Regional Variations in Cyclical Employment

by

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ABSTRACT

There are wide variations in the manner in which states experience national recessions. This thesis develops an empirically based model to explain these cross-state variations in cyclical behavior.

The model explains a state cycle in two sectors, an export industry and a residentiary sector. The export sector proposes that a state's recession can be explained by national demand for a state's exports as well as five state-specific economic and institutional factors. The cycle in the residentiary sector is explained as a function of the fluctuation in the state's export sector.

The model is tested on data from five post World War II recessions between 1950 and 1975 and forty-seven states. This analysis is carried out at the all-industry level. A model similar in form but different in theoretical implications is used to test data on the machinery and textile industries, at the 2-digit manufacturing level.

The findings suggest that the industry mix of a state's exports, the state's capital-labor ratio, the age of its capital stock, the level of its unemployment insurance benefits, the extent of unionization of its labor force, and a short-run export-base multiplier all influence the severity of a state recession.

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Table of Contents

Table of Contents (continued)

Table of Contents (continued)

Table of Contents (continued)

List of Tables

List of Tables (continued)

List of Figures

CHAPTER 1

INTRODUCTION

There are substantial differences in the severity with which regions experience national recessions. Some regions have tended to experience severe and prolonged downturns, while other areas have been by-passed by national recessions altogether. The purpose of this thesis is to identify the economic and institutional factors that explain the differences in regional responses to national cyclical employment. The approach is largely empirical, using data at the state level for five recessions.

The extent of cross-regional differences in cyclical behavior can be seen in Table 1.1. When the United States is divided into nine census regions, and the trend-adjusted severity of each region's recessions is calculated, there are observable variations in regional recessions. For example, during the 1953-54 recession the nation experienced a 2.67 percent deviation in employment from the long-term growth trend. During this recession the East North Central states experienced a 3.8 percent decline in employment, while the West North Central states experienced a decline of only 1.3 percent. As can be seen from Table 1.1, such deviations are clearly the pattern for all five recessions of the 1950's, 1960's and early 1970's. It is the purpose of this thesis to explain these cross-regional differences in the severity of recessions.

There are several reasons for attempting to determine the factors that give rise to spatial differences in the business cycle. First, the study of regions may shed light on national economic relationships.

Table 1.1

Trend Adjusted Severity
of
Regional Recessions
(Percentages)

Year	I Severity of the National Recession	II Severity in the Most Strongly Hit Region	III Severity in the Least Strongly Hit Region	IV Standard Deviation
1953-54	2.67	3.83 (East North Central)	1.27 (West North Central)	.721
1957-58	2.37	3.34 (Pacific)	.91 (West North Central)	.678
1960-61	1.60	2.53 (East North Central)	.93 (New England)	.435
1969-70	1.32	1.90 (East North Central)	.88 (Pacific)	.674
1973-75	2.10	3.28 (East North Central)	1.29 (Mid Atlantic)	1.704

Source: Calculated from quarterly, regional data obtained from Data Resources, Inc.

Because of the high personal and social costs of unvoluntary unemployment, the maintenance of full employment has been a national priority since 1946. Extensive research efforts have been devoted to identifying reasons for cyclical unemployment and many of the findings have informed federal stabilization programs. The study of business cycles at the regional level may contribute to our understanding of national business cycles by providing a new perspective and insights that are overlooked in national time series data.

Studying the business cycle at the state level, we obtain fifty observations at one point in time, holding political and economic institutions constant. Factors that are found to aggravate or stifle the amplitude of the cycle in this cross-regional analysis may be extrapolated to national phenomenon.

A second reason for studying regional business cycles is based on a concern for regional equity in national policy. By identifying economic and institutional variables that aggravate or dampen state's employment cycles, it may be possible to anticipate a regional economy's response to the national cycle. This information could, in turn, be used by government in designing regional countercyclic employment programs and in incorporating regional considerations into monetary and fiscal policies. The Economic Development Administration has already demonstrated an interest in using countercyclic public works investments as one method of regional economic stabilization policy. For example, in response to the 1970 recession, Congress allocated $92 million to accelerate public works construction (Vernez et. al., 1977: v). The effectiveness of such programs would be greatly enhanced if policy makers were able to predict the length, timing, and severity of the regional fluctuations that accompany national cyclic changes.

This study will also shed light on the regional impact of national monetary and fiscal policies and provides information that may be useful for national macroeconomic stabilization policy making. For example, monetary policy, which tightens the money supply to put a rein on inflation, probably differs in its regional impact. We should know the answers to such questions as which regions respond more quickly and dramatically and why; and do some states bear a disproportionate burden of the nation's economic stabilization policy? While it is widely believed that federal government policies should be relatively equitable in their regional impact, there has been little work done on the extent to which the effects of monetary and fiscal stabilization policy are evenly distributed across regions.

There are two bodies of literature that have developed peripherally to the subject and approach of this thesis. The main focus of the business cycle theorists in the post-Keynesian period has been on the taming of the short-run cycle. Adherents to this body of thought assumed the causes of the cycle were no longer relevant because, through the fine tuning of monetary and fiscal policy, cyclical fluctuations could be eliminated. It has only been more recently, with the advent of the supply-side shocks and the growth of the Monetarist school that economists have started returning to the exploration of institutional and economic causes of instability (Lucas, 1976). The emphasis, however, has been on the cycles of national economies.

A second body of literature, which also bears on this thesis, belongs to the field of regional economics. In contrast to macro-economists, regional economists have focused almost exclusively on long-run regional growth and long-term regional inequalities, and have ignored cross-regional differences in short-run fluctuations.

The theory and empirical evidence laid out in the chapters that follow is an attempt to bridge the gap between research on business cycles at the national level and economic growth at the at the regional level. This thesis is similar to current research on national busisness cycles in that it seeks to find economic and institutional variables that influence cyclical activity. At the same time, it draws on the work of regional economists by, for example, relying on export-base theory, a theory developed to explain regional growth.

More specifically, this study is the first to test whether local economic and institutional factors influence the severity of regional recessions. Many authors (Borts, 1960; Browne, 1978) have studied the degree to which cross-state differences in regional cycles can be explained by cross-state differences in industry mix. These as well as other authors concur, industrial composition explains some but not all of the cyclical variability of a state's employment. This thesis proposes that and tests the extent to which such factors as a state's capital-labor ratio, age of its capital stock, unionization of its labor force, the level of its unemployment insurance benefits, its peak-year unemployment rate, and a multiplier influence the state's cyclical behavior.

Not only does this thesis contribute to the literature by identifying variables other than industry mix to explain cross-state variations in cyclical employment, but these variables are framed and tested, for the first time, in a broader theoretical context. Earlier empirical studies have proposed that state cycles are explained largely by fluctuations in national industries, appropriately weighted by a state's industry mix. These studies have either run simple correlations between an expected recession based on industry composition and the actual severity of a state's cycle; or they have regressed the later variable on the first. This study frames the question in a theoretical context. Both the theory and empirical test are structured by an export-base model. A state's cycle in this model is determined by national demand for the composite of state exports, the effect of the local institutional and economic factors described above on variability in exports, and fluctuations in a residentiary sector of the economy. The severity of the cycle in the residentiary sector is a function of the cycle in the export sector. Before presenting the theory, model and empirical findings in detail, we review the causes and characteristics of the five national recessions which served as the study's foundation.

National Business Cycles

Before introducing the topics of each chapter in more detail, we begin by reviewing the definition and measurements of business cycles and recessions, in general, and the timing and causes of the recessions between 1950 and 1975. The five recessions falling between 1950 and 1975 are the basis for the empirical work of this study.

Business cycles are recurrent sequences of expansions and contractions in economic activity. These movements in aggregate economic activity are clearly observable in the major series measuring economic activity, such as GNP, employment, investment, etc. Business cycles are irregular in appearance, that is, they vary in duration, amplitude and scope, and they are widely diffused throughout the economy. A business cycle can be divided into four parts, including an expansion, a peak, a contraction, and a trough which is followed by another expansionary phase. The full cycle, whether measured from peak to peak or trough to trough, has been defined by the National Bureau of Economic Research (NBER) as having a duration of at least fifteen months. The expansionary or contractionary phase of the cycle must have, by NBER definition, a duration of at least five months. The minimum duration allows a period sufficiently long for cumulative movements in economic activity to develop in both downward and upward directions (Handbook of Cyclical Indicators, 1977: 170-172).

The NBER analyzes a large collection of time series in assessing the phases of the business cycle. While the actual measurement of historical and current cycles is complex, the basic appraoch can be summarized by considering the division of the time series into three categories, leading, coincident and lagging, indicators. As the names imply, these groups of indicators precede, coincide, or lag behind the movement of the business cycle, respectively. Leading indicators include an index of stock prices, new orders of consumer goods and materials, contracts and orders for plant and equipment, etc. Coincident indicators include the index of industrial production; personal income; and the indicator used in this thesis, the number of employees on non-agricultural payrolls. Principal lagging indicators are the duration of unemployment, manufacturing and trade inventories, and commercial and industrial loans outstanding.

The NBER has identified five contractionary or recessionary phases of the cycle between 1950 and 1975. The general timing of these recessions was adopted for this study. They are:

Recession	Date of Peak	Date of Trough
I	7/53	5/54
II	8/57	4/58
III	4/60	2/61
IV	12/69	11/70
V	11/73	3/75

Source: (Handbook of Cyclical Indicators, 1977: 198).

The five recessions between 1950 and 1975 were varied in their origins and characteristics. The two earliest recessions were caused by inventory overinvestment and military cutbacks. The 1960-61 and 1969-70 recessions originated from tight monetary policy, and the 1973-75 recession was brought on by inventory overinvestment and dramatic increases in world oil prices. The recessions were also varied in their severity. The 1953-54, 1957-58 and 1973-75 recessions were relatively severe by post World War II standards. The 1960-61 and 1969-70 recessions were brief and mild. The sectoral impact of each recession was also different.

For example the construction industry was resilient in the first two recessions, and cyclically sensitive in the last three recessions. By way of background to the empirical work that follows, the severity of each recession, the impetus for the downturn, and the cyclically immune and hardest hit sectors will be briefly identified for each recession.

The 1953-1954-Downturn

The 1953-54 recession was due primarily to inventory overinvestment and a decline in military expenditures. In the early 1950's, United States military expenditures for the Korean War effort increased rapidly. In anticipation of rising prices and shortages, consumers also increased their purchases sharply. This increased aggregate demand led to the economic expansion of 1950 and 1952. Federal expenditures for new goods and services doubled, from $20.9 billion to an annual rate of $47.2 billion between the fourth quarter (IV) of 1950 and 1951 IV (Handbook of Cyclic Indicators, 1977: 156). Personal consumption expenditures in current dollars rose during the same period, late 1950 to mid-1953, from $209.9 to $234.3 billion (Handbook of Cyclic Indicators, 1977: 151). The expansion was extended after the 1952 steel strike. Private sector demand, especially for durable goods, was strong as firms attempted to replenish inventories depleted during the strike.

As military expenditures began to level off in late 1952, deferred civilian consumption for consumer durables resumed. After a year and a half of restraint in purchases, consumers stepped up their buying of consumer durables. However, retail sales began to level off in the first half of 1953, and consumption expenditures shifted from the purchase of durables to that of services and nondurables. With the leveling off of retail sales, output levels attained in 1952 and early 1953 could not be sustained. The production levels in this period were geared to meeting the increases in consumer demand, and expectation of expansions in further demand, and replenishments after the 1952 steel strike. When this demand for consumer durables was not realized, inventories became excessive, and overstocks of inventories led to declines in output and employment.

The 1953-54 recession would probably have been a mild inventory recession had it not coincided with the wind down of the Korean War and the decline in defense expenditures. The cutbacks in military spending aggravated the problem of already excessive inventories.

Another factor that may have contributed to the 1953-54 downturn was a restrictive monetary policy. In an accord between the Federal Reserve Bank (FED) and the United States Treasury, in March 1951, the Fed again acquired the right to pursue an active and independent monetary policy. Until June of 1953, the Fed exercised this right by tightening credit. When it became clear in mid-1953 that the economy was slowing down, the Fed reversed its tight monetary policy and credit conditions eased. The Fed's tight monetary policy was less to blame for the recession than overstocked inventories and retrenchment from the Korean War.

Throughout this downturn several sectors of the economy remained vigorous. The severity of the recession was dampened by a strong demand for residential and non-residential construction, and by state and local governments throughout the recession. Residential and nonresidential construction tended to behave countercyclically because falling interest rates that accompanied the downturn eased mortgage credit and stimulated the construction industry. Population growth also encouraged demand for housing. Expenditures by state and local governments remained strong throughout the recessionary phase of the cycle, because again low interest rates along with a strong market for state and local bonds allowed states and localities to meet the tremendous demand for schools for children of the post-War baby boom, and for roads, streets, and public services for the expanding suburbs.

The 1953-55 recession lasted thirteen months. Throughout that period industrial production fell 10 percent, real GNP fell 3.3 percent (McNees, 1978: 45), and unemployment rose from 2.5 percent to 6 percent. As in all post World War II recessions, prices were resistent to downward pressure.

The 1957-1958 Contraction

The 1957-58 contraction was also brought on by inventory over-investment and cutbacks in military spending. According to the NBER, the 1957-58 recession lasted nine months, from the peak in August 1957 to the trough in April 1958. The contraction was concentrated in investment goods and consumer durables, and because demand for consumer nondurables and construction remained strong throughout the period, the recession was relatively brief and mild.

As the economy moved toward the 1957 peak, production levels and profits began to stabilize, and signs of declining demand for business investment and consumer durable purchases were beginning to materialize This slowdown in investment coincided with announced reductions in defense awards and military procurements.

Contractions in investment took place in manufacturing, mining, and transportation industries, the same major industry divisions where sales and profits had weakened a few months earlier. Within manufacturing there were more severe cuts in outlays for durable goods than for nondurable purchases, a pattern that was in contrast to previous recessions where nondurable and durable goods had moved concurrently. Nearly every manufacturing industry experienced this pattern in the 1957-58 recession (Osborne, 1958: 11).

Reductions in consumer spending for durable goods was concentrated in the auto market and was the principal factor in a $6.5 billion decline in the annual rate of automotive gross product -- a measure of total U.S. output attributed to auto sales (Osborne, 1958: 12). Sales also fell off for furniture and appliances; however, cutbacks were not as marked in these industries as was the decline in demand for autos.

Stability and even growth in consumer nondurables, residential construction, and state and local governments moderated the effects of the downturn. Due, in part, to automatic stabilizers, such as unemployment insurance, transfer payments, corporate dividends, etc., declines in disposable income were a small 3 percent (Osborne, 1958: 12).

Residential construction was also relatively strong throughout 1958. With low interest rates and the easing of eligibility requirements for VA and FHA loans residential construction expanded throughout that year. In July of 1957, private annual housing starts totaled 1,191 and they increased every year throughout the recession, with annual housing starts equaling 1,598 in December of 1958 (Handbook of Cyclical Indicators, 1977: 85).

State and local government expenditures continued to grow throughout the recession. From $36.7 billion in 1957 II, state and local expenditures increased to $42.7 billion in 1958 IV (Handbook of Cyclical Indicators, 1977: 156). As in the case of the 1953-54 recession, the strength in this sector can be attributed to low interest rates, strength in municipal and state bond markets, and a seemingly insatiable demand for schools, roads, and infrastructure (Osborne, 1958: 9-17; Moore, 1959: 292-308; and Gordon, 1974: 124-126).

The 1960-1961 Recession

The 1960-1961 contraction was mild and brief, lasting from April 1960 to February 1961. Gross National Product (GNP) fell, in real terms, by only 1.5 percent, and unemployment rose from 5 to 7 percent.

At least in part, this recession can be attributed to the Fed's excessively tight credit policy during 1958 and 1959. This Fed policy was later reversed but not before the economy began to experience slow-downs in several sectors. As in the earlier recessions the major portion of the loss in GNP was centered in producer durables and consumer durables. Gross output of consumer durables fell by 9.1 percent, and producer durables fell by 11.5 percent. In contrast to earlier recessions residential construction also fell by 6.1 percent (Gordon, 1974: 132). Automatic stabilizers, especially corporate dividends, bolstered disposable income throughout the contraction; consequently, income and consumer nondurable purchases were stable.

Federal expenditures began to rise rapidly in early 1961, as the federal budget moved from a $7 billion surplus in the last 1960's to about a $5 billion dollar deficit in 1961 I. A turnaround in inventory investment in conjunction with expansionary monetary and fiscal policy provided the basis for an economic recovery and the beginning of an economic upswing that was to last throughout the 1960's (Gordon, 1974: 131-133).

The 1969-70 Contraction

The downswing lasting from December 1969 to November 1970 was a "policy recession." In an attempt to slow the accelerating inflation of the late 1960's, the Federal Reserve authorities began to tighten credit in 1968. By increasing reserve requirements and the discount rate and contracting the money supply through open market operations, interest rates were driven up to levels "not reached in a century" and the growth of the money supply was curtailed from an annual rate of 7.5 percent in 1968 IV to about 1.5 percent in 1969 IV (Gordon, 1974: 170).

Fiscal policy, working in harmony with monetary policy, was also contractionary. In real 1972 dollars, Federal purchases of goods and services declined from $260.9 billion in the third quarter of 1968 to $249.2 billion in the second quarter of 1970 (Handbook of Cyclical Indicators, 1977: 156).

Business expenditures on plant and equipment were relatively resilient. Purchases of plant and equipment increased slightly, in constant dollars, from $77.8 billion in 1969 III to $81.9 billion in 1970 III, but then declined to $78.63 billion in 1970 IV before expanding again. The General Motors strike caused the slowdown in the last quarter of 1970, and without it the recovery would have probably occurred several months earlier (Gordon, 1974: 171).

As in the earlier recessions the largest losses to GNP were felt in consumer durables, which fell by 9.6 percent and in investment in inventories, which fell by 49.7 percent in real 1958 dollars (Gordon, 1974: 161). Disposable income was, as in the previous four recessions, stable. However, consumption of nondurables appears to have been more sensitive than history would have predicted. The personal savings rate increased sharply from about 6.5 percent in the second half of 1969 to over 8 percent in the second half of 1970.

With the end of the strike and expansionary monetary and fiscal policy and economy began its recovery. During the 1969-70 recession unemployment had climbed from 3.5 percent in December 1969 to 6.1 percent in December 1970 (Gordon, 1974: 170-173).

The 1973-1975 Recession

In terms of GNP, the 1973-75 recession was the most severe of the post war period. As shown in Table 1.2 GNP growth rates fell to -7.5 in 1974 IV and then to -9.2 in early 1975 (Dornbusch and Fischer, 1978: 535-36). From peak to trough, real GNP dropped 5.9 percent, nearly twice as much as the largest previous post-war decline of 3.3 percent in 1953-54 (McNees, 1978: 45).

Table 1.2

Growth Rates of Quarterly Real GNP, and Unemployment Rate, 1973-1975

	1973				1974				1975	
	I	II	III	IV	I	II	III	IV	I	II
Growth rate of real GNP	8.8	0.2	2.7	1.4	-3.9	-3.7	-2.3	-7.5	-9.2	3.3
Unemployment rate*	4.9	4.8	4.8	4.9	5.0	5.3	5.9	7.2	8.5	8.7

* Last month of quarter.

Source: Economic Report of the President 1975, 1976.

It is clear in retrospect that the U.S. economy was heading for a downturn prior to the oil embargo. As shown in Table 1.2 GNP growth rates had begun to fall prior to the end of 1973. This slowdown may have been in part due to contractionary monetary and fiscal policies designed to curb inflation; high food prices, caused by the shortfall in world grain production in 1972; and increased costs of imports due to the depreciating dollar. The quadrupling of oil prices at the end of 1973 and increases in agricultural prices in mid-1974 explain the sharper declines in GNP, as well as the increase in unemployment from 4.9 in 1973 IV to 8.7 in 1975 II, shown in Table 1.2.

In large part, the fall in the GNP growth rate from 1973 I to 1973 II was attributable to declines in residential investment and consumer spending. Residential investment fell as a result of the high interest rates. The treasury bill rate had gone from 5.6 percent in 1973 I to 7.5 percent in 1973 IV (Dornbusch and Fischer, 1978: 537). Consumption expenditures, especially for durables, also fell. From 1973 I to 1973 III personal consumption expenditures on durable goods fell from $124.9 billion to $121.2 billion. During that same period demand for services increased, while demand for consumer nondurables stabilized. These figures and observations are all based on 1972 dollars (Handbook of Cyclical Indicators, 1977: 151-153).

During the most acute phase of the recession the major sources of reduced demand were, as in 1973, residential construction, inventory investment, and consumer demand. Residential construction fell from $64.5 billion to $33.6 billion from 1973 I to 1975 I. This was equivalent to 45% of the decline in GNP during that period. Inventory investment fell from $11.9 billion to $9.0 billion in the same period and durable goods purchases by consumers fell from $124.0 billion in 1973 I to $104 billion in 1975 I. The decline in consumer durable purchases was concentrated in the auto industry (Dornbusch and Fischer, 1978: 538-540).

The path of non-agricultural employment did not track the path of real GNP throughout the recession. Despite the severity of the drop in output, employment declined by only 1.3 percent. This was a smaller decline in employment than any of the post World War II recessions, except the very mild 1969-70 recession. The slow growth in employment during the recovery suggests that labor hoarding during the recession explains the relatively mild employment decline (McNees, 1978: 53).

Data from these five recessions provide the empirical base for the model tested in this thesis. The five recessions differed in their origins, severity, and sectoral impact. The 1953-54 and 1957-58 recessions are explained by overinvestment and cutbacks in military spending. Two recessions, the 1960-61 and 1969-70 recessions, were due primarily to a tight monetary policy on the part of the Fed while the 1973-75 recession is attributed primarily to shortages and price increases in essential commodities. These differences, as well as other major differences in sectoral impact, and severity, test whether the model laid out in Chapter Three is a general one. Can it explain cross-state differences in cyclical employment independent of the recession's particular characteristics?

Concept of a Region

Before proceeding to outline the remaining six chapters, one additional introductory topic should be mentioned, if only briefly. Most regional economics theses begin with an acknowledgement of the ambiguities inherent in defining a region. A region is, in some sense, an artificial subdivision of the national economy.

For the purposes of this study, the more homogeneous the industrial composition, the production process, the institutional setting, and the labor market, the more appropriate the region is for testing the model presented herein. Greater homogeneity within regions means that there will be a more precise measure of the variables. For example, one variable measures the age of a state's capital stock. This variable is actually the age of all the capital stocks of all manufacturing firms in a state. The more similar the age of each firms' capital stock to the mean state value the more precisely the age variable will be calculated. On the other hand the greater the differences in values across states, the greater the variance in the independent variable and the better an econometric model will test the hypotheses proposed in this thesis. Thus, the ideal region would maximize homogeneity within a region and maximize heterogeneity across regions.

However, all such discussions about the appropriate delineation of a region is limited by the availability of data. The data needed to test the hypotheses proposed in Chapter Three are spatially disaggregated in public documents only to the state level, and not to smaller regional units. A regional division by state is thought to be adequate for the following reasons.

Two of the variables to be tested, including unionization and unemployment insurance benefits, are influenced by state laws and regulations. Thus we would expect unemployment insurance benefits to be almost always uniform within state boundaries and union practices to be similar within state boundaries. For example, right-to-work laws influencing union practices, are instituted and enforced by state government.

The smaller the regional unit the more precisely three additional variables—the industrial composition, age-of-the-capital stock, and capital-labor ratios—will be measured. The best measure for unemployment rates would be labor markets, which are approximated but not alwasy adequately specified by state boundaries. The smallest spatial unit, given the available data, is the preferable regional breakdown. For this study that breakdown is the state level.

Outline of the Study

The purpose of this thesis is to determine why recessions have had a differential impact on state economies. Chapter Two of the thesis reviews two sets of previous research that bear on the topic. First business-cycle theories are examined, and secondly, several models of regional business cycles are considered.

Chapter Three presents the theory and empirical model. This chapter lays out hypotheses explaining regional differences in the employment cycle during recessions. These hypotheses propose that cross-state differences in business cycles occur because of differences in industry composition, production processes and labor market characteristics.

The model designed to test the hypotheses is econometric and relies on data for 48 states and five recessions.

Chapter Four describes the data. It addresses its sources as well as the transformation of the original data into variables needed to test the model formulated in Chapter Three.

Chapter Five presents empirical regularities; this chapter addresses such questions as which regions are most cyclically sensitive and which are most stable? Are the same states consistently stable or volatile over time? Are the variables calculated to test the model consistent with data on regional economic trends, and are state cycles becoming more alike with time?

Chapter Six presents the estimations of the model. Here we examine the findings which support, contradict and do not support the original hypotheses. The conclusions, policy implications and directions for further work are laid out in the final Chapter Seven.

CHAPTER 2

LITERATURE REVIEW

Much of the literature relevant to business cycles in general and regional fluctuations in particular has been woven into Chapters Three, Four, Five and Six. However, there are two sets of literature which are not covered, yet provide background and context to this thesis, and, consequently, are important to review. One set of literature covers the theoretical research into the origins and protraction of the business cycle, while the second set focuses on modeling regional cyclic behavior. These two areas of research will be summarized in this chapter. The first section reviews business-cycle theory, the second considers several regional business-cycle models, and the third compares and contrasts the findings of the regional models as they relate to the framing of the problem in this thesis.

Business-Cycle Theory

While there are many permutations, refinements, and extensions of business-cycle theories, they can be broadly divided into two categories: the accelerator-multiplier theory and the monetarist theory. It is not the purpose of this section to recount these theories in detail. That topic would not only be a thesis in and of itself, but it has been explored before, for example, see Haberler (1964) Depressions and Prosperity. Rather it is the intention of this section to give a brief introduction to the two, broadly defined schools of business cycle theories and then to draw several conclusions that shed light on regional differences in cyclical amplitude.

Accelerator-Multiplier Theory

The best articulated theory of business-cycles is that which relies on the accelerator and the multiplier. This theory was formalized by Paul Samuelson (1939) and extended by many others (Hicks, 1950; Goodwin, 1951).

According to the accelerator theory, investment occurs in order to enlarge the capital stock which must be increased to meet rising output levels. The magnitude of the increase in investment under these circumstances depends upon the capital-output ratio, that is, how much additional capital is needed to produce the required output levels.

The accelerator theory combined with the multiplier lays out a relationship where a rise (or fall) in autonomous investment brings about an increase (or decrease) in the level of income in the next period, through the Keynesian multiplier. Increases in income lead to increases in consumption. Producers meet this new demand for goods by adding to their capital stock, which in turns stimulates demand in investment-goods industries. As output and purchases of capital goods rise, incomes rise, generating increases in consumption and the process continues. The result is a cyclical path of income and an even more volatile path of investment.

Samuelson's (1939) mathematical formulation of the accelerator-multiplier principle can be summarized with the following equation:

$$Y_t = C_a + cY_{t-1} + I_a + \omega(C_t - C_{t-1}) \qquad (2\text{-}1)$$

This equation states that aggregate income and output in any period equals the sum of autonomous consumption (C_a) and autonomous investment (I_a) plus an additional amount of consumption that depends on the marginal propensity to consume (c) times the income of the preceding period and an additional amount of investment that depends on the accelerator (ω) times the difference between consumption in the current period and the previous period. The accelerator, ω, is equivalent to the capital-output ratio. It can easily be shown, using a simple numerical example, that a one time rise in I_a to a higher, but constant, value will lead to a series of self-generating cyclical fluctuations.

Whether this cyclical process dampens or explodes depends upon the different combinations of values for c and ω. The various types of movements that result from the multiplier-accelerator interaction have been the basis for the formation of two groups of business cycle theorists. Hicks (1950) and Goodwin (1951) claimed that the cycles are explosive, but bounded by a "ceiling" and "floor " while Frisch (1966) and Hansen were proponents of the weak accelerator theory. Hansen's view was that through the accelerator-multiplier interaction, a shock to the economic system results in an increasingly mild cycle and than a new equilibrium (Shapiro, 1974: 363). The economists that argue this position explain history's pattern of continuous cyclical fluctuations in terms of continuous shocks to the system. Frequent shocks, generated by inventions, population growth, and exploitation of frontiers keep the system in motion and prevent its settling down into equilibrium.

Hicks (1950), on the other hand, described cycles as oscillating around a Harrod-Domar growth trend. An upward divergence from the trend is bounded by full employment and resource capacity constants, while the downward divergence from the growth trend is halted by the underlying secular growth rate of the economy. Thus when the economy hits full employment, the rate of growth in output falls, investment falls even more severely, and income falls, etc. At some point, the increase in investment induced by the underlying growth trend reverses the direction of the cycle (Shapiro, 1974: 363-367).

Whether the cycles produced by the accelerator-multiplier model are explosive or deadened with time depends, as stated above, on the values of the multiplier and the accelerator. A relatively low multiplier (e.g., 2.5) and high accelerator (e.g., 5) or a high multiplier (e.g., 10) and a low accelerator (e.g., 2.5) will produce explosive cycles. Similarly, both a low accelerator and multiplier will produce dampened cycles (Shapiro, 1974: 360-361).

A notable characteristic of the business cycle that is important for understanding regional business cycles is the highly volatile nature of durable goods. The empirically observed volatility of the producer goods industries is consistent with the accelerator-multiplier theory. Fluctuations in output should be greatest in those stages of production furthest from consumption. If replacement demand for capital goods is constant, then demand for durable goods changes with the <u>rate</u> of change in final demand not with the absolute change in final demand (Haberler, 1964: 85-94). Therefore, during the boom or expansionary phase of the cycle when the <u>rate</u> of output is growing, capital is added to the current stock, and growth in investment goods production is strong. During the downturn when the rate of increase is zero or negative, a sufficient or excess capital stock capacity discourages all new investment and causes a precipitous drop in demand for producer goods.

Among the theorists that have addressed the issue of business-cycles, there are differences in opinion about the impetus to upswings and downturns. Theories about the initiatives of expansion are that an increase in final demand results from expansionary monetary policy or the shift from one commodity to another. The shift in demand from one commodity to another stimulates investment in industries producing the now popular good (Haberler, 1964: 98-105). Another set of theories explain the origin of the expansionary phase of the cycle as beginning not with final demand, but investment. An autonomous jump in investment increases incomes, consumption, further investment, etc. These theories attribute the initial increase in investment to profitable opportunities brought in by monetary policy or technological change (Haberler, 1964: 72-84).

The turning at the peak of the cycle is also addressed by several theorists. First, the contractionary phase of the cycle can be brought on by a tightening of credit, which increases interest rates, reducing investment, income, etc. (Haberler, 1964: 20-21). A second theory is that the contraction is brought on when the round-about process of production is complete, that is, capital goods are finally in place, and then they begin to produce consumer goods. Investment demand falls, followed by a decline in incomes, consumption etc. (Haberler, 1964: 103). A third theory blames the downturn on underconsumption. Savings rates that are too high result in sufficient aggregate demand. The high savings rate is primarily blamed on an unequal income distribution which worsened during the previous expansion (Haberler, 1964: 122-123). Finally, a fourth theory blames the contraction on the breakdown of capital investment due to overinvestment during the expansion. This overinvestment during the expansion may have been caused by interest rates that were too low or an actual rate of interest that was below the "natural" rate (Haberler, 1964: 45-49). Once the upturn or downswing is generated, the momentum of the cycle is created through the accelerator-multiplier interaction.

The proponents of the accelerator-multiplier theory integrate both monetary and non-monetary phenomenon into their explanations of the business-cycle. In contrast, monetarists propose that changes in the flow of money are the sole and sufficient cause of economic fluctuations. This monetarist view, as advocated by current day as well as early economists will be briefly set forth in the next section.

Monetarist Theory of Business Cycles

The monetary theory of business cycles argues that changes in the flow of money are the only causes of economic fluctuations. The monetary theory of business cycles is set out by R.G. Hawtrey, Wicksell, Hayes, and more recently, by Friedman and Schwarz, and Lucas.

The monetarist view as presented by Robert Lucas (1975 and 1976) is that cyclical fluctuations in employment and output are caused by changes in prices. Fluctuations in prices, in turn, are brought about by movements in the quantity of money. Consider a single entrepreneur. An economic agent faced with a change in the selling price of his product is uncertain as to whether the observed price increase is permanent or temporary. If the producer believes the price increase to be a permanent change in the selling price, labor supply and thus employment will fall. This conclusion is based on the assumption that real wages remain constant and the empirical evidence that labor-supply elasticities are negative or zero.

If, at the opposite extreme, the price change is viewed by the economic agent as transitory, the employment and output response to an observed increase in price depends upon the rate at which the producer is willing to substitute labor today for labor tomorrow. If leisure is highly substitutable over time, and empirical evidence by Ghez and Becker (1974) suggest it is, the agent will work longer on high price days and close early on low price days. On the basis of this argument employment should be highly elastic in response to transitory price changes, a result consistent with observed co-movements of prices and employment.

Economic agents also make investment decisions based on observed prices. If a price increase is viewed as transitory and the current capital stock is satisfactory for current output levels, then the rational producer will not acquire additional capital which will raise his output-per-hour in future periods. By the time the new capital is in place, the price movements that made it appear profitable will have vanished. On the other hand a price change that is perceived as a permanent change in a relative price will have the maximum impact on capital accumulation and, therefore, output.

To arrive at the empirically consistent result of price movements coinciding with employment and output levels, it must be the case that the producer facing uncertain price movements perceives them to be a mix of transitory and permanent elements. The transitory component of price leads to increases in employment, whereas it is the permanent component of the price increase that leads to increases in investment and output.

> To recapitulate, our hypothetical producer is taken to face stochastic price variability, which is describable as a mix of transitory and permanent components, both unobserved . . . . Under assumptions consistent with rational behavior and available evidence, his response to an unforeseen price increase is a sizeable increase in labor supplies, a decline in finished inventory, and an expansion in productive capital accumulation of all kinds. Thus behavior is symmetric; the responses to price decreases are the opposite. (Lucas, 1976: 19)

For the same reason that a producer faced with a change in the selling price of her product finds it difficult to decide whether the change is permanent or temporary, she finds it difficult to tell whether the price change represents a change in relative or general prices. A change in relative prices signals increasing demand for the product and the producer will want to respond by increasing employment, investment and output. If the price change is only part of a general rise in the price level, output expansion is unwarranted.

In the initial stages of a general price rise, many economic decision makers will mistakenly perceive the price changes as relative, and a sign of expanding demand. Many producers will also perceive the price changes to be a mix of transitory and permanent price movements. The net effect will be an expansion in employment, output, and investment along with prices, just as observed over the business cycles. Thus this theory depends crucially on economic agent's confusion between relative and general, and transitory and permanent price movements.

The monetarist explanation of the cyclically sensitive nature of the durable goods industry also depends upon the generally risky and uncertain situation faced by economic actors. For individual investment projects, rates of return are highly variable. A quick response to what may be a weak signal is often the key to a successful investment. An agent who waits until the situation is clear may lose the chance to supply the perceived increase in demand. As many economic agents confuse a general price rise for a change in relative prices favoring their product, high amplitude changes in investment will be observed.

The economic downturn is automatically built into the expansion. When producers begin to recognize the price rises as general inflation rather than a relative change in prices for their products, they will adjust capital capacities downwards. Misperceived signals lead to overinvestment which must be compensated for by underinvestment in the next period, causing the downturn in the cycle.

The Austrian or "monetary-overinvestment" theorists, such Hayek and Machlup, also base their argument on a mistaken investment decision caused by a misreading of price changes. The difference between the monetary overinvestment theorists and the new monetarists appears to be that the first group concentrates on interest rates rather than product selling price as the misread signal which causes the business cycle.

The overinvestment theorists introduce a natural or equilibrium rate of interest. The natural market rate of interest is defined as that rate at which the demand for loan capital just equals the supply of savings. A contraction of the money supply pushes the actual interest rate above the natural market interest rate, demand for credit will fall, some savings will not be used and deflation will follow. If the actual interest rate is lower than the natural rate, capital appears artificially cheap and the production process "elongates" due to the shifting of resources from the production of consumer goods to production goods. Prices in the consumption goods industries rise faster than real incomes and demand for these products fall. The structure of the economy has become "top heavy" with an over-production in capital goods industries and falling purchases of consumer goods. The capital goods industry is most severely hit as the economy readjusts to the proper balance between investment and consumer goods.

To summarize, the argument for an expansionary phase of the cycle is as follows. An over extension in the money supply drives actual interest rates below the natural rate of interest. The artificial lowering of the interest rate lures economic actors into over investing. Only when expansion credit halts will the economy be unable to sustain the "top heavy" or capital goods heavy production process, and a recession will ensue. Capital projects remain idle as the capital stock is over-sized for meeting consumer demand (Haberler, 1964: 33-68).

Price (including interest rate) movements, according to the monetarists, are the source of business cycles, and changes in the quantity of money are, in turn, responsible for price fluctuations. Thus monetary forces and frequent mismanagement of monetary policy is the impetus for the real business cycle.

It was not the purpose of this brief review of the monetarist and non-monetarist theories on business cycles to debate which set of theories is correct and to what extent. Rather the intention was to look for additional insights into the causes of national and regional business cycles, as well as to provide background for the review of regional business cycle models that follow.

Interregional Business-Cycle Models

This chapter now turns to two categories of business-cycle models. One category includes an interregional business-cycle model, based on the Hansen-Samuelson multiplier-accelerator theory, and the second category focuses on models that emphasize the effect of monetary policy on regional fluctuations.

The Multiplier-Accelerator Model

The multiplier-accelerator interregional model is based on a merger of the multiplier-accelerator principle and trade theory. The business-cycle or multiplier-accelerator portion of the regional model is based on the Samuelson model described earlier in this chapter. And the multiplier-accelerator model explains the initial shock and perpetuation of the cycle. International trade theory provides the links for the transmission of cycles from region to region once they have occurred.

The most comprehensive model of regional business cycles is by Airov (1963). Harry Richardson (1969: 281-286) presented an interregional business cycle model in his text Regional Economics. However, Richardson's formulation appears to have been based primarily on the work of Airov. Airov's paper is, in turn, dependent on the work of Lloyd Metzer (1950).

Metzer's model dealt with the effects of investment in one region on the employment and income in all other (n) regions in the country.[1] His major contribution was to expand trade relationships between two regions to trade relationships between n regions.

Briefly, Metzer's study made the following contribution. Regional income is set equal to expenditures on consumer's goods and services, plus net investment plus exports of goods and services less imports of goods and services. Consumption, net investment, and imports are all dependent on the level of income and employment at home, while the remaining item, exports, depends upon income in all of the regions to which goods are sold. Metzler then used a Leontief input-output type table to show the interregional relationships. In other words, regions replaced the industries, and imports and exports replaced inputs and outputs in the Leontief framework. From this table the marginal (average) propensities of a region to import from another region could be calculated.

Airov (1963) used both the multiplier-accelerator principle and Metzler's trade matrix to model the transmission of business cycles from one region to another.

Summarized, his model was the following. For region i, d = domestic and f = foreign, Y_i = net regional income

$$C_i = C_{di} + C_{fi} = \text{personal consumption expenditures by residents of region } i \qquad (2\text{-}2)$$

$$I_{di} = (I_d)_{di} + (I_d)_{fi} = \text{net private domestic investment} \qquad (2\text{-}3)$$

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[1]Metzler's work was applied to trade among countries as well as regions.

$(I_d)_{fi}$ = net private domestic investment purchased from foreign regions (2-4)

X_i = exports, $M_i = C_{fi} + (I_d)_{fi}$ = imports (2-5)

E = net regional expenditures (NRE) (2-6)

$E_{di} = C_{di} + (I_d)_{di}$ = net NRE on domestic production (2-7)

Thus imports and export may consist of both investment and consumption goods. According to regional income accounting:

$$Y_i = C_{di} + (I_d)_{di} + X_i \quad (2\text{-}8)$$

$$E_i = C_i + I_{di} \quad (2\text{-}9)$$

$Y_i = E_i$; only if $X_i = M_i$

The basic accounting identities for region i are

$$Y_i = E_{di} + X_i \quad (2\text{-}10)$$

$$E_i = E_{di} + M_i \quad (2\text{-}11)$$

Using equations 2-10 and 2-11, the accounting framework for an n-region income and trade model was developed.

Let

X_{ij} = imports from the i^{th} region to j $(i \neq j)$

M_{ij} = imports from the i^{th} region to j $(i \neq j)$

From this a table (Table 2.1) was constructed with the net regional product of region i,

$$Y_i = E_{di} + \sum_j X_{ij}$$

in row i; and in the corresponding column

$$E_i = E_{di} + \sum_i M_{ij}$$

Table

Region	1	. . .	n	Regional Income
1				
.	E_{di}	X_{12}	X_{in}	Y_i
.				.
.				.
.	X_{21}	. . . . .	.	.
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
n	X_{ni}	. . . .	E_{dn}	Y_n

Using a simple consumption function

$$C_{i_t} = M_{ii}Y_{i_{t-1}} \tag{2-12}$$

where m_{ii} is the domestic marginal propensity to consume and

$$C_{ij} = m_{ij}Y_i \tag{2-13}$$

where consumption in region i of j products is a function of the marginal propensity of i to consume j's products time i's income. These multipliers can be put into the Leontief input-output framework. Because one region's exports can be considered another region's imports, the whole matrix of multipliers can be described in terms of import multipliers.

In terms of matrices and vectors:

$$Y(t) = C(t) \tag{2-14}$$

$$C(t) = \bar{M}Y(t-1) \tag{2-15}$$

Substituting into the n-equation multiplier model in n regions is:

$$Y(t) = \bar{M}Y(t-1) \tag{2-16}$$

where $\bar{M} = [m_{ij}]$, a matrix of consumption coefficients.

Airov's interregional model in vectors and matrices was composed of the following components:

$$Y(t) = C(t) + I(t) \tag{2-17}$$

$$C(t) = \bar{M}Y(t-1) \tag{2-18}$$

$$I(t) = B[Y(t-1) - Y(t-2)] \tag{2-19}$$

Equation 2-17 is the regional accounting identity. Equation 2-19 is the consumption function where $\bar{M}$ is a matrix of consumption coefficients m_{ii} and m_{ij}. Equation 2-19 is the interregional accelerator, which states that investment is a function of change in the income levels in the previous periods. B is the matrix of accelerators or capital coefficients, where b_{ii} is the accelerator for investment goods purchased from region i as a function of the rate of change in income in region i. So that:

$$I_{d_{ii}}(t) = b_{ii}[Y_i(t-1) - Y_i(t-2)] \tag{2-20}$$

is the intraregional investment expenditures by region i caused by the rate of change in the level of income in region i.

$$(I_d)_{fij}(t) = b_{ij}[Y_i(t-1) - Y_j(t-2)] \qquad (2\text{-}21)$$

is the export of capital goods from region i to region j as a function of the rate of change in income in region j. Having derived the consumption function and the induced investment function, we get the interregional accelerator model.

By substituting equation 2-12, 2-13, 2-20 and 2-21 into the income identity gives this result:

$$Y_i = m_{ii}Y_i(t-1) + b_{ii}[Y_i(t-1) - Y_i(t-2)]$$

$$+ \sum_{j=1} m_{ij}Y_j(t-1) + \sum_{j=1} b_{ij}[Y_j(t-1) - Y_j(t-2)]. \qquad (2\text{-}22)$$

The mathematical solution to these equations depends on the interregional trade patterns. The system is indecomposable if each region trades directly or indirectly with every other region; it is decomposable if some regions are isolated or there are blocs that only trade with each other; and it is completely decomposable where any region is isolated from all others. When the system is indecomposable, the system's solution is found by solving one simultaneous system. This case is probably most appropriate for an industrialized nation such as the United States.

This model will generate cycles that vary by region, but will exhibit similar timing. The amplitude of the cycles will depend on the values for m and b, the proportions of the regional economy's activity in consumption and investment, the extent of trading relationships with other regions, and the stability or instability of those trading partners.

The disadvantages of the model are its massive data requirements and the fact that the multipliers and accelerators are likely to be unstable throughout the recession. The multipliers and accelerators are calculated as average values at one point in time. The true marginal values are likely to vary substantially over the phases of the business cycle.

One strength of the Airov model is the degree to which the interregional transmission of the business cycle is made explicit. Fluctuations in investment and consumption are transmitted from state to state via the multiplier, m_{ij}, and accelerator, b_{ij}, so that a state trading with a cyclically variable region will experience larger than expected cycles. Cross-regional differences in recessions due to the stability or instability of trading partners could not be captured in the simpler model of this analysis.

Monetary Models of Regional Business Cycles

Another type of regional business cycle model stresses the links between changes in the money supply and short-run fluctuations in regional incomes. These models are based on the argument that monetary policy is not neutral in its regional impact. First, federal policies, such as open-market operations, may vary in their effect on the net source base of a region.[2] Secondly, the interest elasticity of demand for money may vary across regions and finally, there may be variations in the extent to which changes in interest rates affect local aggregate demand.

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[2]Net source base is equivalent to high powered money.

Roberts and Fishkind's (1979) model of the Florida economy is based on the assumption of regional differences in the second stage described above, that is, there are cross-regional differences in the interest elasticity of demand for money. In a two region model of the United States, Miller (1978; 1979) explored in detail regional differences in the first of two stages of monetary policy and in less detail the third stage. In a third paper, Beare (1976) studied the impact of national changes in the money supply on regional incomes. Each of these papers will be considered in turn.

Roberts and Fishkind argue that although capital is more mobile than any other factor of production, it is not perfectly mobile and that, in fact, regional differences in interest rates are significant. To support these two claims, Roberts and Fishkind cite the evidence of Lösch's study (1954), comparing interest rates for bank credit in a number of U.S. cities from 1923-35. Lösch found that interest rates paid in bank deposits increased uniformly with distance from a Federal Reserve Bank City. Lösch attributed this to regional differences in the supply and demand for funds, with peripheral areas growing faster and thus having a greater demand for funds.

This evidence presented by Roberts and Fishkind is, however, substantially out-of-date. Improvements in communication technology since the 1930's should lead to the elimination, through arbitrage, of any spatial differences in interest rates. Therefore, Roberts and Fishkinds argument for persistent cross-region differences in the level of interest rates is not convincing. The importance of this question for regional business cycles is that persistently higher interest rates in a region would discourage investment and thus lead to a relatively severe cycle in that high-interest rate region.

A second slightly more convincing argument made by Roberts and Fishkind is that the interest elasticity of demand for money varies by region. As evidence, they cite the empirical findings of Ebner (1976). Ebner found that deposits in savings and loan institutions were more sensitive to fluctuations in the treasury bill rate in some states than in others. For example, deposits in California, Florida, and Ohio were more responsive to changes in the treasury bill rates than in New Mexico and Idaho. This evidence suggests that the interest elasticity of demand for money varies by region and the more isolated an area, the less interest elastic the demand for money. Therefore, we should expect the slope of the LM curves to vary across regions. The greater the slope of the LM curve, due, for example, to a greater elasticity of demand for money, the larger impact a change in exports, government expenditures, autonomous investment (or any shift in the IS curve) will have on regional income in the short run.

To analyze the effects of regional compartmentalization of financial markets, the authors built two models, neither of which was laid out in their published paper. One model was a fully specified structural regional financial market with monetary and financial variables. In particular, it contained saving flows into banks and savings and loans, which, in turn, determined housing starts, which, in turn, determined employment in construction and other industries. Their second naive model predicted Florida's employment as a function of national employment weighted by the ratio of Florida population to U.S. population. From a simulation of the models, they found that the structural financial model captured the behavior of Florida's employment during the period 1972:I to 1974:IV far better than the naive model. The structural model was especially an improvement over the naive model in predicting troughs and peaks.

Fishkind and Roberts' finding suggest that the monetary sector is important in explaining regional business cycles; however, because their model only includes Florida, it does not test for any across-region disparities in the impact of monetary policy.

A second attempt to model the monetary sector of regional economies was made by Randall Miller. In the fourteen simultaneous equation model, Miller attempted to explain the impact of monetary policy on incomes of two regions, the Northeast and the rest of the country.

Rather than present the formal model here, in mathematical terms, the equations will only be briefly described. Miller's model simulates the process by which exogenous changes in the net source base (high powered money), due to monetary actions by the Fed, affects the income levels of two regions. The first equation in the recursive model estimates the flow of the net source base to the Northeast, while the second estimates the flow of the net source base to the rest of the country. The net source base in each region is a function of the level of demand deposits in the last period in that region, the level of demand deposits in the last period in the other region, the change in federal reserve float, the change in the gold stock, the change in other Fed assets, and the change in other Fed liabilities.

The second set of equations estimate the endogenously determined interregional flow of the net source base. This flow is considered to be a function of the net interregional commercial and financial transactions. Because those data were not available on a quarterly basis, Miller used the average level of demand deposits in each of the two regions during the preview period as a proxy for interregional transactions.

Once the flow of the net source base to the regions is determined, the flow of money in each region is determined by the interaction of the net source base and the regional money multiplier. Miller's seventh and eighth equations state that the change in the money supply in a region during the period equals the product of the money multiplier for the region and the change in the net source base, plus the level of the net source base at the beginning of the period times the multiplier.

Miller made explicit two reasons why we would expect the magnitude of the money multiplier to vary by region. First, the ratio of member to non-member banks in the Federal Reserve may differ. Member banks must comply with more stringent reserve requirement minimums than non-member banks.[3] Therefore, a region with a larger proportion of non-member banks would have a larger money multiplier. Second, because of discretion or actions of the banking or non-banking public, some regions may keep large excess reserves. For example, the variance in demand or interregional money flows may differ by region and areas with large variances in demand would be likely to keep a relatively large pool of excess reserves. Greater excess reserves means a smaller money multiplier.

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[3] Current legislation has made this argument out of date. Non-member banks must comply with the Fed's reserve requirements. See <u>Wall Street Journal</u>, November 5, 1980.

Once the change in the money supply for the two regions is predicted, two equations indicate the impact of that change on the personal incomes of the regions. The equations state that current period changes in nominal personal income are functions of current and lagged values of changes in a region's money supply.

The model is recursive so that the system predicts changes in a region's money supply as a function of the regional multiplier and the region's net source base. These changes in the money supply generate changes in nominal personal income in the current period. The changes in nominal personal income lead to changes in the interregional relationships and the interregional money flows. These interregional money flows lead to endogenously determined changes in income.

Miller estimated the coefficients in the model using quarterly data from the period 1960-75. He then checked to see how well the model tracked the historical path. He found that the model successfully tracked the historical series for the regional flow of the net source base. While the results often fell short of the actual magnitude of change in a region's net source base, it did pick up the various peaks and troughs. The model did not track the changes in the money supply as accurately as it did the net source base, and the poorest results were in estimating regional incomes.

There are several findings in Miller's study that directly address cross-regional differences in cyclical activity due to monetary policy. All exogenous factors, excluding the Federal Reserve float variable, have a larger current-period impact on the rest of the country than in the Northeast. For example, a unit increase in the Fed's holdings of securities, the gold stock, and other assets have an impact of .5, .6, and .5 on the personal incomes in the Northeast, respectively. The same impact multipliers for personal income in the rest of the country are 1.5, 1.3, and 1.4, respectively. The relatively larger impact on the income of the rest of the country is a result of a larger impact of Federal Reserve activities on the net source base of that region as well as a larger increase in personal income caused by the change in the money supply.

An important implication from Miller's study, relevant to this thesis, is that there appears to be cross-regional differences in short-run regional incomes due to monetary policies on the part of the Federal Reserve. This study suggests that these regional variations are due to differences in the growth of the net source base, in money multipliers, and the response of income to the change in the money supply.

Three shortcomings of the Miller study as it relates to the topic of the current thesis are apparent. First of all, the regional results are not weighted by the size of the regions. Therefore, because the Northeast is a smaller region than Miller's rest-of-the-country region, we would expect that an increase in the Federal Reserves holdings of government securities in the current period would have less of an impact on the monetary base of the Northeast than on the rest of the country.

