360-76

INSTITUTE FOR RESEARCH ON POVERTY DISCUSSION PAPERS

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September 1976

The research reported here was supported by funds from NIE-G-74-0100 from the National Institute of Education and by funds granted to the Institute for Research on Poverty of the University of Wisconsin-Madison by the Department of Health, Education, and Welfare pursuant to the provisions of the Economic Opportunity Act of 1964. Glen Cain, W. Lee Hansen, Michael Olneck, and Burt Weisbrod provided helpful comments on previous drafts. The author is greatly indebted to the computational assistance of Luise Cunliffe and Nancy Williamson. The opinions expressed and any remaining errors are the responsibility of the author.

ABSTRACT

The neat correspondence between private and social gains to schooling breaks down when, because of differential market power or government regulations, workers of the same skill are paid different wage rates. The expected private wage differential remains as before, the average college wage minus the average high school wage. The marginal social product of college, however, comes to depend upon which industries are induced to expand their use of college graduates and which industries are induced to contract their use of high school graduates.

An examination of the college labor market yields the conclusion that private wage differentials are generally about 90 percent of corresponding social wage differential. There are two sources of the positive discrepancy between social and private returns. The "union queue externality" arises because part of the college package is a lower likelihood of a career in a high wage unionized industry. The union job and the associated quasi-rent the college graduate might have obtained goes instead to someone who did not enter college.

The "shortage externality" arises from the tendency for both the wage differentials for a year of college and the responsiveness of these differentials to changes in supply or demand to be higher in nonunion industries. Consequently, most of the substitution between the two labor types will occur in nonunion industries where the social return to schooling is highest. The finding that for college training social wage differentials are larger than private wage differentials suggests that public subsidy of higher education is socially efficient.

Queuing for Union Jobs and the Social Return to Schooling

Over the last fifteen years there has been a proliferation of economic analysis of the impact of schooling on productivity and earnings. Debate has centered around the extent to which the average earnings differentials observed in census tabulations or estimated in cross-section surveys exaggerate the true value added of schooling. The omitted variable bias produced by the correlation of ability, motivation, and family background with schooling has received much attention [Griliches and Mason, 1972; Hause, 1972; Behrman and Taubman, 1975]. Measurement error in schooling, income, background, and ability proxies have received some attention [Bishop, 1975; Bowles and Nelson, 1974]. These two sources of bias have an impact primarily upon the accuracy of our measures of the value added of schooling. Measures of private and of social returns to schooling are equally affected by these problems.

A very different and more important set of issues has been raised by the screening hypothesis [Stiglitz, 1975; Arrow, 1972] and by the job competition model [Thurow, 1975]. In the job competition model and some screening models (those in which an improvement of the match of a worker's skills and his job responsibilities does not increase output), the social value added of schooling is substantially smaller than the private benefits of schooling. In these models, the higher wage received by the person who obtains schooling is matched by an almost equal loss by someone else. If these effects are believed to be large, the inescapable policy implication is that instead of subsidizing schooling we should tax it; instead of compelling it, we should prohibit it.

Evaluating the empirical relevance of screening or job competition is not the objective of this paper. Instead, we demonstrate the existence of

another mechanism that has been operating in the opposite direction--a market imperfection that raises the marginal social product (MSP) of college education above the average before-tax private wage premium (APP) for college. The market imperfection analyzed is the wage differentials and queuing caused by unions. Following the bulk of the literature, the union-nonunion wage differential is assumed to result from market power rather than unmeasured productivity characteristics of union members. The higher wages paid workers of equal quality results in a large number of nonunion workers willing to switch into the union sector whenever the chance arises. College graduates are substantially less likely to be union members and to work in unionized industries than high school graduates. Consequently, in the process of gaining the higher wage rates normally awarded college graduates, many college students are giving up opportunities to receive the higher wages paid in highly unionized industries. The union jobs vacated by the high school graduates who go on to college become available to those who chose not to attend college. It is proposed that the discrepancy between the social and private effects of college thereby produced be called a "union Q-nality" (Queue-nality). A "union Q-nality" is a benefit of college education that is not captured by the individual receiving the schooling.

A very simple example may serve to illustrate "union Q-nalities." Assume a two-sector (union and nonunion) economy with two factors of production, (college and noncollege labor), competitive product markets and zero cross elasticity of demand between the two sectors. Assume that noncollege wages are $10,000 for the 25 percent of the group that work in the nonunion sector and $14,000 for the 75 percent in the union

sector. College workers' salaries are $15,000 in the nonunion sector where 75 percent work and $19,000 in the union sector where 25 percent work. The individual calculates his private return as being the economy-wide average college wage ($16,000) minus the economy-wide average high school wage ($13,000). The private wage differential (APP) is $3000. The marginal social product, however, is $4000. Transforming high school graduates into college graduates results in a slight decline in the relative wage of college workers in the production function of each sector. While the simplicity of this example tends to exaggerate the size of the union Q-nality, we will demonstrate that generalizing to a multifactor, multi-industry economy with significant price responsiveness in the product markets does not eliminate this effect.

The second source of a discrepancy between the marginal social product (MSP) of college and the private before-tax college wage differential (APP) is the greater flexibility of relative wages in the nonunion sector. During a period of shortage for college-trained workers, relative wage rates rise most of all in the nonunion sector. The unionized sector is able to retain its college-trained workers because it has previously been paying them a premium. In such an environment any increase in the supply of college graduates tends to lower relative wages and cause factor substitutions of college for less well-educated labor primarily in the nonunion sector. Since during a shortage, college wage differentials are higher in precisely these industries, the MSP of college has an additional reason for being larger than the APP. This source of discrepancy will be called a "shortage

Q-nality." If a period of surplus were to result in college differentials in the nonunion sector falling below those in the union sector, the shortage Q-nality would have a negative sign.

A brief review of the history of the recently ended boom in the demand for college graduate employees will demonstrate the empirical relevance of this shortage externality. The growth of government, defense research and development, education, and medicine made the 1950s and 60s a period of rapidly expanding demand for skilled labor (especially college graduate labor). A shortage resulted--a shortage whose greatest impact was on the nonunion sector of the economy.[1] Wage differentials for schooling reached 30-year highs, growing especially large in industries where relative wages could respond to demand and supply forces--the nonunion sector of the economy.

