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Project Report

ECONOMIC ANALYSIS OF EFFECTS OF BUSINESS CYCLES ON THE ECONOMY OF CITIES

REGIONAL VARIATIONS IN CYCLICAL EMPLOYMENT

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1. INTRODUCTION

There are wide variations in the severity with which regions experience national recessions (Borts [1960], Browne [1978], Freidenberg and Bretzfelder [1980], Gellner [1974], Howland [1979,1981], Sum and Rush [1975]). This paper presents and tests an econometric model to explain these cross-regional differences in cyclical behavior.

The model, based on export base theory, is tested with state-level data from the five post-World War II recessions between 1950 and 1975. The findings suggest that cross-state differences in the industry mix of exports, capital-labor ratios, age of manufacturing capital stocks, levels of unemployment insurance benefits, unionization of labor forces, and multiplier impacts on the residentiary sector of the economy explain cross-state differences in the severity of state recessions.

Isard [1957] hypothesized and Borts [1960] and Browne [1978] tested the proposition that "[d]ifferences 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 economies industries appropriately weighted" (Isard, 1957, p31]. Empirical tests of this hypothesis indicate that while industry composition is important in explaining regional cycles, it alone does not explain cross-regional variations in employment and income. The model presented herein places these empirical tests in an export base framework, determines the percent of cross-state variation in regional cycles explained by industry composition, and tests five economic and institutional variables expected to influence local cycles. These five variables are states' capital-labor ratios, age of capital stocks, proportion of labor forces in unions, level of unemployment insurance benefits, and peak-year unemployment

rates.

To this author's knowledge, the relationship between a state's capital-labor ratio and its business cycle has not been hypothesized prior to this study. A positive association between the age of a state's capital stock and cyclical variability has been proposed but not tested by Bolton [1978], and Variaya and Wiseman [1977]. Other investigations found evidence to suggest that cross-state differences in the proportion of the labor force belonging to unions (Medoff [1979]), in the level of unemployment insurance benefits (Hamermesh [1972] and Feldstein [1976, 1978]), and in the availability of labor during the upswing of the cycle (Thirwall [1966]) explain spatial differences in the severity of recessions. This study tests these relationships in one model with new data. Finally, the model presented here incorporates the impact of a cyclical fluctuation in the export sector on the region's residentiary sector and calculates a short run export-base multiplier.

2. MODEL

The model divides each state economy into an export sector and a residentiary sector. The severity of a state's recession is equivalent to the weighted recessions in the state's export sector and residentiary sector, as indicated in equation 1.

$$\dot{E}_{jr} = (\dot{E}_m \cdot E_m/E_T)_{jr} + (\dot{E}_s \cdot E_s/E_T)_{jr} \qquad (1)$$

where:

$\dot{E}$ = Trend-adjusted severity of the recession.

$\dot{E}_m$ = Trend-adjusted severity of the recession in the export sector.

$\dot{E}_s$ = Trend-adjusted severity of the recession in the residentiary sector.

E_m/E_T = Proportion of total employment in exports

E_s/E_T = Proportion of total employment in residentiary activities

Subscript r = States 1,.....,48

Subscript j = Recessions 1,.....,5

The dependent variable is equivalent to the trend-adjusted percentage decline in state employment. While the National Bureau of Economic Research's cycles are used to identify the national recessions, the actual peaks and troughs for each state are allowed to vary.

Export Sector

State's export sector employment ($\dot{E}_m$) is divided into a nationally determined and a locally determined component. The national or industry mix component captures short-run fluctuations in national demand for a state's exports, and is measured by weighting the trend-adjusted percentage change in employment in each national manufacturing industry by the importance of that industry in each state. The industry mix component is measured by:

$$\hat{\dot{E}}_{jr} = \sum_{i=1}^{19} (\dot{E}^{i}_{jo} \cdot w^{i}_{jr(t)}) \qquad (2)$$

where the notation is the same as above, and:

$\hat{\dot{E}}$ = The industry mix component

$\hat{\dot{E}}^{i}_{o}$ = The trend-adjusted severity of the recession in national industry i.

w^i = The proportion of employment in industry i.

Subscript t = Peak-year prior to recession, 1, ..., 5.

Superscript i = Manufacturing industry at the two-digit Standard Industrial Code (SIC) level.

The remaining variation in export sector employment is explained by a local component--including five state-specific factors. The first two factors include the capital-labor ratio and the age of manufacturing capital. Both are expected to explain cross-state differences in demand for regional output. The final three variables hypothesize reasons for cross-state differences in layoff practices. These variables are the proportion of the state's labor force in unions, the level of unemployment insurance benefits, and the existence of a labor shortage or surplus during the upswing of the cycle. Each of the five hypotheses are explained below.

