The American Wage Structure
1920-1947

by

Thomas Ferguson
James K. Galbraith

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Correspondence may be directed to either author:

Thomas Ferguson, Department of Political Science, The University of Massachusetts at Boston, Harbor Campus, Boston MA 02125. Fax 617-265-7173.

James K. Galbraith, Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin, Austin Texas 78713. Telephone: 512-471-1244; Fax 512-480-0246. Email: < Galbraith@mail.utexas.edu >.

Impressed by the sweeping implications of the mind-body problem, the German philosopher Arthur Schopenhauer referred to that famous conundrum as the *Weltknoten,* the "World Knot." Economic history is more prosaic. Yet the economic experience of the United States between World War I and the end of World War II did generate one problem with nearly so sweeping repercussions in its field: the behavior of wages.

This period spans the slump following World War I, the Roaring Twenties, the Great Depression, the New Deal and World War II -- times of turmoil encompassing every form of economic, technological, political and social change. Studies of wage determination during this time can therefore illuminate many competing hypotheses, perhaps more effectively than studies of the more-tranquil postwar period.[1] Such inquiries also have intriguing implications for other fields, including history, political science, and even international relations.

Yet *systematic* assessments of the relevant empirical evidence are rare; previous studies tend to be monographic.[2] The earliest can be traced back to the thirties, when data collected by the Federal government (and studies by Paul Douglas) became widely available. This wave crested between the end of World War II and the late fifties. A second and very recent wave followed the decay of the original postwar American wage system. In line with the focus of much recent research on inequality, it emphasizes work-force characteristics, technological change, and the acquisition of skills.[3]

The major studies of the first wave agreed that inter-industry wage differentials narrowed substantially during World War II, as did skill differentials. But these studies differed sharply in other respects, particularly in their assessments of the stability of wage structures in both the long

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and short run. These early studies were marked, also, by inconsistent conclusions about the pattern of relative wage changes at important junctures, such as in parts of the Depression and the 1920-21 downturn.[4] Differences of measurement and method accounted in part for these inconsistencies.[5]

The early studies also made little effort to investigate whether political events such as the New Deal or such economic developments as changes in international trade or the devaluation of the dollar in 1933 affected the evolution of the wage structure; unionization is the only politico-economic event to receive extensive discussion. And most investigators in this early Keynesian era appeared to share a conviction that changes in the inter-industry wage structure over several decades occurred in a neoclassical long run, and were not consequences of wage policy, market power, or changes in aggregate demand.[6]

The newest wave of studies frankly avows that the "Great Compression" of the 1940s in American wages was strongly rooted in the full employment policies of World War II. Progress, to be sure, has been made.[7] Still, many threads from the wage-historical World Knot continue to dangle. What were the roles of politics, trade, technology, unions and the year-to-year fluctuations of the business cycle? How much can be attributed to the rising educational levels of the workforce? What happened to inequality in this period, and why? With these questions in mind, a fresh look at wage behavior between 1920 and 1947 should be rewarding, particularly if it draws on data that other studies have not fully exploited and on techniques that illuminate this data in fresh and interesting ways.

The Present Study

This paper uses industrial wage data and a systematic if unconventional selection of methods to examine changes in the inter-industry structure of wages between 1920 and 1947.

Our data come from published sources and most of them have been used in earlier papers, though we believe we are first to use all of them in a single analysis. Many previous studies rely on detailed data from either the Census Bureau or the Bureau of Labor Statistics. Unfortunately, before the mid thirties these sources reported data for many industries only at fairly long intervals, sometimes only once or twice a decade. Our approach requires regular and complete time series, and for this paper we have brought together annual data from a variety of sources on (nominal) average hourly earnings for workers in 83 different industries or industry branches, including two cases broken down by region, from 1920 to 1947. We reach beyond manufacturing, where most of our data come from surveys conducted by the National Industrial Conference Board, an important source for that time. Eventually we succeeded in locating data for railroads, electric utilities, coal mining, gas utilities, construction (where we have separate series for skilled and unskilled labor), public roads disaggregated by region, and agriculture (also broken down by region); these are described in detail in Appendix 2. The series for railroads are divided into 31 occupational subcategories; these are described further in Appendix 3.

This data set provides a solid base for testing important hypotheses about the labor market in this period. But one also has to acknowledge its limitations. First, some parts of the economy, notably the retail trades, are still shortchanged. Second, these data are aggregated; all the series that cover the period as a whole refer to all workers within each industry. Inevitably, therefore,

one runs risks of slighting important differences within industries, between firms, among regions, across cities, within companies, and between skilled and unskilled labor. Given that most workers in most of these industries were assuredly males and predominantly white, it is also difficult to unravel influences of race or gender. But thanks to the diligence of the Conference Board in those years, a subset for manufacturing covering the period 1921-37 reports wages separately in each industry by gender and skill levels; data for skill levels are also available for a few other sectors. By combining these bits of information, we are able to hazard some generalizations about how the New Deal and rising demand for labor during World War II may have altered the ways gender and skill figured in labor markets.[8]

We analyze our data in several stages. Inspired by Dunlop's classic discussion of wage contours, recent work in business history, and Katz and Summers' work on industry-specific labor rents, we first attempt to sort among the 83 "industries" for blocs that appear to exhibit common patterns of wage changes.[9] The appropriate technique for this is cluster analysis; the technical details, which follow earlier papers by Galbraith and Calmon (1994,1996, see also Galbraith 1998), appear in Appendix 1. The cardinal point is that annual rates of wage change are the criterion variable and industries are sorted according to the similarity of their paths of wage change through time. The actual clustering procedure is Ward's minimum-variance method, using Euclidean distances in a phase hyperplane whose dimensionality equals the number of years under observation.

The basic idea of industry-specific labor rents is that under some conditions employees, rather than owners, can succeed in capturing part of the gains from an imperfectly competitive

market structure (Katz and Summers 1989). It is a simple step forward to argue that differences in patterns of wage *change* across industries through time reflect differences in the economic performance (and therefore of gross rents) of the industries themselves. It follows that if two industrial subgroups have similar patterns of wage change through a sufficiently extended history, marching up in some years and down in others but always substantially in step, then it is likely that they are being influenced by the whole range of external forces in similar ways. We may then infer that they are, in some economically meaningful sense, closely related to each other.

Precisely how many groups one distinguishes depends in the end on one's sensitivity to small differences in performance. As we will see momentarily, our analysis yields a set of tables and a striking tree diagram indicating that the 83 industries and branches can be divided quite cleanly into eight distinct groups. This indicates that there are eight usefully distinct patterns of wage change in the data; lesser variations may be treated as occurring within groups.

We then investigate how these variations might be affected by differences of skill and gender within the workforce. Our analysis, which is based on the smaller sample of industries and shorter time time period for which relevant data are available, leads to a surprising conclusion. Differences in the rates of wage change between skilled or semi-skilled and unskilled workers mattered little; such differences within industries were almost always smaller than differences in wage change between industries. On the other hand, our evidence about gender suggests that in this period women's work constituted something of an "industry" in its own right. Since it was, in effect, a special form of common labor practiced across conventional industry lines, it was affected dramatically by improvements in the position of the lowest paid workers during the New

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Deal and World War II.

The next stage is an exploratory data analysis. By plotting the average annual rates of wage change of the various industries and industry segments in our clusters, we can illustrate how each group reacted to landmark events. We also compare how wages in each group performed through time with respect to the others. This stage, though necessarily informal, provides a "feel" for the data which will prove useful in interpreting the more formal analaysis to follow.

Following this, we present a systematic decomposition of the sources of wage variation across groups and through time. We compute the canonical roots of a discriminant function, designed so as best to separate the wage change performance of each group of industries over the period. This yields a set of eigenvectors, consisting of weights or impulses, each of which is a representation of a lineally independent force acting on the wage structure. The fact that our cluster analysis relies on wage-change observations in percentage form produces eigenvectors in time-series format; thus each eigenvector is itself an artificially constructed economic time series. We identify four such forces that together explain 97% of the variance in wage change across groups. Of these, the first two account for 75% of all cross-cluster variations and the first one alone accounts for over half.

To summarize, by this point we will have established: first, that a very high proportion of total wage variation in this period was inter-industrial; second, that inter-industrial variations were dominated by the relative movements of eight large clusters; and third, that most cross-cluster variations can be reduced to just two canonical time-series, with four accounting for virtually all of them.

This raises a beguiling possibility. It may be that simple explanations account for most of the relative-wage changes during the tumultuous twenty-seven years under study. In a reversal of the usual notions of micro-to-macro causality, it may be that a small number of *macroeconomic* variates account for a large proportion of *distributional* changes. The fact that our eigenvectors have a time-series representation suggests that they may also have an historical interpretation, a meaning. Can these forces be identified as substantially similar to, as in effect reflections of, known and perhaps even familiar events?

The traditional method of assigning meaning to a weighting function in discriminant or factor analysis involves computing a "canonical score" (or factor score) for each object, and inferring meaning from the distribution of scores across objects. This is a purely *post hoc* procedure, and absent some form of hypothesis test the resulting inference cannot be regarded as final. Our procedure permits a crude test, for the fact that our eigenvectors are time series allows us to compare the root directly to the time path of those historical economic time series one conjectures may be closely associated with it. We find the visual evidence in several cases compelling, and on occasion simple correlation or bivariate regression coefficients are, in fact, significant. On the other hand, the fact that we are often dealing with multiple, closely collinear *explananda* for our *explanandum* -- for instance, exchange rate ratios for several different countries for a root apparently associated with the terms of trade -- means that multi-variate regression coefficients are typically unstable. As with all historical research, the possibility of course also exists that the comparisions may be improved by the discovery of more appropriate historical series.

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In a final section, we return to the underlying data. The group-wise decomposability of Theil's T measure of inequality (see Appendix 1, section 4) permits us to compute an estimate of the evolution of inequality in the wage structure over time. This estimate is independent of our clustering procedures and of our discriminant analysis, and unlike those procedures it produces a measure of changing relative wage dispersion that is weighted by the relative size of the underlying classes of economic activity -- in particular, it gives the heavy weight to agriculture that the large size of the farm population in those days demanded. This measure is well-suited to regression analysis. Using it, we test a simple macroeconomic explanation of inequality in the wage structure. The results are spectacular. We think they carry implications for several major questions of theory and policy.

Stage I: Cluster Analysis

Figure I presents the cluster analysis. The figure should be read as though it depicted the American economy as a sort of multi-divisional corporation à la Chandler (1962). By beginning at the top, and tracing downward through each major fork in the chart, increasingly detailed groupings of industries become visible.

How much clustering one wants to work with finally depends on the researcher. Few interesting questions in economic history are likely to be answered by reference to the two giant clusters revealed in the upper parts of the figure -- essentially railroads, coal, and utilities on one side, and everything else on the other. Nor would it make sense to keep clustering until the differences between industries became so fine that one reached a Euclidean distance of 0 at the

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bottom of the graph, when one would be back to 83 different subgroups including some thirty-one occupational subdivisions of the railroads.[10] In this paper we work with the eight rather large clusters identified in stylized form by the names in smaller print on the figure ("Farms," "Textiles," etc.). For some purposes, we condense the two railroad clusters into one.

These clusters appear sensible on both casual and close examination. Virtually the entire large cluster indicated by the top left fork in Figure I refers to the railroad industry. Two of the big lower level clusters nested within the broader railroad grouping represent branches of that industry exclusively. They separate, broadly, the through-freight and passenger workers from the local line and office workers of this by-then heavily regulated industry. The third branch (denominated "Utilities") includes the coal industry, the gas and electric utilities, and two industries with exceptionally strong unions, books and newspapers. This last branch also includes one entity from the railroad group, "Yard Firemen and Helpers," that seems anomalous but probably isn't. Firemen and their helpers handled fuels -- in this period, mostly coal.[11]

The right-hand prong of the great top fork breaks down into two large clusters. The first, flaring to the left, consists entirely of one sector broken down by region: agriculture. The second, leading down to the right, divides into several nested subclusters. Off by itself on the left is a cluster containing all the regional branches of public road building, with a single instructive exception. On the right, we find all the rest of manufacturing industry.

This final right fork contains three subclusters, stylized in Figure I as "Capital Goods," "Textiles," and "Mass Production." This part of Figure I, with its restricted range of variation, is essentially what papers that analyze data only for manufacturing have examined. Within these

subclusters, there are well-defined patterns. The left most subcluster -- our "capital goods" -- roughly defines what in the USSR at that time was symbolized by the name "Stakhanov": toilers in foundries, heavy equipment, machines and machine tools, hardware and small parts, paper products, and both skilled and unskilled construction.[12]

The remaining two subclusters contain the rest of American manufacturing for which we have data. The first -- "Textiles" -- consists of several sub-subclusters with readily intelligible internal linkages: cotton and wool, linked to another subcluster of silk and rayon and hosiery knitting, plus lumber, and boots and shoes. All were labor-intensive but essentially non-mass production industries that were sensitive not only to labor costs but also to the price of commodities and raw materials.

Two industries that also processed commodities but were celebrated examples of mass production -- rubber and meat packing -- cluster with a bloc of other industries: paint, chemicals, leather, furniture, and iron and steel. Like the sectors in "Textiles" and most of the industries in our "Capital Goods" group, these industries were recurrently tempted by economic nationalism in the inter-war period, either because they faced strong international competition in export markets or depended directly on tariff protection in the home market. In our cluster analysis, however, they link up with another subcluster of mass production industries: autos, foundry machinery, agricultural implements, electrical machinery, and paper and pulp. This latter group includes some of the most internationally successful of all American firms in this period. The lesson we draw from the proximity of the nationalistic sectors to the international success stories is one that contemporaries also drew: a dominant effect of protectionism is to protect.[13]

By the end of our period, it is well known that wage settlements in steel, autos, and a handful of other large unionized industries were setting the pattern for many other industries. But how and when did this system get underway? Some authorities trace its beginnings to the years just prior to World War II, partly because heavy unionization in autos, rubber and steel came only in the late 1930s. But this is not the only possibility. Since the underlying technologies, market structures and demand relationships long antedated the Congress of Industrial Organizations (CIO), it could also have been that the post-war wage system actually evolved from pre-union patterns, and merely represented a more formal version of something that was already evolving in the years after World War I.[14]

Here, our results tend to support the mainstream view. Consider how steel, rubber, and autos fare in our classification.. By comparison with the gulf that divides these industries from the rest of the economy, the distance separating them from each other does not amount to much. So while linkages between these three pattern-setters run back into the 1920s; linkages from them to the rest of the economy evidently do not. While the post-war system of national patterns assuredly emerged out of processes and events that we discuss in this paper, it represented genuine development, not simply an extrapolation of previously-existing trends.[15]

A tighter if less momentous set of linkages emerges in the relationship of wages in public road construction to those in agriculture. During the interwar period, analysts and advocates for the rural poor complained repeatedly that rural elites were manipulating wage levels on public relief projects to assure a suitably compliant, truly low-wage work force for the farms. Subsequent work by economic historians suggests that, at least in the South, those complaints

were justified.[16] Our clustering, too, suggests that through the twenties, wage changes on public

road projects did in fact closely resemble those in agriculture. In the thirties, however, wages in

road building -- a quintessential New Deal activity -- moved toward the manufacturing pattern

and away from that in agriculture. As a consequence, in a cluster analysis for the entire period

wage patterns in public roads resemble a half-way house between the two worlds of agriculture

and industrial production.

The one outlier among the regional subsectors for public roads is the Pacific region. This

shows up in an entirely different (right hand) prong of the fork, where most of American

manufacturing industry can be found. At first glance this separation of roads in the far Northwest

from agriculture and the rest of public roads appears anomalous. But with a closer look the

puzzle disappears; the Pacific region public roads wages did closely track wages not in farming --

but in the locally dominant lumber industry. This exception thus conforms nicely to a larger rule.

The clusters portrayed in Figure I reflect patterns of wage variation across the workforce

as a whole. But one naturally asks how the results would appear if one examined the fate of

particular social and demographic groups, such as women workers, skilled workers, or individual

ethnic and racial groups. Would our focus on inter-industrial variation still appear justified, or

would some other classification principle come instead to predominate?

We have been unable to find data that allow us to compare how racial groups fared within

the industries in our data set. But we do have data on the annual average hourly earnings of male

skilled and unskilled workers between 1921 and 1937 in the manufacturing industries as well as

in printing and news; these data come from Conference Board surveys that requested each

establishment to distinguish between purely unskilled workers and all others. Similar data also exist for skilled and unskilled construction workers, under the safe assumption that women workers in that sector were few. Obviously, a classification that lumps semi-skilled with highly-skilled workers is not ideal, but over a wide range of industries this distinction, if it is important, might be expected to show up in different patterns for industries requiring large proportions of highly skilled craft workers as against those where the "skilled" group was dominated by semiskilled factory hands.

Figure II shows the result: the skilled and unskilled portions within each industrial category virtually all appear close together. In most cases, they are side-by-side.[17] This is a simple showing of an important fact. In the period we are concerned with, changes between industries were -- almost always -- more important in explaining patterns of wage change than was the evolution of the skilled/unskilled differential within industries. Further discussion follows, but the basic result (illustrated in Figure XVIII) is that once inter-industrial variations are controlled for, variations of the the skill differential are minor, with exceptions mainly in printing and construction which may indeed reflect a high proportion of craft workers in those trades.

For the same time span, data are also available for annual average hourly earnings of wages of men and women in our manufacturing industries.[18] As Figure III indicates, gender is a different story. Sex proves to be a more important marker of intra-industry wage change than skill. On the right hand side of the figure (which, again, refers exclusively to manufacturing industries between 1921 and 1937) we find groups of industries in which wages of males tracked each other closely -- autos, foundries and machinery, or chemicals. On the left are several clusters

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in which industry played the dominant role in determining wage changes for both genders --
printing is a representative case. In the center-right, are those industries whose female workers
had closely co-moving wages.

In interpreting these clusters, it is useful to note that the proportion of women working in
different industries varied hugely. In hosiery and knitting, for instance, women comprised a large
percentage of the workforce. Other industries, such as foundries, employed very few. And in
many industries, such as automobiles, the work done by women differed markedly from that
performed by males, and so one is in effect looking at a within-industry occupational classification
into which female workers were steered.[19]

Looking at the evidence for individual industries, we notice that many show a reduction in
the "gender gap" -- the ratio of ratio of women's to men's average hourly earnings -- in the early
New Deal years. We will have more to say about this process later, when we consider how
various New Deal policies, including unionization, minimum wages and dollar devaluation,
affected industries in which women worked in large numbers. For now, our conclusion is simply
that the low pay ratios are evidence that women's work in this period was essentially a special
form of common labor. Precisely because of this, women workers benefitted disproportionately
from the developments which improved the relative position of the lowest paid workers during
the New Deal and World War II.

Stage II -- Exploratory Data Analysis

Figures IV, V, VI, and VII explore some of our findings. They are in effect a graphical

commentary on the debates mentioned earlier over how wages changed within and between industries.

Figure IV begins by separately plotting wage change in each of our major clusters over time, save that the two railroad groups have been consolidated. Figure V displays rates of wage change for a number of individual industries extensively discussed in the literature, but here consolidated within the seven large groups. We present them as concrete examples of the more general patterns.