The launching of Sputnik became an occasion for a governmental response to the shortage. The federal government established the National Defense Student Loan Program and expanded fellowship support of graduate students. Encouraged by the shortage and the growth of the college-age population, state governments upgraded sleepy teachers' colleges into state universities and established new public universities and junior colleges in the urban centers of their states. In 1965 the federal government began subsidizing new construction on college campuses and broadened its student aid programs. The growth of student aid and the movement of state systems of higher education into previously unserved markets--two- and four-year commuter colleges for urban dwellers, one- or two-year technical education programs, and liberal arts education in some of the Eastern states--lowered the cost of college attendance. Young people responded to the lowered cost of college and the

large wage premiums for college by seeking a bachelors degree. The combination of a strong rise in supply of college graduates and a slow-down in the growth of demand ended the shortage. The high wage differentials that were a manifestation of the shortage have now declined. Government's massive investment in higher education has achieved one of its objectives--ending the shortage. Industries with flexible relative wage structures, which during the shortage had had the largest wage differentials, have been experiencing the largest correction.

Unless elasticities of substitution are substantially higher in unionized industries, we would expect the small response of relative wages in these industries to result in only a small amount of factor substitution. Consequently, the movements along production isoquants that have been induced by the end of the shortage of skilled labor have primarily occurred in industries with weak unions. The unskilled labor that schooling has subtracted from the economy has, therefore, come primarily out of jobs in the nonunion sector that pay very low wages.[2] The bulk of the skilled workers that have been added to the economy have obtained well-paying jobs in this same sector.

The GNP impact or marginal social product of expanding the supply of college graduates is the difference between wages paid the college graduates added to the economy and the wages paid the noncollege workers that have been subtracted from the economy.[3] Since it is the nonunion sector where most of these additions and subtractions occurred, the GNP impact of schooling was larger than the average before-tax wage differential between college and high school graduates.

The arguments made in general terms above rest on empirically verifiable characterizations of the labor market. Both the "union queue" effect and the "shortage" effect require that:

1) Workers with identical productive capabilities are paid more in unionized industry and this is, in fact, a market distortion not a premium for some negative nonpecuniary characteristic of the job.

The "union Q-nality" rests on two further asserted facts;

2) There is a negative correlation between years of college and industry unionization.

3) College graduates do not take union jobs away from high school graduates. Either college-trained workers choose not to enter the queue for nonmanagerial jobs in union industries; they stay with the jobs only a short time when they do get them; they stay do not use college as a screen for selecting blue collar and low level white collar workers.

The "shortage Q-nality's" existence rests on three further asserted facts about the economy:

4) During the period in question (1950 to the present) there has been a negative association between an industry's unionization and the size of its wage premium for schooling.

5) In both the short and medium run, relative wages are more flexible in the nonunion sector of the economy.

6) Elasticities of substitution between different skill classes of labor do not tend to be substantially higher in industries with strong unions.

A search of the literature failed to uncover any studies of elasticities of substitution between college and noncollege labor for a broad range of industries. Because undertaking such a study is beyond the scope of this paper, the estimate of the social return to school that is calculated at the end of the paper is based on the assumption of no correlation between industry unionization and the elasticity of substitution between college and noncollege labor. This paper will focus on hypotheses (1) through (5). Section I examines the association between unionization and the education of the work force (hypotheses 2 and 3). Section II reviews the evidence on the association between skill differentials and industry unionization (hypotheses 4). Section III derives a formula for the marginal social product of college for a multisector, multi-input economy that has a union wage differential and varying flexibility of relative wages. Section IV and V present the specification and results of our regression analysis of 1968, 1973, and 1974 CPS data on earnings. Using a fully specified earnings function the nature of union schooling interactions is explored and support hypotheses 2, 4 and 5 is found. In Section VI the social return to schooling is calculated and compared to private return.

I. Unionization, College and Occupation (hypotheses 2 and 3)

The negative association between years of college completed and the unionization of one's industry of employment is well established. In our data for white males the correlation between years of schooling greater than 12 and collective bargaining coverage of the blue collar workers in one's industry was -.192 in 1968 and -.224 in 1974. This negative association occurs primarily because most professional technical workers are employed in a sector of the economy with weak unions.

The model to be built in Section III treats college-trained and non-college workers as separate factors of production. In fact, however, most college-trained workers are capable of doing what high school graduates do. Thus, if they want to, college graduates can enter the high school graduate labor market. Some of these jobs (especially those in highly unionized industries) pay very attractive wages. It is possible that the paper credentials of college-trained workers might enable them to take away the best jobs from high school educated workers. Such a queuing phenomenon is a central part of Thurow's job competition theory. It is hard to imagine why firms that are paying a free market wage rate for clerical and blue collar jobs or that are free to set any wage rate they choose, would want to require a college education for a job that a high school graduate can do just as well. If college graduates are applying for and taking these jobs, the rational thing for an employer to do is to lower his wage offer. If an outside force such as a union causes a firm to pay more than the equilibrium wage for a job, however, a long queue of people wanting to take clerical or blue collar jobs in the firm will develop. Under these circumstances a firm may be able to use schooling as a screening device despite the fact that its relationship to productivity on the job might be small. On the other hand, firms may find that hiring college-educated workers for routine clerical and blue collar jobs may lead to worker discontent and turnover.

Empirical evidence, for clerical and blue collar jobs, of a positive association between turnover and college background is not hard to find. Numerous examples are cited in Ivar Berg's Education and Jobs: The Great

Training Robbery. Linear regression models of interindustry mobility between 1965 and 1970, find that for clerical and blue collar workers in 1965 there is a strong positive association between having more than twelve years of schooling and changing industries. Certainly employers are aware of this association. Thus, when they have many more applicants than jobs, worker characteristics that have a direct relationship with turnover or productivity such as being married, typing speed, or having a relative already working for the company--not years spent in college--are likely to be the primary criteria for selecting new employees.

Are highly unionized industries more likely to have people with more than twelve years of schooling in clerical and blue collar jobs? We have seen that a priori arguments can be made either way. The empirical evidence presented in Table 1 conclusively demonstrates that no such positive association between unionization and college exists within nonmanagerial occupations. If there is an association, it is negative. The dependent variable is the number of years of college the worker has completed if he has been to college and zero if he has twelve or fewer years of schooling. The independent variables not shown in the tables are age, self-employment, and characteristics of the person's state of residence in 1965. Only three of twenty coefficients on unionization are positive and none are significant. The estimated models have a heteroskedasticity problem. Rather than go to the trouble and expense of running them with GLS or in a Tobit specification, we adjust upward our critical t by 50 percent. By this test six of the twenty coefficients are significantly negative at the .05 level. When no other characteristic of the industry is controlled (model I) four out of five unionization coefficients are significantly negative.

