21	—	93.07	—
1955	95.39	95.39	93.18	—	97.78	—	95.87	—	94.84	—
1956	95.83	95.83	93.37	—	100.00	71.28	98.21	—	98.34	66.94
1957	96.61	96.34	93.66	—	99.11	70.00	96.77	—	100.00	66.80
1958	90.28	89.35	87.29	—	93.85	65.50	94.09	—	94.87	63.35
1959	91.25	89.69	88.00	—	95.96	67.70	96.49	—	95.84	63.56
1960	93.22	91.04	89.70	91.0	93.23	72.62	96.75	94.2	97.70	64.40
1961	98.01	95.14	94.09	93.0	100.00	76.52	96.88	94.4	100.00	68.13
1962	94.87	92.56	91.86	93.8	94.10	78.61	94.86	92.5	97.00	65.27
1963	93.79	92.52	92.13	91.1	96.09	79.94	92.53	90.2	93.61	65.93
1964	96.92	96.54	96.47	91.1	100.00	82.67	97.36	93.4	97.03	69.40
1965	94.01	94.01	93.68	90.0	92.48	79.19	96.49	92.6	94.26	69.35
1966	90.54	90.54	89.81	87.3	85.59	75.45	89.63	86.0	85.85	67.80
1967	89.41	89.41	88.27	86.9	81.68	78.00	86.86	83.4	83.38	68.55
1968	94.50	94.50	92.86	92.4	82.25	74.39	92.82	89.1	100.00	68.21
1969	95.76	95.76	93.67	85.8	84.14	73.54	90.04	86.5	95.48	67.47
1970	95.42	95.42	92.92	86.0	81.78	75.24	89.48	85.8	89.98	67.60
1971	87.76	87.56	84.98	79.7	74.07	71.56	86.40	82.9	90.62	65.34
1972	95.30	95.30	92.46	86.5	80.54	74.02	90.86	86.4	97.68	69.14
1973	92.67	92.67	94.11	—	—	73.30	89.67	—	—	72.98
Mean	94.00	93.48	92.15	88.81	90.46	74.41	93.65	89.03	92.52	67.39
S.D.	2.55	2.62	2.79	3.75	7.61	4.25	3.49	3.95	6.92	2.27
C.V.	2.71	2.80	3.02	4.22	8.41	5.71	3.72	4.43	7.47	3.37

(table continues on next page)

TABLE I (contd.)

COTTON TEXTILES

(in percentages)

Year	*Wharton measure*	*Index of potential utilisation*	*Maximum output per loom/spindle*	*Machine hours*	*Minimum capital output ratio*	*Two shifts*
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1950	—	—	74.63	—	100.00	—
1951	94.74	—	79.91	—	96.20	—
1952	93.77	—	89.36	—	79.77	—
1953	96.44	—	91.71	—	86.11	—
1954	95.67	—	94.05	—	78.76	—
1955	95.12	—	95.66	—	84.13	—
1956	96.87	—	98.80	68.14	71.49	—
1957	95.91	—	99.75	67.69	56.66	—
1958	92.20	—	94.59	63.95	58.01	—
1959	94.13	—	95.15	64.71	60.16	—
1960	92.82	92.4	95.21	68.98	60.85	—
1961	95.32	93.6	100.00	72.80	60.71	41.3
1962	93.19	93.2	95.39	74.03	51.01	—
1963	92.31	90.7	94.99	73.68	50.38	45.8
1964	96.86	92.1	98.68	76.79	51.53	—
1965	94.93	91.2	93.27	74.83	55.78	50.1
1966	89.73	86.7	85.71	72.06	64.63	46.8
1967	87.64	85.3	82.43	73.81	61.21	50.1
1968	92.84	90.9	90.12	73.66	61.59	50.2
1969	92.06	86.1	89.17	70.85	62.97	52.5
1970	91.39	85.9	85.42	70.91	60.28	55.6
1971	85.60	81.1	81.41	68.80	—	53.6
1972	91.75	86.5	88.14	71.86	—	—
1973	92.14	—	—	73.16	—	—
Mean	93.19	88.90	91.02	71.15	67.24	49.56
S.D.	2.76	3.68	6.68	3.38	14.21	4.06
C.V.	2.96	4.14	7.34	4.75	21.17	8.19

NOTE: S.D. Standard Deviation. C.V.: Coefficient of Variation.

