

ORIGINAL

ECONOMIC ANALYSIS OF  
BUSINESS CYCLES ON THE ECONOMY OF CITIESGEOGRAPHICAL DIFFERENCES IN  
PLANT CLOSINGS AND TEMPORARY LAYOFFSMarie Howland  
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A region or city's industry composition is an important determinant of the amplitude and timing of its local business cycles. Local economies comprised of cyclically sensitive industries should experience recessions that are severe relative to the nation, whereas local economies made up of cyclically stable activities should exhibit mild cycles relative to the nation.

The effects of industry mix on local cycles are clearly stated by Walter Isard (1957):

Differences in the intensity and timing of regional cycles are explained in terms of differences in the sensitivity and responsiveness of particular industries. Cycles of a regional economy are simple composites of the cyclical movement of the economy's industries appropriately weighted (Isard, 1957:31).

Borts (1960), Browne (1978), Engerman (1965), and Howland (1981) conducted empirical tests of the industry mix hypothesis and found industry mix to be an important explanatory factor in regional recessions. For example, Howland (1981) controlled for states' industrial composition at the two-digit SIC code level and found that industry composition explained an average of 36 percent of the variation in state business cycles for the five recessions between 1950 and 1975. Controlling for industry mix at the three-digit level for machinery manufacturing (SIC 35), Howland found that for the 1973-75 recession 38 percent of the variation in two-digit machinery manufacturing could be explained by industry composition at the three-digit level. For textile manufacturing (SIC 22), none of the cross-state variation in the 1973-75 recession could be explained by industry composition at the three-digit level. These findings as well as those of the above authors indicate that the strength of the relationship between an expected cycle based on industry mix and the actual cycle varies across regions as well as recessions and industries

and that there must be factors other than industry mix that explain the severity of local recessions.

The purpose of this study is to go beyond the industry mix hypothesis to explore economic and institutional factors particular to local economies that influence local cycles. Holding industry composition constant, such factors as the age of an area's capital stock, the labor or capital intensity of the aggregate production function, the extent to which the workforce is unionized, the skill level of its workers, the level of unemployment insurance benefits, and a shortage or surplus of workers are all expected to influence the amplitude of local short run fluctuations in employment. While many of the following factors should also influence output and employment behavior in single plant firms, the focus of the discussion is on temporary layoffs and plant closings in the multiplant firm, and factors expected to explain geographical differences in business cycle fluctuations.

#### THEORY

Each of the factors expected to influence local plant closings and temporary layoffs will be considered here in turn. First, two hypotheses proposing reasons that the same industry will reduce output unevenly across space will be considered. Second, four reasons that layoff practices are expected to vary by region will be considered.

#### Cross-area Differences in Output Fluctuation

Regional and city-suburb differences in the age of capital are expected to explain, in part, spatial differences in business cycles. The reason why age of capital is expected to influence a firm's and ultimately an area's business cycle will be presented first. Secondly, a hypothesis

proposing area differences in production functions which explains some of the cross-area differences in cyclical output will be outlined.

Age of Capital. The effects of age of capital on local cycles and firm closings are expected to depend upon whether the firm is a single establishment operation or the branch of a multiunit operation. The focus here is on the behavior of multiunit firms.

Branch plants that have an old capital stock relative to other branch plants of the same firm are expected to absorb a disproportionate share of the firm's output fluctuations over the business cycle. Employment in new capital branch plants is expected, ceteris paribus, to remain relatively stable over the cycle. The micro based economic theory behind this hypothesis applies to the profit-maximizing, competitive or monopolistic firm that responds to falling demand for its homogenous product with a combination of cutting prices and reducing output.

New equipment should be, on average, more appropriate for current relative prices of land, labor, and other inputs than old equipment. Moreover, operations in an old plant are suspected of being less efficient than production in a new plant. The reason has less to do with the productivity of the physical plant than the plant's location. New investment in plant occurs when a location offers cost-minimizing access to markets, raw materials, labor, energy, etc. The longer the physical plant exists the less likely the location will be an optimal one and, conversely, the less optimal the location the higher the average age of the plant because the location does not warrant new investment.