Table 1. Years of Schooling Beyond High School of Workers in 1965 by Occupation and Industry Characteristics

	Model	Industry Unionization	Sales Concentration Ratio	Proportion White Collar	Previous Employment Growth of Industry	Proportion Manuf. Emp. in Estab. GT 250	Proportion Non-Manuf. Emp. in Estab. GT 50	R^2
Operatives	I	-.022						.003
(.099)		(1.4)						
N=16,692	II	-.048	.096	.141	.060			.011
		(2.1)	(4.3)	(4.4)	(2.3)			
	III	-.046	-.093	.164	.063	.049	-.004	.010
		(1.9)	(3.8)	(4.7)	(2.4)	(2.0)	(.1)	
	IV	-.008	-.016	.198	.054	.089	.001	.019
		(.3)	(.5)	(5.1)	(1.9)	(3.0)	(0)	
Low Skill	I	-.098						.005
Craftsmen		(4.3)						
(.13)	II	-.059	.077	.168	.064			.007
N=11,049		(1.0)	(1.3)	(4.1)	(1.5)			
	III	-.061	.043	.202	.059	.079	.034	.013
		(.9)	(.7)	(3.9)	(1.4)	(1.2)	(.8)	
	IV	.014	.041	.025	.063	.055	.096	.027
		(.2)	(.6)	(.4)	(1.3)	(.8)	(2.0)	
High Skill	I	-.167						.008
Craftsmen		(4.3)						
(.82)	II	-.136	-.002	.212	.122			.012
N=8,589		(2.0)	(0)	(3.7)	(2.0)			
	III	-.215	.044	.208	.086	.231	.333	.020
		(3.0)	(.9)	(3.6)	(1.4)	(3.2)	(6.5)	
	IV	-.029	.101	.422	.040	.164	.139	.047
		(1.7)	(1.2)	(5.2)	(.6)	(2.18)	(2.03)	

Table 1. Years of Schooling Beyond High School (cont.)

	Model	Industry Unionization	Sales Concentration Ratio	Proportion White Collar	Previous Employment Growth of the Industry	Proportion Manuf. Emp. in Estab. GT 250	Proportion Non-Manuf. Emp. in Estab. GT 50	R^2
Low Skill Clerks	I	-.227						.002
		(3.6)						
(.35)	II	-.180	-.738	.285	.067			.041
N=10,091		(1.5)	(5.0)	(4.8)	(1.3)			
	III	-.153	-.610	.174	.069	.384	.032	.014
		(2.1)	(5.8)	(5.4)	(2.4)	(3.6)	(1.8)	
	IV	-.652	-.239	.224	.031	.831	.104	.075
		(3.7)	(1.0)	(3.3)	(.5)	(3.6)	(2.7)	
High Skill Clerks	I	-.175						.007
		(5.1)						
(.52)	II	-.125	-.095	.256	.096			.038
N=11,834		(1.5)	(1.2)	(4.0)	(1.8)			
	III	.008	.014	.182	-.002	-.031	-.020	.048
		(.2)	(.4)	(7.4)	(.1)	(.3)	(.5)	
	IV	.044	.013	.130	.005	.048	.021	.111
		(1.4)	(.4)	(5.3)	(.2)	(1.4)	(1.3)	

Notes: The dependent variable is the schooling of individuals in a particular occupation. Independent variables are characteristics of the state of residence, the characteristics of industry of employment and in some models a few individual characteristics.

Model I--Variables not shown: age, self-employed, log of SMSA's population, heating degree days (proxy for North-South), local price level, school expenditure per pupil in the state.

Model II--Model II contains: a set of four dummies for a retail industry, for a service industry, for a construction industry, and for mining, transportation, and utilities; four dummies for individual characteristics--female, Spanish American, black male, and black female--and three variables describing industry characteristics--the concentration ratio, proportion white collar, and rate of employment growth between 1960 and 1965.

Model III--Model III does not contain the four individual characteristics variables of Model II but does contain two variables describing the size of the industries' establishments.

Model IV--Model IV adds to Model II the two size variables and up to 60 dummy variables for detailed occupation.

When other characteristics of the industry are added to the model, the unionization coefficient becomes less negative. Industries with a high proportion of white collar workers were hypothesized to require more paper work of their blue collar workers and to have more complex administrative procedures. The hypothesis that the proportion white collar is a proxy for the need for verbal skills seems to be confirmed, for in nineteen of the twenty models the proportion white collar has a significantly positive relationship with the tendency to hire people with a college background for nonmanagerial jobs. Rates of employment growth and size of plant were supposed to measure opportunities for upward mobility within the firm and the complexity of the technology of the industry. Most of these coefficients are positive as hypothesized but many are nonsignificant.

II. Industry Unionization and Skill Differentials (hypothesis 4)

Theoretical arguments and empirical evidence have been presented for both a widening [Rosen, 1970] and a narrowing [Johnson and Youmans, 1971] impact of unions on wage differentials among union members. The impact of the degree of unionization on an industry's wage structure is a different issue, however, for generally only a portion of an industry's workers are represented by a union.

Since, in most industries, the white collar workers are not organized, collective bargaining coverage of the blue collar workers will generally raise blue collar wages relative to white collar wages. This hypothesis is supported by the pattern of unionization coefficients obtained when separate earnings functions are estimated for each broad occupational group.

Table 2 presents coefficients on industry unionization from regressions predicting the log of the hourly wage rate of full-time, full-year workers in which dummies for the detailed occupation of the individual were included as one of the control variables. Unionization is defined (here and throughout the paper) as the proportion of the blue collar workers covered by collective bargaining agreements. The coefficient on industry unionization is largest in the three least-skilled occupations and smallest for professionals.

When workers are categorized by schooling, the differential impact of industry unionization is even stronger. In data from the combined 1968, 1973, and 1974 Current Population Surveys, regressions predicting the log of the weekly wage obtained coefficients on unionization of .120 for men with two or more years of graduate school, .217 for college graduates, .271 for high school graduates, .419 for men with eight years of schooling, and .567 for men with four years of schooling. The strong tendency for industry unionization's impact on earnings to decline with schooling means that wage differentials for schooling are substantially smaller in heavily unionized industries.