The lower a state's capital-labor ratio, the more severe its expected recession. The hypothesis applies to both multiplant firms with branches located across state boundaries, as well as single plant firms.

During periods of cyclical downturn, managers of profit-maximizing multi-plant firms should, ceterus paribus, allocate 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 born entirely by the firm, whereas the cost of idle variable inputs is not or 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 states, 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.[1]

This hypothesis would not be reasonable without 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 lay-offs

Differences in capital-labor ratios should also influence the bankruptcy or closure rates for single-plant firms in a competitive industry. The loss-minimizing strategy for the single-plant firm is to operate as long as average variable costs (AVC) are met. At the point where average revenues (AR) fall below AVC's the firm is temporarily or permanently closed.

Labor intensive firms pay a higher proportion of total costs to variable factors than do capital-intensive firms. As AR's fall during the downswing of the cycle, the point where AR falls below AVC will be earlier, ceterus paribus, for the higher AVC firm than the low AVC firm. Thus labor-intensive, high AVC firms, should shut down sooner than capital-intensive firms. The argument is not that total profits or losses will be greater in the labor or capital intensive plant, rather that there will be different points when AVC = AR, different rates of firm closures, and consequently more severe cyclical unemployment in regions where labor-intensive plants are concentrated. This analysis applies to the competitive market case with flexible prices as well as the case where AVC's rise due to a reduction in output.

To illustrate the cross-regional variations in production functions,

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[1]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.

within 2-digit SIC level industries the capital-labor ratios for the South, Northcentral, 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, Northcentral, and Northeast regions, respectively in 1972.

Because capital and skilled labor are complements in the production process, owners of capital-intensive firms may be reluctant to reduce output through layoffs due to the high cost of replacing skilled workers during the recovery. This effect would reinforce a negative sign on the capital-labor coefficient. Skill-level data, by state, is not available so that the affect of skill levels could not be controlled. In addition, it is worth mentioning that capital-intensive operations are energy using. Thus in the post-1973 period, these firms may have relatively high average costs.

The age of capital is also expected to influence a state's cyclical behavior. The theory applies to profit-maximizing multiplant and single plant firms that respond to falling demand by either cutting prices or maintaining prices and reducing output. The arguement is as follows.

Newer capital is, on the average, more appropriate for current relative prices of land, labor, and other inputs than old plant and equipment. For this reason, firms with a high average age of capital will have higher average costs and lower profits than plants producing the same product with a new capital stock.

For the multiplant firm, where prices are flexible and any level of output can be sold at the lower price, the 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, the old capital plant will be closed. This is shown in diagram 1.

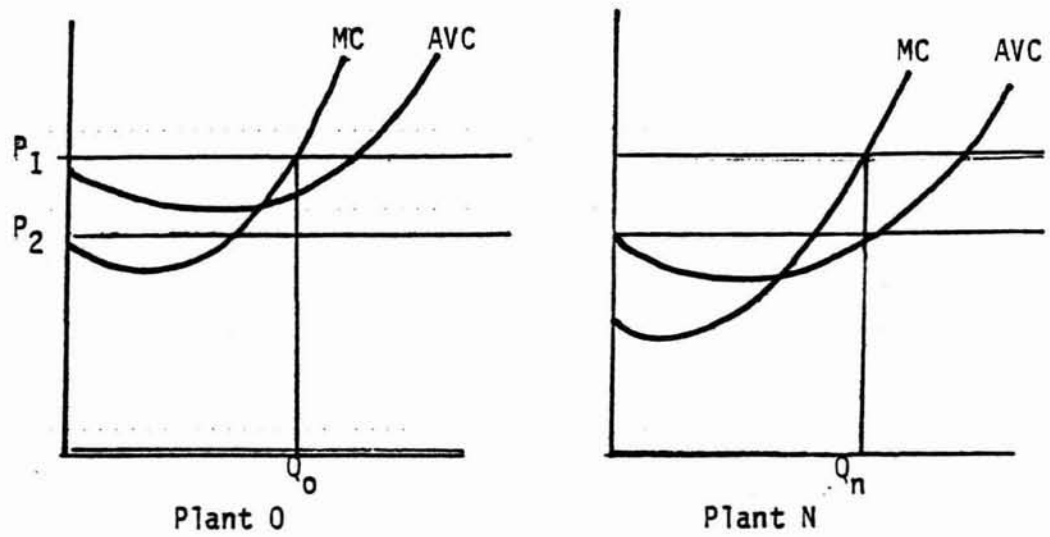

Diagram 1

At price P_1, Q_o will be produced at the old capital plant O and Q_n will be produced at new capital plant N. When prices fall below P_2, the profit maximizing manager will halt production at the old plant, because average revenues are not longer covering average variable costs. When these closures are observed at the aggregate or macroeconomic level, the region with the higher average aged capital stock will experience greater cyclical unemployment than the region with the newer capital stock.