Older plants are more likely to be in inefficient locations than new plants for several reasons. First, markets shift over time. Thus, an old plant may serve a smaller than efficient market or else be required to

serve more distant customers, adding to shipping and contact costs. Secondly, production technologies change and new mixes of raw materials, labor skills or energy sources may be required. Third, new, cheaper sources of energy or raw materials may be discovered. In the second and third cases above transportation costs may rise as inputs are imported from more distant sites, or firms in old locations must now compete with establishments that, because of technological change, are selecting more cost-effective sites near cheap labor, less energy costs, skilled labor, etc. For these reasons establishments with a high average age of plant and equipment have higher average cost curves and lower profits than plants producing the same product with a new capital stock.

The case for plants in a competitive industry will be presented here. For the case of the monopolist see Appendix I. To simplify, we consider here the case where a firm is comprised of two branch plants. One plant produces with old capital, the other with a new capital stock. Both plants produce the same, single product and sell it at a universal price  $P$ . Since producers adjust to falling short run demand by cutting both prices and output, both cases will be considered here.

Where prices are flexible and any level of output can be sold at the lower price, the firm manager will continue producing at the old capital plant as long as the price is greater than average variable costs (AVC). When price falls below AVC, theory suggests the old capital plant (O) will be closed. This shutdown will take place earlier in the old capital plant than in the new capital plant (N). Since newer plants are less likely to shut down, the recession will be milder in regions where new capital is concentrated. This is shown in diagram 1.



old capital, low profit plants. This argument is demonstrated in diagram 2.

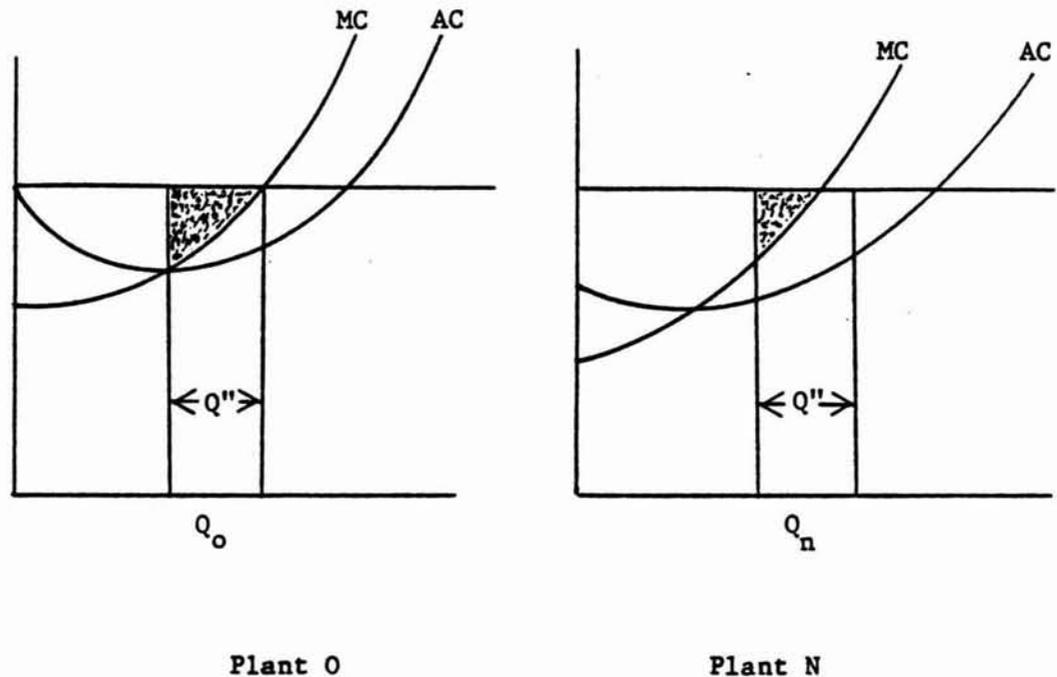


Diagram 2

Total output in plants N and 0 is equivalent to  $Q_n + Q_0$ . If output is cut by  $Q''$ , due to falling demand for the products produced by this firm, reductions in profits are minimized if these cutbacks are made in the low profit, high average cost plant 0. This can be seen by comparing the reduction in profits if cutbacks are made in high average cost plant 0 versus the loss in profits if cutbacks are made in low average cost plant N. Again, the loss minimizing strategy is to reduce production in the old capital plant.