III. The Labor Market Model

Assume a multi-industry economy in which in some industries union market power has raised the wage of noncollege labor above the wages of equally skilled workers in unorganized industries. Many of those working in the nonunion sector would prefer to work in the unionized sector and a queue forms as a result. The unionized sector consequently faces a horizontal supply curve of noncollege labor.

Table 2

The Effect of the Proportion of an Industry Covered by Collective Bargaining Agreements on the Log of the Wage Rate

Blue Collar Workers		White Collar Workers	
Service Workers	.39	Labor Skill Clerical	.15
Laborers	.32	Medium Skill Clerical	.19
Operatives	.26	Managers	.20
Medium Skill Craftsmen	.20	Technical	.19
High Skill Craftsmen	.16	Professional	.05

Note: Sample is all nonfarm, full-time, full-year workers in the 1970 Census. Dependent variable is log of the hourly wage. Variables controlled are age, schooling, race, sex, self-employed, log hours last week, size of SMSA, rural dummy, heating degree days, price level, proportion of state blue collar workers in union and dummies for detailed occupation. If an establishment size variable had been included, the effect of unionization would have declined.

The wage rate of the college-educated workers (managers and professionals) in the unionized industries is the higher of either (a) the market wage for these workers in the nonunion sector, or (b) a wage rate that maintains a customary minimum percentage differential between blue collar workers and their managers. This customary differential is considered necessary for three reasons: (1) to maintain the loyalty and morale of lower level executives, (2) to prevent supervisors and clerical workers from being organized, and (3) to act as an incentive for internal promotion into the job of foreman, etc. College grads in the nonunion sector do not choose to enter the noncollege queue in the union sector because the wages are too low. The empirical work described in Section I establishes the validity of this assumption at least for the late 1960s.

Supply and demand determines relative wage rates in the nonunion sector. Increases in the supply of college graduate workers and corresponding decreases in the supply of noncollege workers cause changes in relative wages in the nonunion sector that induce substitution of college for noncollege labor sufficient to employ the increment in the college graduate labor force. If in the union sector the relative wage of college and noncollege workers does not change (for example, because nonunion college wages are falling but the union sector's college wage is already at the morale constraint), all of the adjustment occurs in the nonunion sector.

The individual calculates his private return as being the economy-wide average college wage minus the economy-wide average noncollege wage, the APP. He does this because he figures his probability of getting into the higher wage union sector is the same as everyone else's with the same education. The high school graduate earnings stream that he expects to forgo if he

gets a college education is an average of the union and nonunion wage weighted by the number of high school graduates in each sector.

The log of the average before-tax wage differential (the private monetary benefit) is given by

$$APP = \log (\bar{S}/\bar{W}) \approx \frac{\Sigma \bar{C}_i S_i}{\Sigma \bar{C}_i} - \frac{\Sigma \bar{H}_i W_i}{\Sigma \bar{H}_i} \qquad (1)$$

where

$\bar{C}_i$ = the hours worked by college graduates in the ith industry

$\bar{H}_i$ = the hours worked by noncollege graduates in the ith industry

S_i = the log of the ith industry's college graduate salary, and

W_i = the log of the ith industry's noncollege wage rate.

In an environment of multiple wages for the same quality of labor, social return to small increments in the number of college graduates is not in general equal to the average wage ratio upon which private decisions are based. The marginal social product of transforming high school graduates into college graduates depends upon which industries respond to the change in relative supplies by expanding employment of college graduates and which industries contract employment of high school graduates. If, for instance, the union sector's college wage is on the "morale" constraint, changes in the aggregate supply of college graduates will leave relative wages in the union sector unaffected and consequently, there will be no changes in factor intensities in this sector. Under these circumstances the marginal social product (MSP) is equal to the wage increment in the nonunion sector.

If all industries experience some change in relative wages, calculation of the MSP is more complicated. In order to derive the necessary formulas, we must either empirically estimate or assume a complete set of elasticities of substitution for each industry. We will follow the latter course. The multi-input production functions of each sector are assumed to have college

and high school graduate labor functionally weakly separable from all other inputs. Solow [1956] has shown that this assumption implies the existence of consistent aggregate price and quantity indexes for these other inputs. We, therefore, treat all other inputs as an aggregate and may express the logarithmic first derivative of the demand functions for the two inputs of interest as a simple function of the quantity of output and the three input prices [Allen, 1938: 508].

$$dC_i = \kappa_{ci}\sigma_{cci}dS_i + \kappa_{hi}\sigma_{ch_i}dW_i + \kappa_i\sigma_{c*_i}dP^*_i - \eta_i(\kappa_{ci}dS + \kappa_{hi}dW_i + \kappa_i dP^*_i)$$

$$dH_i = \kappa_{ci}\sigma_{hc_i}dS_i + \kappa_{hi}\sigma_{hh_i}dW_i + \kappa_i\sigma_{h^*_i}dP^*_i - \eta_i(\kappa_{ci}dS_i + \kappa_{hi}dW_i + \kappa_i dP_i^*) \qquad (2)$$

$$\sum_j \kappa_{ji} = 1$$

$$\sum_j \kappa_{ji}\sigma_{jki} = 0$$

P^* = natural log of the price index of other inputs,

C_i = natural log of total hours worked ($\bar{C}_i$) by college graduates in industry i,

H_i = natural log of total hours worked ($\bar{H}_i$) by noncollege graduates in industry i,

η_i = elasticity of demand for output of industry i, $N > 0$,

κ_{ji} = the cost shares of the j th input in the i th industry,

σ_{jki} = Allen elasticities of substitution between j th and k th inputs

Berndt and Christensen [1973] have shown that weak functional separability implies that the Allen partial elasticity of substitutions between the aggregate of other inputs and college trained labor and between the aggregate and high school graduate labor are equal.