FOOTNOTE: The combined rate for Wharton is based on variant 3 of spinning with weaving. In combining both in the case of Wharton Measure and Machine Hours and Maximum Output per Spindle/Loom the following relative weights of spinning and weaving have been used:

Period	*Weights*		*Base year*
	Spinning	Weaving	
1950-59	[illegible] 91	23.19	(1956=100)
1960-73	11.79	9.39	(1960=100)

NOTES: Variants differ in the specific peaks taken as peak output

Index of potential utilization is the Reserve Bank of India measure

Machine hours is the National Productivity Council measure of capital utilization reported in A above.

B1.3 Tanzania

Wangwe, S. M., "Factors Influencing Capacity Utilization in Tanzanian Manufacturing," International Labor Review, January/February, 1977, pp. 65-77

Data: Capacity Utilization

Method/measure: Not described, but apparently survey data of the McGraw-Hill type (inferred from note on table).

Date/source: 1972, 1973, 1974, 1975. Survey of 39 firms randomly selected from manufacturing sector.

Distribution of surveyed firms by industry

Industry	No. of firms
All industries	39
Beverages	3
Food manufacturing	6
Wood, furniture and fixtures	1
Leather and leather products	1
Rubber products	1
Chemicals	4
Non-metallic mineral products	1
Basic metal and metal products	7
Plastic products	2
Cordage, ropes and twine	3
Spinning, weaving and finishing	4
Other textiles, e.g. clothing	6

Distribution of surveyed firms by capacity utilisation [1]

Capacity utilisation (%)	Frequency distribution (%)
0-20	5
21-30	5
31-40	8
41-50	10
51-60	10
61-70	20
71-80	10
81-100	32

[1] Estimates of actual operations for the period January 1974-September 1975, and in a few cases for 1972 and 1973 as well.

NOTES: No further details of capacity utilization data reported.

B1.4 Brazil

Tyler, William G., "Technical Efficiency in Production in a Developing Country: An Empirical Examination of the Brazilian Plastics and Steel Industries," Oxford Economic Papers, 31(3), November 1979, pp. 477-95.

Data: Capacity Utilization

Method/measure: This study is not explicitly addressed to capacity utilization, but instead to empirical evaluation of productive efficiency — to the presence of "X-inefficiency." While that broader question is associated with a very different literature — and one that was not the focus of this survey — if carefully done, it can produce data indistinguishable from good capacity utilization data based on production function estimates of "capacity." "The Farrell measure of technical efficiency is the ratio of (1) the firm's observed output to (2) the maximum possible output of the firm, i.e., output on the frontier, given its observed factor usage. As this ratio approaches 1.00, maximum technical efficiency for the firm is approached" [Tyler, p. 479]. So this study is included both for its information on industry (and firm) specific capacity estimates and to indicate a literature that may in the future yield additional data on capacity utilization.

Two production function estimates define "full capacity": the Farrell Index and a non-stochastic Cobb-Douglas estimate.

Date/source: 1971. Firm specific data for two industries -- steel and plastics -- from published sources. Sample biased toward large firms: 16 firms in the plastics industry, 22 in steel.

TABLE 2

Firm specific comparisons of indexes of technical efficiency for the Brazilian plastics and steel industries

PLASTICS				STEEL			
Firm number	Ownership: Foreign (F) or Domestic (D)	Farrell efficiency index	Nonstochastic (LP) frontier production function efficiency index (NSFPF)	Firm number	Ownership: Government (G), Foreign (F) or Domestic (D)	Farrell efficiency index	Nonstochastic (LP) frontier production function efficiency index (NSFPF)
1	F	1·00	1·00	1	G	0·58	0·61
2	D	0·69	0·64	2	G	0·55	0·83
3	F	0·98	0·73	3	G	1·00	1·00
4	F	0·75	0·59	4	F	0·61	0·92
5	D	0·80	0·58	5	G	0·20	0·29
6	F	0·51	0·30	6	F	0·45	0·73
7	D	0·34	0·26	7	F	0.72	0·63
8	D	0·75	0·55	8	G	0·0[illegible]	0·07
9	D	1·00	0·61	9	F	0·57	0·71
10	D	0·49	0·37	10	F	0·72	0·64
11	D	0·40	0·35	11	D	0·70	0·84
12	D	0·71	0·40	12	D	0·49	0·53
13	F	0·35	0·27	13	D	0·32	0·31
14	D	0·56	0·35	14	D	1·00	1.00
15	D	0·43	0·25	15	D	0·39	0·39
16	D	0·70	0·48	16	F	0·37	0·42
				17	D	0·37	0·37
Averages:				18	D	0·38	0·46
All 16 Firms		0·65	0·48	19	D	0·55	0·61
Foreign Firms (5)		0·72	0·58	20	D	0·86	0·87
				21	D	0·54	0·48
				22	F	1·00	1·00
				Averages:			
				All 22 Firms		0·57	0·62
				Foreign Firms (7)		0·64	0·72
				Government Firms (5)		0·48	0·56

Note: The extraordinarily low observed levels of efficiency for steel industry firm number 8 led to some further investigation. It was learned that this particular firm in 1971 was undertaking a large scale expansion program which had resulted in a large, but still largely unused, capital stock.