Given this shortcoming it is unclear whether Federal monetary policy has a greater proportionate effect on one region than another.

Second, the institutional and economic factors that Miller hypothesizes will cause cross-regional variations in cycles appear to produce only temporary disequilibriums. For example, a larger money multiplier in region A than in region B will cause a larger contraction in A's money supply, when the quantity of high-powered money is reduced. This relatively large reduction in A's money supply will lead to relatively large increases in A's interest rates, and ceterus paribus, a greater decline in A's aggregate demand than in region B's. If the differences in interest rates persisted, A would experience the more severe recession. However, these regional differences in interest rates would probably be small and temporary. Through arbitrage, the regional discrepancies in interest rates would quickly disappear. Thus, it seems possible that regional differences in monetary policy may explain some of the differences in timing of recessions, and possibly the magnitude of severity in the earliest stages of the recession, but not total amplitude.

Third, Miller assumes that the distribution of the monetary base influences regional growth when in fact the causal relationship may move in the opposite direction. Miller's model is based on the premise that flows of money to regions stimulate economic growth. However it is more likely that money is drawn to areas that are growing for economic reasons, such as low wages, no unions, nice climate, etc. Money might, therefore, be an endogenous variable, rather than exogenous, and income growth may be exogenously determined rather than endogenously determined.

A third study of the regional impact of monetary policy is by Beare (1976). Beare's model was applied to the Prairie Provinces of Canada. His single equation was

$$E_i = \alpha + B_1M + B_2A_i \qquad (2\text{-}23)$$

where E_i was expenditures on products in the i^{th} region, M was the national money supply, and A_i was autonomous expenditures on products of the i^{th} region.

The question of interest to Beare was: how do expenditures, by region, fluctuate with changes in the national money supply? He argued that this regional effect would depend upon the income or wealth elasticity of demand for the products of each region. The model was tested with annual data spanning the period 1956 to 1971 with net income from farm operations being used as the proxy for autonomous investment. The regression equations for all Prairie Provinces as well as each province separately suggested that money is of much greater importance in explaining income levels than is farm income in the short run.

It is interesting to note that the coefficient on the money supply variable is roughly similar for Manitoba and Saskatchewan, .09 and .05 respectively, but larger for Alberta at 1.9. These differences between Manitoba and Saskatchewan and Alberta suggest that changes in the money supply may have a differential short-run impact on regional expenditures. However, reasons for these differences are not a point explored by Beare, and his results are by no means conclusive.

Beare's study suffers from one of the same problems as Miller's. Beare also assumes that the positive association between flows of money and income are due to the influence of the money supply on growth. However, as stated earlier, the causal effect may be the opposite, with money flowing to growing regions.

Although not addressed by any of the above authors there is one area where the monetary sector may have uneven spatial impacts. Due to regulation Q, when interest rates rise, savings and loan institutions are faced with severe losses of funds through disintermediation. The effects of this rapid contraction on construction industry capital may have a differential regional impact.

During periods of low interest rates, financial capital flows out of savings and loans located in slow-growth regions to support construction in fast-growth areas. When interest rates rise and savings and loan funds dry up, the contraction is felt only marginally in slow-growth regions. Construction was not occurring there anyway. The fast-growth regions, on the other hand, lose capital from local as well as national sources. A booming local construction industry, in this case, faces severe reductions in capital availability, and a more severe recession than its slow-growth counterpart.

This uneven regional effect does not enter into the model of this thesis. The reason is that the construction industry cycle generally precedes the GNP and employment cycle. Therefore, when the employment cycles are in the downswing, real interest rates are falling and construction activity expanding. Because this thesis only considers the employment cycles from peak to trough, it does not capture downturns in the credit and construction cycles.

Summary and Comparison

This chapter has reviewed several theories and models of national, as well as regional business cycles. The strengths of the Airov model are that it makes explicit the importance and role of the Keynesian multipliers, the accelerator principle and trade relationships in explaining regional business cycles. Its disadvantages are the massive data requirements to implement the model, and, once estimated, the likely instability of the coefficients over the business cycle.

The monetary business cycle models suggest, but do not make explicit, one reason why the timing of regional cycles may vary. The evidence of Roberts and Fishkind, Miller, and Beare suggest that there may be temporary regional differences in interest rates that influence local investment and explain differences in the timing of local cycles. But none of the authors establish the existence of persistent regional differences in interest rates. Consequently there is little evidence that cross-state differences in the severity of recessions can be found in variations in the elasticity of demand for money or in local banking practices. While monetary policy may well be responsible for bringing on a national recession, it does not appear to explain cross-state differences in the severity of recessions, except, as mentioned above, possibly in the case of construction industries.

How does the approach of the reviewed studies compare with the approach of this thesis? First of all, both the Airov and Miller models address the strength of economic interrelationships at an earlier stage of the recession. If a recession is caused by misguided or intentional contractionary monetary policy and the contraction is divided into stages, then 1) the Federal Reserve Bank tightens the money supply; 2) the supply of high powered money or in Miller's terms, the net source base, declines; 3) the demand for money falls as interest rates rise; 4) investment and consumption fall; 5) aggregate demand falls; 6) output falls; 7) and employment declines. Miller's model dissects the regional impacts of the first five steps of the contraction. Airov focuses on stages 4 and 5 of the downswing while this thesis concentrates on the regional variations in stages 5 through 7 of the recession. If the recession is not caused by monetary policy, Miller's framework is irrelevant for explaining that recession.

Second, both Airov and Miller's models formulated specific mechanisms for the interregional transmission of cycles. This thesis does not. Third, the Miller and Airov models predict income cycles over time. The model of this thesis is static. Fourth and finally, both the Miller and Airov formulations are theoretical with either no empirical testing or else tested only at a two-region level. The simpler model presented in this study allowed for a thorough empirical test including forty-eight states and five recessions. We now turn to the theory and model tested in this thesis.

CHAPTER 3

THEORY AND MODEL

The formal model is presented in this chapter. First, the general framework is laid out, followed by a discussion of the hypotheses to be tested and the underlying theory. Finally, the models and their functional form are presented.

The focus of this thesis is on the reasons for cross-state differences in employment declines during recessions. The hypotheses proposed to explain these differences are framed in an export-base model. Export-base theory distinguishes between two sectors of a regional economy, an export or basic sector, and a residentiary or non-basic sector. Employment in the basic sector is determined by national and international demand for a region's goods and services. Employment in the non-basic or residentiary sector is a function of employment growth or decline in the basic sector because, according to this framework, a region's non-basic activities exist to cater to the community producing export commodities (North, 1955; Tiebout, 1959 and 1962).

Growth in exports are transmitted to the residentiary sector via an export-base multiplier, which quantifies the strength of the relationship between growth in residentiary activities and exports. For example,an employment multiplier estimates the total number of jobs created in a region for every job created in basic industries. So that a multiplier of three implies that one job in the basic sector supports two jobs in the residentiary sector. Economic activities generally considered basic are manufacturing, mining, and agriculture. Non-basic activities usually include services, wholesale and retail trade, and government.

The export-base model is adopted here as the framework for explaining regional business cycles. It is assumed that national recessions are transmitted to state economies via states' export industries. A region whose export commodities are cyclically sensitive will experience a relatively severe recession. Regions producing commodities resistant to cyclical demand will exhibit relative stability.

While the severity of the recession in export industries is assumed to be determined nationally cyclical variability in a region's non-basic sector is determined locally. The recessionary impacts are transmitted from the export sector to the residentiary sector via a short-run multiplier, which ranges between zero and the long-run multiplier. The severity of the recession in service industries should, therefore, depend upon national demand for local exports and the size of the short-run multiplier.

Using the export-base model as the underlying framework, the severity of a state's recession is equivalent to the weighted recessions in the state's manufacturing (export) and residentiary sector.

$$\dot{E}_{jr} = (\dot{E}_m \frac{E_m}{E_T})_{jr} + (\dot{E}_s \frac{E_s}{E_T})_{jr} \qquad (3\text{-}1)$$

where;

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

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

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

E_m/E_T = Proportion of total employment in manufacturing.

E_s/E_T = Proportion of total employment in residentiary activities.

r = States 1, ..., 48.

j = Recessions 1, ..., 5.

A number of economic and institutional factors are hypothesized to explain cross-state variations in export sector ($\dot{E}_m$) and residentiary sector ($\dot{E}_s$) employment. The proposed causes of cyclical variability in each sector will be addressed, in turn, with the export-sector analysis presented first.

Export Sector

To simplify the analysis, the causes of cross-state variability in export-sector employment are divided into a national and a local component. The national component captures the short-run fluctuation in export-sector employment that occurs because of the fluctuation in national demand for the state's exports. The local component posits that state-specific economic and institutional factors explain, in part, cross-state variations on state cycles.

To restate:

$$\dot{E}_{m_{jr}} = \hat{\dot{E}}_{jr} + \dot{E}_{L_{jr}} \qquad (3\text{-}2)$$

where the variables are the same as above except that:

$\hat{\dot{E}}$ = The national component of states' manufacturing cycles.

$\dot{E}_L$ = The local component of states' manufacturing cycles.

Before exploring the national and local factors, in detail, the implications of considering employment cycles rather than fluctuations in sales or output should be addressed.

The state business cycles are measured in terms of employment, because these data are the only series available on a monthly basis, by state. Monthly or even quarterly data on sales or output are either not available by state or extend only to the recent past. Monthly employment data, on the other hand, are available from 1947 to 1980 for most states.

Employment, however, is a derived demand, and such, is a function of aggregate output. Aggregate output is, in turn, a function of sales or aggregate demand. Consequently, during a national recession, state employment fluctuations may differ from one state to another for any one of three reasons. First, the percentage change in aggregate demand may vary across states. Some states may experience stable demand throughout the recession while others experience highly volatile demand for their output. Second, the same percentage reductions in aggregate demand across states may have a differential effect on output levels, and finally, even if states experience the same percentage declines in output, layoff practices may differ.

What factors might lead to a spatially uneven fall in demand, output, or layoffs? Percentage declines in demand for good and services may vary across states because of differences in industry mix, capital-labor ratios, or the age of the capital stock. Output responses to reductions in aggregate demand may differ across states because of variations in industry composition, inventory practices, inventory laws, local economic conditions, and markets. Cross-state differences in layoff practices may occur because of industry composition, the economic position of the industry, the cost of rehiring or retraining new workers during the recovery, and employee preferences. Because the only series we can observe is employment, the existence of cross-state differences in demand,output, and layoffs can only be inferred by testing for the significance of variables expected to cause these differences. The variables, tested here, that are expected to cross-state differences in output are the industry composition (national component), capital-labor ratio, and age-of-the-capital stock. Whether cross-state differences in layoffs are due to the level of unemployment insurance benefits, unionization of the labor force, peak-year unemployment rates or industry composition will also be tested. We now turn to consider the national component of a state's manufacturing cycle. This is the only variable expected to explain cross-area differences in cyclical demand, output, and layoffs.

National Component

The national component proposes that a state's employment cycle is caused by fluctuations in national demand for local exports. This fluctuation in demand is measured by viewing each state economy as a unique composite of industries. Because various export (manufacturing) industries are more or less sensitive to the business cycle, we expect state responses to national cycles to vary, depending on the industrial make-up of the state's manufacturing sector. For example, regions with high proportions of business-cycle sensitive industries would be expected to show larger-than-average fluctuations. The concept is 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)

One of the most thorough empirical tests of the importance of industry mix in explaining regional cycles was conducted by Borts (1960), who studied variations in manufacturing employment from 1914 to 1953 in 33 states. His hypothesis was that "the cyclical behavior of each industry group in a particular region is independent of its location" (Borts, 1960: 154-55). The implication is that regions with the same industrial compostition will experience the same cyclical behavior.

In order to assess the importance of industrial composition, Borts estimated an expected regional cyclical amplitude--the amplitude the region would have experienced if all its industries had performed the same way regionally as they did nationally. He found a strong relationship between the actual and expected cycles in the period 1929 to 1937 and a weaker correspondence between expected and actual fluctuations for the period 1948 to 1953, suggesting that industrial composition was a less-important explanatory variable during this later period than during the former period. In his analysis Borts also found that industries producing consumer durables experienced more severe cycles than those industries that produced nondurable goods.

In another study Engerman (1965) attempted to determine the relationship between industrial structure and rates of decline and expansion during regional recessions. Engerman used annual non-agricultural employment data for two recessions. He correlated rates of decline during the cyclic downturns in two periods between 1949 and 1958, with the share of employment in manufacturing and mining and the share of employment in durable goods production. He found that all were positively and significantly correlated. Engerman's results are shown below.

RANK CORRELATION COEFFICIENTS BETWEEN TWO INDICES OF INDUSTRIAL COMPOSITION AND RATES OF DECLINE IN EMPLOYMENT DURING RECESSIONS[1]

Rates of Decline in Employment	Percent of Nonagricultural Employment in Manufacturing and Mining	Percent of Nonagricultural Employment in Durable Goods Industries
1949-54	.56	.46
1954-58	.66	.63

Source: Engerman, 1965: 24.

[1]See footnote 2 for description of calculation of variables.

When the same correlations were calculated between the two indices of industrial composition and rates of expansion and average amplitude, the results were insignificant.

In a third empirical study, Lynne Browne (1978) examined how well industry mix predicted changes in regional income in three recessions. Using the nine census regions as the geographical breakdown, Browne weighted national industry changes in labor and proprietors income, by the importance of each national industry in each region. These weighted income changes were then used to explain the regional amplitudes, adjusted for trend, over three cycles. Browne's results suggested that in the 1969-70 and the 1973-75 recessions industry mix was a factor in determining how a recession affected various regions. For 1961, she found that although the relationship between the industry mix variable and the trend-adjusted amplitude was positive, the relationship was not strong enough to permit such a conclusion. Browne further argued that the relationship between income level based on industry mix and the actual income level in all recessions in sufficiently weak to indicate factors other than industry mix are at work.

In a second test Browne ran a separate time series regression for each region, using a variant of the industry mix variable, to explain proprietors income over the cycle. She found that industry mix was a significant explanatory variable in all regions except Pacific (Browne, 1978: 47).

The findings of Borts, Engerman, and Browne all indicate that industry mix is an important explanatory factor in regional recessions. However, the strength of the relationship between an expected cycle based on industry mix and the actual severity varies across recessions as well as regions. Moreover, the failure of the expected recessions to explain all of a region's cyclical fluctuation suggests that factors other than industry mix explain the severity of regional recessions.

The national component of the export sector cycle is computed using the same technique as Borts (1960). This expected recession controls for the proposition that cross-state differences in business cycles may occur because of variations in state's industrial structure.

Several assumptions are hidden in the calculation of this expected recession. As stated above, demand for labor is a derived demand, and as such is dependent on demand for the products that labor produces. Because the calculation of the expected recession used in this study depends upon employment data, several assumptions about demand for an industry's product, the way in which the industry adjusts output levels in response to that fluctuating demand, and finally the industry's layoff practices are hidden in the calculation of the expected recession.

The assumptions that are incorporated in the expected recession are as follows:

If

$$Q_o = \alpha D_o \tag{3-3}$$

$$E_o = \beta Q_o \tag{3-4}$$

$$Q_r = \hat{\alpha} D_r \tag{3-5}$$

$$E_r = \hat{\beta} Q_r \tag{3-6}$$

where D = aggregate demand, Q = aggregate output, E = employment, subscript o = nation, subscript r = state, and supercript i = industry. Then for the expected recession it is assumed that

$$\Delta D_o{}^i / D_o{}^i = \Delta D_r{}^i / D_r{}^i \tag{3-7}$$

$$\alpha^i = \hat{\alpha}^i \quad (3\text{-}8)$$

$$\beta^i = \hat{\beta}^i \quad (3\text{-}9)$$

If $\hat{\beta}^i = \beta^i$ and $\hat{\alpha}^i = \alpha^i$ and $\Delta D_o^{\,i}/D_o^{\,i} = \Delta D_r^{\,i}/D_r^{\,i}$ we then can get the result implied by the expected recession.

$$\Delta E_r^{\,i}/E_r^{\,i} = \Delta E_o^{\,i}/E_o^{\,i} \quad (3\text{-}10)$$

In words, this hypothesis states that each national manufacturing industry behaves the same way independent of that industry's location. So that the local industry experiences the same percentage reduction in aggregate demand, the same proportionate reduction in output, and the same proportionate reduction in employment as the national industry.

Weighting the change in each manufacturing industry's national employment by the importance of that industry in each state, we derive the expected recession or the nationally determined component of states' manufacturing cycles.

$$\hat{\dot{E}}_{jr} = \sum_{i=1}^{20} (\dot{E}_{jo}^{\,i} \cdot \omega_{jr}^{\,i}) \quad (3\text{-}11)$$

where

$\hat{\dot{E}}$ = The expected recession.

$\dot{E}_o^{\,i}$ = The severity of the recession in national industry i.

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

r = States 1, ..., 48.

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

i = Industries at the manufacturing 2-digit SIC level.

The expected recession is the percentage decline in employment that a state would experience if the assumptions in equations 3-7, 3-8 and 3-9 held.

Local Component

As suggested by the findings of Borts, Engerman, and Browne, the industry mix of exports does not explain all of the cross-state variation in recessions. Five hypotheses propose reasons for the divergence between the expected recession and the actual recession within the export sector. The first two hypotheses propose reasons for cross-state variations in the percentage drop in aggregate demand during recessions. The next three hypotheses suggest reasons for cross-state differences in layoff practices, or $\hat{\beta}$. This section concludes with a discussion of hypotheses about local or state-specific factors that would be likely to influence states' cyclic behavior in the export sector, but which could not be tested due to the absence of data.

Factors Influencing Aggregate Demand for Regional Exports

There are two variables that are expected to explain spatially uneven declines in aggregate demand during recessions, after industry mix is held constant. They include the manufacturing sector's capital-labor ratio and the age of the capital stock.

Capital-Labor Ratio

Capital-labor ratios are used as a proxy for the ratio of firms' fixed to variable costs. This ratio is expected to influence the severity with which firms and consequently regions experience national recessions. The argument applies to both the multiplant and single-plant firm.

Economic theory predicts that regions with relatively low wages tend to attract labor-intensive industries. Similarly, theory suggests that plants located in relatively labor-abundant, low-wage areas will adjust the composition of their inputs to take advantage of the low cost of labor relative to the cost of capital. In either case we would expect firms located in low-wage states, like the Southern regions of the U.S., to be more labor-intensive than their counterparts in the relatively high-wage states, such as the Northern areas of the U.S. The cross-regional differences in production methods should, holding industry composition constant, have an impact on regional business cycles. First, we consider the multiplant firm.

A manager of a multiplant firm faced with declining demand for output, will shift cutbacks to the plants where the short run marginal costs are highest. In other words, the plant in which total costs fall most rapidly with reductions in output will be the plant that absorbs the greatest proportion of the recessions impact.

The argument that the higher marginal cost firm will be the labor-intensive firm can be made clearer with the following equations.

If

$$TC_K = TC_L \qquad (3\text{-}12)$$

and

$$f_K > f_L \tag{3-13}$$

then

$$VC_L > VC_K \tag{3-14}$$

since

$$TC = f + VC \tag{3-15}$$

where TC = total costs, f = fixed costs, VC = variable costs, subscript K = capital-intensive firm, subscript L = labor-intensive firm.

Differentiating

$$\frac{\delta TC_K}{\delta Q_K} = \frac{\delta VC_K}{\delta Q_K} \tag{3-16}$$

and

$$\frac{\delta TC_L}{\delta Q_L} = \frac{\delta VC_L}{\delta Q_L} \tag{3-17}$$

Since $VC_L > VC_K$ then

$$\frac{\delta VC_L}{\delta Q_L} > \frac{\delta VC_K}{\delta Q_K} \tag{3-18}$$

The cost-minimizing strategy for the multiplant firm, faced with declining demand for its products, is to reduce production in the labor-intensive plant (L) first. If cutbacks are made in L, then relatively large numbers of employees and small amounts of capital will remain idle. Whereas if the capital-intensive operations (K) experienced the same reduction in output as L, the company would have to absorb the cost of idle capital and could take advantage of only small reductions in variable costs.

This hypothesis would not be reasonable without the evidence of Feldstein (1976), McLure (1977), and Vickery (1979). All three researchers found that with current methods of experience rating in the unemployment insurance system, firms do not bear the full cost of layoffs, especially in cyclically sensitive firms. For example, Vickery found that in California, over the period from 1965 through 1974, the contract construction industry accounted for 8 percent of all wages in covered industries, only 10 percent of all employer contributions into the unemployment insurance fund, and 18 percent of all insurance benefits collected. In 1974 benefits exceeded contributions for contract construction by $91 million (Vickery, 1979: 7). While this finding refers to industries rather than firms, it does indicate that many firms, especially those that are cyclically sensitive, do not pay the full actuarial cost of their layoffs, thus the findings of Feldstein, McLure, and Vickery support the view that cyclically volatile firms do not bear, the full cost of idle labor.

The behavior of the single-plant firm as well as the multiplant firm lead to differences in state recessions to the extent that there are different rates of shut downs or bankruptcies across states. A profit-maximizing or loss-minimizing strategy for the single-plant firm is to operate, even when revenues are exceeded by costs, as long as average variable costs (AVC) are met and some fixed costs (FC) are covered. At the point where average revenues (AR) are equal to AVC's the owner will be indifferent to operating and when AVC's are greater than AR's the firm will shut its doors, temporarily or permanently.

Labor-intensive plants have higher AVC's relative to fixed costs than do capital-intensive plants. It may be that capital-intensive plants find that, during a downturn, it is easier to meet AVC and cover at least some of their fixed costs. Here the capital-intensive plant's loss-minimizing strategy is to continue operation. On the other hand, the labor-intensive plants, whose costs are comprised largely of variable costs may have more trouble meeting these costs and therefore will minimize losses by shutting down. This is not to say that total profits or losses will be greater in one plant over the other, rather that there will be differential points when AVC $\leq$ AR 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 my knowledge, this hypothesis has not been previously tested.

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. Unfortunately skill-level data, by state, is not available so that we could not control for the affect of skill levels on the severity of state recessions.

Age-of-Capital Stock

The next hypothesis is that differences in the age of the states' capital stock may lead to differential reductions in demand for states' output. The hypothesis predicts that, with industry mix held constant, the older the capital stock of a state, the more severe the decline in aggregate demand. This hypothesis applies both to the multiplant as well as the single-plant firm. The argument for the multiplant firm applies to firms that respond to falling demand by cutting prices, as well as to cases where prices are rigid and adjustments are made by reducing output.

We expect a newer capital stock to be, on the average, more appropriate for current relative prices of land, labor, energy, and other inputs than old plant and equipment. For this reason, it is posited that branches of multiplant firms, with a high average-age of capital, will have higher marginal costs than plants producing the same product with a newer capital stock. In the case of a recession, when aggregate demand has fallen nationally, company managers of cost-minimizing firms will distribute the loss in demand for their products unevenly across plants, cutting demand in the higher marginal cost plants first.

The following diagram clarifies this argument.

At price level P_1, q_A is produced at plant A and q_B is produced at plant B. Total output is equivalent to $q_A + q_B$. If the price falls to P_2 (or output is reduced with prices constant), the largest percentage declines on output take place in the highest marginal cost firm, plant B. If the price level falls below P_2 (or output is reduced below q_A') plant B while shut down, and total output will be produced at plant A.

The age of capital stock argument also applies to the single-plant firm in a competitive industry with both flexible and rigid prices.

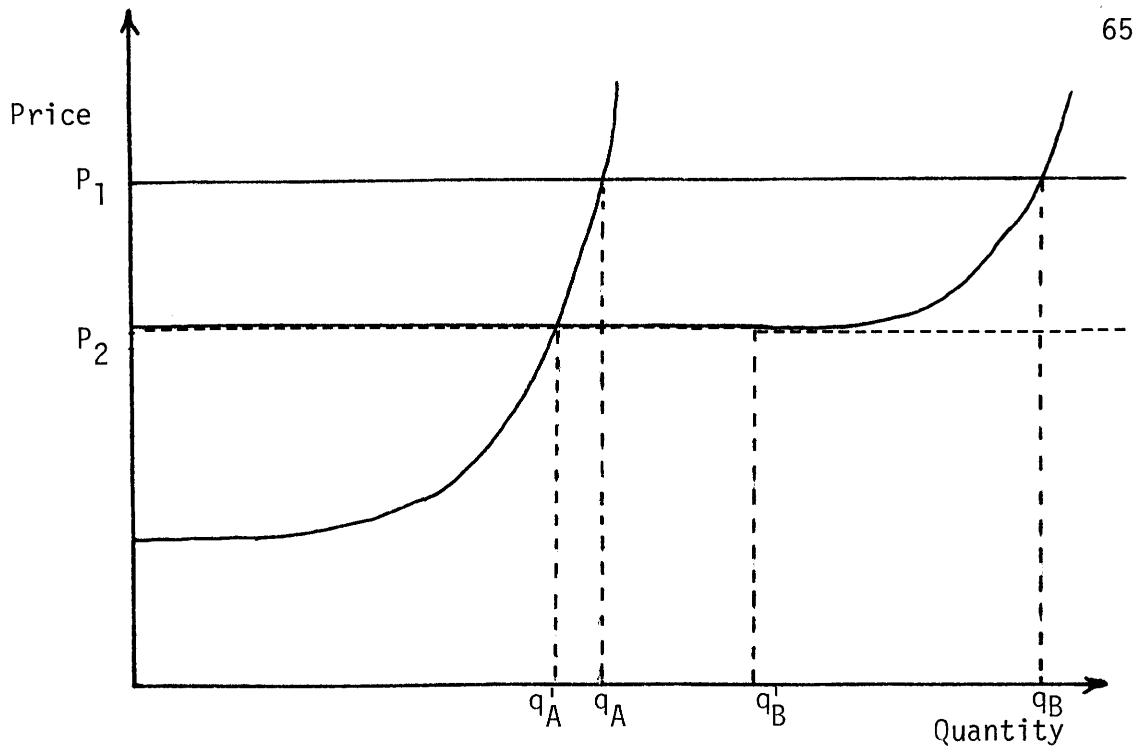

Figure 3.1

Production Levels for Plants of Multiplant Firm

Single-plant firms with relatively old capital are expected to have high average variable costs (AVC) for the same reasons stated above. That is, old capital stock requires combinations of variable factors that are inefficient due to changes in relative factor prices. Thus AVC are expected to be higher for firms with old capital stocks than for firms with recently installed capital.

As long as AR exceed AVC a single-plant firm will stay in business (even if total revenues are less than total costs). However, when AR fall below AVC, the loss-minimizing firm will close its doors.

Firms with high AVC will have a greater probability than firm's with low AVC of failing to cover variable costs, and, therefore, will have a greater probability of shuting down, either permanently or temporarily. If a region has relatively more high variable cost firms, it may have a higher than average proportion of bankruptcies, and constantly 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).

New-capital firms are expected to have lower marginal and average costs than old-capital firms, because a new capital stock is more appropriate for current relative prices. This assumption should, however, be stated with some qualification. Relative energy prices fell slowly during the post war period, 1945 to mid 1973, encouraging a transition toward energy--using capital. Well known events of late 1973 have led to a reversal of the energy price trend and relative energy prices have increased. Newer energy-intensive capital may now be less efficient than older energy-saving capital, leading to higher marginal costs for the new-capital firm or plant. This particular change in relative prices would only affect the result for the last recession (1973-75) included in this study. However the possibility of other reversals in relative price trends necessitate a qualification of the hypothesis.

A third reason that an old capital stock may be related to more severe recessions is that retirement of obsolete capital are probably concentrated in regions where the average age of capital is higher. During the expansionary phase of the cycle scheduled retirement 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 cycles (Varaiya and Wiseman, 1977).

A number of other researchers have hypothesized that the age of capital stock plays a role in explaining the amplitude of regional cycles, however, there is little evidence that the hypothesis has been tested. For example, in a paper analyzing the sensitivity of state payrolls to state business cycles, Friedenberg and Bretzfelder (1980) suggest that swings in manufacturing payrolls were greater in the North than in the South and West.

> [P]roduction costs in the North stay relatively high over the cycle, because capital stock is relatively old and, thus, expensive to maintain. Declining revenues and continuing high costs squeeze profit margins, and so Northern manufacturers tend to reduce the rate of capacity utilization early in recessions (Friedenberg and Bretzfelder, 1980: 17).

When asked for documentation on this argument both researchers agreed that they had no evidence other than casual empiricism.

The age of a state's capital stock is associated with the state's rate of economic growth. Both slow growth and a high average age of capital occur when new and replacement investment fail to enhance the productive capacity of a local economy. Because both the secular growth rate and the average vintage of a state's capital stock are theoretically highly correlated, it is worth citing, in this context, studies that have tested the significance of the long-run regional growth and cyclical sensitivity relationship. Evidence supporting a relationship between strong secular growth leads to mild trend-adjusted recessions would strengthen the age-of-capital-stock hypothesis forwarded here.

Both Borts (1960) and Engerman (1965) addressed the hypothesis that secular growth is related to a regions cyclical activity. Borts, using manufacturing employment for 33 states for the years 1914 to 1953, compared states cyclical amplitudes and rankings of states by growth rates. He found that strongly growing states were, on the average, more variable than weakly growing states. Borts' evidence is not overwhelming. As he recognizes, he has not carefully controlled for industry mix in the states, and secondly he finds a number of exceptions. Out of 17 cases, Borts found four cases in which weakly growing states had, on the average, more variability in their cycles than did strongly growing states (1960: 184).

Engerman (1965), on the other hand, claimed a positive correlation between growth measured as employment growth, and rates of expansion during the business cycle and a negative relationship between secular growth and rates of decline during the recession. These correlations shown below, were significant at the one percent level.[2]

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[2]Borts' measures were the following: Decline rates and expansion rates = changes in cycle values per year/an average of all observations over the cycle (1960: 200). Trend growth = employment at one cycle peak/employment at an earlier peak (1960: 156). Engerman's indicators are similar. Expansion = peak minus initial trough/average of all observations over the cycle. Decline = peak minus terminal trough/average of all observations over the cycle (1965: 16). Growth = employment at one peak/employment at an earlier peak (1965: 29).

Borts and Engerman both used rank correlations of average annual amplitude against growth. Borts' measure of average annual amplitude = 1/2 *((peak minus initial trough/number of years of rise) + (peak minus terminal trough/number of years of decline)) / average of all observations over the cycle. Engerman's cycle amplitude measure = average annual expansion [expansion/number of years of upswing] + average annual decline.

ENGERMAN'S RANK CORRELATION COEFFICIENTS
BETWEEN GROWTH AND CYCLICAL BEHAVIOR IN TWO CYCLES
1949-54 and 1954-58

Growth and:	1949-54	1954-58
Rate of Expansion	+ .71	+ .78
Rate of Decline	- .63	- .51

Source: Engerman: 29.

One reason for the significant relationship between secular growth and rates of expansion and decline in Engerman's study is probably due to the fact that the decline and expansion rates are not adjusted for secular trends. Through the influence of secular growth trends, a fast-growing region would experience weaker declines and more rapid expansions than a slow-growing region. A better test of the existence of a relationship between secular growth and the behavior of business cycles would eliminate the trend from cyclic fluctuations.

Engerman also tested for a relationship between growth and a cycle's amplitude. Using a trend-adjusted measure for the business cycle, he found the correlations to be insignificant.

Another study of the relationship between secular growth and the business cycle was conducted by the author (Howland, 1979). The study regressed the trend-adjusted severity of regional recessions against the percent of a region's employment in durable goods production, and the region's peak-to-peak growth rate over the period prior to the recession. Using data on five post World War II recessions and nine census regions, there was no evidence that long-run regional income growth had any effect on the severity of regional recessions.

Although there is no substantial evidence of a relationship between economic growth and cyclical activity, tests replacing growth with the age-of-the-capital stock may suggest otherwise. The major theoretical reason for secular growth to be associated with cycles condenses into an age-of-capital-stock argument, therefore the more theoretically sound and precise measure, the age-of-capital stock, may prove to be significant, whereas secular growth is not. The age of capital stock is measured, where possible, with three previous years of real investment divided by the value of the capital stock in the final year.[3]

Factors Influencing Layoffs

The second set of three hypotheses to be explored here are factors that are proposed to create cross-state differences in layoff practices during a recession. The hypotheses suggest that holding industry mix constant, the magnitude of unemployment insurance benefits, peak-year unemployment rates, and unionization of the work-force will influence states' cyclical employment.

Labor Surplus or Shortage

The first hypothesis 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 firms in labor-short states may anticipate difficulties in rehiring and, therefore, find it cheaper, in the long run, to hoard workers throughout the recession.

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[3]I am grateful to Roger Bolton for his suggestion to calculate the age of the capital stock in this manner.

Using the annual peak-level unemployment rate as a proxy for the tightness of the labor market, it is hypothesized that the higher the annual peak level unemployment rate, prior to the recession, the greater the severity of the state recession. At least one empirical study supports this hypothesis. Thirwall's (1966) findings, using data from Great Britain, indicate that regions experiencing the greatest cycle sensitivity were those that persistently had unemployment rates above the national average.

Unemployment Insurance

The next hypothesis is that regions with greater unemployment insurance benefits (UI) will appear 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 may, therefore, be inclined to lay off workers expecting them to be available for rehiring at a later date. In contrast the unemployed in low UI states are likely to feel pressed to seek, and possibly relocate to take, another job. In these low UI states employers may expect rehiring to be problematic during the recovery and decide to keep employees on the payroll throughout the recession. It is also possible that employees with some bargaining power are more likely to accept lay offs in high UI states than in low UI states. In low UI states workers may prefer wage or hour reductions to lay offs. In either case, it is expected that the higher the UI, the greater the reduction in employment during the recession.

There is a contradictory hypothesis raised by Welch (1977). An experience rating UI system, even one that does not fully attribute UI benefit costs to the responsible firms, will raise a firm's costs of laying off workers. As a consequence experience ratings should reduce labor turnover. Given that the payroll tax is greater in high benefit states than low benefit states, the incentive for firms to hoard labor through the recession may be greater in the states with high UI benefits. This hypothesis contradicts the previous hypothesis and may, in fact, cancel the proposed positive relationship between UI benefits and layoffs.

The literature on the economic effects of unemployment insurance indicates that UI programs have had an impact on both temporary layoffs and the duration of unemployment. Two empirical studies have estimated the effect of UI benefits on unemployment during recessions. Hamermesh (1972) found that the national unemployment rate, during recessions was .45 percentage points greater during the depth of recessions than it would have been in the absence of the UI programs. He suggests that further extensions in benefits or coverage would produce further increases in the unemployment rate (Hamermesh, 1972: 125-126).

Feldstein (1978) looked more specifically at the effect of UI benefits on temporary layoffs. Feldstein used longitudinal data from the Current Population Survey (CPS) and state formulas on UI benefits. He divided those samples into six categories. The six categories represented levels of the ratio of an individual's potential UI benefit to his or her foregone earnings, net of taxes. Thus, a 60 percent "benefit replacement ratio" means that an unemployed individual could lose 40 percent of his income, net of taxes, by being unemployed. In comparing the replacement ratios with the CPS data, Feldstein found that the greater the benefit replacement ratio, the higher the probability of being on temporary layoff. Feldstein's conclusion suggests that the UI program distorts the behavior of firms by encouraging them to lay off workers rather than cutting hours worked, reducing prices, or building inventories.

The implications, of the Hamermesh finding, for this study are unclear. The .45 percent increase in the unemployment may be due either to increases in layoffs or decreases in discouraged job searchers. The first effect would show up in the data of this thesis; the second effect would not. Feldstein's findings are consistent with the relationship hypothesized here.

Most empirical findings concur that UI benefits lengthen the duration of unemployment. The greater the benefits, the longer the job searchers take to select another position (Holen, 1977; Classen, 1977; and Welch, 1977). Classen's evidence is typical. Looking at the experience of UI claimants in Pennsylvania and Arizona who received benefits in 1968, Classen found that a 10 percent point increase in the weekly benefit-to-wage ratio led to an increase of about one week in the total period for which claimants record benefits (Classen, 1977: 440). These results suggest that once laid off, higher UI benefits encourage job searchers to look longer before taking another job (or leaving the labor force). This is consistent with the argument that it is easier for employers to rehire during the recovery in high UI benefit states than in low benefit states, and therefore may be more inclined to lay off in high UI benefit states during the downswing.

An additional complication with the UI variable should be noted.

That 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 may have been more aggressive in instituting larger UI benefits. Thus a positive and significant relationship between UI benefits and cyclical volatility must be interpreted judiciously.

Unionization

The third argument hypothesizes that cross-state differences in layoff practices are due to cross-state differences in union strength. The argument is based on the "exit-voice" model of Albert O. Hirschman (1970), which was applied more directly to labor markets by Richard Freeman (1978).

According to Freeman's application of the "exit-voice" model workers respond to an unpleasant workplace, low wages, and insufficient benefits in one of two ways. Either workers exit (which includes rejecting a job offer, quitting, absenteeism, a partial withdrawal of labor time, malingering on the job, or quiet sabotage) or workers escape from the objectionable state of affairs through the voice option by staying and establishing collective bargaining.

In non-unionized firms, where discontent leads to quitting, employers judge worker preferences inferentially by linking changes in workplace conditions with quit behavior or by taking "exit surveys." In such cases the limited information obtained by management is based on the objections of the marginal worker, who is more likely to be young and mobile.

Whereas quits reflect the preferences of marginal workers, voice reflects the demands of the average worker. Trade unions "transform the supply side of the job market by making median rather than marginal preferences the determinant of the labor control" (Freeman, 1978: 286). Worker-employer agreements are a complex package of pecuniary and non-pecuniary benefits. The composition of this package, under an exit or competitive market will differ from that established under voice or collection bargaining. Freeman cites the following example. Method A greatly reduces the well being of immobile senior workers, whereas method B has no effect on senior workers, but is unacceptable to the more mobile younger workers. In a market where information is conveyed by quits, the behavior of the young would lead management to choose method A despite the loss in welfare to older workers. In a market with collective bargaining the union might arbitrate the difference in preferences so that the firm will pick B and then provide some compensation for the younger employees.

In a 1979 article, Medoff applied the Freeman version of the "exit-voice" model to the market for labor. Medoff tested 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; leave positions vacated by quits unfilled, reduce or slow the growth in real wages, reduce hours, and increase layoffs.

Adjustments through unreplaced quits are less of an option for the unionized firm than the non-unionized firm. The reason, as implied by the above argument, is that the quit rate for unionized firms is relatively low (Freeman, 1978; Johnson, 1976).

A second option for labor adjustments is a reduction in wages. Empirical studies indicate that the relative impact of unions on wages has tended to increase during economic downturns. Hamermesh (1970; 1972) and Lewis (1978) found that wages in the union sector are less sensitive to changes in the unemployment rate than are wages in the nonunion sector. This finding suggests that unionized establishments are relatively less likely 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, would 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 non-unionized 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.

Based on 2-digit standard industrial classification (SIC) data for several state groupings, Medoff's results implied that in the 1965-69 period, workers in unionized establishments had a higher probability of being laid off than did nonunionized workers in similar firms. Using 3-digit SIC code data for 1958-71, Medoff's results suggested that the average monthly layoff rate during the 1956-71 period was .010 in non-union firms and .022 in similar but unionized firms.

Medoff's result is supported by Feldstein (1978). In the same study cited earlier, on the effects of UI benefits on layoffs, Feldstein found that the relationships were stronger for union members than non-union members. That is, union members had higher temporary layoffs and their layoffs were more sensitive to UI benefits than non-union members. In a sample of 6,845 union members, the temporary layoff rate was 3.14 percent, twice the rate of non-union members. In a regression equation of layoffs regressed against UI benefits and a union dummy, the coefficient on the union variable indicated that the temporary layoff unemployment rate was 1.15 percentage points higher than the rate for non-members (Feldstein, 1978: 840-841).

There is one additional hypothesized reason for the positive relationship between unionization and layoffs. 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 give up 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 has shown that years of tenure with an employer are positively correlated with unionization (Freeman, 1978). These results are consistent with the argument that workers are willing to wait out the recession to hold on to a union job.

Union members tend to be highly skilled workers. Since workers are reluctant to lay off highly skilled employees, the impact of unionization on the severity of states recessions will be counteracted by the fact that the workers are more likely to be skilled and costs of retraining relatively high.

Summary--Local Component

To summarize, the local component includes state-specific economic and institutional factors, hypothesized to influence the cyclical variability of states. These local factors are the capital-labor ratio, age-of-the-capital stock, unionization of the labor force, peak-level unemployment rates, and the ratio of unemployment benefits to wages.

The local component is measured as:

$$\dot{E}_{Ljr} = \hat{\dot{E}}_{jr} \left(\beta_1 KL_{jr} + \beta_2 A_{jr} + \beta_3 U_{jr} + \beta_4 UE_{jr} + \beta_5 UI_{jr}\right) \qquad (3\text{-}19)$$

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

KL = The capital-labor ratio.

A = The age of capital stock.

U = The proportion of the labor force that is unionized.

UE = The peak level unemployment rate.

UI = The ratio of unemployment insurance benefits to wages.

The local component, equation 3-19, includes the national component, $\hat{\dot{E}}$. This formulation implies that the magnitude of the beta coefficients depend upon the level of the national component. A large expected recession signifies that the state has a large proportion of cyclically sensitive industries. Firm managers of those industries must make output and layoff decisions and the more severe the decline in demand the greater the necessary 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 cyclically sensitivity of a firm's exports, the more important the local component in explaining fluctuations in employment and output.

Variables not Included Due to an Absence of Data

There are several additional local factors that may cause differences in cyclical employment across states but that could not be tested due to the lack of data. A discussion of these factors is the current topic and again the points will be organized by whether they propose cross-state differences in industry's aggregate demand, output responses to reductions in aggregate demand, or employment responses to reduction in output.

Cross-state variations in aggregate demand may still occur even when industry mix is held constant. In addition to testable hypotheses discussed earlier, it is hypothesized that these variations may occur because a state supplies a disproportionate share of its output to foreign markets or because of multiplier impacts on intermediate suppliers. The timing of foreign business cycles 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, during a domestic recession, a milder decline in aggregate demand than will states supplying domestic markets during a recession.

Furthermore, the aggregate demand of intermediate producers tied to local markets will diverge from that industry's behavior nationally. Intermediate producers supplying local and cyclically stable industries will be less sensitive than the national average whereas firm supplying cyclically volatile industries will be more sensitive than average. For example, SIC code 227, floor coverings, may be more cyclically sensitive in Michigan, where they produce carpeting for cars, than in California, where rugs are produced for homeowners.

The stability or instability of trading partners should also influence the amplitude of a state's cycle. Demand for 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 cycle larger than that of the national tire industry, while a state selling tires to Kansas should expect a smaller than average cycle. The influence of the cyclical behavior of states trading partners is not captured in the model of this study.

In addition to cross-state differences in aggregate demand, industries may respond to similar reduction in aggregate demand with dissimilar inventory policies. If inventory policies are inconsistent across states, the result will show up in cross-state differences in employment cycles. A number of factors determine a firm's inventory holdings, many of which will be accounted for in the industry mix, or expected recession variable. For example, firms producing quickly obsolete goods tend to hold small inventories; firms with a high variability in sales generally hold larger inventories, greater total sales generally correspond to a smaller proportion of inventory holdings; and oligopolists may hold larger inventories in order to stabilize prices (Scherer, 1970: 152). These and other determinants of inventory holdings are held constant by controlling for industrial mix.

However, there are probably some factors that are not accounted for. Again, firms producing for a local market are more susceptible to the behavior of their local purchasers than firms producing for export to a national market. Therefore, these firms faced with a more volatile demand from purchases may be more likely to increase inventories during the recession than firms supplying to a more stable purchaser. Also, it is possible that inventory taxes and laws vary across states. While it has not been possible to find data to shed light on this question, it is clear that firm's inventory policies are highly responsive to tax policies.

Finally, employment policies, or layoffs, may vary across states because of differences in employee skill levels. Firms that use unskilled labor in the production process can lay off workers during the recession and rehire new workers during the recovery without the expense of retraining, whereas firms dependent on skilled labor may anticipate high retraining costs and be more inclined to retain their workers through the recession. It, therefore, seems reasonable for firms in different regions within the same industry to have different skill requirements and that regions with a high proportion of firms dependent on unskilled labor will experience more severe employment losses.

Unfortunately, there are limited data on skill levels or the amount of on-the-job or prior training in industries by state. However, there is some evidence that skill levels do affect firms' layoff decisions. In a study of the New England machine tool industry, Glynnis Trainer found that during the 1973-75 recession the machine tool industry tended to hoard labor. Shortages of skilled workers made it difficult for them to rehire during past economic recoveries and employers had learned from experience that it was more efficient to support their workforce through the downturn than to lay off and attempt to rehire them later (Trainer, 1979: 94). While Trainer found that shortages of skilled machine tool workers were geographically pervasive, this finding does point out the existence of a relationship between employee skill levels, labor shortages, and layoff practices.

Some of the failure to capture the importance of cross-state differences in skill levels will be captured in the capital-labor ratio and unionization variables. Skilled labor and capital tend to be complements. This positive association will reinforce the hypothesized result of a negative relationship between layoffs and capital-labor ratios. Skilled labor and unions also tend to be complements and the higher expected layoffs for union members is expected to be counteracted by the lower layoff rates for skilled labor.

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 for five reasons. The capital-labor ratio, age-of-the-capital stock, unionization, unemployment insurance benefits, and peak-level unemployment all influence the severity of state recessions, and cause the actual recession to be either greater or milder than the expected recession. 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 a recession in residentiary activities is assumed, in this thesis, to be explained by the severity of the recession in the export or manufacturing sector of the local economy and the short-run multiplier. As demand for exports fall, incomes in the export sector fall, leading to a decline in demand for local services. So that the more cyclically sensitive the state's composite of export industries and the larger the export-base multiplier, the greater the impact on residentiary employment.

The residentiary sector in this study was assumed to include construction; wholesale and retail trade; transportation; utilities; finance, real estate, and insurance; government; and services. The formulation of the multiplier is described in more detail in the following section.

Multiplier

The multiplier measures the impact of a percentage decline in export employment on the percentage decline in residentiary employment. More specifically the multiplier was formulated in the following manner. The short-run export-base multiplier was incorporated into the model by hypothesizing the relationship that:

$$\hat{\dot{E}}_{s_{jr}} = \mu\left(\frac{E_m}{E_T} \quad \dot{E}_m\right)_{jr} \qquad (3\text{-}20)$$

where

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

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

E_m/E_T = the proportion of total employment in manufacturing.

superscript r = State, ..., 48.

subscript j = Recessions 1, ..., 5.

The larger $\dot{E}_m$, E_m/E_T and μ the more severely the recession affects the residentiary sector. The parameter μ is an endogenously determined short-run multiplier, measuring the affect of severity of the recession in the export sector, weighted by the size of the export sector, on the state's residentiary sector. The parameter μ should range between zero and the long run export-base multiplier, $1/(1 - E_s/E_T)$ or $1/(E_m/E_T)$ and should approach the long-run multiplier the more prolonged the recession. This is shown below in equations 3-21 through 3-23.

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, replacing $\dot{E}_m$ with $\dot{E}_s$;

$$\dot{E}_{s_{jr}} = \mu(\frac{E_m}{E_T} \cdot \dot{E}_s)_{jr} \qquad (3\text{-}21)$$

$$(\frac{\dot{E}_s}{\dot{E}_s}) = \mu(\frac{E_m}{E_T})_{jr} \qquad (3\text{-}22)$$

$$\mu = 1/(E_m/E_T)_{jr} \qquad (3\text{-}23)$$

The severity of the recession in manufacturing, $\dot{E}_m$, is weighted, in equation 3-20, 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. Without the weighting of $\dot{E}_m$ by E_m/E_T, μ would be biased downwards.

The parameter μ is expected to be small relative to other multipliers such as those of the Multiregional Input Output Model (MRIO) or the Regional Industrial Multiplier System (RIMS). The estimated μ of this study measures the effect of a short-run, temporary, and marginal change in export employment on residentiary employment, whereas the multipliers of the RIMS or MRIO models estimate long-run, permanent and average multipliers.

Because μ is a short-run multiplier it is likely that the first round of impacts of change in export employment on residentiary employment are not played out. That is, given the relatively brief nature of the five post World War II recessions, μ may not reach the size of first round or direct multipliers calculated from comparable but long-run models.

The parameter μ is also expected to be of small magnitude because it measures the effect of a temporary change in manufacturing employment on residentiary employment. Because employers in the residentiary sector expect the fluctuation in manufacturing to be temporary, they are less likely to alter their behavior, by cutting output and laying 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. In either case, we would expect a relatively stable residentiary sector and a small value for μ.

Alternative multiplier estimates, such as those made by RIMS and MRIO are not only long run estimates but they measure the effect of a permanent change in employment in a given sector on total employment in the state. Economic actors, in this case, are assumed to behave as if the exogenous change in employment (such as a cut in regional defense expenditures) is permenent. Entrepreneurs, therefore, alter their behavior by laying off employees, halting all expansion of capital, and cutting orders on raw materials and inputs. This is one reason for the expected difference between the size of multipliers of the RIMS and MRIO models and the expected value of μ.

Another reason for an expected small value for μ in relation to other multiplier estimates is that μ captures a marginal change in employment whereas multipliers estimated with the Multiregional Input Model and the RIMS model are average values. Changes at the margin should be smaller than average changes, in part due to the above argument, but also because supply constraints and substitutability among factors are ignored in empirically estimated average multipliers, but accounted for in empirically estimated marginal multipliers.

A final difference between μ and other commonly used multipliers is that μ does not capture interindustry effects. Thus we should expect μ to be smaller than multipliers, such as the RIMS or MRIO multipliers, that capture these effects.

Shortcomings of the Export Base Formulation

There are a number of shortcomings of the export-base formulation, many of which have been well documented (Blumenfield, 1955; Tiebout, 1956; Borts and Stein, 1964; and Richardson, 1969). Only the criticisms particular to this study will be addressed here. First the division between manufacturing as exports and services as non-basic is not clear cut. Some services are exported and their demand determined exogenous to the state. For example, insurance services in Connecticut are an export industry.

Secondly, agriculture is an export industry and an important one for some states, such as California. Because agricultural employment was excluded from the data, μ is likely to be biased in agricultural states because $\dot{E}_s$ reflects percentage changes brought about by fluctuations or stability in agriculture, when agricultural employment is not included in $\dot{E}_m$.

Third, the multiplier estimated by equation 3-23 is an average value calculated with cross-section data. Interesting and important cross-state differences in μ will, of course, be missed because data limitations eliminated the possibility of calculating a separate for each state with time-series data.

Finally, service or residentiary activities may behave independent of the manufacturing sector. For example, services in some states have grown rapidly in the last few years because of the growth of retirement communities. In such cases service industries are independent of manufacturing fluctuations and instead grow and decline with the changes in the number of retirees and social security and other retirement benefits.

Econometric Model

This final section of Chapter Three lays out the models used to test the hypotheses described above. The statistical methods were primarily econometric, using a combined cross-section time-series equations. The analysis was carried out for all industries, the machinery industry (SIC 35) and the textile industry (SIC 22).