When prices are rigid and output levels are reduced in response to oversized inventories, reductions in output will also be concentrated in old capital plants. This arguement is demonstrated in diagram 2.

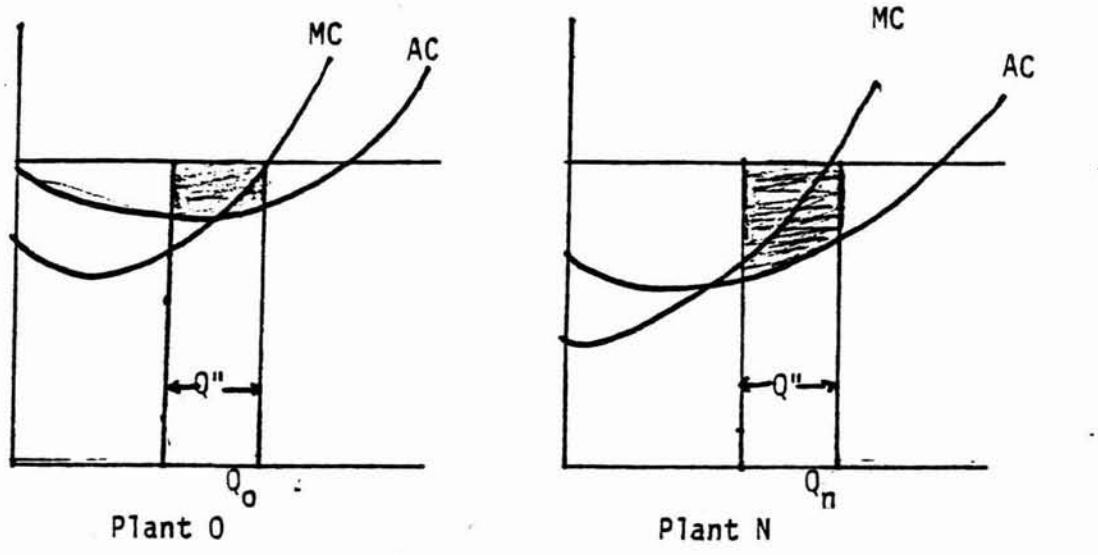

Diagram 2

Total output in plants O and N is equivalent to $Q_o + Q_n$. If output is cut by Q", due to falling demand for the products produced by this firm, profits are maximized if cutbacks are made in the low profit, high average cost plant O. This can be seen by comparing the reduction in profits if cutbacks are made in high average cost Plant O versus the loss in profits if cutbacks are made in low average cost plant N. Again, the loss minimizing or profit maximizing strategy is to reduce production in the old capital plant. Layoffs, therefore, will be more severe in regions with relatively high proportion of old capital. This arguement holds for oligopolists as well as firms in more competitive industries.

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. However, the old capital plant will still experience a disproportionate share of the firms cutbacks.

The arguement can be extended to the single plant firm in industries characterized by competition. A firm will stay in business as long as average revenues (AR) exceed AVC, even if total revenues are less than total costs. However, when AR's fall below AVC, the loss minimizing firm will close its doors. Firms with high AVC will have a greater probability than firms with low AVC of failing to cover variable costs, and therefore will have a greater probability of shutting down, either permanently or temporarily. If a region has relatively more high variable cost firms, it will have a higher than average proportion of closures and consequently a more severe recession. This analysis does not necessarily assume that prices fall during the recession. It is possible that prices remain constant, and that average costs rise when the volume of output falls. (Bolton [1978]).

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 post war 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. New energy-intensive capital may now be less efficient than older energy-saving plant and equipment, leading to higher marginal costs for the new capital firm or plant. This particular change in relative prices would only affect the results for the 1973-75 recession. However, the possibility of other reversals in relative price trends necessitate a qualification of the hypothesis.

Variaya 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.

Additional evidence suggests that, contrary to the above hypotheses, the relationship between age of capital and the severity of regional cycles may be negative rather than positive. Rather than measuring efficiency of production, the age of capital stock may measure the average age of firms in the state. More clearly, states with a low average age of capital may be fast growth states with a high proportion of small, new and dynamic firms. New, small firms are more likely to borrow credit to the limit , to make high risk decisions, to be dependent on external funds, and therefore to be more susceptible to bankruptcy than their larger, older counterparts. Birch [1981] found that small service and manufacturing firms are more likely to go bankrupt during recessions than are medium or large firms. He also found that the total number of jobs lost are greater during the downswing of the cycle in small than in medium or large sized firms. These findings suggest that states with a low average age of capital may be more cyclically sensitive than states with an older capital stock, because the former have a high proportion of small, new and cyclically vulnerable firms. Thus, while most authors hypothesize a positive relationship between the age of a region's capital stock and the severity of recessions, there is some evidence to suggest that the relationship may be negative.