Source: Author's computations as explained in text.

NOTES: Both Farrell efficiency and nonstochastic frontier production function efficiency indices can be interpreted as capacity utilization estimates.

B1.5 India

National Council of Applied Economic Research, Under-Utilization of Industrial Capacity, New Delhi: V.G.K. Thathachary, Ag. Administrative Officer, National Council of Applied Economic Research; 1966)

Data: Capacity Utilization -- cross section and time series

Method/measure: This is the most frustrating study I have come across in this survey. It presents voluminous data -- literally 63 pages of tables covering 140 industrial sectors for ten years -- but it is entirely silent on the method of estimation of "capacity" on the basis of which the capacity utilization figures it reports were generated. The study is therefore nearly meaningless so I have not included their figures except the summary table below. The study (pp 1-3) describes "percent underutilization of capacity" as "1-(actual annual production/actual installed capacity)x100" when installed capacity is defined "on the basis of a particular number of working days per year...and shifts per day." But having meticulously described that time dimension for each industry, the authors then give no hint of how this normal operating period is related to output to establish the productive "capacity" that is the denominator of the underutilization index. My best guess is that an unsystematic bureaucratic guess was used, in each case, to establish "capacity" levels. The discussion of the establishment of "desirable multiple shift working" (bottom p. 5) strongly suggests that these estimates were little informed by plant managers or others involved in the production process. This monumental amount of work, therefore, has no obvious value in studying capacity utilization.

Year	*Overall per cent underutilization of industrial capacity*
1955	13·3
1956	11·0
1957	10·8
1958	15·2
1959	13·6
1960	11·8
1961	10·9
1962	9·4
1963	11·0
1964	10·5

B1.6 Colombia

Currie 1961 Capacity Utilization Survey, reported in Thoumi, World Bank Study cited in A1.1 above.

A 1961 mail survey of all manufacturing firms employing more than 24 workers. Yielded 342 responses. Data were collected on average daily hours of operation and on reasons for "underutilization" making it difficult to compare with capital utilization data based on a more comprehensive time frame. The purpose of the survey was to discover excess capacity — the increase in output demand that could be accommodated without a "large" additional investment. It also enumerated the respondents' judgment of the causes of underutilization. These are reported in the following table from Thoumi.