All-Industry Model

The final all-industry equation was derived by substituting equations 3-2, 3-11, 3-19, and 3-20 into 3-1. This equation is equal to:

$$\dot{E}_{jr} = \frac{E_s}{E_T} \mu \left(\frac{E_m}{E_T} \cdot \dot{E}_m \right)_{jr} + \frac{E_m}{E_T} (\hat{\dot{E}}_{jr} + \hat{\dot{E}}_{jr} (\beta_1 KL_{jr} + \beta_2 A_{jr} + \beta_3 U_{jr} + \beta_4 UE_{jr} + \beta_5 UI_{jr})) \tag{3-24}$$

Replacing $\dot{E}_m$ with equations 3-2, 3-11, 3-19:

$$\dot{E}_{jr} = \frac{E_s}{E_T} \mu\{[E_m/E_{T_{jr}} (\hat{\dot{E}}_{jr} + \hat{\dot{E}}_{jr} (\beta_1 KL + \beta_2 A + \beta_3 U + \beta_4 UE + \beta_5 UI))]\} + \frac{E_m}{E_T} (\hat{\dot{E}}_{jr} + \hat{\dot{E}}_{jr} (\beta_1 KL + \beta_2 A + \beta_3 U + \beta_4 UE + \beta_5 UI)) \tag{3-25}$$

factoring out the component, $\dot{E}_{m_{jr}}$

$$\dot{E}_{jr} = [1 + \mu\ (E_s/E_T)] \cdot [(E_m/E_T) \cdot (\hat{\dot{E}}_{jr} + \hat{\dot{E}}_{jr}\ (\beta_1 KL_{jr} + \beta_2 A_{jr} + \beta_3 U_{jr} + \beta_4 UE_{jr} + \beta_5 UI_{jr}))] \qquad (3\text{-}26)$$

where

$\hat{\dot{E}}_{m_{jr}}$ = $[(\sum_{i=1}^{20} \dot{E}^{i}_{m_{jo}} \cdot \omega^{i}_{jr})]$

A_{jr} = $[(I_{jr(t)} + I_{jr\ (t-1)} + I_{jr(t-2)})/K_{jr(t)}]$

$\dot{E}$ = Trend-adjusted severity of a recession, calculated as the percent decline in employment.

μ = Short-run multiplier.

E_s/E_T = Proportion of total employment in local or service industries.

E_m/E_T = Proportion of total employment in export or manufacturing industries.

ω^{i}_{r} = Percentage of each state r's manufacturing industry in 2-digit industry i.

KL = Capital-labor ratio.

I = Total investment in fixed plant and equipment.

K = Value of the capital stock.

U = Percent of the labor force that is unionized.

UE = Peak-year unemployment rate.

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

subscript s = Residential or local industries.

subscript m = Manufacturing or export industries.

subscript T = Total employment.

subscript j = Recessions 1, ..., 5.

subscript o = National data.

subscript r = States 1, ..., 48.

superscript i = Manufacturing industries, 1, ..., 20.

subscript t = Time.

Equation 3-26 explains the severity of a state's recession in two components. First there is an employment decline in the manufacturing sector. This percentage fall in cyclical manufacturing employment is caused by a decline in demand for a state's exports as well as several characteristics of the local manufacturing sector that may either aggravate or dampen the recession's impact. The effect of the recession in the manufacturing sector on total employment depends on the proportion of the state's employment in manufacturing. Thus the component $\dot{E}_{m_{jr}}$ is weighted by E_m/E_T.

A second component of a state's recession depends upon the loss in employment in the residentiary sector which, according to export-base theory, is a function of the change in employment in manufacturing. Thus the multiplier, μ, measures the impact of a change in manufacturing, weighted by the size of the manufacturing sector, on services. This change in services is weighted by E_s/E_T to get the magnitude of the impact on total employment.

The greater the magnitude of the short-run multiplier, the recession in manufacturing, or the size of the manufacturing sector, the greater the severity of the recession in the service sector. The larger the service sector the greater the impact of $\dot{E}_s$ on total employment.

Thus, a state's recession is explained by the loss in employment in the manufacturing sector, weighted by the importance of manufacturing in the state economy, and by a second round of employment declines in services, caused by the decline in income and output in the manufacturing sector, and weighted by the size of the residentiary sector. Equation 3-26 was estimated with non-linear least squares, using 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 3-26 using non-linear squares. The model was tested on data for each recession, as well as for all recessions combined. Allowing 50 iterations and a number of starting values,only two recession-specific equations would converge. Those were the equations representing the 1953-54 recession and the equations representing the 1969-70 recession. 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. When the coefficients on the independent variables are statistically insignificant, the maximum likelihood surface is relatively flat. The least squares program searches over this likelihood surface for maximum values, or peaks. When no peaks are found the program continues to search, and convergence does not occur.

Although the parameters for the combined cross-section time-series equation could be estimated using non-linear least squares, 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 as the pooled recession data, the model was simplified and re-estimated with linear least squares. The simplified model is:

$$\dot{E}_{jr} = \frac{E_m}{E_T} (\hat{\dot{E}}_{m_{jr}} + \hat{\dot{E}}_{m_{jr}} (\beta_1 A_{jr} + \beta_2 A_{jr} + \beta_3 U_{jr} + \beta_4 UE_{jr} + \beta_5 UI)) + \frac{E_s}{E_T} \mu (\frac{E_m}{E_T} (\hat{\dot{E}}_{m_{jr}})) \qquad (3\text{-}27)$$

Equation 3-27 assumes that only the expected recession, based on industry composition, 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 model.

Disaggregate Model

A model similar to the all-industry equation is used to test the hypotheses with data from machinery manufacturing (SIC 35) and textile manufacturing (SIC 22). The industry-specific models differ slightly from the all-industry model (Eq. 3-26) in form and in theoretical implications.

The disaggregated model, as in the case of the all-industry model, divides the cycle into a national and local component. The national component explains the state's 2-digit industry recession in terms of fluctuations in national demand for the products of 3-digit industries.

The local component, again, tests the hypothesis that local economic and institutional conditions dampen or aggravate the effects of the national component. These local conditions include the capital-labor ratio, age-of-capital, unionization, peak-year unemployment, and unemployment insurance benefits.

$$\dot{E}'_{jr} = \hat{\dot{E}}'_{jr} + \dot{E}'_{L_{jr}} \quad (3\text{-}28)$$

$$\hat{\dot{E}}' = \sum_{i=1}^{9} (\dot{E}^{i\,'}_{o} \cdot \omega^{i\,'}_{r}) \quad (3\text{-}29)$$

$$\dot{E}'_{L} = \hat{\dot{E}}'_{jr} (\beta_1 KL'_{jr} + \beta_2 A'_{jr} + \beta_3 U'_{jr} + \beta_4 UE_{jr} + \beta_5 UI_{jr}) \quad (3\text{-}30)$$

where the variables are the same as described above except that:

superscript i = 1 ..., 9 3-digit SIC code level industries.

superscript ' = Data specific to the textile or machinery industry.

$$\dot{E}'_{jr} = \hat{\dot{E}}'_{jr} + \hat{\dot{E}}'_{jr} (\beta_1 KL'_{jr} + \beta_2 A'_{jr} + \beta_3 U'_{jr} + \beta_4 UE_{jr} + \beta_5 UI_{jr}) \quad (3\text{-}31)$$

Whereas the all-industry model measures the macroeconomic all-industry relationships, the industry-specific model tests microeconomic relationships. For example, the level of a state's unemployment insurance benefits may have a stabilizing affect on employment, when all-industries are included in the model. High benefits act as an automatic stabilizer, maintaining incomes and employment in the residentiary sector. On the other hand, the relationship between unemployment insurance and severity of the cycle may be reversed at the microeconomic or industry-specific level. That is, high unemployment benefits are expected to have a destabilizing affect at the industry-specific level, because high benefits encourage layoffs. This argument is made in more detail earlier in this chapter. Another obvious difference between the macroeconomic all-industry model and microeconomic industry-specific model is the exclusion of the multiplier from the second model. A multiplier is a macro concept and is not relevant to a particular export industry's cycle.

Another reason for the disaggregate model is that it permits a more precise test of several of the hypotheses included in the local component. It is suspected that, in the all-industry model, heterogeneity within the 2-digit SIC categories of the expected recession may cloud the measurement of the local components. In the all-industry model, disaggregating the national component or expected recession to the 3-digit rather than 2-digit level would have been difficult.

Calculating the expected recession for the all-industry equation required weighting the recessions of twenty 2-digit national industries by the i composition in forty-eight states, in five recessions. To disaggregate the expected recession to the 3-digit SIC code level would have required calculating the severity of the cycle in nearly two hundred national industries, for five recessions, as well as calculating two hundred weights for forty-eight states, for all five recessions. Clearly the mechanics of such computations would be exceedingly expensive in computer costs and time.

It did, however, seem important to attempt a further disaggregation of the data. As is well known, there are large differences in the manufacturing industries that fall within the 2-digit SIC code category.

For example, aircraft, tractors, and autos all fall into SIC code 37, each of which respond very differently to the business cycle.

In order to get a more refined expected recession, and therefore a better test of the remaining independent variables, the two 2-digit industries of machinery and textile manufacturing were selected for further disaggregation. The national component or expected recessions for these two industries were calculated from the nine 3-digit level industries within each 2-digit industry.

Machinery manufacturing and textile manufacturing were selected for three reasons. First, it was believed that a comparison of the results of a durable and a non-durable goods industry may yield interesting results. For example, durable-goods production is typically more cyclically sensitive, and therefore should exhibit more variation in the dependent variable. The greater the variation in the dependent variable the better the test of the independent variables; it is possible, therefore, that the model would explain fluctuations in the durable goods industry better than in nondurable goods, implying that the fits for the all-industry equation were poorer due to the averaging of durable and nondurable goods.

Aside from the constraint of selecting one durable and one nondurable goods industry, the choice was based on maximizing the availability of data, and finding industries that were as widely dispersed geographically as possible.

The machinery industry analysis includes 34 states and two recessions, 1970-71 and 1973-74. The textile data were available for 24 states and the 1970-71 and 1973-75 recessions. The data, their sources and the calculation of the variables for the all-industry, machinery and textile industries are described in detail in the following chapter.

Summary

To summarize, this study will test the extent to which national fluctuations in demand for a state's exports, local economic and institutional factors, and fluctuations in a residentiary sector explain the recessionary phase of a state's employment cycle. The local economic and institutional factors include capital-labor ratio, age-of-the-capital stock, peak-year employment rates, the size of unemployment insurance benefits, and unionization.

The fact that a state's industrial mix influences a state's recession has been well documented. However, all findings concur that industrial composition does not explain all cross-state differences in cyclical amplitude. It is the purpose of this thesis to identify other factors. States with cyclically sensitive industries and large export base multipliers are expected to have more severe fluctuations in basic industries than the straight industry-mix hypothesis would suggest. States with a high average-age capital stock, and a low capital-labor ratio are expected to bear disproportionate declines in aggregate demand due to higher marginal and average costs. Tight peak-year labor markets and low unemployment insurance benefits of the industry level are expected to make rehiring during an economic recovery problematic and, therefore, hinder layoffs during a downturn, and finally, union collective bargaining may lead to contracts that favor layoffs to other labor demand adjustments.

In addition to the all-industry model, an industry-specific model, to be tested with data on machinery manufacturing and textile manufacturing, is laid out. The purpose of this thesis is to test the importance of each of the variables proposed to influence a state's cyclical sensitivity. This test will be carried out at a macroeconomic level with data on all-industries as well as at a microeconomic industry-specific level.

CHAPTER 4

DATA SOURCES AND VARIABLE CALCULATIONS

Chapter Four describes the variables used to estimate equation 3-26 of Chapter Three. First, the data, their sources, and their limitations will be described; and second, the procedure used to transform the data into variables will be documented. In most cases these two steps will be completed for one variable before proceding to the next. The variables used in equation 3-26, are the severity of the state recession, expected recession based on industry composition, capital-labor ratio, age of the capital stock, extent of unionization, unemployment insurance benefits, and peak-year unemployment rate.

Before proceeding, the direction of this chapter will be clearer if the study's organization is briefly restated. In order to explain cross-state differences in cyclical variability, the empirical work is divided into three sections. First, an all-industry equation is tested, using data on forty-eight states and five post World War II recessions. A second analysis focuses on the machinery industry, using thirty-four states and three post World War II recessions, and the final analysis includes data on the textile industry from twenty-four states and two post World War II recessions. Each variable was, therefore, calculated, in most cases, three times, once for each of the three industry breakdowns described. The calculation of the dependent variable, the severity of the recession will be described first.

Severity of the State Recessions

The severity of the states' recessions are measured as percentage declines in non-agricultural employment, from the peak to the trough of the business cycle. In the section that follows the basic data, their limitations, the seasonal adjustment process, and the final calculations of the severity measures will be described.

The dependent variables were calculated from state and state-by-industry monthly employment data obtained from the Bureau of Labor Statistics (BLS). The dependent variable for the all-industry equation was calculated from all non-agricultural employment, while the dependent variables for the machinery and textile equations were calculated from manufacturing employment at the 2-digit Standard Industrial Code (SIC) Level for those industries. These monthly employment series span various time periods, but in most cases the all-industry series extend from 1950 to 1979 and the state-by-industry data extend from 1968 to 1976.

The employment data represent the total number of persons employed either full-time or part-time during a specified payroll period, and are collected by the Bureau of Labor Statistics (BLS) each month from a sample of business establishments in all non-agricultural activities. The business establishments participating in the survey extract the data from their payroll records. In 48 states, participation in the survey is volunatry. In California and North Carolina participation is required by state law.

The BLS's method of sample selection is known as the "sampling proportionate to average size of establishment" technique. This procedure involves stratifying the establishment population by industry and then within each industry by size of establishment, in terms of employment. For each industry the number of sample units is distributed among the size class cells. Under this type of design, large establishments within an industry fall into the sample with certainty. Thus, in a manufacturing industry in which a high proportion of total employment is concentrated in a few establishments, a large percentage of the industry's total employment is included in the sample. On the other hand, in an industry which a large proportion of total employment is in small establishments, it is necessary to accept samples with a smaller proportion of universe employment.

In March of each year, a complete count of total employment in each industry and state is collected and used as an employment benchmark. The employment benchmark information is, in most cases, compiled by the State Offices of Employment Security, because of their role in administering unemployment insurance programs. For the few industries exempt from unemployment insurance, the BLS uses alternative sources of data. Employment data on non-office insurance sales workers and private educational services are collected by the Bureau of the Census and published in the _County Business Patterns_; data for interstate railroad workers employment are obtained from the Interstate Commerce Commission; data on private elementary and secondary school employees are derived from the U.S. Office of Education and the National Catholic Welfare Association; and government employment numbers are acquired from the U.S. Civil Service Commission and the _Census_ and _Survey of Governments_ conducted by the Bureau of the Census.

A procedure known as the benchmark and link-relative technique is used for estimating monthly employment. This method takes advantage of the complete annual count of employment and the monthly sample of employment levels in successive months in identical establishments. For example, if total count employment for a given series (e.g., employment in electrical components in Maine)was 50,000 employees in March, while the sample count was 25,000 employees in March and 26,000 in April, the April estimate would be derived from the following calculation:

$$50{,}000 \times \frac{26{,}000}{25{,}000} = 52{,}000$$

Any discrepancies between two annual employment benchmarks are spread evenly across all intervening months.

There are several potential shortcomings of the data. One is that anyone working part-time or full-time is counted as employed. As the economy moves through the recessionary phase of the business cycle it is likely that many workers move from full-time to half-time employment. In such cases growing underemployment will not show up in the statistics, underestimating the employment impact of the business cycle. This problem may well influence the results of the study when there are cross-state differences in the proportion of workers that are laid off versus shifted from full-time to part-time work. Such cross state differences are expected to occur. For example, Medoff found that unionized work forces tended to favor lay offs to part-time work. Medoff suggests that this finding may be due to the seniority system within unions, where senior union members prefer lay offs to across-the-board cuts in hours worked (Medoff, 1979). Thus, it is possible that in non-unionized states, the data tend to disguise more underemployment than in unionized states.

A second problem with the data is estimation error in the sample data. In order to insure promptness in publishing survey results, the sample size is kept at approximately 130,000 to 150,000 establishments. While this reflects about 42 percent of total non-agricultural employment, the coverage within industry categories, as mentioned earlier, depends upon the industry (Employment and Earnings, May 1973: 163-164).

A small sample is most accurate for cyclically stable and concentrated industries. In industries composed of many small, cyclically volatile firms, a relatively larger sample size is necessary to insure the same estimation error. For example, estimation errors are greater for the construction industry than durable goods industries, even though both are cyclically volatile. Since durable goods industries are characterized by a relatively few large firms, a small sample can capture a large proportion of their total employment. In contrast, the construction industry is comprised of a large number of relatively small economic units. Thus, a small sample less accurately captures cyclical employment fluctuations in construction. The problem of measurement error in the construction industry is further aggravated by the fact that construction firms enter and leave the industry more frequently than the larger firms of durable goods industries. Therefore, it is more difficult for the BLS to sustain a consistent sample over time.

How do these sampling errors affect the data for the machinery and textile industries? Typically, the machinery industry is more cyclically sensitive than the textile industry; however, the 1973-74 recession was an exception. In the 1969-71 recession, the textile industry's employment declined from its trend by 1.8 percent, while the same figure for the machinery industry was 3.7 percent. However, in the 1973-75 recession the trend-adjusted severity of the textile industry was 11.1 percent. This was larger than the 4.6 percent decline in machinery employment. The relative cyclical variability of the machinery industry is due to its durability. As mentioned earlier durable goods tend to be more cyclically sensitive than nondurables. Textile's relative cyclical sensitivity in the 1973-75 may be due to its use of petroleum in the production of synthetics.

Also, there are slight differences in the industry structures of textiles and machinery production, with the textile industry being slightly more concentrated. In 1972, 0.1 percent of the establishments producing textiles and 0.2 percent of the establishments producing machinery had more than 2,500 employees. In the same year 41 percent of the machinery establishments had 1 to 4 employees, while only 15 percent of the textile establishments fell into this category. Thus, there may be some reason to expect somewhat larger sampling errors in the machinery than in the textile industry (Census of Manufactures, 1972: 22-23 and 35-3).

A third problem with the data in addition to sampling error, is that the data are susceptible to reporting errors. These may include undocumented workers, accounting mistakes on the part of business establishments, or a refusal on the part of businesses to participate fully in the survey.

A fourth problem is that establishments are classified according to their major product. Many plants make more than one product. Therefore, employment in secondary product production is underestimated in the employment statistics, while the number of employees producing the primary product is overstated. Moreover, when the composition of a firm's output changes so that what was once a secondary product becomes a primary one, the establishment is reclassified under another industry. This reclassification as well as the overestimation of employees producing the primary products should have little systematic effect on the measurement of the state's business cycles.

A fifth problem is self-employed agricultural workers, domestic workers, and the military are not included in the employment totals. This does not appear to be a serious problem. Agricultural workers would have been excluded from the study anyway, because the hypotheses stated earlier only refer to manufacturing and service industries. The total employment in the remaining omitted occupational categories is quite small and therefore does not create significant gaps in information.

One advantage of the BLS data collection method should be noted. For purposes of the employment survey, an establishment is defined as a single physical location where business is conducted, or a unit for which separate inventory and monthly payroll records are maintained. When a company has several plants or establishments, the BLS attempts to obtain separate reports for each establishment. This procedure avoids the problem of overestimating employment in the states with the firm's headquarters and understating employment in areas with its branch plants.

As has been made clear, employment, rather than unemployment, was selected to measure the severity of the state recessions. Historical unemployment data by state are substantially less reliable than monthly employment data by state for two reasons. First, the definitions of who is unemployed for purposes of Unemployment Insurance benefits (UI) varies by state. State unemployment rates are estimated from the numbers of individuals collecting UI. However, both eligibility and size of UI vary by state, and thus the base for calculating unemployment rates is regionally inconsistent. For example, a worker is counted as unemployed for UI purposes as long as earnings from part-time work do not exceed the "disregard point"--that is, the point where a portion of the claimant's weekly benefit is withheld due to his or her earnings in part-time employment. This disregard point varies by state: in Alabama ($6), Minnesota ($25), and West Virginia ($15) the disregard point is a flat rate; in Colorado (one-fourth), Louisiana (one-half), and New Hampshire (one-fifth) the disregard point is a portion of the weekly UI benefit. Other states such as Delaware, Indiana, and Vermont have even more complicated formulas (Wetzel and Ziegler, 1974: 43). The implication for state unemployment rates is that the base from which they are calculated varies by state, leading to problems in the comparability of state unemployment rates.

Secondly, even if the base numbers of insured unemployed were consistent across states, there are biases created by the formula used to adjust these base numbers upwards to equal state unemployment rates. The adjustment formula relies on assumptions of seasonality of local industries, the demographic structure of the work force, the ratio of workers covered by UI benefits to those not covered, and the rate of employment growth. Since these factors vary by state, the formula inevitably biases state rates. These biases in the adjustment formula also reduce the comparability of unemployment rates across states (Wetzel and Ziegler, 1974: 40-43).

To summarize, because the focus of this thesis is cross-state variations in cyclical employment, it is especially important that the data be comparable across states. The non-agricultural employment data are judged to be superior, in this respect, to the state-level unemployment data.

We now turn to the seasonal adjustment process of the monthly employment series. The original state BLS monthly employment data are unseasonalized. Seasonal movements in the data are caused by climatic conditions, vacation practices, holidays and similar factors and are often large enough to mask or accentuate the cyclical movement in data. Therefore, before the severity of recessions could be calculated, these annually repetitive or seasonal movements in the data had to be eliminated.

This was done with Shiskin's seasonal-adjustment procedure. Shiskin's method was selected because it was the only seasonal adjustment package available on the Univac Computer, where the empirical work of this thesis was conducted.

Shiskin's procedure involves several steps. Let T_i, i = 1, ..., N be the original monthly employment series. First T_i was smoothed using a combined moving average and fitted polynomial method. During this step of the procedure, 12 items, (T_{-6}, ..., T_0, ..., T_{+6}) in the time series were selected, a polynomial of degree 3 was fitted to data for these 12 months using a least squares regression method, and the equation was solved for T_0. The solved polynomial at T_0 was the smoothed value. This process was continued throughout the series so that T_1 became T_0, etc.

Next, the ratio of the smoothed to the original series gave the first approximation to the seasonal factors. Let U_i, i = 1, ..., N be the smoothed series obtained from T_i. The first approximations to the seasonal factors were then T_i/U_i. These factors were normalized so that the sum of their values for each year equalled 12.0.

Using these seasonal factors, T_i was deseasonalized by dividing T_i by the normalized first approximation of the seasonal factors. This deseasonalized series was smoothed again. The same process described above was used again, except this time a wider smoothing formula was used to produce a smoother, deseasonalized series. The ratio of the above series to the original series (T_i) was taken and again normalized to produce the final seasonality factors. The original series (T_i) was divided by these final seasonal factors. (Univac , 1973: 10-1, 10-10.)

This procedure was carried out for the 105 employment series. First, the monthly employment series for each of the 48 states was adjusted. Second, the monthly machinery industry employment data for each of the 34 states that had a machinery industry were adjusted. And finally, the textile data for 23 states with a textile industry were seasonally adjusted.

The severity of the regional recessions was calculated from these seasonally adjusted monthly employment series. The actual calculations were carried out in the following way. There are two possible measures of the severity of the state recessions, including an absolute severity measure and a trend-adjusted measure. The absolute severity measure includes the secular trend, whereas the secular trend is removed from the trend-adjusted measure. Figure 4.1 clarifies the computation of each.

The first measure of the severity of the state recessions is called the absolute severity. It is the percentage decline from peak to trough in the seasonally adjusted smoothed data series. In the

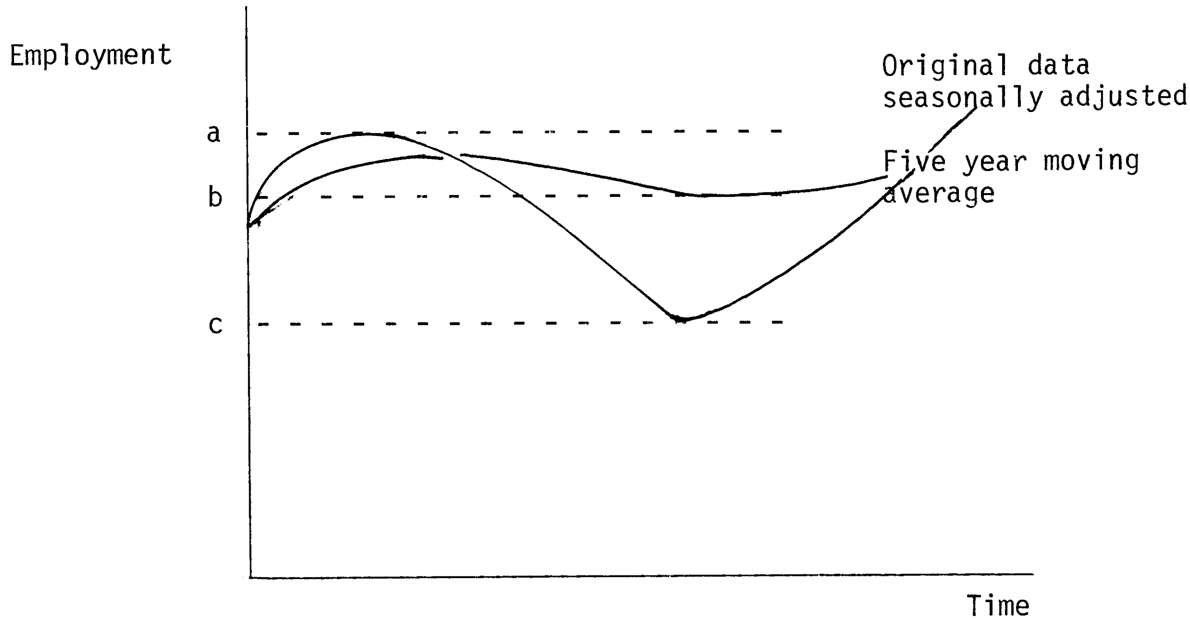


Figure 4.1

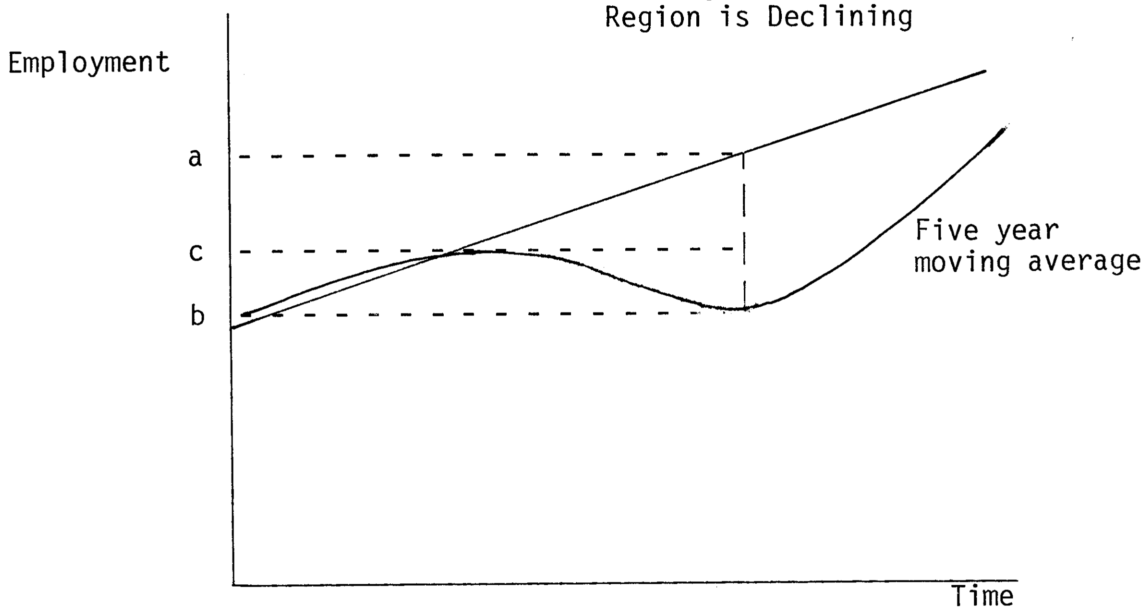
Methods of Calculating Absolute and
Trend-Adjusted Measures of Severity

diagram above, it is equivalent to (a - c)/c.

The second, trend-adjusted severity, measure requires both the seasonally-adjusted series and a five-year moving average of the same original series. This measure is equivalent to the percent deviation of the seasonally adjusted data from the five year moving average at the trough of the recession, or (b - c)/b in Figure 4.1.

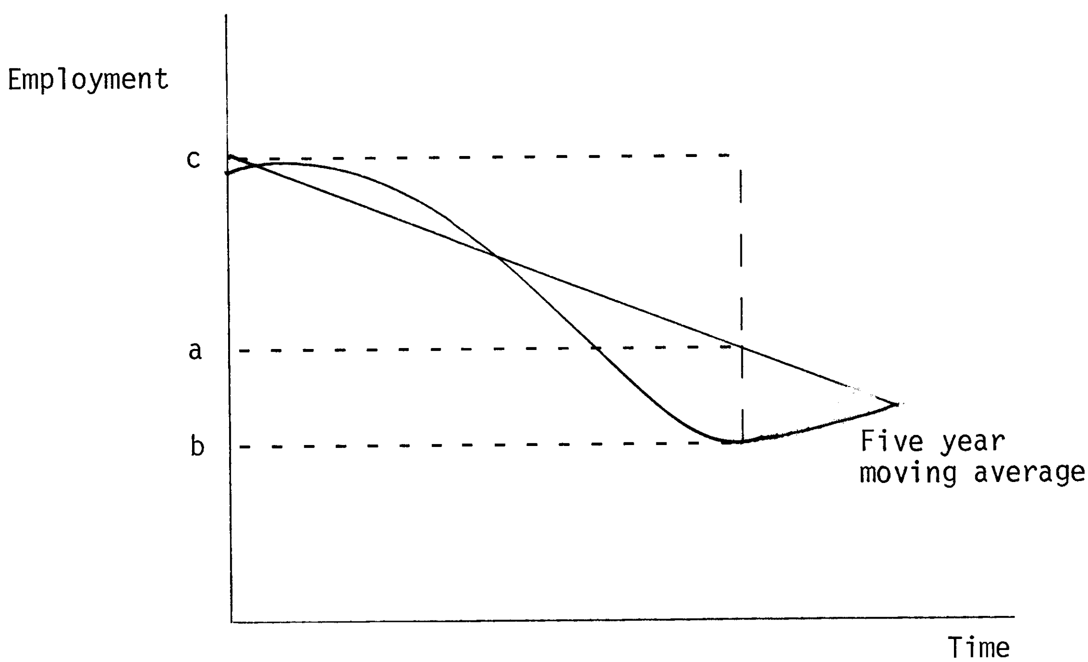
The trend-adjusted variable is the superior measure of the severity of state recessions. By removing the secular trend from the cycle, distortions caused by the influence of long-term growth and decline on cyclical activity are eliminated. For example, if a region is experiencing strong secular growth in employment, then the absolute severity

Comparison of Non Trend-Adjusted Measures for the Severity of Recessions When Region is Growing and When Region is Declining



Absolute Severity for Growing Region

Figure 4.2



Absolute Severity Measure for Declining Region

Figure 3.4

measure of (c - b)/c will be less by definition than a region experiencing secular decline. The trend-adjusted measure circumvents this problem, as can be seen by comparing figure 4.2 with figure 4.3. It is the state cycle, not the cycle plus long term growth, that is of interest in this study. Therefore the trend-adjusted measure is the preferred measure of cyclical variation.

Both measures were calculated for each state for all recessions for total employment and machinery and textile employment. The two measures are compared in Chapter Five.

In all cases the timing of the recessions was allowed to vary across states and industries, so that, for example, the date of the trough in New Jersey may differ from the date of the trough in Indiana. In other words, all calculations were made at each state's individual trough and/or peak. The idiosyncracies of each set of severity variables are discussed in the following sections.

All Industries

Total state employment data are not available for all states for the total time span studied here. The states and time periods for which data are not available include Arkansas, 1950-58; Connecticut, 1950-71; Louisiana, 1950-59; Maine, 1950-71; Massachusetts, 1950-71; Michigan, 1950-71; New Hampshire, 1950-71; New Jersey, 1950-71; Oklahoma, 1950-57; and Texas, 1950-58. The observation for these states within these years were, therefore, eliminated from the all-industry analysis.

Machinery Industry

The severity of the recessions for the machinery industry--SIC 35--

were calculated in the manner described above. Unfortunately these dependent variables could not be computed for all states and all five recessions. One reason is that many states have insignificant numbers of employees in the machinery industry. This is the case for Alabama, Arizona, Delaware, Kansas, Maine, Montana, Nevada, New Mexico, North Dakota, South Dakota, Utah and Wyoming. A more pervasive reason, however, for the elimination of many observations is that in 1972 the SIC codes were revised. While each state is required to update its industry data in order to provide a consistant historical industry series, most states, such as California, Illinois, and New Jersey, had not completed the task at the time of the study. Therefore, there are no data, prior to 1972, for many states with large machinery industries. The states and years included in the machinery industry recessions are noted in Table 4.1. The states excluded for reasons other than the lack of employment data are coded by reasons for exclusion.

When computing the trend-adjusted dependent variable, four observations are lost, due to the calculation of the five-year moving average. When computing a five-year moving average, 30 months of data are lost at the beginning and end of the series. For this reason, observations for Maryland for the 1970-71 recession and Indiana, Kentucky, and Oklahoma for the 1960-61 recession could not be calculated. As mentioned above the actual timing of the recessions was allowed to vary across states.

Textile Industry

For the textile industry as well, employment data are not available for the states with a negligible textile industry. The states eliminated from the analysis because of an insignificant textile industry

Table 4.1

State Included in Analysis of Machinery Industry

Recession V

Arkansas	Maryland	Oklahoma
California	Massachusetts	Oregon
Colorado	Michigan	Pennsylvania
Connecticut	Minnesota	Rhode Island
Florida	Mississippi[a]	South Carolina
Georgia	Missouri	Tennessee
Idaho[a]	Nebraska	Texas
Illinois	New Hampshire	Vermont
Indiana	New Jersey	Virginia
Iowa	New York	Washington
Kentucky	North Carolina	West Virginia
Louisiana	Ohio	Wisconsin

Recession IV

Arkansas
Florida
Indiana
Kentucky
Maryland[b]
New York
Ohio
Oklahoma
South Carolina
Virginia
West Virginia

Recession III

Indiana[b]
Kentucky[b]
New York[c]
Ohio[c]
Oklahoma[b]

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[a]Eliminated from all equations because capital-stock data can not be calculated

[b]Eliminated from trend-adjusted equations because five-year moving average data are not available.

[c]Eliminated from trend-adjusted equations because the sample is too small.

Table 4.2

States Included in Analysis of Textile Industry

Recession V	Recession IV
Alabama	Alabama
Arkansas	Arkansas
California[a]	Delaware
Connecticut	Georgia
Delaware	Kentucky[a]
Georgia	Maryland
Illinois	Mississippi
Kentucky[a]	New York
Maine	Ohio
Maryland	South Carolina
Massachusetts	Texas[b]
Mississippi	Virginia
Missouri	
New Hampshire	
New Jersey	
New York	
North Carolina	
Ohio	
Oregon[a]	
Pennsylvania	
Rhode Island	
South Carolina	
Tennessee	
Vermont	
Virginia	
Wisconsin	

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[a]Elminated because capital stock cannot be calculated.

[b]Eliminated because five-year moving average data are not available.

and therefore a lack of data, are Vermont, Indiana, Michigan, Minnesota, Iowa, Nebraska, West Virgina, Florida, Louisiana, Oklahoma, Idaho, Colorado, New Mexico, Utah, and Washington.

For 1972 through 1979, monthly employment data are available for 25 states. For the 1968-71 recession data are only available for nine states, and for earlier recessions data are only available for six states.

Monthly employment data for 1972-79 are available for three states that could not be included in the analysis. They are California, Oregon, and Kentucky. In the case of California and Oregon, data on capital investment in their textile industries are withheld due to confidentiality regulations. In the case of Kentucky, the base-year gross book value of depreciable assets is not available. Therefore, for these three states the capital stock values cannot be calculated, and they are eliminated from the analysis. The states included in the textile equations are listed in Table 4.2. This table also notes excluded observations by reason of exclusion. The severity of the state's recessions in the textile industry was calculated in the same trend-adjusted manner described above.

The textile industry is in economic decline. Thus, there are a number of states for which troughs cannot be located due to continuous employment declines, and other states where the magnitude of the recessions appears unusually high. The anticipation and reason for these problems were discussed earlier, and have led to the elimination of the absolute severity measure for the textile industry.

Expected Recession

The second variable is the independent variable, expected recession based on industry composition. Again, this variable was calculated for each state for all recessions, as well as for the textile and machinery industries separately. To capture an expected recession based on industry composition, a statistical standardization technique was used to test the null hypothesis that the cyclical behavior of each industry was independent of its location. Thus, if a state had the same industrial composition as the nation, the state would be expected to experience the same cyclical behavior as the nation. This standardization technique involved calculating the percentage decline in employment in each of the national industries, then weighting these percentage declines by the importance of the industries in a single state.

In order calculate the severity of the national recessions in each industry, the national, seasonally-adjusted monthly employment data from the Bureau of Labor Statistics national industry tapes were adjusted for secular trends. The secular trends were eliminated from the data by converting the original series into five-year moving averages.

Rather than attempt to discuss the calculation of the expected recessions in general terms, the presentation will be made clearer if we turn to specifics of constructing the expected recession for the all-industry equations.

<u>All Industries</u>

To calculate the expected recession for the all-industry equation, the manufacturing sector was subdivided into twenty 2-digit industries. As explained above, only manufacturing industries are included in the all-industry expected recession because the export-base

model is the adopted framework. Demand for
is assumed to be determined nationally, while demand for residentiary goods and services to determined locally.

The expected recessions were calculated, as explained in Chapter Three, with the following equation.

$$\hat{\dot{E}}_{jr} = \sum_{i=1}^{20} (\dot{E}_o^i \cdot \omega_r^i) \tag{4-1}$$

where

$\hat{\dot{E}}$ = Expected recession

$\dot{E}_o^i$ = Trend- adjusted severity in national industry i

ω^i = Proportion of employment in industry i

i = Industries 1, ..., 20

r = States 1, ..., 48

j = Recessions 1, ..., 5

The severity of the recessions in each national industry was calculated from the national BLS data. These data are collected in the same manner as the state statistics described earlier, and the same shortcomings hold for them as well.

The national data, at the 2-digit SIC code level and major industry division are seasonally adjusted. The BLS seasonally adjusts their series using the X-11 Census Bureau method, a method similar to the Shiskin method described earlier in that it employs a ratio-to-moving-average technique.

The data used to calculate the industry composition weights (ω) were taken from the Census of Manufactures (CM) and the Annual Survey of

Manufactures (ASM). The 1953-54 recession is weighted by the state's industry composition in manufacturing in 1951 taken from the ASM, Table 2, 1951. The 1957-58 recession is weighted by state's industry composition in 1956, which was obtained from the ASM, Volume III, Table 3, 1956. The 1958, 1968, and 1972 weights were taken from the CM, Volume III, Table 4, 1958; the ASM Volume III, Table 3, 1968-69; and the CM, Volume III, Table 5, 1972; respectively.

A problem was encountered during the computation of all manufacturing weights. In many states the total percent of employment in the sum of the twenty 2-digit manufacturing categories does not equal 100 percent of the state's employment in manufacturing. Due to inadequacies in the state-by-industry data, total employment in a state is often not accounted for in the 2-digit manufacturing industry breakdown. The seriousness of this discrepancy varies across states and time. For example, in the 1952 data there are thirty-four states in which the percent of employment in all of the 2-digit manufacturing industries is less than 90 percent of total state manufacturing employment. In 1972 there are only five states in which this occurs. Ninety percent or more of the state's employment can be accounted for in the twenty 2-digit categories in all five peak years for the largest employment states, such as California, New York, New Jersey, Ohio, and Pennsylvania. In states such as Delaware and Utah, the total percent of employment in the 2-digit industries never reaches 90 percent of the state's total manufacturing employment.

In order to keep this problem from biasing the data on the expected recessions downwards, the percentages were adjusted upwards. This was accomplished by locating all of the states and years in which manufacturing employment in the sum of the 2-digit industries is less than 90 percent of the total and then distributing the missing employees evenly across all of the manufacturing industry categories.

An additional and uncorrectable shortcoming of the expected recession data is that state economies are not homogeneous within 2-digit SIC categories. Thus, not all of the state's industry structure can be controlled. This failure to control for total industry composition effects is expected to show up in the error term and unexplained residual.

Machinery and Textile Industries

A similar procedure was followed in calculating the expected recessions for the industry-specific equations. Although computed separately, the computation of the expected recessions for the machinery and textile industries are described together to avoid repetition.

In the case of the machinery manufacturing industry, employment in SIC code 35 is subdivided into nine 3-digit SIC code categories. These categories include

Industry	SIC Code
Machinery, except Electrical	35
Engines and Turbines	351
Farm and Garden Machinery	352
Construction and Related Machinery	353
Metal Working Machinery	354
Special Industry Machinery	355
General Industrial Machinery	356
Office and Computing Machines	357
Service Industry Machines	358
Miscellaneous Machines	359

In the case of the textile industry, SIC category 22 is further divided into the following 3-digit SIC code categories

Textile Mill Products	22
Cotton Weaving Mills	221
Synthetic Weaving Mills	222
Wool Weaving and Finishing Mills	223
Narrow Fabric Mills	224
Knitting Mills	225
Textile Finishing Mills, Wool	226
Floor Covering Mills	227
Yarn and Thread Mills	228
Miscellaneous Textile Mills	229

Two data sets are necessary to compute the expected industry-specific recessions. The first is national monthly employment data at the 3-digit industry level and the second is the total annual employment in each 3-digit industry in each state.

The severity of the national recessions was calculated from the monthly 3-digit employment series for 1960-61, 1969-70 and 1973-75 for the machinery industry and for 1969-70 and 1973-75 for the textile industry. For example, the percentage decline in the nation's employment in Engines and Turbines was calculated for the 1960-61, 1970-71, and the 1973-74 recession. The same was done for farm and garden machinery, construction, and related machinery, as well as the remaining six machinery industries at the 3-digit level.

The national monthly employment data for machinery and textiles are available from the BLS, and required seasonal adjustment prior to calculating the severity of the national recessions in each 3-digit industry.

The recessions in the 3-digit machinery and textile industries are those that generally coincide with the national recessions already identified. However, the specific timing of the peaks and troughs varies across industries. In other words, the peaks and troughs are the actual ones for each industry series, rather than a peak or trough at a date imposed by the timing of the national average of all industries.

The next step was to weight each national machinery and textile industry recession by the importance of each 3-digit industry in each state. The state weights are the percent of each state's annual total 2-digit industry employment in each 3-digit category. For example, in Arkansas in 1972, 9 percent of the machinery industry employment was in Farm and Garden Machinery production, 16 percent in construction and related machinery production, 10 percent in metal working machinery production, etc. The employment totals, from which these percentages were calculated, can be found in the CM, Volume III, Area Statistics, Table 5, 1972, and the CM, Volume III, Area Statistics, Table 5, 1967.

It may be noticed that in the all-industry expected recession and elsewhere throughout the study, 1968 is identified as the peak year. However, 3-digit data, by state, are only available in the CM, which was not published in 1968. Therefore data from the 1967 CM replaces 1968 data. Since 1967 was a non-recession year and it is unlikely that industry structure varies significantly across a one-year time span, it is doubtful that this switch in data distorts the results.

There are several shortcomings of the machinery and textile industry expected recessions. One problem is that composition within the 3-digit categories is not homogeneous across states. Consequently cross-state differences within 3-digit SIC industries are not controlled. It is expected that the unexplained residual in the regression equations will, in part, be due to this inability to completely control for or eliminate the effects of industry composition on the severity of regional recessions.

There are several additional problems with these data. In a number of states the weights do not total 100 percent. This discrepancy ranges from 48 percent of employment accounted for in Kentucky in the machinery industry in 1967 to 100 percent in most all states in 1972. No adjustments were made in these data. Also, for a number of states and industries the CM reports a range of numbers in place of one actual employment value. In such cases the midpoint of the range was selected as the actual value. Third, in several states there is no 3-digit SIC code category, but only a 4-digit SIC subcategory. In such cases, the 4-digit sub-category replaces the 3-digit category. Finally, the weighted machinery and textile industry recessions were only calculated for states for which there are data for dependent variables. These observations are listed in Tables 4.1 and 4.2.

Capital Stock

The value of the capital stock was calculated for each state for all-manufacturing industries and for each state for the machinery industry and the textile industry. These newly-calculated capital-stock series span the years 1952 to 1976 for all-manufacturing industries and for varying years for the specific industries. Each of the three sets of capital stock series are described in more detail below. However, first the general method of calculating the series as well as the sources of data are presented.

Each capital-stock series was calculated using the perpetual inventory model, a real investment series, the value of the capital stock in a single base year, and a rate of depreciation. These general procedures and the source of data are described in turn.

The formula for the perpetual inventory model is shown in Equation 4-2.

$$K_t = I_t + (1-\delta)K_{t-1} \tag{4-2}$$

where K_t = end-of-the-year capital stock; I_t = gross real investment in the current period; δ = the annual rate of depreciation or replacement.

Data on the gross book value of depreciable assets in manufacturing industries were used as the base-year capital stock values (K_{t-1}) and to calculate the rates of depreciation. Data on the book value of depreciable assets are the best available measures of a state's capital stock. They measure the end-of-the-year value of all depreciable assets on the books of manufacturing establishments in a state. The numbers represent the actual cost of the assets at the time they acquired, including all costs incurred in making the assets usable, such as transportation and installation. Included in the values are buildings, structures, machinery and equipment for which depreciation reserves are maintained. Depletable assets, such as timber and minerals, are excluded as are non-depreciable assets such as inventories.

The 1957, 1962, and 1964 book values of depreciable assets (capital stock) were obtained from the ASM, "Special Geographical Supplement to 1962-64 Data on Book Value of Fixed Assets and Rental Payments for Buildings and Equipment," 1972. The 1970-71 data on book values on depreciable assets, which are only available at the state, all-manufacturing level, were taken from ASM, 1970-71, Table 2, page 131. Because these data are only available at the state level for the years 1957, 1962-64, and 1967-71, and the state-by-industry level for the years 1962-64 these data cannot be used as the capital stock series. Rather, they must be combined with a real investment series (I), an estimated annual rate of depreciation (δ) and the perpetual inventory equation to generate a continuous capital stock series for each state for all-manufacturing and the machinery and textile industries.

The values of gross investment (I_t) used in calculating the capital stock series were extracted from the CM and ASM. These data are described as new expenditures for plant and equipment or capital expenditures new, respectively by the CM and the ASM. These statistics include manufacturers investment in capital equipment and physical structures. They exclude maintenance and repairs charged as part of current operating expenses, and expenditures for land. The sources of the investment data for all-manufacturing, the textile, and the machinery industries are displayed in Tables 4.3 and 4.4.

In the 1951 ASM, the data on capital expenditures relate only to manufacturing establishments in operation during that year. They do not include expenditures incurred during the year for constructing and equipping new plants not yet in operation. After 1951, the census collected data for plants under construction. This study uses the total of capital expenditures for operating and non-operating plants as the definition of investment for all years, except, of course, 1951, when only investment in operating plants is available.

The reason that this study uses the total of capital expenditures for operating and non-operating plants is that for several years after 1951 the two categories are not reported separately. Thus the total of investment in operating and non-operating plants was selected because of the most consistent series over time.

The investment series was converted from nominal values into real numbers with an implicit price deflator. This deflator is the ratio of total gross domestic fixed non-residential expenditures in the current period to gross domestic fixed non-residential expenditures in constant 1958 prices. Fixed non-residential expenditures includes producer's durable equipment as well as structures. This implicit price deflator was taken from the Historical Statistics of the United States, Colonial times to 1970, Part I, House Document No. 93-78, U.S. Department of Commerce, Bureau of the Census, 1975 for the years 1950 to 1970. In order to deflate the 1971 to 1974 investment series, a base-year 1958 implicit price deflator was taken from a later year of the original source, the Survey of Current Business, Vol. 54, No. 7, 1974, Table 8.1. The implicit price deflators used in this study can be found in Appendix IX.

In order to calculate the capital stock series for each state, an "implied" depreciation rate was estimated by solving the perpetual inventory formula, equation 4-2, for δ as shown below.

$$\delta = -\frac{K_t - I_t}{K_{t-1}} - 1 \qquad (4\text{-}3)$$

The preceding description of the calculation of the capital stock series applies to the all-manufacturing calculations, as well as to those for

Table 4.3

Sources of Investment Data

All Manufacturing

1951	ASM*, Table 2, 1951
1952	ASM, Table 2, 1952
1953	ASM, Table 2, 1953
1954	CM, Vol. I, Summary Statistics, Table 5, 1954
1955	ASM, Table 2, 1955
1956	ASM, Table 3, 1956
1957	ASM, Table 3, 1957
1958	CM, Volume III, Area Statistics, Table 4, 1958
1959-60	ASM, Table I, 1959-60
1961-66	ASM, Table A, 1966
1967	CM, Volume III, Table 5, 1967
1970-71	ASM, Table 3, 1970-71
1972	CM, Volume III, Area Statistics, Table 5, 1972

ASM: Annual Survey of Manufactures

CM: Census of Manufactures

Table 4.4

Sources of Investment Data

Machinery and Textile Industries

1957	ASM, Table 3, 1957
1958	CM, Volume III, Area Statistics, Table 4, 1958
1959	ASM, Table 2, 1959
1960	ASM, Table 2, 1960
1961	ASM, Table 2, 1961
1962	ASM, Table 2, 1962
1963	CM, Volume III, Area Studies, Table 5, 1963
1964-65	ASM, Table 3, 1964-65
1966	ASM, Table 3, 1966
1967	CM, Volume III, Area Statistics
1968-69	ASM, Table 3, 1968-69
1970-71	ASM, Table 3, 1970-71
1972	CM, Volume III, Area Statistics, Table 5, 1972

the textile and machinery industries. Before proceding with the general discussion we will now consider each of these separately.

All Manufacturing

The first step in calculating the capital-stock series for each state for all-manufacturing was to estimate a depreciation rate. For the all-manufacturing series two depreciation rates were calculated, in order to see whether the final results were sensitive to different assumptions about the rate at which a state's capital stock depreciated. The two sets of depreciation rates were based on data from different years. First, the gross book value of depreciable assets in the years 1957 and 1962 were used as K_{t-1} and K_t respectively in equation 4-3. Nominal expenditures on plant and equipment in the years 1958 to 1962 were summed to get I_t. The results of the equation's solution were then divided by 5 to get an annual average rate of depreciation for the years 1958 and 1962. The results of this calculation are displayed in Table 4.5, column I.

As can be seen from this table, eleven of the forty-eight depreciation rates are negative numbers. This implies that the value of a state's capital stock at the end of 1957 plus the total investment in the state's capital stock for the years 1958 to 1962 is less than the total value of the state's depreciable assets at the end of 1962. Thus the value of the capital stock appears to have appreciated rather than depreciated.

There are two possible explanations for these results. One is that the data are inadequate. Depreciable assets in 1957 may be undervalued, investment in the years 1958 to 1962 may be undervalued and/or the book value of depreciable assets in 1962 may be overvalued. Another possible explanation is that the depreciable assets in some states, those with the wrong sign, changed hands more frequently than did the states with positive rates of depreciation. As explained earlier, the capital stock figures used in this study reflect the purchase price of fixed assets. Therefore, if plant and equipment changed hands it may have been revalued upwards. This appreciation of depreciable assets does not show up in new capital investment, only in the capital-stock figures for the years following the purchase. Discussions with Leonard Pomeroy and Milt Eisen at the CM suggest that the first explanation is more plausible than the second.

Assuming that inadequacies in the data are the most likely causes of negative rates, two approaches were taken. First, a new set of depreciation rates were calculated, using data from later years for K_t and K_{t-1}, and secondly the unrealistic rates of depreciation were adjusted to be more believable.