The second set of three hypotheses to be explored in this model are factors proposed to explain cross-regional differences in layoff practices

during a recession. The hypotheses suggest that holding industry mix constant, whether there is a labor surplus or shortage, the magnitude of unemployment insurance benefits and unionization of the workforce will influence a region's cyclical employment.

First, employers in labor-surplus markets may expect low labor search costs during the recovery and therefore readily lay off workers during the downturn. Comparable firms in the labor-short states 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, the greater the unemployment rate, the greater the expected recession. Thirwall [1966] found, using data from Great Britain, that regions experiencing the greatest cycle sensitivity were those with unemployment rates persistently above the national average.

Second, regions with greater unemployment insurance (UI) benefits relative to wages are expected to experience more severe regional recessions. 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 layoff 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.

Hamermesh [1972] and Feldstein [1978] found that the level of unemployment insurance benefits have a positive effect on temporary layoffs at the firm level. The results of work by Holen [1977], Classen [1977], and Welch [1977], indicating that higher unemployment benefits lengthen the duration of unemployment, are consistent with the arguement that re-hiring is easier in

high than in low UI states.

A contradictory hypothesis by Welch [1977] suggests that an experience rating system, even one that is not fully experience rated, will raise the cost of laying of workers and consequently reduce layoffs. Since the payroll tax is greater in high benefit states than low benefit states, the incentive for firms to hoard workers throughout the recession is stronger in states where UI is generous.

A final arguement for greater stability in high UI than in low UI states is that UI acts as an automatic stabilizer. The greater the benefits, the more stable a state's income level, and the smaller the effects of the recession on the residentiary sector.

One complication with the UI variable is that the causal relationship may, in fact, move in a direction opposite to that hypothesized. More clearly, we may obtain a positive relationship between UI benefits and severity of the recession because states with cyclically sensitive industries have been aggressive in instituting large UI benefits. Thus a positive and significant relationship between UI benefits and cyclical volatility must be interpreted judiciously.

Third, it is hypothesized that cross-regional differences in layoff practices are due to cross-regional 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 [1978]).

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 arguement 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.

To summarize, the recession in the region's export sector is equal to:

$$\dot{E}_{m_{jr}} = \hat{\dot{E}}_{jr} + \dot{E}_{L_{jr}} \qquad (3)$$

where the variables are the same as above except that:

$\dot{E}_L$ = The local component of a state's export-sector cycle.

The local component ($\dot{E}_L$) includes the five economic and institutional factors described above and is equivalent to:

$$\dot{E}_{L_{jr}} = \hat{\dot{E}}_{jr}(\beta_1 KL_{jr(t)} + \beta_2 A_{jr(t)} + \beta_3 U_{jr(t)} + \beta_4 UE_{jr(t)} + \beta_5 UI_{jr(t)}) \qquad (4)$$

where the β's are parameters to be estimated and the variables are the same as above except that:

$$A_{jr} = [(I_{jr(t)} + I_{jr(t-1)}) / K_{jr(t)}]$$

KL = Capital-labor ratio.

I = Total investment in fixed plant and equipment.

K = Value of the capital stock.

U = Percent of the labor force belonging to unions.

UE = Peak-year unemployment rate.

UI = Ratio of weekly unemployment insurance benefits to the average weekly wage.

The local component (equation 4) includes the industry mix component, $\hat{\dot{E}}$.

This formulation implies that the magnitude of the beta coefficients depends upon the severity of the recession due to industry mix. A large value for $\hat{\dot{E}}$ signifies a state has a large proportion of cyclically variable exports. Managers of those industries must make larger than average adjustments in output and layoffs. It is these output and labor adjustments which are influenced by capital-labor ratios, age-of-the capital stock, unionization, etc. Thus the greater the cyclical sensitivity of a state's exports, the more weight given to these states in estimating the beta coefficients.

To summarize, it is proposed that within the manufacturing or export sector of a state economy the severity of the actual recession deviates from the expected recession based on industry mix for five reasons. The capital-labor ratio, the age of states' capital stock, the extent to which its labor force is unionized, the existence of a labor shortage or surplus in peak years, and the level of unemployment insurance benefits vary across states and may influence the severity of state recessions. A final factor expected to influence the severity of the regional recessions are differences in the decline in employment in state's residentiary activities.

