

Market Responses to Interindustry Wage Differentials

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July 2000

Both authors thank the National Science Foundation for research support. Ramey also thanks the Sloan Foundation for research support.

ABSTRACT

This paper examines the link between interindustry wage differentials and subsequent growth of industry variables such as employment, GDP and labor productivity. We find that industries that paid higher than average wages in 1959 experienced significantly lower employment growth and GDP growth in the subsequent 30 to 40 years, while at the same time experiencing higher-than-average growth in the capital-labor ratio and in labor productivity. We argue that the evidence is best explained by a non-competitive model of the interindustry wage structure, as both firms and the market respond to the wage rigidity implied by the long-run persistence of the interindustry wage structure.

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I. Introduction

The wide dispersion in wages across industries is one of the more puzzling characteristics of labor markets. The fact that a worker with the same socioeconomic characteristics—including education, age, sex, and race—earns 38 percent more in automobile manufacturing than in apparel production presents a challenge to standard competitive labor market theories (Krueger and Summers, 1988; Katz and Summers, 1989). Moreover, these industry wage differences cannot be dismissed as temporary disequilibria. They are highly persistent over long periods of time (Krueger and Summers, 1987), and there is no evidence of arbitrage activity in employment movements, even among young, mobile workers (Helwege, 1992).

The existing literature often invokes efficiency wage considerations, rent-sharing between firms and workers, or unobserved worker characteristics to explain why comparable workers earn different wages when they are employed in different industries. Each of these models has some degree of empirical support in the literature.

The efficiency wage hypothesis argues that some industries find it optimal to pay higher-than-average wages to reduce turnover, shirking, and other forms of productivity-reducing behavior. The observed negative correlation between quit rates and industry wage premia is consistent with this argument. Interindustry wage differentials could also reflect rent sharing between firms and workers (Krueger and Summers, 1987). This explanation is consistent with the fact that the wage premia received by a particular industry extends over many occupations within that industry. It is also consistent with the significant positive relation between profitability and wages (Blanchflower, Oswald and Sanfey, 1996). Finally, interindustry wages differentials may not reflect deviations from competitive behavior, but rather systematic differences in *unobserved* workers' characteristics (Murphy and Topel, 1987, 1990; Gibbons and

Katz, 1992; Blackburn and Neumark, 1992). However, the available evidence on the sorting hypothesis is mixed: some studies find evidence of unobserved ability differences, but most studies do not. The cumulative evidence leads many observers to conclude that the persistence of interindustry wage differentials challenges the implications of competitive labor market theory.

This paper offers new evidence showing that the market *does* adjust in response to interindustry wage differentials. Although the tendency for wages to converge across industries is extremely weak, several other economic variables exhibit strong long-run responses to the initial interindustry wage structure. In particular, industries that paid relatively higher wages in 1959 experienced significantly slower employment growth over the subsequent thirty years. The high-wage industries also experienced slower GDP growth and faster growth of the capital-labor ratio and labor productivity.

Our evidence rejects the simplest competitive model of labor markets where flows of workers across industries provide an equilibrating mechanism for industry wages. Instead, workers flow in a direction *opposite* to that predicted by the competitive model. When considering all of the evidence presented, we conclude that noncompetitive wage theories, such as efficiency wages or rent sharing, are more plausible explanations than unobserved ability differences. In fact, practically any theory that generates a rigid interindustry wage structure is consistent with the dynamic correlations documented in this paper. The “story” that explains much of the empirical evidence is that firms in high-wage industries respond to their immutably high wages by substituting capital for labor and by increasing labor productivity. At the same time, the market responds by switching to goods produced by lower-cost industries.

The paper proceeds as follows. Section II describes the data and methods used to estimate the industry wage premia. Section III specifies and estimates a simple competitive model of

interindustry wage differentials. This section focuses on the relation between wage and employment dynamics and the initial interindustry wage structure. Section IV investigates the dynamics of other key industry variables. Section V examines if the leading theories of the interindustry wage structure are consistent with the evidence.

II. Data

We calculate the interindustry wage differences by using data drawn from the 1950-1990 Public Use Microdata Samples (PUMS) of the decennial Census. We matched Census industry codes (CIC) to Standard Industrial Classification Codes (SIC codes), based on descriptions of the products included in each industry. Because of changing codes over the years, we sometimes had to combine industries in order to maintain a consistent description of each industry.

The Census data extracts form a one percent random sample of all working persons aged 18-64 (as of the Census year) who do not live in group quarters. The analysis is restricted to persons employed in the wage-and-salary sector. The wage information refers to the wage in the previous calendar year, so the 1960 Census estimates the wage premium for 1959, the 1970 Census estimates the wage premium for 1969, etc. In contrast, the information regarding the worker's industry of employment refers to the week prior to the Census. To avoid confusion, we will refer to the employment data that we calculate from the Census (i.e. the number of workers in each industry) as if it referred to employment in the previous calendar year.¹

We estimated the following regression model separately in each Census year:

¹ For example, we will refer to the industry employment data calculated from the 1960 Census as giving industry employment in 1959. Note that there is measurement error in the estimate of the industry wage premium because the wage variable does not necessarily indicate what the worker would earn in the industry that employed him or her in the week prior to the Census.

$$(1) \quad \ln w_{hit} = X_{hit} \beta_t + \omega_{it} + \varepsilon_{hit},$$

where w_{hit} is the wage rate of worker h in industry i in Census year t ; X is a vector of socioeconomic characteristics; and ω is an industry fixed effect. The vector X controls for the worker's age (indicating if the worker is 18-24, 25-34, 35-44, 45-54, or 55-64), educational attainment (indicating if the worker has less than 9 years of schooling, 9 to 11 years, 12 years, 13-15 years, or at least 16 years), race (indicating if the worker is black), sex, region of residence (indicating in which of the 9 Census regions the worker lives), and occupation (at the one-digit level). We also used the Census data to estimate the number of persons employed in industry i at time t . These employment statistics will be used in part of the empirical analysis that follows.

We will typically estimate a generic second-stage regression model linking the change in some variable y_i (such as output per worker or the capital-labor ratio) between 1959 and 1989 to the industry wage premium observed in 1959, ω_{it} :

$$(2) \quad \Delta y_{it} = \theta \omega_{it} + \eta_{it}.$$

Note that the regressor in this second-stage regression is not the true industry wage premium, but rather the *estimated* premium $\hat{\omega}$. The fact that the regressor is a series of estimated coefficients suggests that the error term in equation (2) will likely be heteroscedastic. In addition, the value of the wage premium at time t could have a contemporaneous correlation with the error term in equation (2). We weigh the regressions by some measure of the sample size in the industry cell to address the heteroscedasticity problem, and we estimate the models using both ordinary least squares and instrumental variables to address the potential endogeneity of the wage premium.

We use the previous decade's estimated industry wage premium (e.g., the industry wage premium in 1949) as the instrument. It turns out that the results are quite similar regardless of which method we use to estimate the regression.

III. Wage and Employment Dynamics in a Competitive Market

Many studies have documented the stability of the interindustry wage structure over time. For example, Krueger and Summers (1987) report that the correlation of average wages across one-digit industries in 1900 with average wages in 1984 is 0.6. Helwege (1992) finds a correlation of 0.71 between the wage structures in 1940 and 1980, even after adjusting for differences in worker characteristics across industries. Furthermore, Lewis (1963) and Krueger and Summers (1987) analyzed the trend in the standard deviation of wages across industries. Neither of these studies found a downward trend in this standard deviation, even over a period stretching several decades.²

Although there has been some discussion in the literature about how interindustry wages should behave over time in a competitive labor market, the typical presentation of the model is heuristic (Helwege, 1992). We believe it is useful to interpret the evidence in terms of a formal model. In this section, we present a theoretical framework that captures the key features discussed in the literature in a parsimonious manner. The model helps to isolate the possible sources of interindustry wage differentials in a competitive setting. We then estimate and test the competitive model using data drawn from the 1950-90 Censuses.

² However, if one uses the data reported in Krueger and Summers (1987, Table 2.2) to graph the standard deviation of industry wages over time, there seems to be a break in the series so that the standard deviation is much lower in the post-World War II period. There is no obvious continuing downward trend after 1950.

A. A Competitive Model of Labor Market Adjustment

Consider a simple competitive model of the labor market where homogeneous workers switch sectors gradually in response to wage differentials. The representative competitive firm in each industry i ($i = 1, 2, \dots, I$) has the Cobb-Douglas production function:

$$(3) \quad Y_{it} = \phi_{it} L_{it}^{\alpha} K_{it}^{1-\alpha},$$

with $0 < \alpha < 1$. The variable Y_{it} represents industry i 's output in period t ; ϕ_{it} gives the level of technology; L_{it} gives employment; and K_{it} gives the capital stock. The representative firm chooses employment to maximize profits, taking output prices P_{it} , industry wages w_{it} , and the rental cost of capital R_{it} as fixed. The demand for industry output is given by the inverse demand function:

$$(4) \quad P_{it} = \lambda_{it} Y_{it}^{-\eta},$$

with $\eta > 0$. The industry's demand for labor, derived by substituting equation (4) into the representative firm's first-order conditions, is:

$$(5) \quad \ln L_{it} = \frac{1}{\eta} \ln \lambda_{it} + \frac{1-\eta}{\eta} \ln \phi_{it} - \frac{\alpha + \eta(1-\alpha)}{\eta} \ln w_{it} - \frac{1-\alpha - \eta(1-\alpha)}{\eta} \ln R_{it} \\ + \frac{1}{\eta} [\ln \alpha + (1-\alpha)(1-\eta) \ln \frac{1-\alpha}{\alpha}].$$

For simplicity, suppose that the aggregate supply of labor is fixed at \bar{L} . We assume that various market imperfections, such as mobility costs and the slow diffusion of information about trends in the interindustry wage structure, prevent workers from moving across industries instantaneously to equalize wages. Instead, workers flow gradually across sectors, away from low-wage industries and towards high-wage industries. We capture this idea with the following equation of motion for labor supply in industry i :

$$(6) \quad \ln L_{it} = \ln L_{it-1} + \theta (\ln w_{it-1} - \ln \bar{w}_{t-1}) + \varepsilon_{it},$$

where θ is the labor supply elasticity and is non-negative; $\ln \bar{w}_{t-1}$ is the mean log wage in the economy, and ε_{it} is an i.i.d. error term, uncorrelated across industries. This labor supply equation states that the percent change in the number of workers employed in a particular industry is positively related to the *relative* wage of that industry in the previous period. This backward-looking supply response is consistent with optimizing behavior on the part of workers if wage movements are highly persistent and there are lags in information flows.