The second series of depreciation rates were calculated using 1970 and 1971 depreciable assets as K_{t-1} and K_t respectively and new capital expenditures in 1971 as I_t. The results of this calculation are displayed in Table 4.5, Column 2. As can be seen from Table 4.5, when the "implied" depreciation rate for 1971 is calculated, only one depreciation rate for Missouri turns up with the wrong sign.

The rates of depreciation were then used, in conjunction with a 1957 base-year figure for capital assets and a 1952-to-1976 real investment series, to generate a 1952-to-1976 capital-stock series for each state. But in order to avoid unreasonable estimates of the final

Table 4.5

Depreciation Rates, All Manufacturing, By State

State	1 Depreciation Rate $= -\left(\frac{K_{1962} - I_{1958-62}}{K_{1957}}\right)$	2 Depreciation Rate $= -\left(\frac{K_{1971} - I_{1971}}{K_{1970}}\right)$
Alabama	-.027	.039
Arizona	-.053	.008
Arkansas	.026	.036
California	.022	.048
Colorado	.001	.054
Connecticut	.037	.037
Delaware	.015	.022
Florida	.001	.051
Georgia	-.008	.044
Idaho	.037	.063
Illinois	.026	.048
Indiana	.014	.033
Iowa	.033	.048
Kansas	-.024	.047
Louisiana	-.027	.086
Maine	.002	.017
Maryland	.008	.043
Massachusetts	.041	.055
Michigan	.030	.040
Minnesota	.025	.060
Mississippi	-.015	.043
Missouri	.020	-.006
Montana	.005	.035
Nebraska	.020	.023
Nevada	-.037	.075
New Hampshire	.016	.009
New Jersey	.017	.061
New Mexico	-.083	.038
New York	.037	.063
North Carolina	.010	.035
North Dakota	-.084	.055
Ohio	.018	.043
Oklahoma	.011	.046
Oregon	.023	.021
Pennsylvania	.022	.041
Rhode Island	.040	.062
South Carolina	-.016	.038
Kentucky	.006	.051

Table 4.5. (Cont.)

	1	2
South Dakota	.071	.132
Tennessee	.016	.036
Texas	-.017	.008
Utah	.001	.027
Vermont	.055	.621
Virginia	.015	.029
Washington	.021	.042
West Virginia	.005	.030
Wisconsin	.033	.045
Wyoming	.048	.034

capital-stock series, all of the depreciation rates of the wrong sign were adjusted. In the case of the 1958-62 rates, the signs on the rates were merely reversed when the reversed rate appeared consistent with other states. When the reversed sign yielded unusually high rates of depreciation (greater than .040) the rate was replaced with a depreciation rate of .010.

In several cases the low depreciation rate of .010 does not lead to reasonable capital-stock series. For example, with a depreciation rate of .010 up to .080, the series for the state of New Mexico yields negative or extraordinarily low capital stock values in the early years of the series. Therefore, a depreciation rate of .083 is used because it is the smallest depreciation rate that generates believable capital stock values. The situation for North Dakota is similar, and its 1958-62 depreciation rate was changed from .010 to .030.

It may at first glance appear counterintuitive that larger depreciation rates lead to smaller capital stock values in the early years. This can be explained as follows. Additions to the capital stock in the years 1952 to 1957, minus depreciation, must be equal to the 1957 baseline capital-stock value. In the perpetual inventory method, the investment series, the depreciation rate, and the 1957 value of the state's capital stock are given. If the depreciation rate is low, capital stock values must be low because very little of the capital stock depreciated. In 1970-71 only one depreciation rate was negative, the sign on this rate was simply reversed.

As mentioned above, the capital stock value used as the base year (K_{t-1}) in equation 4-2 was 1957. This year was selected for the

Table 4.6
Capital Stock, By State, For All Manufacturing, 1952-1976
($000's)

	Alabama	Arkansas	Arizona	California	Colorado	
1952	1297274	379230.1	129594.9	4961823	365726.0	1952
1953	1364026	449156.4	137128.4	5393074	377623.2	1953
1954	1407820	483358.2	152304.9	5831128	392751.6	1954
1955	1462837	526857.0	169310.3	6226573	410404.6	1955
1956	1664932	562473.5	183130.0	6762582	458223.3	1956
1957	1907537	629395.0	202094.0	7323528	487420.0	1957
1958	1998287	654963.8	228175.2	7725162	511812.3	1958
1959	2068186	683964.3	259958.5	8063857	528055.1	1959
1960	2184091	727746.9	291585.3	8429784	558212.6	1960
1961	2260104	769613.7	354271.0	8698904	585221.9	1961
1962	2295979	814365.8	389087.2	9157605	633429.7	1962
1963	2347484	855271.6	433296.0	9660733	664321.2	1963
1964	2522904	894121.4	466957.4	10173756	688691.9	1964
1965	2770424	958560.0	511627.3	10784447	730227.2	1965
1966	3046850	1034492	578753.0	11601802	809171.5	1966
1967	3268210	1152215	672794.1	12417872	854899.9	1967
1968	3436154	1234310	758645.8	13129304	925841.7	1968
1969	3613363	1336948	848836.8	13898203	1001944	1969
1970	3792872	1450723	931523.9	14434929	1119037	1970
1971	3905772	1524469	1028400	14781598	1233444	1971
1972	4007816	1605691	1162294	15253313	1330735	1972
1973	4183327	1707651	1304410	15844274	1473230	1973
1974	4627443	1881909	1458708	16806148	1632342	1974
1975	5127231	2035257	1636006	17659324	1779679	1975
1976	5647207	2257425	1737418	18603614	1924327	1976

Source: Census of Manufactures (CM) and Annual Survey of Manufactures (ASM).

Table 4.6 (Cont.)
Capital Stock, By State, For All Manufacturing, 1952-76
($000's)

	Connecticut	Delaware	Florida	Georgia	Idaho	
1952	1613233	339047.4	852801.3	811764.1	162477.3	1952
1953	1713488	363759.7	932171.5	947315.6	172262.7	1953
1954	1802908	383321.9	1008543	1109721	185734.4	1954
1955	1909111	400994.9	1049776	1287146	212878.6	1955
1956	2044644	554944.7	1122865	1481611	232508.4	1956
1957	2198326	602979.0	1251234	1616369	237415.0	1957
1958	2312429	617639.5	1339724	1715120	241653.9	1958
1959	2392566	628590.5	1424326	1811250	249374.9	1959
1960	2496434	645692.5	1500656	1899801	270049.1	1960
1961	2569647	687816.1	1642065	1959703	278178.2	1961
1962	2689754	728196.2	1742419	2057188	286167.8	1962
1963	2795598	797157.6	1835964	2160129	295283.7	1963
1964	2902375	848392.2	1900109	2289584	319644.0	1964
1965	3046060	895151.7	2080141	2476164	375101.8	1965
1966	3299626	957855.8	2252439	2702888	403772.5	1966
1967	3577701	1040841	2407541	2964011	430139.5	1967
1968	3786858	1098538	2525693	3186105	439296.0	1968
1969	3955200	1136566	2651273	3463803	453815.5	1969
1970	4072452	1163405	2806227	3659552	466085.3	1970
1971	4159996	1195183	2969052	3871532	476487.2	1971
1972	4243612	1234433	3149292	4194666	500121.8	1972
1973	4331387	1286020	3347478	4472213	520512.0	1973
1974	4490526	1355661	3667423	4883569	576119.7	1974
1975	4700248	1435320	4008900	5111917	632082.2	1975
1976	4826276	1503555	4346321	5420056	692198.6	1976

Source: CM and ASM.

Table 4.6 (Cont.)
Capital Stock, By State, For All Manufacturing, 1952-76
($000's)

	Illinois	Indiana	Iowa	Kansas	Kentucky	
1952	5949841	3363590	788568.4	506490.8	791594.7	1952
1953	6380984	3759790	827638.5	552583.3	880202.1	1953
1954	6753038	3990962	879499.1	589132.0	1014794	1954
1955	7077507	4376915	925246.3	635881.1	1072134	1955
1956	7627754	4866786	1023334	702755.5	1145707	1956
1957	8204858	5371731	1087147	760869.0	1243233	1957
1958	8541753	5709759	1138157	824067.2	1291110	1958
1959	8783195	5902412	1192298	860596.3	1324517	1959
1960	9060153	6241361	1269609	878030.7	1366935	1960
1961	9304452	6402769	1329257	891633.6	1413906	1961
1962	9596083	6558372	1370213	919929.5	1475191	1962
1963	9877066	6873282	1425928	978436.4	1612415	1963
1964	10268584	7505782	1520397	1028349	1682916	1964
1965	10843624	8234900	1618743	1067800	1803787	1965
1966	11636059	8939382	1742297	1120492	1972873	1966
1967	12418344	9546160	1865795	1207800	2174018	1967
1968	13093923	10080073	1967471	1264821	2375863	1968
1969	13678829	10697349	2090431	1304887	2525082	1969
1970	14186147	11124828	2206296	1350085	2630798	1970
1971	14588337	11379205	2293057	1383843	2702360	1971
1972	15008512	11653620	2418950	1461496	2834044	1972
1973	15460499	12033164	2528306	1577209	3034776	1973
1974	16154728	12571002	2748748	1706680	3243434	1974
1975	16817043	13127643	3061453	1833756	3387356	1975
1976	17469325	13616368	3357941	1952757	3537214	1976

Source: CM and ASM.

Table 4.6 (Cont.)
Capital Stock, By State, For All Manufacturing, 1952-76
($000's)

	Louisiana	Maine	Maryland	Massachusetts	Michigan	
1952	1872001	345381.6	1270607	2416651	4949771	1952
1953	2002973	385454.2	1353989	2470893	5595001	1953
1954	2036373	448400.3	1406508	2548081	6397693	1954
1955	1967958	503445.3	1550906	2632854	7071202	1955
1956	1975531	549185.4	1830563	2735677	7886681	1956
1957	2112740	600265.0	2028426	2834399	8280819	1957
1958	2104427	634389.5	2069289	2907020	8414859	1958
1959	2060495	664426.8	2097133	3011183	8600896	1959
1960	2018255	706351.2	2181021	3126093	8894250	1960
1961	2004811	746703.0	2276316	2980947	9083061	1961
1962	1973843	780636.3	2393545	3092854	9253608	1962
1963	2005850	827163.6	2459337	3183975	9612471	1963
1964	2051107	879946.6	2501722	3300262	10203013	1964
1965	2195013	970568.0	2603004	3437609	11146442	1965
1966	2448589	1075410	2736614	3692963	12051916	1966
1967	2903660	1145833	2844833	3933107	12791064	1967
1968	3171051	1223545	2933058	4091935	13303506	1968
1969	3354520	1286973	3059701	4271188	13886488	1969
1970	3427475	1372775	3223372	4511004	14330030	1970
1971	3526329	1438065	3313307	4596207	14638927	1971
1972	3630085	1513117	3393113	4728444	15537181	1972
1973	3803957	1564620	3466049	4930078	16294507	1973
1974	4108950	1653488	3609409	5168590	17543193	1974
1975	4506613	1828217	3751301	5284576	18301659	1975
1976	5094544	2114262	3853121	5482424	19046530	1976

Source: CM and ASM.

Table 4.6 (Cont.)
Capital Stock, By State, For All Manufacturing, 1952-76
($000's)

	Minnesota	Mississippi	Missouri	Montana	Nebraska	
1952	1211274	339379.4	1233050	75115.8	215374.2	1952
1953	1253018	362469.6	1359990	110440.4	253314.6	1953
1954	1274757	390887.3	1498521	130836.7	290429.4	1954
1955	1289767	412647.7	1656073	201319.7	307843.0	1955
1956	1319154	433201.8	1826170	284811.4	334614.3	1956
1957	1344070	465231.0	1993169	295270.0	403195.0	1957
1958	1371947	513356.3	2167089	304833.6	443827.5	1958
1959	1392247	554319.8	2325885	309866.9	468375.9	1959
1960	1422290	570748.8	2467126	316239.3	490448.7	1960
1961	1472153	584787.0	2617476	322743.4	518435.3	1961
1962	1517746	665053.0	2799889	333897.0	548355.7	1962
1963	1578892	762672.0	2985061	359135.9	579843.0	1963
1964	1642401	828781.6	3182395	386164.1	613987.2	1964
1965	1692788	903233.3	3422269	401733.9	653156.7	1965
1966	1782267	1035568	3689785	416053.4	706665.8	1966
1967	1882999	1240054	3979013	463351.9	754517.4	1967
1968	1990104	1310270	4218543	477687.7	795206.0	1968
1969	2119641	1405970	4436565	482350.8	853989.5	1969
1970	2222877	1557902	4701343	497957.0	898095.8	1970
1971	2309607	1631135	4939680	517505.7	940902.5	1971
1972	2389870	1731610	5193637	553691.0	992542.6	1972
1973	2474566	1823824	5463097	580067.5	1044593	1973
1974	2651892	1960357	5795118	626298.5	1116101	1974
1975	2807359	2045312	6153186	653603.9	1194173	1975
1976	2948230	2169971	6489704	684227.7	1271394	1976

Source: CM and ASM.

Table 4.6 (Cont.)
Capital Stock, By State, For All Manufacturing, 1952-76
($000's)

	Nevada	New Hampshire	New Jersey	New Mexico	New York	
1952	55624.1	185493.5	4347402	5098.6	7393704	1952
1953	57159.4	201182.4	4478567	9330.8	7539967	1953
1954	58591.8	221178.3	4668086	16275.0	7750187	1954
1955	60150.1	243442.6	4810947	30494.5	7895035	1955
1956	60962.4	280021.1	5049639	42195.2	8147846	1956
1957	65330.0	303456.0	5280411	58862.0	8378556	1957
1958	65585.2	325089.9	5408040	78227.1	8642908	1958
1959	66057.7	346653.3	5499105	89670.9	8778345	1959
1960	66387.2	369135.0	5619669	100638.0	8949407	1960
1961	64870.4	393486.9	5729132	102463.7	9044971	1961
1962	65720.8	419890.7	5891270	102249.0	9203309	1962
1963	69069.3	445095.4	6034300	103162.1	9373314	1963
1964	71662.0	479451.0	6141334	103577.7	9671944	1964
1965	82267.8	512181.5	6341206	106288.9	10084350	1965
1966	81842.7	573344.1	6658896	107386.5	10525457	1966
1967	89531.1	636059.7	6992782	107453.4	11038776	1967
1968	94901.4	676292.7	7216861	108210.3	11485972	1968
1969	101198.4	753458.1	7535331	114297.5	12058290	1969
1970	103593.1	802898.1	7768687	113609.5	12465285	1970
1971	111744.4	854146.0	7880564	135820.3	12730375	1971
1972	120197.4	917447.2	8073273	145931.1	13007158	1972
1973	119947.3	979583.6	8240086	173806.9	13322076	1973
1974	127151.2	1040101	8539574	254645.2	13948252	1974
1975	136002.0	1093449	8792983	347010.7	14470866	1975
1976	158926.8	1169608	9016798	391161.2	14999014	1976

Source: CM and ASM.

Table 4.6 (Cont.)
Capital Stock, By State, For All Manufacturing, 1952-76
($000's)

	North Carolina	North Dakota	Ohio	Oklahoma	Oregon	
1952	1635144	56959.2	7017112	427767.1	648443.2	1952
1953	1739118	55382.4	7590882	482963.6	710274.7	1953
1954	1831105	54251.9	8173208	521761.5	775324.8	1954
1955	1965014	52874.1	8605538	550218.4	852318.6	1955
1956	2106778	51529.9	9375706	579629.1	934168.8	1956
1957	2232466	52420.0	10207008	613530.0	1021347	1957
1958	2345622	58678.9	10563880	647234.6	1123238	1958
1959	2493890	58062.1	10773376	700750.5	1202797	1959
1960	2650342	57216.6	11093538	732410.0	1293948	1960
1961	2777386	57674.2	11344045	742004.5	1376853	1961
1962	2962782	57272.5	11602166	752530.3	1452233	1962
1963	3159972	61839.2	11914566	778738.8	1548066	1963
1964	3382907	74531.8	12428746	801549.7	1649453	1964
1965	3740404	80841.8	13133361	826749.1	1829244	1965
1966	4274185	82798.4	14007603	852766.8	2048637	1966
1967	4721284	85606.7	14926285	886173.7	2215887	1967
1968	5098677	90004.7	15779689	916984.2	2338204	1968
1969	5535020	90420.3	16706935	981225.7	2496907	1969
1970	5889682	94894.2	17298598	1048301	2618127	1970
1971	6278114	99579.6	17516020	1116294	2733580	1971
1972	6765256	108501.0	17977301	1225259	2867650	1972
1973	7255594	124824.7	18542648	1343846	3036967	1973
1974	7801049	138426.0	19427714	1508162	3248324	1974
1975	8325883	154361.0	19986193	1669948	3463529	1975
1976	8843602	176371.1	20464599	1849755	3627169	1976

Source: CM and ASM.

Table 4.6 (Cont.)
Capital Stock, By State, For All Manufacturing, 1952-76
($000's)

	Pennsylvania	Rhode Island	South Carolina	South Dakota	Tennessee	
1952	8033196	486858.0	1108125	89223.8	1131687	1952
1953	8626411	496724.0	1136087	81339.1	1277182	1953
1954	9019245	498558.0	1167049	74663.7	1415234	1954
1955	9416112	503008.4	1218688	68847.3	1503768	1955
1956	9956834	513191.0	1282735	63668.5	1670066	1956
1957	10525659	517367.0	1351223	57822.0	1833335	1957
1958	10910427	515185.2	1375494	55400.5	1977047	1958
1959	11133185	515648.9	1416903	56777.5	2066347	1959
1960	11495293	518953.6	1503324	56600.6	2198753	1960
1961	11742066	529768.9	1600002	59025.9	2306091	1961
1962	11997074	544405.4	1697829	66428.5	2409695	1962
1963	12249385	551903.0	1805403	64682.9	2557297	1963
1964	12532284	562331.2	1952525	65407.8	2749228	1964
1965	13018387	577889.0	2141472	66923.7	3012811	1965
1966	13776359	610156.0	2423244	65067.1	3367750	1966
1967	14678040	639483.8	2705196	63840.4	3616775	1967
1968	15431133	677708.2	2943675	64519.9	3896188	1968
1969	16056424	701462.6	3123604	61369.1	4181535	1969
1970	16606099	713809.1	3289469	62715.4	4420939	1970
1971	17016884	728247.0	3530794	64341.6	4650413	1971
1972	17378862	755087.1	3759661	70246.8	4869817	1972
1973	17749283	769486.3	4028043	83265.4	5159307	1973
1974	18384895	799444.8	4440711	92741.1	5597172	1974
1975	18918598	826976.0	4792609	104047.6	5928642	1975
1976	19393248	865328.5	5152990	120813.3	6203523	1976

Source: CM and ASM.

Table 4.6 (Cont.)
Capital Stock, By State, For All Manufacturing, 1952-76
($000's)

	Texas	Utah	Vermont	Virginia	Washington	
1952	2818236	298000.5	152599.7	977048.5	1095195	1952
1953	3396509	307822.3	154480.2	1109278	1198105	1953
1954	3934607	327087.8	155369.4	1206693	1321287	1954
1955	4344487	360331.4	157201.3	1348804	1496803	1955
1956	4908625	400827.5	160081.4	1499888	1674902	1956
1957	5698598	424377.0	172281.0	1675727	1846183	1957
1958	6264081	444229.8	173197.6	1773594	1929088	1958
1959	6636323	461089.8	178890.8	1839528	1961599	1959
1960	7083265	481445.1	181364.2	1933048	2019148	1960
1961	7651872	503201.4	188318.9	2050028	2070825	1961
1962	8155378	528026.1	195826.6	2166282	2162962	1962
1963	8632972	542095.7	198688.2	2325264	2209357	1963
1964	9269318	549253.8	205983.5	2518305	2284355	1964
1965	10131121	557799.7	226761.4	2750497	2414757	1965
1966	11153304	590966.9	243639.6	3010803	2692800	1966
1967	12328937	628162.2	260047.7	3235036	2996922	1967
1968	13498561	644393.3	277711.9	3427858	3189860	1968
1969	14602199	668214.2	302119.8	3644629	3304748	1969
1970	15728929	694949.6	334924.5	3841853	3404812	1970
1971	16708234	728937.3	350622.8	4049809	3529234	1971
1972	17538536	757894.9	355245.3	4351992	3634373	1972
1973	18456889	786293.1	362550.6	4650284	3789735	1973
1974	20333167	861596.5	386272.5	5038425	4003900	1974
1975	22625083	923236.6	411742.9	5325859	4357026	1975
1976	25424145	986996.7	445964.9	5738534	4587906	1976

Source: CM and ASM.

Table 4.6 (Cont.)
Capital Stock, By State, For All Manufacturing, 1952-76
($000's)

	West Virginia	Wisconsin	Wyoming	
1952	863118.3	2264593	152401.2	1952
1953	972672.4	2365942	164389.8	1953
1954	1060100	2459265	166936.1	1954
1955	1184575	2548747	167121.9	1955
1956	1362669	2676511	174619.4	1956
1957	1590870	2873446	179332.0	1957
1958	1715081	2947888	180219.7	1958
1959	1764929	3011857	178286.0	1959
1960	1834745	3145639	183370.0	1960
1961	1889766	3224503	187267.9	1961
1962	1994105	3324647	184964.2	1962
1963	2099834	3443617	192044.8	1963
1964	2207462	3577964	199056.5	1964
1965	2325976	3746093	201032.7	1965
1966	2482462	4009899	209342.8	1966
1967	2649504	4284293	209048.6	1967
1968	2749253	4484606	209515.4	1968
1969	2827751	4667514	209709.0	1969
1970	2936390	4817000	206188.7	1970
1971	3025334	4898401	203800.5	1971
1972	3089302	5061425	213633.4	1972
1973	3155836	5321170	217135.9	1973
1974	3260894	5676984	221220.0	1974
1975	3397842	5989519	227375.9	1975
1976	3476406	6290679	238707.6	1976

Source: CM and ASM.

following reasons. The book value of depreciable assets is the total purchase price of the capital stock. One shortcoming is that the value of the capital stock varies according to when the capital was purchased. Older capital stock producing the same level of output as new capital stock is valued at less, because it was purchased at lower nominal prices. Since inflation was lower in the 1950's than any decade since 1959 capital stock values should reflect a more homogenous combination of capital stock values. In addition since the investment series was converted into real 1958 dollars, the 1957 nominal capital stock value was most consistent with the real investment series.

Both sets of capital stock values, generated from the perpetual inventory method, are presented. Table 4.6 presents the capital stock series for each state, when the depreciation rate over the period is assumed to be the annual average depreciation rate for the year 1971. The result of the capital stock series when the 1958-62 depreciation rate is assumed to prevail throughout the period is displayed in Appendix VIB. The investment series used in calculating the values in Table 4.6 and Appendix VI.B can be found in Appendix VI.A. A sensitivity analysis was carried out by conducting all of the empirical work twice, once with each capital-stock series.

Machinery Industry

The same perpetual inventory method described above was used to calculate the value of capital-stock series for the machinery industry, by state. The machinery industry, as defined here, is equivalent to the manufacturing activities included in SIC code 35.

The depreciation rates for each state were calculated from the gross book values of depreciable assets in 1962 and 1963. These statistics are available in the ASM, "Special Geographic Supplement to 1962-64 Data," Table 2, 1972. The 1963 value of capital expenditures (investment) was taken from the ASM, Table 5, 1963. The results of the solution of equation 4-3, using these data, are presented in Table 4.7.

Based on the assumption that the 1963 "implied" depreciation rate prevailed over the period 1957 to 1962, the 1963 gross book value on depreciable assets (capital), and the real investment series, the machinery industry capital stocks were estimated. The specific data sources for new capital expenditures (investment) are listed in Table 4.4. The nominal values were converted to real values with the fixed-investment non-residential price deflator described above. The real investment series are displayed in Appendix VII.

The final capital-stock figures for the machinery industry are displayed in Table 4.8 As can be seen in this table, the span of years for which the capital-stock series were calculated varies from state to state. The reason is that the capital stock values for peak years are to be used in conjunction with a dependent variable. There is no reason to calculate the independent variables if the data on the dependent variable are missing, and for reasons discussed earlier, data on the severity of the recessions in the machinery industry are not available for every state for every post World War II recession.

Textile Industry

The third set of capital stock series was calculated for the textile industry, SIC code 22. Except for the following differences,

Table 4.7

Depreciation Rates,
Machinery Industry, By State

Arkansas	.017
California	.026
Colorado	.019
Connecticut	.011
Florida	.042
Georgia	.023
Illinois	.013
Indiana	.016
Iowa	.021
Kentucky	.035
Louisiana	.033
Maryland	.002
Massachusetts	.037
Michigan	.014
Minnesota	.015
Missouri	.016
Nebraska	.004
New Hampshire	.023
New Jersey	.015
New York	.039
North Carolina	.030
Ohio	.022
Oklahoma	.029
Oregon	.048
Pennsylvania	.014
Rhode Island	.063
South Carolina	.014
Tennessee	.020
Texas	.025
Vermont	.009
Virginia	.023
Washington	.013
West Virginia	.007
Wisconsin	.035

Table 4.8
Capital Stock, Machinery Industry, By Year
for States Included in Machinery Industry Analysis
($000's)

	Arkansas	California	Colorado	Connecticut	
1963	16361.0	585037.0	31403.0	490316.0	1963
1964	17427.9	622179.4	32552.5	514923.2	1964
1965	18650.6	673442.4	41901.9	547399.1	1965
1966	22649.4	751122.2	71044.4	603372.9	1966
1967	24960.1	870712.3	80910.3	659791.3	1967
1968	26751.0	965186.0	95024.5	710907.9	1968
1969	30526.6	1064039	103534.7	753697.9	1969
1970	33313.3	1169259	114767.7	783508.2	1970
1971	37959.4	1253149	127542.6	803776.5	1971
1972	41186.1	1331759	137642.3	823983.0	1972

	Florida	Georgia	Illinois	Indiana	Iowa	
1963	38073.0	49216.0	157449.0	394567.0	295337.0	1963
1964	42880.7	50580.9	273964.1	419727.6	317898.0	1964
1965	45263.7	53954.5	445166.3	463353.5	348237.6	1965
1966	51428.9	55120.3	605878.2	511726.7	381087.3	1966
1967	63264.7	60294.8	759610.7	565181.1	435497.0	1967
1968	77105.6	63990.3	898671.9	604279.9	464817.7	1968
1969	91494.0	69484.8	1027640	641501.1	484150.5	1969
1970	109061.5	72697.6	1163896	680072.4	515284.4	1970
1971	121773.9	81561.4	1289044	710418.4	533193.8	1971
1972	130388.6	88535.4	1410181	755426.5	569024.8	1972

Source: Census of Manufactures and Annual Survey of Manufactures.

Table 4.8 (Cont.)
Capital Stock, Machinery Industry, By Year
for States Included in Machinery Industry Analysis
($000's)

	Kentucky	Louisiana	Maryland	Massachusetts	Michigan	
1958	161893.1					
1959	161803.5					
1960	162257.0					
1961	164408.5					
1962	170051.5					
1963	175798.0	17546.0	79496.0	397452.0	981991.0	1963
1964	186142.9	18888.7	84210.2	412891.9	1047468	1964
1965	195640.9	20365.1	95091.1	431082.3	1136909	1965
1966	216765.7	22779.4	106960.8	469224.8	1249543	1966
1967	231380.0	25720.2	118239.1	500248.3	1386113	1967
1968	247127.1	27182.2	128215.4	526049.6	1489613	1968
1969	259948.3	29388.2	136983.3	558082.7	1593081	1969
1970	275272.9	35038.3	154067.3	606795.6	1668041	1970
1971	293582.1	38448.3	153832.5	629369.3	1709573	1971
1972	322831.9	43287.6	166920.3	661060.1	1766508	1972

Source: CM and ASM.

Table 4.8 (Cont.)
Capital Stock, Machinery Industry, By Year
for States Included in Machinery Industry Analysis
($000's)

	Minnesota	Missouri	Nebraska	New Hampshire	New Jersey	
1963	266595.0	157101.0	24159.0	56616.0	440995.0	1963
1964	284677.4	167687.5	24714.1	59411.3	466171.4	1964
1965	310933.8	178819.0	28497.7	60831.2	497258.3	1965
1966	340457.6	189287.7	32583.1	67801.2	526423.0	1966
1967	374047.1	217541.4	38731.1	77381.6	575480.0	1967
1968	401457.7	229423.4	47930.1	81141.4	610056.7	1968
1969	440801.7	239944.8	60005.2	84811.8	653588.9	1969
1970	474819.4	258657.5	70659.5	90550.1	681757.7	1970
1971	505774.9	268730.7	79020.1	99628.3	703205.3	1971
1972	533790.0	279742.6	88143.8	111816.8	741076.1	1972

Source: CM and ASM.

Table 4.8 (Cont.)
Capital Stock, Machinery Industry, By Year
for States Included in Machinery Industry Analysis
($000's)

	New York	North Carolina	Ohio	Oklahoma	Oregon	
1957	824018.5		1046350	62302.9		
1958	861633.2		1106141	63791.2		
1959	886679.0		1150397	64032.2		
1960	929930.4		1213555	65099.1		
1961	969816.3		1255040	64810.0		
1962	998373.1		1300459	66417.5		
1963	1030708	64703.0	1351756	69795.0	37317.0	1963
1964	1079567	70834.1	1430300	79265.3	37657.4	1964
1965	1160641	76455.9	1527824	84391.6	41269.3	1965
1966	1229451	77228.6	1651511	93705.4	44976.5	1966
1967	1299973	99137.6	1777117	100647.0	49178.7	1967
1968	1347478	138016.0	1891567	108071.0	49356.6	1968
1969	1434793	136043.0	2010331	117007.5	49980.8	1969
1970	1482026	136696.4	2103833	124012.9	55554.4	1970
1971	1514683	157880.0	2171029	128364.0	56906.4	1971
1972	1568687	188642.1	2255649	156108.8	58169.3	1972

Source: CM and ASM.

Table 4.8 (Cont.)
Capital Stock, Machinery Industry, By Year
for States Included in Machinery Industry Analysis
($000's)

	Pennsylvania	Rhode Island	South Carolina	Tennessee	Texas	
1963	920594.0	62851.0	61537.0	69108.0	307602.0	1963
1964	981903.1	67348.5	64972.5	72439.3	327269.6	1964
1965	1047621	68507.6	73241.6	78960.4	348639.4	1965
1966	1110412	78715.9	73883.0	87329.3	375337.3	1966
1967	1223324	80260.5	81453.0	106475.9	407074.3	1967
1968	1322586	83840.0	88381.5	127208.1	444727.2	1968
1969	1440929	84860.2	94606.2	138934.7	445722.9	1969
1970	1528677	82475.0	114153.7	148940.8	487268.0	1970
1971	1596484	80255.0	165724.2	165873.2	524902.9	1971
1972	1652126	79178.9	189660.3	180342.7	561064.0	1972

	Vermont	Virginia	Washington	West Virginia	Wisconsin	
1963	39364.0	35307.0	36473.0	20008.0	642197.0	1963
1964	41355.5	38296.9	38473.1	20989.9	662078.9	1964
1965	43734.6	42572.9	40785.7	21945.0	697967.2	1965
1966	46639.2	42103.2	44256.8	23038.8	776324.3	1966
1967	50963.9	48518.1	50616.9	25478.9	854312.9	1967
1968	54149.5	54830.7	55175.6	28021.4	902283.6	1968
1969	60637.8	66198.6	58388.4	30017.6	950441.9	1969
1970	63914.1	73388.1	61729.2	30956.5	967984.8	1970
1971	65520.7	81054.5	63305.3	34918.7	984021.8	1971
1972	69209.4	88399.9	66382.2	37392.8	1006619	1972

Source: CM and ASM.

these series were calculated in the same manner as the earlier capital stock series.

The rates of depreciation were calculated for the year 1963. That means that depreciable assets for 1962 and 1963 were used as K_t and K_{t-1} respectively, in equation 4-3. New capital expenditures on investment in 1963 was set equal to I_t. The depreciable assets data came from the ASM, "Special Geographical Supplement to 1962-64 Data," 1972, and the figures on 1963 investment in textile industries were taken from the ASM, 1963.

The 1963 depreciation rates, which are assumed to prevail throughout the period, are shown in Table 4.9. As can be seen from this table, there are only twenty-five states for which depreciation rates were calculated. This is either because not all states have a textile industry, or because data are missing and the capital stock series did not need to be or could not be calculated.

In computing calculating the textile industry's capital stock series for each state, the 1963 book values of depreciable assets were used as the base period capital stock values. The nominal investment series were deflated by the non-residential fixed-assets price deflator described earlier to calculate real investment. The real investment series are displayed in Appendix VIII while the final capital stock series are displayed in Table 4.10.

Limitations of Capital Stock Data

The book value of depreciable assets is the total purchase price of the capital stock. While this measure is a satisfactory measure of

Table 4.9

Depreciation Rates,
Textile Industry, By State

Alabama	.017
Arkansas	.017
Connecticut	.012
Delaware	.055
Georgia	.043
Illinois	.029
Indiana	.069
Maine	.082
Maryland	.007
Massachusetts	.056
Michigan	.006
Mississippi	.007
Missouri	.010
New Hampshire	.011
New Jersey	.011
New York	.008
North Carolina	.008
Ohio	.026
Pennsylvania	.030
Rhode Island	.003
South Carolina	.015
Tennessee	.024
Texas	.004
Virginia	.015
Wisconsin	.003

Table 4.10

Textile Industry, Capital Stock, By Year,
for States Included in Textile Industry Analysis
($000's)

	Alabama	Arkansas	Connecticut	Delaware	Georgia	
1956	189632.3				579566.0	1956
1957	199101.1				589673.3	1957
1958	202739.4				592112.4	1958
1959	209532.5	18441.9		7370.6	601555.6	1959
1960	221378.7	18961.2		7798.1	612298.1	1960
1961	235040.8	19747.2		8477.5	625233.3	1961
1962	237494.6	21046.5		9646.2	646567.3	1962
1963	250170.0	22778.0	90808.0	11205.0	654323.0	1963
1964	268506.6	24467.3	93904.9	12665.3	703012.0	1964
1965	301547.5	26432.7	98765.7	14350.0	749605.5	1965
1966	332727.9	28001.4	104215.8	15578.9	822074.9	1966
1967	366306.5	30667.8	110776.3	17864.4	892399.9	1967
1968	391228.3	32614.5	114808.7	19350.0	951728.8	1968
1969	413195.3	37263.4	120341.5	23489.0	1028040	1969
1970	434819.2	40162.9	126424.3	25730.1	1078151	1970
1971	453326.0	46376.7	135912.4	31211.5	1100756	1971
1972	475562.2	49384.8	142447.6	33291.4	1143037	1972

Source: Census of Manufactures and Annual Survey of Manufactures.

Table 4.10 (Cont.)

Textile Industry, Capital Stock, By Year, for States Included in Textile Industry Analysis ($000's)

	Illinois	Indiana	Maine	Maryland	Massachusetts	
1963	26745.0	39805.0	9664.0	54695.0	162796.0	1963
1964	28535.7	41672.8	9835.3	57321.3	170008.2	1964
1965	31618.1	46873.0	10298.0	59516.3	180146.4	1965
1966	38154.3	51134.7	10748.5	61627.6	192119.9	1966
1967	41247.3	52752.0	11090.0	66596.3	204204.8	1967
1968	43553.0	54255.1	11574.8	70526.1	215864.8	1968
1969	46543.8	58021.7	12922.5	74211.1	232405.4	1969
1970	48875.9	65065.6	13330.9	78691.7	249973.8	1970
1971	50490.2	69966.0	13417.7	81793.3	276307.5	1971
1972	51619.9	74204.0	13426.8	84628.6	305278.0	1972

	Michigan	Mississippi	Missouri	New Hampshire	New Jersey	
1963	33595.0	4886.0	65214.0	18867.0	244807.0	1963
1964	34453.3	4991.9	67113.3	19442.1	242606.9	1964
1965	34881.8	4996.6	70427.0	21465.9	245698.3	1965
1966	35806.7	4962.2	73643.9	21665.0	252173.3	1966
1967	36563.9	4799.3	76915.4	22860.1	248646.0	1967
1968	36950.4	4893.7	80300.1	23721.3	250040.9	1968
1969	39130.9	4881.3	83641.5	24530.9	252542.7	1969
1970	41145.1	5005.3	87657.4	25664.9	249921.1	1970
1971	43106.7	6053.9	94072.8	26585.7	238053.1	1971
1972	44865.2	5922.7	100125.4	27044.3	244636.2	1972

Source: CM and ASM.

Table 4.10 (Cont.)

Textile Industry, Capital Stock, By Year,
for States Included in Textile Industry Analysis
($000's)

	New York	North Carolina	Ohio	Pennsylvania	Rhode Island	
1956	164504.2		39324.7			
1957	178451.7		41769.1			
1958	193646.1		43288.1			
1959	205709.5		45098.0			
1960	218729.5		46840.9			
1961	231932.3		49715.9			
1962	243488.0		50596.2			
1963	256981.0	1475690	54761.0	345285.0	126869.0	1963
1964	270623.7	1596961	56720.0	358012.6	132623.3	1964
1965	290714.2	1766624	62384.3	374287.3	140447.8	1965
1966	311402.1	2032771	71463.8	391748.4	151972.0	1966
1967	334588.7	2216455	75800.7	405314.6	161033.0	1967
1968	355571.6	2376340	77319.3	421921.2	177571.2	1968
1969	371914.0	2555541	80593.5	448125.3	198095.4	1969
1970	387371.9	2713361	83183.2	467707.7	204260.0	1970
1971	423377.8	2890407	84101.9	488819.5	211350.8	1971
1972	462899.1	3144074	88648.8	510687.9	221246.8	1972

Source: CM and ASM.

Table 4.10 (Cont.)

Textile Industry, Capital Stock, By Year,
for States Included in Textile Industry Analysis
($000's)

	South Carolina	Tennessee	Texas	Virginia	Wisconsin	
1956	931042.5			207131.5		
1957	961947.1			216755.8		
1958	977866.9			220537.5		
1959	1009589			227891.9		
1960	1057096			238078.0		
1961	1093542			248914.0		
1962	1153553			260451.2		
1963	1220411	165811.0	47957.0	272188.0	28796.0	1963
1964	1311573	174640.4	50207.4	290644.9	30694.3	1964
1965	1417914	183836.5	54636.7	319854.8	32643.8	1965
1966	1571481	197488.5	62257.7	347189.4	35593.1	1966
1967	1685726	207670.7	66649.9	364966.0	38628.7	1967
1968	1728525	229362.3	79981.8	389363.6	41236.2	1968
1969	1798207	252948.8	82506.1	410352.6	44852.4	1969
1970	1875612	268021.9	83794.7	423859.4	50094.1	1970
1971	1944323	286729.0	89486.1	442079.6	52511.7	1971
1972	2031060	296180.1	92083.0	492325.2	54145.0	1972

Source: CM and ASM.

capital services, there are at least two important shortcomings of the data. One is that the value of the capital stock varies according to when the capital was purchased. Older capital stock producing the same level of output as new capital stock is valued at less because it was purchased at lower nominal prices. Because inflation was low during the 1950's, this problem should only begin to seriously affect the data in the 1960's and 1970's. The expected bias for the last three recessions is that the capital stock will be overestimated in the rapidly growing states where the capital is relatively new. Counteracting the overestimation of the new capital stock is the fact that newer capital embodies more capital, because it is more productive and efficient. It is too much to hope that these effects will exactly cancel each other.

The second shortcoming of the data is that there are bound to be sampling errors in the original base year capital stock values. The data on gross book value of depreciable assets are derived from a sampling of individual establishments. Thus there are bound to be differences between the estimates and the values obtained if a total census is taken. CM notes the probability of the true estimates falling outside of a two percent range on either side of the published value in two out of ever-three cases. The number in brackets represents a percent range around the estimated book value. The probability that the true value will fall within this percentage range is 66%. Thus the higher the number in brackets, the less reliable the 1957 base-year value of the capital stock. The states are listed in declining order of the unreliability of the estimates: Wyoming (40), North Dakota (12), Oregon (12), Utah (10), Vermont (10), South Dakota (9), Tennessee (9), New Mexico (9), Nevada (6), Maine (6), Idaho (5), Montana (5), Pennsylvania (5), Nebraska (5), California (5), Rhode Island (4), and Washington (4) (CM, 1958: 9-46 - 9-29).

A third problem is that the capital stock data should be adjusted for utilization rates. Since the capital-stock value is the numerator of the capital-labor ratio, the failure to adjust for utilization will interject a bias. For example, in states where capital utilization is high, the capital-labor ratio will be underestimated because the proportion of labor applied to the capital stock will be overestimated. Because capital-intensive operations tend to have higher capital utilization rates, high capital-labor ratio states will have a downwardly biased ratio, while low capital-labor ratio states will have an upwardly biased ratio.

The capital-stock values described here were used in the calculation of two variables, the age of the capital stock and capital-labor ratios. We turn now to them.

Capital-Labor Ratios

Capital-labor ratios were calculated for each peak year. The denominator of the ratio is the total number of employees in each state in all-manufacturing for the all-industry equation, in the machinery industry for the machinery equations, and the textile industry for the textile equations.

The employment data for the peak years 1952, 1956, 1969, 1968, and 1972 were taken from ASM and the CM. The total manufacturing employment for each state for 1952 and 1956 are from the ASM, Table 3, 1952 and the ASM, Table 3, 1956 respectively. The total number of manufacturing employees for 1959 and 1968 from the ASM, Table A, 1968-69, and the 1972 data is from the CM, Volume III, Area Statistics, Table 5, 1972.

The total number of employees in machinery and textile manufacturing in each state were taken from the following sources: the 1956 data was from the ASM, Table 3, 1956; the 1959 data from the ASM, Table 2, 1959-60; the 1968 data from the ASM, Table 3, 1968; and the 1972 data from the CM, Volume III, Area Statistics, Table 5, 1972.

The numerators of the capital-labor ratios are the capital-stock values taken from series described earlier. The final capital-labor ratios represent the capital stock in thousands of dollars per employee.

The original 1957 estimate of the gross book value of depreciable assets is highly unreliable for the state of Wyoming. The probability that the true value falls within a 40 percent range above or below the estimated value is 66 percent. Consequently the results of the capital-labor ratio calculations, which indicate Wyoming has the highest ratio of any other state for all five peak years are highly suspect, and Wyoming was, therefore, eliminated from the sample.

Age of the Capital Stock

The age of the capital stock was calculated for each state for all industries, the machinery industry and the textile industry. The age-of-capital variable is roughly equivalent to the proportion of a state's capital stock put into place within the last two or three years. The data sources and specific procedure for calculating this variable are described below.

All Manufacturing

The age of the capital stock for the all-industry equations were calculated in two ways.

$$\frac{(I_{t-2} + I_{t-1} + I_t)}{K_t} \qquad (4-4)$$

where I = real investment, K = capital stock, t = a peak year, and

$$\frac{(I_{t-1} + I_t)}{K_t} \qquad (4-5)$$

The peak years are 1952, 1956, 1959, 1968, and 1972.

While equation 4-4 is the preferred measurement of the capital stock's age, one piece of information is missing for the first recession. Not until 1951 did the CM or ASM begin to collect state data on new capital expenditures. Therefore, 1950 investment figures are not available to calculate equation 4-4 for the 1953-55 recession. In order to permit a combined cross-section time-series for all five recessions, 4-5 is the equation used to calculate the all-industry age-of-capital-stock variable.

The investment data are the same as those used to calculate the original capital-stock values. The sources can be found for the corresponding year in Table 4.3. The nominal investment data were converted into real 1958 values using the GNP fixed investment price deflator cited earlier.

Machinery and Textile Industry

Equation 4-4 was used to calculate the ages of the machinery and textile industries' capital stocks. As mentioned earlier the absence of monthly employment data from which to calculate the dependent variables for the 1952-55 and 1956-58 recessions meant that the age variables were only required for the last three recessions. Thus, it was possible to use 3 years of investment in the numerator. The sources of investment data for the textile and machinery industries can be found in Table 4.4.

Unionization

All Manufacturing

Data on the percent of the labor force unionized by state and by state-by-industry are needed to test the hypothesis that union membership has an impact on the severity of a state's recession. Unfortunately, these data are not published on a regular basis. The of available data and the manner in which these data were adjusted to get the percent of the labor force unionized in peak years will now be described.

The percent of the non-agricultural labor force unionized by state is available for the years 1939, 1953, 1958, 1960, 1964, 1966, 1968, 1970, and 1972. The 1953 data were obtained from the Statistical Abstract of the United States, 1957, Table No. 277, p. 31, and adjusted to a 1952 level by subtracting .3 percent from the total 1953 percentage for each state. The adjustment of .3 percent was chosen because statistics show that union membership showed slow but steady gains until 1956 (Cohany, 1961: 1302). Therefore, it is assumed that union membership in 1952 was slightly lower than that of 1953. The trend of unionization from 1939 to 1953 shows an .8 percent annual increase in the percent of non-agricultural unionized labor (Statistical Abstract, 1957: 231). Since the growth in labor movements was substantially greater in the period 1939 to 1945 (Cohany, 1961: 1302), the figure of .8 percent has to be an upper bound. The number of .3 percent was selected on an ad hoc basis as the annual percent addition to the unionized labor force from 1952 to 1953.

The percent of the labor force unionized in 1956 and 1959 was obtained by extrapolating between 1953 and 1960. The 1960 data on unionization by state were taken from the Statistical Abstract, 1962, Table No. 322, page 242. Unfortunately, these data include only estimated membership in the AFL-CIO, rather than the percent of non-agricultural employment. Therefore, before the data could be extrapolated between 1953 and 1960, the 1960 data had to be adjusted upwards.

The 1960 data were adjusted by estimating the total proportion of the unionized labor force in the AFL-CIO for 1968. The percentage of the total unionized labor force in the AFL-CIO in 1968 was assumed to prevail in 1960. The extrapolation between the 1953 and the 1960 data was straightforward except that an adjustment was made for the knowledge that 1956 was the peak year for union membership.

The 1968 data on all non-agricultural employee and AFL-CIO union membership by state were taken from pages 76 and 77 of the Directory of National and International Labor Unions in the U.S., 1969, Bureau of Labor Statistics Bulletin 1665, Department of Labor, 1970. The 1972 percent of the non-agricultural labor force that is unionized was taken from the Directory of National Unions and Employee Associations, 1973, Bureau of Labor Statistics, Department of Labor, 1974, page 84.

Machinery Industry

Most workers in the machinery industry covered by bargaining agreements are represented by the Machinists (IAM), Auto Workers (UAW), or the Steel Workers (USA). Unfortunately, data on the membership in these and other smaller unions, by state, are scant. However, some usable data are available. Data on the proportion of machinery establishments with collective bargaining agreements covering a majority of their plant workers can be found in the publications Industry Wage Survey--Machinery Manufacturing for Winter 1970-71, B.L.S. Bulletin 1754, U.S. Department of Labor, 1972, and Industry Wage Survey--Manufacturing for September-November 1968, B.L.S. Bulletin 1664, U.S. Department of Labor, 1970. These sources present the results of two surveys taken in approximately twenty-two metropolitan areas. The union membership for these SMSA's were applied to the corresponding state, for the years 1967 and 1972. For five states there are two SMSA's included in the study. They are New York City and Buffalo for New York, San Francisco-Oakland and Los Angeles-Orange County for California, Boston and Worcester for Massachusetts, Dallas and Houston for Texas, and Pittsburgh and Philadelphia for Pennsylvania. For these states a weighted average of the two SMSA's was used as the state level unionization rate. Because these data are only available for areas in 16 states in 1972, one regression equation was run using only the observations for which these unionized data are available. The regression included the following states in 1972: California, Colorado, Connecticut, Illinois, Maryland, Massachusetts, Michigan, Missouri, Minnesota, New York, New Jersey, Oklahoma, Ohio, Oregon, Pennsylvania, Texas, and

Wisconsin.

In 1968, the data are available only for New York and Ohio. Because of the inadequacies of these data, the state-level union rates, described in the all-industry section, are also used in the machinery equation in place of the SMSA data.

Textiles

The major unions in the textile industry are the Textile Workers Union of America and the United Textile Workers of America, both AFL-CIO affiliates. Approximately two fifths of the workers in New England and the Middle Atlantic states and one-eighth of the workers in the Southeast were covered by union contracts in 1971 (Industry Wage Survey, 1974: 2). Unfortunately, no more specific textile industry union data by state could be located. As a second-best strategy, the state union totals described in the section on all manufacturing are used in the machinery and textile industry equations.

Unemployment Insurance Benefits

The unemployment insurance benefits are included in the equation to test the impact of unemployment insurance on cyclical employment. The measure of benefits used in this study is the ratio of average weekly benefit amount to the average weekly total wage. These figures were obtained for all states for the peak years of 1952, 1956, 1954, 1968, and 1972.

More specifically, the variable was calculated in the following manner. The numerator is equivalent to the benefits paid for total unemployment during the year divided by the number of weeks for which benefits were paid. Payments for partial unemployment are excluded altogether.

The denominator of the ratio was derived as follows. The total wages paid, on a one-year period, to all private, public, and non-profit organization employees covered by unemployment insurance. This figure includes cash bonuses, the cash value of meals, lodging, tips, and any other gratuities. Deferred compensation, such as retirement, stock bonus plans, and life or health insurance benefits, is not included. This figure is divided by the twelve-month average of covered employees times 52 weeks.

The source of these data for all of the five peak years for all states is the Handbook of Unemployment Insurance, Financial Data 1938-76, United States Department of Labor, 1978. The state rates were used in the machinery, textile, and all industry equations.

Unemployment Rates

The sixth variable used in the equations is the insured unemployed for the peak years for each state. This variable measures the extent to which a shortage or surplus of labor in boom periods influences lay-off patterns during periods of economic slowdown.

The insured unemployment rates were taken from the Manpower Report of the President. The 1952, 1956, and 1959 data came from Table D-5, page 236 of the 1964 publication. The 1968 and 1972 data were obtained from Table D-5, page 208 of the 1973 edition. The total state rates were used in all-industry equation as well as the two industry-specific equations.

The data sources and the manner in which they were calculated have been documented. Before turning to the test of the formal model, empirical regularities in the data will be explored in Chapter Five.

CHAPTER 5

EMPIRICAL REGULARITIES

There are a number of interesting preliminary empirical findings from the data that deserve attention before proceeding to the results of the formal model. The purpose of this chapter is to present these noteworthy results. The first section of Chapter Five focuses on the all-industry data. In this section the questions of whether state cycles are becoming more alike with time and whether a cyclically sensitive state is always volatile while a cyclically stable state is always stable will be considered. Finally, cross-regional comparisons of the business cycle, capital-labor ratios, and age of the capital stocks will be made. These data will be summarized, as well as checked for consistency with other data on regional trends.

The second and third sections of this chapter will describe the preliminary findings for the machinery and textile industries, respectively. Again, the regions that tend to have cyclically sensitive industries will be identified and the capital-labor ratios and age-of-capital-stock data will be analyzed by region. We now turn to the all-industry data.

All Industries

The trend-adjusted and absolute measures of the severity of state recessions were averaged for each recession. These mean measures of cyclical amplitude, as well as standard deviations provide some basis with which to compare the severity of the five post World War II recessions as well as an opportunity to check the data used in this thesis for consistency with other empirical findings.

Table 5.1 and 5.2 display the mean state severity measures for each recession. The values of Table 5.1 are trend-adjusted, while those of Table 5.2 are not. Calculation of the trend-adjusted and absolute measures of cyclical severity were discussed in some detail in Chapter Four, and therefore will not be reiterated here. In addition to the mean values, the standard deviations and minimum and maximum values are also displayed.