For example, Figure V shows a dramatic collapse of construction wages in the severe downturn of 1920-21. It also testifies to another sharp fall in the wages of both skilled and common construction workers between 1930 and 1932, which bottomed out only as wages in other sectors, which had fallen less, were also turning up after passage of the Davis-Bacon Act defending the prevailing wage in construction in 1931. The rise in farm wages in the Second World War jumps off the page and will play an important role in our story later on. So does the sharp run up in coal-miners' wages in 1934.

The most suggestive fact recorded by Figures IV and V together concerns the relative rise of wages in textiles and related industries at the outset of the New Deal. (Figure IV's "Textiles" refers to the whole cluster as earlier defined; Figure V plots the cotton industry separately.) Along with the coal miners, unions in these industries are widely credited with kicking off the historic wave of strikes and union-recognition struggles that began shortly after the passage of the National Recovery Act in 1933. The textile and coal unions also spearheaded the campaign that led to the famous split within the ranks of the A.F.L. and the formation of the C.I.O.[20]

What explains the sudden upsurge of militancy within this sector, which had never before and never would again witness such striking success in raising its wages relative to pay in other industries?

What may possibly explain it, we think, is something that labor historians have neglected: the differential effects of dollar devaluation and the Roosevelt administration's decision to go off the gold standard as it inaugurated the National Recovery Administration. Textiles and garments were at that time pressed vigorously by foreign competitors. Not only had the British recently floated the pound and erected the Ottawa System (creating problems for many American manufacturers) but in addition textiles, garments and their supplier industries (notably rayon) faced a special challenge: low cost competition from the Orient, particularly Japan (see e.g., Wright, 1995). Along with the demand stimulus arising from the New Deal's relief activities (at that time very limited) and its equally slow-moving efforts to unfreeze frozen banking assets, dollar devaluation suddenly created demand and thus the possibility of profits. This was something to fight over in an industry that had stagnated since the end of the First World War.[21]

The early success of the textile unions in capturing some of those gains, in turn, helped fuel the broader drives for unionization. First, although one usually associates textiles with cities and coal mining with the countryside, in parts of the Northeast and the South these two industries importantly overlapped. In many instances, the textile industry appears to have drawn much of its workforce from wives, children or other extended family members of miners. The dramatic successes of their kin and neighbors can hardly have dampened spirits among male miners when John L. Lewis famously sounded the trumpet soon after the US abandoned gold and textiles

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wages had commenced their dramatic rise. Second, what was sauce for the business goose could

also, in the special conditions of the devaluation(s), become sauce for the labor gander. By

recycling of a portion of its newly replenished treasury into the C.I.O.'s organizing efforts,

organized labor, too, showed it appreciated the logic of the investment theory of party

competition.[22]

The textile workers had not, of course, discovered a foolproof way to hold on to the gains

from devaluation in the long run. As Figure IV shows, workers in this group of industries did not

do as well, in terms of annual rates of wage improvement, as those elsewhere in manufacturing

through the middle and late 1930s. By 1936 -- at which time monetary stabilization, represented

by accords like the Tripartite Monetary Agreement between the U.S., Britain and France, was

becoming acutely controversial (Ferguson, 1995, p. 155) -- wage gains in textiles were falling

behind most other industry groups. It nevertheless appears that the devaluation of 1933 may have

played a distinct role in the causal chain leading to the creation of the CIO, setting up a path-

dependent and, perhaps, spatially conditioned sequence of events that would have otherwise

played out differently.

As Figure VI indicates, in many industries gender gaps improved (they were not, of

course, eliminated) early in the New Deal. While some of this doubtless reflects the impact of

unionization and minimum wage laws, including those incorporated in many National Recovery

Administration codes, the crucial point is that taken together these political and economic

developments actually conferred relative gains on women workers. And the rebirth of the

women's movement that marked the years of the High New Deal surely owed at least as much to

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this sudden broad empowering of women workers as it did to the personal influence of well known individual women such as Eleanor Roosevelt or Frances Perkins.[23]

Because we do not have employment weights for our individual industries we cannot compute weighted average wage levels by year for our clusters. The next best thing is to compute the evolution of the relative wage structure from a common base year, and this is possible because we know that the within-cluster departures from a common growth rate are small. Figure VII plots relative wage movements, with 1920 set to 100, for all of the major groups of our cluster analysis. This figure thus summarizes the relative evolution of the entire American wage structure, beginning with the postwar slump of 1920.

As the speculative boom that followed the 1918 armistice gave way to the sharp recession in 1920, the wage structure split apart.[24] In agriculture (and public roads) where wages were lowest, wages fell the most. In coal and utilities, where wages were among the highest, they fell the least. Indeed, though federal troops were called out repeatedly to quell resistance in the coalfields, and though statistical studies of judicial behavior indicate that an unprecedented wave of injunctions crashed over unions in this period, still, in coal and utilities wages held up rather well and then soon began to rise again.[25] On the railroads (where the courts also repeatedly intervened, virtually always on management's side), wages first fell, though not by as much as in manufacturing nor nearly as much as in agriculture. As the cycle turned up, railroad wages rose very slightly (amid a wave of strikes). Following the passage of the Railway Labor Act of 1926, which can be viewed as a precursor of the Wagner Act, they rose more steeply until 1932. In the thirties, manufacturing wage settlements caught up with wages on the railways, and the 1920

parities were restored from 1937 to 1940. During World War II, however, railroad wage settlements fell further and further behind (even though the absolute level of railroad wages remained quite high). This outcome might be held to reflect the long term decline of the railroads or the eventual success of the Railway Labor Act at incorporating the unions into the bargaining process, or both.

The recession of 1920-22 hammered nominal wages in heavy manufacturing as well as in textiles and garments, though neither suffered as much as agriculture and public roads. However as Figure VII also shows, these sectors recovered after taking a second beating, like all other clusters, early in the Great Depression. Our annual data also suggest that the recession of 1938 -- the first downturn in which the Federal government employed a deliberately counter cyclical macro policy on a large scale, accompanied by the first broad minimum wage laws, the Fair Labor Standards Acts of 1937 and 1938 -- temporarily halted the rise in manufacturing wages, but nowhere seriously reversed their course.[26]

Then, as many studies including Goldin and Margo (1991) have observed, with World War II the great upward pull of demand began to operate on the wage structure as a whole. But the combined force of demand, military enlistment and rising wage standards on the wages of unskilled farm workers, still forty percent of employment in 1940, is especially dramatic. This is the Great Compression of the 1940s. By 1945 it had nearly erased the Great Decompression of the early 1930s.

Indeed, by including sectors beyond manufacturing, notably public roads and agriculture, and carrying our data back to 1920, our study sharpens the discussion of the effects of the New

Deal and World War II on the wage structure. The wage structure that evolved during the war essentially represented a restoration of the wage structure that had briefly existed at the end of the previous Great War, in 1920. World War II's Great Compression was, in truth, the Second Great Compression: the first having occurred in 1917-19. [27]

There is dramatic contrast in how the two Great Compressions played out. Though our data end in 1947, we know that the wage structure carried on from that point, with comparatively minor changes, for at least another two decades. Egalitarian by previous standards and yet also stable, this postwar wage structure surely qualifies as a very striking form of persistent structure. Like the Great Red Spot on the planet Jupiter, it demands recognition as an enduring phenomenon in its own right. For those inclined to view labor market outcomes as driven by free market forces, this must inevitably be discomforting. What changes in, say, the peacetime labor force or in civilian technology occurring strictly between 1940 and 1946 could possibly have accounted for both the emergence of the wartime wage structure *and* its enduring stability a quarter century after the war?

Stage III: Discriminant Analysis

In the third stage of our analysis, we apply discriminant function analysis to the eight clusters derived in the first stage. The technical details are outlined in Appendix 2, but the basic idea is straightforward. Having previously found the best (minimum variance) clustering of industries into groups, we have groups that are as strongly differentiated as any structure of aggregation based on wage behavior will yield. The differences between these groups thus contain

most of the economic information that may appear in the wage structure overall. To extract this information in its most compact form, we find the set of canonical roots or eigenvectors that best discriminates the disparate patterns of wage behavior exhibited by the clusters. These eigenvectors are ranked in importance by their associated eigenvalues, which measure the proportion of inter-group variance explained by each.

Our analysis yields four roots that together explain 97% of the variance in the intergroup wage structure; as noted previously the first two of these alone account for 75% and the first one accounts for over half. Since the roots are comprised of year-specific weights, we can treat them as economic time series in their own right. Now, as explained earlier, the task is to try to determine whether these roots correspond to known variates in the historical record.

The First Root and the Movement of Aggregate Demand

Figure VIII presents the distribution of factor scores on the first canonical root, which we plot here against the cumulative change in nominal wages from 1920 through 1939. A remarkable association emerges. Activities scoring above zero on this root showed relatively high and uniform cumulative wage gains through this period; industries scoring below zero show cumulative wage gains that are progressively lower as the score declines.

A possible, albeit *post hoc*, explanation emerges when one considers the identity of the groups splayed across the figure. Agriculture and textiles were low-wage, competitive sectors; the former remained un-unionized throughout the period and the latter substantially so until the early- to mid- 1930s; these are industries that Dunlop (1957) long ago identified as heavily

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dependent on unskilled labor. Road wages, as previously discussed, were kept tied to those in agriculture for political reasons until the New Deal. In contrast, in mass production, in the capital goods sector and in railroads and utilities wages were comparatively high, workers comparatively organized and firms monopolistic. Capital goods production naturally rises and falls with gross investment; to some extent so does the mass production of consumers' durable goods.

We therefore hypothesize that the differences in scores across sectors may reflect differences in the ability of workers to capture the benefits of increasing aggregate demand, something akin to industry-specific labor rents or a pass-through from Kalecki's famous degree of monopoly power.[28] This thought motivates a search for a proxy for the movement of aggregate demand. Of course, the most reasonable of these is also the most easily obtained: estimates of the movement of Gross National Product. Figure IX plots the yearly values of our first root (scaled for expositional clarity) against the annual rate of change of nominal GNP as recorded by Robert J. Gordon (1986).

Magnitudes and timing do not accord precisely -- it may be that aggregate supply factors affect GNP in some periods, lags as well as interdependencies in both directions are possible, and it may be that relative wages sometimes responded to the movement of real as opposed to nominal GNP. But we believe the general correspondence between these two series is striking; considering that one series is constructing from gross expenditures on goods and services, while the other is extracted from a matrix of changes in relative wage rates. The simple correlation coefficient between the two series is .41; we think it is an understatement.[29]

The Second Root: Strikes?

The second root accounts for 20 percent of the variance in the intergroup wage structure. Following previous procedure, Figure X plots scores along this root against cumulative wage change in the interwar years. The ranking isolates textiles and roads at the high end of the spectrum, farm workers at the bottom end. Mass production, railroads and capital goods hold the middle ground, with utilities ranking below them. Notably, while the very low ranking farm sector showed the lowest wage gains, the highest ranking sectors do not show the greatest gains.

Railroads, heavy manufacturing and mass production industries were all heavily unionized by the end of this period. Although textiles were not unionized in the South, the Conference Board data we use are drawn heavily from Northern mills, and these became unionized in the great drives of the early 1930s. Agriculture and public roads, in contrast, were essentially un-unionized, but the wage behavior in roadbuilding was altered dramatically during this period, as we have seen, by a political decision.[30]

It thus seems plausible that this root is capturing, not the degree of labor power but the change in it, the relative degree of labor militancy across sectors. A suitable proxy for this may be the total number of days lost to strikes, particularly strikes that ended in labor victories or in compromise.[31] This information is plotted against the second root in Figure XI. Though the match is again imperfect, the two series share a pattern; both show the abrupt upsurge of the early 1930s and again at the end of World War Two. Once again, there is a significant positive correlation between them (rho=0.35). Correlations to measures of total work stoppages and the number of workers involved are even higher: .40 and .46, respectively. Figure XII illustrates.

It does not, of course, follow that a high ranking on this root produces the highest overall rates of wage gain. The root only captures 20 percent of the intergroup variation; its effects are therefore dominated by those of the first root. Textile wage gains overall were low, though textile workers were militant; though railroad workers were less militant over the whole period railroad wage gains were high. Still, overall these figures suggest quite clearly that strikes and related political decisions made a difference, particularly in separating the wage performance in unionized textiles from those on the farm.

The Third Root: Terms of Trade and Exchange Rates

The first two roots explain 75% of the total variance. But there is a third root that accounts for another 15 percent. Again following protocol, we plot in Figure XIII the canonical scores on this root against cumulative interwar wage change, and notice that now mass production, textiles, capital goods and utilities all rank high, while farms, roads and railroads rank low. Can it be that this root is picking up the influence of trade in manufactured commodities?

Figure XIV puts this hypothesis to a preliminary test, by plotting a version of the third root in index number form against an index of crude food to manufactured import prices, and an index of total import values. The family resemblance is not bad; the sharp fall in imports that accompanied the outbreak of war in Europe is telling. But we have found something even better: the exchange rate against sterling and the yen -- the latter particularly important for textile trade owing to competition between rayon and silk. Figure XV presents these comparisons; once again there are significant correlations, of 0.25 against sterling and O.44 against the yen.

Looking back at the scatter plot in light of this evidence, only utilities seem curiously out of place. Leontief's famous study of the interwar economy [Leontief, 1951, pp. 178ff.] observed that while direct exports from this sector were modest, it profited strongly from its customers' growth. By contrast, wages on roads and railroads often zigged as the (in the twenties, usually improving) international economy zagged. And while one normally thinks of American agriculture as a successful export industry, in the interwar period this bromide was just close enough to the truth to be seriously misleading. Many crops dominant in certain regions -- for example, many dairy products or fresh vegetables -- were not traded at all, or on only a very small scale (save in the form of canned goods). Others were scarcely competitive with imports at any price, and sought (and received) tariff protection. More internationally competitive crops, such as wheat, cotton, or tobacco, all too frequently faced shrinking foreign markets as governments around the world sought to protect their agricultural producers from competitors through a wide variety of tariffs and direct controls.[32]

The Fourth Root: A Mystery?

At this point, just ten percent of cross-cluster variation remains, and our analysis reveals a fourth root that explains seven percentage point of that. This root is not so easy to identify. Figure XVI shows that utilities ranked highest on this root; combined with Figure XVII's choppy downward trend after 1925 this suggests to us that it might perhaps reflect the long-term structural transition of the economy from coal to oil. But we have no historical series with which to test this thought, and for the time being we leave the question open.

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But What About Education and the Increasing Supply of Skill?

Goldin and Margo (1991) and Goldin and Katz (1995) have offered arguments for believing that education and perhaps technological change played important roles in the movement toward greater equality of wages in this period from the early thirties to the end of World War Two. They argue that the increasing supply of high school graduates, in particular, increased competition for skilled jobs, depressed skill differentials and compressed the wage structure. Several empirical analyses involving certain specialized occupational groups, such as clerks in New York State and railroad machinists, appear to lend weight to this claim.

Education plays no apparent role in our analysis at all. Why not? Considering the importance of this issue for policy, it is worth asking whether there is something in our methods that might mask the influence of an educational effect on labor supply. For example, might education somehow resemble immigration, which, because it was sharply cut down at the beginning of the period with which we are concerned, might have effects unlikely to be detected by a method that operates on rates of wage changes from year to year?[33] Is there perhaps something about between-group comparisons of industries that muffles an effect observable in micro data? Or is it possible, as one referee has suggested to us, that entirely separate determinants can drive the year-to-year movement of relative wages on the one hand and the long-term trend of differentials on the other?

The first possibility can be excluded. The trend in total school enrollments is well documented; its plot shows a gently rising trends, save during the Depression and World War II. The rise in the number of workers who had completed high school, perhaps the most relevant

construct for a measure of labor supply, is even steadier, falling only during World War II. Thus changes in the educational status were happening continuously over the period; education was not like immigration.[34]

Nor is it likely that we are being misled because by our data. Unlike researchers using Census or other individual level data, we do not have direct evidence on intra-industry wage variations. But for a theory of wages driven by rising or falling differentials in education to hold up, given our evidence, it would be necessary to show that *intra-industry* education differentials rose (or fell) in ways *not* consistent with, and *not* explained by, the forces governing movements of the *inter-group* wage structure (which we consider to be fully explained, as of now, by the four forces we identify). This would require large *mean-preserving* shifts in the distribution of wages within industries, which would necessarily have occurred without also disturbing the inter-industry and inter-group structures. Put bluntly, the forces driving wages within groups would have to be radically different from those responsible for the between-group differences that we have analyzed.

This is very improbable. We employ a diverse set of time series collected from different sources and at widely differing levels of aggregation, and include a full set of occupational wages for one industry, namely railroads, marked by wide differences in skill levels. Yet these various parts moved together. Further, no one argues that more educated workers were randomly distributed across all of American industry. From the late twenties forward, they were concentrated in newer industries, including many with a distinct orientation toward technology. What might in some industries register mostly as within-group differences, accordingly, should in

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other cases also lead to easily detectable differences between groups, corresponding to movements of the skill-to-unskilled differential.[35]

But not only don't we pick up such differences, some of our findings are incompatible with their existence. In Figure III, we show that in most industries the movement of the skill-to-unskilled differential for the period from 1920 to 1937 is less than the wage variation between that industry and even its near neighbors. Most of the important wage variation was inter-industrial, not across skill levels. It is true that skill is not quite the same thing as education, and that the Conference Board's measurement, which differentiates only the wholly unskilled from everyone else, is crude. Nevertheless, even this crude distinction was surely correlated with education levels, and as Figure XVIII illustrates, the movement in the skill-to-unskilled differentials in most industries was small. The printing trades were, conceivably, an exception -- but if so they were a minor one in the larger scheme of industrial wages.

Finally, we reject the argument that long-term trends can somehow supersede the patterns detected in our analysis. This argument amounts essentially to a claim that the endpoints of an arbitrarily chosen time period can be explained without reference to the events occurring in between. We don't think so. The inter-industry wage movements we identify occurred, and we think they occurred because of particular movements of aggregate demand, labor action, and exchange rates. Had these movements been different, so too we believe would have been the major variations of relative wages. To show an effect of education on these movements, one must therefore show either that one of our identifications is incorrect, or that changing skill levels controlled one of our three identified proximate causes.

Neither seems likely. Our measures of the main forces on intergroup wage variation do not exhibit gently rising trends. Rather, they are subject to sharp discontinuities and even to reversals. None appears to be a plausible proxy for changing education differentials. And collectively they just about exhaust the interindustry variation of the wage structure.

To deny the existence of an "education effect" on wages in this period does not imply that the "premium" paid to high school or college educated was invariant. Instead, it segregates effects of the evolving composition of the labor force from changes in the composition of jobs on offer. More educated people qualified, to be sure, for better jobs, as Table A4 in Goldin and Katz (1995) demonstrates. Following their logic, one might expect that supply pressures emerging at the upper end of the labor market would have systematically depressed skill premia throughout the twenties and especially in the thirties, when good jobs were scarce. But this would happen even if the wage structure -- the pattern of payments for particular lines of work -- had remained unchanged. It *would* happen, inevitably, simply because lower-wage jobs would increasingly fall to over-educated workers. The effect of an increased supply of educated labor on the wage structure itself would emerge *only* if employers responded to the increased supply of education by reducing wage rates for skilled positions.