Equations (5) and (6) yield the paths of equilibrium wage and employment in each industry, for given sequences of demand shocks λ , technology shocks ϕ , and the rental cost of capital R . Interindustry wage differentials are created by shocks to any of these variables. To illustrate, suppose industry i experiences either a positive permanent shift of relative demand or a positive technology shock relative to other industries. As a result of the shock, labor demand shifts out for this industry. Because labor supply is inelastic in the short-run, wages in industry i rise relative to wages in other industries. These higher wages attract more workers in the

following periods. As workers flow into industry i , w_i declines relative to the wage in other industries until wages are again equalized.

We can manipulate equations (5) and (6) to derive the subsequent changes in employment and wages as a function of the initial industry wage. These equations are given by:

$$(7a) \quad \Delta \ln w_{it} = \frac{-\theta\eta}{\alpha + \eta(1-\alpha)} (\ln w_{it-1} - \ln \bar{w}_{t-1}) + v_{it},$$

$$(7b) \quad \Delta \ln L_{it} = \theta (\ln w_{it-1} - \ln \bar{w}_{t-1}) + \varepsilon_{it},$$

where $v_{it} = \frac{1}{\alpha + \eta(1-\alpha)} [\Delta \ln \lambda_{it} + (1-\eta)\Delta \ln \phi_{it} - (1-\alpha)(1-\eta)\Delta \ln R_{it} - \eta\varepsilon_{it}]$. Equation (7a)

predicts that industries with high initial wages should experience lower-than-average subsequent wage growth. Equation (7b) predicts that industries with high initial wages should experience higher-than-average employment growth.

Equation (7a), which links wage growth to initial wages, is similar to the type of convergence regressions used in the studies that examine international (or inter-regional) differences in growth rates (Barro, 1991; Barro and Sala-i-Martin, 1992). The typical test of convergence in that literature estimates a cross-country regression of output growth on initial output. A negative coefficient on initial output is interpreted as indicating some sort of convergence—namely, that initially poorer countries are more likely to grow faster than initially richer countries. By applying Galton’s fallacy, Quah (1993) points out that this type of “mean” convergence does *not* imply that the cross-sectional dispersion diminishes over time. Galton’s fallacy also applies to the persistence of interindustry wage differences. An empirical finding that

there is some mean reversion in interindustry wages is not necessarily related to trends in the standard deviation of the cross-sectional distribution of wages over time. In other words, the question of whether high-wage industries regress to the mean is distinct from the question of whether the standard deviation of the cross-sectional distribution of wages is decreasing over time.

B. Empirical Estimates of the Competitive Model

We estimated versions of equations (7a) and (7b) across industries for 3-digit industry groupings. Our model implies that the error term in the employment growth regression consists of the error in the employment adjustment equations (ε), whereas the error term in the wage growth regression consists of both ε and the growth rates of λ , ϕ , and R between periods $t-1$ and t . Both because of the measurement error issues discussed above and because of possible correlation between the growth rate of these variables and initial wages, we also use instrumental variables (using the previous decade's wage as the instrument) to estimate the models. All regressions are weighted by the sample size of the industry cell.

The top panel of Table 1 reports the relevant coefficients estimated from the wage growth regressions that use data spanning the entire sample period (1959 through 1989), as well as for each intermediate decade. Consider first the estimates for the entire period, shown in the first row of the table. The evidence indicates that industries with higher initial wages (in 1959) have lower wage growth for the subsequent thirty years. However, the estimated regression coefficients, whether estimated by ordinary least squares or instrumental variable, imply extremely sluggish adjustment, with a rate of convergence of only 0.5 percent per year. If we take this point estimate literally, it would take 138 years to close just half of the initial gap

between the industry premium and the mean. These results confirm the literature's conclusion that the interindustry wage structure is very stable.

A possible source of the wage sluggishness is evident from the coefficients estimated in the employment growth regression, shown in the bottom panel of the table. The relation between employment growth and initial wages is the opposite of that implied by the competitive model. In other words, industries with high initial wages experience *lower* rather than higher employment growth. Moreover, the estimated coefficients are statistically significant in all cases. The point estimates imply a value of θ , the labor supply elasticity, of $-.042$ to $-.053$, which is contrary to the basic prediction that θ should be positive. Moreover, the estimated value of θ , combined with the convergence coefficient from the wage growth regression, implies very high elasticities of demand. If the labor share α is 0.75 , the OLS regressions imply a value of η of $.09$, indicating elasticities of labor demand exceeding 10 . Put simply, the basic competitive explanation of interindustry wage and employment adjustments is clearly at odds with the data.

Figure 1 illustrates the relation between the annual rate of growth in the industry's employment (measured as log differences) and the initial industry wage premium, using three-digit SIC codes. Appendix Table A-1 describes the SIC codes used in the analysis. The size of the circle denoting each data point in the figure is proportional to 1959 industry employment. Figure 1 shows the unambiguous negative relation implied by the regressions. Industries with high initial wages and low-subsequent employment growth include railroad transportation (SIC 40), coal mining (11), and steel (331). In contrast, such industries as florists (599), dressmaking (729), and eating and drinking retail (58), had low initial wages and high subsequent employment growth. Some of the "outlying" industries (i.e., those industries with fast employment growth and high initial wages) include miscellaneous professional services (892),

services for transportation (47), air transport (45), and securities and brokerage (62). It is worth noting that several of these atypical industries were deregulated during the 1959-89 period.

The remaining rows of Table 1 report the estimated regression coefficients when the models are estimated separately for each of the decades between 1959 and 1989. The evidence on wage convergence varies considerably across decades. There was some regression to the mean between 1959 and 1969. In fact, the regression coefficient implies that half of the initial wage gap would be eliminated in 26 years. The wage convergence coefficient, however, changes erratically across decades. In contrast, the negative coefficient in the employment growth regressions is fairly stable over time. In each decade, the industries that paid relatively higher wages at the beginning of the decade experienced relatively lower employment growth during the decade.

In sum, the evidence contradicts a simple competitive explanation for the interindustry wage structure. There is little mean convergence in wages. And industries that pay higher than average initial wages experience slower employment growth in subsequent years.

IV. More Evidence on Market Responses

We have seen that there is a strong employment response to the interindustry wage structure: employment declines in high-wage industries. One can explain the decline in employment in terms of a simple non-competitive story. Employers respond to persistently high wages by shrinking their work force, and perhaps switching towards other modes of production. To shed light on this and other explanations, we now examine whether there exist any other dynamic responses to interindustry wage differentials. The literature already provides a large set of stylized facts regarding the cross-section correlations between interindustry wage premia and

such variables as capital-labor ratios, unionization, and productivity (Krueger and Summers, 1987; Dickens and Katz, 1987). We estimate *dynamic correlations* between the interindustry wage structure and several key economic variables. In the next section, we discuss possible mechanisms leading to these correlations.

The additional data used in this section are drawn from the National Income and Product Accounts (NIPA), which are available only at the two-digit industry level. We construct the two-digit interindustry wage differentials by taking employment-weighted averages of the three-digit wage premia. Unless otherwise indicated, we now use the NIPA data for full-time equivalent employment as our employment measure.³ Our industry groupings are dictated by NIPA data availability. For example, all retail trade is aggregated into one category. We have a sample of 52 industries after aggregating the data. Appendix Table A-2 lists the two-digit industries used in our study. Finally, the NIPA data are available through 1997, so we estimate the dynamic correlations over the 1959-1997 period.

A. Basic Results from the NIPA

Table 2 reports the coefficients from regressions that relate the change in nine different economic outcomes to the initial wage premium in the industry. The first row of the table reproduces the employment growth results using the NIPA employment measure (i.e., full-time equivalent employment), rather than the Census measure of the number of workers employed in the particular industry.⁴ The employment evidence from the NIPA data is quite similar to the

³ Unlike the Census, where the employment data for, say, 1959 refers to the number of workers employed in a particular industry in the last week of March 1960, the NIPA measure of employment for 1959 refers to employment in that year.

⁴ The employment and wage growth regressions estimated at the two-digit level yield results that are very similar to the (Census-based) three-digit regressions reported in the previous section. In the wage growth regression,

evidence from the Census data. The growth in full-time equivalent employment is negatively related to initial wages, and this negative correlation is found not only for the entire 38-year period from 1959 to 1997, but for each decade as well. Figure 2 illustrates the relation between (NIPA) employment growth over the entire sample period and the 1959 wage premia. The figure shows a tight negative relationship. Examples of low-wage and high employment growth industries are retail trade (200), hotels (70), and health care (80). Examples of high-wage and low employment growth industries are coal mining (11), railroad transportation (40), and primary metals (33). The outliers tend to be small industries, such as leather (31) and securities and brokerage (62).