($\sigma_{c*i} = \sigma_{h*i}$). This means the own elasticity of input demand may be written as

$$\kappa_{ci}\,\sigma_{cci} = -\kappa_{hi}\,\sigma_{chi} - \kappa_i\sigma_{c*i};$$
$$\kappa_{hi}\,\sigma_{hhi} = -\kappa_{ci}\,\sigma_{chi} - \kappa_i\sigma_{c*i}. \tag{3}$$

The transformation of high school graduates into college graduates leaves p* unchanged ($dP_i^* = 0$) but causes high school wages to rise and college wages to fall. For simplicity, we assume the ratio of these changes to be the same throughout the economy and that their relative size is just sufficient to preserve the wage ratio between the college-high school labor aggregate and P*. $dW/dS = -\alpha = (-1)$ (Economy-wide compensation of C)/Economy wide compensation of H). The i th industry's change in the number of college and high school graduate workers is given by:

$$\Delta\bar{C}_i = \bar{C}_i dC_i = (-\kappa_{hi}\,\sigma_{chi}\,(1+\alpha) - \kappa_i\sigma_{c*i} - \eta(\kappa_{ci} - \alpha\kappa_{hi})\,\bar{C}_i dS_i,$$
$$\Delta\bar{H}_i = \bar{H}_i dH_i = (+\kappa_{ci}\,\sigma_{chi}\,(1+\alpha) + \kappa_i\sigma_{c*i} - \eta(\kappa_{ci} - \alpha\kappa_{hi})\,\bar{H}\,dS_i. \tag{4}$$

The marginal social product of expanding the supply of college graduates is the difference between the wages paid the extra college graduates and the wages that would have been paid the noncollege workers that have been subtracted from the economy. Thus, it is a difference between weighted averages of S_i and W_i where $\Delta\bar{C}_i$ and $\Delta\bar{H}_i$ are the weights.

$$\text{Marginal Social Product} = MSP = \frac{\sum_i S_i\Delta\bar{C}_i}{\sum_i \Delta\bar{C}_i} - \frac{\sum_i W_i\Delta\bar{H}_i}{\sum_i \Delta\bar{H}_i}. \tag{5}$$

If the elasticity of substitution between high school and college labor is zero ($\sigma_{chi} = 0$ for all i) and $\kappa_i \sigma_{c*} \, dS_i$ is the same in every industry, the MSP will equal the APP, the private wage differential.

If the elasticity of substitution between the other input aggregate and college or high school labor is zero ($\sigma_{c*} - \sigma_{h*} = 0$), the MSP can be roughly approximated as an average of wage differentials ($S_i - W_i$) with dS_i as weights. As long as changes in nonunion relative wages are at least as great as the changes occurring in the union sector, such an average will invariably be greater than the APP (given the negative correlation of unionization and proportion of the work force that is college educated).

IV. Empirical Specification

Between 1968 and 1974 there were substantial declines in the wage premiums received by workers with a college education. It was hypothesized at the beginning of the paper that the decline in schooling wage differentials was largest in the nonunion industries. This hypothesis is examined by comparing earnings functions estimated at the peak of the shortage of college graduates, 1968, with earnings functions estimated in 1973 and 1974, years which reflect the bust in the market for college graduate labor. If such a comparison is to be valid, identical specifications and data sources are necessary. The Annual Demographic Files of the Current Population Survey (CPS) provide a data base with the necessary comparability. When it shifted over to the 1970 Census Coding procedures in 1971, the number of industry groups uniquely identified by the CPS increased from 150 to 226. No comparability problem is created, however, for the match between the industry coding systems in the 1960 and 1970 Censuses

is quite high, and the 1960 Census industry groups that were subdivided are quite homogeneous.[4] Comparability of specification is maintained by using a semi-log earnings function and constraining all coefficients except those on weeks worked, schooling, and the unionization-schooling interaction to be equal in all years.

The group of workers studied was limited to men between the age of 16 and 70 who had worked for pay in the preceding year. Men who reported that attending school was their major activity last week were excluded as were all people who did not report their earnings. While some results are presented for black males, we focus on white males for two reasons: 1) Sample sizes (using the CPS) are large enough to enable a powerful test of interactions between unionization and the decline in the return to schooling, and 2) white male college graduates are the group that has presumably suffered the most from the relative decline in the demand for college graduates. The only sector that has not yet been reached by the bust in the market for college graduates is the health sector. Consequently, the earnings functions presented are estimated on a sample that excludes workers employed in the health industries.[5]

A number of modifications were made in the standard Mincer type earnings equation containing weeks worked, years of schooling, experience and experience squared.

1) Schooling is specified in four linear segments: elementary, high school, college, and graduate school. Even if all forms of human capital received the same rate of return this specification would be preferred because each stage of the educational process has a different ratio of purchased inputs to foregone time inputs, a different correlation

of schooling years with omitted variables, and a different amount of measurement error.

2) Depreciation of earnings capacity is assumed to occur as a function of both age and experience. Age-related depreciation is captured by a dummy for being over 65 and a variable defined as the number of years a person is over 61.

3) Location was assumed to both shift the level of the earnings function and to influence the impact of unions and schooling on earnings. Since 1968 the CPS Annual Demographic Public Use tapes have explicitly identified the residents of the eighteen largest metropolitan areas (SMSAs) and of thirty states or aggregations of states. Whether the individual lives in an SMSA is also available so there are almost eighty unique locational classifications. Three separate measures of the attractiveness of location were added to each individual's record: the natural log of the SMSAs population, the log of the local cost of living index, and heating degree days (a measure of fuel requirements for heating homes). These characteristics were then combined into one location index by the formula: Loc. Index = .0372 log SMSA Pop + .275 log Price Index + .0001 Heating Degree Days. The weight assigned each component of the index was based on the coefficients obtained in a 1972 earnings function. The location index is hypothesized to capture compensating differentials for the attractiveness of a location and disequilibrium geographic wage differentials. Interactions with unionization and schooling capture geographic differences in the impact of unionization and schooling on wage rates.

4) The proportion of nonsupervisory employees covered by collective bargaining agreements in the industry of longest employment last year is

interacted separately with three schooling segments: graduate school, college, and years of schooling under 12.

V. Empirical Results

The estimates of schooling impacts obtained from the earnings functions provide further evidence of the decline in the college wage differential. When an earnings function is estimated separately for each year (line 1 of Table 3), the private wage differential per year of college is estimated to have fallen .0126 from .0868 in 1968 to a .0742 average for 1973 and 1974. If the sketch of recent history outlined in the introduction is accurate, wage differentials for both undergraduate and graduate schooling should have been declining and becoming more equal across industries. Consequently, our specification constrains the undergraduate and graduate coefficients to move together over time. A further constraint has been placed on our model by combining the data from all three years and forcing the effects of each variable except weeks worked, schooling, and the union-schooling interaction to be equal in all three years. We do this because except for the specifically hypothesized interactions, we have no theoretical reason to expect a change in the structure of the earnings function between 1968 and 1973-74. Combining data also makes tests of hypothesis of specific structural changes over time quite convenient. Placing constraints on all coefficients in this way reduces the estimate of the 1968 to 1973-74 decline to .0076.