Figures III and XVIII present demonstrations that this did not generally occur; if it had, the skilled labor components of various industries would have clustered in a slower growing group, instead of alongside their respective industries. But Goldin and Katz did not find any such pattern either; in their data skill premia were depressed sharply in both wars, but during the interwar period skill premia displayed little variation (Goldin and Katz, 1995, Tables 5, 6, and 7).

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Goldin and Margo (1991), on the other hand, do report that certain fairly narrow groups of relatively educated workers, notably clerks in Class I steam railroads and office workers in New York State, experienced a pattern of increasing returns to their educated status in the late twenties and early thirties, followed by sharp and continuing declines thereafter (Goldin and Margo, 1991). From these 1930s declines come, it appears, the foundation of the argument that the increased relative supply of skilled workers drove down the premium to education through the nineteen thirties and forties.

Our Figure XVIII directly addresses the question of how much within-industry variation in skill differentials there actually was in the larger economy during this period. The answer is: "not very much." Only a few cases -- hosiery and knitting, newspapers and magazines, and construction -- display perceptible patterns of change. In the event that the bumps in the Goldin-Margo data for clerks in New York are, indeed, intra-industrial in character, this figure demonstrates that they are quite atypical of intra-industrial differentials between unskilled and skilled workers. From 1920 through 1937, the average change across all industries was an *increase* in skill premia of about 6 percent -- not particularly consistent with the hypothesis of excess supply of skilled labor -- and most industries are within a few points of that figure. While the exceptions mentioned above stand out, overall there is no perceptible association across industries between increases in the proportion of skilled positions and changes in the skill premium.

What then of the Goldin-Margo finding that skill premiums declined from the early thirties through the 1940s? The answer is now fairly clear: the particular series for clerical workers

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chosen by Goldin and Margo do not reflect the broader pattern of skill premia. They mainly reflect, we think, the general improvement of the position of the common laborer brought about by the New Deal and, eventually, tight labor markets during World War II. We suspect, in other words, that the Goldin-Margo series simply mirrors the *inter-industrial* trends that our paper has already identified.

Figure XIX presents the Goldin-Margo data for railroad clerks, relative to laborers, and of railroad machinists, again relative to laborers. Against this series, we plot a ratio indicating the relative wage in railroads as opposed to that in our "mass production"cluster. The similarity of movement is pronounced. Our interpretation is that railroad workers, who were highly skilled on average relative to the common run of factory workers, suffered a decline in relative position due to the general improvement of the common laborer's lot after 1933. Goldin and Margo have, we believe, merely measured an element of this general trend, which is already distinct in our inter-industry data.[36]

Figure XX takes up the second Goldin-Margo series, for clerks in New York State, and compares it to the ratio of the average wage in the industrial cluster that includes books and utilities, divided by the farm wage. Once more, the three series are very similar, allowing for the fact that Goldin and Margo use of average weekly *earnings* rather than *hourly* wages may account for the relatively sharp spike in the clerk's relative position in 1929-32. But again, the sovereign fact, easily confirmed by examining what moved and what didn't in our Figure IV (particularly, farm wages as against utilities), is that it is the wages of the unskilled, not those of the clerks, that are the real story in this picture.

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Goldin and Margo's own data confirm that movements in the wages of the unskilled dominate in the fluctuations in the ratio of clerical-to-unskilled wages. From 1923 to their peak in 1930, the weekly earnings of clerical workers in New York state rose 17 percent. From 1931 to the trough in 1933, wages in this group fell 16 percent -- to just below their 1923 values. But weekly earnings for unskilled workers fell by 41 percent from their peak in 1929 to the trough in 1932! This is what gives the Goldin-Margo series for clerks its sharp upward thrust, and it is the subsequent rise in laborers' earnings -- 54 percent by 1937 -- that brings the ratio back down again.

One final point. During World War Two, the enormous in wages of the truly unskilled workers who toiled in agriculture and on the public roads owed nothing to any Roads Scholarships program. The spectacular rise in their wages was the effect, surely, of demand, spurred by record public deficits, and the absorption of some ten million men into uniformed government employment. And the result was an almost perfect inversion of Protestant ideology and conventional thinking about education and labor markets, for the prime beneficiaries certainly included many millions of workers who were functionally illiterate and possessed of the very lowest educational credentials of all.[37] And yet, and yet, it was this wage structure, socially constructed in national emergency though it was, that persisted for a generation following the war.

Stage IV: Explaining the Evolution of Wage Inequality as a Whole

To conclude our analysis, we abandon clustering and discriminant functions and return to our original data set. With some compression, so as to match our wage data to 1940 data on employment and thus to get employment weights for each industry, and with some approximations (mainly filling in a few years of missing wage data here and there, by interpolation), we can compute a single annual index of inequality in the wage structure.

To be precise, we have calculated the between-groups component of Theil T statistic, a well-known measure of inequality, for the 83 industries in our sample, by averaging them into 26 major groups and using 1940 employment weights from the *Historical Statistics of the United States*. Figure XXI displays the result. As noted previously, Appendix 1.4 gives details. As an absolute measure of wage inequality, our measure means little. But as a measure of *changes* in inequality it turns out to be very interesting indeed.

Clearly, the time path of this statistic does not square with any argument based on gentle changes. Our estimate rises in 1920-21, falls to a plateau in the 1920s, rises sharply in the Great Depression, and only comes down again, in a dramatic rush, during World War Two.

Figure XXII adjusts our inequality measure by a factor of 200 for visual comparison and reveals clearly what does track inequality in the wage structure: the unemployment rate. In a regression using only one variable, unemployment accounts for 83 percent of the variation in the Theil statistic. (Appendix 4 provides details). It is worth noting that we are looking here at and the dispersion of wages among the *employed*. The falling incomes of the unemployed have no direct effect on the computation of this particular inequality statistic.

What then is the contribution of the forces associated with the canonical roots to the movement of wage inequality as a whole? There is no reason *a priori* for clear associations to exist, for two reasons. First, the between-group Theil statistic is employment-weighted, while our clusters are not; it could be that major variations across clusters, picked up by the discriminant functions, affected only small groups of workers and therefore carried little impact on the Theil statistic. Second, even where some force significantly affects cross-cluster differentials, it may or may not affect the overall dispersion of wages, depending on whether initial differences in average wage levels between the clusters are large or small.[38]

A reasonable first test of the influence of our canonical forces on inequality is simply to add the variable most strongly correlated to each canonical root to the Theil regression. For the first root we have two potential proxies of equal power, and no strong *a priori* reason to prefer one over the other; they are the change of nominal GNP, and change in unemployment. We use total workers involved in strikes as our proxy for the second root, and the foreign exchange index for Japan for the third. We would expect the signs *a priori* to be positive for GNP growth, negative for the change in unemployment, and negative again for the strike variable. It appears from our earlier analysis that high growth rates benefited relatively high-wage workers -- because the surge of investment would raise the incomes of construction, capital goods, and durable-goods producers -- while strikes benefited relatively less-well-paid workers. For the sign of the exchange rate variable we have no theoretical prediction, for that would depend on the particular pattern of trade relations between the U.S. and Japan, as well as the extent to which the US/Japan exchange rate may have tracked rates with other countries for which we do not have data.

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Unemployment raises inequality and again does most of the work in these equations. The growth of GNP or the change in unemployment, on the other hand, have the expected effects: initially, increases in aggregate demand increase inequality; it is only with sustained high employment that inequality declines. We are inclined to take both results as continuing confirmation of the primacy of aggregate demand effects on the wage structure.

To our surprise, given the independent power of the unemployment variable, the coefficients on both the labor and dollar/yen variables are also significant in this regression, with negative coefficients. The labor variable thus exhibits the correct sign; we have no interpretation for the sign of the exchange rate index. Overall, the regressions explain around 95 percent of the variance in the Theil statistic. Durbin Watson statistics do indicate serial correlation in the residuals; we therefore caution against over-interpreting the significance of our T-statistics..

The historical picture this analysis suggests is straightforward. At the end of World War I, the structure of wages in the American economy resembled what it would look like almost a generation later (or, for that matter, two generations later). But after the brief post-war boom this relatively egalitarian wage alignment disintegrated, under the hammer blow of the recession of 1920-22, when unemployment soared. A recovery in the early 1920s led to a plateau for the rest of that decade, until the Great Crash of 1929.

The Depression of 1929-32 drove inequality upwards, as the low wage farm sector, still forty percent of all employment, collapsed. The dollar depreciation in 1933 exacerbated this effect, though as we argued it may also have contributed to the rise of labor militancy, which

worked to reduce inequality -- however the effects of this force remained swamped by unemployment. Only the full employment policies and direct controls of World War II, accompanied by a strong movement for greater wage equality within the trade union movement, returned the wage structure by 1946 to something like, and actually more egalitarian than, it had been in 1920.

Indeed, so powerful was the wartime rise in the lowest wages that the whole labor market began to change in ways not well captured by our study. It is well known that as the price of unskilled labor rocketed upward, employers began accepting and in many instances recruiting new sources of unskilled labor. Depending on the nature of the work process, the location of production, and other variables, they began to hire larger numbers of women, Negroes, Mexicans and Puerto Ricans as these groups were then called. In effect, sustained full employment restructured the market for unskilled labor. And many of its biggest beneficiaries were groups that had been largely excluded from both manufacturing employment and education before the War (Haddy and Tolles, 1957).[39]

And yet, and yet: despite its artificial, government-inspired and policy-driven origins in a temporary emergency, the World War II wage alignment persisted. Instead of deliberately engineering a recession, as the Federal Reserve Board did in 1920-21, policy makers after World War II managed to avoid the worst macroeconomic mistakes of the earlier period. Encouraged by the postwar strike wave, the spread of Keynes' views, the beginning of the Cold War and later the war in Korea, they maintained high levels of aggregate demand and employment nearly consistently for 25 years, if rarely attaining "full employment."

Theorists who see this process as importantly driven by education and changing skill levels are, we believe, in danger of putting the cart before the horse. The G.I. Bills came at the very end of the period we are concerned with, and the National Defense Education Acts and Great Society education programs lay far in the future. For all the success of the public schools, access to education between 1921 and 1947 remained very far from equal. Indeed, though the question would require another paper, it seems likely that the vast increase in education levels that followed the war owed much to the prior leveling of the wage structure and the new political structures engendered by the New Deal. And we suspect that those business groups who accepted the G.I. Bills but worked hard to prevent the Employment Act of 1946 from becoming what its original sponsors intended -- the Full Employment Act of 1946 -- well understood that the *Weltknoten* could be unraveled.[40] They had already grasped what our study has told us. They knew that no public policies work so reliably to reduce inequality as the deliberate, simultaneous effort to combine full employment with collective bargaining rights and rising wage standards.

Notes

This paper represents a particularly pleasant case of joint work, so that the alphabet settled the order of the authors' names; they are, respectively, Professor of Political Science, University of Massachusetts, Boston and Professor of Public Affairs and Government, University of Texas, Austin.

1. The persistence of the mid-to late forties wage structure and the role of pattern bargains are widely acknowledged, see, e.g., Goldin and Margo, 1991, p. 1, who cite Thurow, 1975, p.111. See also Eckstein and Wilson (1962) and Maher (1961a) and our comments below on the "Great Red Spot." Various analysts date the decay of that wage structure differently, but no one known to us any longer disputes the fact of that decline.

2. For reasons of space, the remainder of this essay collects as many references as possible in a single footnote at the end of each paragraph. A good, if sometimes curiously selective, overview of recent work in English on inter-war wage adjustment and the controversies over relief is Eichengreen, 1992. See esp. pp. 216-218. See also Eichengreen and Hatton, 1988 and Borchardt, 1991, Chapters 9,10, 11. Wallis, 1989, is another interesting analysis of the relief and wages controversy in the US.

3. Our dating of the earlier wave of wage structure studies follows Dunlop, 1988, p. 58; the second wave of wage studies now includes a huge number of papers. See, e.g., the references

in Goldin and Margo, 1991. On the notion of "wage structure" see the classic reference by Ross, 1957.

4. Compare Cullen, 1956; Backman and Gainsbrugh, 1948, Slichter, 1950; Reder, 1962 (especially p. 269); Bell 1951; Lebergott, 1947; Keat, 1960; Maher, 1961a; and Dunlop, 1988. While not an inter-industry study, Ober, 1948 also contains much of interest.

5. Some of these differences, as the investigators quickly realized, were artifacts of data or method. Rank orderings of industries, for example, usually looked more stable than alignments founded on ratio or interval measures such as absolute differences in cents per hour. The common technique (which we, too, employ in our study) of tracing levels of wages in a consistent set of industries over a generation or more may mislead, by leaving out of account new industries that arose during the period or older ones that collapsed. Still, the first wave of wage structure studies topped out without resolving how much of a difference such differences ultimately made. See especially, Cullen 1956, which is quite complete. Note that a study like ours, which covers barely a generation, runs a much smaller risk of omitting important industries than studies spanning longer periods.

6. See Haddy and Tolles, 1957; by comparison, Haddy and Currell, 1958 is more conventional. Reder, 1957, pp. 276ff. brings out particularly clearly the neoclassical frame of reference in which most of these discussions moved. Discussions of market power did predominate in regard to one subject: labor unions, on which a vast literature arose. See, e.g., Lewis, 1962.

7. See Goldin and Margo, 1991; Goldin and Katz, 1995; in regard to the role of education,

the former is quite reserved, though suggestive.

8. Useful cautions appear in Dunlop, 1988, Slichter, 1950, especially its sobering note 1; Douglas, 1930; for geography, see especially Earle, 1993. For a review of data broken down by gender, see Goldin, 1990; in regard to race, see Sundstrom, 1993; for both race and gender, see also Amott & Matthaei, 1991. Note that during most of our period, fringe and supplemental benefits were quite unimportant as factors in compensation. They began to appear in some contracts in the late thirties, and became more important as a way around wage controls during World War II. In the post-war period, they certainly bulked rather larger, though by no means covering the whole labor force. See the discussion and data presented in Lewis, 1963, pp. 234ff. For this paper it is impossible to believe that neglecting them -- which all analysts known to us perforce have to do, since available statistics are meager -- could possibly make much difference, since our cutoff is 1947. It is interesting to note that economists writing about this period have usually been clear on this point, despite a vast literature by historians on the "welfare capitalism" of the twenties. The pathetically limited character of this movement is obvious in, for example, Lewis' data.

9. For Dunlop, see e.g, his (1957); among recent works on business history, see especially Jacoby, 1985; Chandler, 1962; and Lazonick, 1991; Katz and Summers, 1989.

10. Not wishing to waste available numbers, we include two composite series in the 83: one for the average wage on all public roads, and the other for the average of 25 manufacturing industries as computed by the Conference Board. Though redundant with the other data in the figure, they are useful markers and their inclusion does no harm.

11. It is reasonable to ask how sensitive these and other results presented in this paper are to slight variations in our methods. Two issues in particular may provoke concern: our reliance on annual data and the particular time period we chose to analyze. Would our results differ significantly if either of these varied? Our attention was drawn to the first possibility by John Dunlop, who asked us how our methods would register industries which were in fact patterning their wage settlements after each other, but only after a lapse of some time (as for example, when the lagging industry's contract expired early in the following year). Several points seem important here. First, while some non-unionized industries may have been informally tracking each other, very few of the industries we analyze had formal union contracts during most of the period we analyze in this paper. While it is easy to imagine extreme cases in which an industry whose contracts expire in February follows another industry that settles in November, such cases could not be regular events without long term contracts. More commonly, especially in a predominantly non-union era, informal pattern bargaining figures to distribute randomly throughout the year, or over the business cycle, which would cause no persisting problems with our methods. Neither would the processes discussed by Mehra, 1976, p. 307, in which not formal pattern bargains, but similarly interacting product and labor markets produce the correlated wage changes.

Nevertheless, this possibility still worried us. Fortunately, NICB data for most of the manufacturing industries in our data set are available on a monthly basis between 1920 and 1937. Such data inevitably will be very noisy. But when we analyzed all the industries for which complete monthly data exist (our methods are sensitive to missing data) only two industries switched positions from where they placed according to annual data over the same time period --

and there is reason to believe that these industries were affected by the accidental termination of our series in the middle of a strike wave (one was rubber). One should also note that while possibilities like these occasioned much discussion in the post-war literature over pattern bargaining, no actual argument over which industries were actually in a hypothesized pattern ever seems to have turned on this question. Compare the discussions in Ross, 1957; Maher, 1961a and 1961b; Mehra, 1976; Eckstein and Wilson, 1962, where the discussions focus on simple failures to include particular industries in samples. (This is not our problem, since every industry for which we have data is in the sample.) Note also that while our different time period inevitably distinguishes our results from those of analysts who concentrated on post-war pattern bargains, our data for the forties differs little from traditional accounts of the pattern. In regard to the time period, see the discussion below in regard to the emergence of pattern bargaining..

12. True, the eponymous hero was in fact a coal miner. But he worked in an economy whose degree of vertical integration would have been the envy of Carnegie or Frick. And it was the heavy industrial complex, not the coal mine, that captured imaginations.

13. For the political economy of various sectors and groups of firms in the inter-war period see Ferguson, 1995a; the key point is that many protectionist firms did some exporting into particular regions even as they argued strenuously for tariffs in their home market. During most of the period, the decisive political cleavage lay between firms that were truly successful multinationals or exporters, and those that weren't; their comparative statuses fluctuated with the world economy.

14. Compare the various economic criteria discussed in, e.g., Mehra, 1976, Ross, 1957, or

Eckstein and Wilson, 1962.

15. Just how highly developed the pattern became is suggested in Maher, 1961a and 1961b. On the contribution of unions, see also Soffer, 1959 and Mehra, 1976. A consistent application of the latter's viewpoint would lead to important modifications of the "labor rents" view.

16. For complaints during the Depression, see, e.g., Wyckoff, 1946. For the correctness of the complaints in the South, see Alston and Ferrie, 1985.

17. The data for the skilled and unskilled males as well as the data for men and women in manufacturing come from the NICB; see Appendix 2, which also indicates the source of the construction data.

18. Note that the restricted sample of industries and different period of coverage assure that the resulting clusters differ from those in Figure I.

19. Besides the sources listed in Appendix 2, see also the table in Woytinsky, 1942, p. 169, for one set of statistics illustrating the differing percentages of women in various industries during the 1930s. The segmentation of jobs by gender within industries is obvious is many case studies. See, e.g., Gabin, 1990, pp. 12ff.

20. The key role of unions either in the textile industry, or very closely tied to it, is apparent in all accounts of the formation of the CIO. Along with the United Mine Workers, the International Ladies Garment Workers Union and the Amalgamated Clothing Workers of America appear to have been the biggest investors in the early drive for what became the CIO. See the brief discussion of the early financing in Zieger, 1995, p. 23 as well as the discussion in Galenson,

1960, Chapter I). The much smaller United Textile Workers and (parts of) the Hatter, Cap and Millinery Worker also figured in this effort. (Zieger, 1995, p. 24).

21. For the long decline of textiles since World War I, see, e.g., Galambos, 1966 as well as the discussion of the Taylor Society and the New Deal in Ferguson, 1995, pp. 137-38. On the Japanese export drive in textiles, see, e.g., Matsui, 1958, pp. 50-54, and Wright, 1995. Note that in many instances, cheaper Japanese imports of higher quality products (e.g., silks) were squeezing lower grade American products, such as rayons. This sort of pressure does not always register in standard trade statistics organized by particular product lines.