It is possible that average costs in the old capital plant could fall below average costs in the new capital plant as output levels are

reduced. If this occurs some reduction in output will occur in the new capital plant as well as in the old capital plant.<sup>1</sup>

It is clear from the above discussion that the nature of spatial differences in business cycles should be influenced by the extent to which producers respond to falling demand by price reductions versus output reduction. For example, if aggregate demand falls from  $D$  to  $D'$  as shown in diagram 3, and firms respond by dropping prices from  $P_1$  to  $P_2$ , then output ( $Q$ ) remains constant. In this case, cross-area differences in plant

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1. This argument can easily be made as follows:

FC = Fixed Costs	P = Price	Subscript n = New Capital Plant
AVC = Average Variable Costs	q = Quantity	Subscript o = Old Capital Plant

$$\pi = P \cdot q_n + P \cdot q_o - AVC_n \cdot q_n - AVC_o \cdot q_o - FC_n - FC_o$$

$$\frac{\partial \pi}{\partial q_o} = P - AVC_o$$

$$\frac{\partial \pi}{\partial q_n} = P - AVC_n$$

Since  $AVC_o > AVC_n$  then  $\partial \pi / \partial q_o < \partial \pi / \partial q_n$

In order to minimize losses in profits, cutbacks will be made only in plant o as long as  $AVC_o > AVC_n$  at the marginal level of output.

closings should explain most of the cross-area differences in recessions due to age of capital (see diagram 1, above).

When producers respond to falling demand by adjusting  $Q$  to  $Q'$  and holding prices constant at  $P_1$ , cross-area differences in employment fluctuations, due to old capital, should be explained primarily by cross-area differences in temporary layoffs (see diagram 2, above).

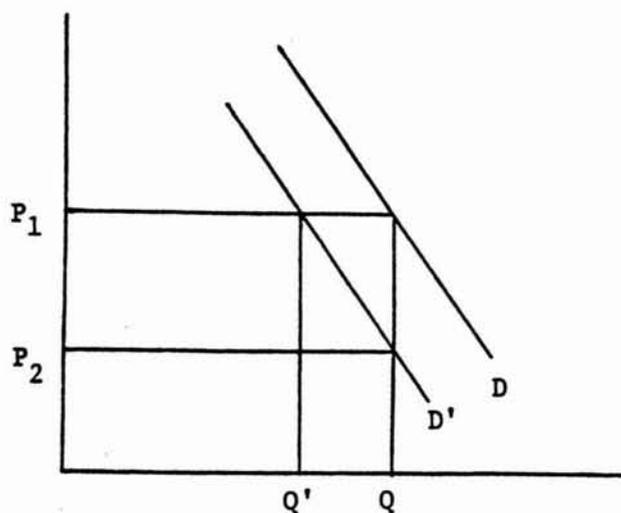


Diagram 3

An empirical study by Gordon (1981, p. 501) tested the responsiveness of the aggregate price level to changes in GNP. The elasticity was well below 1 and was equivalent to approximately .437 for the years 1954 to 1979 when four quarters are allowed for adjustment.

Gordon also found that price adjustments after 1953 were more sluggish than they had been in earlier periods. Unfortunately, Gordon does not consider differences in price adjustment behavior within the period 1953 to 1979. It is, however, likely that the trade off between price and output adjustments varies by recession as well as by industry.