Residentiary Sector

The severity of the decline in residentiary employment is assumed to be explained by both the severity of the employment decline in the export sector and the short-run multiplier. The formulation of the multiplier is described below. The multiplier measures the impact of a percentage decline in export employment on residentiary employment. More specifically, the multiplier is formulated as follows.

$$\dot{E}_{s_{jr}} = \hat{m}(E_m/E_T \cdot \dot{E}_m)_{jr} \qquad (5)$$

The parameter $\hat{m}$ is an endogenously determined short-run multiplier and should

range between zero and the long run export-base multiplier, $1/(E_m/E_T)$. The parameter $\hat{m}$ should approach the long-run multiplier the more prolonged the recession. This is shown below in equations 6 through 8.

In the long run $\dot{E}_s = \dot{E}_m$, or the percentage decline in manufacturing employment leads to an equivalent percentage decline in services. In this case, substituting $\dot{E}_s$ for $\dot{E}_m$:

$$\dot{E}_{s_{jr}} = \hat{m}(E_m/E_{T_{jr}} \cdot \dot{E}_s)_{jr} \qquad (6)$$

$$(\dot{E}_s/\dot{E}_s)_{jr} = \hat{m}(E_m/E_T)_{jr} \qquad (7)$$

$$\hat{m} = 1/(E_m/E_T)_{jr} \qquad (8)$$

The severity of the recession in manufacturing, $\dot{E}_m$, is weighted, in equation 5, by the proportion of state employment in manufacturing because it is not only the severity of the recession in the export sector that influences the severity of the recession in residentiary activities, but the relative size of each sector.

The parameter is expected to be of small magnitude because it measures the effect of a temporary change in manufacturing employment on residentiary employment. Where employers expect the fluctuation in manufacturing to be temporary they are less likely to cut output and lay off residentiary sector workers. Moreover, workers in the manufacturing sector are more likely to draw from savings and maintain current levels of demand for residentiary services when the downturn is expected to be shortlived.

Shortcomings of the Model

There are several shortcomings of the model. First, the model does not capture the interregional transmission of business cycles. For example, the stability or instability of domestic trading partners should influence the amplitude of a state's cycle. Intermediate products sold to cyclically

sensitive states will be more volatile than the national average of an industry's behavior would suggest. So that, for example, a state whose tire industry supplies Michigan should experience a larger than average cycle, while a state selling tires to the relatively stable state of Kansas should expect a smaller than average cycle.

Moreover the model does not capture the international transmission of business cycles. Foreign cycles can generally be distinguished from domestic cycles. Thus it is possible that states or industries within states that depend on foreign purchasers will appear to experience either a milder or more severe decline in aggregate demand than the national average, depending on the stability of foreign economies.

Another shortcoming of the model is omitted variables. Two omitted variables are inventories and worker skill levels. Industries may respond to similiar reductions in aggregate demand with dissimilar inventory policies. If an industry's inventory policy differs by state, differences in output and employment cycles will result. A number of factors determine a state's inventory policy, most of which are particular to the industry and are accounted for in the industry mix variable. Among the unaccounted determinants of inventory policy are cross-state differences in the cyclical variability of trading partners and in inventory laws.

In addition to cross-state differences in inventory holdings, employment policy may vary across states due to regional differences in worker skill levels. Where an industry employs skilled labor, high retraining costs may be anticipated leading employers to retain workers throughout the downturn. In low-skill areas layoffs and later rehiring may be cheaper. Unfortunately, there are limited data on skill levels, or on-the-job training by industry by state.

A third shortcoming of the model is that some of the activities included in the residentiary sector are basic in some states. For example, tourism in Florida or finance in New York would be better classified as an export industries. Thus, the unexplained variation in cross-state recessions may be explained by the failure of the model to capture the interregional transmission of business cycles and several omitted variables. The unexplained variation may also be due to the difficulty of dividing local economies between export and residentiary activities. None of these shortcomings are expected to bias the coefficients, except where mentioned above.

Econometric Model

The final all-industry equation was derived by substituting equations 2, 3, 4, and 5 into 1, replacing $\dot{E}_m$ with equations 3 and 4, and factoring out the component, $\dot{E}_m$, the final equation is:

$$\dot{E}_{jr} = [1 + \hat{m}(E_s/E_T)_{jr}] \cdot [(E_m/E_T)_{jr} \cdot (\hat{E}_{jr} + \hat{E}_{jr} \quad (\beta_1 KL_{jr(t)} + \beta_2 A_{jr(t)} + \beta_3 U_{jr(t)} + \beta_4 UE_{jr(t)} + \beta_5 UI_{jr(t)}))] \qquad (9)$$

Using the data for all industries in each state for the five recessions 1953-54, 1957-58, 1960-61, 1969-70, and 1973-75, an attempt was made to estimate equation 9. The model was tested on data for each recession, as well as for all recessions combined. Allowing fifty iterations and a number of starting values, only two recession-specific equations would converge. Those were the equations representing the 1953-54 and the 1969-70 recessions. The equation for the combined cross-section time series also converged to a solution. The failure of the 1956-57, 1960-61, and 1973-75 recession-specific equations to converge is most likely due to the flatness of the maximum likelihood surface.