There is no reason to overstate a good case: There is no question that the full force of devaluation was stayed, not least by conservative monetary policy (Eichengreen, 1992, pp. 342-47; though we would analyze the whole episode rather differently). Also, as discussed below, the prevalence of high tariffs and exchange controls in the rest of the world inevitably limited the success of U.S. exports. The prospect of cartelization -- the inner meaning of the NRA -- also probably held a special attraction for the long depressed textile industry. The inventory boom that accompanied the early days of the NRA (as many firms sought to restock before prices rose) and the administration's slowly moving plans for unfreezing bank assets and increased public works spending no doubt also helped fire up industrialists -- and their workers -- with visions of potential profits. But in a world of depreciated currencies, devaluation was helpful to many industries seeking to reclaim the home market, if not the rest of the world, particularly from Japanese competitors.

22. For the geographical overlap between some of the militant coal mining areas and

textiles, see Montgomery, 1994, p.344-45 and Bernstein, 1970, pp. 76-77. Montgomery notes the wildcat nature of many of the early 1933 strikes and indicates that the link with textiles was strongest in the anthracite region. That our own data series for coal mining is for bituminous coal is irrelevant in this context: both areas were in an uproar and strongly affected by the UMW; data specifically for the anthracite regions showing parallel wage movements in this period can be found in (Commerce, U.S.D.o., 1936, p. 33). Foner (1980, p. 286) also mentions an overlap between textiles and mining in parts of the South. These latter mines probably were bituminous; note that in this period while southern textiles workers were not striking with anything like the frequency of their northern counterparts, the (less comprehensive) data indicate that their wages were rising, too.

Given the critical role played by the "alliance" between the Mine Workers and the unions in textiles (broadly construed), John L. Lewis's own attitudes toward women were plausibly of real importance to the workings of devaluation. While Lewis and other UMW leaders undoubtedly shared some attitudes toward womens' social roles that could charitably be termed "Victorian," (Dubofsky and Van Tine, p. 201) and the CIO was never likely to be confused with the Women's Trade Union League (Gabin, 1990), Kenneally (1981, p. 164) observes that Lewis had long been an annual contributor to the Women's Trade Union League, "vigorously" supported the equal pay movement in the NRA codes, and in a New York Times interview committed the new CIO to equal pay for "substantially the same work." See also Foner, 1979, especially p. 320-22.

For the investment approach to party competition, see Ferguson, 1995a.

23. Kenneally, 1981, pp. 156ff., has a short but illuminating discussion of the NRA equal pay movement. He notes that some twenty-five percent of the codes still clearly discriminated against women workers, though the episode was widely acknowledged to have given the equal pay movement an enormous lift. His discussion is a warning of the pitfalls of any econometric effort to neatly divide politics from economics in this period or to partial out the influence of "government" from "unions." The only woman appointed to the NRA's Labor Advisory Board (who strongly and rather successfully championed the principle of equal pay) was on leave from the Women's Trade Union League.

24. On the role of monetary policy in bringing about the 1920-21 recession, see Hicks, 1974, pp. 209ff. The U.S. case is clear cut, particularly in regard to why the policy of tight money continued so long: "Governor Strong and Dr. Miller thought wages were still too high." (D'Arista, 1994, p. 61; summarizing material from Fed minutes and policy directives from early 1921.)

25. For the striking rise in injunctions, see the data in Witte, 1932; after 1920 the trend could be mistaken for a power series; for the use of troops, see the discussion and sources in Ferguson, 1995b. Cf. also Goldstein, 1978, for statistics on meetings broken up by the authorities. As the Secretary of the Treasury, himself a major Pittsburgh mine owner, famously observed at the time: "You can't run a coal mine without machine guns." (What Mellon actually said was: "You could not run without them." Cf. Koskoff, 1978, p. 304.)

26. The pursuit of minimum wage policies embraced a good deal more than passage of the well known minimum wage laws in this period. See, e.g., Strackbein, 1939; rules on government

procurement were one such policy lever.

27. The links between economics and politics in this period are complex, but very powerful. It is futile to attempt to untangle all of them. Wartime government policy affected wages not only through the policies of the National Labor Relations Board -- itself, of course, one of the earlier fruits of the high New Deal -- but through war time controls that often both deliberately favored unionization under moderately conservative trade union leaders, but also frequently sought to level up wages of the lowest paid workers and prevent wage cuts. In contrast to later times, many parts of organized labor supported this project -- indeed prominent labor leaders favored continuing wage controls after the war, along with wage policies that awarded the largest percentage rises to the lowest paid, rather than the most senior. This era has virtually vanished from historical memory, but see Montgomery, 1993. Employer resistance to these trends was quite fierce, and spilled over into major conflicts over state as well as national labor laws. The issue of equal pay also received attention during the war, particularly from the National War Labor Board. See, e.g., Board, NIC, 1943.

28. See e.g., Dunlop, 1957, Chapter 7; on Kalecki's "degree of monopoly" and subsequent controversies about this notion, see especially, Sebastiani, 1994, particularly chapter 2 and Sawyer, 1985, pp. 28-42. Mehra's discussion (1976, p. 307) is also considerable relevance here.

29. Another potential proxy for the change in aggregate demand might be the negative of the change in the unemployment rate. Not surprisingly, a plot of this series against the first root also shows a good fit, with a nearly identical correlation coefficient of .41. The correlation of real

GNP movement to this root is somewhat lower: 0.31. We should note here that for expository purposes in Figure IX we have taken the negative of the calculated first root from the discriminant function; for consistency we also take the negative of the calculated canonical scores. So long as consistency between coefficients and scores is preserved, this should have no effect on the analysis.

30. Estimating which parts of the economy were unionized at what points in this period can be tricky, but the cases we discuss here are not controversial. See the discussion in Lewis (1963, pp. 258ff.). Troy (1965) is also helpful.

31. Lost strikes usually do little to enhance the power of labor. In the thirties, there is no doubt that labor's success rate skyrocketed. But statistics in fact exist for part of our period and confirm that the percentage of won strikes began rising -- at first very gently -- in the late twenties. See Griffin, 1939, and also the discussion in Edwards, 1981, p.139. There is no question that the Wagner Act, originally passed in 1935 and influenced by the earlier Railway Labor Act (Ferguson, 1995a, p. 171, n. 104) eventually made a major difference in the outcomes of labor disputes in this period. But it should be noted that only continued political pressures secured its effective implementation and that membership in unions truly soared during the War. See Appendix 2 for the data on won and lost strikes.

32. Leontief's industrial categories probably differ somewhat from ours; this is particularly the case for utilities, where he included petroleum, as well as coal. But given coal's continuing enormous importance, it probably matters little. An excellent summary of many trends in foreign trade, with details about how particular industries fared in the US and worldwide is Woytinsky

and Woytinsky, 1955. See especially pp. 120ff. An extremely interesting summary of trends in

agriculture is Ezekiel, 1932, which notes that many countries protected their agricultural

populations to preserve peasant proprietors as bulwarks against communism.

The figure is also of interest for its suggestion that textiles benefitted from the outbreak of

war in 1939.

33. Note that all immigration was not cut off during this period; immigration from North

and Latin America continued.

34. Goldin and Katz, 1995, document rising high school enrollments over time, increases

in the numbers and proportions of workers who had completed high school, etc.

35. On the differential distribution of educated workers across industries in the inter-war

period, see, e.g., the discussion in Goldin and Katz, 1995; and particularly their Tables A4 and 12.

36. In their Appendix, "Skill Ratios and Wage Distributions 1920s to 1950s," Goldin and

Margo (1991) suggest cautiously that some fluctuations during part of our period in a small

portion of the data within the railroad series indicate changes in premia to skill that could be

related to education. Our cluster analysis examines the whole structure of railroad wages. If

variations within the railroad sector were substantial, this should be reflected in diverging series.

But in fact variations within the railroad sector are among the smallest in the wage structure and

the principal source of variation arises from differences between the local and the through-freight

lines.

37. Note that education should presumably have its main impact on wages through its

effects on productivity. In this respect, the dismal record of econometric attempts to find relations

between most industry level variables and wages during the post-war period of pattern bargaining (e.g., Eckstein and Wilson, 1962) serves as an eloquent warning about overemphasizing productivity's effect on wage bargains.

38. A referee suggested that we attempt to measure the Theil statistic strictly across our eight large clusters. This, however, is difficult to do with precision, because the 26 employment categories available to us do not necessarily break cleanly into our eight large groups. At any rate, our work on Theil statistics persuades us that more disaggregation generally provides more precise estimation of the movement of inequality overall, which is the target of this particular phase of the analysis.

39. Because of the lop-sided distribution of capital gains that has historically accompanied big rises in the stock market (TNEC, 1940, p. 41-44), rising stock prices may of course sharply increase inequality in the wealth structure as they somewhat equalize the wage structure.

40. Haddy and Tolles, 1957, make the interesting point that substantial numbers of employers appear to have restructured their work schemes in order to tap into these untraditional reserves of labor.

41. On the politics of the 1946 Employment Act, see especially Collins (1981) and Burch, 1973.

Appendix 1

A Note on Methods

Our methods are distinctive in four respects. These are, first, the use of time-series data as a guide to aggregation and classification; second, the application of numerical taxonomy in the form of cluster analysis to determine group structure; third, the application of discriminant function analysis to the resulting groups, including the extraction of canonical roots that are, in consequence, themselves time series data; and fourth, the computation of a between-group Theil statistic from industrial and data.

1. Time Series Classification

The use of dated information as a tool for classification, though unknown in economics, is well-established in disciplines such as geology, paleontology and archeology. In evolutionary biology and social psychology, where living specimens may be observed, similarities in behavior through time can form the basis of a classification scheme. The same is true in epidemiology and applied medicine, whose diagnostics often rely on distinguishing patterns, through time, in a course of symptoms.

Classification by time-series has advantages from a formal or numerical perspective. Time-series can be converted to percentage rates of change, and therefore freed of all questions of units and scale. Each year measured is exactly equivalent to any other. As the data set expands with the passage of time, new information is acquired, but each new year is a declining proportion of the total information available. Once a sufficient set of years has accumulated, classification by time-series tends to be relatively stable.

In our view, changes in annual average hourly wages are well-suited to the industrial classification problem. The notion of industry-specific labor rents is helpful here. If capital markets clear, but labor markets don't, we should expect that rates of profit equalize across industries but that skill-adjusted rates of pay do not. There is, in fact, a persuasive body of information to this effect, summarized in Katz and Summers (1989).

Prior measures of industry-specific labor rents have been essentially static, based on the degree of monopoly power at a particular moment of time. But as degrees of monopoly change, then industry-specific labor rents will also change. And if that is so, then the patterns of change through time can serve as markers of similarity and difference among and between industries.

To summarize this argument: First, anything that alters the relative performance of an industry -- whether technological advance, changing structure of materials prices, or changing pattern of competition -- will eventually show up in the average wage that the industry can pay. Second, when a pattern of such changes is essentially identical in two separate industrial subclassifications over a long period of time and a wide range of historical experience, it becomes increasingly unlikely that this is accidental. Instead, similar effects result from structural characteristics that produce like reactions to common causes. And that being so, patterns of similar effects can be used for industrial classification.

2. Cluster analysis.

The application of cluster analysis to our problem is straightforward (See Galbraith and Calmon, 1994 for additional details). We begin with a rectangular nxt matrix, **H**, of annual average hourly wages by industrial subcategory, where categories are chosen to be as disaggregated as the available data permit. In the present analysis, we employ 81 separate industrial classifications, of which 31 are occupational subcategories in the railroad industry (including four series that are composites -- see Appendix 3), plus two composite time series (average wages across 25 manufacturing industries and average wages on public road projects across all regions) that happen to be available in our data set. We have virtually complete data for 1920-1947.

From **H**, we extract the nxt-1 matrix **G**, of percentage rates of change of average hourly wages by industrial subcategory, in this case for the years 1921-1947. Missing data at this stage are filled in by use of the annual average wage change across all categories. In this way, all data can be employed without undue distortion due to missing cases. **G**, of course, is unit-free.

Our cluster analysis evaluates the similarity of the paths through T-1 years of wage change in the n industrial subcategories. It is based on the Euclidean distance metric **d** in t-1 dimensional hyperspace, the standard measure of distance between two points u and v where u is the data point $(a_2, a_3, ... a_T)$ and v is the point $(b_2, b_3, ... b_T)$; in this case the a's and b's represent rates of change for each year.

Cluster analysis may take many different forms. We employ a hierarchical agglomerative procedure known as Ward's method, which adds elements to groups at each step so as to minimize the ratio of within-group to between-group variation in **d**. This method is known to produce relatively compact clusters, if clusters exist in the data.

As we say in the text, the choice of level of aggregation (number of groups) is substantially subjective. We do employ a measure of information loss from agglomeration as an approximate guide (not reported). Our essential technique in this paper, however, is eyeball examination of Figure I, using the vertical axis as a guide to the degree of separation between groups. Figure I has a number of possible stopping points; we choose seven distinct groups. One can quibble about this, but the fact is that one or two more or less makes very little difference to the analysis, so long as one follows the group structure of the tree diagram.

3. Discriminant analysis

In principle, cluster analysis reduces a *nxt-1* matrix **G** to the *kxt-1* matrix **G'**, which contains annual rates of change of average wages for the k *groups* identified. **G'** is an *efficient* reduction of **G**, since it contains (nearly) the largest amount of intergroup variation that can be achieved, given a decision to reduce n to k. The "average" rates of wage change so identified are not precise, since no weighting by the size of the component industrial subcategories is employed. But since the clusters themselves are chosen to minimize within-group differences in annual rates of change, this source of error cannot be very large. Knowing the relative size of the component subcategories becomes important only when one wishes to calculate average wage levels or other types of information for the composite groups that the cluster analysis has constructed.

The next step is to extract the principal elements of the intergroup variation. This is done through the derivation of the canonical roots of a discriminant function. In matrix notation, let **B**

be the kxk matrix of between-group sums of squares and cross-products in annual rates of change of wages, and let **W** be the corresponding nxn matrix of within-group sums of squares and cross products. Following Rencher (1992), we seek y=**a'x**, which maximizes $\sum (y_i - y) / \sum (y_{ij} - y_j) =$**a'Ba/a'Wa**. There will be k-1 canonical discriminant functions, each of which is a linear combination of annual impulses chosen to be uncorrelated and orthogonal to other such combinations and collectively to exhaust the information discriminating between the behavior of groups. Not all of the k-1 roots are economically significant, however, which is why we stop in this case at the first four which capture 98 percent of the between-group variation [tr(**W⁻¹ B**)].

Ranking canonical roots by their associated eigenvalues, we can arrive at the relative importance of mutually uncorrelated forces on the wage structure. The unstandardized coefficients of these canonical roots are themselves, in this particular case, time-series variates. It is appropriate to treat them as impulses, or forces affecting rates of change. To associate them with actual historical time-series, we may either report them as though they actually measured the rate of change of some underlying force, or else convert them to index numbers based on the year of origin of the data set (in which case they mimic the level of such an underlying force). This choice depends on the nature of the variables to which the canonical roots are being compared.

For practical purposes, we find the microcomputer program Statistica™ well-suited to the purposes we describe above.

In general, these procedures may be applied to any disaggregated time-series data set capable of smooth aggregation, including all data sets organized by hierarchical conventions. In our experience, they are a potent device for distilling and evaluating historical data organized by industry, and have applications also in the interpretation of national income and product accounts and in the analysis of government budgets.

4. Computation of Between-Group Theil Statistic

The between-group component of Theil's T statistic, T', is a well-known lower-bound estimate of inequality, that will converge to the population T as the group structure grows increasingly disaggregated. Our argument is that the movements of T' will be highly correlated with unobservable movements of T, and that therefore T' computed from our industrial data set is a useful indicator of changes in wage inequality, for a historical period for which household sample surveys do not exist on an annual basis.

The formula for computing T from grouped data is:

$$T = \sum (p_i \, \mu_i / \mu) \log(\mu_i / \mu) + \sum (p_i \, \mu_i / \mu) T_i$$

(2)

where p_i is the proportion of workers employed in the i-th group, μ_i represents the average income for the i-th group, μ represents average overall income, and T_i is the Theil T as measured strictly within the i-th group. The grouped Theil statistic is the weighted sum of that part of inequality that occurs between groups and a part that occurs within groups. The formula for T', the between-group-Theil statistic, is just the first (between-group) element in the formula for computing the Theil T from grouped data:

$$T' = \sum (p_i \, \mu_i / \mu) \log(\mu_i / \mu)$$

<div align="right">(3)</div>

Since the within-group element in variation is omitted, this is obviously a lower-bound estimate of dispersion.

For present purposes, as noted in the text, we used the Historical Statistics of the United States for 1940 to measure relative employment in 26 industrial groups, and compressed our 83 wage series into these 26 categories by taking simple averages of wage rates from the Conference Board and other data sets. In the case of farm wages, we estimated a pseudo-hourly wage rate from monthly earnings data. These procedures are necessarily rough. However, it should be noted that small errors in estimating individual group-wise wage rates, due to lack of appropriate within-group employment weights, are unlikely to have a significant effect on the large movements of the resulting Theil statistic.

Appendix 2
Description of Data

The principal source of hourly wage data for manufacturing industry in this study is Ada M. Beney, National Industrial Conference Board Studies No. 229, *Wages, Hours and Employment in the United States, 1914-1936*, New York: National Industrial Conference Board, Inc., 1936. Most of these data series were continued through December, 1937 in a Conference Board publication: *Wages, Hours, and Employment in the United States July, 1936-December, 1937*, which was issued as a Supplement to Conference Board Service Letter, June, 1938. Data for later years are drawn from issues of The Conference Board's *Economic Almanac*.

Construction wages are drawn from the 1942 and 1949 supplements to the *Survey of Current Business* (U.S. Department of Commerce). These series cover union and non-union worksites.

Wages in the printing trades are from "*Union Wages and Hours: Printing Industry -- July 1, 1967 and Trend 1907-67*" Bulletin No. 1592, U.S. Department of Labor, May 1968 and Part I of *Historical Statistics of the United States*.

Gas and electric distribution wages are in The Conference Board, *Economic Almanac for 1948*, p. 188.

Wages on public road-building projects are from US Department of Commerce, *The Statistical Abstract of the United States, 1951*, p. 202 and the *Survey of Current Business, 1936 Supplement*, p. 42.

Railroad wages are from Harry E. Jones, *Railroad Wages and Labor Relations, 1900-1952: A Historical Survey and Summary of Results*, Bureau of Information of the Eastern Railways, 1953. The data come originally from the Interstate Commerce Commission.

Hourly-equivalent wages for farm workers are estimated by the authors from annual data on *monthly* farm wage rates in U.S. Department of Labor, *Handbook of Labor Statistics 1950 Edition*. The method is to convert 1920 farm wages to an approximate hourly equivalent by dividing by average hours in manufacturing, and then to use the observed rates of change in monthly wages to generate the path of the corresponding pseudo-hourly series. Since farm hours exceed manufacturing hours by an unknown amount, this overstates the average hourly farm wage and understates the initial degree of inequality between agricultural and other wages when estimated on an hourly basis. But the patterns of change in wages or inequality should not be affected.

Employment data by industry for 1940 are drawn from the *Statistical Abstract of the United States, 1947*, Table No. 210, p. 191.