While further exploration of this issue is beyond the scope of this paper, it is worth noting that variations in cyclical employment and output across areas may differ by recession because firms' price adjustment behavior varies across recessions.

Varaiya and Wiseman (1977) have suggested that an old capital stock may lead to more severe regional recessions because the retirement of obsolete capital is concentrated in regions where the average age of capital is higher. During the expansionary phase of the cycle, scheduled retirements may be postponed because either the revenues from running the old capital are temporarily higher than the salvage value of the land, labor and capital, or orders from regular or new customers must be met. With the end of the expansion, the delayed retirements combined with the regularly scheduled retirements are bunched together, creating the appearance of a more volatile cycle. This phenomenon is expected to explain a concentration of plant closings during economic downturns.

Old capital in this argument is a sign of long run disinvestment. Due to high relative wages, unionization of the labor force, relatively high energy costs, declining markets, etc., firms may disinvest in a region with a view to eventually closing the plant. It is these permanent plant closings described by Varaiya and Wiseman.

The age of a plant's capital stock should be distinguished from the age of the firm. Young firms are more likely to go bankrupt during recessions because they lack the retained earnings and access to credit that can cushion them during bad economic times. Moreover, new firms are more likely to make high risk decisions to establish their position in the market. Thus, they are more susceptible to downward swings in the business cycle. Since multiplant firms are most likely older than the average

firm, whole multiplant firms are less likely than the average firm to file for bankruptcy during recession. This suggests that areas with a high proportion of new single-establishment firms may be relatively susceptible to severe business cycles due to high rates of firm closures. According to the incubator hypothesis, such firms should be concentrated in central cities. This suggest that, *ceterus paribus*, central cities will experience relatively severe employment and income cycles.

Since branch plants and single plant establishments with old capital are spatially concentrated in the Northeast and Midwest and in cities rather than suburbs, it is expected that, all other factors constant, the Northeast and Midwest will experience more severe recessions than the South and West.

Table 1 and Figure 2 demonstrate the regional and large city/other area differences in age of capital. Table 1 demonstrates the age distribution for machine tools in all manufacturing for the four major regions. This table indicates that the age of machine tool equipment does not vary significantly by region. Figure 2 indicates the regional variation in the median age of plants by large city versus other areas in 1971. Consistent with general wisdom, the average age of plant is oldest in the Northeast. The North Central region has the second highest median age of capital, followed by the South and West. Figure 2 also demonstrates that the median age of plant is higher in the major cities than in other areas for the Northeast, North Central and Western regions. While there are no age of capital data to support the hypothesis, we expect plant to be older in central cities than in suburbs and, therefore, *ceterus paribus*, to be more variable in cities than in suburbs.