The second row of the table examines the link between output and the interindustry wage structure. The dependent variable is the growth in the industry's nominal GDP. The coefficient estimated for the entire sample period indicates that the industries with high initial wages had relatively lower subsequent GDP growth. The elasticity of the GDP response to the initial wage is only about half the size of the employment elasticity. Although the regression coefficient relating GDP growth and initial wages is significant when we use the entire 1959-97 period, the coefficients are less precise when we estimate the model in each of the individual decades. Figure 3 shows the scatter diagram of industry GDP growth (over the 1959-97 period) and initial wages. While the relationship is not as tight as the one for employment growth, the negative pattern is evident. Many of the industries in this graph have roughly the same placement as in the graph linking employment growth and initial wages. In fact, the across-industry correlation between full-time equivalent employment growth and GDP growth is 0.92.

the coefficient on initial wages is -.004 in the two-digit data, which is quite close to the coefficient of -.005 obtained in the three-digit data. Similarly, in the employment growth regression, the OLS coefficient on initial wages is -.054 in the two-digit data and -.042 in the three-digit data.

We next investigate the relation between worker productivity (defined as GDP per worker) and the interindustry wage structure. The third row of Table 2 shows the results from regressions of the growth rate of GDP per worker on the initial wage premium. The data reveal a significant positive relationship between the initial wage premium and the growth of labor productivity both in the 1959-1997 period, as well as in each decade. The regression that uses the entire span of the data produces the highest R-squared of the table, indicating that 31 percent of the variation in labor productivity growth across industries can be explained by the initial wage premium. Figure 4 shows the scatter plot of worker productivity growth for 1959 to 1997. Besides the obvious positive relationship, the graph shows another pattern. The scatter of points appears to be lower triangular: while high-wage industries experience a range of rates of growth of productivity, low-wage industries experience uniformly lower rates of growth of productivity.

The results reported in rows 2 and 3 of the table (for industry output and worker productivity) use the *nominal* GDP data because these variables are available for the entire sample period. Beginning in 1977, the NIPA data can be used to break up GDP into its price and output components. Prices are measured using the implicit price deflator for industry output and output is measured in chained 1992 dollars. Rows 4 and 5 of the table relate these two components of the growth of GDP to the initial wage in the industry.

Although most of the regression coefficients suggest that price changes and real GDP growth are negatively related to initial wages, the effects are often insignificantly different from zero. There is, however, a marginally significant relation between price changes and the initial wage premia over the entire 1959-97 period. The drop in the precision of the estimates is due to the splitting of industry GDP into its components, rather than to the truncated time period. The regression of nominal GDP on the initial wage premium for the sample period of 1977 to 1997

(not shown in the table) is precisely estimated, with a coefficient of $-.047$ and a standard error of $.018$. Hence it is the *combined* effect of the negative relationships between initial wages and prices and between initial wages and output that makes the total impact on nominal GDP significant.

In contrast, row 6 of Table 2 shows that real GDP per worker has an even stronger positive relationship with initial wages than nominal GDP per worker. The coefficient for the truncated period of 1977 to 1997 is $.065$ for output per worker, whereas the regression of nominal GDP per worker for the same sample period (not shown in the table) has a coefficient of $.024$ and a standard error of $.010$. The elasticity is weaker for nominal GDP per worker because of the negative relationship between initial wages and the subsequent changes in relative prices.

The evidence, therefore, strongly shows that at the same time that employment was declining in high-wage industries, worker productivity was rising. This finding suggests that the persistent high wages in some industries encouraged firms to switch to alternative methods of production. Rows 7 and 8 of Table 2 examine this hypothesis by estimating the relation between changes in the capital stock and in the capital-labor ratio to the initial wage premium. In most cases there is a negative, but insignificant, relationship between the growth in the real capital stock and the initial wage in the industry. However, capital per worker grows significantly faster in those industries that paid relatively higher initial wages. The growth in the capital-labor ratio was particularly rapid for the high-wage industries during the 1970s. Figure 5 shows the scatter diagram relating the growth of capital per worker (between 1959 and 1997) to the initial wage premium.

Finally, the last row of Table 2 shows that there is a negative relationship between the growth in labor's share of output and the initial wage in the industry. The coefficient is

significantly negative for the entire sample and for the 1960s. Industries that began the period paying relatively high wages show a tendency for slower growth in labor's share of GDP.

Our dynamic results are related to some of the static results documented in the literature. In particular, as noted by Krueger and Summers (1986), there is some consensus that high-wage industries also tend to have higher capital-labor ratios and lower labor share of costs in the cross-section. Our dynamic evidence shows that these effects grow over time: despite beginning the period with higher-than-average capital-labor ratios, high wage industries experience even greater growth of the capital-labor ratio over time.

To summarize, we have found that a high initial wage premium in the industry is associated with:

- Slower growth in employment
- Slower growth in GDP
- Faster growth in worker productivity
- Faster growth in the capital-labor ratio
- Slower growth in labor's share of GDP

B. The Role of Manufacturing

Before proceeding to discuss the firm-level and market-level adjustments that could generate these dynamic correlations, it is worth examining if our evidence is driven by trends in the manufacturing industry. It is well known that many industries in the manufacturing sector paid relatively high wages in the 1950s (perhaps as a result of high unionization rates) and that employment in these industries shrank (as a fraction of the work force) in the subsequent decades.

It turns out, however, that the correlation between the interindustry wage premia and manufacturing is not all that high. For example, distinguishing whether an industry is a manufacturing industry explains only twelve percent of the cross-sectional variation of the 1959 wage premium.⁵ To investigate whether the manufacturing distinction can explain the dynamic correlations, we re-estimated the regressions for the 1959-97 period after adding a dummy variable indicating if the industry is in manufacturing. The results are presented in Table 3.

The first row of the table regresses the change in employment on the initial wage premium. The data indicate that the manufacturing dummy variable has significant predictive power: employment declined much faster in manufacturing industries. However, the data also indicate that the initial wage premium remains significantly and negatively related to subsequent employment growth. In other words, the shrinking employment in high-wage industries cannot be attributed to a spurious correlation generated by trends in the manufacturing sector.

The remaining rows of the table indicate that, for the most part, the sign of the dynamic correlations is unaffected by the introduction of the manufacturing sector dummy. The point estimates, however, are often less significant. In some cases, such as in the regression that relates the industry's GDP to the initial wage, the estimated coefficient is negative, but no longer significant. Nevertheless, even after adjusting for trends in the manufacturing sector, the initial wage premium still has a strong positive effect on the growth of GDP per worker (whether real or nominal) and on the capital-labor ratio. In short, most of the key dynamic correlations that we have uncovered cannot be attributed to long-run trends in the manufacturing industry.

C. Worker Productivity and the Interindustry Wage Structure

⁵ This statistic reports the R-squared from a regression of the 1959 industry wage on a dummy variable

Some of the most intriguing evidence to emerge from the dynamic correlations reported in Tables 2 and 3 relates to the positive effect of initial wages on worker productivity. The link between labor productivity and the interindustry wage structure is, of course, related to an issue that has interested many researchers in recent years, the link between wages and the adoption of new technologies. We now explore the relationship between productivity and the wage premium in more depth.

The first three columns of Table 4 report the estimated coefficients from regressions of labor productivity growth on alternative measures of worker compensation. The first column reproduces the “baseline” regression from Table 2 for reference. This column shows the regression of productivity growth on the initial (Census-based) wage premium.

Column 2 of the table estimates the same regression using a different independent variable. In particular, column 2 uses the initial average compensation per worker, rather than the Census-based wage premium, as the wage measure. Average compensation per worker combines the returns to *both* observed and unobserved characteristics of workers. While this variable is also positively related to subsequent productivity, the point estimate is smaller (about half the size) and the explanatory power falls by about a third. Column 3 shows that when both variables are entered in the regression, the Census-based wage premium is still significant, but the compensation variable is not. In fact, the addition of the compensation variable to the regression does not increase the explanatory power of the model. Therefore, the evidence indicates that whatever is driving productivity growth is intimately linked to that part of wages that is *unrelated* to the observable characteristics of workers.

indicating if the industry is in the manufacturing sector.

The remaining columns of Table 4 explore the sensitivity of this finding to the inclusion of additional variables in the regression. Column 4 shows the effect of including the *level* of capital per worker in 1959 in the regression. This variable is not significant, and adds little explanatory power. The coefficient on the initial wage premium is unchanged.

As we saw in Table 2, however, industries with high initial wages had higher subsequent growth in the capital-labor ratio. To determine how much of the growth in labor productivity can be accounted for by the contemporaneous growth in capital per worker, we added the latter variable to the regression. Column 5 shows that the growth in the capital-labor ratio has a significant and positive independent effect on the growth in labor productivity, increasing the R-squared of the regression from 0.31 to 0.54.⁶ Note, however, that the coefficient on the initial wage premium remains significant and its magnitude falls only slightly. In other words, while the growth in the capital-labor ratio can explain a good part of the contemporaneous variation in the growth of output per worker, much of the impact of the initial wage premium on labor productivity is operating through an independent channel.

Column 6 of Table 4 adds output per worker in 1959 to the regression specification. This variable plays no role in explaining the interindustry dispersion in worker productivity growth. Finally, column 7 adds the growth in output per worker in the preceding decade, 1949 to 1959, to the regression. This variable is also not significantly related to subsequent labor productivity growth. In sum, none of the controls added to the regression specification significantly dampen the relationship between the initial wage premium and labor productivity growth.