The addition of industry characteristics such as unionization and size of plant and union schooling and location interactions to the model, changes the interpretation of the estimated hedonic wage function. No longer are we estimating a private rate of return, for one's industry of employment is

Table 3

Gross Wage Differentials per Year of College and High School in 1968 and 1973/74

	College			High School		
	1968	1973/74	Change 68/73/74	1968	1973/74	Change 68/73/74
All Industries						
Private unrestricted	.0868	.079/.072	-.0126	.0674	.064/.063	-.0042
restricted[2]	.0825	.0749	-.0076*	.0681	.0632	-.0049*
Industrial-unrestricted	.0936	.084/.079	-.0121	.0657	.064/.063	-.0026
restricted avg.[2]	.0906	.0825	-.0081*	.0666	.0631	-.0035
Interact[3] Union=.5	.0864	.0803	-.0061	.0671	.0640	-.0031
All Industries except Medical						
Private Avg.[2]	.0827	.0755	-.0072*	.0682	.0634	-.0048*
Industrial Avg.[2]	.0909	.0823	-.0086*	.0665	.0632	-.0033
Interact[3] Union=0	.1018	.0887	-.0131	.0891	.0804	-.0087
Union=.5	.0865	.0799	-.0066*	.0671	.0643	-.0028
Union-1.0	.0710	.0710	+.0000	.0451	.0482	+.0031
Ag LT 40						
All Industries						
Private[2]	.0817	.0712	-.0105	.0993	.0943	-.0050
Industrial[2]	.0920	.0804	-.0116	.0962	.0920	-.0042
All Industries except Medical						
Private[2]	.0823	.0711	-.0112*	.0997	.0949	-.0048
Industrial[2]	.0920	.0793	-.0127*	.0963	.0923	-.0040
Interact[3] Union=0	.1045	.0879	-.0166	.1212	.1111	-.010o
Union=.5	.0877	.0766	-.0111*	.0971	.0928	-.0043
Union=1.0	.0709	.0653	-.0056	.0730	.0745	+.0015

Table 3. (continued)

Notes:
Private is the average before tax wage differential that should influence private decisions. Because the choice of industry and occupation is influenced by schooling, being in a licensed occupation and size and unionization of industry are not used as control variables.

Wage differentials described as industrial are from models with the following additional controls: industry unionization, size, the interaction of industry size and unionization, union location interaction and being in a licensed occupation that controls the board that sets requirements for licensing. It measures the marginal productivity differential implicit in the production function of a given industry.

*Statistically significant at .05 on two-tail test.

[1]Separate regressions for each year with no schooling interactions.

[2]All years combined. The year 1968 was interacted only with weeks worked and schooling. Schooling is interacted with location.

[3]All years combined. 1968 is interacted with weeks worked, schooling, and the union-schooling interaction. Schooling is also interacted with location, unionization. Tabulated rates of return are for the mean of the location index. The statistical significance of the change in rate of return between 1968 and 1973-74 is tested for Union = .5 only.

[4]Same model as the one presented in Table 4.

a consequence of schooling. We now have an estimate of a wage offer function that describes: a) wage differentials between industries; b) the relative marginal productivity of specific personal characteristics; and c) the pattern by which these relative marginal productivities vary across industries.

In addition to the industry variables, we add a dummy for licensed occupations which control their own state licensing boards. This variable is designed to capture the effect of a form of market power that disproportionately aids college graduates. Including this variable causes a substantial reduction in the coefficient on graduate education but leaves the coefficient on the first four years essentially unchanged. Except for the hypothesized change in the effects of schooling and the union x schooling interaction, the set of wage differentials and the pattern of relative marginal productivities across industries are assumed to be the same in all three years.

The estimated earnings functions strongly support the hypothesis that schooling wage differentials were substantially greater in nonunion than in union industries. The schooling x unionization interactions are highly significant in every year. In 1968 the proportionate wage differential for a year of college was .0710 in industries with all their blue collar workers covered by collective bargaining and .1018 in industries with none of their workers covered. This gap (the coefficient on the union schooling interaction) of - .029 becomes - .023 when health industry workers are included.

Unionization's interaction with years of elementary and secondary schooling is even larger. The coefficient on this interaction, the gap between nonunion and union wage differentials per year of high school was -.044 in 1968.

The data is also consistent with the hypothesis of greater wage flexibility in nonunion industries. A restriction that union-schooling interactions were the same in 1968 as in 1973/74 was rejected with an F statistic of 3.81 [Critical $F_{.025}$ (2,38000) = 3.69].

While the premium for four years of college in nonunion industries fell between 1968 and 1973-74 by .053 from .407 to .354 (expressed as a log coefficient); the premium in unionized industries remained stable at .284. The coefficient on the union-college years interaction fell from -.031 to -.018. The decline in the payoff to high school had a similar pattern. The coefficient on the unionization -X- years of school less than 12 interaction declined from -.044 to -.032. The wage premium for four years of high school declined .035 from .36 to .32 in nonunion industries while rising slightly from .18 to .19 in highly organized industries. Most industries do not lie at either extreme of the unionization scale so the declines in schooling differentials for particular industries range over the interval described above.

While the size of the decline of the college premium is greater for younger workers, the pattern of the decline is the same. The coefficient on college years union interaction (the gap between nonunion and union wage premiums) declined from .034 to .024. For white men under 40 years old working outside the health field, the wage differential received by college graduates fell by .066 from .418 to .352 in nonunion industries. In unionized industries it fell by .023 from .284 to .261. The pattern of changes in the return to high school for younger workers was also very similar to the pattern for all workers.