Table 1

Age Distribution of Machine Tools by Region<sup>1</sup>

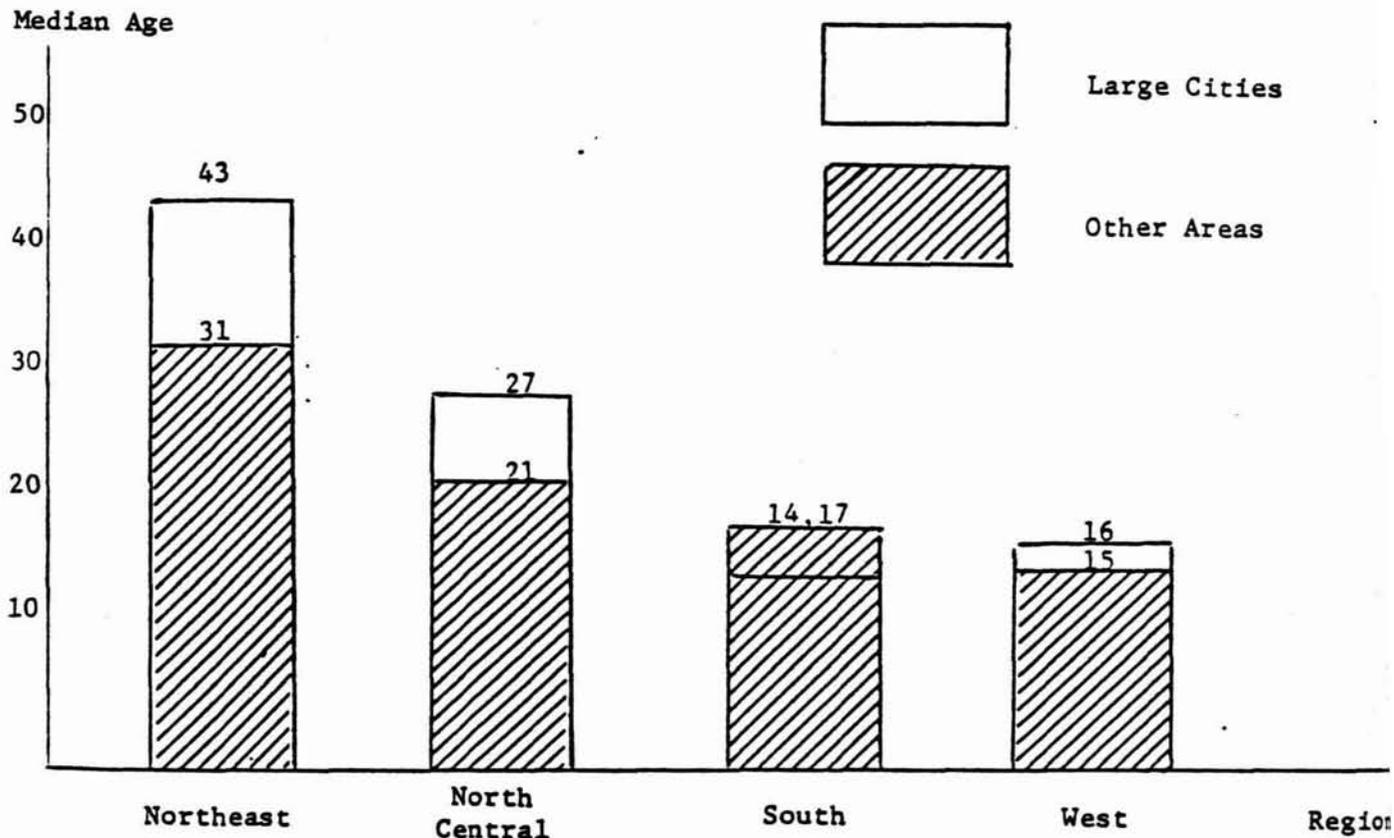
	Northeast				Northcentral			
	0-9 Years	10-20 years	More than 20 years	Total	0-9 Years	10-20 years	More than 20 years	Total
1958	36.4%	43.8%	19.9%	100.0%	39.9%	41.5%	18.6%	100.0%
1963	35.0	42.5	22.5	100.0	33.7	44.1	22.2	100.0
1968	36.2	40.3	23.5	100.0	34.7	40.9	24.4	100.0
1973	32.8	34.4	28.9	100.0	32.2	38.2	29.6	100.0
1978	31.0	39.4	29.7	100.0	30.1	38.2	31.6	100.0

	South				West			
	0-9 Years	10-20 years	More than 20 years	Total	0-9 Years	10-20 years	More than 20 years	Total
1958	38.0%	45.0%	17.0%	100.0%	52.3%	40.3%	7.5%	100.0%
1963	41.5	43.9	14.5	100.0	47.4	39.9	12.8	100.0
1968	35.4	42.2	22.5	100.0	37.1	42.1	20.8	100.0
1973	33.1	39.5	27.5	100.0	32.9	38.6	28.6	100.0
1978	30.1	39.8	30.0	100.0	32.2	40.9	26.9	100.0

1. Source: 8th, 9th, 10th, 11th and 12th American Machinist Inventories; The 12th Inventory was taken during 1976, 1977, and 1978. Details may not add due to rounding error.

From: Hulten, et al., "The Regional and Urban Impacts of Federal Tax Policy," Working Paper No. 1485-06. Washington, D.C.: The Urban Institute, 1982, p. 98.