Data on strikes and unionization are from the Census Bureau, *The Statistical History of the United States from Colonial Times to the Present*, Stamford, Fairfield Publishers, 1965, and from William Goldner, *Strikes*, Institute of Industrial Relations, University of California, Berkeley, 1951.

Data on trade and commodity prices are from R.E. Lapps, *Price and Quantity Trends in the Foreign Trade of the United States*, Princeton, NBER, 1963, Tables A-3 and A-6

Macroeconomic data are from Robert J. Gordon, ed., *The American Business Cycle:*

Continuity and Change, Chicago: University of Chicago Press, 1986.

Exchange rate data are from Board of Governors of the Federal Reserve System, *Banking and Monetary Statistics, 1914-41*, Washington, D.C., 1943 and *Banking and Monetary Statistics, 1941-1970*, Washington, D.C., 1976.

Appendix 3

List of Industry Variables used and Variable Codes

Name	Figure I Code	Figure II Codes
25 Industry Average	Indus25	Ind25_MU,Ind25_MS
Agricultural Implement	Ag_Imple	Agi_MU, Agi_MS
Automobile	Auto	Auto_MU,Auto_MS
Boot and shoe	Boot_Sho	BS_MU,BS_MS
Chemical	Chemical	Chem_MU,Chem_MS
Cotton-North	Cotton	Cott_MU,Cott_MS
Electrical manufacturing	Elect	Elec_MU,Elec_MS
Foundries and Machine Shops	Foun_Mac	FM_MU,FM_MS
Foundries	Foun_Sho	Foun_MU,Foun_MS
Machines and machine tools	Machiner	Mach_MU,Mach_MS
Heavy equipment	Heavy_Eq	Heav_MU,Heav_MS
Hardware and small parts	Hardware	Hard_MU,Hard_MS
Other products	Oth_Foun	not used
Furniture	Furnitur	Furn_MU,Furn_MS
Hosiery and knit goods	Hos_Knit	HK_MU,HK_MS
Iron and steel	Iron_Ste	Not used
Leather tanning and finishing	Leather	Leat_ MU,Leat_MS
Lumber and millwork	Lumber	Lumb_MU,Lumb_MS
Meat packing	Meat_Pac	Meat_MU,Meat_MS
Paint and varnish	Paint	PV_MU,PV_MS
Paper and pulp	Paper_Pu	Pa_Pu_MU,Pa_Pu_MS
Paper products	Paper_Pr	Pa_Pr_MU,Pa_Pr_MS
Printing -- book and job	Books	Print_MU,Print_MS
Printing -- news and magazines	News	News_MU,News_MS
Rubber	Rubber	Rubb_MU,Rubb_MS
Silk (&Rayon)	Silk	Not used
Wool	Wool	Wool_MU,Wool_MS
Farm wages	FarmWage	Not used
Mid-Atlantic	Fa_Midat	"
Northeast	Farm_NE	"
East North Central	Farm_ENC	"
West North Central	Farm_WNC	"
West South Central	Farm_WSC	"
East South Central	Farm_ESC	"
South Atlantic	Farm_SA	"
Mountain	Fa_Mount	"

Pacific	Fa_Pac	"
Public Roads	Roads_US	"
Mid-Atlantic	Ro_Midat	"
Northeast	Roads_NE	"
East North Central	Road_ENC	"
West North Central	Road_WNC	"
West South Central	Road_WSC	"
East South Central	Road_ESC	"
South Atlantic	Ro_So_At	"
Mountain	Ro_Mount	"
Pacific	Ro_Pacif	"
Coal	Coal	"
Gas Utilities	Util_Gas	"
Electric Utilities	Util_Elec	"
Railroads	RR (1 to 31)	"
Common Construction	Comm_Con	Con_Comm
Skilled Construction	Skild_Co	Con_Skil

Key to reading the Railroad Categories in Figure I

Following are the 31 subcategories of wages by industrial subsector and occupation for the railroad industry listed in order of their appearance from left to right on Figure I.

RR 21 Road Freight Brakemen and Flagmen (Through Freight)
     14 Road Freight Conductors (Through Freight)
     8 Road Freight Firemen and Helpers (Through Freight)
     3 Road Freight Engineers and Motormen (Through Freight)
     25 All Other
     24 Switch Tenders
     23 Yard Brakemen and Yard Helpers
     16 Yard Conductors and Yard Foremen
     5 Yard Engineers and Motormen
     20 Total Road Freight Brakemen and Flagmen
     13 Total Road Freight Conductors
     7 Total Road Freight Firemen and Helpers
     2 Total Road Freight Engineers and Motormen
     19 Road Passenger Brakemen and Flagmen
     18 Road Passenger Baggage Men
     12 Road Passenger Conductors
     6 Road Passenger Firemen and Helpers
     1 Road Passenger Engineers and Motormen
     31 Maintenance of Way Group
     30 Stationary Engine and Boiler Room and Shop Laborers Group
     28 Shop Crafts Group

29 Clerical and Station Employees Group
27 Floating Equipment (Marine) Group
17 Assistant Road Passenger Conductors and Ticket Collectors
11 Outside and Inside Hostlers and Helpers
22 Road Freight Brakemen and Flagmen (Local and Way)
15 Road Freight Conductors (Local and Way)
9 Road Freight Firemen and Helpers (Local and Way)
26 Train Dispatchers Group
4 Road Freight Engineers and Motormen (Local and Way)
10 Yard Firemen and Helpers

Appendix 4

Determinants of Changing Inequality in the Wage Structure, 1920-1947

Dependent Variable: THEIL
(T-Statistics in parentheses)

Alternative Specifications

Independent Variables	#1	#2	#3	#4
UNEMP	**.918**	**.761**	**.906**	**.875**
	(11.1)	(9.17)	(14.4)	(15.0)
DUNEMP	--	--	--	-.177
				(2.98)
DNGNP	--	--	.215	--
			(3.03)	
DRGNP	--	.087	--	--
		(1.43)		
STRIKERS	--	-.310	-.238	-.275
		(4.12)	(3.26)	(3.98)
FOREXJAP	--	-.360	-.18	-.25
		(4.62)	(1.96)	(3.23)
CONSTANT	**0.03**	**.069**	**.05**	**.059**
	(12.3)	(9.17)	(5.94)	(8.24)
R2	.83	.94	.95	.95
D-W	.38	1.71	.92	1.04

Coefficients significant at .01 level shown in bold; note that with serial correlation in the residuals significance may be overstated.

Variables used:

THEIL: The dependent variable is the between-group Theil statistic computed for 26 industrial groups using 1940 employment weights, authors' calculations.
UNEMP: Unemployment Rate, from Gordon (1986)
DUNEMP: First difference of UNEMP
DNGNP: Change of nominal Gross National Product, from Gordon
DRGNP: Rate of change of real Gross National Product, also from Gordon.
FOREXJAP: Index of US/Japan exchange rates; no change assumed for the period after trade relations end in 1942-45.
STRIKERS: Number of workers involved in strikes, in thousands.
Coefficients reported are Durbin Betas.

NOTE: In an test of alternative specifications, we ran forward stepwise regression on a larger set of regressors including the three demand variables and the sterling exchange rate as well the yen exchange rate and STRIKERS. Regressors included in the results were UNEMP, DNGNP, STRIKERS and FOREXJAP, in that order. In a backward stepwise regression only UNEMP and DNGNP survived exclusion.

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Figure I

Clustering of Industries by Annual Rates of Wage Change
Ward's Method/Euclidean distances/1920-1947
Manufacturing, RR, Utilities, Coal, Agriculture and Roads
83 Industrial, regional and occupational groupings

Figure II
Wage Variation Between Skilled and Unskilled Male Workers By Industry
Clustering on Annual Rates of Wage Change for 1921-1937
Inter-industry variations dominate variations across skill classification
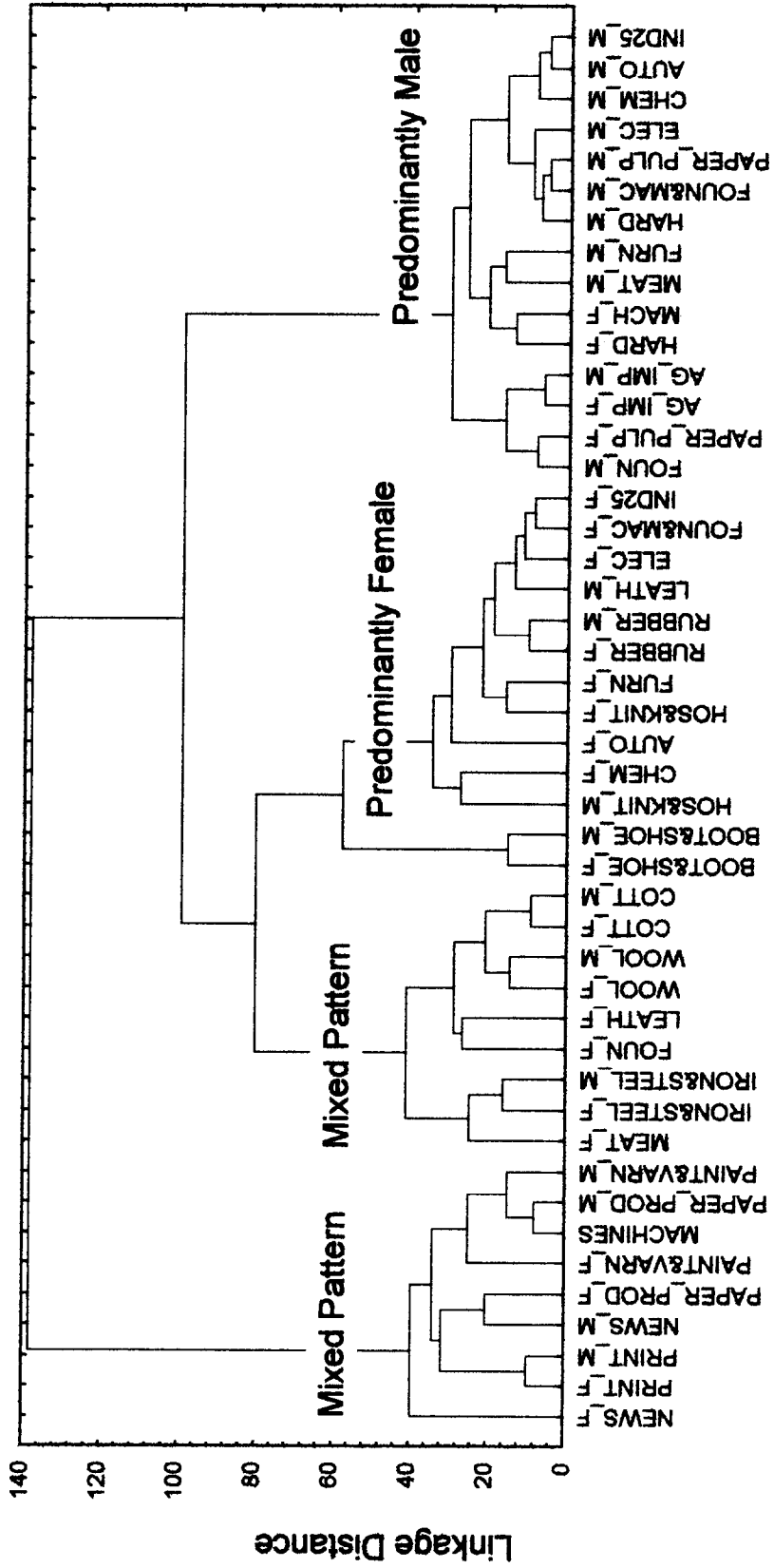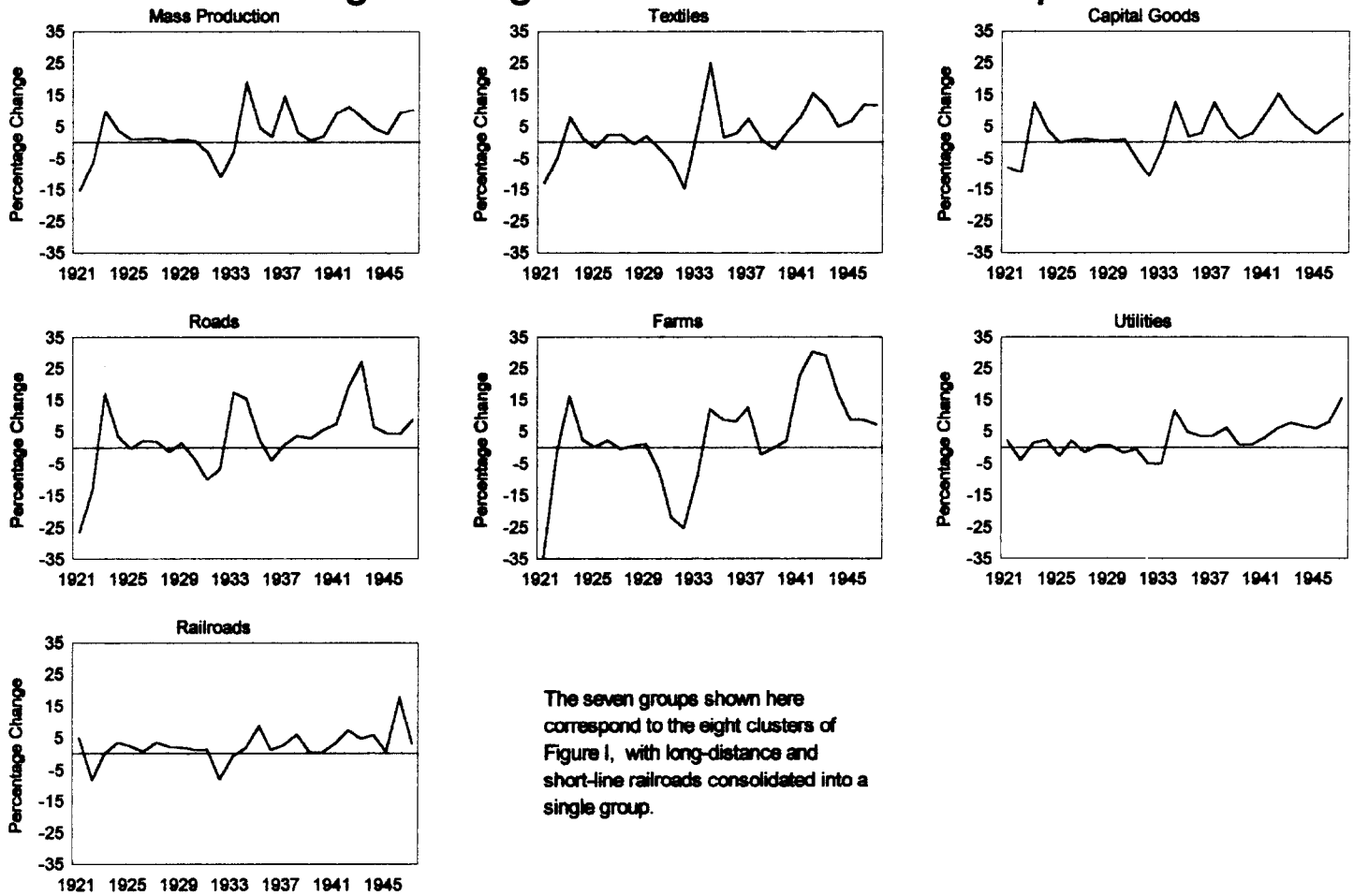Ward's Method/ Euclidean Distances
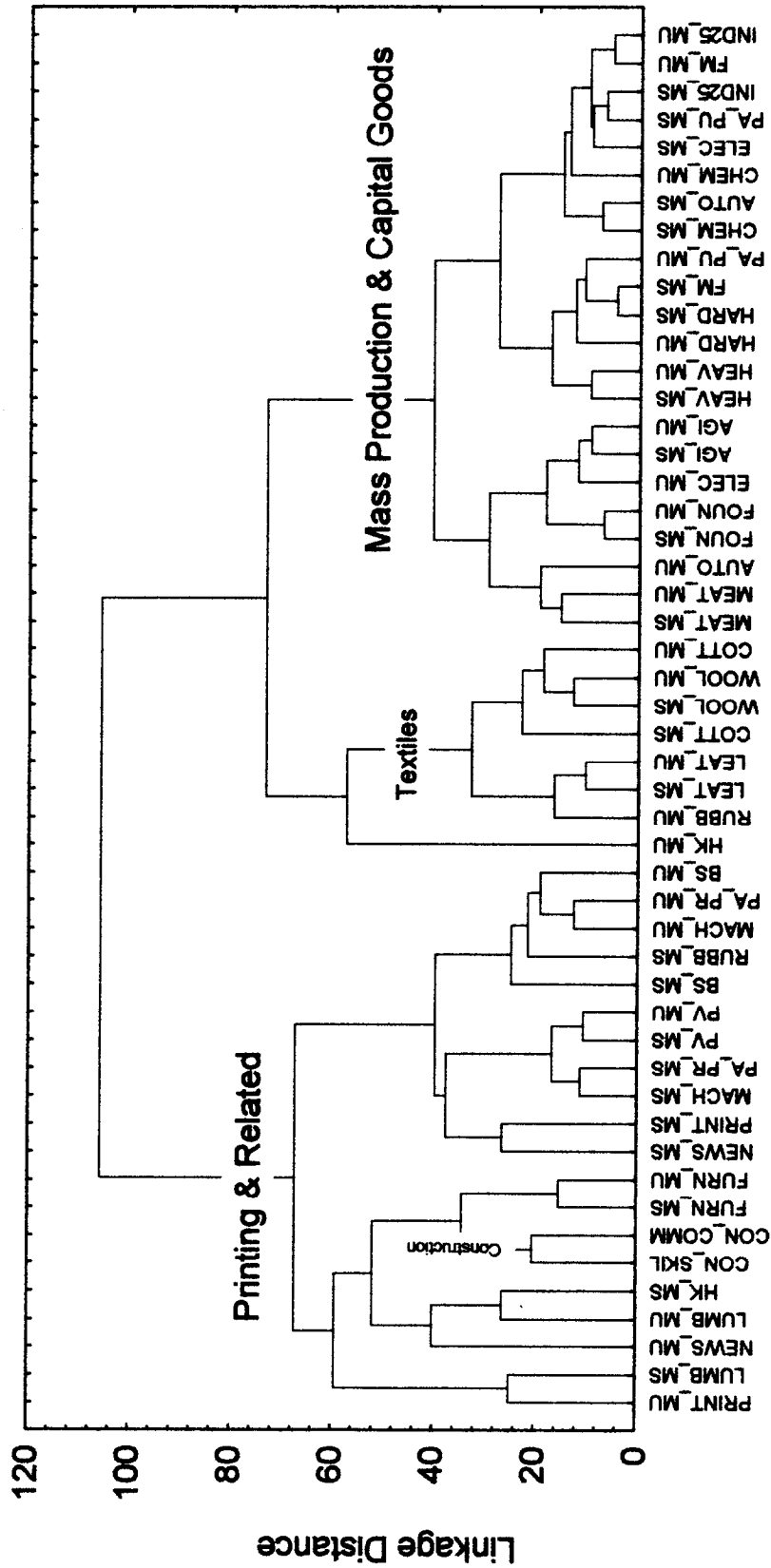
Figure III
Wage Variation Between Male and Female Workers By Industry
Clustering on Annual Rates of Wage Change for 1921-1937
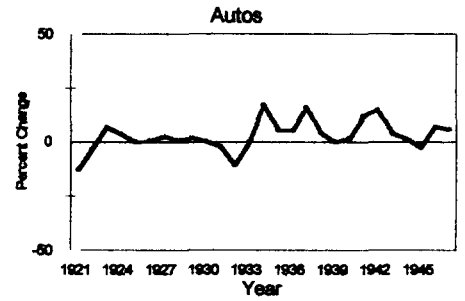Gender variations dominate industrial variations in some sectors, not in others
Ward's Method/Euclidean Distances