Table 4

Earnings Functions from 1968, 1973-1974
All Industries

	All Whites		Whites LT 40		All Blacks	
	1968	1973/74	1968	1973/74	1968	1973/74
Elementary	.0468	.0437	.0474	.0428	.0026	.0042
High School	.0671	.0640	.0968	.0922	.0515	.0531
College	.0861	.0803	.0888	.0776	.0804	.0734
Graduate School	.0554	.0493	.0833	.0721	.1088	.1018
Ux X Ed LT 12	-.0438	-.0321	-.0475	-.0368	-.0191	-.0123
Un X Ed GT 12	-.0293	-.0167	-.0331	-.0238	-.0965	-.0666
Un Ed Gt 16	-.0260	-.0140	+.0082	+.0175		
Log Wks. Wkd.	.807	.943	.752	.941	.820	.985
Part Time	-.853	(.0094)	-.738	(.011)	-.625	(.026)
Log Hours Wkd.	.070	(.0026)	.082	(.0033)	.091	(.007)
Experience	.0399	(.00086)	.0910	(.0022)	.0246	(.0031)
Exp. squared -64	-.00060	(.00002)	-.0024	(.000078)	-.00037	(.00007)
Cohort Size	-.475	(.023)	.012	(.049)	-.518	(.079)
Union	.300	(.0108)	.304	(.014)	.444	(.040)
Size: Prop. in Est. GT 250	.0661	(.0076)	.016	(.0097)	.209	(.025)
Union X Size	-.2463	(.0222)	-.105	(.029)	-.301	(.072)
Location Index	.799	(.033)	.738	(.042)	1.155	(.110)
Union X Location	-.432	(.085)	-.330	(.111)	-.917	(.284)
Heating Degree Days	.000	(.001)	.0004	(.0014)	.008	(.0046)
Union X D.D.	.0154	(.0036)	.027	(.0047)	.044	(.015)
Loc. X Ed LT 12	-.0395	(.0114)	.0003	(.018)	-.0913	(.0247)
Loc. X Ed GT 12	.0498	(.020)	.0478	(.027)	-.000	(.071)
License Own	.352	(.0156)	.274	(.021)	.146	(.109)
Self Empl.	-.174	(.0076)	-.164	(.012)	-.261	(.033)
Farmer	-.121	(.0107)	-.130	(.015)	-.006	(.029)
σ of estimate	.563		.513		.546	
R^2	.622		.676		.713	
Number of Observation	76,422		39,141		6,761	

The contrasts between the earnings functions of blacks and whites are instructive (Table 4). For blacks the impact of the first eight years of schooling on the wage rate seems to be almost negligible. The wage differential for four years of college is almost as large as for whites. The small number of blacks who get graduate education seem to receive a very high rate of return to their last few years of schooling. Consistent with Ashenfelter's findings, the impact of unionization on a black's wages is larger. The difference between the black unionization coefficient of .444 and the white coefficient of .300 is highly significant, as is the difference between the coefficients on industry size (.209 and .066, respectively). The similarities between black and white earnings functions are just as striking. As with whites, the impact of schooling on earnings is largest in nonunion industries. The unionization x schooling interaction is statistically significant. As with whites there have been no appreciable changes in average wage differentials for the first twelve years of school, while there have been important declines in the wage premium paid college graduates. The sample has only a small number of blacks in the college-educated category, however, so while the size of the decline in the average wage differential between 1968 and 1973/74 is slightly larger than the white decline (-.007 vs. -.0058), the decline is not statistically significant. The small sample makes comparison of third order (union x schooling x year) interactions impossible.

VI. Calculating the Social Return

Estimates of the social and private returns to schooling can be calculated by taking the appropriate weighted averages of the industry-specific wage rates predicted by our regression equations. The before-tax private wage differential presented in line 1 of Table 5 uses the number of college-educated employees reported in the 1970 Census as the industry weight for calculating

Table 5

The Private and Social Marginal Products of a Year of College Calculated as Weighted Average of Industry Specific Wage Rates (Q-nality as a Percent of Private Differential in Parentheses. Union Plus Shortage Q-nality is the Sum of the Two.)

	Flexibility of Industry Wage Relatives	All Workers		Young Workers	
		1968	1973/74	1968	1973/74
Private Wage Differential		.0822	.0737	.0838	.0711
Marginal Social Product when $\sigma_{ch} = 2\sigma_*$					
1. Composition of Output Fixed ($\eta = 0$)	Same	.0857 (4.3)	.0778 (5.6)	.0872 (4.1)	.0750 (5.4)
	Vary	.0918 (7.4)	.0820 (11.3)	.0904 (3.8)	.0774 (3.3)
2. Price Elasticity = 1/4 College - High School Subst. Elast. ($\sigma_{ch} = 4\eta$)	Same	.0846 (3.0)	.0765 (3.9)	.0862 (2.8)	.0738 (3.8)
	Vary	.0911 (7.9)	.0812 (10.3)	.0895 (4.0)	.0764 (3.6)
3. Price Elasticity = College High School Subst. Elast. ($\sigma_{ch} = \eta$)	Same	.0819 (-.3)	.0734 (-.4)	.0836 (-.3)	.0708 (-.4)
	Vary	.0895 (9.2)	.0794 (7.8)	.0873 (4.4)	.0738 (4.2)
Marginal Social Product when $\sigma_{ch} = \sigma_*$					
4. Price Elasticity = 1/2 College-High School Subst. Elasticity ($\sigma_{ch} = 2\eta$)	Same	.0834 (1.5)	.0752 (2.0)	.0850 (1.4)	.0725 (1.9)
	Vary	.0905 (8.7)	.0805 (9.2)	.0885 (4.3)	.0753 (3.9)

the average college wage and similarly the number of high school graduates as the weight for calculating the high school wage. As expected, these estimates of the APP are quite close to the regression coefficients on years of college when unionization is uncontrolled. The estimates of marginal social products assume that the structure of production may be roughly characterized by a value added production function with weak functional separability of high school and college labor from other inputs. These assumptions plus data on the share of compensation received by each input in each industry allows the use of the formulas given in equation 5 as the weights for calculating a variety of marginal social products.[6] In the absence of information on how they vary, we assume that price elasticities (η) and the two elasticities of substitution that define this production structure (σ_{chi} and σ_{*i}) are constant across industries.[7]

When the assumed shock to the system is an equal percentage change in wage rates of all industries, the differential between the MSP and APP measures the union Q-nality. The union Q-nality as a percent of the private differential is given in parenthesis on the second line of each panel. A comparison of the four hypothetical economies reveals that as σ_{ch}, the elasticity of substitution between college and high school labor, falls relative to price elasticities, the union Q-nality declines and eventually becomes negative. In 1973/74 the union Q-nality falls from 5.6 percent when $\eta = 0$ to 3.9 percent when $\eta = .25\sigma_{ch}$ to -.4 percent when $\eta = \sigma_{ch}$. This occurs because when product market substitution opportunities are extensive, a fall in the relative price of a factor heavily used by nonunion industries causes a shift of employment away from

industries with high labor productivity, the union sector of the economy. Houthakker and Taylor (1970) found that price elasticities for aggregated expenditure categories were rather small, so η is expected to be substantially smaller than σ_{ch}. The union Q-nality also falls as σ_*, the elasticity of substitution between the college-high school labor aggregate and other inputs, rises relative to σ_{ch}. Economies 1, 2, and 3 are structured under a maintained hypothesis that is is substantially easier to substitute college for high school labor than to substitute either of these for capital or unskilled labor. σ_{ch} is assumed to be twice σ_*. If we reduce σ_{ch} by half, the union Q-nality falls to half its former value. (Compare economy 4 and 2.)