Source: Hulten, et al., "The Regional and Urban Impacts of Federal Tax Policy," Working Paper No. 1485-06. Washington, D.C.: The Urban Institute, 1982, p. 98.

Figure 1

DISTRIBUTION OF BUILDINGS BY MEDIAN AGE  
 AND REGION, 1971; LARGE CITIES VERSUS  
 OTHER AREAS

The assumption that new capital stock is more appropriate for current relative prices should, however, be stated with some qualification. Relative energy prices fell slowly during the postwar period, 1945 to 1973, encouraging a transition toward energy-using capital. Well known events of late 1973 led to a reversal of the energy price trend and relative energy prices have increased. Energy-intensive capital aged 10 to 20 years may be less efficient than older energy-saving plant and equipment, leading to higher marginal costs for middle aged capital firm or plant than for old capital. The possibility of other reversals in relative price trends necessitates a qualification of the hypothesis.

Labor Intensity of the Production Process. A second hypothesis is that labor-intensive branches of multi-establishment firms absorb a disproportionate share of the firm's output adjustments during the business cycle. Because labor-intensive operations are concentrated in low wage regions and/or regions with relatively old capital, local business cycles in these areas may be more severe than the national average, holding all other factors constant.

During periods of cyclical downturn, managers of profit-maximizing multi-plant firms should allocate, *ceteris paribus*, production cutbacks disproportionately with high variable cost plants bearing a larger burden of economic slowdown than the high fixed cost plants. The reason is that the cost of idle fixed inputs is borne entirely by the firm, whereas the cost of idle variable inputs is not or is only partially assumed by the firm. Labor is a major variable cost, whereas capital is a major fixed cost. Thus, losses to the firm are minimized when labor-intensive plants are idled, workers laid off, and production shifted to capital-intensive plants. As a consequence it is predicted that, during economic downturns,

firms and, in the aggregate, regions and cities with low capital-labor ratios will experience more severe reductions in aggregate output and therefore greater cyclical unemployment than their high capital-labor ratio counterparts.<sup>2</sup>

This hypothesis depends upon the evidence of Feldstein (1976), McLure (1977), and Vickery (1979). All three researchers found that with the current unemployment insurance system, firms do not bear the full cost of layoffs.

To illustrate the cross-regional variations in production functions, within two-digit SIC level industries the capital-labor ratios for the South, North Central, and Northeast were 12.0, 8.81, and 8.97, respectively, for textile manufacturing in 1972. The values for machinery manufacturing were 7.92, 7.61, 10.4, and 11.98 for the West, South, North Central, and Northeast regions, respectively, in 1972.

Because capital and skilled labor are complements in the production process, the owner of capital-intensive plant may be reluctant to reduce output through layoffs in that plant due to the high cost of replacing skilled workers during the recovery. This effect would reinforce a positive relationship between layoffs and labor intensity of branch plants. It is worth mentioning that capital-intensive operations are energy using. Thus in the post-1973 period, capital-intensive plants may have had relatively high average costs. This effect would counteract the negative relationship between layoffs and capital intensity hypothesized here.

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2. It is possible that instead of low capital-labor ratio plants being cyclically sensitive, plants in cyclically sensitive states produce with labor-intensive technologies, so as to allow flexibility during swings of the business cycle.

### Cross-area Differences in Layoff Practices

When faced with falling demand for their product, firms have several adjustment options. They can accumulate inventories, reduce wages and prices, or cut back on output by reducing employment. The following four hypotheses argue that employment reductions through layoffs are the more common adjustment strategy in unionized plants with low-skilled workers, located in labor surplus areas, with high unemployment insurance benefits. When business cycles are measured as employment fluctuations, areas with larger than average layoffs will experience more volatile cycles.