Although the parameters for the combined cross-section time-series equation could be estimated, without estimating the recession specific equations it was not possible to test whether pooling of the data was justified. In other words, the question of whether each of the five samples were drawn from the same sample could not be answered.

In order to estimate equations for each of the five recessions, as well the pooled recession data, the model was simplified and reestimated. The simplified model is:

$$\dot{E}_{jr} = \left(\frac{E_m}{E_s}\right)_{jr} \left(\hat{\dot{E}}_{jr} + \hat{\dot{E}}_{jr} \left(\beta_1 KL_{jr(t)} + \beta_2 A_{jr(t)} + \beta_3 U_{jr(t)} + \beta_4 UE_{jr(t)} + \beta_5 UI_{jr(t)} \right.\right.$$
$$\left. + \left(\frac{E_m}{E_s}\right)_{jr} \cdot \hat{m}(E_m/E_T)_{jr} \cdot \hat{\dot{E}}_{jr}\right) \qquad (10)$$

Equation 10 assumes that only the national component has repercussions on the residentiary sector. The capital-labor ratio, age-of-the-capital stock, unionization, unemployment rates, and unemployment insurance benefits are assumed to have an affect on the severity of the recession in the export sector, but the second round impact of these factors on the residentiary sector are not measured in the simplified all-industry mode.

4. RESULTS

Several of the coefficients are unstable across recessions. Therefore, equation 10 is estimated with a mixed degree of pooling. The coefficients on the capital-labor ratios exhibit substantial instability across recessions and consequently are estimated individually for each recession. Two coefficients are estimated for the age-of-capital variable and the peak-level unemployment rate. The remaining variables are estimated jointly for all recession. The results are presented in Table 1.

RESULTS FOR THE SIMPLIFIED MODEL
UNCORRECTED AND CORRECTED FOR HETEROSCEDASTICITY
(EQUATION 10)
TABLE 1

	UNCORRECTED	CORRECTED
KL_I	-.256 (.1440) [-1.777]	-.454 (.1518) [-2.994]
KL_{II}	-.184 (.0920) [-2.004]	-.169 (.0874) [-1.941]
KL_{III}	.153 (.0879) [1.736]	.244 (.0816) [2.991]
KL_{IV}	-.037 (.0765) [-.477]	.013 (.0686) [.193]
KL_V	-.084 (.0391) [-2.150]	-.054 (.0367) [-1.482]
$A_{I,II,V}$	9.525 (2.9064) [3.277]	13.603 (2.803) [4.853]
$A_{III,IV}$	-.579 (4.4633) [-.129]	1.334 (4.2825) [.311]
$U_{I,V}$	.030 (.0119) [2.528]	.027 (.0100) [2.704]
UE_I	.049 (.1071) [.452]	.094 (.1386) [.676]
UE_{II-V}	-.143 (.1072) [-1.333]	-.237 (.0915) [-2.589]

UI_{I-V}	-5.644 (1.9050) [-2.963]	-4.728 (1.8837) [-2.510]
m_{I-V}	.938 (.2012) [4.664]	.397 (.1749) [2.267]
F STATISTICS	15.77	48.37
SSR	130.	344.000
N	192	192
D.W.	2.11	1.99

Statistics in () are standard errors, in [] are T-statistics.
I represents 1953-54 recession
II represents 1957-58 recession
III represents 1960-61 recession
IV represents 1969-70 recession
V represents 1973-75 recession

The results on the capital-labor ratio (KL) indicate some support for the hypothesis of negative relationship between cyclical sensitivity and a state's capital-labor ratio. However, this relationship appears to hold only when the severity of the national recession is relatively high in terms of loss in real GNP. The 1953-54, 1957-58, and 1973-75 recessions were the most severe post World War II recessions included in the study. It is not surprising that the coefficients are more consistent with the hypotheses during these more severe national recessions. The more severe a national recession, the larger the number of multiplant firms affected by the recession, the greater the cutbacks in their labor-intensive operations, and the more likely these cutbacks will show up at the macroeconomic level.

For example, the more severe the reduction in a firm's sales, the more likely managers are to adopt a layoff policy. Economic decision makers prefer, in general, to build up inventories, encourage employee vacations, and leave vacated positions unfilled before instituting layoffs. The milder the

recession, the more likely firms are to find these preliminary adjustments sufficient. It is possible that, in mild recessions, too few labor-intensive multiplant firms reach the point of laying off workers for the effects of the recession due to capital-labor ratios to show up in aggregate data. Furthermore, during mild recessions, bankruptcy rates should be lower than during more severe recessions. Again, it is possible that bankruptcies, due to high-variable costs, are so few during mild recessions, that they do not show up in aggregate data.