As we noted earlier, one of the leading explanations for the existence of interindustry wage differentials is the unobserved heterogeneity of workers across industries. Workers in some

industries are paid more because they have unobserved abilities that lead them to be more productive. The sorting hypothesis, in effect, assumes a positive correlation between worker productivity and the industry wage premium. One could assess the validity of this assumption by examining if variations in productivity across industries can explain interindustry variation in wages. To address this question, we regressed two measures of industry compensation on GDP per worker and compared the results for different time periods. The first wage measure is the Census-based industry premium we have used throughout the paper. By construction, this measure adjusts for differences in observable characteristics (such as education, occupation, gender, and age) across workers employed in different industries. The second wage measure is the NIPA total compensation per full-time equivalent employee. We would expect the second measure to be more highly correlated with output per worker because it does not adjust for differences in observable skills across industries.

Table 5 reports the estimated *R*-squared from the cross-section regressions of industry compensation on GDP per full-time equivalent employment. The real estate industry is a significant outlier in the data, so that we show the results both including and excluding this industry from the sample.⁷

The regressions show an intriguing pattern: industry wages and labor productivity have become increasingly correlated over time. For example, the *R*-squared from regressions of the Census wage measure on worker productivity (and excluding the real estate industry) rose from 25 percent in 1959 to 70 percent in 1989. Looking at individual decades, the cross-section

⁶ The *R*-squared of a regression that only includes the variable measuring growth in the capital-labor ratio is 0.36.

⁷ Measured GDP per full-time equivalent worker is exceedingly high in the real estate industry because the imputed rental value of housing is counted as part of the output in this industry. We attempted to adjust real estate GDP to exclude the rental value of housing, but we encountered various confounding measurement issues.

correlation between labor productivity and wages increased the most during the 1970s and the least during the 1960s. Figure 6a illustrates the relation between the industry wage premium and labor productivity in 1959, while Figure 6b illustrates the same relationship in 1989. There is obviously a much tighter link between the two variables in 1989.

To summarize, we have found:

- It is the part of wages *not* related to observable characteristics of workers that is correlated with labor productivity growth.
- Higher initial capital per worker does not explain the link between the initial wage premium in the industry and subsequent productivity growth
- The effect of the initial wage premium on productivity growth operates through a channel other than through an increase in the capital-labor ratio.
- The cross-sectional correlation between labor productivity levels and the interindustry wage structure increased substantially over time.

Overall, these findings tell an interesting story. As we have seen, the interindustry wage structure is stable over time. The interindustry productivity structure, however, is not. The data clearly show that the productivity structure adjusted to the existing (and rigid) interindustry wage differentials, so that high-wage industries became increasingly more productive.

V. Implications for Leading Theories of Industry Wage Differentials

Which of the leading theories of the interindustry wage structure can best explain the dynamic correlations reported in the last two sections? It is beyond the scope of this paper to write down fully specified models for each of the contending theories. We can, however, discuss

whether the empirical evidence presented in this paper is consistent with or contradicts the broad implications of these theories.

First, we believe the evidence strongly points to a *non-competitive* theory of wage setting as the source of the initial wage differentials. The negative association between initial wages and subsequent employment and GDP growth suggests that high wage industries were at an initial competitive disadvantage. This disadvantage, in turn, created a tendency for them to shrink over time. In contrast, the industries that started the period with low wages had a competitive advantage: they experienced faster than average employment and GDP growth over the subsequent three or four decades.

It is also difficult to explain many of these dynamic correlations by relying on a model that stresses unobserved ability differentials as the *initial* source of the interindustry wage structure. The sorting theory argues that the measured wage premia represent returns to skills that are unobserved by the econometrician. If this explanation were correct, we would expect a higher correlation between initial wages and initial labor productivity than the one we presented in Table 5. Moreover, if the workers in the high-wage industries indeed had higher-than-average ability, why did those industries consistently shrink in every decade since 1960? One could argue that an increase in the return to skills—which indeed occurred in the U.S. labor market—might hamper industries that require higher skills, and hence induce them to reduce employment and shrink. This argument, however, ignores the fact that wage differentials across skill groups did not begin to rise until the late 1970s, while employment in high-wage industries declined in every decade since 1960.

As a result, non-competitive models of interindustry wage differentials are most consistent with the facts. Unfortunately, our results do not help us distinguish between the two leading non-competitive theories of the interindustry wage structure.

Consider, for example, the long-run implications of rent sharing. Historical labor institutions and market structures that may have led to rent sharing could account for the initial differences in wages across industries. For example, Borjas and Ramey (1994) present a model in which market power in the output sector translates into higher wages for workers through bargaining outcomes. While these rent-sharing mechanisms may have arisen because these industries initially had a high degree of market power and profitability, the high wages they created put these industries at a competitive disadvantage in the long run. Bargaining models along the line of Lawrence and Lawrence (1985) might explain the puzzling failure of wages to decline. Lawrence and Lawrence suggest that when an industry declines, the elasticity of labor demand also declines because substitution of capital for labor is hampered by the putty-clay nature of capital. The lower elasticity of labor demand raises workers' bargaining power, so wages may actually increase during an industrial decline.

Efficiency wage theories are also potentially consistent with the facts. Firms in some industries may find it difficult to monitor workers or face particularly disruptive effects when workers quit their jobs. Firms in these industries find it optimal to pay wages above the competitive level to encourage workers not to shirk or leave their jobs. Over time, however, the higher efficiency wage puts these industries at a competitive disadvantage. As market forces play themselves out, the high-wage industries again experience lower employment and GDP growth.

In short, practically any theory that generates a rigid interindustry wage structure is consistent with the basic facts. Firms operating in the industries that face higher labor costs do

not sit idly by. Instead, they try to maximize profits subject to the constraints imposed by the rigid wage structure. Faced with immutably high wages, these firms try to attenuate the negative consequences in two distinct ways. First, they are more likely to substitute capital for labor. This behavior generates the steeper decline in employment and the higher growth in the capital-labor ratio observed in high-wage industries. Second, they are more likely to create and adopt new technologies that significantly increase the labor productivity of their workers. This strategy was so successful that the observed correlation between the wage premia and labor productivity doubled or tripled in 30 years. In other words, since wages could not fall to equal productivity, high wage firms responded *by raising productivity to equal wages*.

By the end of the period, therefore, the data are consistent with the *observable* prediction of the sorting hypothesis: more productive workers are working in high-wage industries. The mechanism behind the correlation, though, may be the reverse of the one that is typically used to motivate the sorting story. For example, Bartel and Sicherman (1999) argue that the positive correlation between technological change and wages is primarily due to the sorting of more able workers into industries with more rapid technological change. This argument fits neatly with the conjecture that a more able workforce is necessary for the adoption of new technology. Bartel and Sicherman estimate a strong positive correlation between the wages of young workers from the National Longitudinal Survey of Youth (NLSY) and various contemporaneous measures of technological change at the industry level. However, this correlation vanishes once the model includes worker fixed effects, presumably implying that there is a strong correlation between the interindustry wage premium and ability differentials across industries.⁸

⁸ By construction, the impact of the technological change variable in the Bartel-Sicherman study is identified from the evolution of wages in the subsample of workers who switch industries in the sample period, a switch that is assumed to be exogenous. One could question whether many workers would voluntarily choose to switch a well-paid job in a high-wage industry for a less lucrative job in a low-wage industry.

Our evidence indicates that rather than technology leading to higher demand for more able workers, and hence higher wages in the technology-using industries, the more likely mechanism appears to be that higher wages led to new technology and the selection of more able workers. Firms responded to the existing interindustry wage structure by adjusting their hiring and investment decisions so as to justify the high wages that they had to pay in the first place. If the initial source of the high wages in high-wage industries had been a more able workforce, and if this high-quality work force allowed firms to adopt new technology at a faster pace, it would seem that these industries should have experienced faster-than-average GDP growth. Instead, our evidence reveals that the high wages led to a shrinking of the work force and to a shrinking of the industry itself.

Finally, not only do the firms in high wage industries adapt to the constraints imposed by a rigid interindustry wage structure, but the market itself also changes. Because high-wage industries are at a competitive disadvantage, the market responds by substituting other goods for those produced by high-wage firms. This type of market-level substitution generates both the relative decline in prices observed in high-wage industries as well as the decline in the GDP of these industries. In other words, labor became a less important input in the production process of high-wage industries, and the output produced by these industries became a less important part of the overall market.

VI. Conclusions

We began our analysis of how the market responds to the interindustry wage structure by specifying and estimating a simple competitive model of interindustry wage differentials. Our empirical results contradict the basic implications of the competitive model. We found very weak

tendencies for industry wage differentials to converge over time. And rather than workers flowing to high wage industries (and thus helping arbitrage the wage differentials), we found that high wage industries in 1959 experienced significantly slower-than-average employment growth from 1959 to 1989.

The paper also investigated the relationship between the initial industry wage premia and the adjustment of other economic variables. The evidence suggests that industries that had initially high wages experienced not only slower employment growth, but also slower GDP growth. Moreover, these industries also experienced significantly greater growth of labor productivity and capital-labor ratios. Finally, the cross-sectional correlation between the industry's wage premium and labor productivity grew dramatically between 1959 and 1997.

The evidence is not consistent with either a simple competitive model or with a model that attributes the interindustry wage structure to unobserved heterogeneity of workers across industries. We conclude that the evidence is most consistent with a non-competitive model of the interindustry wage structure, such as rent-sharing or efficiency wages. In fact, any model that generates a rigid interindustry wage structure will likely generate many of the dynamic correlations documented in this paper. The rigid wages encourage firms to substitute capital for labor, and encourage the market to substitute cheaper goods for the relatively expensive goods produced by the high-wage industries.