Table 5-4 *Colombia—Utilization of Capital in Manufacturing, 1961*

ISIC		Number of plants	Average daily operation (hours)[a]	Percentage increase in output from planned expansion	*Response to 25 percent increase in demand* Overtime	Larger crew	More shifts	Small investments	Large investments	Planned expansion is enough	*Causes of underutilization* Energy	Financing	Market	Inputs	Other	Number of causes per firm
3112	Dairy products	5	13.6	176	1	—	—	1	—	3	1	2	2	2	—	1.5
3113	Canning and preserving	1	8.0	10	1	1	1	—	—	—	—	—	1	—	—	1.0
3115	Oils and fats	4	24.0	95	—	—	1	1	—	3	2	2	—	2	—	1.5
3116	Grain mill products	2	8.0	25	1	—	—	1	1	1	—	—	—	1	1	1.0
3117	Bakery products	11	14.0	28	3	1	1	3	2	7	5	6	1	3	1	1.5
3118	Sugar refining	7	22.9	22	—	—	1	—	2	4	—	5	4	2	—	1.6
3119	Candy	6	9.3	29	4	1	3	3	3	1	2	1	1	1	—	0.8
3121	Food products, n.e.c.	7	16.1	18	3	1	2	2	2	4	2	4	—	1	—	1.0
3131	Distilled beverages	6	8.0	50	4	2	2	—	—	1	—	—	4	1	—	0.8
3132	Wine	1	16.0	100	1	—	—	—	1	—	—	1	—	—	—	1.0
3133	Malt liquors	3	24.0	5	—	1	1	1	—	—	—	—	1	1	—	0.7
3134	Soft drinks	7	16.0	75	5	1	2	—	2	6	3	4	1	1	1	1.4
3140	Tobacco products	4	18.0	5	2	—	—	1	1	—	—	2	3	1	—	1.5
3210	Textiles	49	19.2	11	11	17	17	20	6	14	12	30	14	11	—	1.4
3220	Wearing apparel except footwear	38	8.0	25	11	13	6	10	6	12	7	27	6	9	—	1.3
3231	Tanneries	10	10.4	7	4	4	5	4	1	2	3	6	4	3	—	1.6
3240	Leather footwear	8	8.8	10	1	5	1	1	2	2	1	3	2	1	—	0.9
3311	Sawmills and woodmills	7	13.7	19	3	2	3	1	2	3	2	6	2	3	—	1.9
3320	Furniture and fixtures	6	8.0	7	2	2	—	1	—	6	3	3	1	1	—	1.3
3411	Pulp, paper, paperboard	2	24.0	7	—	—	—	1	—	1	—	—	1	1	—	1.0
3412	Paper containers and boxes	9	10.2	20	5	2	—	1	—	3	2	3	3	4	—	1.3
3420	Printing and publishing	13	10.6	25	8	2	5	4	2	6	5	8	1	4	—	1.4
3521	Paints, varnishes, lacquers	3	8.0	33	1	1	3	2	1	1	1	3	2	—	—	2.0
3522	Drugs and medicines	19	8.5	20	7	10	7	9	3	5	11	12	9	4	—	1.9
3523	Soap and cosmetics	13	9.0	33	6	3	2	5	2	5	1	7	3	—	—	0.8
3529	Chemical products, n.e.c.	5	9.3	8	3	1	1	1	—	1	1	—	1	2	—	0.8
3530	Petroleum refining	1	24.0	18	—	—	—	—	—	—	—	—	1	—	—	1.0
3559	Rubber products, n.e.c.	3	18.7	15	1	2	—	1	—	6	2	1	2	1	—	2.0
3560	Plastic products, n.e.c.	6	22.7	53	1	2	2	3	3	3	3	5	—	3	—	1.8
3610	Pottery and china	3	18.6	10	—	1	1	1	2	1	1	1	—	1	—	1.0
3620	Glass and products	7	17.1	21	2	4	2	2	1	1	1	2	2	1	—	0.9
3691	Structural clay products	8	14.0	43	2	2	3	4	6	6	2	6	1	1	—	1.3
3692	Cement, lime, plaster	11	24.0	28	1	2	—	5	4	5	3	3	3	3	—	1.1
3699	Nonmetallic minerals, n.e.c.	17	13.7	54	9	5	5	5	6	6	7	10	7	7	—	1.8
3710	Iron and steel	1	16.0	50	—	—	1	—	—	1	1	—	1	—	—	2.0
3811	Cutlery and hand tools	10	10.4	26	8	4	6	4	6	4	3	5	4	6	—	1.8
3812	Metal furniture and fixtures	1	16.0	30	—	—	1	1	—	—	—	—	—	1	—	1.0
3813	Structural metal products	3	13.3	28	—	2	1	—	1	1	1	2	—	2	—	1.7
3819	Metal products, n.e.c.	8	12.4	26	5	3	2	5	—	2	5	7	1	2	—	1.9
3822	Agricultural machinery	3	16.0	—	1	2	—	—	—	—	—	2	2	1	—	1.7
3831	Electrical industrial machinery	4	14.0	15	1	2	3	1	—	2	2	2	4	1	—	2.3
3833	Electrical appliances	2	16.0	63	—	2	—	1	1	—	—	2	—	1	—	1.5
3841	Shipbuilding and repair	1	8.0	50	1	—	—	1	—	—	1	1	—	—	—	2.0
3849	Transport equipment	2	8.0	25	1	2	—	—	—	—	—	1	1	1	—	1.5
3909	Manufacturing industries, n.e.c.	3	8.0	7	2	1	—	—	1	—	—	1	1	—	—	0.7

— Means zero

a Estimated assuming that one shift = 8 hours, two shifts = 16 hours, and three shifts = 24 hours.

Source Fundación para el Progreso de Colombia, unpublished data.

C. Other Studies: (1) That Did Not Report Their Utilization Estimates or (2) Whose Utilization Estimates are Unavailable

C.1. Utilization Estimates Omitted

Two important studies of capital utilization in LDCs are omitted from the survey of empirical estimates of capital utilization because they did not report the data on the basis of which their analyses were done. They are:

C1.1 Kenya

Baily, Mary Ann, Capital Utilization in Kenya Manufacturing, Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy, Massachusetts Institute of Technology, January, 1974.