The age-of-capital stock (A) coefficients are estimated with a mixed degree of pooling. The coefficients for recessions I, II and V are stable, consequently data from these periods are pooled; and the coefficients for recessions III and IV are similar, so these two data sets are pooled. Similar to the case for the capital-labor ratio variable, the coefficients on the age-of-capital stock is statistically different from zero at the .01 level for the more severe 1953-54, 1957-58, and 1973-75 recessions. The coefficient is insignificant for the milder 1960-61 and 1969-70 recessions.

In contrast to the negative relationship hypothesized by most researchers, the coefficient on $A_{I,\ II}$ and $_{V}$ is positive. A positive parameter suggests that states with a newer manufacturing capital stock experience more severe recessions than do states with a relatively old stock of capital. It is worth noting here that a high value for the age of capital variable signifies a new capital stock.

One explanation for the positive value on age of capital is that rather than measuring "efficiency" of production, the age variable measures the average age and size of firms in the industry. As stated above, a positive relationship between the size of a firm and its resiliency during recessions has been established by Birch [1981]. Regions with new capital may have a

high proportion of new, small, dynamic firms that have a high probability of going bankrupt during recessions. In order to find out whether that age of state's capital stock is associated with the average size of its firms and the number of its bankruptcies, the age variable is correlated with the percent of manufacturing firms in a state with 20 or more employees and with the percent of manufacturing firms completing bankruptcy proceedings in each state in 1973-75. The results do suggest that states with new capital tend to have both more small firms and higher rates of bankruptcies during recessions. The simple correlation between the age of capital variable and bankruptcy is .49. That is, states with new capital experience higher rates of bankruptcy during recessions. The simple correlation between age of capital and the size of firms is -.52, indicating states with new capital tend to have smaller firms.

The insignificance of the coefficient on the age-of-capital stock variables for the pooled 1960-61 and 1969-70 recession can be explained by the mildness of these two recessions. If high rates of bankruptcies explain the negative relationship between age-of-capital stock and severity of state recessions, (or the positive sign between the age-of- capital variable and severity), then it is likely that most firms, independent of age and size, weathered the milder 1960-61 and 1969-70 downturns.

The insignificance of the 1960-61 and 1969-70 age coefficient, as well as those of the capital-labor ratio for the same period, suggest that there is a threshold effect. During a relatively mild recession, firms independent of size, age, and labor-intensiveness, are likely to survive through such mechanisms as extensions of credit or savings. Labor-intensive firms faced with disproportionate reductions in sales are able to reduce output to the appropriate level by building up inventories and reducing output without layoffs. These factors may explain why the age of capital stock as well as

capital-labor ratios have little influence on the severity of states' cycles during moderate national recessions.

The coefficients on unionization (U) are extremely stable across all recessions, and all five samples were pooled to estimate one coefficient. As expected, the coefficient is positive and statistically different from zero at the .01 level. The coefficient of .027 suggests that an increase in the proportion of the state labor force belonging to unions will lead to greater amplitude in the state's employment cycle. The evidence does indicate that at least part of the cross-state variation in employment cycles can be explained by the degree to which the labor force is unionized.

The coefficients on the peak-level unemployment rate (UE) are stable for the four recessions between 1956 and 1975. Consequently, this coefficient is estimated with data from all 4 recessions. The coefficient for the 1953-54 data is estimated individually. Contrary to the hypothesis, the coefficient on UE_{II-V} negative, -.24, and statistically significant at the .025 level. The coefficient on UE_I is not statistically different from zero.

The negative, statistically significant sign on UE_{II-V} is not readily explained by economic theory, but may be explained by misspecification of the model. The peak-level unemployment rate is hypothesized to explain the severity of the subsequent recession. It is, however, possible that the unemployment rate is not independent of the severity of the previous recession. For example, a state with cyclically volatile cycle may not fully recover from the last downturn before the peak-level unemployment rate is registered. If the next recession in the state is relatively mild, we might get a high rate of unemployment with a mild state recession.

The variable UE was dropped from the equation to determine whether this misspecification was distorting other coefficients. Eliminating UE made no

noteworthy changes in the magnitude or statistical significance of the remaining parameters.

The parameter on the ratio of average weekly unemployment insurance benefits to weekly wages (UI) is estimated with the pooled data, after determining that the coefficients are stable across recessions. As shown in Table 1 the pooled coefficient is positive and statistically significant at the .02 level.