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**Table 1. Estimates of Wage and Employment Convergence
(3-digit Industries, 129 observations)**

<u>Regression specification</u>	<u>OLS Regression</u>		<u>IV Regression</u>	
	<u>Coefficient</u>	<u>R-Squared</u>	<u>Coefficient</u>	<u>R-Squared</u>
A. Regression of average annual wage growth on the initial wage premia				
1. 1959 to 1989	-.005 (.002)	.064	-.005 (.002)	.064
2. 1959 to 1969	-.026 (.002)	.555	-.027 (.003)	.555
3. 1969 to 1979	.015 (.005)	.066	.020 (.005)	.057
4. 1979 to 1989	-.005 (.003)	.025	-.006 (.003)	.025
B. Regression of average annual employment growth on the initial wage premia				
1. 1959 to 1989	-.042 (.011)	.096	-.053 (.015)	.089
2. 1959 to 1969	-.034 (.015)	.040	-.048 (.019)	.033
3. 1969 to 1979	-.043 (.018)	.043	-.063 (.019)	.034
4. 1979 to 1989	-.052 (.015)	.078	-.041 (.017)	.074

Notes: Standard errors are reported in parentheses. All regressions include a constant term. The IV estimates use the previous decade's wage premium as an instrument. The regressions are weighted by the industry's employment in the initial year (as measured by the decennial Census).

**Table 2. Regressions on Initial Wage Premium
(Two-digit industries, IV estimates)**

Dependent variable is the 1959-97 growth in:		<u>1959- 1997</u>	<u>1960s</u>	<u>1970s</u>	<u>1980s</u>	<u>1990s</u>
1. Full-time equivalent employment	Coefficient	-.061 (.016)	-.037 (.018)	-.074 (.026)	-.077 (.024)	-.043 (.021)
	R-squared	.206	.056	.076	.271	.089
2. Nominal GDP	Coefficient	-.032 (.016)	-.024 (.016)	-.011 (.026)	-.048 (.026)	-.018 (.021)
	R-squared	.070	.035	.000	.136	.000
3. Nominal GDP per worker	Coefficient	.029 (.006)	.014 (.007)	.062 (.015)	.029 (.013)	.025 (.014)
	R-squared	.307	.019	.181	.102	.120
4. Relative prices (1977-97)	Coefficient	-.038 (.022)	---	---	-.015 (.027)	-.035 (.029)
	R-squared	.015			.024	.003
5. Real GDP (1977-97)	Coefficient	-.006 (.022)	---	---	-.032 (.021)	.016 (.033)
	R-squared	.006			.060	.002
6. Real GDP per worker (1977-97)	Coefficient	.065 (.025)	---	---	.044 (.026)	.059 (.032)
	R-squared	.086			.108	.063
7. Real Capital Stock	Coefficient	-.028 (.021)	-.015 (.022)	.005 (.025)	-.041 (.033)	-.059 (.022)
	R-squared	.037	.008	.002	.026	.080
8. Capital per worker	Coefficient	.034 (.016)	.022 (.016)	.078 (.026)	.036 (.032)	-.016 (.021)
	R-squared	.065	.019	.110	.069	.000
9. Labor's share of GDP	Coefficient	-.013 (.005)	-.014 (.007)	-.019 (.016)	-.010 (.010)	-.008 (.011)
	R-squared	.069	.022	.000	.039	.026

Notes: Standard errors are reported in parentheses. All regressions include a constant term and have 52 observations. The IV regressions use the wage premium at the beginning of the previous decade as an instrument. The regressions are weighted by the industry's employment in the initial year.

Table 3. Sensitivity of Results to the Manufacturing Sector
(Two-digit industries, IV estimates)

Dependent variable is the 1959-97 growth in:	<u>Coefficient on the</u> <u>1959 wage premium</u>	<u>Coefficient on the</u> <u>manufacturing dummy</u>	<u>R-squared</u>
1. Full-time equivalent employment	-0.042 (.016)	-0.017 (.005)	0.380
2. Nominal GDP	-0.014 (.015)	-0.015 (.004)	0.256
3. Nominal GDP per worker	0.028 (.007)	0.001 (.002)	0.317
4. Relative prices (1977-97)	-0.028 (.023)	-0.010 (.007)	0.067
5. Real GDP (1977-97)	-0.003 (.023)	-0.003 (.007)	0.008
6. Real GDP per worker (1977-97)	0.046 (.025)	0.017 (.007)	0.191
7. Real Capital Stock	-0.015 (.022)	-0.012 (.006)	0.105
8. Capital per worker	0.027 (.017)	0.004 (.005)	0.082
9. Labor's share of GDP	-0.010 (.006)	-0.003 (.002)	0.128

Notes: Standard errors are reported in parentheses. All regressions include a constant term and have 52 observations. The regressions use the wage premium at the beginning of the previous decade as an instrument. The regressions are weighted by the industry's employment in the initial year.

Table 4. Labor Productivity Growth Regressions
Dependent Variable: Annualized growth of GDP per worker between 1959 and 1997
(Two-digit industries, IV estimates)

<u>Variables</u>	<u>Regression</u>						
	<u>(1)</u>	<u>(2)</u>	<u>(3)</u>	<u>(4)</u>	<u>(5)</u>	<u>(6)</u>	<u>(7)</u>
1959 Wage premium, from the 1960 Census	0.029 (.006)	---	0.043 (.016)	0.028 (.007)	0.022 (.005)	0.030 (.007)	0.031 (.007)
NIPA average compensation per worker	---	0.014 (.004)	-.010 (.010)	---	---	---	---
Capital per worker in 1959	---	---	---	0.001 (.001)	---	---	---
Growth in capital per worker, 1959-97	---	---	---	---	0.214 (.044)	---	---
Nominal GDP per worker in 1959	---	---	---	---	---	-.001 (.002)	---
Growth in nominal GDP per worker, 1949-59	---	---	---	---	---	---	-.032 (.075)
R-squared	0.307	0.208	0.316	0.323	0.536	0.308	0.309

Notes: Standard errors are reported in parentheses. All regressions include a constant term and have 52 observations. The regressions use the 1949 wage premium as an instrument for the 1959 wage premium. The regressions are weighted by the industry's employment in 1959.

Table 5. Cross-Section Regressions of Industry Wages on Labor Productivity

Year	Wage Premia from Census		Compensation per FTE from NIPA	
	<u>R-squared, all 52 industries</u>	<u>R-squared, excluding real estate</u>	<u>R-squared, all 52 industries</u>	<u>R-squared, excluding real estate</u>
1959	0.098	0.256	0.165	0.401
1969	0.133	0.323	0.208	0.484
1979	0.299	0.577	0.353	0.664
1989	0.412	0.698	0.451	0.712
1997	---	---	0.486	0.724

Appendix

Table A-1. Three-Digit Industry Codes

10 Metal mining	326 Pottery	521 Lumber retail
11 Coal mining	328 Misc stone	525 Hardware & firm retail
13 Oil & gas extraction	331 Primary steel	533 Variety stores
14 Nonmetal mining	333 Primary aluminum	53 General merchandise
15 Construction	342 Cutlery, handtools	545 Dairy product retail
201 Meat products	344 Fabric. Struct. metal	54 Food stores
202 Dairy products	341 Misc Fabric structural	55 MV retailing
203 Canning	35 Misc machinery	554 Gas stations
204 Grain Mill products	352 Farm equip	56 Apparel retail
205 Bakery products	357 Office & computer	566 Shoe retail
206 Confectionery	36 Electrical equipment	571 Furniture retail
208 Beverage	371 Motor vehicles	572 Appliance, TV
209 Misc food prep	372 Aircraft	58 Eating & drinking
21 Tobacco manuf	373 Ships & boats	591 Drug stores
225 Knitting Mills	374 Misc transport equip	592 Liquor stores
226 Dyeing & finishing	38 Instrument	597 Jewelry stores
227 Floor coverings	386 Photo	598 Fuel & ice
221 Yarn, thread	387 Watches & clocks	599 Florists
229 Misc textile mill	39 Misc manufacturing	593 Misc retail
231 Apparel	40 RR transportation	60 Banking & credit
239 Misc textile	41 Bus & urban	62 Security, brokerage
261 Pulp & paper	412 Taxis	63 Insurance
267 Misc paper	421 Trucking	65 Real estate
265 Boxes	422 Warehousing	731 Advertise
271 Newspaper	44 Water transport	73 Business services
272 Printing, publishing	45 Air transport	75 Automobile services
281 Many chemicals	46 Pipe lines	76 Misc repair services
283 Drugs	47 Services for transportation	70 Hotels
285 Paints	483 Radio & TV	721 Laundering
291 Petroleum refining	481 Telephone	723 Beauty shops
295 Misc petroleum	482 Telegraph & misc	725 Shoe repair
301 Rubber products	491 Electric power	729 Dressmaking
307 Misc plastic	493 Electric & gas	722 Misc. personal services
311 Leather finishing	492 Gas & steam supply	78 Theatres
313 Footwear	494 Water & misc	793 Bowling, pool
315 Leather products	495 Sanitary	791 Misc. entertain
241 Logging	501 Motor vehicles wholesale	80 Medical except hospitals
242 Sawmills	512 Drugs, chemicals wholesale	806 Hospitals
244 Misc wood	506 Electrical, hardware, plumbing	81 Legal services
25 Furniture	505 Raw farm products	82 Education Services
321 Glass	508 Machinery equipment	891 Engineering & archit.
324 Cement	509 Petroleum products	893 Accounting
325 Structural. Clay	510 Rest of wholesale	892 Misc profess