This study omitted data in order to protect the confidentiality of her survey respondents. She noted that a reader could have access to that information but only on a basis that would continue to respect confidence. The Baily data were used to test for the influence of day/night shift wage differentials on the shift working decision of firms.

C1.2 India

Betancourt, Roger R. and Chris Clague, Capital Utilization: A Theoretical and Empirical Analysis (New York: Cambridge University Press; 1981)

Estimates of utilization rates in their cross section econometric analysis for India (as well as three other advanced countries) were based on 1968 UNIDO data but the data themselves were not reported with their analysis of it. From their description of the data base (pp. 105-8), it is clear that the capital utilization estimates that were their dependent variable were: (a) derived from UNIDO information on the shift distribution of the labor force by establishment, (b) reported in the original source, (c) used without adjustment for variations in days of operation per week or seasonal changes in capital utilization, and (d) aggregated into 48 industries. These data were used in an extensive econometric test of the propositions of the optimal capital utilization model.

C.2. Studies Unavailable or Inappropriate

C2.1 India

Vijay K Seth, Economics of Utilization of Capacity: A Case Study of Indian Manufacturing Sector.

A monograph currently in preparation. In contact with author March, 1984.

C2.2 Brazil

Bonelli, Ver Regis, Tecnologia e Crescimento Industrial: Uma Experiencia Brasileira nos Anos 60 (IPEA, serie monografica no. 25, Rio de Janeiro, 1976)

C2.3 Peru

Abusada-Salah's 1978 Cornell University PhD thesis on capital utilization in Peruvian manufacturing.

C2.4 Nigeria

Vielrose, Egon, "Manufacturing Industries in Nigeria: Notes on Profits, Growth and Capacity Utilization," Nigerian Journal of Economic and Social Studies, March, 1970

C2.5 Capacity Studies — various countries

The working papers of the "UNIDO Expert Group on the Use of Excess Capacity for Exports" (Rio de Janeiro, 1969) were not available to me.

C2.6 India

Solomon, Morris J., Better Plant Utilization in India -- a Blueprint for Action, Indian Statistical Institute. (New York: Asia Publishing House; 1963)

This is a primer on production management that contains no data and no empirical analysis.

IV. Conclusions and Research Recommendations

This final part addresses three issues: (a) the quality of the data surveyed in this report; (b) the causes of capital idleness revealed so far in these studies and their implications for policy; and (c) the most promising agenda for future research on capital utilization in developing countries.

A. The Existing Data on Capital and Capacity Utilization

Certainly the dominant fact about the quality of existing data on capital and capacity utilization in developing countries is its variability. Some of the studies generated huge amounts of data in amazing detail (like ten years' observations for 140 industrial sectors), some generated data of unexceptionable quality in concept and execution, some produced numbers that are quite meaningless. Unfortunately, there was no necessary correlation between the resources that went into these studies and their quality. Very great care should be used in making comparisons between these data sets, though clearly some of their major aspects do bear comparison.

It appears that the data on capital utilization are quite a bit better than those on capacity utilization. This could probably have been predicted. The concept of capital utilization is of more recent vintage and it reflects, quite simply, more time for accumulated thinking about this important and complicated aspect of productive efficiency. It was much more difficult to identify the potential ambiguities and lurking pitfalls in utilization studies done before the early 1970's than since. Utilization was of clear importance in advanced countries and the appearance of massive idleness of productive capital was both obtrusive and paradoxical in developing countries. But it was not evident either that the definition of capacity was freighted with difficulties or that the measure of capacity utilization was not entirely relevant to the issue of capital efficiency in development. A second reason for the superior quality of the capital utilization estimates is the inherent ambiguity in definitions of "capacity." So capacity utilization estimates must struggle with how to define capacity output while capital utilization estimates, objectively measuring how much of the time the capital stock is in use, do not. The third reason is certainly the World Bank's dominant contribution to our accumulated data base and the fact that it had both the resources and the wisdom to support a generally excellent study. This is a study, importantly, that has not yet been fully exploited but that is a fact to which I will return below.

Over the past decade and more, capital utilization has received the most attention as reflected in the summarized studies. Partly, again, this is because of the role of the Bank, but it may also be in recognition of its greater relevance to development problems. Having said that, however, I have the impression from those contacted for information about recent studies that interest in these issues has flagged in the past five or six years. It is most likely due for a resurgence because of the effect of high real interest rates — as evidenced in the present study. One can certainly hope so.