Two observations are worth noting from Tables 5.1 and 5.2. First, the difference between the trend-adjusted and unadjusted results are substantial. Not only are the mean amplitudes and standard deviations different, but the states identified as hard hit and moderately affected vary depending on which severity indicator is used. For example, in the 1953-54 recession the trend-adjusted data suggest that Oregon was hit hardest with a 6.6 percent deviation from its employment trend. However, when the data are not adjusted for secular trends Indiana appears to have been hardest hit with an absolute amplitude of 10.3. When the data are not adjusted for trend the severity of the recessions in the fast-growing states is underestimated while the measures for the slow-growth states are overestimated. The failure to distinguish between the two measures has, at times, led to faulty conclusions.

For example, there was a great deal of consternation about the harshness with which the 1973-75 recession affected the Northeast, and, in terms of absolute severity, it was true. New England experienced the greatest percentage decline in employment. As shown in Table 5.8, the percentage decline for the Northeast was 4.6. The next most severe recession was felt in the Southern states with a percentage decline of 3.8.

However, if the data are adjusted for trend as shown in Table 5.7, the rankings change dramatically. The South now appears to have suffered the greatest employment loss, with the North second and the Northeast ranking third. Thus, from looking at the trend adjusted data we might conclude that the Northeast was relatively resilient in the 1973-75 recession.

A second point of interest from Tables 5.1 and 5.2 is that the 1973-75 recession appears to have been milder than the 1953-54 and 1957-58 recessions. This finding is in accordance with national data. Although the 1973-75 downturn was the most severe post-World War II recession in terms of GNP losses, it was much more moderate than earlier recessions in terms of employment declines. Employment declined by only 1.3 percent nationally during the 1973-75 recession, whereas declines in employment during the recessions of the early 1950's ranged from 3.1 to 4.2 percent nationally. The small employment increases during the 1975-76 economic recovery suggests that "labor hoarding" may have been responsible for the uncharacteristically moderate employment decline during the downturn (McNees, 1978: 53). Further exploration of the reasons for relatively mild employment reductions during the 1973-75 recession are beyond the scope of this thesis.

The severity measures are carried out to the two digit level in Tables 5.1, 5.2, and elsewhere in this chapter. This captures

Table 5.1

Average Trend-Adjusted Severity for Each Recession
(Percentages)

Recession	1953-54	1957-58	1960-61	1969-70	1973-75
Mean	2.48	2.47	1.48	.87	2.16
S.D.	1.424	.864	.817	.801	.967
Minimum	.0 (Florida, Nevada, North Dakota)	1.19 (South Carolina)	.0 (Nevada, South Dakota)	.0 (Arizona, Florida Idaho, Kentucky, Louisiana, Maryland, Montana, Nevada, North Carolina, North Dakota)	.12 (Washington)
Maximum	6.64 (Oregon)	4.72 (Ohio)	3.00 (Nebraska)	3.09 (Virginia)	4.28 (South Carolina)
	n = 33	n = 35	n = 37	n = 40	n = 47

Source: Bureau of Labor Statistics Data. See Chapter 4 for computations.

Table 5.2

Average Absolute Severity for Each Recession
(Percentages)

Recession	1953-54	1957-58	1960-61	1969-70	1973-75
Mean	3.74	4.01	2.02	1.14	3.36
S.D.	2.265	2.560	1.426	1.504	2.135
Minimum	.00 (Arizona)	.00 (Arizona)	.00 (Arizona)	.00 (Arizona, Colorado, Kentucky, New Mexico, South Carolina)	.04 (North Dakota)
Maximum	10.26 (Indiana)	10.28 (West Virginia)	5.29 (Ohio)	7.13 (Washington)	7.64 (Rhode Island)

Source: Bureau of Labor Statistics Data. See Chapter 4 for computations.

subtle differences cross-state differences in the severity of recessions, and while the numbers are small, it should be remembered that a small percentage change in employment is a large change in the total number of jobs.

One question of interest to regional economists has been: Are the regions' cycles becoming more alike with time? Borts addressed this question in his study of manufacturing employment cycles. His results, using data on five recessions over the period 1914 to 1953, suggested that the variation in state cycles was diminishing with time. Borts attributed this diminishing variation to the observation that states formerly specializing in highly cyclical industries were diversifying (Borts, 1960: 174). Thus Borts suggests that a growing similarity in state's industry structure was leading to a similarity in business cycles. Borts also notes that the decline in the variation of state's cycles may have been due to the mildness of the later recessions of his study (Borts, 1960: 152).

The question of whether states' cycles are becoming alike with time was also addressed by Dick Syron (1978). Syron's results contradicted those of Borts. In a 1978 paper in the New England Economic Review, Syron examined the question of whether regional responses to national economic fluctuations were becoming more or less alike over time. Syron hypothesized that regional cycles would become more similar because advances in communications and transportation were resulting in increased integration of regional economies.

Using both trend-adjusted and unadjusted data for the five recessions between 1948 and 1973, Syron calculated indices of amplitude for nine regions and five recessions. An index number greater that 100 meant that an area suffered a more severe employment loss during a recession than the nation as a whole. A number less than 100 signified a more moderate employment loss. He then calculated standard deviations of these regional indices for each recession. Comparing the statistics of variation over time, Syron concluded that there has been no convergence in the pattern of regional cycles. The most variation among regions occurred in the 1970-71 recession and the least in the 1948-49 recession (Syron, 1978: 25-34).[1]

The hypothesis tested by Syron was repeated in this study with three exceptions. First, state-level data was used, in contrast to Syron's nine region geographical breakdown. Second, this study included data on five recessions between 1950 and 1975, whereas Syron's study included the five recessions between 1948 and 1973, and finally, this study calculated the standard deviations of actual trend-adjusted severity measures, whereas Syron calculated the standard deviations of indices.

Tables 5.1 and 5.2 contain the results of the mean amplitudes and standard deviations calculated from state data. To review, the amplitudes in Table 5.1 were adjusted for secular trends while the data in Table 5.2 were not.

The more the states' recessions are alike, the smaller the standard deviation will be. Therefore, if cycles were becoming more

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[1]The same test was done at the 9 census region level in Howland (1979), "The Regional Business Cycle and Long Run Regional Growth." The findings were similar to Syron's.

similar with time we would expect the standard deviations to decrease with time. As indicated in Tables 5.1 and 5.2, this is not the case. Looking at the trend-adjusted data we see that the greatest variation was in the 1953-54 recession and the second largest deviation was in the 1973-75 recession. While these statistics do not match Syron's for the smallest and largest variations, the conclusion is the same. There is no tendency for states to become more alike in their recessions.

In contrast to Borts hypothesis that mild natural recessions are associated with small differences in regional cycles. The data in Tables 5.1 and 5.2 indicate that there is no clear relationship. Although the most severe national recession, in terms of employment loss, was in 1953-54 and the state recessions showed the least similarity in that year, the second most severe national recession, in terms of employment loss, was in 1957-58 where the standard deviation ranked third largest. However the remaining standard deviations do seem to be positively associated with the severity of the national recessions that is, as the lower the severity, the lower the standard deviations for the 1960-61 and 1969-70 recessions.

This chapter now turns to the question of whether there is a consistent pattern of states' cyclical sensitivity, that is, is a state's amplitude of a constant ranking relative to all other states in each recession. For example, is Michigan's employment loss among the most severe in every recession and is Arizona relatively stable in all recessions?

This question was posed for several reasons. First of all, one of the purposes of this study is to inform countercyclic policy. If states' relative amplitudes are similar in all recessions then the targeting of money to the most needy areas is a simpler matter. The states with a relatively severe fluctuation in the next recession. In such a case, a more sophisticated theory of regional business cycles is not crucial for policy-making.

The second reason for exploring this question was to delve deeper into the hypothesis put forward in Chapter Three. State rankings of relative amplitudes may remain constant because both industry compositions within states and the relative amplitudes of national industries are constant over time. Or a similar ranking of state recessions may occur because the rankings of other significant explanatory variables have varied little over the period under study.

The hypothesis was put forward that the probability of a state experiencing a severe, an above average, a below average, or a mild recession was independent of the state's performance in the previous recession. In order to test this hypothesis, the states were given ordinal rankings for each recession. These rankings were then divided into four equal sized categories, with any odd numbers distributed evenly among the top categories first. The top quartile of the ranked states was classified as having experienced a relatively severe recession, and the states in second, third, and fourth quartiles were characterized as having experienced an above-average, below-average, or a mild recession, respectively.

The states were then further categorized by the percent of the recessions in which they fell in each category. The results are displayed in Table 5.3. So that, for example, Indiana only appears in the table once because in all five recessions, or 100 percent of the cases, Indiana experienced a severe recession. The greater the number of states in all four column categories, in the 100th or 80 percent rows, the more consistent are states' behavior across recessions.

As noted in Table 5.3, data were missing for several states. The states with less than five observations are noted by putting in parentheses the number of available observations.

Table 5.4 is a contingency table and the figure within each cell represents the number of states that would be expected to fall in each category if the probability of falling into any of the four severity categories was equally likely and the pattern of state rankings were independent of the pattern in preceding recessions. It should be noted that the states for which there were less than five observations were eliminated from the contingency table and the statistical test. The inclusion of these states posed major complications in calculating the contingency table and did not seem justified by the small number of additional observations.

A log likelihood ratio test[2] was used to test whether the actual frequencies displayed in rows 1 and 2 of Table 5.3 (minus the noted observations) were significantly different from the expected frequencies displayed in rows 1 and 2 of Table 5.4. The test included only the first two rows, because if a state falls into the 100 percent or

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[2]Namboodiri, N.K., et al., Applied Multivariate Analysis and Experimental Designs, p. 387-390. The log likelihood test statistic is equivalent to

$$Q = \sum_i \sum_j 2 \text{ Obs}_{ij} \ln \frac{\text{Obs}_{ij}}{\text{Exp}_{oj}}$$

where i = rows, j = columns,
Obs = observed frequencies, Exp = expected frequencies.

Table 5.3

Trend-Adjusted Severity for All States
The percent of times a state fell into each category.

	Severe	Above Average	Below Average	Mild
100%	Indiana Michigan (1)*	Maine (1) Massachusetts (1) New Hampshire (1) New Jersey (1)	Connecticut (1)	Oklahoma (3) Washington (1)
80%	Ohio	Illinois	Alabama	Nevada
75%			New Mexico (4)	
60%	Delaware Kentucky Rhode Island	Maryland Missouri Pennsylvania Vermont	Minnesota North Dakota	Arizona Florida Iowa Montana New York
50%	Arkansas (2)	Louisiana (2)	Arkansas (2) Texas (2)	Louisiana (2) Texas (2)
40%	Oregon West Virginia Wisconsin	Delaware Georgia Oregon Rhode Island South Carolina Virginia	Georgia Kansas Mississippi North Carolina South Dakota Tennessee Wisconsin	California Colorado Idaho Mississippi Nebraska North Carolina North Dakota South Carolina Tennessee Utah
25%				New Mexico (4)
20%	Alabama Arizona California Colorado Georgia Idaho Illinois Kansas Mississippi Missouri Montana Nebraska Nevada North Carolina	California Colorado Florida Idaho Iowa Kansas Kentucky Minnesota Nebraska New York Ohio South Dakota Utah West Virginia	Arizona California Colorado Florida Idaho Iowa Maryland Minnesota Missouri Montana Nebraska New York Oregon	Kansas Kentucky Maryland Pennsylvania South Dakota Vermont Virginia West Virginia

Table 5.3 (Cont.)

20%	Pennsylvania South Carolina South Dakota Tennessee Utah Virginia	Wisconsin	Vermont Virginia West Virginia

Source: Calculated from Bureau of Labor Statistics Data.

*Values in parentheses signify the number of times that a state was captured in the sample.

Table 5.4

Contingency Table for Table 5.3

Number of states expected if each severity category were equally likely and states' behavior was independent of behavior in previous recessions.

Percent of 5 Recessions	Severe	Above Average	Below Average	Mild	
100%	.03	.03	.03	.03	.13
80%	.48	.48	.48	.48	1.93
60%	2.90	2.90	2.90	2.90	11.59
40%	8.70	8.70	8.70	8.70	34.80
20%	13.05	13.05	13.05	13.05	52.21
0	7.83	7.83	7.83	7.83	31.32
	33.00	33.00	33.00	33.00	132.00

n = 33

80 percent categories they have demonstrated a consistent ranking across recessions. The log likelihood ratio then tests whether the number of states with a consistent pattern of severity is significantly different than would be experienced under the assumptions of randomness and independence described above.

The resultant log likelihood ratio was 8.87. This statistic is distributed χ^2_6, thus the critical value at the 5% level is 12.59 and we cannot reject the hypothesis of randomness and independence.

This result indicates that the same states do not always experience and same severity ranking relative to all other states. A state hit severely in one recession, is equally likely to be mildly, moderately, or severely hit in the next recession.

This result is somewhat surprising. One likely reason for this apparent non-uniformity in severity rankings across recessions could be that national recessions are different in nature. As a consequence national industries may exhibit different relative severities across recessions. To test whether this non-uniformity in the cyclical sensitivity of national industries is the case, a similar test was conducted on twenty-seven national industries.

Table 5.5 lists the number of recessions that an industry fell in each category. Lumber and primary metals ranked among the top most severely hit industries in all five recessions. Wholesale and retail trade, government, food and kindred products, etc. ranked among the nine most mildly hit industries in all five recessions.

The hypothesis to be tested was that the probability of the relative severity of an industry's recession was independent of the

Table 5.5

Severity of Trend-Adjusted Recession

The number of recessions in which an industry fell in the high, medium, or low category of severity of recessions.

Number of Recessions	High	Medium	Low
5	lumber, primary metals	misc. manufacturing	wholesale & retail trade, government, food & kindred products, newspapers, services, finances
4	transportation (manuf.), furniture, machinery (exc. elec.), fabricated metals	apparel, textiles, transportation & public utilities	petroleum
3	electrical machines, rubber & plastics	instruments, stone & clay, tobacco	chemicals
2	instruments, construction, stone & clay, paper	mining, electrical machinery, construction, leather & leather products, chemicals	mining, paper leather & leather products
1	mining, apparel, tobacco, leather & leather products, textiles	transportation (manu.), machinery (exc. elec.), fabricated metals, rubber & plastics, furniture, paper, petroleum, tobacco	construction, rubber & plastics, transportation & public utilities

Source: Bureau of Labor Statistics Data.

same industry's relative behavior in the previous recession. The Contingency Table 5.6 notes the number of industries expected in each cell if all twenty-seven industries are equally likely to experience a severe, average, or mild recession and if an industry's behavior is independent of its behavior in previous recessions.

A log-likelihood ratio was calculated to determine whether the actual number of observed states with the same behavior over four or all five recessions was substantially different from the expected number of states in that category under the assumption of independence. The log-likelihood ratio was 31.83. This statistic is distributed χ^2_4. Because the critical value is 18.47 at the .001 percent level, we can comfortably reject the hypothesis of independence. Industries that are cyclically sensitive in one recession tend to be cyclically sensitive in all recessions.

Thus, we have observed dissimilar rankings of state's amplitudes across recessions, while there are similar rankings of national industries across recessions. These findings suggest three explanations about cross-state differences in business cycles. First, industry compositions within states may vary over time. Second, within industries there may be irregular patterns of output cutbacks and layoffs across states, or third, unionization, unemployment rates, and unemployment insurance benefits may change in relative importance across recessions. These issues will be considered again in Chapter Six.

We now turn to a review of the data, subdivided into four regional catagories. First, regional cycles will be compared .

Table 5.6

Contingency Table for Table 5.5

The expected number of industries in each category if severity of recessions were random.

Number of Recessions	Severe	Average	Mild	Total
5	.11	.11	.11	.33
4	1.11	1.11	1.11	3.33
3	4.44	4.44	4.44	13.33
2	8.89	8.89	8.89	26.67
1	8.89	8.89	8.89	26.67
0	3.56	3.56	3.56	10.67
Total	27	27	27	81

Comparison of the Severity of Regional Recessions

The forty-eight states of the contiguous United States are divided into four regions, the Northeast, North Central, South, and West. The average percentage decline in employment in each region is calculated for all five recessions. The results for both the trend-adjusted and unadjusted recessions are presented in Tables 5.7 and 5.8, respectively.

The data presented in these tables are consistent with those of other authors such as Syron (1978), Friedenburg and Bretzfelder (1980) and Gellner(1974). When employment data are adjusted for secular trends, the North Central region has been, on the average, the most cyclically sensitive region. When the secular trend is not removed from the data, the Northeast appears to be substantially more cyclically sensitive because the impact of the recession is compounded by the slow long-run growth trend in the Mid-Atlantic and New England. This result is shown by the sum of the rankings in Tables 5.7 and 5.9.

Even though the North Central region has been the most cyclically sensitive region more often than any other region when the data are adjusted for trend, it should be noted it is not always the most sensitive. For example, as indicated in Table 5.7 the Northeast was hit hardest by the 1970-71 recession. This same observation was made by Gellner (1974: 19-21) using unemployment rates.

The Western region was the most stable region, independent of whether the data are adjusted for trend or not. In both cases, the total ranking for the Western states is highest. The Southern region ranks second to the West as the most cyclically stable region over the

Table 5.7

Trend-Adjusted Severity for Five Recessions
by Four Major Regions.
(Percentages)

	Northeast	North Central	South	West
1953-54	2.65 (1)**	2.24 (4)	2.42 (3)	2.62 (2)
1957-58	2.18 (4)	2.82 (1)	2.31 (3)	2.37 (2)
1960-61	1.60 (2)	1.83 (1)	1.35 (3)	1.20 (4)
1970-71	1.30 (1)	1.26 (2)	.67 (3)	.53 (4)
1973-75	2.10 (3)	2.16 (2)	2.58 (1)	1.55 (4)
Total of Ranks	11	10	13	16

Source: Bureau of Labor Statistics Data.

*Data were not available for all states and all years. The missing observations are noted on pages of Chapter Four.

**Rankings are in parentheses.

Table 5.8

Absolute Severity for Five Recessions
by Four Major Regions
(Percentages)

	Northeast	North Central	South	West
1953-54	5.30 (1)**	3.78 (2)	3.31 (3)	2.38 (4)
1957-58	5.91 (1)	4.22 (2)	3.48 (3)	3.43 (4)
1960-61	2.86 (1)	2.19 (2)	1.67 (4)	1.67 (3)
1970-71	2.58 (1)	1.84 (2)	.27 (4)	.67 (3)
1973-75	4.62 (1)	3.22 (3)	3.78 (2)	1.70 (4)
Total of Ranks	5	11	16	18

Source: Bureau of Labor Statistics Data.

*Data were not available for all states and all years. The missing observations are noted on page of Chapter Four.

**Rankings are in parentheses.

past five recessions.

Two points should be kept in mind when comparing the results of Tables 5.7 and 5.8 with the results of other authors. First, some states are excluded from the early estimates. For example, Michigan did not enter the sample until the 1973-75 recession.

Second, these are averages of state severities; thus, the recessions of small states are weighted the same as recessions of populous states. The consistency of the severity measures with other studies does, however, suggest the data are reliable and consequently will provide an adequate test of the formal model.

Comparison of Regional Capital-Labor Ratios

Table 9.5 presents the capital labor ratios for each of the four major regions for the peak years of 1952, 1956, 1959, 1968, and 1972. The tables show that the highest capital labor ratios are to be found in the Western states, while the lowest ratios are exhibited in the Northeast. The Southern and North Central states rank second and third respectively. This ranking holds for all five points in time. For example, in 1972, an average employee in the Western states worked with an average of $13,390 worth of capital whereas an average employee in the Northeast worked with an average of $9,950 worth of capital. As stated in Chapter Four, the capital stock is valued in 1958 dollars. The depreciation rates used in estimating the numerator of the ratios displayed in Table 5.9 are the 1971 depreciation rates for each state.

In order to test the sensitivity of the results to variations in depreciation rates, the tables were recalculated, assuming that the average of the 1958-62 depreciation rate in each state prevailed over the period 1952-72. A second set of capital stock figures were calculated based on this alternative assumption and used to recreate the numerators of the capital-labor ratios. The results, which are presented in Appendix VI.B., again indicate that the Western states had the highest capital-labor ratios, followed by the Southern and North Central regions. The Northeast exhibited the lowest ratio. As with the case of the 1971 depreciation rate assumption, this ranking prevailed over all five periods covered in the study.

The North Central region is further subdivided into two categories, the East North Central and West North Central states. As expected in both cases manufacturing production in the East North Central states was more capital-intensive than in the West North Central states. The capital-labor ratio of the East North Central appears to be similar to that of the South, while the capital-labor ratio of the West North Central ranks just above that of the Northeast in all cases.

In addition to an across regional comparison of capital-labor ratios, the upward trends in the standard deviations of the capital-labor ratios are worth noting. As discussed earlier it has been hypothesized by regional economists that the composition of state economies are becoming more homoegeneous over time. However, as Table 5.9 indicates the standard deviations on the capital-labor ratios have increased with time, suggesting less cross-state homogeneity in the production process. For example, in the Northeast the standard deviation increased from 1.0 to 2.7 from 1952 to 1972. In the West the standard deviation

Table 5.9

Capital-Labor Ratios and Age-of-Capital Stock
for All-Manufacturing, By State
1952
(δ = 1971)

	Capital-Labor Ratios ($000's)				Age-of-Capital Stock[b]	
	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation
Northeast	3.82	1.003	2.19 (NH)	5.49 (NJ)	.22	.045
North Central	5.33	1.779	3.26 (MO)	9.66 (ND)	.24	.081
East	5.00	.360			.26	.036
West	5.56	2.359			.23	.104
South	5.77	2.498	2.76 (GA)	13.82 (LA)	.26	.079
West[a]	6.62	4.242	.33 (NM)	16.67 (NJ)	.47	.673

Source: Census of Manufactures (CM) and Annual Survey of Manufactures (ASM). See Chapter Four for discussion of calculations.

[a]Excluding Wyoming.

[b]Proportion of capital stock put in place in the previous two years.

Table 5.9 (Cont.)

Capital-Labor Ratios and Age of the Capital Stock
for All-Manufacturing, By Region
1956
(δ = 1971)

	Capital-Labor Ratios ($000's)				Age-of-Capital Stock[b]	
	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation
Northeast	4.60	.992	3.47 (NH)	6.36 (PA)	.18	.026
North Central	6.21	1.180	4.64 (MO	8.65 (ND)	.19	.056
East	6.65	.978			.21	.035
West	5.90	1.283			.17	.062
South	7.21	2.650	4.27 (MS)	13.86 (LA)	.23	.057
West[a]	8.05	3.221	5.20 (AZ)	13.29 (MT)	.32	.182

Source: CM and ASM.

[a]Excluding Wyoming.

[b]Proportion of capital stock put in place in previous two years.

Table 5.9 (Cont.)

Capital-Labor Ratios and Age of the Capital Stock
for All-Manufacturing, By Region
1959
(δ = 1971)

	Capital-Labor Ratios ($000's)				Age-of-Capital Stock[b]	
	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation
Northeast	5.46	1.377	4.01 (NH)	7.83 (PA)	.5	.017
North Central	7.42	1.681	4.27 (SD)	10.16 (IN)	.17	.036
East	8.30	1.505			.14	.017
West	6.79	1.60			.19	.032
South	8.56	3.319	4.99 (MS)	15.22 (LA)	.16	.038
West[a]	9.19	3.528	5.82 (AZ)	15.97 (MT)	.20	.108

Source: CM and ASM.

[a]Excluding Wyoming.
[b]Proportion of capital stock put into place in previous two years.

Table 5.9 (Cont.)

Capital-Labor Ratios and Age of the Capital Stock
for All-Manufacturing, By Region
1968
(δ = 1971)

	Capital-Labor Ratios ($000's)				Age-of-Capital Stock[b]	
	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation
Northeast	7.59	1.889	5.43 (RI)	10.90 (ME)	.19	.024
North Central	9.43	2.594	3.89 (SD)	14.09 (IN)	.19	.031
East	10.99	2.101			.18	.013
West	8.40	2.477			.19	.040
South	11.40	4.785	7.43	22.30	.21	.058
West[a]	11.99	4.485	6.60 (NM)	22.53 (MT)	.21	.041

Source: CM and ASM.

[a]Excluding Wyoming.

[b]Proportion of capital stock put in place in previous two years.

Table 5.9 (Cont.)

Capital-Labor Ratios and Age of the Capital Stock
for All-Manufacturing, By Region
1972
(δ = 1971)

	Capital-Labor Ratios ($000's)				Age-of-Capital Stock[b]	
	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation
Northeast	9.95	2.666	6.39 (RI)	15.21 (ME)	.15	.023
North Central	11.17	3.146	4.04 (SD)	16.57 (IN)	.17	.066
East	13.19	2.520			.13	.018
West	9.73	2.842			.19	.078
South	13.17	5.618	8.59 (OK)	25.60 (WV)	.17	.040
West[a]	13.39	5.344	6.08 (NM)	25.00 (MT)	.20	.078

Source: CM and ASM.

[a]Excluding Wyoming.

[b]Proportion of capital stock put in place in previous two years.

rose from 4.2 to 5.3. The trends are similar for all regions independent of the assumption made about depreciation rates. The reason for the divergence in capital-labor ratios is not obvious. It cannot be simply explained by identifying persistently lagging states, because the minimum capital-labor ratios have increased over time. For example, in the Northeast in 1952, the minimum capital-labor ratios was 2.2 for New Hampshire, whereas in 1972 the minimum was 6.4 for the state of Rhode Island, an increase of 66 percent over the period. In 1952, Georgia had the lowest capital-labor ratio of any other Southern state: 2.8. Yet in 1972 Oklahoma's ratio of 8.6 was the lowest among the Southern states. This minimum in the Southern region increased by 67 percent. Rather than lagging growth in capital-labor ratios in selected states, the growing divergence in ratios appears to be due primarily to a rapid increase in the growth of the capital stock relative to labor in several states, such as West Virginia, North Carolina, Texas, and Louisiana in the South; Montana in the West; and Main and New Hampshire in the Northeast.

The maximum capital-labor ratio in the Northeast grew by 64 percent from 5.5 for New Jersey in 1952 to 16.2 in 1972 for Maine. The ratio in the West grew from 16.7 for Nevada in 1952 to 26.0 for Montana in 1972, an increase of 36 percent. The increase in the South was similar.

In contrast to the West, South, and Northeast, the divergence in state capital-labor ratios within the North Central region appears to be due to the slow to no growth in capital-labor ratios in a number of North Central states. As shown in Table 5.9, the minimum capital-labor ratio in the North was 3.3 in 1952, for the state of Missouri.

In 1972, the minimum had increased to 4.0 for the state of South Dakota, only a 19 percent increase. The data show a decline in the capital-labor ratio for South Dakota from 7.7 in 1952 to 4.0 in 1972. In 1952 Minnesota's capital-labor ratio was 5.7. By 1972, the ratio had only increased to 7.9, an increase of 28 percent. The state of Missouri's capital stock did grow, however, from 3.3 in 1952 to 12.0 in 1972.

Thus, as capital-labor ratios increased in every region over the twenty-year period, the standard deviations also increased. In the North this divergence is best explained by lagging growth in South Dakota and Minnesota relative to other states in the region, whereas in the South, West, and Northeast the divergence is best explained by a rapid growth in the ratios of Texas, Louisiana, West Virginia, North Carolina, Maine, and New Hampshire relative to other states in the region.

There are three factors that should be kept in mind as causes of bias in these results. First of all, as discussed earlier, the 1957 base capital-stock value, used in calculating the capital stock series, measures the value of the plant and equipment at the time of purchase. Thus, the values of two machines with the same productive capacity may differ solely because they were purchased at different nominal prices; the machine purchased later would carry the higher value. Thus, it is expected that the base-year capital-stock value in states with a more recently purchased capital stock in 1957 overvalued relative to states with an older capital stock in that year. This relatively overvalued capital-stock figure was then carried backward to earlier years and forward to later years when the total series was estimated, overvaluing all capital stock values in the series. It is expected this overvaluing of the capital-stock numbers in fast-growth states relative to slow-growth states has biased the capital-labor ratios in the Western and Southern states upwards. In particular, it is suspected that the capital-labor ratios of Alabama, Arizona, Louisiana, West Virginia, Texas, and Oregon many have been overestimated.

This overestimation will be counterbalanced by the fact that new capital stock is in a sense more capital because it embodies more efficient production. It is too much to expect that these two effects will cancel each other out and produce unbiased state capital stock values, however the two effects do counteract each other.

As mentioned earlier in Chapter Four, a second factor that probably lead to biases in the capital-labor ratios is errors in the base-year capital-stock figures. The Census of Manufactures (1958: 9-46 to 9-29) notes high standard errors for the following states: Wyoming (40), North Dakota (12), Oregon (12), Utah (10), Vermont (10), South Dakota (9), Tennessee (9), New Mexico (9), Maine (6), and Nevada (6). The capital-stock estimates will differ from actual values by less than the percentage shown in brackets in two out of three samples.

These errors probably explain the unusually high capital-labor ratios of Wyoming, which are estimated as the highest capital-labor ratios in the United States. Wyoming's ratio is estimated to be 27.9 in 1952 and 30.1 in 1972. Because these ratios are unbelievably high, Wyoming was dropped from the analysis. A large sampling error probably also explains the ratios in North Dakota, which was 9.7 in 1952, the seventh largest capital-labor ratio in the United States in that year, and Utah, which appeared to have the fourth largest ratio in the United States in 1952.

A third factor suspected of causing bias in the results is the relatively large estimation errors in the labor force statistics for several states. For the years 1952, 1956, 1959, and 1968 the denominators of the capital-labor ratios were extracted from the Annual Survey of Manufactures (ASM). Because these data are obtained by a sample survey, the numbers are apt to differ from those obtained by a complete census. A guide to the sampling error is provided by the ASM indicating large sampling errors for New Mexico, North Dakota, and Nevada for 1968 as well as earlier years (ASM, 1968: 12-25). In 1952, the estimated capital-labor ratio for Nevada was 16.7, the highest ratio, after Wyoming, for any state. The third highest ratio, 9.7, belonged to North Dakota. These unexpectedly high ratios may well be due to underestimated employment totals.

Underestimation probably also occurs in areas with large numbers of undocumented workers and migrant workers. Such states as Arizona, New Mexico, Texas, and California may well be susceptible to this bias.

Comparison of the Age of the Regional Capital Stocks

The age-of-capital-stock variable is measured as the proportion of the capital stock in a peak year that was put in place in the previous two years. Thus, the higher the ratio, the newer the capital stock.

As mentioned in Chapter Four the preferable measure would have been the proportion of the capital stock put in place in the previous three or four years. However, since manufacturing investment by state was not available for 1950, the 1952 value could only be estimated with two years of investment in the numerator. To permit comparability for all five recessions, the remaining variables were calculated with two years of investment in the numerator as well.

To test whether the use of a two-year rather than three-year numerator made a significant difference to the analysis, the simple correlations between the results of equations 4-4 and equation 4-5 in Chapter Four were computed. The results show that little is lost by using two rather than three years of investment in the numerator. The correlation coefficients for the two equations for the peak years of 1956, 1959, 1968 and 1972 were .97, .94, .96, and .97 respectively.

The results of the age-of-capital-stock ratios are displayed, by region, in Table 5.9 and Appendix IV. The data in Table 5.9 is based on the 1971 depreciation rate, whereas the data in Appendix IV is based on the 1958-62 depreciation rate. The results of both tables are similar, so they will be discussed in reference to Table 5.9, only.

In all of the peak years except 1968, the data in Table 5.9 show that the Western region had the newest capital stock. The exception was 1968, when the age-of-the-capital stock was lowest in both the West and South. In 1952 and 1956 the Southern capital stock appears to rank second, whereas in 1959 the capital stock in the North Central region ranked second to the Western region. In 1972 the age of the capital stock in the North Central and in the South appear to be equivalent. In all five periods the Northeast appears to either be tied for or to have the oldest capital stock of the four major regions.

When the North Central region is divided into the East North Central and West North Central regions, the data indicate that, on the average, the capital stock of Ohio, Michigan, Illinois, Indiana, and Wisconsin was newer than that of Minnesota, Missouri, Iowa, Kansas, South Dakota, North Dakota and Nebraska during the early fifties.

From 1959 to 1972 however, the data suggest that the average age of the capital stock in the East North Central states began to increase, while that of the West North Central states began to decline.

From 1959 to 1972 the capital stock in the East North Central region appears to have been older than that of the Northeast. For example, in 1972 the age ratio for the Northeast was .15 whereas the ratio was .13 in the East North Central region.

For the reason described earlier it is suspected that the capital stock of the states growing rapidly in 1957 was overestimated, underestimating the age-of-capital-stock variable. Since the Western and Southern regions were the higher growth areas in the mid-1950's, the age-of-capital-stock ratios for these regions may be low relative to the ratios of the North Central and Northeast.

The age-of-capital-stock results presented in Table 5.9 are consistent with our current understanding of regional growth trends. That is, the higher a state's economic growth, the lower the age of that state's capital stock. For example, the slowest annual rate of employment growth from 1952 to 1972 was in the Northeast region, a fact consistent with the figures in Table 5.9. Moreover, in the decade of the 1950's the annual average rate of employment growth in New England and Middle Atlantic states was .95 percent. During the 1960's the annual rate of growth rose to approximately 2.00 percent and then again dropped to around .3 percent in the early 1970's. The Northeast's age ratios of Table 5.9 and Appendix IV exhibit the expected concurrent changes. The age of the Northeast's capital stock appears to have increased during the fifties, with an age ratio of .22 in 1952 decreasing to .15 in 1959. During the growth period of the 1960's in Northeast's capital stock appears to have declined in age, with the age ratio increasing to .19. In the early 1970's the trend again reversed and the Northeast's capital stock began to age, with its ratio decreasing to .15.

The annual rate of employment growth in the North Central states was above that of the Northeast, but slower than that of the Western and Southern region. This relationship is also consistent with the age-of-the-capital stock data presented in Table 5.9 and Appendix IV, Table 5.9 indicates that the age ratios for the North Central states range from .24 in 1952 to .17 in 1972. These ratios are greater than those of the Northeast, .22 in 1952 and .15 in 1972; both lower than the ratios of the Western and Southern regions.

Again, the age-of-capital-stock variable moves in a direction consistent with the data on employment growth. The North Central region's employment grew at an approximate 1.3 percent annual rate in the 1950's, increasing to an annual 2.3 percent rate of growth in the 1960's and decreasing to a 1.5 percent annual rate of growth in the first half of the 1970's. The age-of-capital-stock variable shows the same trend, declining from .24 to .17 from 1952 to 1959, increasing to .19 in 1958 and declining to .17 again in 1972.

The most rapid rate of economic growth throughout the twenty-five year period from 1950 to 1975 was in the Western states. As expected

Table 5.10

Average Annual Rates of Growth of Nonagricultural Employment, Selected Periods, 1950-75

Region	Rate of Growth (Percentages) 1950-60	1960-70	1970-75
United States	1.80	2.69	1.69
New England	.95	2.08	.65
Mideast	.95	1.85	-.05
Great Lakes	1.12	2.25	.65
Plains	1.47	2.46	2.08
Southeast	2.58	3.69	3.00
Southwest	3.04	3.55	4.00
Rocky Mountain	2.72	3.00	4.74
Far West	4.07	3.54	2.58

Source: Advisory Commission Intergovernmental Relations, Regional Growth Historic Perspective, p. 22.

the age-of-capital-stock variable is highest in this region throughout the same period. For example, in 1972, the age variable was .20 for the West, .17 for the South and North Central, and .15 for the Northeast. The annual rates of employment growth by region are displayed in Table 5.10.

To summarize, widely available data on regional economic trends corroborate the regional cycle measures, capital-labor ratios and age of the capital stock variables calculated for this study. The substantiation of these statistics allow us to put more confidence in the data used to test the formal model of this study as well as permit a contribution to our understanding of regional economies.

We now turn to consideration of the machinery industry. First, the regions with cyclically sensitive industries will be identified, followed by a discussion of the capital-labor ratios and age-of-the-capital stocks.

Machinery Industry

In 1972, 2.7 percent of all non-agricultural employees were in the machinery industry. This percentage was down slightly from the 3.0 percent of employees in the same category in 1952 (CM, 1972: SR 3-70).

The machinery industry, SIC code 35, is more geographically dispersed than the textile industry. The absolute numbers and distribution of employment across the nine census regions is shown in Table 5.11. The largest proportion of employment for the industry is

Table 5.11

Machinery Industry Employees by Region

	All Employees (000's)		Proportion of Employees in Each Region (Percent)	
	1967	1972	1967	1972
United States	1,864.5	1,827.7		
New England	178.7	152.3	.10	.08
Middle Atlantic	359.5	320.1	.19	.18
East North Central	783.4	698.1	.42	.38
West North Central	153.1	165.4	.08	.09
South Atlantic	90.0	117.6	.05	.06
East South Central	54.5	75.9	.03	.04
West South Central	80.6	108.0	.04	.06
Mountain	31.2	34.4	.02	.02
Pacific	140.5	155.9	.08	.09

Source: Census of Manufactures, 1972: 35-3.

found in the East North where 38 percent of total United States machinery industry employment was located in 1972. The industrialized states of Michigan, Ohio, and Illinois alone accounted for 29 percent of the nation's machinery employment. Only 2 percent of the nation's employment in the machinery industry was located in the mountain states.

As shown in Table 5.11, New England, the Middle Atlantic and East North Central regions experienced a net loss in machinery industry jobs over the period 1967 to 1972. New England's employment fell from 178.7 to 152.3 employees; employment in the Middle Atlantic states fell from 359.5 to 320.1 employees; and machinery industry employment in the East North Central states fell from 783.4 to 698.1 employees. All of the remaining Western and Southern regions showed a net gain over the same period. The largest gains were made in the West South Central states.

Two of the hypotheses stated in Chapter Three propose that multiplant firms have an effect on the cyclical variation of employment across states. The reason being that managers can shift employment from plants located in states with an old-capital stock and a low capital-labor ratio to plants with a new, more efficient capital stock and a capital-intensive operation located in another state. Thus, it is worth considering at this point whether the multiplant firm is a significant organizational form in machinery production. Approximately 73 percent of all machinery workers were employed in multiplant firms in 1972 (CM, 1972: SR 3-70). Unfortunately, there is no way to determine what proportion of branches are located across state boundaries. With a substantial proportion of machinery workers holding jobs in multiplant firms, the possibility of finding and measuring destabilizing effects of multiplant firms on state economies is still unresolved.

Tables 5.12 and 5.13 summarize the data for the machinery industry by region. The data are only presented for the trend-adjusted severity measures and only for the year 1972. The average trend-adjusted severity by region is shown in Table 5.12. The percentage decline in employment during the 1973-75 recession was greatest in the Northern states, where the average state experienced a loss of 5.6 percent of employment from the peak to the trough of the recession. The Southern states experienced, on the average, the second most severe recession with a severity measure of 4.9. The Northeast and West ranked third and fourth with losses in employment of 4.5 percent and 2.6 percent, respectively.

The Northern states are further divided into the Eastern and Western states. Surprisingly, the data showed that the recession in the machinery industry hit the West North Central states harder than the East North Central states. This was due to the inclusion of Nebraska in the West North Central. Nebraska experienced a trend-adjusted loss in machinery employment of 9.2 in the 1973-75 recession.

Based on industry composition alone, the Southern states should have experienced the most severe recession. The expected recession, based on industry composition was 4.5 percent for the South. The expected recession for the Northern states was lower at 4.1 percent. This provides further evidence that industry composition alone does not explain all of the variation in regional responses to national recessions. We now turn to considering capital-labor ratios in the machinery industry and the age-of-the-machinery capital stock, by region.

Table 5.12

Actual and Expected Severity of Recessions by Region
Machinery Industry
1973-75
(Percentages)

	Actual Trend-Adjusted Severity of Recession		Expected Recession[a]	
	Mean		Mean	
Northeast	4.52		3.97	
North Central	5.55		4.06	
East		4.52		3.96
West		6.84		4.17
South	4.90		4.50	
West	2.57		3.29	

Source: Census of Manufactures and Annual Survey of Manufactures, and Bureau of Labor Statistics Data. See Chapter Four for computations.

[a]The expected recession is equivalent to the percentage decline in employment that a state would experience if that state's machinery industries behaved like the national average.

The machinery industry, according to these data, was more labor-intensive in 1972 than the national average of all manufacturing. The average capital-labor ratio in the machinery industry was 9.4 as compared to 12.1 for all manufacturing. One possible explanation for the machinery industry's relative labor-intensiveness is that machinery firms produce unique products designed to customer specifications. This inhibits automation of the production process. During interviews with New England metal working firms, Glynnis Trainer (1979: 137-138) found this to be ture for the metalworking industry.

In contrast to the regional pattern of capital-labor ratios for all manufacturing, the most capital-intensive production processes in machinery manufacturing were located in the Northeast. On the average, the capital-labor ratio in the Northeast was 12.0. The capital-labor ratio in the South was the lowest at 7.6, while the ratios of the North Central and West ranked second and third, respectively. The average capital-labor ratio in the North Central states was 10.4, and the ratio in the West was 7.9.

It is interesting to consider the age-of-the-capital-stock figures, in relation to the capital-labor ratios. The age-of-capital-stock values are also shown in Table 5.13. The table shows that regions with high capital-labor ratios tendto have an older capital stock. For example, the South with the lowest machinery industry capital-labor ratio appears to have the newest capital stock. The Northeast has the oldest capital stock in conjunction with the highest capital-labor ratios. The proportion of the South's machinery capital to be put in place in the two years prior to and including 1972 was .32. The ratios

Table 5.13

Capital-Labor Ratios and Age-of-Capital Stock
by Region
Machinery Industry
1972

	Capital-Labor Ratios ($000's)		Age of Capital Stock[b]	
	Mean	S.D.	Mean	S.D.
Northeast	11.98	2.43	.18	.064
North Central	10.40	1.67	.21	.065
East	10.56	2.114	.19	.066
West	10.21	1.170	.23	.065
South	7.61	1.40	.32	.089
West	7.92	2.12	.25	.064

Source: Census of Manufactures and Annual Survey of Manufactures. See Chapter Four for description of calculations.

[b] Proportion of capital stock put in place in previous three years.

for the West, North Central, and Northeast were .25, .21 and .18. respectively.

There are two possible explanations for the combination of lower capital-labor ratios and new capital in the South. One possibility is that labor-intensive machinery production has tended to shift from the Northern states to the South. According to economic theory this shift is consistent with Southern low wages. Out of a 1973 sampling of twenty-three cities across the nation, relative pay levels in the non-electrical machinery industry were lowest in Atlanta, Dallas, and Tulsa. For example, class A machine tool operators averaged a 1973 wage of $6.01. an hour in San Francisco to $3.81 in Atlanta (Monthly Labor Review, 1974: 55-56). A second possible explanation is that when machinery firms move to or are established in the South they substitute labor for capital. This second explanation is also consistent with observed low Southern wages. The two explanations need not be mutually exclusive.

The lower age of the Southern and Western region's capital stocks is consistent with observed economic trends. The combination of the aforementioned 1973 study along with a previous 1970 study of twenty-two common cities, found that there were major regional employment shifts amidst steady state growth in the machinery industry from 1970 to 1973. Machinery industry employment rose most strongly in Dallas, 29 percent, and Denver, 21 percent. Declines were found in eight areas, ranging from 16 percent in Philadelphia to 3 percent in Detroit and Pittsburgh (Monthly Labor Review, 1974: 55). These trends are consistent with relatively new machinery capital in the South and

West, and older capital stocks in the Northeast.

Textile Industry

The textile industry is located primarily in the Eastern states of the United States. The largest producers are North Carolina, South Carolina, and Georgia. Together, these three states comprised 56 percent of the national textile employment in 1972.

Nationally, employment growth in textiles has been slow. Textile employment rose by .03 percent from 929 thousand employees in 1967 and 952 thousand employees in 1972 (CM, 1972: 22-23). As has been well documented and discussed, this slow growth in the textile industry has been accompanied by a regional redistribution of textile employment. The New England, Middle Atlantic, East North Central, and West North Central states have been net losers, while the Southern and Western states have been net gainers. These trends are shown in Table 5.14.

In order to discern the importance of the multiplant firm in the textile industry, the percent of all employees working in multiplant firms was calculated. In 1972, 77 percent of all textile employees worked in single-plant firms (CM, 1972: SR 3-14). This proportion was equivalent to the percent of workers in multiplant firms in the machinery industry.

In the 1973-75 recession the Northeast experienced the most severe decline in textile employment. This is shown in Table 5.15. The trend-adjusted percentage loss in this region was 10.1. The North Central states experienced the recession least severely with a trend-adjusted severity of 6.9. The expected recessions, based on industry composition, move concurrently with the actual recessions. The greater the actual recession, the larger the expected recession. Thus, this cursory look at the data suggests that the surprisingly moderate recession in the Northern states is due to the location of textile industries in the North that are cyclically stable, nationally.

The data (Bureau of Labor Statistics Data) show the textile industry to be less capital-intensive than the all-manufacturing average. The average capital-labor ratio of all manufacturing industries for 47 states was 12.1 in 1972. This was higher than the ratio of 10.4 for the textile industry.

Textile production in the South is more capital-intensive than textile manufacturing in the North Central and Northeast, a relationship consistent with casual empirical observation. However, the finding of an equivalent capital stock in the South and Northeast is surprising. A cursory look at the state data indicates that Delaware was estimated to be .05, indicating that Delaware had the oldest textile capital stock in the country. While this ratio may be accurate, (Delaware is subject to large error due to its small size), it is not indicative of Southern trends. Thus, Delaware was removed from the sample.

Without Delaware, the data shown in Table 5.16 are more in accordance with other regional data on the textile industry. First of all, the newer capital stock tends to be associated with higher capital-labor ratios. The South now has the newest capital stock with a ratio equal to .19 and a capital-labor ratio of 12.4. The Northeast has the next highest capital-labor ratio, of 9.0 and an age ratio of .18.

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[3] Excluding Alaska, Hawaii, and Wyoming.

Table 5.14

Textile Industry Employees by Region

	All Employees (000's)		Proportion of Employees in Each Region (Percent)	
	1967	1972	1967	1972
United States	929.0	952.0	100.	100.
New England	92.0	76.1	.10	.08
Mid-Atlantic	149.1	146.7	.16	.15
East North Central	25.2	23.4	.03	.02
West North Central	4.9	4.3	.01	.01
South Atlantic	550.5	582.0	.59	.61
East South Central	83.6	89.9	.09	.09
West South Central	12.2	13.8	.01	.01
Mountain	.4	1.7	.00	.00
Pacific	6.07	14.6	.01	.02

Source: Census of Manufactures, 1972: 22-23.

Table 5.15

Actual and Expected Severity of Recessions by Region
Textile Industry
1973-75

	Actual Trend Adjusted Severity of Recession (Percentage)	Expected Recessions (Percentage)
Northeast	10.12	8.36
North Central	6.85	7.38
South	9.39	8.18

Source: Bureau of Labor Statistics Data. See Chapter Four for computations.

The North Central has the lowest capital-labor ratio of 8.8 and the oldest capital stock with an age ratio of .16.

These results are consistent with our knowledge of the textile industry. The textile industry is still labor-intensive relative to other manufacturing industries. In the ten years ending in 1971, the ratio of payroll to value added, a measure of labor intensity, averaged .54 in textiles compared to .48 in all manufacturing. With the exception of the furniture and leather industries, textiles had, in 1971, the highest payroll-value added ratio of the 20 major manufacturing industries (Monthly Labor Review, 1973: 18).

Consistent with concern about low rates of investment in the textile industry, the capital stock in that industry is older than in the all-manufacturing or machinery industry. A booming economy in the 1960's spread to the textile industry. Revised depreciation laws, trade agreements, and investment tax adjustments encouraged investment and the replacement of older capital equipment. Expenditures for plant and equipment rose from $330 million in 1961 to a peak of $820 million in 1966.

However, in the mid 1960's capacity utilization in the textile industry fell. This excess capacity was due to slower domestic economic growth, strong competition from European and Asian textile producers, an increased competition from paper and plastic materials (Bureau of Labor Statistics, 1578, 1968: 7). This unutilized capacity discouraged both investment and technological change.

The age ratios calculated for the textile industry confirm these observations. First, the ratios are low relative to the machinery

Table 5.16

Capital-Labor Ratios and Age of the Capital Stock
Textile Industry

1972

	Capital-Labor Ratios ($000's)		Age of Capital Stock[a]	
	Mean	S.D.	Mean	S.D.
Northeast	8.97	3.523	.18	.048
North Central	8.81	1.584	.16	.061
South	12.00	4.236	.18	.068
South, (exc. Delaware)	12.41	3.761	.19	.052

Source: Census of Manufactures and Annual Survey of Manufactures. See Chapter Four for computations.

[a]Proportion of the capital stock put in place in previous three years.

industry and the all-industry average. In 1972 the all-state average ratio was .25 for all-manufacturing and .25 for the machinery industry. Both indicate a newer capital stock than that of the textile industry with an average ratio of .18 for 1972.

Moreover, within the textile industry the age ratios indicate a slightly older capital stock in 1972 than 1968, a finding consistent with more rapid investment in the early half of 1960 and slower investment thereafter. In 1968, the nine states for which data were available had an average age ratio of .22 while in 1972 the ratio for the same nine states fell to .19. For a listing of the nine states for which data could be obtained for 1969-70, please see Table 4.2.

Conclusion

In conclusion, the estimates of the trend-adjusted and absolute severity of state recessions, the capital-labor ratios, and the age-of-the-capital stocks appear to be reliable and consistent with other data on regional economic cycles and trends. The North Central region tends to be the most cyclically sensitive region whereas the Western states are the most stable. The age-of-the-capital stock in the textile industry is older than that of the machinery industry and the all-manufacturing average, and all of the age measures move in a direction consistent with secular economic growth.

Moreover, in accordance with information on production processes, the capital-labor ratios are lower in textiles and machinery manufacturing than for the all-manufacturing average. There were several cases where the capital-labor ratios are suspicious. These include Montana, North Dakota, Nevada, and Wyoming for the all-industry data and Delaware for the textile industry. In spite of these "problem" states, the data appears to be, on the whole, dependable, and we can be reasonably confident that the data used to test the formal model will, in fact, provide an adequate test of the model formulated in Chapter Three.

CHAPTER 6

FINAL RESULTS

Chapter Six presents the study's results. The chapter is organized by industry. First the results for the all-industry equation will be presented and discussed. The second and third sections of the chapter discuss the results drawn from the industry-specific machinery and textile models, and the final section summarizes the major conclusions.

All-Industry Results

The all-industry results were estimated with the model described in Chapter Three. To review briefly, cross-state variations in business-cycle activity are hypothesized to occur because of cross-state variations in industry compostion, capital-labor ratios, age-of-the capital stock, peak-level unemployment rates, insurance benefits, and multiplier impacts. The first six variables described above are expected to influence the amplitude of fluctuations in the manufacturing or export sector. Fluctuations in this basic sector are expected to influence cyclical activity in the non-basic or residentiary sector.

The strength of the relationship between the export sector and the local service sector is measured by μ of equation 3-20. When $\mu = 0$, the local service sector is unaffected by fluctuations in export industries and when $\mu = \frac{1}{\frac{E_m}{E_T}}$ or the long-run export-base multiplier, the percentage change in service employment is equivalent to the percentage loss in export employment.