Figure IV
Wage Change in Seven Industrial Groups

Mass Production

Textiles

Capital Goods

Roads

Farms

Utilities

Railroads

The seven groups shown here
correspond to the eight clusters of
Figure I, with long-distance and
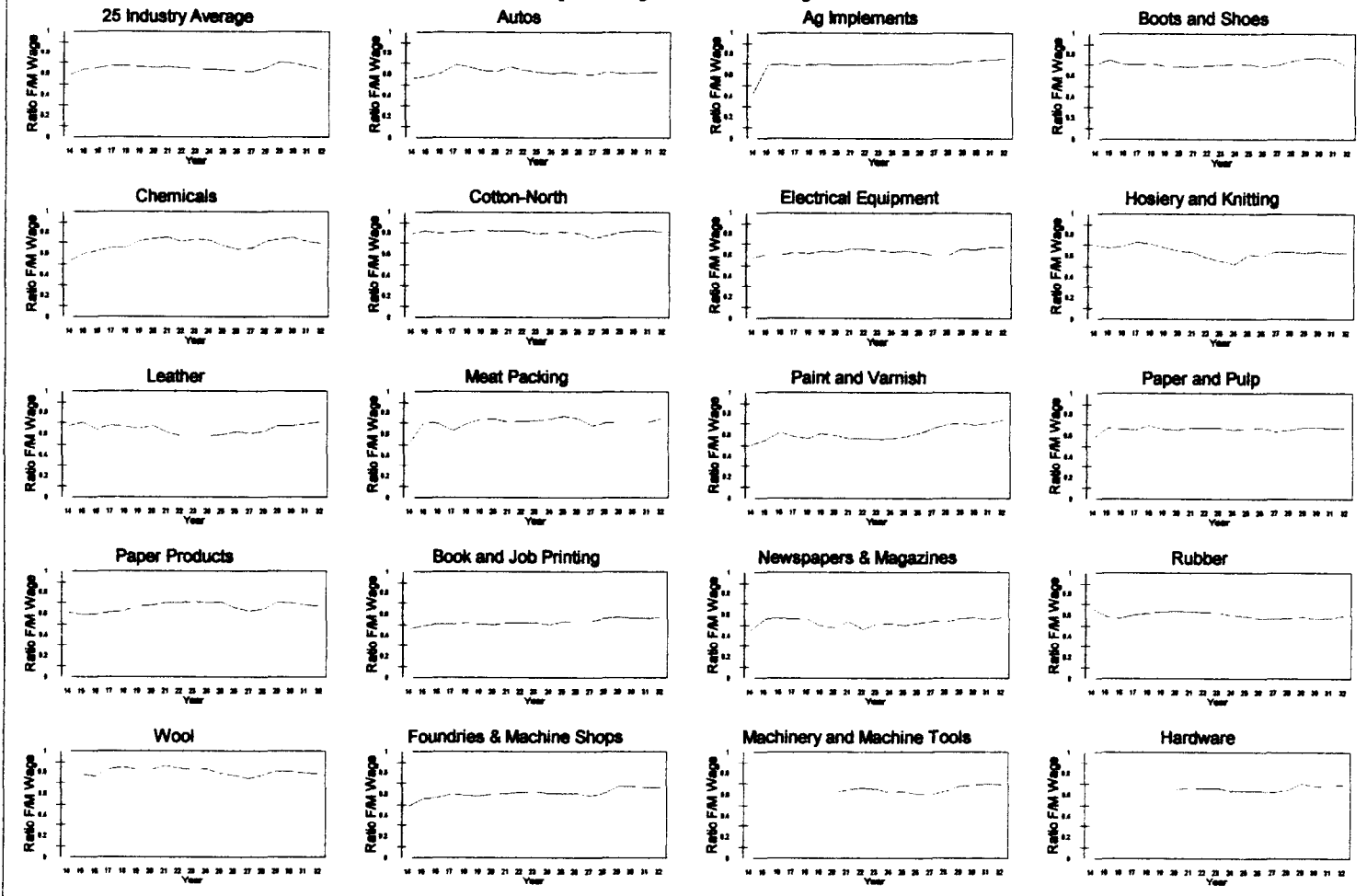short-line railroads consolidated into a
single group.

Figure V
Wage Change in Selected Industries
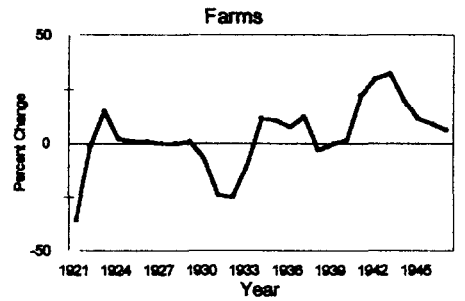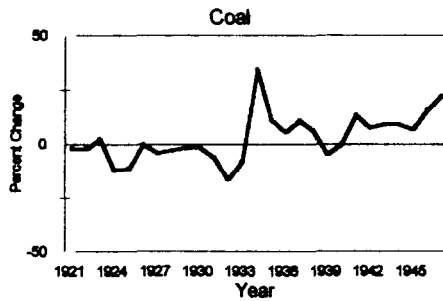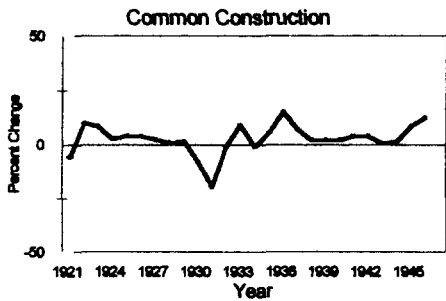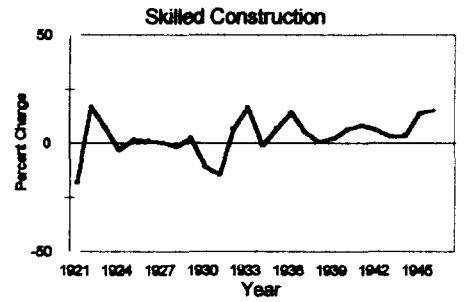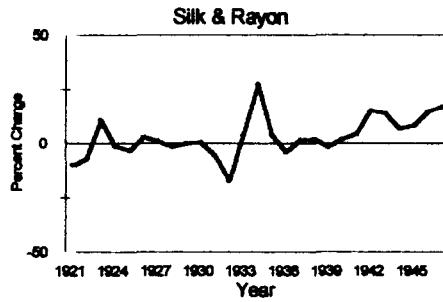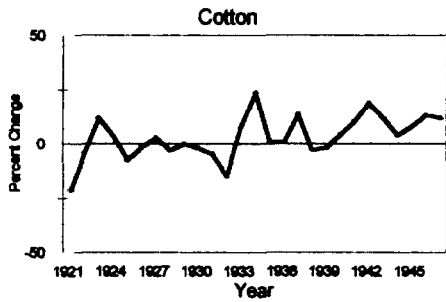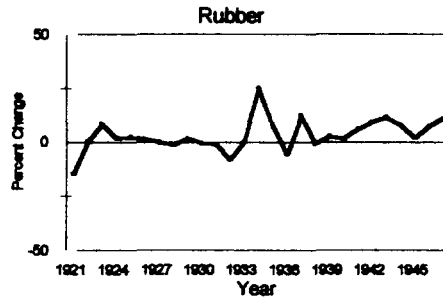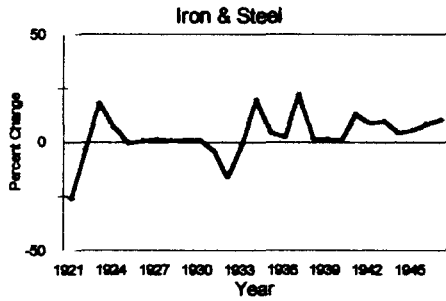
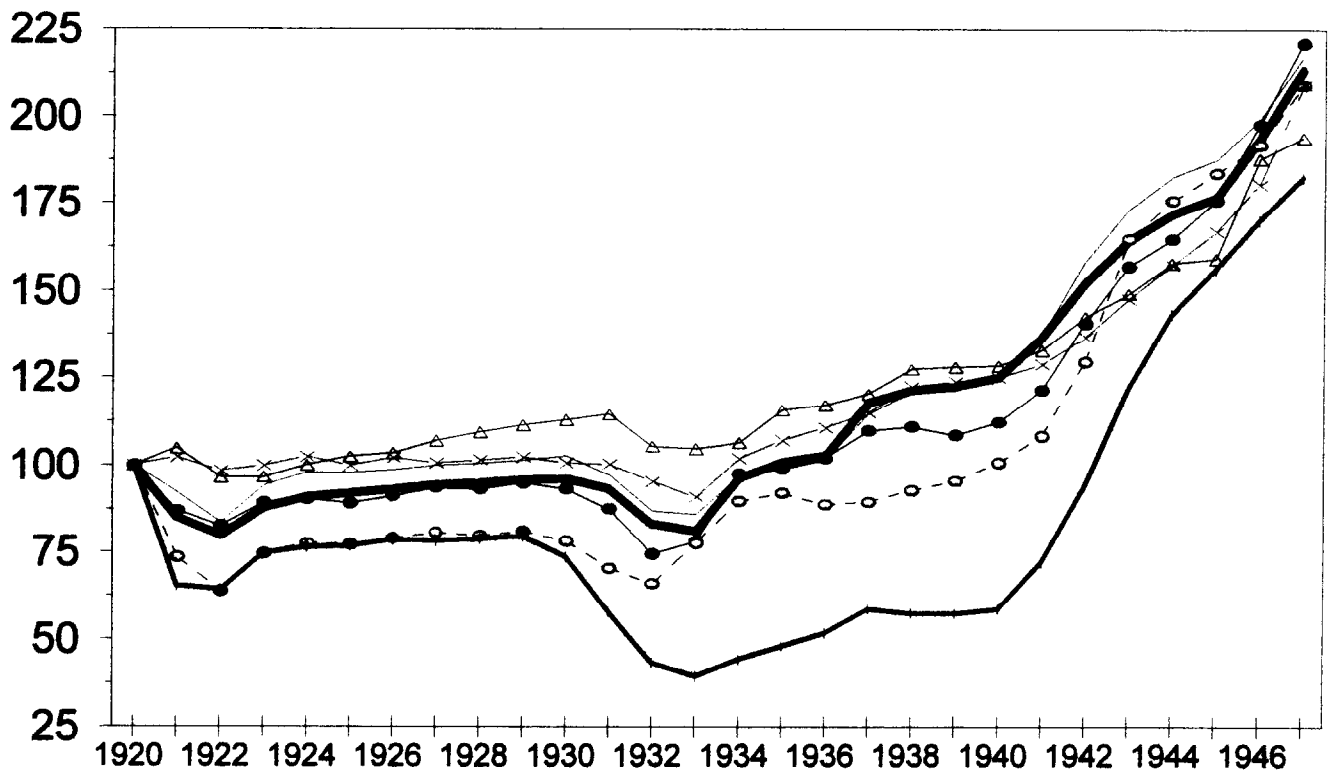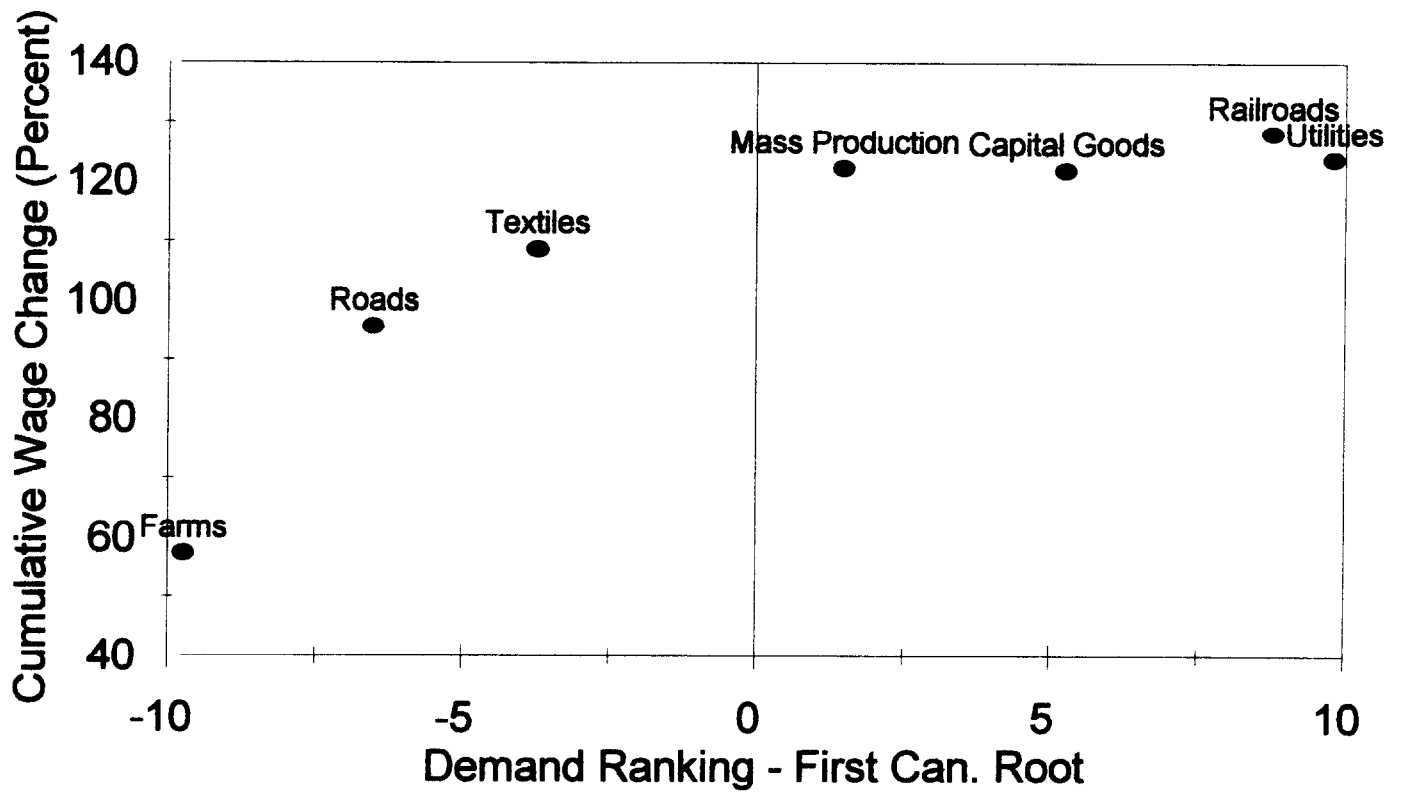# Figure VI
Gender Gaps by Industry 1914-1937
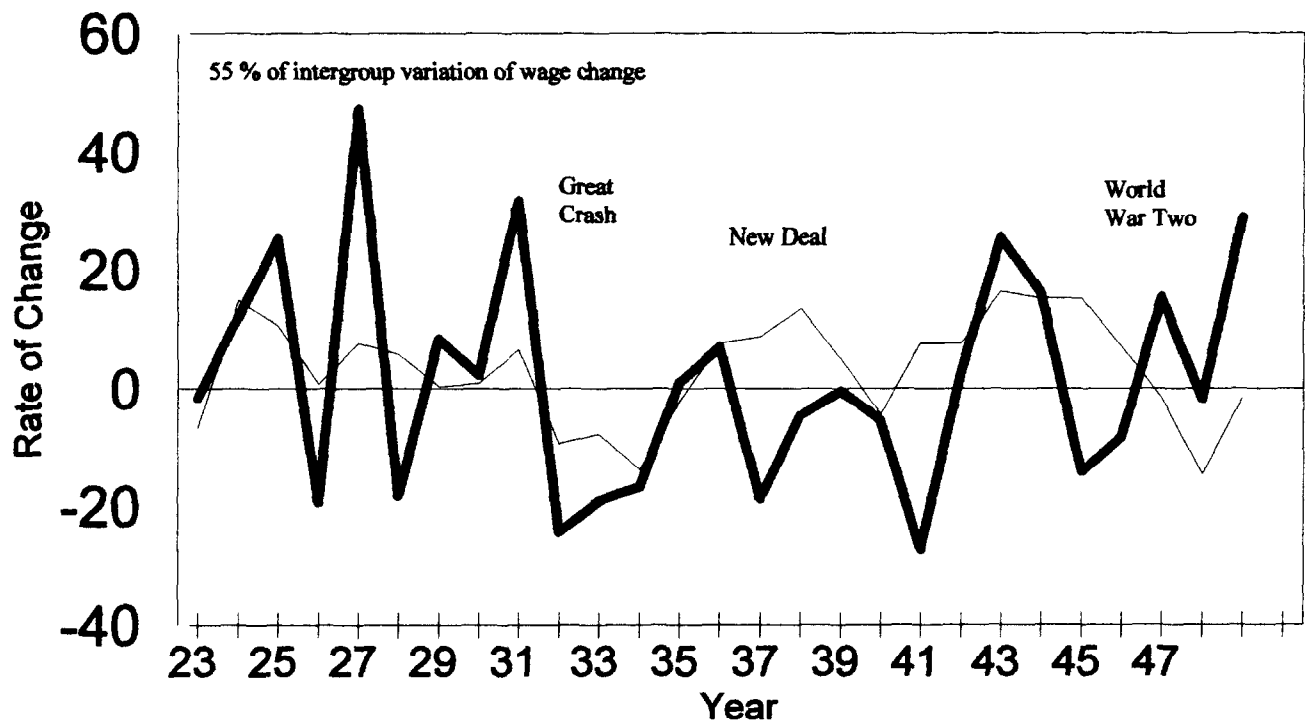
Figure VII
Evolution of Wage Structure 1920-47

Legend: Mass Production, Textiles, Capital Goods, Roads, Farms, Utilities, Railroads

Figure VIII
Demand and Wage Variation 1921-1939

(Scatter plot with x-axis labeled "Demand Ranking - First Can. Root" ranging from -10 to 10, and y-axis labeled "Cumulative Wage Change (Percent)" ranging from 40 to 140.)