There are two possible explanations for this result. First, the experience rating system, even though not fully rated, discourages layoffs. In order to avoid unemployment insurance taxes, firms prefer to hold on to employees during recessions. The greater the unemployment insurance benefits in a state, the higher the tax schedule, and the higher the schedule, the greater the incentive for firms to keep down their tax rating (Welch [1977]). However, a second explanation that is that at the macroeconomic level, unemployment insurance benefits act as a automatic stabilizer. The greater the benefits, the more stable a state's income level and the smaller the effects of the recession on the residentiary sector. This second explanation is consistent with the findings of Hamermesh [1972], Feldstein [1978], and Howland [1981] indicating that unemployment benefits encourage temporary layoffs at the firm or industry level.

The short-run multiplier is an average value for all states and it measures the impact of the severity of the to export sector recession, on the residentiary sector. The model estimates $\hat{m}$ to be approximately .4 and the coefficient is statistically significant at the 5 percent level. This result is consistent with theory as well as empirical evidence.

What proportion of the variation in states' recessions is explained by the model? To permit the calculation of an adjusted R^2, a constant is added

to the model. In addition, as equation including the constant and the expected recession:

$$\dot{E}_{jr} = \alpha + \hat{\dot{E}}_{jr} \qquad (11)$$

and an equation including a constant, the expected recession and the local component:

$$\dot{E}_{jr} = \alpha + \hat{\dot{E}}_{jr} + \hat{\dot{E}}_{jr} \quad (\beta_1 KL_{jr(t)} + \beta_2 A_{jr(t)} + \beta_3 U_{jr(t)} + \beta_4 UE_{jr(t)} + \beta_5 UI_{jr(t)}). \qquad (12)$$

are estimated to determine the extent to which the local component and the residentiary component, contribute to the model's explanatory power. The variables are the same as defined above, except

α = vector of 1's.

The results indicate that the national component or industry mix alone explains 36 percent of the variation in state cycles. The inclusion of the local component explains an additional 14 percent of the variation, while the addition of the residentiary sector in the form of the complete model or the simplified model contributes .00 to the R^2. The model, therefore, appears to explain 50 percent of the variation in the dependent variable. The unexplained variation may be due to the exclusion of the interregional transmission of cycles, to omitted variables variables, or to shortcomings in the basic non-basic breakdown. The unexplained variation may also be explained by heterogeneity within 2-digit SIC catagories.

To estimate how much variation in the dependent variable can be explained by heterogeneity within 2-digit SIC categories of the industry mix variable, the severity of the recession in the machinery and textile equations are regressed against a 3-digit industrial composition variable. The results suggest that the degree of heterogeneity depends upon the industry. For example, there appears to be a substantial degree of variation in SIC 35

(machinery manufacturing) explained by industry composition at the 3-digit level. The machinery equation suggests that 38 percent of the cross-state variation in employment fluctuations in SIC 35 can be explained by industry composition at the 3-digit SIC level. According to the findings from SIC 22, none of the cross-state variation in the textile recessions is explained by industry composition at the 3-digit level. These results suggest that if the industry mix or national component was calculated with a finer industry breakdown, the model would explain more of the regional variation in cyclical employment.

5. CONCLUSION

This study uses cross-section time-series data to test an export base model of regional employment cycles. The findings suggest that 36 percent of the cross-state variation in employment cycles can be explained by cross-state differences in industry mix. This study also found evidence that there are cross-state differences in several economic and institutional variables that influence the severity of state business cycles. Holding industry mix constant, states with high capital-labor ratios and an old capital stock, that are non-unionized and distribute high unemployment insurance benefits tend to be cyclically stable.

Appendix I

Data Sources

Severity of recession (E), Percentage deviation of seasonally adjusted data from a five-year moving average of the data at the trough of the recession, calculated from the Bureau of Labor Statistics' monthly non-agricultural employment data.

States' industry composition weights (w), Census of Manufactures and Annual Survey of Manufactures.

States's capital stock (K), Estimated with the perpetual inventory method and base year book values of depreciable assets from the Annual Survey of Manufactures, Special Geographical Supplement to 1962-64 Data on Book Value of Fixed Assets and Rental Payments for Buildings and Equipment, 1972; an investment series taken from the Census of Manufactures and the Annual Survey of Manufactures; and an implied depreciation rate calculated from two years of book values of depreciable assets and intervening years of investment.

States's manufacturing employment (L), Census of Manufactures and the Annual Survey of Manufactures.

Age of states's capital stock (A), Census of Manufactures and Annual Survey of Manufactures.

States' proportion of manufacturing employees belonging to unions (U), Statistical Abstract, 1957 and 1962 and the Directory of National and International Labor Unions in the U.S., 1969 and 1973.

States' average weekly unemployment insurance benefits (UI), Handbook of Unemployment Insurance, Financial Data, 1938-76.

States' unemployment rates (UE), Manpower Report of the President, 1964 and 1973.

States' bankruptcy rates, U.S. Courts data base.

Number of firms with 20 or more employees, Census of Manufacturers, 1972

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