B. Evidence on Capital Idleness, Its Causes and Policy Implications

Despite the variability in data quality, these studies clearly indicate (a) that variability in levels of utilization are large and (b) that there is considerable variation both between industries and within any given industry. Even so crude a fact as this suggests the promise of further investigation of the sources of that variability and the promise of policies that might increase utilization and capital productivity.

The major causes of idle capital identified in these studies make gratifying good sense — and generally support the recent theoretical analyses of capital and capacity utilization described in Part I. Firms leave their scarce and valuable capital stocks idle both because unexpected things happen that they can't control -- like deficient demand or inadequate supplies of materials — and they leave capital idle because they find it most efficient to do so -- to shut down

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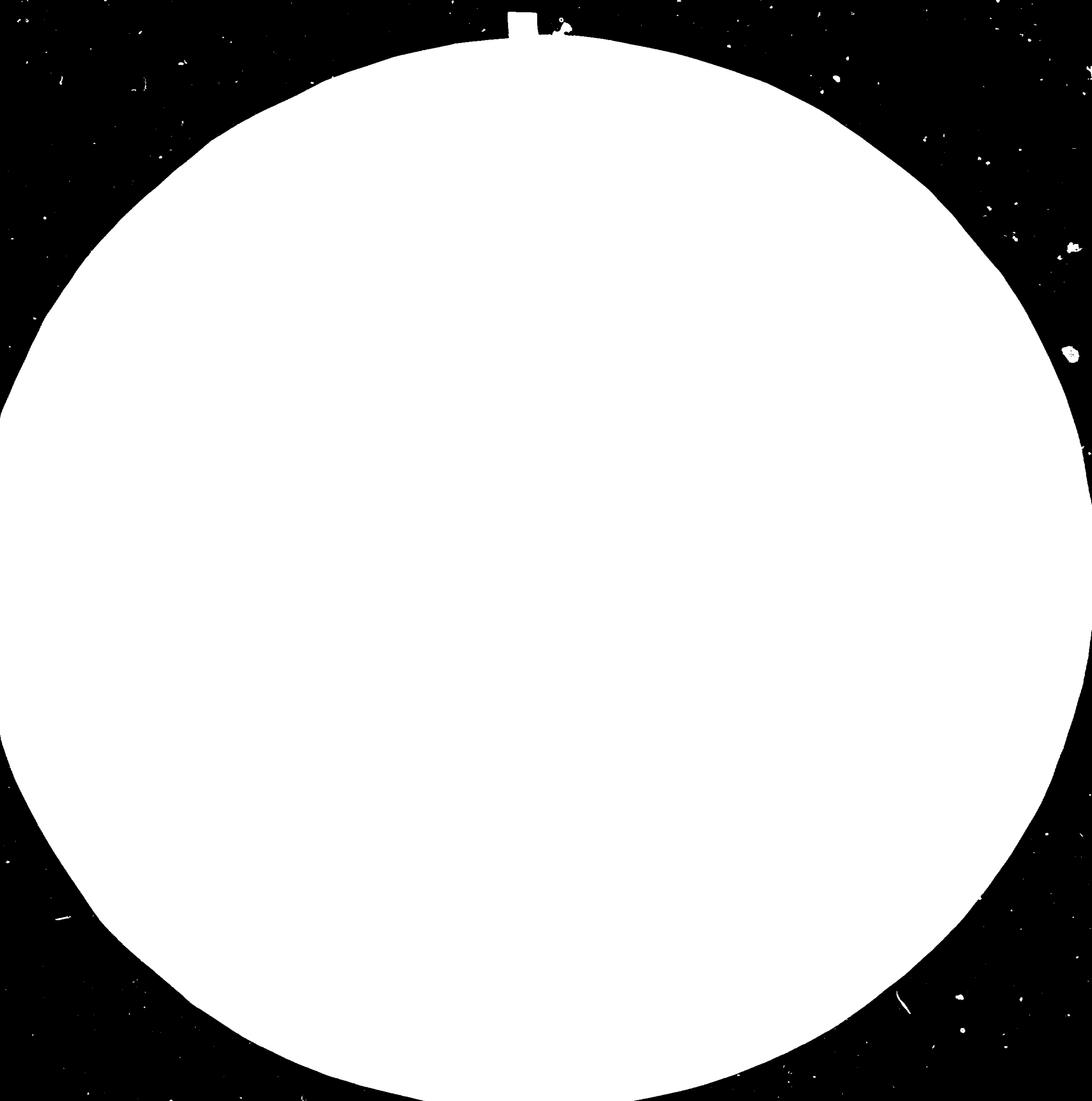