Table A2. Two-Digit Industry Codes

10 Metal mining	45 Air transportation
11 Coal Mining	46 Pipelines
13 Oil & gas extraction	47 Services for transportation
14 Nonmetal mining	48 Communications
15 Construction	49 Utilities
20 Food manufacturing	50 Wholesale
21 Tobacco	52 Lumber retail
22 Textiles	53 General merchandise retail
23 Apparel	54 Food retail
26 Paper	55 Motor vehicle & gas retail
27 Printing and publishing	56 Apparel & shoe retail
28 Chemicals	57 Furniture & appliance retail
29 Petroleum manufacturing	58 Eating & drinking retail
30 Rubber & plastics	59 Misc. retail
31 Leather	60 Banking & credit
24 Logging	62 Security & brokerage
25 Furniture	63 Insurance
32 Stone, clay & glass	65 Real Estate
33 Primary metals	73 Business services
34 Fabricated metals	75 Automobile services
35 Nonelectrical machinery	76 Misc. repair services
36 Electrical equipment	70 Hotels
100 Motor vehicles	72 Personal services
37 Other transportation equipment	78 Theatres
38 Instruments	79 Misc. entertainment
39 Misc. manufacturing	80 Health Care
40 Railroad transportation	81 Legal services
41 Urban transportation	82 Education services
42 Trucking and warehousing	89 Professional services
44 Water transportation	200 All Retail

Fig1A: 1959-89 Employment Growth versus 1959 Wage
3-digit industries, labelled with SIC Codes

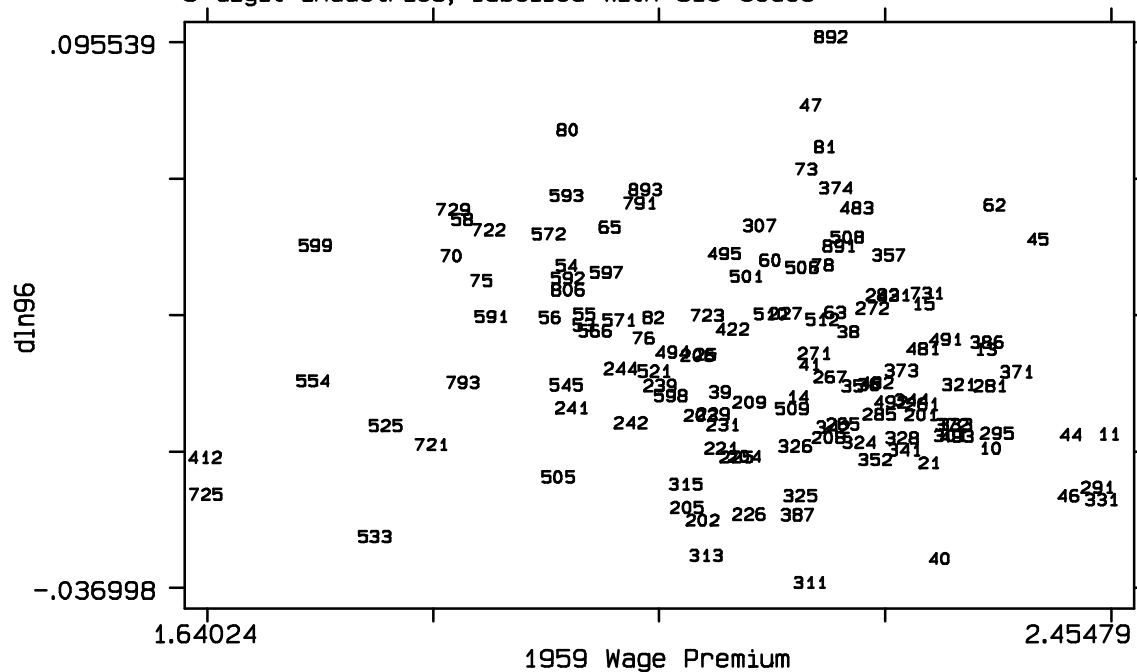


Fig1B: 1959-89 Employment Growth versus 1959 Wage
3-digit industries, circle size proportional to 1959 employment

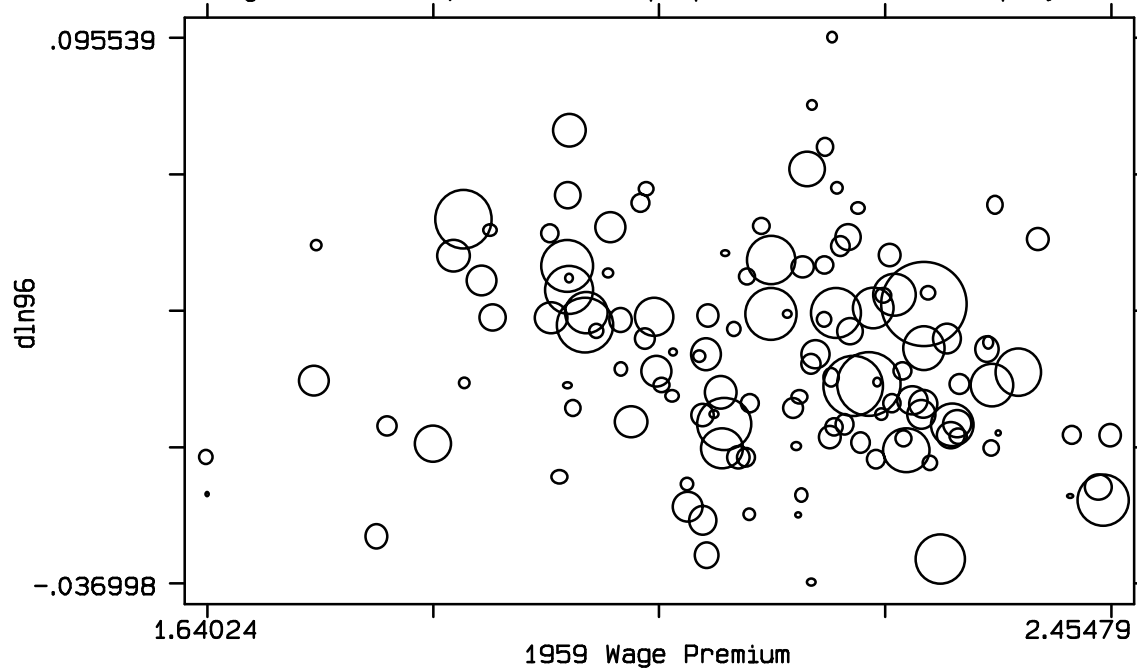


Fig 2A: Two-Digit Employment Growth vs. Initial Wage Premium
(labelled with SIC codes)

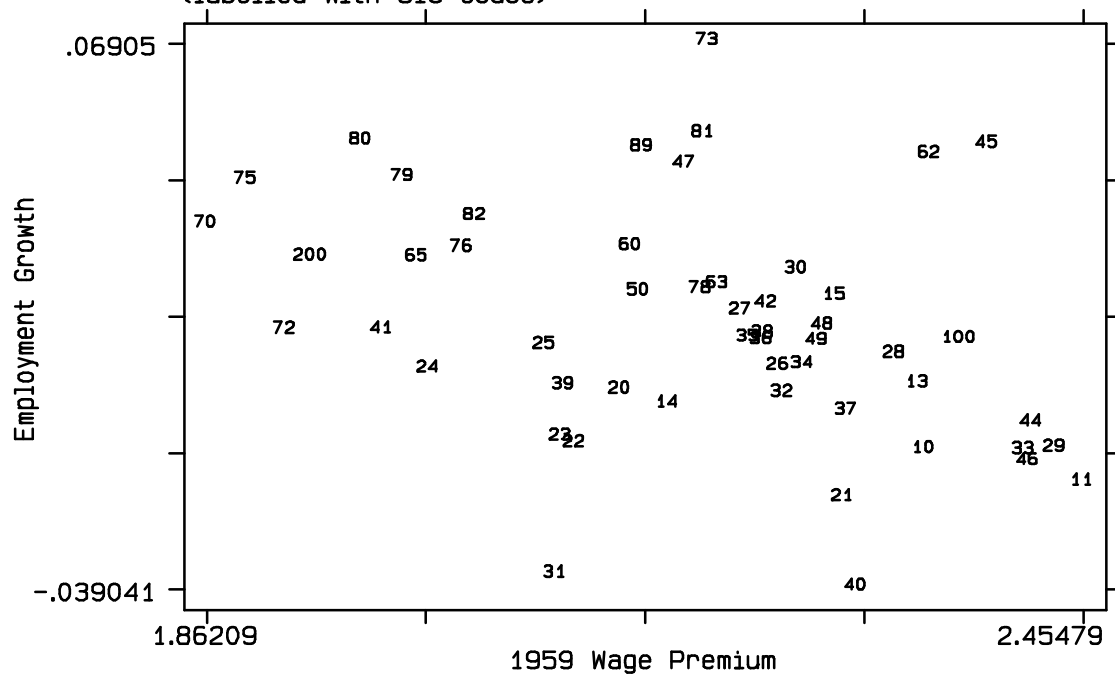


Fig 2B: Two-Digit Employment Growth vs. Initial Wage Premium
(circle size is proportional to initial employment)