As derived in Chapter Three, the final equation to be estimated is:

$$\dot{E}_{jr} = (1 + \mu\frac{E_s}{E_T})[\frac{E_m}{E_T}_{jr} (\hat{\dot{E}}_{ji} + \hat{\dot{E}}_{jr}(\beta_1 KL_{jr} + \beta_2 A_{jr} + \beta_3 U_{jr} + \beta_4 UE_{jr} + \beta_5 UI_{jr}))] \quad (6\text{-}1)$$

To restate:

$\dot{E}$	= Severity of the state recession
$\hat{\dot{E}}$	= Severity of the expected recession based on industry composition in manufacturing
KL	Capital-labor ratio
A	= Age of the capital stock
U	= Proportion of the labor force that is unionized
UE	= Peak-level unemployment rate
UI	= Ratio of weekly unemployment insurance benefits to weekly wages
E_m/E_T	= Proportion of the labor force in manufacturing
E_s/E_T	= Proportion of the labor force in non-basic industries
subscript j	= Recessions 1, . . . 5
subscript r	= States, 1, . . . 48
subscript m	= Basic industries
subscript s	= Non-basic industries

The results that follow only apply to the trend-adjusted date unless it is specifically mentioned otherwise. The capital-stock series used to calculate the age of the capital stocks and capital-labor ratios rely upon the assumption that the 1971 depreciation rate, in each state, prevailed throughout the period 1952 to 1976. Calculating the results with the alternative capital-stock series, based on an annual average of the 1958-62 depreciation rate, made little difference in the size of the coefficients and the T statistics of the final equations.

As explained in Chapter Three, the recession-specific equations for the complete model, 6-1 would not converge. Consequently the model was simplified to include only the second round impact of the national component, $\hat{\dot{E}}$, on the residentiary sector. This simplified model is shown in equation 3-27 of Chapter Three.

In order to justify pooling of the data, the recession-specific equations had to be estimated. To accomplish this step the recession-specific results were estimated using the simplified model. These results are displayed in Table 6.1.

From Table 6.1 we can see that μ is of the correct sign, of predictable magnitude and statistically significant in the pooled equation, and the 1957-58 and 1973-75 equations. None of the other five coefficients are consistently statistically significant from zero. Rather than discuss these recession specific results in detail, it is the pooled equation that is of major interest. But before discussing the pooled results it is important to test whether pooling of the date is in fact justified.

An F-test[1], sometimes referred to as a Chow test, was conducted, indicating that some degree of pooling is acceptable. The F-ratio was calculated to test the hypothesis that the coefficients are stable across recessions, and that, as a consequence, the pooling of data provides more precise estimates of the coefficients. The calculated F ratio is 1.94, for the equations presented in Table 6.1 whereas the critical value

[1]The F ratio is equivalent to $\frac{RSSR-URSS/K-1}{URSS/n-k}$ where RSSR is equal to the restricted sum of squared residuals; URSS is equal to the unrestricted sum of squared residuals; and K is equal to the number of linear restriction. See Maddala, 1977: 322-26.

Table 6.1

Final Results, Recession Specific Equations
Simplified Model (Eq. 3-27)

KL	Age	Un	UE	UI	μ	F Stat SSR n
1953-54 Recession						
-.105 (.3596) [-.292]	18.917 (7.4114) [2.552]	.011 (.0397) [.275]	.268 (.2196) [1.213]	-15.192 (6.6060) [-2.300]	.967 (.6203) [1.559]	3.41 39.77 33
1957-58 Recession						
.209 (.2244) [.933]	-5.972 (6.8169) [-.876]	.023 (.0219) [1.043]	-.145 (.1890) [-.767]	-7.242 (3.3119) [-2.187]	1.918 .449 [4.268]	.79 22.34 35
1960-61 Recession						
.033 (.1363) [.240]	-4.128 (11.6029) [-.356]	.032 (.0293) [1.078]	-.321 (.2341) [-1.372]	.713 (4.6530) [.153]	1.068 (.7198) [1.484]	1.94 18.3 37
1969-70 Recession						
-.003 (.0872) [-.035]	-19.249 (8.6725) [-2.231]	.026 (.0366) [.715]	-.680 (.4629) [-1.469]	15.079 (7.1159) [2.119]	-.263 (.4171) [-.632]	6.60 12.69 40
1973-75 Recession						
-.064 (.0435) [-1.470]	11.092 (5.4019) [2.053]	.013 (.0222) [.605]	-.124 (.1681) [-.738]	-4.846 (3.6803) [-1.317]	.713 (.2792) [2.554]	10.472 18.88 47
All Recessions						
-.077 (.0334) [-2.317]	6.466 (1.9676) [3.286]	.026 (.0100) [2.589]	.011 (.0836) [.134]	-5.906 (1.8593) [-3.176]	.893 (.1988) [4.493]	29.06 144.29 192

for $F_{24,\ 162}$ is 1.79 at the .01 level. We therefore must reject the hypothesis of stability of coefficients. There are significant differences in, at least, some of the coefficients across recessions.

Using dummys for each variable for each recession, equation 3-27 was re-estimated with μ as the only coefficient estimated jointly. The stable coefficients were then combined and the less stable coefficients allowed to vary across recessions. The parameters on unionization and unemployment insurance benefits are stable across all recessions, when μ is estimated with the combined data. The coefficients on the age-of-capital stock vary depending on the severity of the recession as do the coefficients on the capital-labor ratios. The unemployment rate was stable for the last five recessions, but not the first. With this semi-pooled equation, the F ratio was recalculated. The new F ratio is 1.57, while the critical value for $F_{18,\ 168}$ is approximately 1.88 at the 1 percent level. Using the semi-pooled equation, we cannot reject the hypothesis of stability in the pooled coefficients and the degree of pooling shown in Table 6.2 is acceptable.

In Table 6.2, the roman numerals aside the acronyms represent the recessions for which the coefficients were estimated. For example, KL_I specifies that this coefficient on the capital-labor ratio was calculated with the data from the 1953-54 recession.

Table 6.2 includes four semi-pooled equations. The parameters in the first and third columns were calculated from the simplified (Eq 3-27) model and the complete (Eq 6-1) model, respectively. The second and fourth columns are the results when the simplified and complete equations are corrected for heteroscedasticity.

As is frequently the case with cross-section data on states, there

Table 6.2

Final Results of Pooled Equations for the Simplified Model (Eq. 3-27) and the Complete Model (Eq. 6-1), Corrected and Uncorrected for Heteroscedasticity

	Simplified Model		Complete Model	
	Uncorrected	Corrected	Uncorrected	Corrected
1				
KL_I	-.256 (.1440) [-1.777]	-.454 (.1518) [-2.994]	-.157 (.0872) [-1.794]	-.361 (.1293) [-2.795]
KL_{II}	-.184 (.0920) [-2.004]	-.169 (.0874) [-1.941]	-.109 (.0560) [-1.956]	-.134 (.0715) [-1.867]
KL_{III}	.153 (.0879) [1.736]	.244 (.0816) [2.991]	.094 (.0552) [1.706]	.196 (.0664) [2.948]
KL_{IV}	-.037 (.0765) [-.477]	.013 (.0686) [.193]	-.024 (.0460) [-.525]	.010 (.0541) [.188]
KL_V	-.084 (.0391) [-2.150]	-.054 (.0367) [-1.482]	.051 (.0226) [-2.242]	-.043 (.0286) [-1.510]
$A_{I,II,V}$	9.525 (2.9064) [3.277]	13.603 (2.803) [4.853]	5.571 (1.9364) [2.877]	10.800 (2.6742) [4.039]
$A_{III,IV}$	-.579 (4.4633) [-.129]	1.334 (4.2825) [.311]	-.564 (2.6938) [-.209]	1.039 (3.4171) [.304]
$U_{I,V}$	.030 (.0119) [2.528]	.027 (.0100) [2.704]	.019 (.0074) [2.514]	.022 (.0083) [2.608]
UE_I	.049 (.1071) [.452]	.094 (.1386) [.676]	.035 (.0712) [.489]	.074 (.1159) [.639]

Table 6.2 (Cont.)

UE_{II-V}	-.143 (.1072) [-1.333]	-.237 (.0915) [-2.589]	-.095 (.0657) [-1.444]	-.192 (.0731) [-2.626]
UI_{I-V}	-5.644 (1.9050) [-2.963]	-4.728 (1.8837) [-2.510]	-3.561 (1.1223) [-3.173]	-3.748 (1.4706) [-2.548]
μ_{I-V}	.938 (.2012) [4.664]	.397 (.1749) [2.267]	1.026 (.2333) [4.397]	.402 (.1842) [2.182]
F Stat	15.77	48.37	15.97	48.45
SSR	130.88	344.000	130.06	344.000
n	192	192	192	192
D.W.	2.11	1.99	2.13	1.99

Statistics in ( ) are standard errors in [ ] are T statistics.

is evidence of heteroscedasticity in the error terms of the semi-pooled equations. The test for heteroscedasticity suggested by Glejser (1969) indicates that the absolute value of the error term is positively and significantly associated with the inverse of the square root of the state's population.[2]

Heteroscedasticity leads to estimates that are unbiased but inefficient. Thus the failure to correct for heteroscedasticity may lead to rejection of statistically significant variables or acceptance of variables whose coefficients are really zero.

To make the necessary corrections, the semi-pooled equations were weighted by the square root of the population of each state. The corrected coefficients are displayed in the second and fourth columns of Table 6.2. The Durbin-Watson statistics of 1.99 indicate that serial correlation is not a problem.

It is clear from comparing columns one and three, and columns two and four that there is little difference between the results of the complete and simplified models. The F-statistic on the complete model is only slightly higher than that of the simplified model, and the sum-of-squared-residuals is similar for both models as well.

The findings will be discussed in reference to the parameters of column two of Table 6.2. Although there are no striking differences among any of the four equations, the fact that this estimation has been corrected for heteroscedasticity and has passed the F test makes it the most easily defended equation of the four.

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[2] $|e| = \beta\sqrt{p}$; where p = population of state; β = 2546. With a T statistic of 9.7 in the case of the simplified model.

Capital-Labor Ratio

The capital-labor ratios of equation 2 of Table 6.2 indicate support for several of the hypotheses presented in Chapter 3. For the three most severe recessions during the period studied, the signs on the capital-labor ratio coefficients are negative as hypothesized. The coefficients are -.45, -.17 and -.05 for the 1953-54, the 1957-58 and 1973-75 recessions respectively. In two of these three cases, the T-statistics indicate the coefficient is statistically significant.

The coefficients on the relatively mild recessions of 1960-61 and 1969-70 are positive, and when corrected for heteroscedasticity the coefficient of .24 for the 1960-61 recession is statistically different from zero at the .05 level.

The coefficients on the capital-labor variable could not be pooled without failing the Chow test. However as indicated in the pooled equation Table 6.1, when all of the data are combined, the coefficient on the capital-labor ratio is negative and statistically significant at the .05 level.

While the results on the capital-labor ratio are far from overwhelming, there is some evidence to support the hypothesis of a negative relationship between cyclical sensitivity and a state's capital-labor ratio. However this relationship only appears to hold 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. Sachs ranked business cycles by their cyclical severity. Using as an indicator of severity the difference between the GNP at the peak and GNP at the trough of the recession, Sachs gave the five recessions studied in this thesis the following ranking; 1973-75 (-15.8), 1957-58

(-11.4), 1953-54 (-9.7), 1969-70 (-8.4), and 1960-61 (-3.9)(Sachs,1980:81). Clearly the 1973-75 recession (V), the 1957-58 recession (II), and the 1953-54 recession (I) were the most severe, in terms of loss in GNP.

It is not surprising that the coefficients are more consistent with the hypotheses during the more severe national recessions (1953-54, 1957-58, and 1973-75). The capital-labor ratio is a proxy for the ratio of fixed costs to variable costs. The argument for the association between high fixed costs and stability, as stated in detail in Chapter Three has two components. First, it is expected that multiplant firms distribute their cutbacks unevenly across plants, with low capital-labor operations bearing the disproportionate burden. The more severe a national recession, the more pervasive its effects on all sectors of the economy and the greater the number of multiplant firms faced with falling sales. The larger the number of multiplant firms affected by the recession and shifting cutbacks to their labor-intensive operations, the more likely these cutbacks are to show up at the macroeconomic level.

Moreover, the more severe the reduction in a firm's sales, the more likely managers are to adopt a lay off policy. Economic decision makers prefer, in general, to build up inventories, encourage employee vacations, and leave vacated positions unfilled before laying off workers. 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.

The second component of the capital-labor ratio hypothesis is that labor-intensive firms find it difficult to cover their high variable costs during recessions, and therefore experience a higher rate of bankruptcies and temporary shut downs than do capital-intensive plants. 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.

As stated above, the parameters in the capital-labor ratios are negative and statistically significant at the .05 level for the 1953-54 recession, statistically significant at the 10 percent level for the 1957-58 recession, and not statistically different from zero for the 1973-75 recession. The statistically significant coefficient for KL_I implies that, as hypothesized, states with higher capital-labor ratios, will, holding all other variables constant, experience milder recessions than states with low capital-labor ratios.

The relationship between the capital-labor ratio and the severity of the expected recession, based on industry composition, is multiplicative. This implies that in a state with a high expected recession, due to a large proportion of cyclically sensitive industries, the capital-labor ratio will have a greater impact on the actual severity of a state's recessions than in a state with a moderate expected recession. For example, if a state had an expected recession of 3.4 percent in 1953-54, and a capital-labor ratio of 5.1 ($5,100 worth of capital per manufacturing employee) in 1952, then the effect of the capital-labor ratio on the severity of the recession in the manufacturing sector would have been -7.9 (-.454 x 5.1 x 3.4). This suggests that, holding all other variables constant, the effects of the capital-labor ratio dampened the severity of the recession in the export sector by 7.9 percent. To estimate the total impact on the state's employment,-7.9 would have to be weighed by the proportion of the state's total employment in manufacturing.

The model and results suggest that a state with the same capital-labor ratio of 5.1, but an expected recession of 1.0 percent would experience only a 2.3 percent decrease in the severity of the recession in manufacturing due to the affects of capital-labor ratio. The result assumes, of course, that the remaining variables are held constant. Thus, there is some evidence to support the hypothesis that capital-labor ratios influence the severity of states' recessions and that at least some of the cross-state variations in cyclical employment can be explained by differences in capital-labor ratios across states.

Age-of-Capital Stock

The age-of-capital stock 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 significant 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 hypothesized negative relationship, 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.

The coefficient of 13.66, and the multiplicative form of the model suggest that a state with an age ratio of .10 (10 percent of a states manufacturing capital was put in place in the two years prior to the peak year) and an expected recession of 3.4 would experience a 4.7 percent (13.7 X .10 X 3.4) increase in the severity of the recession in manufacturing. Another state with the same age ratio, but an expected recession of 1.0 would experience a 1.4 percent increase in the severity of its manufacturing sector's recession. To estimate the total impact on the state, 4.7 or 1.4 would have to be weighted by the proportion of the state's total employment in manufacturing.

Why might the coefficient on the age variable be positive when the hypothesis discussed in Chapter 3 proposed a negative sign. One possible explanation is that rather than measuring "efficiency" of production, a new capital stock may measure age of the firm. New firms may be susceptible to bankruptcy. To the extent that new firms are spatially concentrated, these bankruptcies may show up as cross-state differences in cyclical sensitivity.

It was argued in Chapter Three that areas with young capital tend to be rapidly growing. By definition growth occurs where rates of investment are high and the higher investment rates are, the lower the average age of capital. Ongoing research at the Massachusetts Institute of Technology (Birch, forthcoming) suggests that fast-growth areas are growing because of a high birth rate of new firms rather than because of expansions in established firms. This implies that fast-growth areas have a larger percentage of new firms than do the older-capital regions.

New firms may be more susceptible to bankruptcy because they operate with a small margin of error. They tend to borrow credit to the limit and make high risk decisions to establish themselves in the market. When the economy slows, therefore, these firms are highly susceptible to bankruptcy.

The difficulties of newly established firms are compounded by the fact that they are limited in their access to capital. With little in the way of retained earnings, they must rely almost solely on private capital markets. During the upward swing of the credit cycle, which precedes the employment cycle, these new firms are most likely to be squeezed out. In tight credit markets, venture capital is severely constrained and commercial lending by banks is reserved for established long-term customers. Thus the newer firms experience higher rates of bankruptcy.

A study by David Birch (forthcoming) found some evidence to support this argument. During economic downturns the death rate of firms does rise. His study, based on the Dun and Bradstreet data, suggests that older and larger firms are more likely to contract during recessions while new, small firms are more likely to close their doors. To the extent that new capital-stock regions have a higher proportion of new firms, and research cited above suggest they do, then these new-capital-stock areas will tend to have greater cyclical fluctuations due to a higher rate of firm bankruptcies.

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 positive relationship between age-of-capital stock and severity of state recessions, then it is likely that most firms, independent of age and size, were able to weather these miled 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 threshhold effect. During a relatively mild recession, firms (independent of size, age, or labor-intensiveness) are likely to survive the recession, through such mechanisms as extension of credit terms by suppliers or banks, or through 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 labor productivity 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 age of a state's capital stock does appear to influence the severity of state recessions. In contrast to the negative relationship hypothesized, the evidence, however, suggests that states with new capital are more cyclically sensitive. This result may be explained by the positive association between new capital, high economic growth rates, birth rates of new firms, and new firms' vulnerability to cyclical fluctuations.

<u>Unionization</u>

The coefficients on unionization (U) were 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 and 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 amplitudes in the state's employment cycle. For example a state with 20 percent of its labor force unionized and an expected recession of 3.4 would experience an approximate 1.8 percent (.027 x 20. x 3.4) increase in the severity of its manufacturing sector recession. A state with 30 percent of its labor force unionized, and the same expected recession would experience a 2.8 percent decline in employment (.027 x 30. x 3.4). Again, to get the total effect of unionization's impact on the state's recession, 1.8 or 2.8 would have to be multiplied by the ratio of manufacturing employment to total employment in the state.

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. Unionization either limits other adjustment options and forces employers to adopt a policy favoring layoffs, or employers of union members favor layoffs, because workers are not inclined to give up a union job making rehiring during the recovery nearly costless.

The possibility that the causal relationship may move in the opposite direction should also be noted. Workers in cyclical sensitivity states may have tended to unionize in order to protect themselves from the vagaries of the business cycle.

Peak-level Unemployment Rate

The coefficients on the peak-level unemployment rate (UE) are stable for the four recessions between 1956 and 1975. Consequently this coefficient is estimated jointly, while the coefficient for the 1953-54 data is estimated individually.

Contrary to the hypothesis, the coefficient on UE_{II-V} is negative,

-.24, and statistically significant at the .025 level. The coefficient on UE_I is not statistically different from zero. The hypothesis proposed in Chapter 3 argues that a high peak-level unemployment rate signals a surplus of labor. Employers considering layoffs during the recession would expect low search costs during the recovery, due to the surplus, and would, therefore, be more inclined to layoff workers during the downturn, than would their counterparts in labor-short areas.

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 a cyclically volatile actual recession may not fully recover before the next peak-level unemployment rate is registered. If the next recession in the state is relatively severe, we might get a low rate of unemployment with a severe 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 results indicate no evidence of a positive association between labor-surplus regions and cyclical employment. The negative coefficient, on this variable for the four recessions 1956 to 1975 may well be due to misspecification of the model.

Unemployment Insurance Benefits

The parameter on the variable UI ratio of average weekly unemployment insurance benefits to weekly wages is estimated with the pooled data, after determining that the coefficiencies are stable across recessions. As shown in Table 6.2, column 2, the pooled coefficient is 4.7, contrary to the hypothesis, and statistically significant at the .02 level.

The hypotheses proposes that layoffs are more prevalent in states with high UI than in states with low UI. The argument is that if cusioned by high benefits, employees would be willing to accept layoffs. Moreover, employers would readily lay off workers if high UI benefits encouraged workers to wait out the recession and be available for rehiring during the recovery.

The results do not support these hypotheses, and there are two possible explanations. 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 tax schedule the greater the incentive for firms to keep down their tax rating. (Welch, 1977)

A second possible reason for the negative sign is that unemployment insurance benefits act 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 residentiary activities.

This study, therefore found no evidence to support the hypothesis that a high ratio of unemployment insurance benefits to wages encourages layoffs. Rather, there is support for the hypotheses arguing that high benefit levels promote stability. The experience rating system of raising revenues for unemployment benefits may discourage layoffs and high benefits may act as an automatic stabilizer.

Multiplier

The short-run multiplier is an average value for all states and it measures the impact of the severity of the state recession, due to fluctuation in the export sector, on the residentiary sector. As argued in Chapter 3, the short-run multiplier should lie between zero and the long run export base multiplier, which is equivalent to approximately 3.3 for most states. The model estimates μ 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.

As discussed in Chapter 3, μ measures the effect of a short-run, temporary and marginal change in export employment on residentiary employment. The short-run, temporary, and marginal nature of this multiplier implies that its magnitude should be substantially smaller than the longer-run, permanent and average multipliers calculated by other models, such as the Regional Industrial Multiplier System.

Several industries included in the residentiary sector have been relatively stable or countercyclical at the national level, throughout the period 1950 to 1975. For example, the construction industry remained strong throughout the 1953-54 and the 1957-58 recessions. Low interest as well as demand for residential construction in the expanding suburbs offset any tendency for the recession to extend to construction. Demand by state and local governments also remained strong throughout the recessions of the 1950s. Low interest rates and continuing demand for schools and roads sustained employment in state and local government as well as in spinoff sectors such as construction. Because of unemployment insurance benefits, corporate dividends, and other automatic stabilizers, wholesale and retail trade, as well as services have tended to be resilient during most of the five recessions.[3] These observations lend support to the reasonably small multiplier impact measured in this study.

The short-run multiplier of .4 suggests that the severity of the recession in the service sector is equivalent, on the average, to .4 times the severity of the state's recession due to fluctuations in the export sector. So that for example, the severity of the recession in exports, weighted by the ratio of manufacturing employment to total state employment in Alabama in the 1960-70 recession was 1.35, the results suggest that the severity of the recession in the residentiary sector was approximately .54 (1.35 x .4).

The results indicate that multiplier impacts on residentiary activities explain, in part, the severity of state recessions. As is consistent with both theory and empirical evidence the short-run multiplier is positive, greater than zero, but still relatively small.

Variation Explained by the Model

What proportion of the variation in states' recessions is explained by the model? To permit the calculation of a legitimate $\bar{R}^2$, a constant was added to the simplified and complete models. In addition, an equation including only the constant and the expected recession:

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[3]See Chapter 1 for a more detailed discussion of this point.

$$\dot{E}_{jr} = \text{cons} + \hat{\dot{E}}_{jr} \qquad (6\text{-}2)$$

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

$$\dot{E}_{jr} = \text{cons} + \hat{\dot{E}}_{jr} + \hat{\dot{E}}_{jr}(\beta_1 KL_{jr} + \beta_2 A_{jr} + \beta_3 U_{jr} + \beta_4 UE_{jr} + \beta_5 UI_{jr}). \qquad (6\text{-}3)$$

were estimated to determine the extent to which the local component and the residentiary component, $(\frac{E_S}{E_T}\dot{E}_S)$, contribute to the model's explanatory power. The variables are the same as defined above, except cons = a vector of 1's.

The results indicate that the expected recession, or national component, alone explains 36 percent of the variation in state cycles. In other words, the $\bar{R}^2$ for equation 6-2 is .36. 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 $\bar{R}^2$. The model, therefore, appears to explain 50 percent of the variation in the dependent variable.

The unexplained variation may be due to the omitted variables discussed in Chapter Three, such as worker skill levels, state inventory taxes, inter-industry multiplier effects, or heterogeneity within 2-digit SIC industries. Recession-specific phenomenon not captured by a general model, the imperfect measurement of the dependent and independent variables, and the unmeasured impacts of trade relationships among regions may also be responsible for part of the unexplained residual.

To estimate how much variation in the actual all-industry independent variable was unexplained due to heterogeneity within 2-digit SIC categories, the severity of the recession in the machinery and textile equations were regressed against 3-digit industry expected recessions for those industries. The results for both machinery and textiles manufacturing are displayed in Table 6.3.

The equations suggest that the degree of heterogeneity depends upon the industry. For example there appears to be a substantial degree of variation in SIC 35 explained by industry composition at the 3-digit level. The machinery equation of Table 6.3 suggests that 38 percent of the variation in employment fluctuations in SIC 35 can be explained by industry composition at the 3-digit SIC level.

According to the findings in the second equation of Table 6.3, none of the cross-state variation in textile recessions is explained by industry composition at the 3-digit level. The coefficient on the expected recession is zero, and the R is .02. Clearly the degree of heterogeneity with 2-digit industry classifications varies by industry.

These results suggest that at the all-industry level the expected recession based on 2-digit industry composition explains approximately 33 percent of the cross-state variation in state recessions. Local economic and institutional factors account for another 14 percent of the variation, while the inclusion on the residentiary sector contributes little to the model's explanatory power. Based on evidence from the machinery and textile industries, anywhere from 02 to 38 percent of the variation in the all-industry dependent variable may be explained by heterogeneity within 2-digit industries.

Table 6.3

Results When Trend Adjusted Severity is Regressed Against the Expected Recession, Machinery and Textile Industries, for All Recessions

	Constant	Expected Recession	$\bar{R}^2$ F Statistic SSR n
Machinery Manufacturing	-.623	.292	.38
	(2.629)	(.0630)	29.497
	[-2.371]	[4.636]	2.065
			34
Textile Manufacturing	1.895	-.000	.02
	(.4190)	(.0000)	1.37
	[4.523]	[-1.172]	56.97
			23

The next two sections summarize the results for the industry-specific equations. First the results of the machinery industry, and second the results of the textile industry model are presented.

Industry-Specific Results

The machinery (SIC 35) and textile (SIC 22) models are similar to that of the all-industry model, without the multiplier. The hypotheses propose that the severity of the recessions in machinery and textile manufacturing are explained by capital-labor ratios, age-of capital stock, and the proportion of the labor force belonging to unions in those industries; as well as state level peak-year unemployment rates and the ratio of states' average weekly unemployment insurance benefits to average weekly wages. To restate from Chapter Three, the model is as follows:

$$\dot{E}'_{jr} = \hat{\dot{E}}_{jr} + \hat{\dot{E}}_{jr}(\beta_1 KL'_{jr} + \beta_2 A'_{jr} + \beta_3 U'_{jr} + \beta_4 UE_{jr} + \beta_5 UI_{jr}) \qquad (6\text{-}4)$$

where

$\dot{E}'$ =Severity of the recession in either machinery or textile manufacturing

$\hat{\dot{E}}'$ =Expected recession based on industry composition at the 3-digit SIC level.

KL' =Capital-labor ratio

A' =Age-of-the capital stock

U' =Proportion of the labor force belonging to unions.

UE =Peak-year unemployment rate.

UI =Ratio of unemployment insurance benefits to weekly wages.

Subscript j=Recessions 1, ---, S

Subscript r=States 1, ---, n

Superscript ´ =Data is industry-specific

Machinery Manufacturing

The results of the machinery industry model are presented in Table 6.4. In the recession-specific equation for 1969-70 and 1973-75, none of the coefficients are statistically different from zero at the .05 level. The coefficient on the capital-labor ratios is negative as hypothesized, with T statistics of -.7 and -1.4, respectively. The parameter on unemployment benefits is positive as hypothesized, and in the equation representing the 1973-75 recession, the coefficient has a T statistic of 1.8, which is significant at the 10 percent level but not at the 5 percent level.

The F-ratio is equivalent to 2.10, whereas the critical value of $F_{5,34}$ is 3.08. This indicates that the coefficients are stable across recessions and that pooling of the data is justified. The coefficients are more precisely estimated in the combined cross-section, time-series result.

Combining the data for the two periods, the capital-labor ratio becomes significant at the .05 level, with a T-statistic of 2.4. The coefficient on UI is still positive and significant at the 10 percent level, but not at the 5 percent level.

The machinery industry results therefore support the findings of the all-industry model in the case of the capital-labor ratio. Again a high capital-labor ratio appears to be associated with cyclical stability.

Table 6.4

Final Results, Machinery Industry
(Eq. 6.4)

KL	A	U	UE	UI	F Stat SSR n
1969-70 Recession					
-.650	.242	.031	.496	11.838	2.70
(.3893)	(4.7692)	(.0579)	(.5246)	(9.2189)	49.82
[-1.670]	[.051]	[.531]	[.894]	[1.284]	10
1973-75 Recession					
-.074	-1.179	-.001	-.044	3.722	3.932
(.0549)	(1.2003)	(.0137)	(.1044)	(2.1179)	194.41
[-1.351]	[-.982]	[-.103]	[-.418]	[1.758]	34
Combined 1969-70 and 1973-75 Recession					
-.088	-.594	.007	.026	3.418	4.19
(.0374)	(1.2463)	(.0123)	(.1073)	(1.9107)	319.72
[-2.339]	[-.476]	[-.542]	[.244]	[1.789]	44
				D.W. =	1.79

It is relatively common with cross-section regressions on states to find the variance of the error term associated with the size of the state. Using the test for heteroscedasticity suggested by Glejser (1969), there was no evidence that the absolute value of the error term was related to the size of the industry or the state's total employment in machinery manufacturing.

What might explain the poor results for the machinery industry, in light of the strong results for the all-industry equations? First of all, the samples are relatively small. For the 1969-70 recession, only ten observations could be calculated. For the 1973-75 recession data are available for only 34 states. The small size of the samples may explain, in part, the large standard errors on the coefficients.

Second, the variation in the independent variables is small. The smaller this variance, the larger the standard of the coefficients errors. The theoretical variance for b_1 is equal to:

$$V(\hat{\beta}_1) = \frac{\sigma_\varepsilon^2}{\Sigma(x_1 - \bar{x}_1)^2(1 - r^2_{x_1x_2})} \qquad (6\text{-}5)$$

where σ_ε^2 is the variance of the population that generated the error terms, and $r_{x_1x_2}$ is the correlation between independent variable X_1 and X_2. (Rao and Miller, 1971:23) It is clear from equation 6-5 that the smaller the variation in X_1, the larger the variance of β_1. The small variance of several of the independent variables used to estimate the equations of Table 6.4 can be seen from Table 6.5.

The variance of age-of-capital and UI are particularly small. The variance for age is .01, and for UI is .002. This may partially explain the failure of these two variables to be statistically significant when data on only one or two recessions are available.

Table 6.5

Mean Values and Standard Errors of the Capital-Labor ratio, Age of Capital Stock, Unionization, Unemployment Rates, and Unemployment Insurance Benefits for Machinery and Textile Manufacturing, 1972.

	Machinery		Textiles	
	Mean	Variance	Mean	Variance
Expected Recession	4.1	.49	8.1	1.31
Capital-Labor Ratio	9.4	6.47	10.4	14.93
Age-of-Capital Stock	.3	.01	.2	.00
Unionization	24.4	89.64	23.2	72.27
Unemployment	3.3	2.06	3.1	1.89
UI	.4	.002	.4	.002

Sources: The sources are described in Chapter 4.

The fact that the pooled all-industry results support several of the hypotheses, while the recession-specific equations do not, suggests that the pattern may well be the same for the machinery industry. That is, with the added variation in the variables, obtained from additional observations on earlier recessions, the machinery industry coefficients may have been more precisely measured and statistically significant.

The machinery industry equations explains approximately 18 percent of the variation in the dependent variable, for the pooled equation. Almost all of the explanatory power of the model is due to the inclusion of the expected recession, $\hat{\dot{E}}$.

For the 1973-75 recession the model explains approximately 37 percent of the variation in state recessions, whereas 26 percent of the total is due to the expected recession and 11 percent is due to the local component.

These estimates were obtained by estimating equation 6-4 with a constant, and reading the $\bar{R}^2$. A second equation, with only a constant and the natural component was also estimated, to determine the contribution of the local component to the $\bar{R}^2$. This equation is:

$$\dot{E}'_{jr} = \text{cons} + \hat{\dot{E}}'_{jr} \qquad (6\text{-}6)$$

where the variables are the same as defined earlier.

The unexplained residual may be attributed to such factors as heterogeneity with 3-digit SIC industries, and omitted variables such as employee skill levels and cross-state differences in inventory tax policies. Measurement errors in the dependent and independent variables, interindustry multiplier impacts and the cyclical sensitivity of trading patterns are all factors that should influence state recessions, but which were not captured by this model.

Textile Manufacturing

The estimated coefficients for the textile industry are estimated with the same model described above. The results of the model applied to the recession-specific 1969-70 and 1973-75 data, as well the results for the pooled data are shown in Table 6.6. An F test was conducted to determine whether or not to pool the data. The results indicate that combining the data does not yield more precise estimates of the coefficients. The F ratio is 6.81, whereas the critical value for $F_{5,22}$ is 4.04 at the .01 level. Consequently the results for the textile industry will be discussed in reference to the 1973-75 recession. Because of the small sample size for the 1969-70 recession, the textile industry results for this equation are not as reliable as that of the 1973-75 recession results.

The findings for the 1973-75 model again suggest that high capital-labor ratio's dampen the cyclical variability of employment. The coefficient is -.05 with a T statistic of -2.4. It is interesting to note that the magnitude of this coefficient is similar to that of the coefficients on the capital-labor ratio for the 1973-75 all-industry and machinery industry equations. The comparable parameter for the all-industry and machinery industry equations are -.0.5 and -.06 respectively, as compared to -.05 for the textile industry. Thus the magnitude of the impact of capital-labor ratios on cyclical variability are remarkably constant across industries.

Contrary to the evidence of the all-industry model, but consistent with the hypothesized relationships, the age-of-capital stock coefficient is negative and significant at the 5 percent level. The coefficient on the unemployment insurance benefit ratio is also

Table 6.6

Final Results, Textile Industry
(Eq. 6-4)

KL	A	U	UE	UI	F Stat SSR n
1969-70 Recession					
.384	-45.233	.081	-.723	25.023	1.56
(.7704)	(20.6292)	(.1114)	(1.6925)	(41.475)	110.18
[.499]	[-2.193]	[.726]	[-.427]	[.603]	
1973-75 Recession					
-.048	-2.494	-.015	-.071	4.495	3.048
(.0204)	(1.1785)	(.0099)	(.0801)	(1.3688)	120.59
[-2.352]	[-2.116]	[-1.479]	[-.890]	[3.283]	23
Combined 1969-70 and 1973-75 Recessions					
-.052	-2.330	-.008	-.132	4.751	.0
(.0366)	(2.0931)	(.0178)	(.1422)	2.4583	587.98
[-1.421]	[-1.113]	[-.456]	[-.927]	[1.932]	32

consistent with the hypothesized relationship, but contrary to the results of the all-industry results. What might explain the difference in signs between the all-industry and textile industry results?

As can be seen in Table 6.6, the coefficient on the age-of-capital stock coefficient is negative and significant when textile industry data from the 1973-75 recession are used to test the model. The implication is that areas with old capital are more cyclically variable than states with new capital. The coefficient is -2.5 with a T-statistic of -2.1. The comparable coefficient for the all-industry model, as shown in Table 6.1, is a positive 11.1 with a T-statistic of 2.0. The implication is that regions with new capital are more cyclically variable than regions with old capital.

The reversal in sign can be explained by the maturity of the textile industry. Recall that the positive coefficient for the all-industry model was explained in terms of cross-state differences in firm birth rates. High-growth regional economies, with high-firm birth rates, experience greater cyclical variability than slow-growth regions, because new firms are more susceptible to failure during periods of economic stringency.

In contrast to the behavior of all-industries, the textile firms that comprise the textile industry tend to be well-established and mature. The movement of firms in and out of the industry, that characterize more dynamic industries, is not typical of textile manufacturing. The maturity of the textile industry is indicated by comparing the age-of-the capital stock variable for all manufacturing to that of the textile industry. The all-state average, for 1972 is .25 for all-manufacturing (or approximately 25 percent of the state's capital stock was put into place during 1971 and 1972. The comparable figure for the textile industry is .18.

While new firms are more likely to fail during a recession, well-established firms adjust to the short-run decline by contracting output. The evidence of this study suggests that the contraction of output, at least for the textile industry, is spatially uneven, as hypothesized, with older less efficient plants bearing the disproportionate burden of the recessionary impact.

Without the "noise" of the firms entering and exiting the industry, the hypothesis proposed in Chapter Three does appear to hold for mature industries. However, the data suggest the fact that the influence of inefficient old capital on the severity of state recessions are outweighed by the effects of instability of new firms. This can be determined not only by the positive coefficient on the age variable for the all-industry equation, but by the magnitude of the coefficients. At the all-industry level, the coefficient is 11.1, as shown in Table 6.1, wheras the coefficient of -2.5 for the textile industry is closer to zero.

The all-industry and industry-specific results suggest that the relationship between the age-of-capital and cyclical variability is more complex than originally anticipated. In dynamic industries, the high death rate of new firms leads to greater cyclical sensitivity in new-capital regions. In mature industries, where firms adjust to an economic downturn by contracting output, the regions with a high proportion of older plants, appear to experience the most severe recessions, when all other variables are held constant. Thus the relationship between age and cyclical variability appears to depend upon the proportion of new to well-established firms in the industry. In industries with rapid growth and high firm birth rates, the age-of-capital variable and cyclical sensitivity should be positively associated. Where the industry is comprised of well-established firms the age-of-capital variable and cyclical variability should be negatively related. We can imagine that there are industries for which the two effects cancel each other. The machinery industry may well fall into this category. As shown in Table 6.4, the coefficients for the age variables in the machinery industry are insignifically different from zero.

The textile industry results also indicate a positive association between UI and the amplitude of the business cycle. This result is consistent with the hypothesized relationship, but again in contrast to the all-industry results. The positive association between cyclical sensitivity and high unemployment insurance benefits may be explained as follows. For the reasons described in Chapter Three, high UI may promote layoffs in manufacturing industries. However the impact of high UI on residentiary activities have the opposite effect. In its role as an automatic stabilizer, high UI leads to relatively stable incomes, and consequently stable demand for the output of the residentiary sector. Thus at the all-industry or macroeconomic level, high UI leads to relative stability during the recession, even though high UI is associated with more severe employment cycles in the industries of the export sector.

The textile industry data support three of the hypothesized reasons for cross-state variations in business cycles. Differences in industry's capital-labor ratios, age-of-capital stock, and UI all appear to influence the cyclical nature of the textile industyr.

With data from the textile industry, equation 6-4 explains approximately 24 percent of the variation in the dependent variable. It is interesting to note the national component, $\hat{E}$, explains none of this variation, implying that, in the textile industry, the local component explains 100 percent of the explained variation.

As stated above, these estimates were derived by including a constant equation 6-4 and estimating an $\bar{R}^2$, as well as regressing the dependent variable on a constant and E, without a coefficient; and again estimating an $\bar{R}^2$. These two equations were calculated for the 1973-75 recession only. As indicated earlier, results of the F-test indicated pooling of the data was not justified. The unexplained residual may be explained by the same factors identified earlier.

Conclusion

These findings offer evidence of a local component to state's business cycles. Regional cycles are not only national cycles appropriately weighted by states' industry mix, but appear to have a component determined by local economic and institutional factors as well. The significance of the capital-labor ratio and age-of-capital stock variables suggests that, holding industry composition constant, recessionary cutbacks in output are distributed unevenly across space. The statistical significance of the unionization and unemployment insurance variable provides evidence that layoff policies vary across regions, explaining in part cross-state differences in employment fluctuations over the business cycle. The statistical significance of the multiplier parameter suggests that at least a portion of the gap between actual and expected state recessions can be explained by multiplier impacts on the local residentiary sector.

It was argued, in Chapter Three, that during recessions, loss-minimizing firms shift cutbacks in output to their high-variable-cost plants. To the extent that these plants are located across state boundaries, we would expect milder recessions, ceterus paribus, in states with high capital-labor ratios. Relying on microeconomic theory, it was also argued that between two loss-minimizing firms faced with declining revenues, the labor-intensive plant will close its doors earlier than the capital-intensive plant. The result is a greater reduction in output and more unemployment in areas where labor-intensive firms are located. In either case low capital-labor ratios would be associated with more severe recessions. The findings support this view. As shown in Table 6.2, during relatively severe recessions, an increase in the value of capital per worker leads to an increase in the severity of a state's recessions. Clearly the impact of the capital-labor ratio on the local cycle is small. This is not surprising given that the theory underlying these results refers to individual firms.

The capital-labor ratios, by region shown in Table 5.9E indicate that, in 1972, the Southern and Western regions had the highest capital-labor ratios in the nation. The lowest ratios were in the Northeast and the West North Central. The capital-labor ratio for the West was highest at 13.4 or $13,400 worth of capital per manufacturing employee. The ratio in the West North Central was the lowest at 9.7. The implication for egional employment cycles are that the relatively high ratio of fixed to variable costs in the South and West promote cyclically stability in those areas, while the reverse situation in the North

Central and East explain, in part, the cyclical sensitivity of those regions.

It should be noted that the magnitude of the coefficient on the variable KL should depend upon the cross-state variation in capital-labor ratios. If all states had equivalent capital-labor ratios, managers of multiplant firms would have no incentive to distribute cutbacks unevenly across plants.

A second reason that industry composition does not explain all of the variation in regional cycles is that the proportion of new firms in a region appears to influence an economy's cyclical sensitivity. The newer a state's capital stock the more cyclically sensitive its employment.

The age variable should have a destabilizing effect on rapidly growing regions: the regions with the newest capital stock are the West and the West North Central. The old capital stock appears to be located in the East North Central and Northeast regions. As shown in Table 5.9E in 1972 the West had the highest age ratio of .20, whereas the East North Central region had the lowest age ratio of .13. Recall that the age ratio approximates the proportion of the state's capital stock put into place in the previous two years.

The results of the industry-specific model, particularly in the case of textiles, suggests that this high death rate of new firms masked another relationship between age of capital and cyclical variability. When firms of an industry are well-established, and new entrants to the industry are rare, then efficiency of capital does appear to influence cyclical employment. The data suggest that within mature industries, regions with older, inefficient production techniques do suffer from relative instability. In dynamic industries this effect appears to be masked by the cyclical instability of new firms.

A third local component that explains part of the variation in regional cycles is union strength. States with large proportions of the work force belonging to unions appear to have greater fluctuations in cyclical employment. For example, the results of Table 6.2 suggest that the 30 percent increase in the proportion of the manufacturing labor force that is unionized will lead to a .03 percent, times the expected recession, decrease in the severity of a state's recessions.

In the East North Central region approximately 30 percent of the labor force is unionized. This area has the highest proportion of unionized workers. The Southern region has the smallest proportion of union members with approximately 18 percent of its labor force unionized. The Western states are relatively heavily unionized as is the Northeast. The results of this study suggest that the presence of unions contributes to the amplitude of the employment cycle in the Western, Northeastern and East North Central states. Statistics on proportions of the labor force belonging to unions are shown, by region, in Appendix V.

Fourth, the results of this study indicate that UI has a dampening effect on employment cycles at the all-industry level, but an aggravating effect on employment cycles at the all-manufacturing level. The inclusion of the residentiary sector at the all-industry level captures UI's role as an automatic stabilizer. Thus higher benefits, appear to lead to a more stable income, and a relatively stable residentiary sector. The results of the textile industry model and, to some extent, the machinery industry model do support the hypothesis that high UI encourages layoffs.

The dampening effect of UI at the all-industry level should be strongest in the Northeast where benefits are highest and weakest in the South where benefits are relatively small. The data of UI by region is also displayed in Appendix V.

Fifth, multiplier impacts on local service sectors also appear to cause cross-state differences in cyclical fluctuations. Employment in residentiary or local service industries depends upon employment in industries that serve national markets. Larger fluctuations in the export sector due to industry composition, capital-labor ratios, age of the capital stock unionization or UI will cause greater cyclical unemployment in local services. The evidence of this thesis suggests that the short-run export-base multiplier is equal to approximately .4. Thus for every percent decline in state employment, due to the decline in export employment, the service sector will experience a .4 percent decline in employment.

This result is consistent with economic theory as well as empirical evidence. Since μ is a short-run temporary multiplier we should expect it to be smaller than the long-run permanent multipliers; which, on the average for all period for all states, approximate 3.3. Residentiary activities include, in this study, government, wholesale and retail trade, transportation, public utilities, finance and insurance, construction, and services. These sectors have been either stable relative to manufacturing industries or countercyclical. Thus we should expect a small μ, which is consistent with the finding of this study.

Both the machinery and textile equations supported the hypothesis that capital-labor ratios influence cyclical employment. Holding all other variables constant, high capital-labor ratios tended to be more stable than their labor-intensive counterparts. Moreover, the size of the parameters on the capital-labor ratio variable were comparable all-industry coefficient.

The highest capital-labor ratios for the machinery industry were in the Northeast with a capital-labor ratio of 12.0. The lowest ratios were found, in 1972, in the South, with a ratio of 7.6. (see Table 5.13) The most capital-intensive textile manufacturing was found in the South with a ratio of 12.0 and the least capital-intensive operation was, in 1972, in the North Central states, with a ratio of 8.8. (see Table 5.16) Thus the capital-ratio had a stabilizing impace on machinery, employment in the Northeast and a destabilizing impact on textiles in the Northeast and North Central states.

To conclude the purpose and findings of this study will be summarized in Chapter Seven. Chapter Seven concludes with a brief discussion of policy implications of the research as well as directions for further work.

CHAPTER 7

CONCLUSIONS AND POLICY IMPLICATIONS

This thesis has explored reasons for cross-state differences in cyclical variability. The fact that cross-state differences in industry composition explain, at least part of, observed spatial differences in business cycles has been well documented. National industries have varying responses to the business cycle, and states comprised of a high proportion of cyclically sensitive industries tend to experience more severe recessions than states comprised of cyclically stable industries.

Little previous research has, however, been done on the extent to which state-specific economic and institutional factors influence a state's cyclical sensitivity. A contribution of this thesis is the discovery that cross-state differences in economic structure and institutions also explain variations in the business cycle. Not only does industry composition explain a state's cycle, but the capital-intensiveness of the state's production process, the age of its capital stock, the extent of unionization of its labor force, and the level of its unemployment insurance benefits either aggravate or dampen state cycles.

The results of the empirical work suggest that states with capital-intensive production processes tend to, holding all other variables constant, experience milder recessions. This result holds whether the data is tested at the macroeconomic all-industry level or the microeconomic industry-specific level. The study also finds evidence that the age of a state's capital stock influences its cyclical sensitivity.

At the all-industry level, a newer capital stock appears to be associated with cyclical variability. New capital is a proxy for a high birth rate of new firms. Since new firms are prone to bankruptcy during recessions, states with new capital appear to be cyclically variable. The results for the textile industry suggest that without the "noise" of high birth and death rates, a mature industry is more cyclically variable in areas with the oldest capital stock.

Unionization of a state's labor force also appears to influence a state's business cycle. High rates of unionization are associated with more severe cycles.

At the macroeconomic level unemployment insurance benefits appear to act as an automatic stabilizer; the higher the benefit level, the more stable the state economy. In contrast, at the industry-specific level the results of the model suggest that high unemployment benefits encourage larger fluctuations in employment.

Finally, second round impacts of fluctuations in the state's export sector on the residentiary sector also appear to play a role in explaining state's business cycles. The magnitude of the multiplier is, however, small, and it appears to contribute little explanatory power to the all-industry model.

Policy Implications

The policy implications are more difficult to draw than anticipated. Chapter One listed two areas where the empirical work of this thesis might influence policy. One area is in the aiding of countercyclical investment policy; the second is in the area of determining the spatial effects of monetary and fiscal policy.

Uncertainty about the extent to which cross-state differences in percentage declines in full-time employment measure cross-state differences in welfare presents one complication. As discussed in Chapter Four, the dependent variable measure does not distinguish between full-time and part-time employment. During a recession many full-time workers are, rather than laid off, shifted to part-time work. Is it correct to claim that welfare is lower in state A, where ten people are laid off, than in state B, where twenty workers are shifted to one-half time? Because of limitations in the data, the recession in state A appears to be more severe than in state B. Therefore great care must be taken before drawing the conclusion that states with a severe percentage decline in employment suffer the greatest loss in welfare.

Two of the independent variables are expected to affect industry trade offs between layoff and work-sharing adjustments to the downturn. The more unionized the state's work force and the higher the unemployment insurance benefits, the more likely employers are to favor layoffs to work-sharing and the more cooperative workers are expected to be with a layoff strategy. Therefore cross-state differences in trade offs between layoffs and work sharing are very clearly expected to exist.

A second complication for policy making is found in evidence indicating industry responds to unintended as well as intended government incentives. The results of the industry-specific equations suggest one unintended side effect of the unemployment insurance program is that the greater the unemployment benefit cushion, the more likely workers are to be laid off. It is highly likely that anticipated countercyclical investment policy would have the same effect. To avoid an indirect subsidy to businesses and a situation where workers, who would otherwise have been kept on private payrolls, end up supported by public funds, such a countercyclical policy would have to be carefully designed. The potential for adverse incentives and a policy which would circumvent the problem are beyond the scope of this thesis.

A third and final complication for policy-making is the finding that a state's cyclical behavior is not consistent across recessions. A relatively severely effected state in one recession will not necessarily experience a severe recession next time. Clearly a more sophisticated model of cyclical behavior is required. However, the all-industry model tested here explains only 50 percent of the variation in the severity of state recessions. Findings presented in Chapter Six suggest that a 3-digit industry-mix breakdown may contribute as much as 38 percent additional explanatory power. Further refinements of the model, including such a 3-digit breakdown, would be necessary before the model could be used for policy making.

Directions for Further Research

There are several possible directions for further research. One direction is to explore the extent to which the cyclically sensitive nature of an industry's employment influences its locational decision. For example, it is possible that cyclically volatile firms locate labor-intensive branch plants in low wage areas to absorb the firm's variability in output. As hypothesized and supported above, low capital-labor states tend to exhibit greater variability in employment, all other variables held constant. It is possible this negative association is the result of a conscious cost-minimizing strategy on the part of cyclically variable firms to locate labor-intensive branch plants in low wage areas. To review, the argument is that the cost of idle capital is greater to the firm than the cost of idle labor. Therefore, costs are minimized if during a downturn labor-intensive plants bear a disproportionate share of reductions in output.

It is also possible that cyclically volatile firms are attracted to states with high unemployment insurance benefits, as it is easier to lay-off and rehire workers in those states. The effect of cyclical variability on locational decisions could be explored by developing a model explaining the birth or relocations of nationally cyclically sensitive firms as a function of such factors as insurance benefits, local wages, and substitutability among capital and labor. These results would then have to be compared with a similar model, with the birth and relocation rate of cyclically stable industries.

A second direction for further research is to study the broader impacts of cyclical sensitivity on economic and institutional factors. For example, throughout this study it has been argued that unionization of the labor force and unemployment insurance benefits influence a state's cyclical variability. It is possible, as stated earlier, that the causal relationship moves in the opposite direction and that unionization and insurance benefits are endogenous and cyclical variability is exogenous. One way to sort out the direction of the causal relationship would be to conduct a cross-state historical analysis of the labor union movement and the inception of the unemployment insurance system focusing on the relationship between the cyclical nature of industries and the evolution of the institutional responses to those cycles.

APPENDIX

State Names and Their Abbreviations
Used in the Following Appendices

Alabama	AL	Nebraska	NB
Arizona	AZ	Nevada	NV
Arkansas	AK	New Hampshire	NH
California	CA	New Jersey	NJ
Colorado	CO	New Mexico	NM
Connecticut	CN	New York	NY
Delaware	DE	North Carolina	NC
Florida	FL	North Dakota	ND
Georgia	GA	Ohio	OH
Idaho	ID	Oklahoma	OK
Illinois	IL	Oregon	OR
Indiana	IN	Pennsylvania	PN
Iowa	IA	Rhode Island	RI
Kansas	KA	South Carolina	SC
Kentucky	KY	South Dakota	SD
Louisiana	LA	Tennessee	TN
Maine	ME	Texas	TX
Maryland	MD	Utah	UT
Massachusetts	MA	Vermont	VM
Michigan	MC	Virginia	VR
Minnesota	MN	Washington	WA
Mississippi	MS	West Virginia	WV
Missouri	MO	Wisconsin	WS
Montana	MT	Wyoming	WY

Appendix I.A

Data for Trend-Adjusted Severity of State Recessions, Trend-Adjusted Expected Recessions, Unionization, Unemployment Rate, Ratio of Unemployment Insurance Benefits to Weekly Wages, Capital-Labor Ratio in Manufacturing, and Ratio of Residentiary to Total Employment for All Industries, 1953-54 Recession, By State.