Data points:
- Farms (≈ -9.5, 57)
- Roads (≈ -6.5, 95)
- Textiles (≈ -3.5, 108)
- Mass Production (≈ 1.5, 122)
- Capital Goods (≈ 5.5, 121)
- Railroads (≈ 9, 127)
- Utilities (≈ 10, 123)

Figure IX
Real GNP and the Demand Root

55 % of intergroup variation of wage change

Great
Crash

New Deal

World
War Two

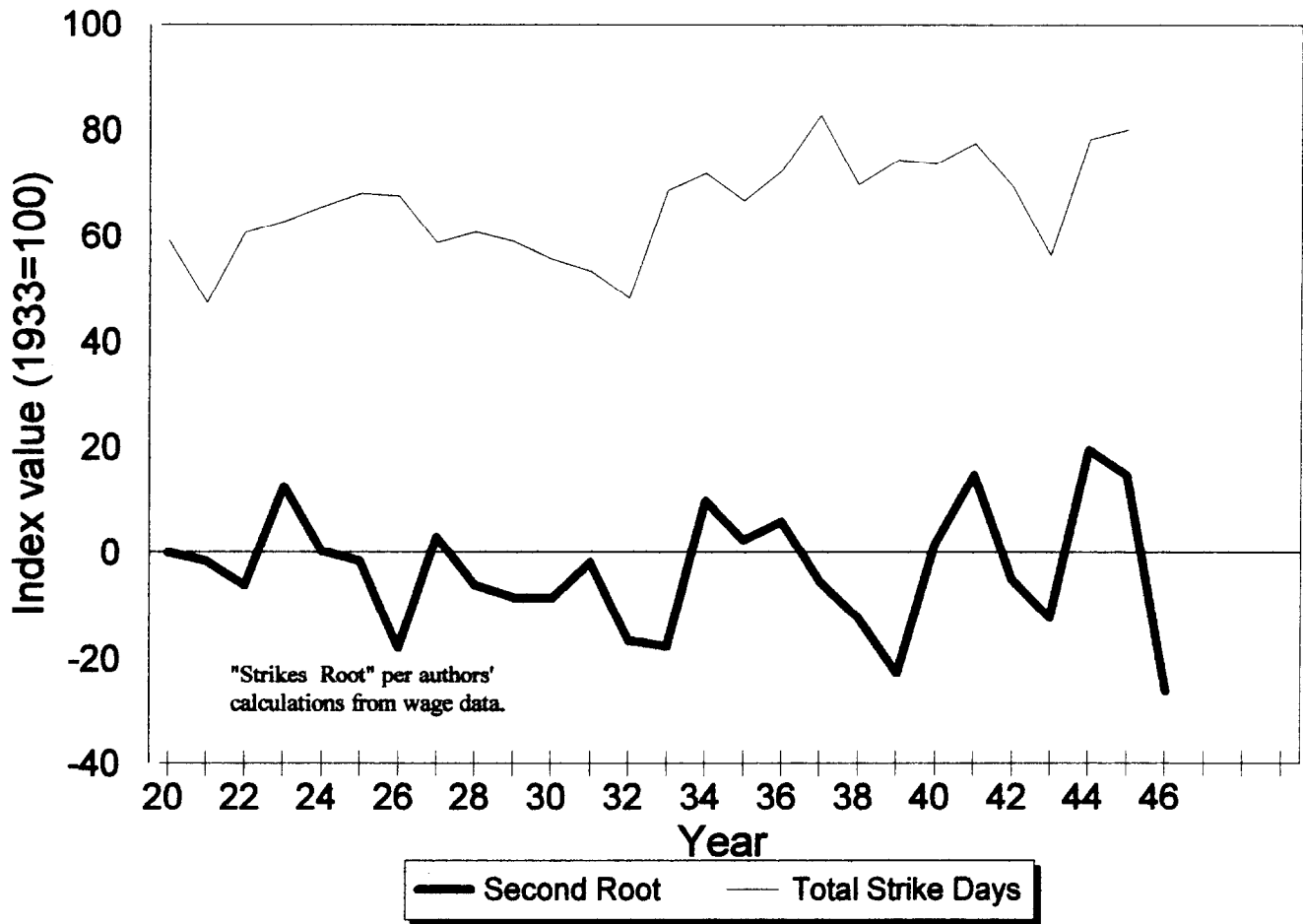Rate of Change

Year

Data on GNP Growth from Robert J. Gordon, The American Business Cycle:
Continuity and Change, Chicago: Univ. of Chicago Press.
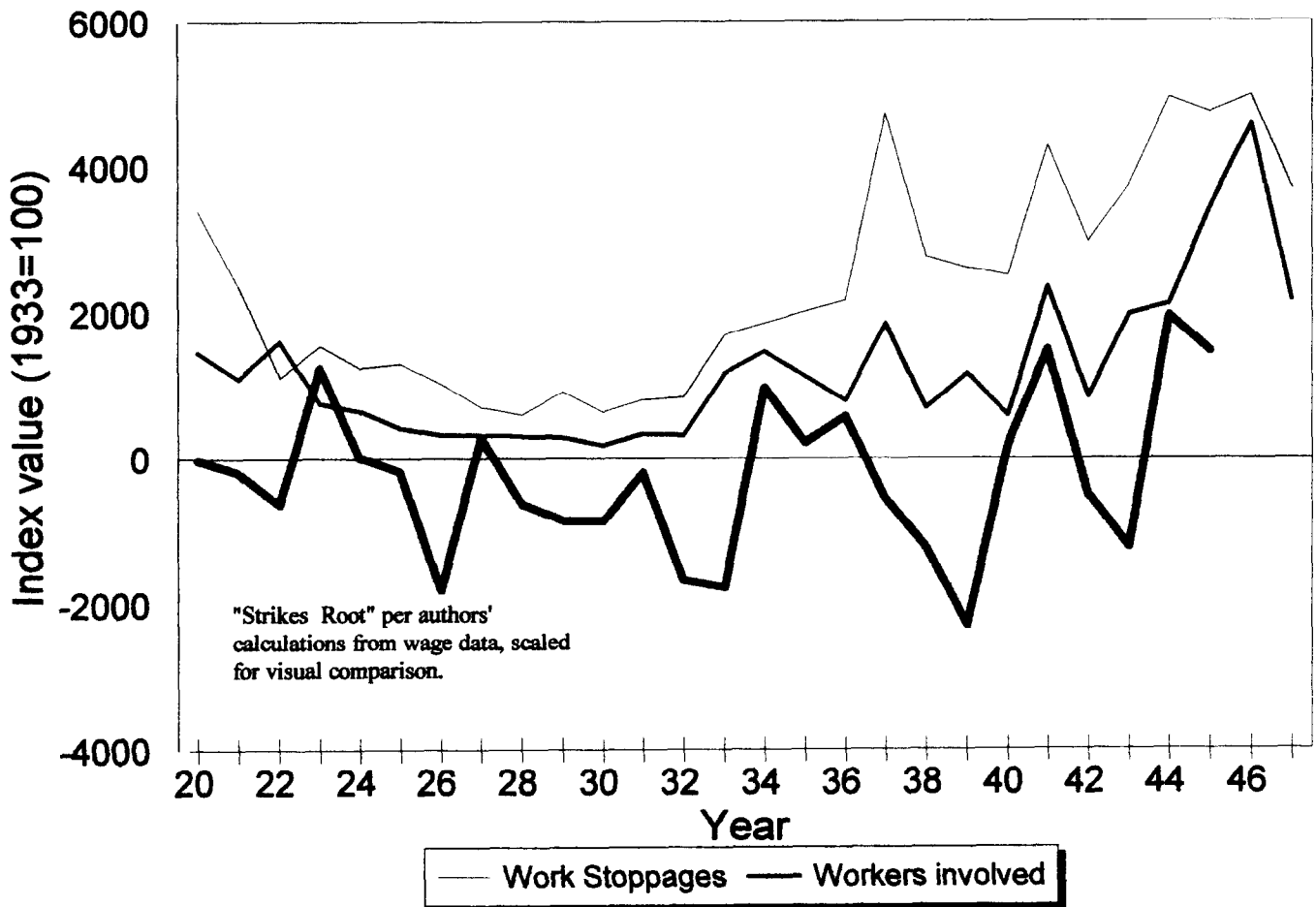
— Nominal GNP Growth   —— Demand Root (Scaled)

Figure X
The "Strike Root" and Wages 1921-1939

Cumulative Wage Change (Percent)

- Utilities
- Railroads
- Cap Gds
- Mass Prod
- Textiles
- Roads
- Farms

The high score of textile and road workers on the "labor root" probably reflects in part the effect on these groups of the minimum wage. The left-right ranking of the other industries on this root probably reflects union power and strike activity.

Strike Ranking - 2d Canonical Root

Figure XI
Strikes and the Strike Root

"Strikes Root" per authors'
calculations from wage data.

Index value (1933=100)

Year

Second Root   Total Strike Days

Figure XII

Strikes and the Strikes Root

"Strikes Root" per authors'
calculations from wage data, scaled
for visual comparison.

Index value (1933=100)

Year

—— Work Stoppages —— Workers involved

Figure XIII
Trade and Wages 1921-1939
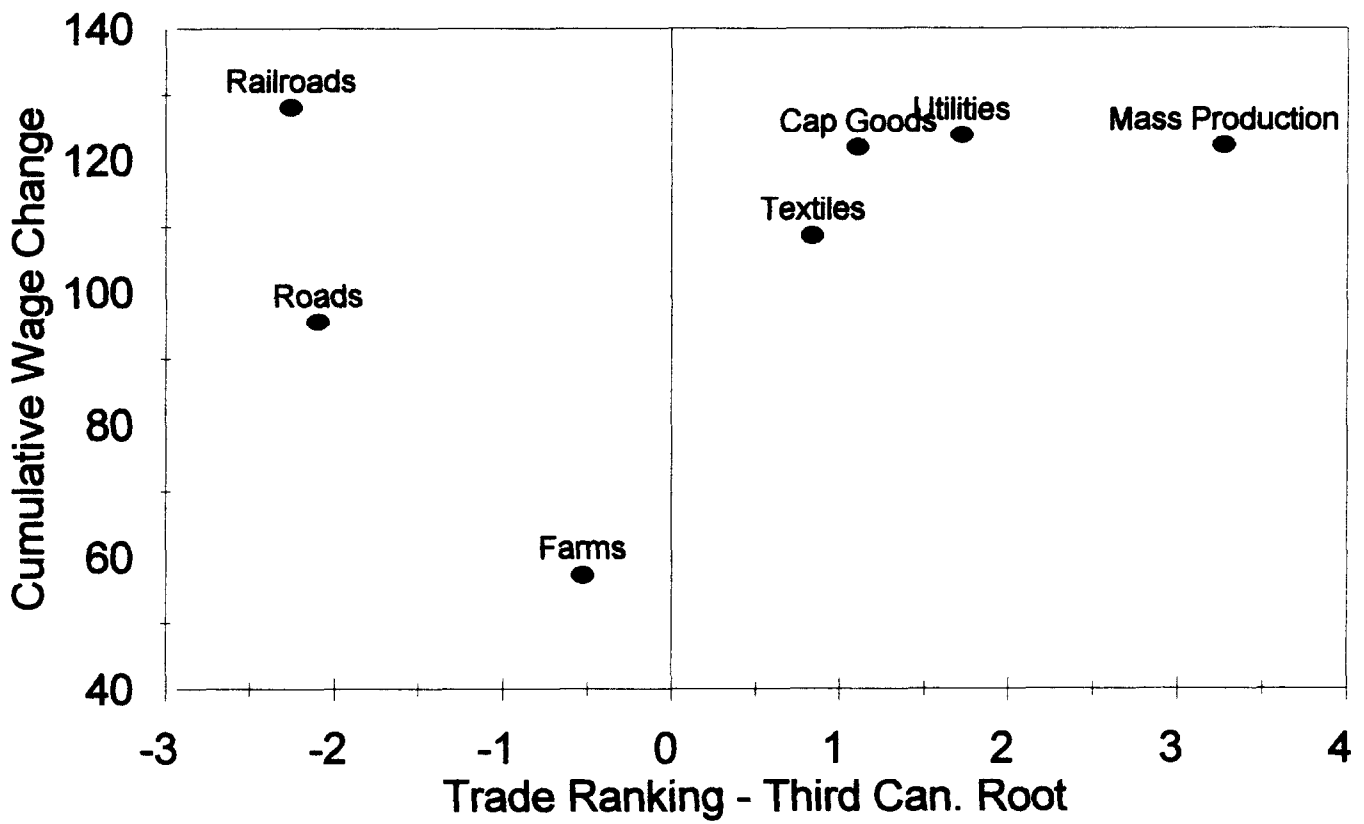
Figure XV
The Dollar and the Trade Root

15% of
intergroup
wage
variation.

US/UK
Exchange
Rate

"Trade Root" per authors'
calculations, from wage
data.

US/Japan exchange rate

Index value (1920=100)

Year
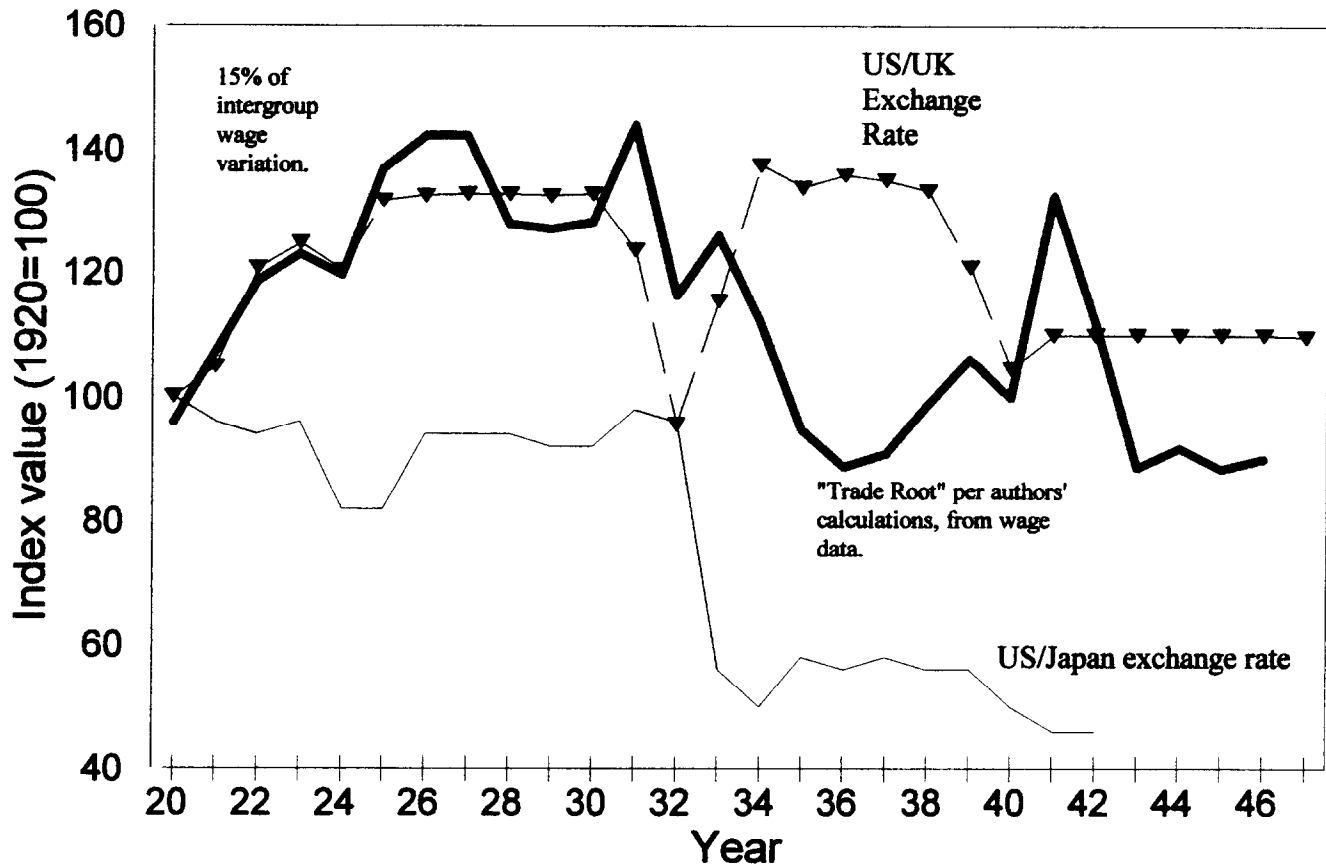
Figure XVI
The Mystery Root and Wages 1921-1939

Does the horizontal axis measure
"coal-intensity of production?"
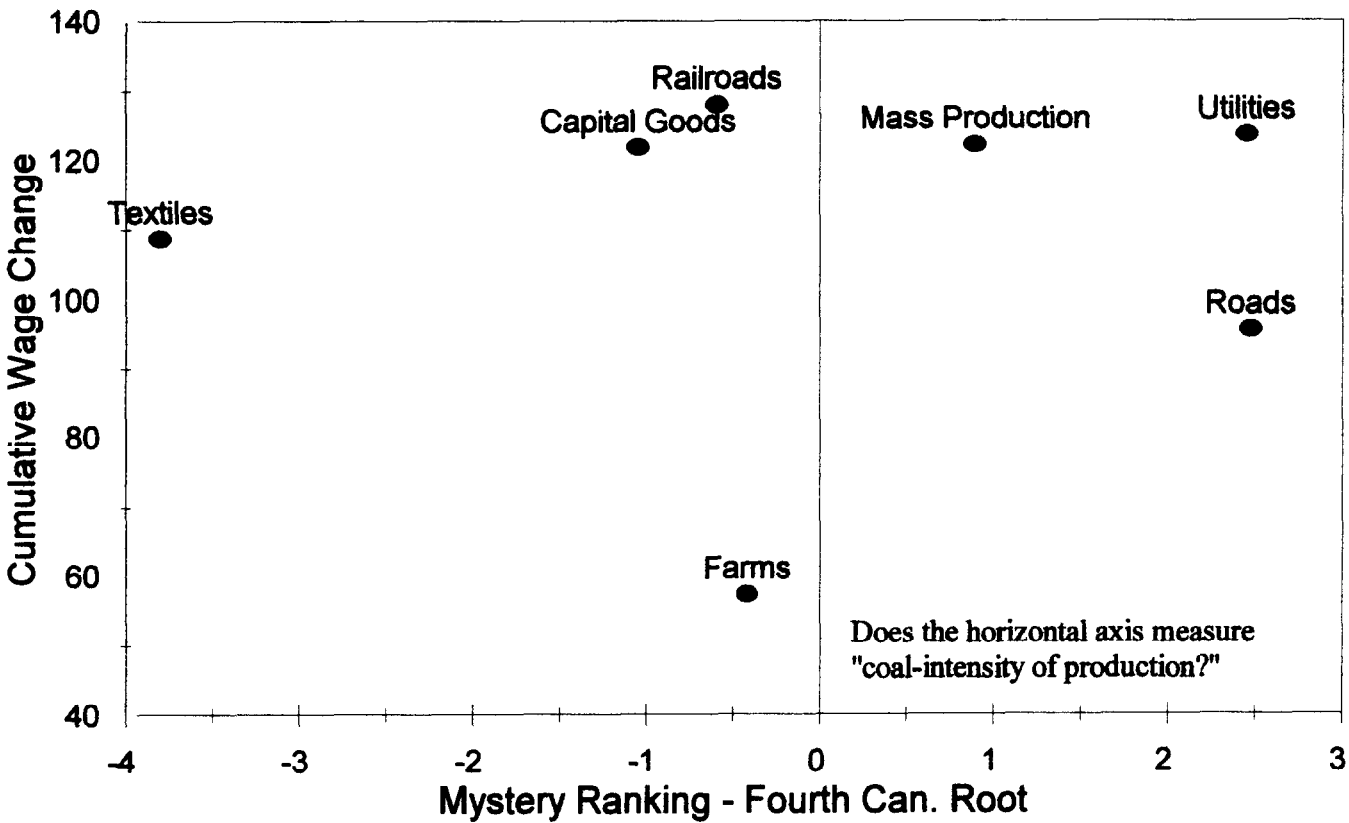
Figure XVII
The Mystery Root

Cumulative Index Value (1920=100)

This root may be picking up the general downtrend in the fortunes of coal and coal-fired utilities in this period, interrupted in 1939 by the threat of the Second World War.