It is also possible that layoffs in unionized, high unemployment, high unemployment insurance, and low-skilled areas may be less costly than other adjustment mechanisms in nonunion, low unemployment, low unemployment insurance benefit, high-skilled areas, and therefore firms may find it less costly to force the former plant to absorb the disproportionate share of total firm cutbacks. Whether due to an uneven spatial distribution of layoffs or this phenomenon combined with an uneven distribution in output, areas with the above four characteristics are expected to experience relatively volatile employment cycles. The theory behind each of these arguments will be presented here in turn.

Unionization. Another hypothesis of spatial differences in business cycles is that cross-area differences in layoff practices occur due to cross-area differences in union strength. Feldstein (1978) and Medoff (1979) found evidence to support the hypothesis that workers in unionized firms have significantly higher probabilities of being laid off than workers in similar nonunionized firms. When demand for labor falls, management has several options for reducing their workforce: to leave

positions vacated by quits unfilled, to reduce or slow the growth in real wages, to reduce hours, or to increase layoffs.

Adjustments through unreplaced quits are less of an option for the unionized firm than the nonunionized firm. The reason is that the quit rate in union firms is relatively low (see Freeman [1978] and Johnson [1976]).

A second option for labor adjustments is a reduction in wages. Empirical evidence by Hamermesh (1970) and Lewis (1978) suggests that real wages in the union sector are less sensitive to changes in the unemployment rate than are wages in the nonunion sector, a finding that suggests that unionized establishments are unlikely to respond to falling labor demand by reducing wages. With lower quit rates and less ability to reduce wages, union firms must make use of either layoffs or work sharing.

Work sharing is likely to be the preferred strategy of the younger, more recently hired workers. With work sharing the marginal worker bears only part of the cost of the cutback whereas with layoffs, the recently hired or marginal worker bears the total cost. The older workers, on the other hand, prefer cutbacks to take the form of layoffs. Under a policy favoring layoffs, senior workers are likely to retain their jobs, and therefore incur no or little cost.

Because in nonunionized firms the marginal worker preference is transmitted to management, it is likely that cutbacks in such firms will take the form of work sharing and cuts in wages. In unionized firms where the demands of the average and more senior workers predominate, layoffs will be more likely to prevail (see Medoff [1979]).

An additional hypothesized reason for the positive relationship between unionization and layoffs is that managers of unionized firms may

find a policy favoring layoffs acceptable because they anticipate low rehiring costs during the recovery. Laid off union workers are not likely to abandon a union job. Rather, they will collect unemployment benefits and wait to be recalled. This ensures the firm a ready pool of workers to draw from during the upswing, making firms less reluctant to lay off workers during the downturn. Additional evidence by Freeman (1978) has shown that years of tenure with an employer are positively correlated with unionization, a result consistent with the argument that workers are reluctant to relinquish a union job.

Union workers tend to be skilled. Since employers are reluctant to lay off skilled employees, the impact of unionization on the severity of regional recession will be muted.

Labor Surplus. Another hypothesis of cross-area differences in layoffs is that employers in labor-surplus markets may expect low labor search costs during the recovery and therefore readily lay off workers during the downturn. Comparable plants in labor-short areas may anticipate difficulties in rehiring and, therefore, find it cheaper in the long run to hoard workers. Using the annual peak-level unemployment rate as a proxy and data from Great Britain, Thirwall (1966) found that regions experiencing the greatest cycle sensitivity were those with unemployment rates persistently above the national average.

Unemployment Insurance. A third hypothesis is that plants located in states with greater unemployment insurance (UI) benefits relative to wages are expected to experience more severe layoffs. The greater the state's UI in relation to wages, the more likely workers are to wait out the recession without looking for and taking another job. Employers, therefore, may be inclined to lay off workers expecting them to be available for

rehiring at a later date. Also, employees with some bargaining power are more likely to accept layoffs in high UI states than in low UI states. In low UI states workers may prefer wage or hour reductions to layoffs.

Worker Skill Levels. A fourth hypothesis is that employment policy varies by region because of differences in worker skill levels. Where a plant employs skilled labor, high retraining costs may be anticipated, leading employers to retain workers throughout the recession. In low-skill plants layoffs rehiring may be cheaper.