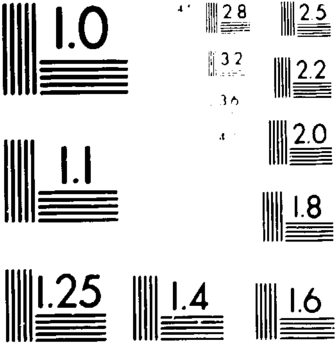
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regularly to avoid paying higher costs. The first of these show up in explaining excess capacity; the second in explaining intentionally idle capital. Both provide opportunities for economic policy to affect capital productivity, quite likely to a considerable extent.

The promise of increasing capacity utilization -- to allow firms to operate closer to their desired levels of operation -- appears to center on measures to reduce demand variability and to assure steady input supplies, including both imported inputs and domestic inputs like transport and electric power. Surprises characterise excess capacity and government policies that tolerate (or exacerbate) unpredictability in conditions of demand or supply will contribute to excess productive capacity.

The promise of increasing capital utilization is to induce firms to define higher targets of "full capacity" -- to set their sights to work at normal operating schedules that keep their plants in production more of the time. The studies surveyed in this paper lend considerable support to the fact that firms will define their "full capacity" or "desired capital utilization" on the basis of the economic (and technical) environment in which they operate. It is an environment very much conditioned by government policy. Those policies take the form, when viewed by the firm making utilization decisions, of penalties or rewards for operating its plant much of the time. Thus the important influence on capital utilization of time-differentiated input prices like high night-time shift wage differentials, of low priced capital that induces firms to waste it through low levels of utilization, of high-cost labor that makes it more economical to work single shifts, of tax policies that add to labor costs or subtract from capital costs.

It is clear, too, that larger plants operate more of the time than smaller plants. So do capital-intensive plants. This deserves further comment. One of the most persistent findings of these studies is that capital-intensive plants are operated more of the time than are labor-intensive plants. This shows up most dramatically in the World Bank study where aggregated utilization rates, as noted earlier, vary markedly according to the weighting scheme used. Capital utilization is lowest when aggregated with labor weights, intermediate when aggregated without weights and highest, markedly, when aggregated with capital weights. What this means is really quite encouraging. Societies tend to run their capital at more inconvenient times than they require their workers to work: the working schedule of the typical insensate machine is less humane than that of the typical worker. (Indeed, an explicit aim of policy in some advanced countries like Sweden and Japan is to exploit computer-assisted manufacture to allow increased utilization of capital without the necessity for increased labor at inconvenient times of day. This is,of course, an expensive and highly capital-intensive luxury.)

The socially desirable target for capacity utilization is zero excess capacity -- 100% capacity utilization. This is not a realistic target, of course, but it is a desirable one. The same is not true for capital utilization. The socially desirable target for capital utilization is not "all of the time" -- 100% capital utilization. The reason, simply, is that that operating schedule would economize on capital but it would be highly uneconomical in terms of all other resources, including human resources. Only if capital stocks were the only valuable resource used in production would 100% capital utilization be an appropriate objective of social policy. It is important, then, in considering utilization policies, that this difference be kept in mind: 100% capacity utilization is fine; 100% capital utilization is highly undesirable.

Utilization policies will focus on the penalties that government economic policies impose on firms' increased utilization of capital. Of course, the policies that produce these utilization penalties serve other purposes — so high wages reward the work force; night-time wage differentials are both humane and appease workers' pressures to emulate advanced countries; low capital prices are assumed to encourage industrial investment; etc. The point is not that all such policies should be swept aside in the name of increasing capital utilization, but rather that such policies must be recognized as having negative effects on capital productivity, effects that become more serious as the real cost of capital rises. It seems quite reasonable, therefore, that a number of government policies that discourage capital utilization might be judged quite desirable in an era of low real interest rates but quite undesirable when real interest rates are high and rising.

C. A Research Agenda

These studies make amply clear that utilization is an important and largely neglected aspect of industrial policy in developing countries and, importantly, that it is a dimension of industrial efficiency that is significantly affected by government economic policies. Considerable urgency is added by high real interest rates hence high capital costs. The case for further research is compelling.