Sources: See Chapter 4 for description of calculations.

δ = 1971; assumes a depreciation equivalent to the 1971 rate prevailed throughout the period.

δ = 1958-62; assumes the annual average depreciation rate over the period 1958-62 prevailed throughout the period.

State	Trend-Adjusted Severity 1953-54 (%)	Trend-Adjusted Recession 1953-54 (%)	Union-ization 1952 (%)	Unemploy-ment Rate 1952	Ratio of Insurance Benefits to Weekly Wages 1952
AL	2.222	4.611	24.6	3.70	.321
AZ	.962	4.627	27.4	1.70	.300
CA	1.620	6.740	35.4	3.30	.306
CO	3.193	4.267	27.5	.70	.315
DE	3.928	4.019	18.1	1.10	.275
FL	.000	3.761	15.9	2.50	.300
GA	2.703	3.826	14.7	2.40	.318
IL	2.933	4.598	39.7	2.60	.319
IN	5.325	4.589	40.0	2.10	.326
IA	1.218	4.033	24.7	1.50	.339
KA	1.780	6.664	23.6	1.20	.337
KY	3.409	3.476	24.7	4.30	.313
MD	2.396	5.275	24.9	1.80	.346
MN	1.015	3.617	37.8	2.40	.280
MS	2.211	3.834	14.4	4.60	.351
MO	2.970	3.713	39.4	2.10	.299
MT	4.439	5.564	46.7	2.40	.286
NB	2.151	2.571	19.4	1.20	.352
NV	.000	3.859	30.1	2.20	.329
NY	1.604	4.251	33.3	3.80	.334
NC	2.041	4.080	8.0	3.50	.319
ND	.000	2.387	15.3	2.90	.396
OH	3.217	5.241	37.0	1.50	.327
OR	6.644	4.198	42.8	4.50	.306
PN	2.985	4.103	37.9	3.20	.373
RI	3.574	4.574	26.1	6.60	.351
SC	2.867	3.962	9.0	2.60	.333
TN	1.668	3.883	22.3	4.60	.295
UT	2.459	5.392	26.0	2.10	.394
VM	2.439	4.947	18.9	3.90	.357
VR	1.917	4.158	17.1	1.70	.306
WV	3.679	4.244	39.8	4.30	.294
WS	2.112	5.215	38.0	1.70	.353

Appendix I.A

1952

State	Age of Capital δ=1971	Age of Capital δ=1958-62	Capital-Labor Ratio ($000's) δ=1971	Capital-Labor Ratio ($000's) δ=1958-62	Ratio of Residentiary to Total Employment
AL	.189	.204	6.090	5.648	.634
AZ	.196	.193	6.072	6.147	.791
CA	.235	.282	5.253	4.391	.723
CO	.220	.311	6.158	4.358	.807
DE	.234	.245	5.779	5.523	.560
FL	.235	.332	7.667	5.428	.803
GA	.332	.446	2.756	2.049	.645
IL	.232	.269	4.739	4.095	.609
IN	.269	.306	5.499	4.837	.535
IA	.232	.311	4.937	3.673	.711
KA	.317	.371	3.572	3.049	.714
KY	.335	.472	5.451	3.868	.670
MD	.190	.241	4.874	3.853	.670
MN	.124	.154	5.716	4.583	.726
MS	.257	.307	4.243	3.557	.708
MO	.243	.223	3.260	3.559	.686
MT	.358	.532	4.314	2.906	.809
NB	.220	.225	4.059	3.974	.822
NV	.142	.220	16.669	10.794	.865
NY	.181	.214	3.792	3.212	.665
NC	.137	.160	3.906	3.335	.558
ND	.398	.457	9.661	8.402	.928
OH	.272	.218	5.252	6.551	.543
OR	.364	.361	4.701	4.731	.684
PN	.268	.302	5.233	4.635	.553
RI	.181	.208	3.697	3.224	.368
SC	.250	.217	5.344	6.143	.585
TN	.243	.280	4.325	3.762	.645
UT	.174	.204	9.152	7.795	.794
VM	.190	.198	3.618	3.464	.606
VR	.273	.303	4.054	3.654	.696
WV	.295	.349	6.425	5.433	.521
WS	.205	.221	4.870	4.517	.564

Appendix I.B

Data for Trend-Adjusted Severity of State Recessions, Trend-Adjusted Expected Recessions, Unionization, Unemployment Rate, Ratio of Unemployment Insurance Benefits to Weekly Wages, Capital-Labor Ratio in Manufacturing, and Ratio of Residentiary to Total Employment for All Industries, 1957-58 Recession, By State.

Sources: See Chapter 4 for description of calculations.

δ = 1971; assumes a depreciation equivalent to the 1971 rate prevailed throughout the period.

δ = 1958-62; assumes the annual average depreciation rate over the period 1958-62 prevailed throughout the period.

Appendix I.B

State	Trend-Adjusted Severity 1957-58 (%)	Trend-Adjusted Recession 1957-58 (%)	Union-ization 1956 (%)	Unemploy-ment Rate 1956	Ratio of Insurance Benefits to Weekly Wages 1956
AL	2.299	5.737	29.3	4.20	.303
AZ	2.113	5.239	30.6	2.60	.297
CA	3.382	5.685	36.5	2.60	.316
CO	3.141	4.667	28.5	1.30	.319
DE	2.780	5.048	33.0	1.60	.318
FL	2.484	3.499	16.5	2.50	.308
GA	2.640	4.419	15.5	3.20	.319
ID	1.201	4.911	16.8	3.70	.365
IL	3.124	5.752	47.3	2.30	.301
IN	4.234	5.793	40.5	2.90	.315
IA	1.915	4.972	29.0	2.00	.337
KA	2.090	5.681	24.0	2.30	.349
KY	2.846	5.068	29.7	6.70	.303
MD	2.509	5.644	27.9	1.80	.326
MN	2.065	4.380	38.9	3.20	.303
MS	1.514	4.690	15.0	5.00	.354
MO	2.426	3.788	46.0	3.10	.274
MT	1.481	5.677	47.5	3.10	.311
NB	2.702	3.074	22.0	2.50	.349
NV	3.065	5.422	25.0	4.20	.371
NY	1.816	4.727	37.8	3.50	.337
NC	1.252	3.906	9.0	3.90	.291
ND	2.029	.826	24.0	3.90	.395
OH	4.721	6.865	40.9	1.90	.343
OR	2.519	5.383	47.0	4.60	.347
PN	2.517	5.792	52.0	4.40	.351
RI	2.497	5.108	27.0	5.10	.380
SC	1.187	4.319	9.5	3.40	.356
SD	2.453	2.727	19.0	2.60	.345
TN	2.142	4.360	23.0	5.90	.301
UT	2.025	4.039	26.8	2.30	.361
VM	1.903	5.625	16.5	2.70	.330
VR	1.497	3.894	18.0	1.80	.288
WV	4.615	5.570	45.0	3.20	.254
WS	3.258	5.776	45.1	2.30	.364

Appendix I.B

1956

State	Age of Capital δ=1971	Age of Capital δ=1958-62	Capital-Labor Ratio ($000's) δ=1971	Capital-Labor Ratio ($000's) δ=1958-62	Ratio of Residentiary to Total Employment
AL	.222	.224	7.151	7.063	.646
AZ	.182	.182	5.200	5.211	.788
CA	.223	.229	5.609	5.460	.714
CO	.238	.251	6.229	5.897	.809
DE	.340	.343	9.595	9.527	.560
FL	.195	.206	7.814	7.423	.849
GA	.322	.334	4.401	4.241	.650
ID	.309	.318	8.148	7.928	.780
IL	.202	.206	5.765	5.635	.623
IN	.237	.241	7.851	7.700	.558
IA	.225	.236	5.943	5.675	.736
KA	.244	.249	5.509	5.379	.741
KY	.209	.219	6.801	6.486	.666
MD	.301	.312	6.614	6.381	.722
MN	.150	.156	5.861	5.650	.733
MS	.176	.181	4.270	4.153	.696
MO	.190	.187	4.643	4.709	.691
MT	.581	.600	13.288	12.887	.799
NB	.173	.174	5.251	5.235	.830
NV	.185	.313	11.672	6.896	.870
NY	.170	.174	3.934	3.828	.680
NC	.194	.199	4.453	4.340	.563
ND	.062	.063	8.645	8.422	.929
OH	.205	.198	6.810	7.053	.565
OR	.207	.206	6.517	6.524	.699
PN	.170	.173	6.361	6.237	.577
RI	.150	.153	3.986	3.895	.515
SC	.161	.157	5.706	5.846	.564
SD	.125	.134	5.477	5.117	.888
TN	.216	.220	5.808	5.690	.641
UT	.230	.236	12.035	11.722	.783
VM	.150	.152	4.172	4.141	.530
VR	.245	.249	5.881	5.791	.710
WV	.271	.278	10.305	10.056	.572
WS	.165	.167	5.552	5.483	.588

Appendix I.C

Data for Trend-Adjusted Severity of State Recessions, Trend-Adjusted Expected Recessions, Unionization, Unemployment Rate, Ratio of Unemployment Insurance Benefits to Weekly Wages, Capital-Labor Ratio in Manufacturing, and Ratio of Residentiary to Total Employment for All Industries, 1960-61 Recession, By State.

Sources: See Chapter 4 for description of calculations.

δ = 1971; assumes a depreciation equivalent to the 1971 rate prevailed throughout the period.

δ = 1958-62; assumes the annual average depreciation rate over the period 1958-62 prevailed throughout the period.

Appendix I.C

State	Trend-Adjusted Severity 1960-61 (%)	Trend-Adjusted Recession 1960-61 (%)	Union-ization 1959 (%)	Unemploy-ment Rate 1959	Ratio of Insurance Benefits to Weekly Wages 1959
AL	1.211	3.959	29.0	5.20	.303
AZ	.621	3.555	30.1	3.90	.338
CA	.559	3.603	36.1	4.10	.327
CO	1.602	2.611	28.3	2.20	.366
DE	2.094	3.333	32.4	3.30	.330
FL	.227	2.342	13.5	3.20	.317
GA	1.250	2.769	13.0	3.80	.331
ID	2.792	2.975	16.0	4.60	.432
IL	1.970	3.267	47.2	3.30	.303
IN	2.703	4.057	36.6	3.10	.306
IA	.865	2.636	28.0	1.90	.308
KA	1.860	3.269	21.4	2.70	.367
KY	2.115	3.068	29.4	6.10	.345
MD	1.756	3.279	26.9	5.00	.360
MN	1.176	2.439	34.6	3.90	.321
MS	.960	3.641	13.0	5.20	.363
MO	1.726	2.911	45.3	3.60	.311
MT	.905	3.793	34.5	6.70	.338
NB	2.992	1.896	21.1	2.00	.352
NV	.000	3.948	20.5	4.90	.391
NM	1.605	2.426	16.5	2.70	.312
NY	1.140	2.698	37.4	5.20	.351
NC	1.556	3.160	8.5	4.10	.299
ND	1.339	1.780	23.3	4.80	.364
OH	2.840	3.794	43.8	3.10	.331
OK	.378	3.118	17.2	4.10	.304
OR	2.448	4.226	46.8	4.60	.368
PN	2.006	3.439	51.4	6.80	.331
PI	1.606	3.509	26.5	5.50	.377
SC	1.636	3.045	7.2	3.30	.356
SD	.000	1.443	18.3	2.10	.348
TN	.549	2.969	19.4	5.10	.292
UT	.263	3.695	22.3	3.40	.383
VM	1.664	3.662	16.0	4.20	.320
VR	1.873	2.876	14.0	2.60	.309
WV	1.944	3.188	44.0	8.30	.254
WS	2.600	3.056	44.9	2.70	.373

Appendix I.C

1959

State	Age of Capital δ=1971	Age of Capital δ=1958-62	Capital-Labor Ratio ($000's) δ=1971	Capital-Labor Ratio ($000's) δ=1958-62	Ratio of Residentiary to Total Employment
AL	.151	.148	9.000	9.201	.675
AZ	.236	.237	5.816	5.796	.807
CA	.181	.173	6.226	6.525	.717
CO	.179	.163	6.242	6.870	.805
DE	.083	.082	10.838	10.984	.560
FL	.214	.196	7.674	8.372	.836
GA	.189	.177	5.589	5.957	.666
ID	.169	.161	8.812	9.244	.734
IL	.157	.151	7.187	7.485	.639
IN	.152	.147	10.164	10.524	.574
IA	.178	.164	6.639	7.195	.730
KA	.202	.194	7.413	7.723	.752
KY	.161	.148	7.621	8.290	.690
MD	.117	.109	8.160	8.716	.704
MN	.152	.142	6.174	6.590	.742
MS	.235	.224	4.989	5.226	.682
MO	.154	.158	5.942	5.795	.701
MT	.115	.109	15.973	16.898	.832
NB	.181	.180	7.729	7.771	.820
NV	.160	.142	12.703	14.332	.914
NM	.478	.475	6.898	6.979	.845
NY	.168	.160	4.470	4.691	.688
NC	.169	.162	5.092	5.324	.571
ND	.202	.193	9.365	9.806	.929
OH	.135	.144	8.496	7.976	.587
OK	.207	.195	7.584	8.059	.766
OR	.188	.189	8.370	8.355	.704
PN	.134	.129	7.834	8.117	.601
RI	.121	.116	4.241	4.424	.519
SC	.119	.125	5.991	5.734	.576
SD	.245	.219	4.269	4.769	.887
TN	.179	.173	6.881	7.133	.654
UT	.130	.124	11.703	12.276	.784
VM	.157	.155	5.126	5.193	.655
VR	.143	.140	6.923	7.117	.713
WV	.155	.148	14.745	15.406	.597
WS	.133	.130	6.437	6.584	.602

Appendix I.D

Data for Trend-Adjusted Severity of State Recessions, Trend-Adjusted Expected Recessions, Unionization, Unemployment Rate, Ratio of Unemployment Insurance Benefits to Weekly Wages, Capital-Labor Ratio in Manufacturing, and Ratio of Residentiary to Total Employment for All Industries, 1969-70 Recession, By State.

Sources: See Chapter 4 for description of calculations.

δ = 1971; assumes a depreciation equivalent to the 1971 rate prevailed throughout the period.

δ = 1958-62; assumes the annual average depreciation rate over the period 1958-62 prevailed throughout the period.

Appendix I.D

State	Trend-Adjusted Severity 1969-70 (%)	Trend-Adjusted Recession 1969-70 (%)	Union-ization 1968 (%)	Unemploy-ment Rate 1968	Ratio of Insurance Benefits to Weekly Wages 1968
AL	.670	3.821	20.1	2.60	.315
AZ	.000	3.203	18.9	2.30	.318
AK	.692	3.007	19.1	2.80	.351
CA	1.182	4.735	31.9	3.70	.359
CO	.177	3.224	21.8	.90	.406
DE	2.049	3.042	26.0	1.70	.325
FL	.000	3.499	14.4	1.60	.289
GA	.868	3.421	16.6	1.30	.333
ID	.000	1.990	19.3	3.20	.405
IL	1.074	3.269	36.0	1.50	.321
IN	2.650	4.968	36.0	1.40	.288
IA	.547	2.818	21.3	1.30	.391
KA	2.079	6.201	18.3	1.40	.383
KY	.000	2.767	27.5	2.50	.339
LA	.000	3.253	18.0	2.40	.320
MD	.000	4.144	22.6	1.80	.361
MN	1.135	2.978	30.2	1.70	.349
MS	.365	3.482	13.8	2.10	.282
MO	1.514	4.795	36.0	2.10	.330
MT	.000	2.769	31.3	3.10	.298
NB	.166	2.959	17.2	1.30	.353
NV	.000	2.107	29.4	3.80	.328
NM	.617	2.462	13.4	2.80	.310
NY	1.322	3.163	36.2	2.50	.323
NC	.000	2.432	7.5	1.70	.284
ND	.000	2.071	18.8	3.00	.409
OH	1.816	4.868	35.8	1.30	.320
OK	.195	4.064	16.7	2.30	.272
OR	1.138	3.532	31.6	3.20	.317
PN	1.531	3.595	37.3	2.10	.345
RI	1.597	2.607	24.1	3.10	.391
SC	.319	2.243	8.6	1.80	.336
SD	1.704	1.478	14.4	1.60	.352
TN	.975	2.807	19.4	2.50	.313
TX	.825	4.097	13.9	.90	.305
UT	1.654	3.845	18.4	3.10	.375
VM	.745	3.084	20.7	2.50	.375
VR	3.093	3.480	16.6	.70	.314
WV	.681	2.574	41.9	3.20	.247
WS	1.197	3.745	32.2	1.90	.392

Appendix I.D

1968

State	Age of Capital δ=1971	Age of Capital δ=1958-62	Capital-Labor Ratio ($000's) δ=1971	Capital-Labor Ratio ($000's) δ=1958-62	Ratio of Residentiary to Total Employment
AL	.185	.171	11.535	12.489	.646
AZ	.250	.253	9.252	9.149	.783
AK	.226	.212	8.329	8.882	.676
CA	.204	.172	8.153	9.677	.755
CO	.223	.159	9.033	12.680	.820
DE	.168	.160	14.745	15.489	.581
FL	.202	.146	8.567	11.840	.838
GA	.230	.183	7.427	9.343	.684
ID	.200	.171	11.777	13.793	.785
IL	.200	.172	9.434	10.963	.673
IN	.174	.153	14.094	16.025	.596
IA	.202	.150	9.172	12.393	.741
KA	.201	.171	8.741	10.244	.767
KY	.260	.196	10.236	13.587	.694
LA	.373	.268	18.697	26.019	.777
MD	.149	.114	10.302	13.405	.778
MN	.215	.169	6.485	8.223	.734
MS	.283	.244	7.744	8.965	.664
MO	.136	.151	9.161	8.278	.699
MT	.193	.156	22.532	27.940	.546
NB	.154	.150	9.990	10.204	.813
NV	.273	.180	13.754	20.842	.938
NM	.182	.176	6.598	6.962	.869
NY	.202	.169	6.011	7.199	.739
NC	.223	.192	7.620	8.864	.586
ND	.183	.155	11.393	13.409	.930
OH	.191	.238	11.029	8.852	.656
OK	.157	.121	7.425	9.669	.783
OR	.162	.163	13.984	13.893	.744
PN	.183	.159	9.931	11.411	.628
RI	.214	.184	5.426	6.315	.553
SC	.243	.277	9.208	8.089	.545
SD	.255	.175	3.887	5.680	.893
TN	.200	.176	8.975	10.184	.514
TX	.188	.199	19.597	18.466	.760
UT	.134	.109	13.481	16.573	.811
VM	.235	.225	6.644	6.936	.695
VR	.175	.158	9.651	10.656	.732
WV	.153	.128	22.297	26.571	.659
WS	.189	.174	8.725	9.481	.685

Appendix I.E

Data for Trend-Adjusted Severity of State Recessions, Trend-Adjusted Expected Recessions, Unionization, Unemployment Rate, Ratio of Unemployment Insurance Benefits to Weekly Wages, Capital-Labor Ratio in Manufacturing, and Ratio of Residentiary to Total Employment for All Industries, 1973-75 Recession, By State.

Sources: See Chapter 4 for description of calculations.

δ = 1971; assumes a depreciation equivalent to the 1971 rate prevailed throughout the period.

δ = 1958-62; assumes the annual average depreciation rate over the period 1958-62 prevailed throughout the period.

State	Trend-Adjusted Severity 1973-75 (%)	Trend-Adjusted Recession 1973-75 (%)	Union-ization 1972 (%)	Unemploy-ment Rate 1972	Ratio of Insurance Benefits to Weekly Wages 1972
AL	3.125	10.036	19.2	2.90	.347
AZ	3.026	6.086	16.6	2.30	.347
AK	4.032	6.880	16.4	3.10	.362
CA	1.684	5.889	28.9	4.70	.333
CO	1.501	5.201	18.9	1.30	.414
CN	1.820	6.288	26.1	4.50	.422
DE	2.197	6.798	20.3	2.50	.327
FL	1.728	6.166	14.7	1.90	.318
GA	3.804	7.850	13.9	1.60	.330
ID	1.918	6.318	17.0	4.20	.404
IL	2.936	5.444	35.6	2.80	.338
IN	3.134	6.598	33.9	2.20	.301
IA	1.891	5.438	20.0	2.20	.413
KA	1.572	5.528	15.4	2.40	.394
KY	2.332	5.875	24.9	2.90	.378
LA	1.889	5.873	16.9	3.40	.352
ME	2.685	8.057	19.1	5.70	.394
MD	1.519	5.915	21.7	3.10	.404
MA	2.100	6.325	26.0	5.10	.380
MC	3.218	5.823	38.4	4.40	.319
MN	1.504	5.704	28.3	3.30	.356
MS	3.494	7.535	12.6	1.70	.323
MO	3.011	5.477	32.9	3.30	.340
MT	1.554	6.483	30.7	4.40	.375
NB	1.373	4.985	17.0	1.90	.386
NV	1.344	4.902	33.6	5.00	.382
NH	2.339	7.475	17.2	2.50	.397
NJ	2.175	5.684	29.1	5.10	.397
NM	1.064	6.158	13.2	3.70	.360
NY	.739	5.879	36.2	4.20	.333
NC	4.152	8.700	7.5	1.60	.313
ND	1.810	6.211	16.1	3.90	.420
OH	2.070	6.383	34.8	2.30	.339
OK	1.169	5.462	16.0	3.10	.293
OR	1.835	7.288	27.9	4.50	.313
PN	1.403	6.780	38.2	4.20	.424
RI	3.442	6.909	27.3	5.10	.436
SC	4.282	8.316	9.0	1.90	.340
SD	1.622	4.262	11.4	2.20	.378
TN	3.470	7.187	18.4	2.50	.346
TX	.454	5.557	13.5	1.30	.348
UT	1.425	5.933	19.4	3.50	.411
VM	2.207	6.726	17.7	5.60	.446
VR	2.322	6.615	15.5	1.00	.358
WA	.123	6.856	38.3	7.10	.371
WV	1.317	5.540	41.3	4.10	.274
WS	1.826	6.522	29.7	4.10	.393

Appendix I.E
1972

State	Age of Capital δ=1971	Age of Capital δ=1958-62	Capital-Labor Ratio ($000's) δ=1971	Capital-Labor Ratio ($000's) δ=1958-62	Ratio of Residentiary to Total Employment
AL	.129	.116	12.423	13.741	.685
AZ	.212	.215	12.378	12.217	.815
AK	.163	.151	8.876	9.579	.679
CA	.146	.117	9.877	12.248	.784
CO	.255	.175	10.036	14.561	.887
CN	.112	.112	10.638	10.638	.638
DE	.100	.093	17.864	19.074	.688
FL	.202	.137	9.179	13.573	.857
GA	.207	.158	8.985	11.775	.712
ID	.187	.153	11.631	14.186	.798
IL	.147	.122	11.492	13.855	.698
IN	.109	.092	16.565	19.566	.626
IA	.177	.123	11.225	16.172	.757
KA	.164	.135	10.621	12.911	.785
KY	.170	.118	10.963	15.706	.698
LA	.221	.145	20.212	30.666	.792
ME	.124	.109	15.207	17.346	.622
MD	.133	.096	13.364	18.440	.815
MA	.152	.135	7.564	8.490	.630
MC	.152	.140	14.441	15.720	.643
MN	.184	.139	7.898	10.455	.763
MS	.178	.148	8.654	10.406	.666
MO	.106	.120	11.950	10.515	.736
MT	.165	.126	25.995	34.033	.854
NB	.138	.134	11.705	12.009	.828
NV	.273	.169	12.020	19.354	.947
NH	.141	.149	10.217	9.653	.668
NJ	.156	.106	9.673	14.218	.693
NM	.372	.360	6.080	6.399	.872
NY	.164	.132	7.737	9.612	.770
NC	.192	.160	9.093	10.923	.600
ND	.224	.185	10.637	12.899	.930
OH	.121	.159	13.356	10.193	.656
OK	.226	.170	8.556	11.426	.783
OR	.126	.127	16.101	15.967	.762
PN	.124	.104	12.268	14.599	.663
RI	.173	.144	6.394	7.687	.581
SC	.194	.227	10.885	9.293	.613
SD	.346	.229	4.037	6.109	.893
TN	.159	.136	10.421	12.191	.660
TX	.118	.127	23.976	22.254	.783
UT	.134	.104	13.582	17.494	.821
VM	.177	.168	9.868	10.366	.745
VR	.170	.151	11.593	13.078	.745
WA	.143	.120	16.174	19.312	.794
WV	.107	.086	25.595	32.131	.673
WS	.135	.121	10.103	11.211	.685

Appendix II.A
1972
Trend-Adjusted Severity, Expected Recession Age of Capital, Capital-Labor Ratio for Machinery Manufacturing, By State

State	Trend-Adjusted Severity 1973-75 (%)	Expected Recession 1973-75 (%)	Age of Capital 1972	Capital-Labor Ratio 1972 ($000's)
AK	12.900	5.990	.301	5.491
CA	3.372	3.470	.268	9.865
CO	.979	2.821	.296	9.625
CN	4.876	3.950	.118	15.938
FL	4.039	4.019	.403	7.670
GA	2.134	4.833	.274	6.971
ID	2.760	3.824	.303	7.169
IL	6.074	3.860	.194	11.012
IN	4.933	4.290	.206	11.855
IA	4.034	4.944	.285	10.057
KY	.602	3.630	.398	6.184
LA	7.862	4.727	.185	8.604
MD	4.184	3.947	.257	8.897
MA	5.792	3.446	.136	12.904
MC	6.516	4.423	.214	9.705
MN	6.764	3.729	.186	9.142
MO	9.151	4.248	.329	10.131
NB	4.152	3.772	.298	11.410
NH	4.064	4.454	.158	11.895
NJ	3.900	3.617	.197	11.611
NY	4.930	4.529	.348	6.145
NC	3.625	4.419	.170	11.358
OH	2.126	3.235	.320	6.877
OK	4.103	3.497	.276	5.759
OR	.707	3.037	.167	13.465
PN	11.648	4.342	.124	8.798
RI	5.798	4.488	.529	10.035
SC	10.067	5.844	.281	6.963
TN	.000	3.502	.271	7.925
TX	2.632	4.596	.149	13.842
VM	6.815	4.752	.307	8.340
VR	1.818	3.362	.155	6.445
WA	2.429	3.974	.215	7.631
WV	4.361	4.251	.157	10.335

Sources: See Chapter 4 for description of calculations.

Appendix II.B
1972
Unemployment Rate, Ratio of Insurance Benefits to Weekly Wages, Total Employment in Machinery Manufacturing, By State

State	State Unemployment Rate[a] 1972 (%)	Ratio of Insurance Benefits to Weekly Wages[b] 1972	Total Employment[c] 1972
AK	3.100	.362	7500.
CA	4.700	.333	135000.
CO	1.300	.414	14300.
CN	4.500	.422	51700.
FL	2.500	.318	17000.
GA	1.900	.330	12700.
ID	1.600	.338	196700.
IL	2.800	.301	68600.
IN	2.200	.413	48000.
IA	2.900	.378	32100.
KY	3.400	.352	7000.
LA	3.100	.404	19400.
MD	5.100	.380	74300.
MA	4.400	.319	136900.
MC	3.300	.356	55000.
MN	3.300	.340	30600.
MO	1.900	.386	8700.
NE	2.500	.397	9800.
NH	5.100	.397	62300.
NJ	4.200	.333	135100.
NY	1.600	.313	30700.
NC	2.300	.339	198600.
OH	3.100	.293	22700.
OK	4.500	.313	10100.
OR	4.200	.424	122700.
PN	5.100	.436	9000.
RI	1.900	.340	18900.
SC	2.500	.346	25900.
TN	1.300	.348	70800.
TX	5.600	.446	5000.
VM	1.000	.358	10600.
VR	7.100	.371	10300.
WA	4.100	.274	4900.
WV	4.100	.393	97400.

Sources: [a]Manpower Report of the President, 1973.

[b]Handbook of Unemployment Insurance, 1978.

[c]Census of Manufactures and Annual Survey of Manufactures.

Appendix III.A
1972 and 1968
Trend-Adjusted Severity, Expected Recession Age of
Capital, Capital-Labor Ratio for Machinery Manufacturing,
By State

State	Trend-Adjusted Severity 1973-75 (%)	Expected Recession 1973-75 (%)	Age of Capital 1972	Capital-Labor Ratio 1972 ($000's)
AL	11.218	8.833	.178	10.882
AK	6.279	7.225	.288	12.045
CO	12.870	11.395	.187	10.958
DE	16.250	7.204	.048	5.720
GA	9.174	8.174	.221	10.242
IL	3.125	8.556	.208	10.197
ME	8.780	7.558	.186	1.316
MD	7.857	10.717	.113	22.537
MA	10.372	8.076	.137	8.407
MS	7.097	8.090	.236	10.028
MO	4.286	6.615	.067	6.713
NH	14.200	8.308	.151	11.135
NJ	7.308	7.617	.264	10.210
NY	8.840	7.211	.217	8.326
NC	7.532	8.498	.208	11.408
OH	7.288	7.391	.164	9.850
PN	7.230	7.277	.205	8.331
RI	11.318	9.439	.113	13.092
SC	10.300	8.194	.156	14.173
TN	9.723	7.498	.209	9.141
TX	8.630	7.474	.112	14.616
VR	9.241	8.032	.205	11.189
WS	12.712	6.947	.180	8.460

State	Trend-Adjusted Severity 1969-70 (%)	Expected Recession 1969-70 (%)	Age of Capital 1968	Capital-Labor Ratio 1968 ($000's)
AL	2.036	1.583	.273	10.719
AK	4.146	1.594	.234	11.648
DE	18.333	1.472	.099	12.900
GA	1.651	1.288	.324	9.276
MS	13.333	2.009	.156	8.477
NY	2.865	1.961	.203	7.533
OH	9.028	2.409	.264	10.739
SC	1.558	1.695	.220	13.557
VR	5.083	1.876	.218	10.581

Sources: See Chapter 4 for description of calculations.

Appendix III.B
1972 and 1968
Unemployment Rate, Ratio of Insurance Benefits to Weekly Wages, Total Employment in Machinery Manufacturing, By State

State	State Unemployment Rate 1972[a] (%)	Ratio of Insurance Benefits to Weekly Wages[b] 1972	Total Employment[c] 1972
AL	2.900	.347	43700.
AK	3.100	.362	4100.
CO	4.500	.422	13000.
DE	2.500	.327	5820.
GA	1.600	.330	111600.
IL	2.800	.338	4400.
ME	5.700	.394	76100.
MD	3.100	.404	1200.
MA	5.100	.380	29100.
MS	1.700	.323	7400.
MO	3.300	.340	2000.
NH	2.500	.397	7600.
NJ	5.100	.397	29900.
NY	4.200	.333	55600.
NC	1.600	.313	275600.
OH	2.300	.339	9000.
PN	4.200	.424	61300.
RI	5.100	.436	16900.
SC	1.900	.340	143300.
TN	2.500	.346	32400.
TX	1.300	.348	6300.
VR	1.000	.358	44000.
WS	4.100	.398	6400.

State	State Unemployment Rate[a] 1968 (%)	Ratio of Insurance Benefits to Weekly Wages[b] 1968	Total Employment[c] 1968
AL	2.600	.315	36500.
AK	2.800	.351	2800.
DE	1.700	.325	1500.
GA	1.300	.333	102600.
MS	2.100	.282	8400.
NY	2.500	.323	47200.
OH	1.300	.320	7200.
SC	1.800	.336	127500.
VR	.700	.314	36800.

Sources: [a]Manpower Report of the President, 1973.

[b]Handbook of Unemployment Insurance, 1978.

[c]Census of Manufactures and Annual Survey of Manufactures.

Appendix IV.A

Capital-Labor Ratios and Age-of-Capital Stock
for all Manufacturing by Region
1952
(δ = 1958-62)

	Capital Labor Ratios ($000's)		Age of Capital Stock	
	Mean	Standard Deviation	Mean	Standard Deviation
Northeast	3.41	.690	.24	.042
Northcentral	4.74	1.465	.27	.090
East	4.86	.981	.27	.047
West	4.64	1.808	.27	.116
South	4.87	1.784	.31	.091
West	5.27	2.841	.56	.782

Source: See Chapter 4 for description of calculations.

Appendix IV.B

Capital-Labor Ratios and Age-of-Capital Stock
for all Manufacturing by Region
1956
(δ = 1958-62)

	Capital Labor Ratios ($000's)		Age of Capital Stock	
	Mean	Standard Deviation	Mean	Standard Deviation
Northeast	4.52	.938	.17	.033
Northcentral	6.10	1.175	.19	.056
East	6.65	.978	,22	.037
West	5.74	1.228	.17	.063
South	7.04	2.541	.23	.058
West	7.41	2.856	.33	.178

Source: See Chapter 4 for description of calculations.

Appendix IV.C

Capital-Labor Ratios and Age-of-Capital Stock
for all Manufacturing by Region
1959
(δ = 1958-62)

	Capital Labor Ratios ($000's)		Age of Capital Stock	
	Mean	Standard Deviation	Mean	Standard Deviation
Northeast	5.64	1.486	.14	.016
Northcentral	7.63	1.670	.16	.030
East	8.39	1.566	.14	.016
West	7.09	1.611	.18	.026
South	8.94	3.556	.15	.035
West	9.70	3.916	.20	.111

Source: See Chapter 4 for description of calculations.

Appendix IV.D

Capital-Labor Ratios and Age-of-Capital Stock
for all Manufacturing by Region
1968
(δ = 1958-62)

	Capital Labor Ratios ($000's)		Age of Capital Stock	
	Mean	Standard Deviation	Mean	Standard Deviation
Northeast	8.50	2.393	.17	.027
Northcentral	10.52	2.764	.17	.024
East	11.57	2.865	.18	.034
West	9.78	2.642	.16	.011
South	13.28	5.790	.18	.049
West	14.45	6.151	.17	.036

Source: See Chapter 4 for description of calculations.

Appendix IV.E

Capital-Labor Ratios and Age-of-Capital Stock
for all Manufacturing by Region
1972
(δ = 1958-62)

	Capital Labor Ratios ($000's)		Age of Capital Stock	
	Mean	Standard Deviation	Mean	Standard Deviation
Northeast	11.40	3.234	.13	.023
Northcentral	12.64	3.463	.14	.036
East	14.11	3.747	.13	.025
West	11.58	3.085	.15	.040
South	15.89	7.051	.14	.034
West	16.58	7.244	.17	.076

Source: See Chapter 4 for description of calculations.

Appendix V

Unionization, Unemployment and Ratio of Insurance Benefits to Weekly Wages for All Industries by Region

1972

	Union (Percentages)		Unemployment (Percentages)		Ratio of Insurance Benefits to Weekly Wages	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Northeast	27.23	7.545	4.54	.961	.40	.036
Northcentral	30.40	7.557	2.88	.972	.35	.037
East	35.08	3.501	3.04	1.413	.34	.035
West	24.55	7.337	2.68	.732	.38	.032
South	17.60	8.457	2.49	.905	.34	.035
West	28.50	7.931	4.40	2.381	.36	.045

Source: See Chapter 4 for description of calculations.

Appendix VI.A
Real Investment by State, 1952-1976
for All Manufacturing
($000's)

	Alabama	Arkansas	Arizona	California	Colorado	
1952	124492.7	64510.9	13550.8	554370.5	41383.8	1952
1953	117346.4	83578.6	8570.2	669419.0	31646.4	1953
1954	96990.6	50371.5	16273.6	696921.0	35520.0	1954
1955	109921.6	60899.7	18223.8	675339.1	38861.6	1955
1956	259146.1	54583.3	15174.2	834885.3	69980.5	1956
1957	307537.3	87170.6	20429.0	885549.5	53940.8	1957
1958	165144.0	48227.0	27698.0	753163.0	50713.0	1958
1959	147831.7	52579.3	33608.6	709502.9	43880.6	1959
1960	196564.6	68405.2	33706.5	752992.2	58672.5	1960
1961	161192.5	68065.8	65018.4	673749.5	57152.8	1961
1962	124019.2	72458.2	37650.3	876248.8	79809.8	1962
1963	141047.8	70223.0	47321.5	942692.8	65096.7	1963
1964	266972.6	69639.5	37127.7	976737.9	60244.1	1964
1965	345912.6	96627.0	48405.6	1099032	78724.7	1965
1966	384472.8	110440.1	71218.7	1335008	118376.6	1966
1967	340186.7	154965.0	98671.2	1372957	89423.6	1967
1968	295404.3	123574.5	91234.0	1307489	117106.4	1968
1969	311219.5	147073.2	96260.2	1399106	126097.6	1969
1970	320430.1	161904.8	89477.7	1203840	171198.2	1970
1971	260821.7	125972.1	104328.7	1039545	174834.9	1971
1972	254369.6	136103.2	142120.3	1181232	163896.8	1972
1973	331815.0	159765.4	151414.8	1323119	214354.7	1973
1974	607266.7	235733.3	164733.3	1722400	238666.7	1974
1975	680258.1	221096.8	188967.7	1659871	235483.9	1975
1976	719937.5	295437.5	114500.0	1791937	240750.0	1976

Source: Census of Manufactures, and Annual Survey of Manufactures, deflated by durable goods deflator.

Appendix VI.A
Real Investment by State, 1952-1976
for All Manufacturing
($000's)

	Connecticut	Delaware	Florida	Georgia	Idaho	
1952	178013.3	38148.9	105901.9	125503.6	30098.1	1952
1953	159944.0	32171.4	122863.1	171269.0	20021.4	1953
1954	152819.6	27564.9	123912.7	204087.3	24324.3	1954
1955	172910.0	26106.1	92667.8	226252.6	38845.4	1955
1956	206169.9	162771.6	126627.7	251099.6	33041.1	1956
1957	229334.0	60243.1	185635.3	199948.9	19554.6	1957
1958	195441.0	27926.0	152303.0	169871.0	19196.0	1958
1959	165696.7	24539.1	152927.6	171595.9	22945.2	1959
1960	192393.6	30931.0	148970.8	168245.9	36384.8	1960
1961	165580.3	56328.8	217942.9	143493.2	25142.2	1961
1962	215184.4	55512.0	184098.9	183711.8	25514.9	1962
1963	205364.6	84981.8	182408.6	193457.4	27144.5	1963
1964	210213.8	68772.0	157778.6	224500.5	42963.1	1964
1965	251073.5	65424.2	276937.7	287321.9	75595.3	1965
1966	366269.5	82397.5	278385.7	335675.1	52302.2	1966
1967	400161.6	104058.2	269976.7	380050.3	51804.6	1967
1968	341531.9	80595.7	240936.2	352510.6	36255.3	1968
1969	308455.3	62195.1	254390.2	417886.2	42195.1	1969
1970	263594.5	51843.3	290169.0	348156.7	40860.2	1970
1971	238224.5	57373.4	305942.8	373000.7	39765.2	1971
1972	237535.8	65544.4	331661.9	493481.4	53653.3	1972
1973	244789.5	78744.0	358799.2	462111.8	51897.9	1973
1974	319400.0	97933.3	490666.7	608133.3	88400.0	1974
1975	375871.0	109483.9	528516.1	443225.8	92258.1	1975
1976	299937.5	99812.5	541875.0	533062.5	99937.5	1976

Source: CM and ASM, deflated by durable goods deflator.

Appendix VI.A
Real Investment by State, 1952-1976
for All Manufacturing
($000's)

	Illinois	Indiana	Iowa	Kansas	Kentucky	
1952	748681.6	459314.8	72376.5	68116.2	156540.0	1952
1953	716735.7	507198.8	76921.4	69897.6	129770.2	1953
1954	678340.8	355244.1	91587.3	62520.0	180362.0	1954
1955	648614.8	517655.1	87963.1	74438.3	110109.6	1955
1956	889967.5	634309.5	142500.0	96760.8	129323.6	1956
1957	943236.0	665548.5	112932.6	91143.0	157103.2	1957
1958	730728.0	515295.0	103193.0	98959.0	112525.0	1958
1959	651446.2	381075.3	108773.0	75260.3	100545.0	1959
1960	698552.0	533728.9	134541.3	57882.4	111292.5	1960
1961	679185.7	367372.3	120589.0	54870.4	118052.2	1961
1962	738245.0	366894.3	104759.8	70202.7	134807.9	1962
1963	742195.2	531336.8	121485.2	101743.5	213934.0	1963
1964	865046.4	859317.9	162913.9	95898.8	154346.3	1964
1965	1067932	976809.3	171325.6	87783.3	208382.3	1965
1966	1312929	976233.2	201253.2	102879.3	262882.9	1966
1967	1340815	901777.7	207128.7	139971.3	303735.0	1967
1968	1271660	848936.2	191234.0	113787.2	314893.6	1968
1969	1213415	949918.7	217398.4	99512.2	272764.2	1969
1970	1163902	780491.6	216205.8	106528.4	237020.0	1970
1971	1083125	621496.7	192663.2	97212.0	208363.9	1971
1972	1120415	649928.4	235959.9	142693.4	272206.3	1972
1973	1172395	764113.2	225465.8	184403.0	348102.1	1973
1974	1436333	934933.3	341800.0	203600.0	366466.7	1974
1975	1437742	971483.9	444645.2	207290.3	312580.6	1975
1976	1459500	921937.5	443437.5	205187.5	326000.0	1976

Source: CM and ASM, deflated by durable goods deflator.

Appendix VI.A
Real Investment by State, 1952-1976
for All Manufacturing
($000's)

	Louisiana	Maine	Maryland	Massachusetts	Michigan	
1952	282887.4	37872.9	116946.7	218934.6	735891.0	1952
1953	291964.3	45944.0	138017.9	187157.1	843221.4	1953
1954	205655.7	69498.8	110740.6	213087.3	1026492	1954
1955	106712.8	62667.8	204877.7	224918.1	929416.4	1955
1956	176818.2	54298.7	346346.3	247629.9	1098328	1956
1957	307104.2	60415.7	276577.1	249183.9	709604.7	1957
1958	173383.0	44329.0	128085.0	228513.0	465273.0	1958
1959	137047.9	40821.9	116823.9	264048.9	522631.1	1959
1960	134963.1	53219.6	174065.1	280524.8	637389.7	1960
1961	160125.7	52359.8	189078.3	26789.2	544581.2	1961
1962	141445.7	46627.3	215110.5	275859.7	533869.4	1962
1963	201757.9	59798.1	168714.8	261227.8	729007.7	1963
1964	217759.7	66844.8	148136.2	291405.9	975040.7	1964
1965	320301.4	105580.5	208856.7	318861.4	1351550	1965
1966	442347.5	121341.2	245539.0	444422.0	1351331	1966
1967	665649.1	88705.3	225893.3	443257.3	1221225	1967
1968	517106.4	97191.5	210553.2	375148.9	1024085	1968
1969	456178.9	84227.6	252764.2	404308.9	1115122	1969
1970	361443.9	107680.5	295238.1	474731.2	999001.5	1970
1971	393617.0	88628.0	228540.0	333308.9	882098.3	1971
1972	407020.1	99498.6	222277.9	385028.7	1483811	1972
1973	486059.4	77225.7	218840.6	461697.7	1378813	1973
1974	632133.3	115466.7	292400.0	509666.7	1900467	1974
1975	751032.3	202838.7	297096.8	400258.1	1460194	1975
1976	975500.0	317125.0	263125.0	488500.0	1476937	1976

Source: CM and ASM

Appendix VI.A
Real Investment by State, 1952-1976
for All Manufacturing
($000's)

	Minnesota	Mississippi	Misouri	Montana	Nebraska	
1952	67262.7	35592.0	156565.4	13266.3	26400.7	1952
1953	114420.2	37344.0	134338.1	37953.6	42894.0	1953
1954	96919.8	43641.5	146691.0	24261.8	42941.0	1954
1955	91496.0	38177.6	166543.3	75062.3	24093.4	1955
1956	106772.7	37885.3	180033.5	90537.9	33851.7	1956
1957	104065.4	50223.7	177956.1	20427.0	76276.8	1957
1958	108521.0	67665.0	185879.0	19898.0	49906.0	1958
1959	102617.4	62524.5	171798.4	15702.5	34756.4	1959
1960	113577.3	39710.4	155196.3	17217.7	32845.5	1960
1961	135200.2	38009.7	165152.8	17572.5	39266.9	1961
1962	133922.2	104827.1	198118.2	22449.6	41844.4	1962
1963	152211.5	125551.2	201971.3	36925.4	44099.5	1963
1964	158242.2	98141.9	215244.1	39597.9	47480.6	1964
1965	148931.2	109260.5	258968.4	29085.6	53291.2	1965
1966	191046.3	170270.4	288049.9	28380.2	68531.8	1966
1967	207667.4	247979.9	311366.5	61860.3	64104.9	1967
1968	220085.1	122297.9	263404.3	30553.2	58042.6	1968
1969	248943.1	150731.7	243333.3	21382.1	77073.2	1969
1970	230414.7	210983.1	291397.9	32488.5	63748.1	1970
1971	220102.7	138664.7	266544.4	36977.3	63462.9	1971
1972	218839.5	168982.8	283596.0	54298.0	73280.8	1972
1973	228088.3	164941.3	300621.1	45755.7	74879.2	1973
1974	325800.0	213133.3	364800.0	66533.3	95533.3	1974
1975	314580.6	167290.3	392838.7	49225.8	103741.9	1975
1976	309312.5	210562.5	373437.5	53500.0	104687.5	1976

Source: CM and ASM, deflated by durable goods deflator.

Appendix VI.A
Real Investment by State, 1952-1976
for All Manufacturing
($000's)

	Nevada	New Hampshire	New Jersey	New Mexico	New York	
1952	5707.0	23141.6	376905.6	5778.5	666882.6	1952
1953	5707.1	17358.3	396356.0	4681.0	612065.5	1953
1954	5719.3	21806.6	462712.3	7765.3	685238.2	1954
1955	5952.7	24254.9	427613.6	15651.7	633109.6	1955
1956	5323.6	38769.5	532160.2	14384.2	750198.1	1956
1957	8939.7	25955.1	538799.8	20380.0	744024.5	1957
1958	5155.0	24365.0	449734.0	24545.0	792201.0	1958
1959	5391.4	24489.2	420956.0	18327.8	679940.3	1959
1960	5283.8	25601.6	456008.7	18858.1	724098.1	1960
1961	3462.3	27674.1	452263.1	10681.8	659376.2	1961
1962	5715.7	29945.2	511614.8	8802.1	728171.0	1962
1963	8277.5	28983.7	502398.1	9911.0	749814.4	1963
1964	7772.9	38361.4	475125.8	9493.9	889148.5	1964
1965	15980.5	37045.6	574494.0	11826.0	1021739	1965
1966	5745.0	65772.2	704502.7	10451.0	1076421	1966
1967	13826.5	67875.7	740079.0	9517.0	1176423	1967
1968	12085.1	45957.4	650638.3	10212.8	1142638	1968
1969	13414.6	83252.0	758699.2	15609.8	1295935	1969
1970	9984.6	56221.2	693010.8	9370.2	1166667	1970
1971	15920.8	58474.0	585766.7	32208.4	1050404	1971
1972	16833.8	70988.5	673424.1	22063.0	1078797	1972
1973	8764.7	70393.4	659282.3	40717.7	1134369	1973
1974	16200.0	69333.3	802133.3	96133.3	1465467	1974
1975	18387.1	62709.7	774322.6	114774.2	1401355	1975
1976	33125.0	86000.0	760187.5	74687.5	1439812	1976

Source: CM and ASM

Appendix VI.A
Real Investment by State, 1952-1976
for All Manufacturing
($000's)

	North Carolina	North Dakota	Ohio	Oklahoma	Oregon	
1952	17082.3	1500.0	905259.1	46334.1	97038.7	1952
1953	161203.6	1555.9	875506.0	74873.8	75448.8	1953
1954	152856.1	1915.6	908733.5	61014.2	79965.8	1954
1955	197997.7	1606.0	783778.5	52457.9	93275.7	1955
1956	210540.0	1564.0	1140206	54720.8	99748.9	1956
1957	199424.9	3724.2	1234458	60563.8	106795.7	1957
1958	191292.0	9142.0	795773.0	61927.0	123339.0	1958
1959	230365.0	2610.6	663743.6	83288.6	103147.7	1959
1960	243738.6	2347.9	783416.9	63894.1	116409.1	1960
1961	219805.6	3604.4	727529.0	43285.3	110078.3	1961
1962	282604.2	2770.4	745915.5	44658.0	104293.9	1962
1963	300888.0	7716.7	811292.8	60824.9	126329.2	1963
1964	333533.6	16093.7	1026507	58632.9	133896.9	1964
1965	475898.6	10409.3	1239051	62070.7	214429.8	1965
1966	664695.1	6402.9	1438976	64048.1	257806.7	1966
1967	596696.0	7362.2	1521009	72634.2	210271.1	1967
1968	542638.3	9106.4	1495234	71574.5	168851.1	1968
1969	614796.7	5365.9	1605772	106422.8	207804.9	1969
1970	548387.1	9447.0	1310061	112212.0	173655.9	1970
1971	594570.8	9904.6	961261.9	116214.2	170432.9	1971
1972	706876.8	14398.3	1214470	160315.2	191475.6	1972
1973	727122.2	22291.2	1338371	174948.2	229537.6	1973
1974	799400.0	20466.7	1682400	226133.3	275133.3	1974
1975	797871.0	23548.4	1393871	231161.3	283419.4	1975
1976	809125.0	30500.0	1337812	256625.0	236375.0	1976

Source: CM and ASM, deflated by durable goods deflator.