For this reason it is expected that headquarters will provide more stable employment than production plants. To determine whether the share of manufacturing employment in administrative position varies by area, the following percentages were calculated. In the New York SMSA, .15 of all manufacturing employment is in administrative positions. The equivalent values for Boston, Baltimore, and Houston are .10, .03, and .07, respectively. The proportion of manufacturing employment in administrative positions also varies by state. For example, the value for Florida is .02 and for Michigan is .09 (Census of Manufactures, 1972). Area differences in employment in central administrative employment may explain, in part, why regional business cycles, within the same industry, vary.

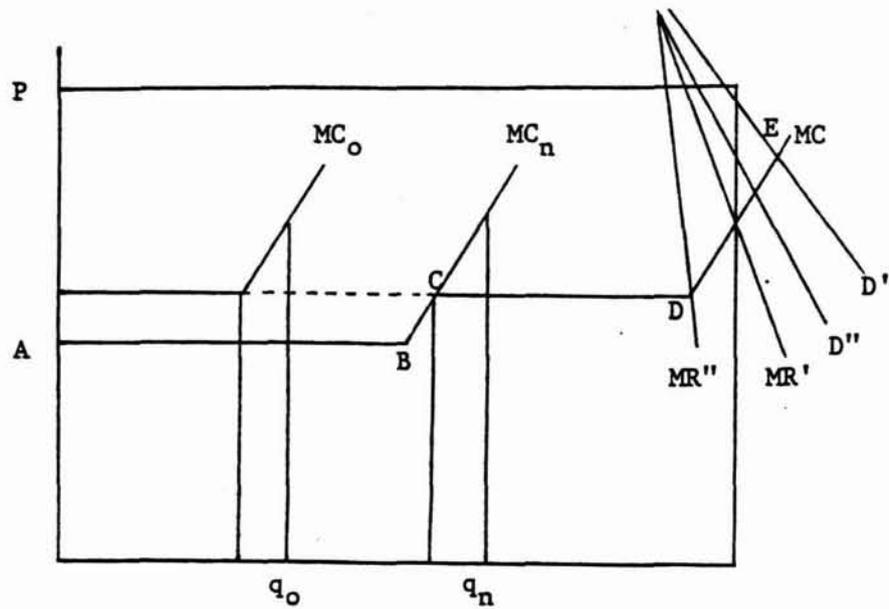
To summarize, it is proposed that spatial variations in business cycles occur for six reasons in addition to spatial variations in industry mix. The age of capital, capital-labor ratios, the extent to which labor forces are unionized, the existence of a labor shortage or surplus in peak years, the level of unemployment insurance benefits, and employee skill levels vary across city/suburb lines, across SMSA/nonmetropolitan lines and across regions and influence fluctuations in output and employment at

the firm and the regional level. Thus city/suburban, city/nonmetropolitan, and census-region business cycles are expected to differ not only because of cross-area differences in industry mix but due to spatial differences in the factors discussed above.

## APPENDIX I

## AGE OF CAPITAL ARGUMENT FOR MONOPOLISTS

The argument that old capital plants will absorb a disproportionate share of cutbacks in output is presented here for the monopolist. To simplify the argument, it is assumed that the slopes of the marginal cost curves are the same for both plants.



The total marginal cost (MC) curve for the monopolist is ABCDE. To maximize profits the monopolist produces the output that equates the firm's MCs with marginal revenues ( $MR'$ ) and distributes output among each plant such that the marginal cost of the last unit produced in each plant is equated to the marginal revenue of the last unit sold in the market. In other words,  $q_n$  is produced in plant N and  $q_0$  is produced in plant 0. Total output is equal to  $Q^x$ .

As MR falls from  $MR'$  to  $MR''$ , cutbacks are made evenly in each plant. If aggregate demand falls below  $D''$ , or MR falls below  $MR''$ , the cutbacks in output are absorbed completely by the old capital plant 0.

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