7% of inter-group variation, wage data.

Year
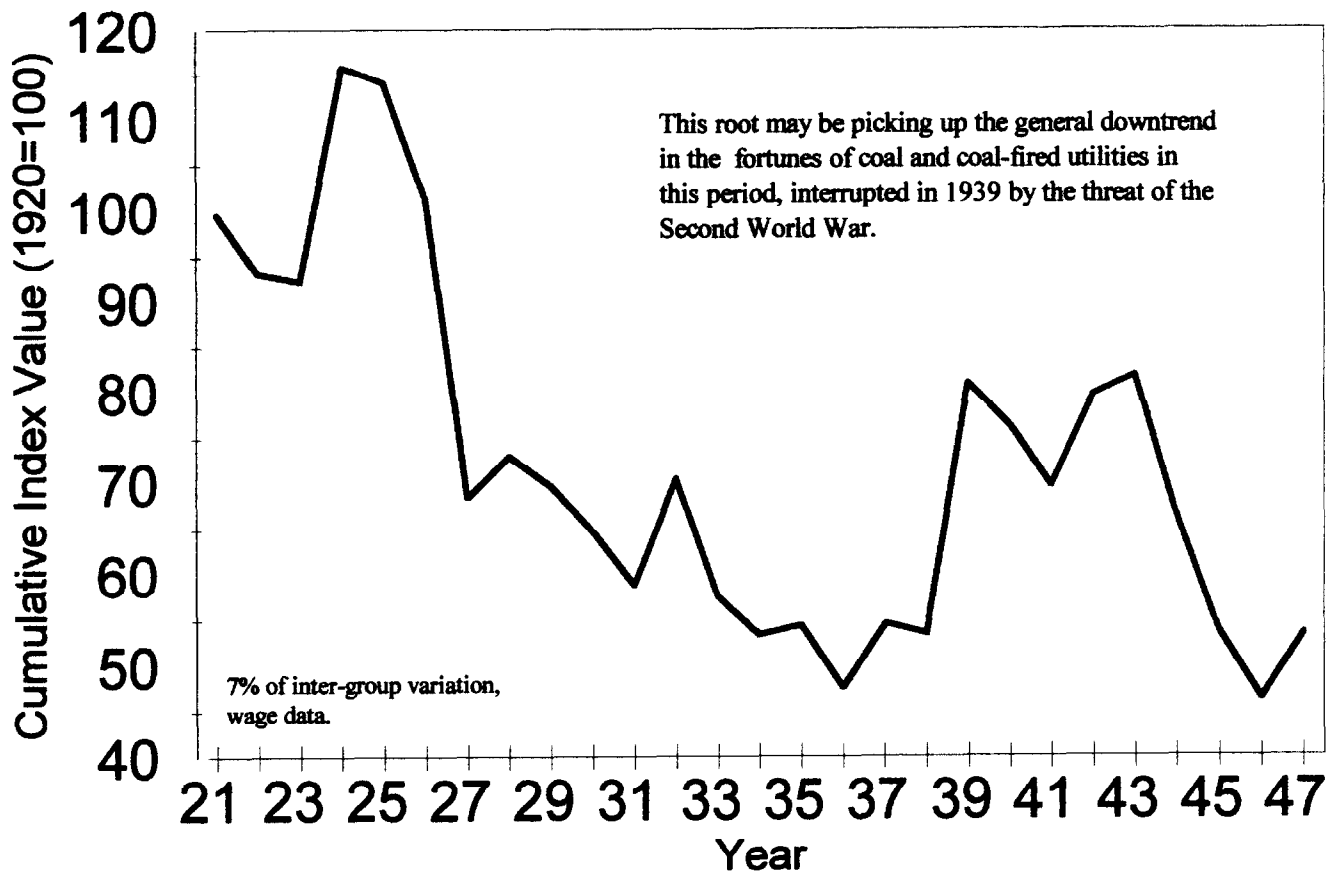
Figure XVIII
Skill Premia by Industry 1914-1937
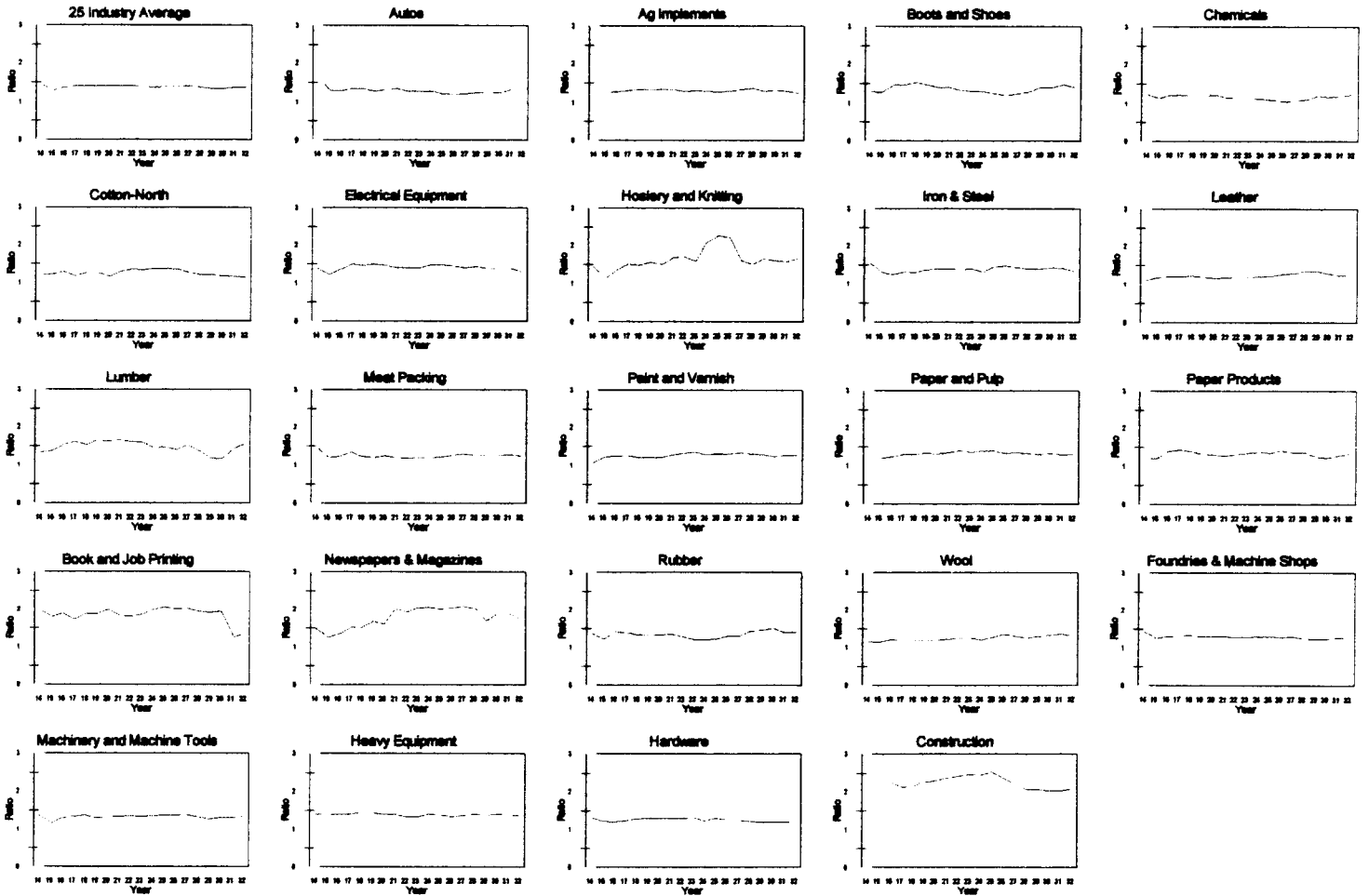
Figure XIX
Within or Between Industries?

This chart shows that the two Goldin/Margo railroad wage ratios for clerks and machinists relative to laborers are in fact closely correlated with the overall movement of railroad wages relative to manufacturing. This confirms the Ferguson/Galbraith argument that the same economic forces operated within industries as between them.

Year
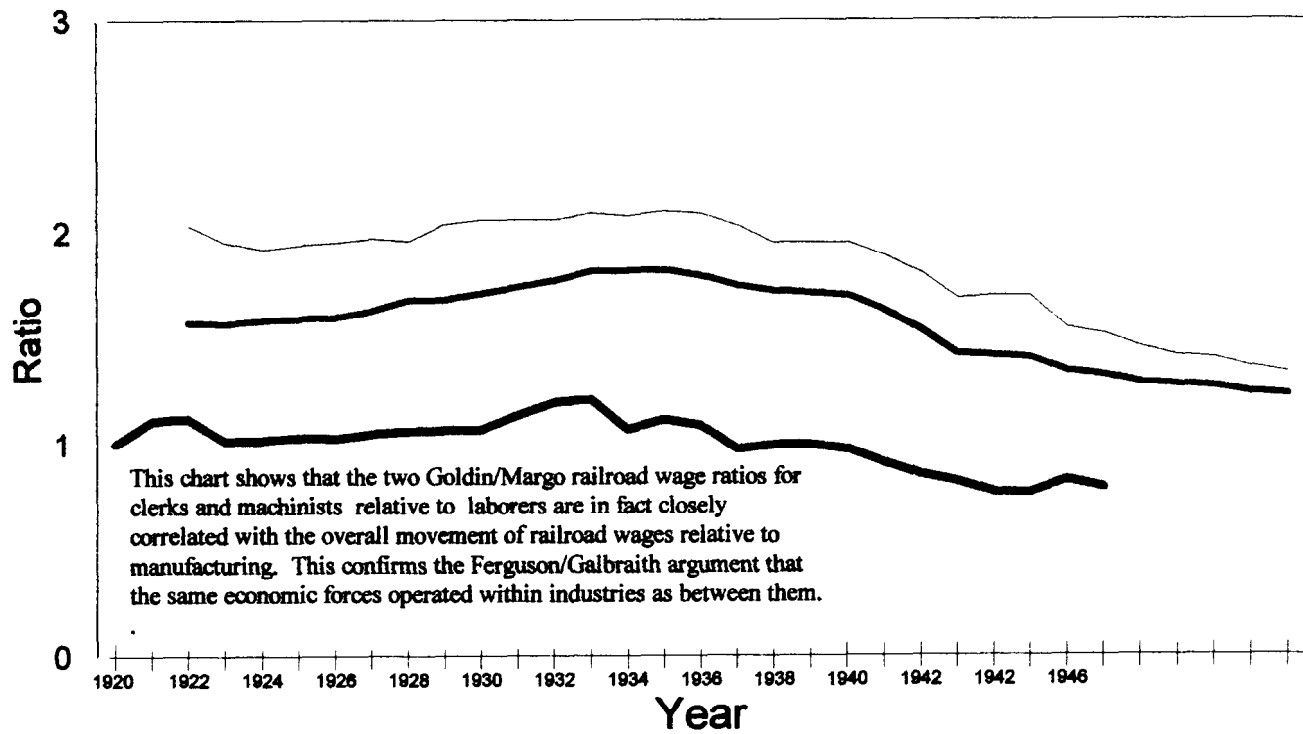
Ratio
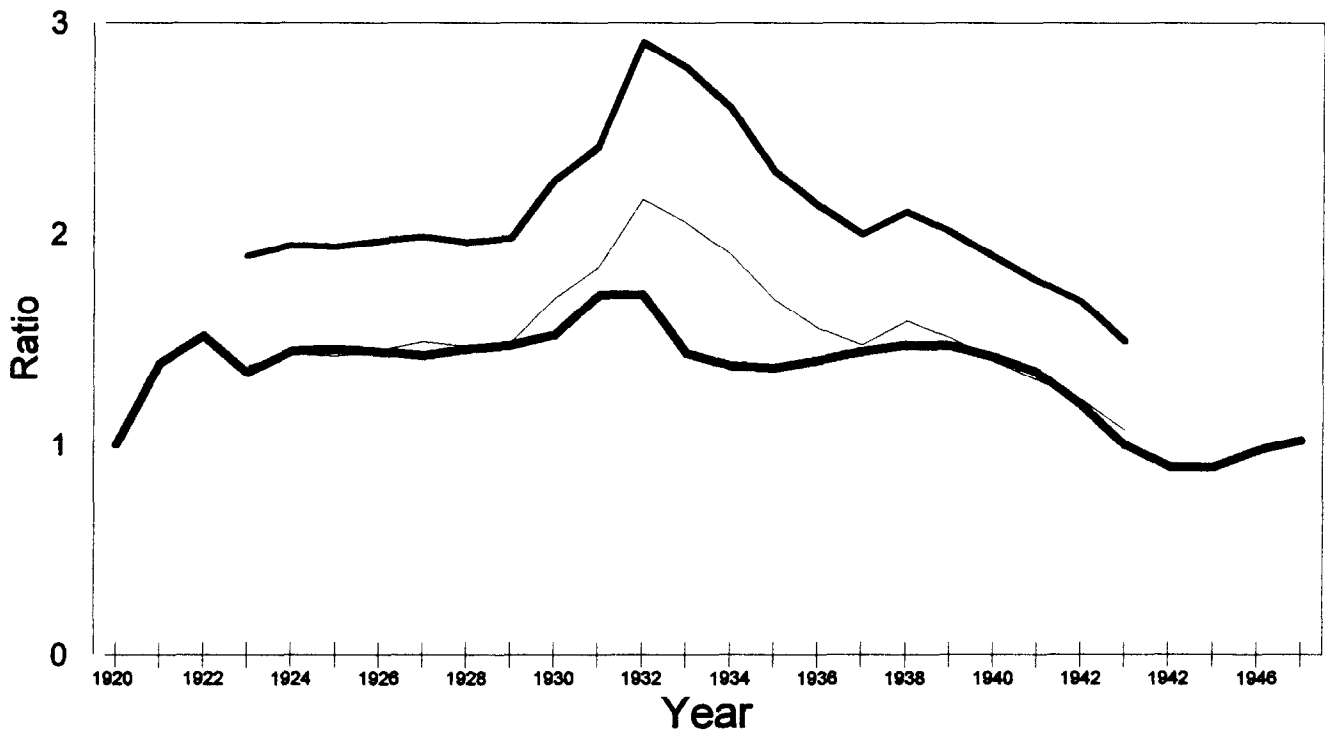
- Ratio of All RR to Mfg wages
- RR Clerks/laborer Ratio
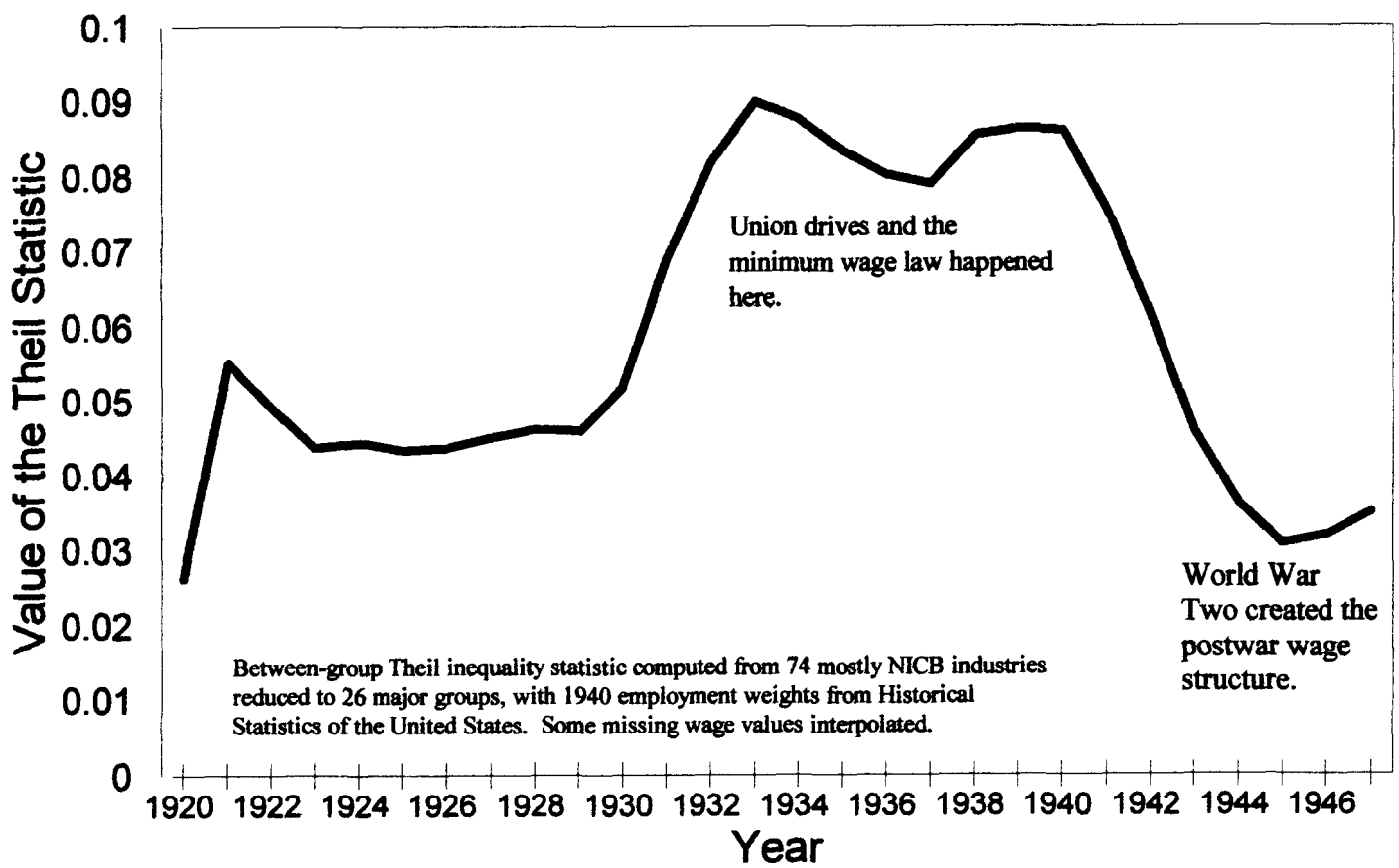- RR Machinists/Laborer Ratio

Figure XX
Within or Between Industries?

Legend: Ratio of Book to Farm wages — NYS Clerks/Unskilled — NYS Clerks/Skilled

Figure XXI
Wage Inequality Across Industries

Value of the Theil Statistic (y-axis, 0 to 0.1)

Year (x-axis, 1920 to 1946)

Union drives and the minimum wage law happened here.

Between-group Theil inequality statistic computed from 74 mostly NICB industries reduced to 26 major groups, with 1940 employment weights from Historical Statistics of the United States. Some missing wage values interpolated.

World War Two created the postwar wage structure.

Figure XXII
Inequality and Unemployment

Between-Group Theil
Inequality Statistic

x200 for scale clarity

Unemployment Rate

Year