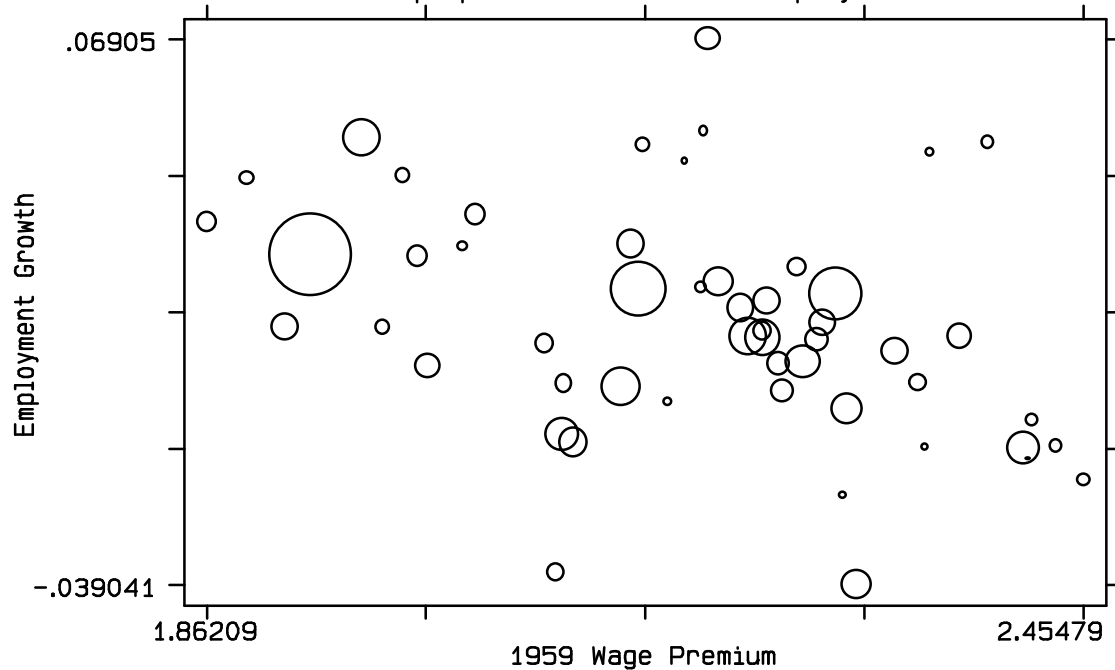


Fig 3A: GDP Growth vs. Initial Wage Premium
(labelled with SIC codes)

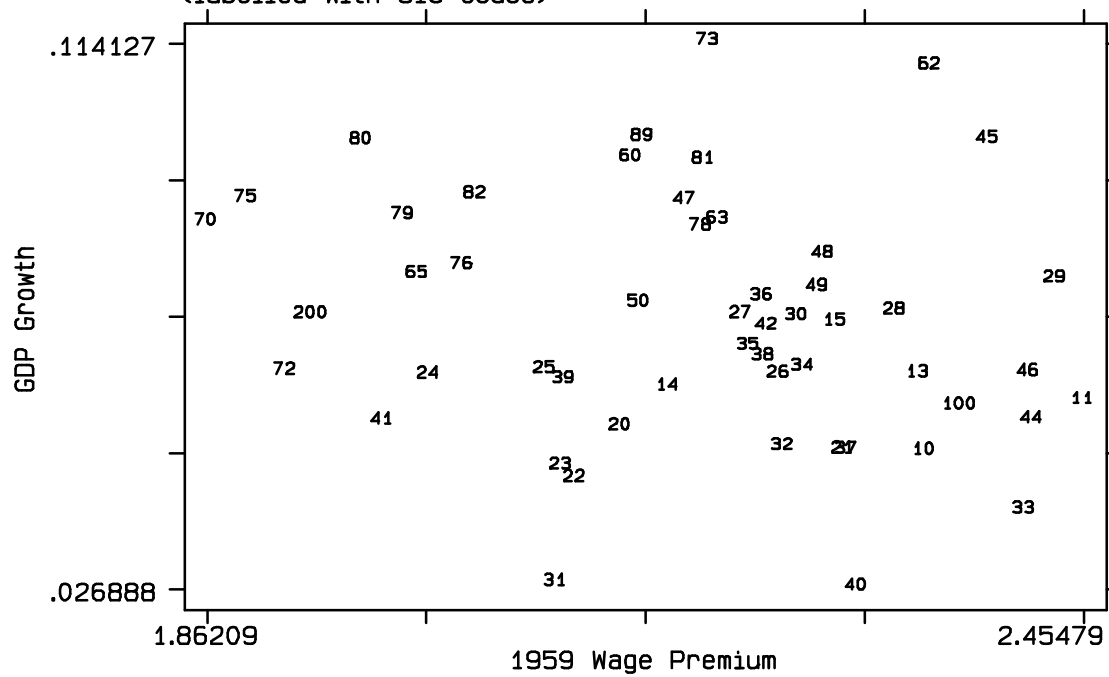


Fig 3B: GDP Growth vs. Initial Wage Premium
(circle size is proportional to initial employment)

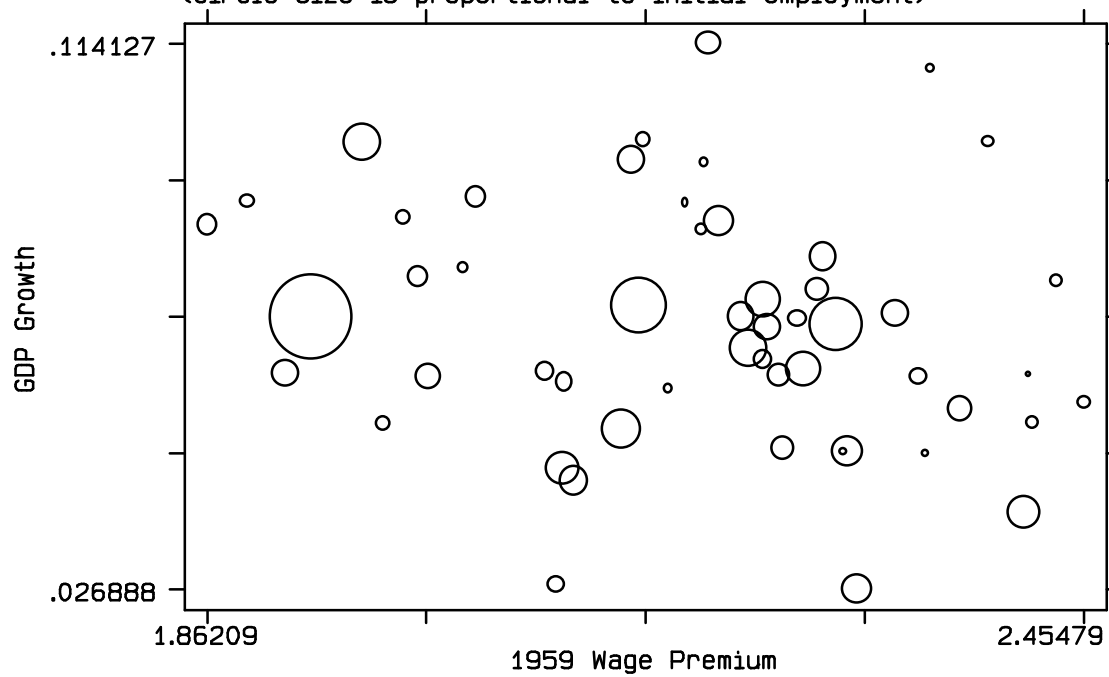


Fig 4A: GDP Per Worker Growth vs. Initial Wage Premium
(labelled with SIC codes)

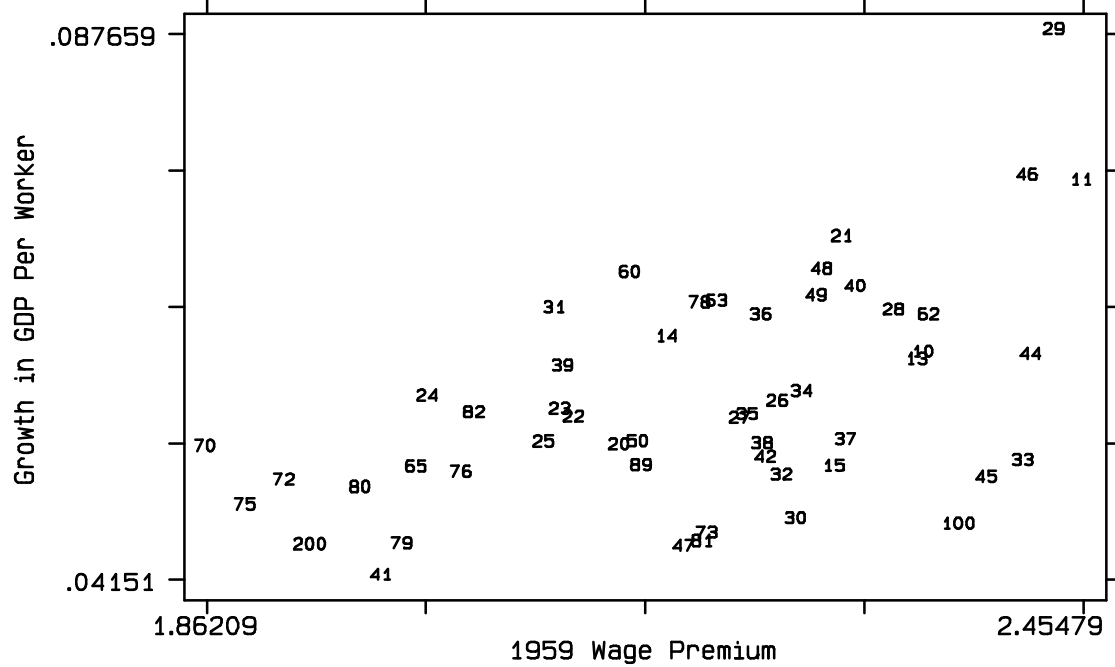


Fig 4B: GDP Per Worker Growth vs. Initial Wage Premium
(circle size is proportional to initial employment)