Appendix VI.A
Real Investment, By State, 1952-1976
for All Manufacturing
($000's)

	West Virginia	Wisconsin	Wyoming	
1952	113605.3	221692.5	18331.7	1952
1953	135447.6	203256.0	17170.2	1953
1954	116607.3	199790.1	8135.6	1954
1955	156278.0	200148.8	5861.6	1955
1956	213632.0	242457.8	13179.7	1956
1957	269080.7	317377.9	10649.6	1957
1958	171937.0	203747.0	6985.0	1958
1959	101300.4	196624.3	4193.7	1959
1960	122763.8	269315.8	11145.8	1960
1961	110063.8	220416.8	10132.5	1961
1962	161031.7	245246.9	4063.4	1962
1963	165552.2	268578.9	13369.4	1963
1964	170622.5	289310.3	13541.2	1964
1965	184738.6	329136.7	8744.2	1965
1966	226265.0	432380.2	15145.2	1966
1967	241515.5	454839.3	6823.5	1967
1968	179234.0	393106.4	7574.5	1968
1969	160975.6	384715.4	7317.1	1969
1970	193471.6	359523.8	3609.8	1970
1971	177036.0	298165.8	4622.2	1971
1972	154727.8	383452.7	16762.2	1972
1973	159213.3	487508.6	10766.0	1973
1974	199733.3	595266.7	11466.7	1974
1975	234774.2	568000.0	13677.4	1975
1976	180500.0	570687.5	19062.5	1976

Source: CM and ASM

Appendix VI.B
Capital Stock Values, By State, 1952-1976
for All Manufacturing, δ = 1958-1962[a]
($000's)

	Alabama	Arkansas	Arizona	California	Colorado	
1952	1203151	353100.2	131188.1	4147772	258808.7	1952
1953	1288012	427498.2	138446.5	4725940	290248.1	1953
1954	1350227	466754.7	153335.6	5318890	325535.9	1954
1955	1423692	515518.7	170026.0	5877213	364137.1	1955
1956	1644398	556698.6	183500.0	6582800	433826.3	1956
1957	1907537	629395.0	202094.0	7323528	487420.0	1957
1958	2021177	661257.7	227771.1	7915573	537743.1	1958
1959	2114437	696644.3	259102.0	8450934	581193.5	1959
1960	2253912	746936.8	290217.5	9018005	639401.0	1960
1961	2354249	795582.2	352333.7	9493359	696042.3	1961
1962	2414703	847355.2	386460.7	10160753	775295.3	1962
1963	2490554	895547.0	429917.6	10879909	839771.7	1963
1964	2690282	941902.3	462746.1	11617289	899343.9	1964
1965	2963557	1014040	506524.2	12460740	977349.1	1965
1966	3268014	1098115	572677.7	13521612	1094944	1966
1967	3519964	1224529	665622.1	14597094	1183491	1967
1968	3720329	1316266	750200.0	15583447	1299651	1968
1969	3931100	1429116	838958.1	16639717	1424709	1969
1970	4145390	1553864	920046.3	17477483	1594767	1970
1971	4294286	1639435	1015174	18132523	1768326	1971
1972	4432710	1732913	1147143	18914840	1930808	1972
1973	4644842	1847623	1287086	19821832	2143619	1973
1974	5126698	2035318	1438949	21108152	2380570	1974
1975	5668535	2203496	1613527	22303643	2614150	1975
1976	6235422	2441643	1711892	23604900	2852808	1976

[a]Source: Census of Manufactures and Annual Survey of Manufacturers, based on average depreciation rate from 1957 to 1962.

Appendix VI.B
Capital Stock Values, By State, 1952-1976
for All Manufacturing, δ = 1958-1962
($000's)

	Connecticut	Delaware	Florida	Georgia	Idaho	
1952	1613233	324034.2	603713.7	603351.1	134118.6	1952
1953	1713488	351345.2	725973.1	769793.3	149177.6	1953
1954	1802908	373639.9	849159.9	967722.2	167982.3	1954
1955	1909111	394141.4	940978.6	1186233	200612.4	1955
1956	2044644	551000.9	1066665	1427843	226230.9	1956
1957	2198326	602979.0	1251234	1616369	237415.0	1957
1958	2312429	621860.3	1402286	1773309	247826.6	1958
1959	2392566	637071.6	1553811	1930718	261602.3	1959
1960	2496434	658446.5	1701228	2083519	288307.8	1960
1961	2569647	704898.6	1917470	2210344	302782.6	1961
1962	2689754	749837.1	2099651	2376373	317094.5	1962
1963	2795598	823571.4	2279960	2550819	332506.5	1963
1964	2902375	879989.8	2435459	2754913	363166.9	1964
1965	3046060	932214.2	2709961	3020196	425325.1	1965
1966	3299626	1000628	2985637	3331709	461890.2	1966
1967	3577701	1089677	3252628	3685106	496604.9	1967
1968	3786858	1153928	3490311	4008136	514485.9	1968
1969	3955200	1198814	3741211	4393957	537645.0	1969
1970	4072452	1232675	4027639	4706962	558612.4	1970
1971	4159996	1271558	4329554	5042307	577708.9	1971
1972	4243612	1318029	4656887	5495450	609987.0	1972
1973	4331387	1377003	5011029	5913598	639315.3	1973
1974	4490526	1454281	5496685	6474422	704060.7	1974
1975	4700248	1541951	6019704	6865853	770268.5	1975
1976	4826276	1618634	6555559	7343989	841706.1	1976

Source: CM and ASM.

Appendix VI.B
Capital Stock Values, By State, 1952-1976
for All Manufacturing, δ = 1958-1962
($000's)

	Illinois	Indiana	Iowa	Kansas	Kentucky	
1952	5142244	2958982	586685.5	432269.9	561618.9	1952
1953	5725282	3424755	661846.8	491793.0	688019.4	1953
1954	6254765	3732053	751448.6	542510.1	864253.4	1954
1955	6740756	4197459	837157.3	603928.1	969177.4	1955
1956	7455464	4773004	977145.8	686194.7	1092686	1956
1957	8204858	5371731	1087147	760869.0	1243233	1957
1958	8722260	5811822	1187079	841567.1	1348299	1958
1959	9146927	6111532	1292290	896629.8	1440754	1959
1960	9607659	6559699	1422955	932993.1	1543402	1960
1961	10037045	6835235	1539275	965471.7	1652194	1961
1962	10514327	7106436	1639417	1012503	1777088	1962
1963	10983150	7538283	1755984	1089947	1980360	1963
1964	11562634	8292065	1913630	1159687	2122824	1964
1965	12329937	9152785	2079214	1219637	2318469	1965
1966	13322288	10000879	2274230	1293245	2567441	1966
1967	14316724	10762645	2474536	1402179	2855772	1967
1968	15216149	11460904	2658346	1482314	3153531	1968
1969	16033943	12250370	2867770	1546250	3407374	1969
1970	16780962	12859356	3075372	1615669	3623949	1970
1971	17427783	13300821	3258809	1674105	3810569	1971
1972	18095076	13764538	3484993	1776620	4059912	1972
1973	18796998	14335948	3700004	1918384	4383655	1973
1974	19744610	15070178	4030704	2075943	4723820	1974
1975	20668992	15830679	4463257	2233410	5008057	1975
1976	21591098	16530987	4893305	2384996	5304009	1976

Source: CM and ASM.

Appendix VI.B
Capital Stock Values, By State, 1952-1976
for All Manufacturing, δ = 1958-1962
($000's)

	Louisiana	Maine	Maryland	Massachusetts	Michigan	
1952	1240040	311685.9	1004442	2212515	4597464	1952
1953	1498523	357006.6	1134425	2308959	5302762	1953
1954	1663719	425791.4	1236090	2427379	6170170	1954
1955	1725511	487607.6	1431079	2552774	6914482	1955
1956	1855741	540931.1	1765977	2695740	7805375	1956
1957	2112740	600265.0	2028426	2834399	8280819	1957
1958	2229079	643393.5	2140284	2946702	8497667	1958
1959	2305942	682928.6	2239985	3089936	8765369	1959
1960	2378644	734782.4	2396130	3243773	9139797	1960
1961	2474547	785672.6	2566040	3137568	9410184	1961
1962	2549180	830728.5	2760622	3284787	9661748	1962
1963	2682110	888865.1	2907252	3411339	10100903	1963
1964	2827452	953932.3	3032130	3562880	10772917	1964
1965	3071413	1057605	3216730	3735663	11801279	1965
1966	3430832	1176831	3436535	4026923	12798572	1966
1967	4003849	1263183	3634936	4305076	13635840	1967
1968	4412851	1357848	3816410	4503717	14250850	1968
1969	4749883	1439360	4038643	4723373	14938446	1969
1970	4983080	1544161	4301572	5004446	15489295	1970
1971	5242154	1629701	4495699	5132573	15906714	1971
1972	5507636	1725940	4682011	5307166	16913324	1972
1973	5844989	1799714	4863396	5551270	17784737	1973
1974	6319307	1911581	5116889	5833334	19151661	1974
1975	6899718	2110597	5373050	5994426	20037305	1975
1976	7688926	2423501	5593191	6237154	20913124	1976

Source: CM and ASM.

Appendix VI.B
Capital Stock Values, By State, 1952-1976
for All Manufacturing, δ = 1958-1962
($000's)

	Minnesota	Mississippi	Missouri	Montana	Nebraska	
1952	971167.6	284495.7	1346200	50596.8	210686.1	1952
1953	1061309	317572.3	1453614	88297.4	249562.4	1953
1954	1131696	356450.3	1571233	112117.7	287512.2	1954
1955	1194899	389281.1	1706352	186619.4	305855.4	1955
1956	1271800	421327.2	1852258	276224.2	333590.0	1956
1957	1344070	465231.0	1993169	295270.0	403195.0	1957
1958	1418989	525917.5	2139185	313691.6	445037.1	1958
1959	1486132	580553.2	2268199	327825.7	470892.7	1959
1960	1562556	611555.3	2378032	343404.3	494320.3	1960
1961	1658692	640391.7	2495624	359259.8	523700.9	1961
1962	1751147	735612.9	2643829	379913.1	555071.2	1962
1963	1859580	850129.9	2792924	414938.9	568069.3	1963
1964	1971333	935519.9	2952310	452462.1	623788.5	1964
1965	2070980	1030748	3152232	479285.3	664603.9	1965
1966	2210252	1185557	3377237	505269.1	719843.6	1966
1967	2362663	1415753	3621059	564603.1	769551.6	1967
1968	2523682	1516815	3812042	592333.3	812203.1	1968
1969	2709533	1644794	3979134	610753.7	873032.2	1969
1970	2872209	1831106	4190950	640188.4	919319.6	1970
1971	3020507	1942304	4373675	673964.7	964396.2	1971
1972	3163834	2082152	4569797	724892.9	1018389	1972
1973	3312826	2215861	4779022	767024.1	1072900	1973
1974	3555805	2395756	5048242	829722.3	1146976	1974
1975	3781491	2527110	5340116	874799.5	1227778	1975
1976	3996266	2699766	5606751	923925.5	1307910	1976

Source: CM and ASM.

Appendix VI.B
Capital Stock Values, By State, 1952-1976
for All Manufacturing, δ = 1958-1962
($000's)

	Nevada	New Hampshire	New Jersey	New Mexico	New York	
1952	36019.2	193834.9	3263857	4368.7	6262580	1952
1953	41366.2	208091.9	3604728	8687.1	6642930	1953
1954	46671.9	226569.0	4006160	15731.4	7082380	1954
1955	52157.8	247198.8	4365669	30077.3	7453441	1955
1956	56959.9	282013.1	4823613	41965.1	7927862	1956
1957	65330.0	303456.0	5280411	58862.0	8378556	1957
1958	69831.7	322965.7	5640378	78521.5	8860750	1958
1959	74524.8	342287.5	5965448	90332.0	9212843	1959
1960	79063.3	362412.4	6320044	101692.5	9596066	1960
1961	81734.9	384287.9	6664866	103933.9	9900388	1961
1962	86633.3	408084.6	7063178	104109.5	10262244	1962
1963	94044.4	430538.9	7445502	105379.4	10632356	1963
1964	100876.9	462011.7	7794054	106126.7	11128107	1964
1965	115848.6	491665.1	8236050	109144.3	11738106	1965
1966	120435.1	549570.7	8800539	110536.3	12380217	1966
1967	133057.3	608653.3	9391009	110878.8	13098572	1967
1968	143811.9	644872.3	9882000	111888.6	13756563	1968
1969	155788.4	717806.4	10472705	118211.6	14543505	1969
1970	164215.1	762542.7	10987680	117770.2	15172062	1970
1971	178493.8	808816.0	11386656	140203.7	15661100	1971
1972	193542.6	866863.4	11866507	150629.8	16160436	1972
1973	200371.9	923387.0	12324059	178845.3	16696868	1973
1974	214568.1	977946.2	12916683	260134.4	17544551	1974
1975	230809.6	1025009	13471422	353317.5	18296757	1975
1976	261626.5	1094609	14002596	398679.6	19059590	1976

Source: CM and ASM.

Appendix VI.B
Capital Stock Values, By State, 1952-1976
for All Manufacturing, δ = 1958-1962
($000's)

	North Carolina	North Dakota	Ohio	Oklahoma	Oregon	
1952	1395789	49540.3	8751969	334899.7	652653.4	1952
1953	1543034	49610.0	8962326	406089.7	713743.8	1953
1954	1680460	50037.3	9189922	462636.8	778007.3	1954
1955	1861653	50142.2	9275267	510005.7	854166.8	1955
1956	2053577	50201.8	9710552	559116.4	935124.0	1956
1957	2232466	52420.0	10207008	613530.0	1021347	1957
1958	2401433	59989.4	10227048	668708.2	1122216	1958
1959	2607784	60800.3	10113536	744641.0	1200675	1959
1960	2825445	61324.2	10128324	800344.1	1290670	1960
1961	3016996	63088.9	10086101	834825.6	1372353	1961
1962	3269430	63966.7	10065473	870300.5	1446455	1962
1963	3537624	69764.4	10111789	921552.1	1540962	1963
1964	3835781	83765.1	10369800	970047.9	1640958	1964
1965	4273322	91661.5	10820747	1021448	1819287	1965
1966	4895284	95314.5	11437346	1074260	2037069	1966
1967	5443027	99817.3	12089117	1135078	2202525	1967
1968	5931235	105929.2	12665578	1194166	2322920	1968
1969	6486720	108117.1	13308767	1287453	2479621	1969
1970	6970239	114320.6	13607362	1385503	2598725	1970
1971	7495108	120795.6	13534464	1486477	2711986	1971
1972	8127033	131570.0	13720315	1630441	2843798	1972
1973	8772885	149914.2	14015942	1787454	3010772	1973
1974	9484556	165883.4	14633131	1993925	3219668	1974
1975	10187582	184455.3	14914884	2203154	3432255	1975
1976	10894831	209421.6	15119165	2435544	3593120	1976

Source: CM and ASM.

Appendix VI.B
Capital Stock Values, By State, 1952-1976
for All Manufacturing, δ = 1958-1962
($000's)

	Pennsylvania	Rhode Island	South Carolina	S. Dakota	Tennessee	
1952	7115589	424570.3	1273792	60684.4	984309.8	1952
1953	7881622	447638.7	1266161	60268.7	1154797	1953
1954	8454743	462364.0	1263059	60050.9	1320350	1954
1955	9035395	479230.5	1281999	59826.5	1438707	1955
1956	9763399	501430.3	1314155	59487.9	1636122	1956
1957	10525659	517367.0	1351223	57822.0	1833335	1957
1958	11110414	526567.3	1344415	58927.6	2013714	1958
1959	11536071	537909.7	1356084	63433.6	2141968	1959
1960	12100846	551668.3	1413626	66247.6	2314491	1960
1961	12552707	572591.9	1481200	71440.5	2463953	1961
1962	13012980	597170.5	1549474	81562.3	2611152	1962
1963	13470886	614534.4	1627047	82794.3	2803725	1963
1964	13959649	634599.2	1743525	86179.0	3042859	1964
1965	14652464	659637.5	1900313	90210.0	3356728	1965
1966	15621836	701348.2	2147542	90782.4	3766422	1966
1967	16744667	740451.7	2390576	91699.0	4076423	1967
1968	17731177	788706.0	2586028	94294.8	4420817	1968
1969	18599058	822930.1	2720069	92965.7	4775694	1969
1970	19397866	845850.1	2838707	95812.2	5089221	1970
1971	20062749	870710.2	3031870	98914.1	5396422	1971
1972	20681039	907873.1	3209963	106289.5	5696898	1972
1973	21309010	932772.9	3425405	121034.2	6070551	1973
1974	22203545	973128.6	3782188	132907.4	6597023	1974
1975	23002550	1011300	4072120	147019.4	7024438	1975
1976	23746807	1060473	4366221	167081.0	7400360	1976

Source: CM and ASM.

Appendix VI.B
Capital Stock Values, By State, 1952-1976
for All Manufacturing, δ = 1958-1962
($000's)

	Texas	Utah	Vermont	Virginia	Washington	
1952	3002963	253815.5	146102.9	880639.8	942551.4	1952
1953	3552731	271429.5	149408.9	1028875	1071666	1953
1954	4057605	298734.7	151658.4	1144055	1222663	1954
1955	4429982	340511.0	154782.0	1305143	1427998	1955
1956	4953566	390395.6	158895.6	1477070	1638974	1956
1957	5698598	424377.0	172281.0	1675727	1846183	1957
1958	6212794	455263.6	174403.5	1798730	1967858	1958
1959	6529531	483662.6	181242.9	1890915	2040065	1959
1960	6918562	515983.6	184839.1	2011310	2137160	1960
1961	7426219	550222.9	192872.2	2156190	2228761	1961
1962	7864694	588083.8	201447.7	2301707	2361069	1962
1963	8273831	615822.1	205370.9	2491288	2448725	1963
1964	8838586	637000.9	213689.5	2716883	2565093	1964
1965	9624288	659739.8	235485.5	2984070	2737571	1965
1966	10563907	707307.8	253471.1	3282364	3059545	1966
1967	11649180	759751.9	271044.0	3547957	3412515	1967
1968	12719399	792183.6	289923.8	3784924	3659660	1968
1969	13714795	832610.9	315604.0	4048114	3831669	1969
1970	14725192	876555.6	349781.9	4294358	3990068	1970
1971	15579999	928430.3	367007.5	4553606	4173701	1971
1972	16279108	976140.9	373183.2	4909483	4339420	1972
1973	17061024	1024026	381988.7	5265250	4556298	1973
1974	18794920	1119535	407179.3	5714537	4833949	1974
1975	20929987	1203319	434203.8	6068082	5253726	1975
1976	23554240	1290803	470072.6	6550253	5557273	1976

Source: CM and ASM.

Appendix VI.B
Capital Stock Values, By State, 1952-1976
for All Manufacturing, δ = 1958-1962
($000's)

	West Virginia	Wisconsin	Wyoming	
1952	729920.2	2100527	165865.3	1952
1953	860988.3	2234466	175074.0	1953
1954	972429.7	2360519	174806.1	1954
1955	1122873	2482770	172277.0	1955
1956	1329768	2643297	177187.3	1956
1957	1590870	2873446	179332.0	1957
1958	1753262	2982369	177709.1	1958
1959	1844043	3080575	173372.8	1959
1960	1955742	3248232	176196.6	1960
1961	2054072	3361457	177871.7	1961
1962	2202779	3495776	173397.3	1962
1963	2355114	3648994	178443.6	1963
1964	2511606	3817888	183419.4	1964
1965	2681275	4021034	183359.5	1965
1966	2891452	4320720	189703.4	1966
1967	3115619	4632976	187421.1	1967
1968	3276159	4873194	185999.4	1968
1969	3417478	5097094	184388.5	1969
1970	3590445	5288414	179147.7	1970
1971	3745938	5412062	175170.7	1971
1972	3878190	5616917	183524.7	1972
1973	4014134	5919067	185481.6	1973
1974	4189783	6319004	188045.1	1974
1975	4399418	6678477	192696.4	1975
1976	4553522	7028775	202509.5	1976

Source: CM and ASM.

Appendix VII

Machinery Industry
Real Investment, By Year,
for States Included in Machinery Industry Analysis
($000's)

	Arkansas	California	Colorado	Connecticut	
1963	1318.7	49444.0	2283.3	28756.0	1963
1964	1343.4	52177.9	1749.3	30196.8	1964
1965	1517.2	67253.0	9971.2	38346.0	1965
1966	4314.0	94987.3	29942.8	62214.2	1966
1967	2693.5	138893.9	11222.8	63296.8	1967
1968	2212.8	116851.1	15659.6	58638.3	1968
1969	4227.6	123658.5	10325.2	50894.3	1969
1970	3302.6	132565.3	13210.4	38402.5	1970
1971	5209.1	113939.8	14967.0	29200.3	1971
1972	3868.2	110816.6	12535.8	29369.6	1972

	Florida	Georgia	Illinois	Indiana	Iowa	
1963	3004.8	3576.1	32524.4	79646.9	20498.6	1963
1964	6414.4	2516.6	118562.0	31434.2	28822.1	1964
1965	4192.6	4557.2	174763.7	50299.5	37079.1	1965
1966	8075.3	2428.3	166499.1	55740.5	40232.3	1966
1967	14006.1	6464.4	161608.9	61591.0	62488.8	1967
1968	16510.6	5106.4	148936.2	48085.1	38553.2	1968
1969	17642.3	6991.9	140650.4	46829.3	29187.0	1969
1970	21428.6	4838.7	149616.0	48771.1	41397.8	1970
1971	17314.7	10564.9	140278.8	41159.2	28833.5	1971
1972	13753.6	8882.5	137894.0	56303.7	47134.7	1972

Source: Census of Manufactures and Annual Survey of Manufactures.

Appendix VII

Machinery Industry
Real Investment, By Year,
for States Included in Machinery Industry Analysis
($000's)

	Kentucky	Louisiana	Maryland	Massachusetts	Michigan	
1958	13051.0					
1959	5625.2					
1960	6165.2					
1961	7879.1					
1962	11446.7					
1963	11749.3	1716.7	5882.3	30347.4	63519.6	1963
1964	16550.6	1913.0	4873.2	30304.6	78734.2	1964
1965	16068.8	2090.2	11049.3	33632.6	103581.4	1965
1966	28030.9	3076.2	12059.9	54265.0	127982.8	1966
1967	22266.1	3681.1	11492.2	48572.5	153438.7	1967
1968	23914.9	2297.9	10212.8	44510.6	122212.8	1968
1969	21544.7	3089.4	9024.4	51707.3	123577.2	1969
1970	24500.8	6605.2	17357.9	69585.3	96467.0	1970
1971	28026.4	4548.8	73.4	45267.8	64049.9	1971
1972	39613.2	6088.8	13395.4	55229.2	80014.3	1972

Source: CM and ASM.

Appendix VII

Machinery Industry
Real Investment, By Year,
for States Included in Machinery Industry Analysis
($000's)

	Minnesota	Missouri	Nebraska	New Hampshire	New Jersey	
1963	30063.2	11424.9	1354.1	3757.9	26938.8	1963
1964	22081.4	13268.7	656.6	4091.8	31614.9	1964
1965	30526.5	13584.2	3887.4	2780.5	37893.0	1965
1966	34187.8	13294.0	4205.1	8363.0	36424.7	1966
1967	38696.4	31244.4	6284.8	11133.1	56742.7	1967
1968	33021.3	15319.1	9361.7	5531.9	42978.7	1968
1969	45365.9	14146.3	12276.4	5528.5	52439.0	1969
1970	40629.8	22503.8	10906.3	7680.5	37711.2	1970
1971	38077.8	14159.9	8657.4	11151.9	31401.3	1971
1972	35601.7	15257.9	9455.6	14469.9	48137.5	1972

Source: CM and ASM.

Appendix VII

Machinery Industry
Real Investment, By Year,
for States Included in Machinery Industry Analysis
($000's)

	New York	North Carolina	Ohio	Oklahoma	Oregon	
1957	117482.1		130668.0			
1958	70081.0		82601.0	3320.0		
1959	58994.1		68369.9	2116.4		
1960	78186.6		88237.1	2949.5		
1961	76525.1		67940.0	1624.8		
1962	66767.5		72779.1	3513.0		
1963	71670.8	3785.6	79646.9	5330.1	2014.4	1963
1964	89469.3	8085.1	108012.3	11522.2	2142.9	1964
1965	123608.4	7760.9	128704.2	7456.7	5430.7	1965
1966	114539.9	3081.7	156993.6	11794.9	5700.5	1966
1967	118962.1	24241.3	161608.9	9696.5	6374.6	1967
1968	98723.4	41872.3	153191.5	10383.0	2553.2	1968
1969	140406.5	2195.1	160000.0	12113.8	3008.1	1969
1970	103763.4	4761.9	137327.2	10445.5	7987.7	1970
1971	91049.2	25311.8	113059.4	7997.1	4035.2	1971
1972	113681.9	35530.1	131948.4	31518.6	4011.5	1972

Source: CM and ASM.

Appendix VII

Machinery Industry
Real Investment, By Year,
for States Included in Machinery Industry Analysis
($000's)

	Pennsylvania	Rhode Island	South Carolina	Tennessee	Texas	
1963	64635.4	3407.7	4536.8	6138.8	17085.2	1963
1964	74289.5	8425.7	4309.4	4734.2	27357.6	1964
1965	79562.8	5368.4	9191.6	7991.6	29551.6	1965
1966	77562.6	14490.0	1681.5	9971.9	35413.8	1966
1967	128568.9	6464.4	8619.1	20919.4	41120.5	1967
1968	116510.6	8595.7	8085.1	22893.6	47829.8	1968
1969	136991.9	6260.2	7479.7	14308.9	12113.8	1969
1970	108064.5	2918.6	20890.9	12826.4	52688.2	1970
1971	89361.7	2934.7	53191.5	19956.0	49816.6	1971
1972	78151.9	3939.8	26289.4	17836.7	49283.7	1972

	Vermont	Virginia	Washington	West Virginia	Wisconsin	
1963	2699.5	3836.4	2882.3	1638.3	39023.0	1963
1964	2357.6	3784.3	2456.0	1123.9	42487.2	1964
1965	2763.7	5137.7	2793.5	1104.2	59193.5	1965
1966	3311.3	488.2	3980.9	1249.5	102925.6	1966
1967	4758.5	7362.2	6913.3	2603.7	105315.1	1967
1968	3659.6	7404.3	5191.5	2723.4	78042.6	1968
1969	6991.9	12601.6	3902.4	2195.1	79918.7	1969
1970	3840.2	8679.0	4070.7	1152.1	50998.5	1970
1971	2201.0	9317.7	2347.8	4182.0	50110.1	1971
1972	4298.0	9169.1	3868.2	2722.1	57235.0	1972

Source: CM and ASM.

Appendix VIII

Textile Industry Real Investment, By Year
For States Included in Textile Industry Analysis

($000's)

	Alabama	Arkansas	Connecticut	Delaware	Georgia	
1956	10822.5				37252.2	1956
1957	12692.5				35028.6	1957
1958	7023.0				27795.0	1958
1959	10239.7	1113.5		1113.5	34904.1	1959
1960	15408.2	832.8		832.8	36609.3	1960
1961	17425.5	1108.3		1108.3	39264.0	1961
1962	6449.6	1635.0		1635.0	48219.0	1962
1963	16712.8	2089.3	5022.1	2089.3	35558.1	1963
1964	22589.5	2076.6	4186.6	2076.6	76824.9	1964
1965	37605.5	2381.3	5987.7	2381.3	76823.1	1965
1966	36306.7	2018.1	6635.2	2018.1	104702.4	1966
1967	39235.1	3142.4	7811.1	3142.4	105674.3	1967
1968	31148.9	2468.1	5361.7	2468.1	97702.1	1968
1969	28617.9	5203.3	6910.6	5203.3	117235.8	1969
1970	28548.2	3533.0	7526.9	3533.0	94316.4	1970
1971	25898.8	6896.6	11005.1	6896.6	68965.5	1971
1972	29942.7	3796.6	8166.2	3796.6	89613.2	1972

Source: Census of Manufactures and Annual Survey of Manufactures, deflated by durable goods price index.

Appendix VIII

Textile Industry Real Investment, By Year
For States Included in Textile Industry Analysis
($000's)

	Illinois	Indiana	Kentucky	Maine	Maryland	
1963	3216.1	67.2	806.9	3390.0	566.8	1963
1964	1832.5	443.1	1050.7	2421.1	707.2	1964
1965	1427.6	349.1	2180.7	3850.5	2159.9	1965
1966	1936.5	310.3	3354.8	3780.4	349.4	1966
1967	1795.7	179.6	1616.1	3860.7	1346.7	1967
1968	1446.8	425.5	13276.6	4000.0	1021.3	1968
1969	3252.0	325.2	11463.4	3983.7	975.6	1969
1970	3149.0	460.8	7834.1	4685.1	1305.7	1970
1971	3154.8	1394.0	2567.9	7116.7	1100.5	1971
1972	3008.6	286.5	2507.2	6805.2	644.7	1972

	Massachusetts	Michigan	Mississippi	Missouri	New Hampshire	
1963	13265.3	1314.1	1356.4	676.3	2043.2	1963
1964	11509.1	1951.2	2146.4	267.9	3173.2	1964
1965	16677.4	3253.5	5492.0	561.0	2768.2	1965
1966	20234.1	6726.0	4589.8	553.5	2906.5	1966
1967	10594.4	3322.0	1975.2	448.9	5387.0	1967
1968	15319.1	2553.2	1872.3	595.7	4595.7	1968
1969	16504.1	3252.0	4146.3	1463.4	4390.2	1969
1970	11520.7	2611.4	7450.1	537.6	5222.7	1970
1971	2127.7	1907.6	5355.8	220.1	3888.5	1971
1972	19914.0	1432.7	4727.8	143.3	3653.3	1972

Source: CM and ASM, deflated by durable goods price index.

Appendix VIII

Textile Industry Real Investment, By Year

For States Included in Textile Industry Analysis

($000's)

	New Jersey	New York	N. Carolina	Ohio	Pennsylvania	
1956		17508.7		7214.3		1956
1957		15263.5		3466.8		1957
1958		16622.0		2605.0		1958
1959		13612.5		2935.4		1959
1960		14665.7		2915.5		1960
1961		14952.6		4092.8		1961
1962		13411.1		2172.9		1962
1963	10852.1	15440.9	103845.3	5480.3	18083.6	1963
1964	8840.2	15698.6	133076.6	3382.8	23086.1	1964
1965	11838.2	22255.4	182439.0	7139.1	27015.1	1965
1966	13775.0	23013.6	280279.5	10701.5	28689.7	1966
1967	14006.1	25677.9	199946.1	6195.0	25318.7	1967
1968	13702.1	23659.6	177617.0	3489.4	28766.0	1968
1969	18699.2	19187.0	198211.4	5284.6	38861.8	1969
1970	19892.5	18433.2	178264.2	4685.1	33026.1	1970
1971	26833.5	39104.9	198752.8	3081.4	35143.1	1971
1972	31733.5	42908.3	276790.8	6733.5	36533.0	1972

Source: CM and ASM, deflated by durable goods price index.

Appendix VIII

Textile Industry Real Investment, By Year

For States Included in Textile Industry Analysis
($000's)

	Rhode Island	S. Carolina	Tennessee	Texas	Virginia	Wisconsin
1956		52145.0			14661.3	
1957		44870.3			12731.4	
1958		30349.0			7033.0	
1959		46390.4			10662.4	
1960		62650.1			13604.5	
1961		52302.7			14407.2	
1962		76414.0			15270.9	
1963	6526.4	84161.4	10078.8	4770.4	15643.6	1080.7
1964	6134.9	109467.9	12643.1	2394.3	22539.7	1984.7
1965	8222.3	126015.1	13212.9	4579.9	33569.5	2041.6
1966	11945.6	174835.8	17880.2	7784.9	32132.5	3047.2
1967	9517.0	137816.5	14724.4	4578.9	22984.4	3142.4
1968	17021.3	68085.1	26468.1	13531.9	29872.3	2723.4
1969	21056.9	95609.8	28861.8	2764.2	26829.3	3739.8
1970	6758.8	104377.9	20890.9	1536.1	19662.1	5376.3
1971	7703.6	96845.2	24871.6	5942.8	24578.1	2567.9
1972	10530.1	115902.6	16045.8	2865.3	56876.8	1790.8

Source: CM and ASM, deflated by durable goods price index.

Appendix IX

Durable Goods Price Deflator

For Years 1952 to 1976

Year	Deflator
1952	.826
1953	.840
1954	.848
1955	.867
1956	.924
1957	.979
1958	1.000
1959	1.022
1960	1.029
1961	1.034
1962	1.041
1963	1.045
1964	1.057
1965	1.075
1966	1.102
1967	1.114
1968	1.175
1969	1.230
1970	1.302
1971	1.363
1972	1.396
1973	1.449
1974	1.500
1975	1.550
1976	1.600

Source: Historical Statistics of United States, part I: 1975, and Survey of Current Business. 54,7:1974.

Appendix X
Trend-Adjusted Severity of Recessions in National Industries
(Percentages)

Industry	1953-54	1957-58	1960-61	1969-70	1973-75
MINING	4.631	4.669	3.270	-.002	-.017
CONST	1.487	7.017	4.770	2.313	5.586
SIC20	.914	1.475	.405	.785	2.151
SIC21	4.123	4.311	1.639	7.810	5.195
SIC22	3.873	4.303	3.282	1.823	11.143
SIC23	4.343	4.211	3.307	1.626	9.446
SIC24	13.231	6.838	5.684	3.319	10.741
SIC25	5.660	5.329	5.912	3.168	11.111
SIC26	1.545	2.746	1.310	3.573	8.879
SIC27	.624	.195	.142	1.366	1.585
SIC28	2.445	2.403	1.240	.920	3.148
SIC29	.709	-.004	1.381	.731	2.962
SIC30	1.171	6.757	1.351	4.484	13.535
SIC31	3.881	5.450	1.029	1.338	9.789
SIC32	4.561	5.874	4.938	1.581	5.113
SIC33	8.273	10.414	7.389	6.554	6.989
SIC34	5.136	6.877	5.254	3.773	6.376
SIC35	5.231	8.966	3.846	3.712	4.578
SIC36	6.407	7.409	3.428	2.729	6.714
SIC37	10.393	9.467	5.838	15.831	6.604
SIC38	4.786	5.412	3.488	3.156	4.887
SIC39	4.595	3.336	3.343	2.764	6.682
TRANSP	2.414	3.085	1.560	1.916	1.716
TRADE	1.543	2.253	1.252	.386	.455
FINANC	.086	-.000	-.002	.000	-.005
SERVIC	.263	.303	-.005	.003	-.031
GOVERN	1.111	.001	-.002	.000	.328

Source: Bureau of Labor Statistics Data. See Chapter Four for a description of calculations.

Appendix XI

Trend-Adjusted Severity of National Recessions for Machinery Industry, at the 3-digit SIC Category, for 1973-75 and 1969-70

Industry[a]	1973-75 Recession	1969-70 Recession
SIC 351	4.70	1.96
SIC 352	5.35	2.00
SIC 353	1.30	2.43
SIC 354	4.53	5.54
SIC 355	4.87	1.87
SIC 356	3.22	2.78
SIC 357	3.05	2.97
SIC 358	10.50	4.04
SIC 359	3.35	2.00

Source: Bureau of Labor Statistics.

[a]See Chapter 4 for description of categories.

Appendix XII

Trend-Adjusted Severity of National Recessions for Machinery Industry, at the 3-digit SIC Category, for 1973-75 and 1969-70

Industry[a]	1973-75 Recession	1969-70 Recession
SIC 221	7.72	1.43
SIC 222	7.51	1.88
SIC 223	8.37	8.27
SIC 224	13.57	2.73
SIC 225	6.14	1.86
SIC 226	8.70	1.18
SIC 227	8.70	1.73
SIC 228	11.99	.91
SIC 229	7.23	2.65

Source: Bureau of Labor Statistics.

[a]See Chapter 4 for description of categories.

BIBLIOGRAPHY

Advisory Commission on Intergovernmental Relations (1980) Regional Growth: Flows of Federal Funds, 1952-76 (June). Washington, D.C.: Government Printing Office.

Advisory Commission on Intergovernmental Relations (1980) Regional Growth: Historic Perspective. A-74 (June). Washington, D.C.: Government Printing Office.

Airov, Joseph (1963) "The Construction of Interregional Business Cycle Models." Journal of Regional Science 5,1:1-20.

Baumol, W.J. (1972) Economic Theory and Operations Analysis. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

Beare, John (1976) "A Monetarist Model of Regional Business Cycles." Journal of Regional Science 16,1:57-63.

Bednarzik, R.W. (1975) "The Plunge of Employment During the Recent Recession." Monthly Labor Review 98,12 (December):3-10.

Bell, F.W. (1964) "The Role of Capital-Labor Substitution in the Economic Adjustment of an Industry Across Regions." The Southern Economic Journal 31,1 (July):123-131.

Blalock, H.M., Jr. (1960) Social Statistics. New York: McGraw-Hill Book Company.

Blumenfeld, Hans (1955) "The Economic Base of the Metropolis." Journal of The American Institute of Planners 21,4:114-132.

Bolton, Roger (1978) "Review of the Literature on Regional Econometric Models and Regional Business Cycles." Unpublished Paper. Williamstown: Williams College.

Borts, George H. (1960) "Regional Cycles of Manufacturing Employment in the United States, 1914-1953." Journal of American Statistical Association 55,289 (March):151-211.

Brechling, F. (1967) "Trends and Cycles in British Regional Unemployment." Oxford Economic Papers 19,1 (March):1-21.

Bretzfelder, R. (1973) "Sensitivity of State and Regional Income to National Business Cycles." Survey of Current Business 53,4 (April):22-27.

Bretzfelder, R. and H. Friedenberg (1979) "State Differences in Nonfarm Personal Income Growth in the Current Business Cycle." Survey of Current Business 59,4 (April):23-24.

Browne, Lynne (1978) "Regional Industry Mix and the Business Cycle." New England Economic Review (November/December):35-53.

Burns, Arthur (1969) The Business Cycle in a Changing World. New York: National Bureau of Economic Research.

Caramela, E.J. (1974) "Wages Up, Employment Trend Mixed in Nonelectrical Machinery." Monthly Labor Review 97,11 (November):55-57.

Classen, Kathleen P. (1977) "The Effect of Unemployment Insurance on the Duration of Unemployment and Subsequent Earnings." Industrial and Labor Relations Review 30,4 (July):438-444.

Cohany, Harry (1961) "Membership of American Trade Unions, 1960." Monthly Labor Review 84,12 (December):1299-1308.

Dornbusch, Rudiger and Stanley Fischer (1978) Macro-Economics. McGraw-Hill Inc.

Ebner, M. (1976) "Development, Estimation, and Forecasting Accuracy of Regional Financial Models: An Application Within the State of Florida." Unpublished Ph.D. Thesis, University of Florida: Gainsville, Florida.

Engerman, Stanley (1965) "Regional Aspects of Stabilization Policy," in Essays in Fiscal Federalism, Musgrave (ed.) Washington, D.C.: The Brookings Institution.

Feldstein, Martin (1974) "Unemployment Compensation: Adverse Incentives and Distributional Anomalies." National Tax Journal 27,2 (June): 231-244.

-------(1976) "Temporary Layoffs in the Theory of Unemployment." Journal of Political Economy 84 (October):937-57.

-------(1978) "The Effect of Unemployment Insurance on Temporary Layoff Employment." American Economic Review 68,5:834-846.

Freeman, Richard B. (1978) "Individual Mobility and Union Voice," in Reynolds, Master and Moser (eds.) Readings in Labor Economics and Labor Relations. New Jersy: Prentice Hall:282-287.

Friedenberg, H. and R. Bretzfelder (1980) "Sensitivity of Regional and State Nonfarm Wages and Salaries to National Business Cycles, 1948-79." Survey of Current Business 60,5 (May):15-27.

Frisch, R. (1966) "Propogation Problems and Impulse Problems in Dynamic Economics," in R. Gordon and L. Klein (eds.) Readings in Business Cycles. American Economic Association Publication. Irwin, Inc.

Gellner, Christopher (1974) "Regional Differences in Employment and Unemployment, 1957-72." Monthly Labor Review 97,3 (March):15-23.

Ghez, G.R. and Gary Becker (1975) The Allocation of Time and Goods Over the Life Cycle. New York: National Bureau of Economic Research.

Glejser, H. (1969) "A New Test for Heteroscedasticity." Journal of American Statistical Association 64,325 (March):316-323.

Goodwin, R.M. (1951) "The Nonlinear Accelerator and Persistence of Business Cycles." Econometrica 19,1 (January):1-17.

Gordon, R.A. (1974) Economic Instability and Grwoth: The American Record. New York: Harper & Row, Publishers.

Haberler, Gottfried (1964) Prosperity and Depression. Fifth edition. Cambridge, MA: Harvard University Press.

Hamermesh, D. 1970) "Wage Bargains, Threshold Effects and the Phillips Curve." Quarterly Journal of Economics 84:501-517.

-------(1972) "Market Power and Wage Inflation." Southern Economic Journal 39,2 (October):204-12.

-------(1978) "Jobless Pay and The Economy," in Reynolds, Masters, and Moser (eds.) Readings in Labor Economics and Labor Relations. New Jersey: Prentice Hall Press:125-129.

Henderson, J.M. and R.E. Quandt (1971) Microeconomic Theory: A Mathematical Approach. New York: McGraw-Hill Book Company.

Hicks, J.R. (1950) A Contribution to the Theory of the Trade Cycle. Oxford, England: Oxford University Press.

Hinton, D. (1963) "New Benchmark Levels for BLS Establishment Employment Estimates." Employment and Earnings 10,3 (September):iv-ix.

Hirschman, Albert O. (1970) Exit, Voice, and Loyalty. Cambridge, MA: Harvard University Press.

Holen, Arlene (1977) "Effects of Unemployment Insurance Entitlement on Duration and Job Search Outcome." Industrial and Labor Relations Review 30,4 (July):445-450.

Howland, Marie (1979) "The Business Cycle and Long Run Regional Growth," in Wheaton (ed.) Interregional Movements and Regional Growth. Washington, D.C.: Urban Institute.

Isard, Walker (1957) "The Value of the Regional Approach in Economic Analysis." Regional Income: Studies in Income and Wealth 21 Princeton, New Jersey: Princeton University Press.

Johnson, George (1978) "Economic Analysis of Trade Unionism, in Reynolds, Masters, and Moser (eds.) Readings in Labor Economics and Labor Relations. New Jersey: Prentice Hall.

Jorgenson, Dale and Zvi Griliches and Edward Denison (1979) An Exchange of Views on The Measurement of Productivity. Reprint 244. Washington, D.C.: The Brookings Institute.

Katz, Arnold and Joseph Hight (1977) "Overview of the Economics of Unemployment Insurance: A Symposium." Industrial and Labor Relations Review 30,4 (July):431-437.

Lewis, Gregg H. (1978) "Unionism and Relative Wages in the United States," in Reynolds, Masters, and Moser (eds.) Readings in Labor Economics and Labor Relations. New Jersey: Prentice Hall.

Losch, A. (1954) The Economics of Location. (Woglum and Stolper, trans.) New Haven: Yale University Press.

Lucas, Robert E. (1975) "An Equilibrium Model of the Business Cycle." Journal of Political Economy 83,6:1113-1144.

-------(1976) "Understanding Business Cycles." Stabilization of the Domestic and International Economy, Carnegie-Rochester Conference Series on Public Policy Vol. 5, Amsterdam: North Holland Press: 7-29.

Maddala, G.S. (1977) Econometrics. New York: McGraw-Hill:Chapter 14.

McLure, Charles E. (1977) "The Incidence of the Financing of Unemployment Insurance." National and Labor Relations Review 30,4 (July):469-479.

McNees, Stephen (1978) "The Current Business Cycle in Historical Perspective." New England Economic Review (January/February) Federal Reserve Bank of Boston:44-59.

McPheters, Lee R. (1976) "Banking System Diffusion of Open Market Operations." Southern Economic Journal 43 (October):1009-1016.

Medoff, James L. (1979) "Layoffs and Alternatives Under Trade Unions in U.S. Manufacturing." American Economic Review 69,3 (June):380-395.

Metzler, Lloyd (1950) "A Multiple-Region Theory of Income and Trade." Econometrica 18:329-354.

Miller, Randall J. (1978) The Regional Impact of Monetary Policy in the United States. Lexington, MA: Lexington Press.

-------(1979) "The Dynamic Properties of a Two Region Model of the Regional Impact of Monetary Policy in the United States." Journal of Economics and Business 31,2 (Winter):90-102.

Mitchell, W.C. (1951) What Happens During Business Cycles: A Progress Report. New York: National Bureau of Economic Research, Inc.

Moore, Geoffrey (1959) "Maintaining Full Employment and Stability. The 1957-58 Business Contraction: New Model or Old?" American Economics Review 49 (May):292-308.

Namboodiri, N., L. Carter, and H.M. Blalock, Jr. (1975) Applied Multivariate Analysis and Experimental Design. New York: McGraw-Hill Inc.

Neff, P. and A. Weifenbach (1949) Business Cycles in Selected Industrial Areas. Berkeley and Los Angeles: University of California Press.

North, Douglass (1955) "Location Theory and Regional Economic Growth." Journal of Political Economy 63,3:243-258.

Olsen, R.P. (1978) The Textile Industry: An Industry Analysis Approach to Operations Management. Lexington, Massachusetts: Lexington Books.

Osborne, Harlow (1958) "A Review of the 1957-58 Decline and Recovery." Survey of Current Business 38,11 (November):9-17.

Persky, J. (1978) "Dualism, Capital-Labor Ratios and the Regions of the U.S." Journal of Regional Science 18,3:373-381.

Richardson, H.W. (1969) Regional Economics: Location Theory, Urban Structure, and Regional Change. New York: Praeger Publishers.

Roberts, R. Blaine and Henry Fishkind (1979) "The Role of Monetary Forces in Regional Economic Activity: An Econometric Simulation Analysis." Journal of Regional Science 19,1:15-29.

Ruffin, Roy J. (1968) "An Econometric Model of the Impact of Open Market Operations on Various Bank Classes." Journal of Finance 23 (September):625-637.

Sachs, Jeffrey (1980) "The Changing Cyclical Behavior of Wages and Prices." American Economic Review 70,1 (March):78-90.

Samuelson, Paul A. (1939) "Interactions Between the Multiplier Analysis and the Principle of Acceleration." Review of Economics and Statistics (May):75-78.

Scherer, F.M. (1970) Industrial Market Structure and Economic Performance. Chicago: Rand McNally & Company.

Shapiro, Edward (1970) Macroeconomic Analysis. New York: Harcourt Brace Jovanovich, Inc.:Chapter 20.

Shiskin J. and Eisenpress, H. (1957) "Seasonal Adjustments by Electronic Computer Methods." Journal of the American Statistical Association 52,280:415-439.

Sum, Andrew and Thomas Rush (1975) "The Geographic Structure of Unemployment Rates." Monthly Labor Review 98,3 (March):3-9.

Syron, Richard (1978) "Regional Experience During Business Cycles: Are We Becoming More or Less Alike?" New England Economic Review (November/December):25-34.

Thompson, Wilbur (1965) A Preface to Urban Economics. Baltimore: Johns Hopkins Press:Chapter 4.

Tiebout, Charles (1956) "Exports and Regional Economic Growth." Journal of Political Economy 64,2 (April):160-169.

-------(1962) The Community Base Study Committee for Economic Development (December):Chapter 6.

Trainer, G. (1979) The Metal Working Machinery Industry in New England. Unpublished Masters Thesis. Department of Urban Studies and Planning, Massachusetts Institute of Technology.

U.S. Bureau of the Census (1951-1976) Census of Manufactures Annual Survey 1951-1976, Area Statistics. Washington, D.C.: Government Printing Office.

U.S. Bureau of the Census (1954, 1958, 1963, 1967 and 1972) Census of Manufactures 1954, 1958, 1963, 1967, and 1972 Area Statistics. Washington, D.C.: Government Printing Office.

U.S. Bureau of the Census (1954, 1957, 1959, 1962, 1977) Statistical Abstract 1954, 1957, 1959, 1962, and 1977. Washington, D.C.: Government Printing Office.

U.S. Bureau of the Census (1967) The X-11 Variant of the Census Method II Seasonal Adjustment Program. Washington, D.C.: Government Printing Office.

U.S. Bureau of the Census (1972) "Special Geographical Supplement to 1962-64 Data." Annual Survey of Manufactures. Washington, D.C.: Government Printing Office.

U.S. Department of Commerce (1974) Survey of Current Business 54,7 (July) Washington, D.C.: Government Publishing Office.

U.S. Department of Commerce (1975) Historical Statistics of the United States, Colonial Times to 1970 Part I. House Document 93-78. Washington, D.C.: Government Printing Office.

U.S. Department of Commerce (1977) Handbook of Cyclical Indicators. Washington, D.C.: Government Printing Office.

U.S. Department of Commerce (1980) Definitions and Conventions of the 1972 Input-Output Study. (July) Washington, D.C.: Government Printing Office.

U.S. Department of Labor (1954) Techniques of Preparing Major BLS Statistical Series. Bulletin No. 1168 (December). Washington, D.C.: Government Printing Office.

U.S. Department of Labor (1956) Employment and Earnings 2,12 (June). Washington, D.C.: Government Printing Office.

U.S. Department of Labor (1957) Employment and Earnings 3,12 (June). Washington, D.C.: Government Printing Office.

U.S. Department of Labor (1959) Directory of National Labor Unions and Employee Associations, 1954. Bulletin 1959. Washington, D.C.: Government Printing Office.

U.S. Department of Labor (1961) Employment and Earnings 8,5 (November) Washington, D.C.: Government Printing Office.

U.S. Department of labor (1964) Manpower Report of the President. Washington, D.C.: Government Printing Office.

U.S. Department of Labor (1968) Technology and Manpower in the Textile Industry of the 1970's. Bulletin 1578 (August). Washington, D.C.: Government Printing Office.

U.S. Department of Labor (1969) Directory of National Labor Unions and Employee Associations 1969. Washington, D.C.: Government Printing Office.

U.S. Department of Labor (1970a) Directory of National and International Labor Unions in the United States 1969 Bulletin 1665. Washington, D.C.: Government Printing Office.

U.S. Department of Labor (1970b) Industry Wage Survey -- Manufacturing for September - November 1968. Bulletin 1664. Washington, D.C.: Government Printing Office.

U.S. Department of Labor (1971) BLS Handbook of Methods. Bulletin 1711. Washington, D.C.: Government Printing Office.

U.S. Department of Labor (1972) Industry Wage Survey -- Machinery Manufacturing for Winter 1970-71 Bulletin 1754. Washington, D.C.: Government Printing Office.

U.S. Department of Labor (1973a) Employment and Earnings 19,11 (May). Washington, D.C.: Government printing Office.

U.S. Department of Labor (1973b) Handbook of Labor Statistics 1973. Bulletin 1790. Washington, D.C.: Government Printing Office.

U.S. Department of Labor (1973c) Manpower Report of the President. Washington, D.C.: Government Printing Office.

U.S. Department of Labor (1974a) Directory of National Unions and Employee Associations, 1973. Washington, D.C.: Government Printing Office.

U.S. Department of Labor (1974b) Industry Wage Survey, Textiles, August 1971, Bulletin 1801. Washington, D.C.: Government Printing Office.

U.S. Department of Labor (1978) Handbook of Unemployment Insurance Financial Data 1938-1976. Washington, D.C.: Government Printing Office.

Univac (1973) Stat Pack, Univac Large Scale Systems Programmer Reference, Sperry Rand Corporation.

Varaiya, Pravin and Michael Wiseman (1977) "The Age of Cities and the Movement of Manufacturing Employment, 1947-72." Working Paper 77-1, Welfare and Employment Studies Project. Berkeley, CA: Institute of Business and Economic Research, University of California.

Vernez, G. and others (1977) Regional Cycles and Employment Effects of Public Works Investments. Santa Monica, California: The Rand Corporation.

Vickery, Clair (1979) "Unemployment Insurance: A Positive Reappraisal." Industrial Relations 18,1 (Winter):1-17.

Vining, Rutledge (1945) "Regional Variation in Cyclical Fluctuations Viewed as a Frequency Distribution." Econometrica 13,3 (July): 183-213.

Wagoner, H.D. (1968) The U.S. Machine Tool Industry from 1900 to 1950. Cambridge, Massachusetts: The M.I.T. Press.

Welch, Finis (1977) "What Have We learned from Empirical Studies of Unemployment Insurance?" Industrial and Labor Relations Review 30, 4 (July):451-461.

Wetzel, James R. and Martin Ziegler (1974) "Measuring Unemployment in States and Local Areas." Monthly Labor Review 97,6 (June):40-46.

Winston, G.C. (1974) "The Theory of Capital Utilization and Idleness." Journal of Economic Literature 12,4 (December):1301-1320.

Winston, G.C. and McCoy, T.O. (1974) "Investment and the Optimal Idleness of Capital." The Review of Economic Studies 12,3 (July):419-428.

Zeisel, R. (1973) "Modernization and Manpower in Textile Mills." Monthly Labor Review 96,6 (June):18-25.

Zellner, A. (ed.) (1968) Readings in Economic Statistics and Econometrics. Boston: Little, Brown and Company.