To estimate the size of the shortage externality, we must drop the assumption that the relative wages of all industries will respond equally to the end of the shortage of college-trained workers. The alternative assumption adopted is that the relative flexibility of each industry's relative wages is given by the size of the 1968 to 1973/74 decline in the college wage differential. The difference between the MSP estimated in this way and the MSP assuming equal changes in relative wages (i.e., between the third and first lines of each panel) provides an estimate of the shortage Q-nality. The shortage Q-nality as a percent of the private differential is given on the fourth line of each panel.

While raising the relative size of η and σ_* lowers the union Q-nality, it raises the shortage Q-nality. In 1973/74 the sum of the two Q-nalities declines slightly from 11.3 percent for $\eta = 0$, to 10.3 percent for $\eta = .25_{ch}$, to 7.8 percent when $\eta = \sigma_{ch}$ as price elasticities rise. Thus the sum

remains rather high even when the union Q-nality is small due to the presence of strong product price effects.

The association between unionization and the size of college wage differentials was stronger in 1968 than it is now and, consequently, the shortage Q-nality was greater. The size of the union Q-nality has moved in the opposite direction. These two changes have roughly cancelled each other out for while the two Q-nalities have a larger size in 1968 (10.9 percent versus 10.3 percent for model 2) the magnitude of the change is small.

Union Q-nality estimated for those under forty are almost identical to those estimated for the full sample. A shortage Q-nality of young workers is smaller. The association between unionization and wage rigidity is weaker and the size of the shortage Q-nality is essentially proportional to the power of this association. The sum of the two Q-nality is, consequently, about 4 or 5 percent lower for young people than for the full sample.

VII. Summary and Conclusion

The neat correspondence between private and social gains to schooling breaks down when because of differential market power or government regulations, workers of the same skill are paid different wage rates. The expected private wage differential remains as before the average college wage minus the average high school wage. The marginal social product of college, however, comes to depend upon which industries are induced to expand their use of college graduates and schoolindustries are induced to contract their use of high school graduates.

An examination of the college labor market yields the conclusion that for workers of all ages private wage differentials are about 90 percent of corresponding social wage differentials. There are two sources of the positive discrepancy between social and private returns. The "union Q-nality" arises because part of the college package is a lower likelihood of a career in a high wage unionized industry. The union job and the associated quasi-rent the college graduate might have obtained goes instead to some one who did not enter college.

The "shortage Q-nality" arises from the tendency for both the wage differentials for a year of college and the responsiveness of these differentials to changes in supply or demand to be higher in nonunion industries. The consequences of this is that most of the substitution between the two labor types will occur in nonunion industries where the social return to schooling is highest. The finding that for college training social wage differentials are larger than private wage differentials suggests that some public subsidy of higher education is socially efficient.

The analysis presented here is not meant to provide a definitive measurement of these externalities. In order to handle the complexities created by dropping the competitive labor market assumption, we have had to make a number of simplifying assumptions. The list of assumptions should be seen as a research agenda. Work is needed on estimating complete sets of industry specific elasticities of substitution which drop the assumption of separable value added production functions. More evidence is required on how the medium and long-run flexibility of relative wage rates vary across industries, for the size of the shortage externality is quite sensitive to this parameter.

The analysis of the structure of relative wages might benefit from a more disaggregated treatment than is implicit in a linear schooling union interaction used here. Continuation of past work on the cause and size of the union-nonunion differential is also required, for the size of the "union queue" effect is essentially proportional to this differential. The proponents of the screening and job competition theories will hopefully take this paper as a challenge to tackle the very tough task of establishing the empirical relevance of their theories.

Notes

[1]The word shortage is meant to imply being out of long-run equilibrium, not being out of short-run equilibrium. Given the easy admissions policies and low public tuitions of the 1960s, the very high wage differentials that existed were clearly not sustainable in the long run unless elasticities of substitution between college and noncollege labor were extremely high.

[2]The subtraction occurs both during schooling itself (the opportunity cost of study time) and after schooling is completed by virtue of the fact that an uneducated individual has been transformed into an educated one.

[3]As long as firms are cost minimizers, wage differentials defined in ratio terms imply corresponding productivity differentials. It is being assumed that, except for the effects of licensing, excise taxes on output and the degree of monopoly power (P/MR) are uncorrelated with the educational composition and unionization of an industry's labor force. The correlation between schooling and monopoly power induced by licensing is explicitly handled in the empirical work. See Bishop [1976] for more on this issue.

[4]Substantial changes did occur in occupation definitions and the reliability of occupation coding. However, the only use made of the occupation codes was to identify licensed occupations. Reliably identifying the members of these occupations has never been a major problem so the 1970 Census revisions does not appreciably change the composition of the groups assigned to the licensed occupation dummies.

[5]All models have been run with health industry workers included and results hardly change at all. The skills of college-trained workers in medicine are specific to the industry. This segmentation of the labor market combined with the continued rapid growth of medical employment, suggested that medicine may not have experienced a decline in the relative wages of college graduates. Consequently, the hypotheses formulated at the beginning of the study referred to the nonmedical industries and so the results that are reported are for that population.

[6]If, contrary to assumption, elasticities of substitution between workers of different educational levels are highest in the nonunion sector, the marginal social product is higher. A positive correlation between unionization and substitution elasticities lowers the marginal social product.

[7]For purposes of calculating shares, the college labor input is defined as all workers with 16 or more years of schooling and one-half the workers with 13-15 years of schooling. The high school labor input is all workers with 12 years of schooling and half the workers with 9 to 11 or 13 to 15 years. For each input, 1970 Census industry specific numbers of workers and median earnings were multiplied to estimate each input's compensation. Each industry's share of capital in total input was derived from the 1967 input-output table and the national income accounts for 1967. Unincorporated business income was divided into its capital and labor components by assuming that the wage rate of self-employed workers was the same as the industry average.

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