This section briefly describes what I see as the most effective uses of research resources to expand our understanding of utilization and relevant policies. These include (1) further firm-level survey research (a) in World Bank countries to get data comparable over time and (b) in an expanded set of countries; (2) further studies based on electric power consumption; and (3) a conference on capital utilization. All of these seem to fall within UNIDO's mandate; all are proposed with an appreciation of their costs.

1. Further Firm-Level Survey Research

Because the utilization aspect of production has only recently been identified, no data on hours of operation per year are routinely collected -- the situation is much like that of GNP accounts before Keynes: their value was apparent only after its theoretical demonstration. Much of the set-up cost of such surveys was borne by the World Bank. This was evident in the much less expensive survey data gathered in Nigeria and a larger sample would not have been a great deal more expensive. Many of the most expensive lessons about doing such surveys have been learned and can be applied more cheaply elsewhere.

The most promising countries in which to collect utilization survey data would certainly include those of the original World Bank study. The decade and more since those studies were done would provide the ideal laboratory for analysis of changes in utilization rates in response to changes in economic policies, to changing international environment, to growth, to changing industrial composition, etc. The payoff to surveys that could thus exploit the Bank's earlier data would appear to be far higher than those of alternative countries. Furthermore, the Bank's data tapes include a good deal of information that has never been analysed and they should be available to inform any new efforts in those countries. If the expense of re-surveying all three of the developing countries in that study were prohibitive, a modest survey (say 50-75 firms) in only one of them (preferably the Philippines, where the original data were of the highest quality) would have a significant return.

2. Further Electric Power Measures

It would be unfortunate if David Morawetz's very penetrating criticism of electric power based measures of capital utilization were to be so effective as to discourage their further use. The shortcomings of those measures that Morawetz pointed out apply only to their use in making interindustry comparisons. But much of what we want to learn from utilization measures is how they change over time in response to changing economic policies and circumstances. For those purposes, electric power measures have a very great deal to recommend them.

The major virtue of electric power measures of capital utilization is that they are inexpensive to generate and cheaply updated. Murray Foss used this device to produce a long series of capital utilization data for US manufacturing and Kim and Kwon did the same for Korea, as reported above. Both serve very nicely to show how utilization rates have changed, concurrently with important policy changes in the latter case. Their conclusions were little affected by the problems raised in intersectoral comparisons. And both studies relied on data readily available from government agencies.

I would therefore recommend (a) that the Korean data be brought up to date to cover the decade of the 1970's; (b) that the Brazilian studies be translated into English; and (c) that a number of other countries' data bases be explored to determine which of them has accumulated the data necessary for estimation of utilization rates over time, with the intention of initiating other studies. Once established, these series should be updated regularly on the basis of incremental changes in installed motor capacity and power consumption.

3. A Conference on Capital Utilization

One of the most useful of research activities would be, simply, to get together those people who have worked on capital utilization studies and those in government planning and statistical agencies whose interests in capital productivity will lead them to consider such studies and policies in the near future.

Two primary purposes would be served by such a conference. The first is to familiarize those busy practitioners in the field with the considerable increase in clarity of these issues that's been made possible by the research of the past decade. We now have a far clearer understanding of this dimension of productive efficiency and its signifiance for capital productivity and that understanding will significantly improve planning efforts and the usefulness of the data gathered on utilization. A conference seems the most fruitful way to convey that information as well as to inform researchers, in turn, of the interests and concerns of those in government.

The other purpose is to encourage the use of coherent methodologies in order that as much as possible of the data generated can be compared. While it would be the researcher's ideal to have all data generated by a common questionnaire on methodology (as in the Bank study), a more realistic aim would be to make those responsible for gathering data aware of the variations inherent in these estimates so that they can make their own choices and do so with more explicitness in their reported studies. The failure of some of the studies reported above to be aware of these problems vitiated their usefulness.

The promise of renewed investigation of capital utilization in developing countries is considerable and timely. I hope that this survey will contribute to that effort.

NOTES

1. The yearly rental rate of capital is, under even the simplest circumstances, $P_k = \bar{P}_m(r+d)$, where $\bar{P}_m$ is the purchase price of a unit of capital stock, d is the rate of real depreciation and r the real rate of interest. The increase in real interest rates noted in the text has increased the real rental rate of capital by about 60% for capital stocks with a twenty year life.

2. See Winston, JEL.

3. This section is based on Winston, 1970, EJ, JEL, Winston-McCoy, AER, and Betancourt-Clague.

4. Under any realistic assumptions about depreciation.

5. Not to be confused with an "overtime wage premimum."

6. We will ignore "GNP Gap" capacity questions as being too aggregated for the issues of this study.

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