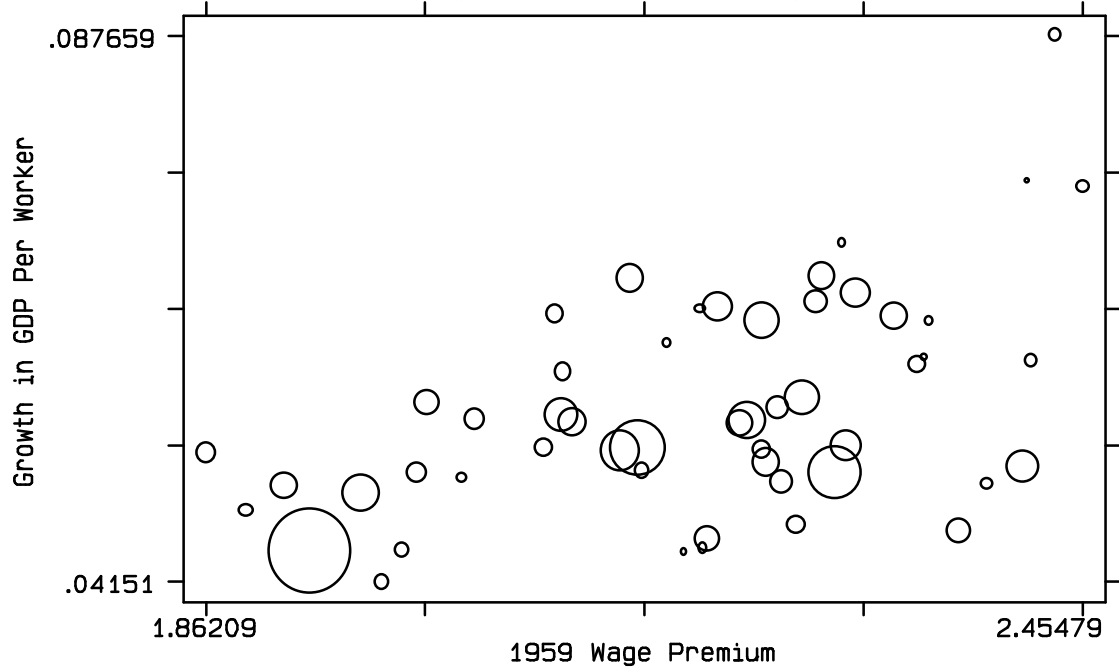


Fig 5A: Capital-Labor Ratio Growth vs. Initial Wage Premium
(labelled with SIC codes)

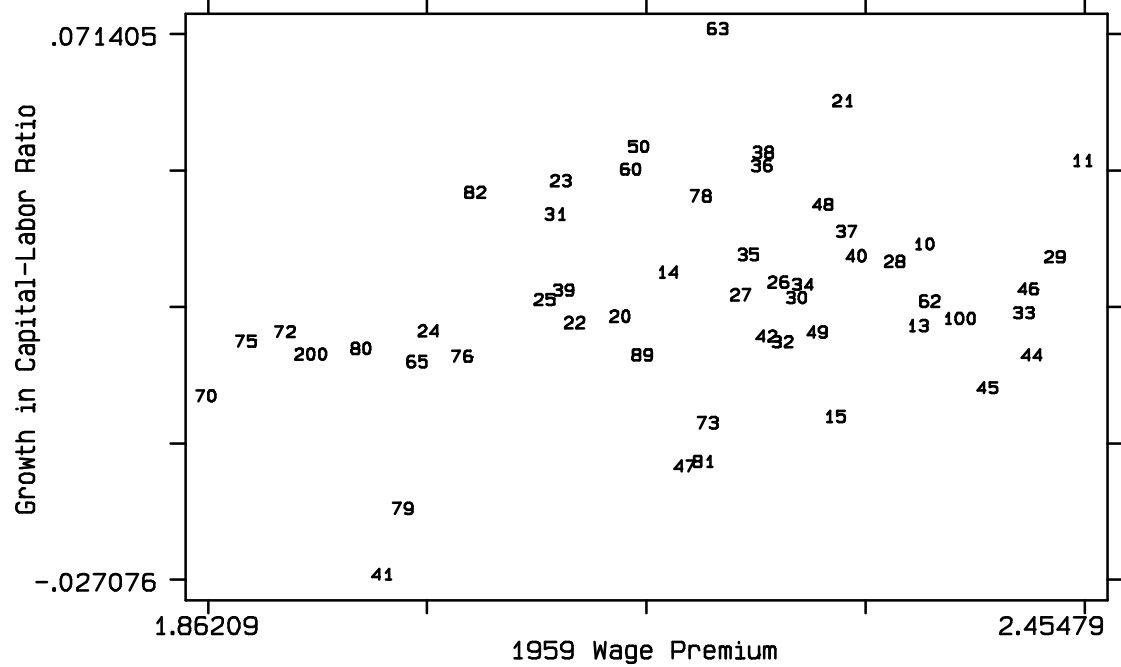


Fig 5B: Capital-Labor Ratio Growth vs. Initial Wage Premium
(circle size is proportional to initial employment)

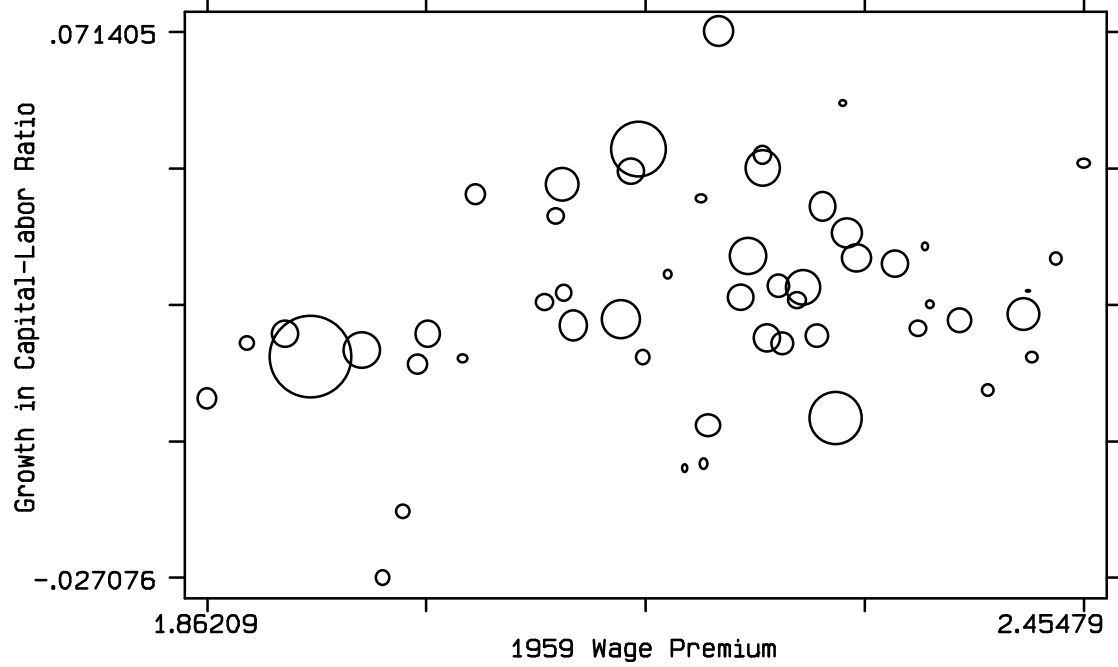


Fig 6A: 1959 Wage Premium vs. 1959 GDP per worker
(circle size is proportional to employment)

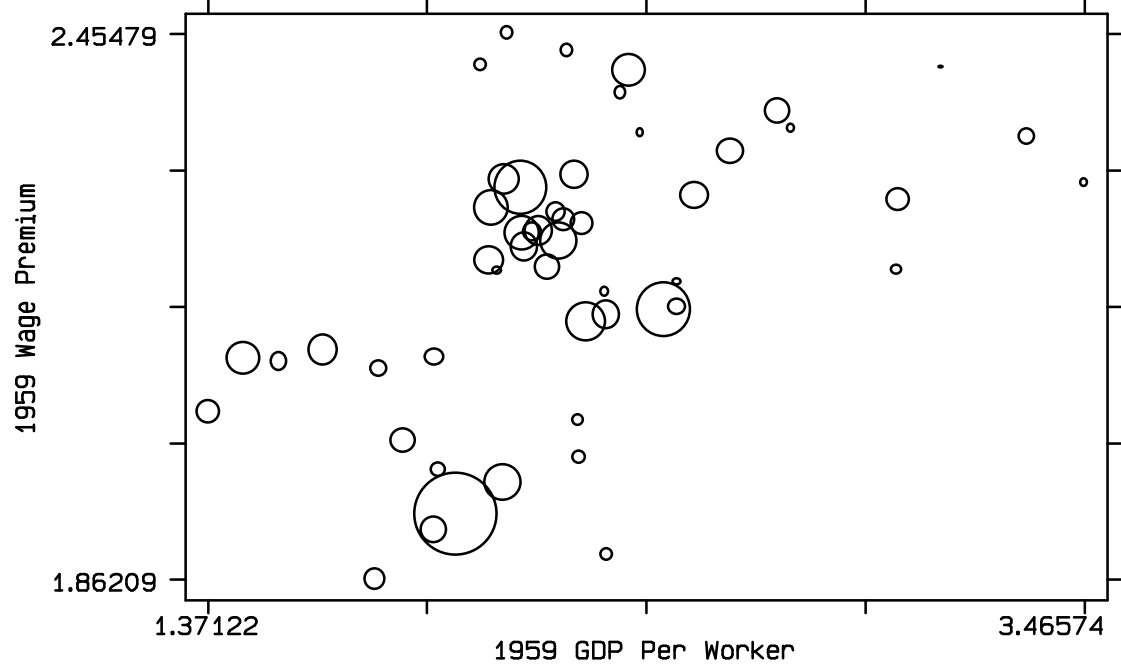


Fig 6B: 1989 Wage Premium vs. 1989 GDP per worker
(circle size is proportional to employment)

