AN ABSTRACT OF THE THESIS OF

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This study re-examines how variations in market power across industries affect the relative number of females and males hired in a given occupation. The study builds upon similar work done by Sharon Oster (1975) to examine the female to male wage differences. Both market power and human capital factors such as education are considered as possible sources of the male/female differentials. The findings show market power in both output and input markets to be a significant factor in most of the occupations analyzed. Educational attainment of females to males is also a significant determinant of the male/female wage and employment differentials across occupations.

A Re-evaluation of Industry Differences in Male/Female Wages and Employment.

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A Re-evaluation of Industry Differences in Male/Female Wages and Employment

I. Introduction

Discrimination in the labor market occurs whenever one person is treated preferentially over another even though both individuals are equally productive except for some characteristic such as gender. While each employer may have individual likes or dislikes, discrimination usually involves a common taste or preference on the part of one social group against another, making discrimination a sociological phenomena. Symptoms of discrimination in the labor market are the earnings gap between males and females (wage discrimination) and the differences in the relative number of men and women hired for each occupation (occupational segregation). Although an earnings gap may persist due to legitimate market-related factors such as work experience or education, it may also persist if employers systematically reward women differently than men with respect to pay and promotions. On the other hand, occupational segregation may exist if women choose to enter professions which tend to pay less or if employers systematically hire women for lower paying occupations despite productive capabilities.

Both the male-female earnings gap and occupational segregation exist in the U.S. economy. In 1994, female year-round full-time workers earned only 76% as much as their male

counterparts, indicating a substantial earnings gap.[1] Occupational segregation was also evident in 1991 when 55.9% of all elementary school teachers were female. In comparison, only 5.6% of all civil engineers, a relatively higher paying occupation, were women.[2]

Differences also exist between industries in the extent to which women are treated differently than men in the labor market. Industry data shows both wage differentials between men and women and differences in the relative number of women and men hired. For example, the ratio of wages of female to male engineers ranges from a low of .45 in the railroad locomotives and equipment industry to a high of 1.98 in the metalworking machinery industry.[3,4] Similarly, the relative number of women engineers ranges from a low of .2 in the paperboard, container and boxes industry to a high of 3 in the fabricated textile products industry.[5]

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[1]Employment and Earnings, Jan 1995, Table No. 37, pg. 207.

[2]Statistical Abstract of the United States, 1994, Table No. 629, pg. 392.

[3]The ratio of wages is defined here to be the mean of female wages divided by the mean of male wages. Source: Extracted data from 1990 Census of Population and Housing.

[4]The metalworking machinery industry encompasses the manufacturing of metal machinery products such as bulldozers, machine tools, power driven portable tools, saws, and electric welding wire.

[5]"Relative" here refers to the number of women divided by the number of men. Source: Extracted data from the 1990 Census of Population and Housing.

Such inter-industry variance in the wage differential and the number of women hired relative to men could reflect differences in the occupational composition of the industries. For example, industries which employ a large number of low-paid secretaries will undoubtedly have higher relative numbers of women in their work force and also lower wage ratios than industries which consist primarily of high wage engineers. Yet, industry differences exist even for narrow occupational classes. Such differences suggest that the degree of discrimination against women may vary among industries.

In the last thirty years, there have been significant increases in the labor force participation rate of women, changes in labor law, and an overall increase in the education of women. The increase in both the labor force participation of women and the female to male ratio of labor force participation can be seen in Table 1.

Table 1: Civilian Labor Force Participation Rate[6]

Year	Males	Females	Female/Male Ratio
1960	83.3%	37.7%	49.8%
1990	76.0%	57.5%	83.0%

[6]Monthly data seasonally adjusted
Source: Economic Report of the President, pg.308, pg. 311

The female-to-male participation ratio has almost doubled since the 1960's. The increase in the labor force participation by women undoubtedly increased the number of women hired. (However, if the increase is not uniform across industries, the ratio of females hired to males hired may increase unproportionately for certain occupations.) Over time, the occupational composition of industries may also change as formerly male dominated occupations become infiltrated by women, or vice-versa.

There have also been significant changes in social attitudes and in the law regarding sex discrimination since the 1960's. Changes in the law reflect the changing attitudes of society which should affect the wage differential over time. Table 2 summarizes some of these important changes.

Table 2: Changes in Law Regarding Discrimination Against Sex Since 1960[7]

Equal Pay Act of 1963	First modern employment discrimination statute. Imposes an obligation on employers to provide "equal pay" for men and women who perform "equal work" with in an establishment unless the difference in pay is based on a seniority or merit system or some other "factor other than sex."

[7]Hill, pg. 51, 52 and Player, pg. 19, 20.

Title VII of the Civil Rights Act of 1964, 42 USCA	Title VII is one title of the omnibus civil rights bill of 1964. It prohibits discrimination by race, sex, color, religion and national origin. It reaches employers, labor organizations and employment agencies.
Title VII of the Civil Right Act is amended in 1972.	It gives the EEOC (the Equal Employment Opportunity Commission) the authority to initiate civil suits in federal district courts, seek injunctions and other remedies for unlawful practices committed by employers, labor unions, joint labor management committees, employment agencies and other institutions covered by the original Act. A new Office of the General Counsel is authorized to conduct litigation on behalf of the commission. The amended act extends coverage to every employer "engages in an industry affecting commerce" with 15 or more members. This coverage adds approximately 6 million private industry employees to EEOC's jurisdiction.

Table 2 (Continued):

Effective Approximately 1978-Executive Order 11246[8]	Requires employers with federal service and supply contracts and employers performing federally financed construction to undertake "affirmative action." It reinforces Title VII in terms of prohibiting discrimination in terms of race, sex and national origin. It also directs contracting employers to undertake a "utilization analysis" to determine the extent to which qualified women and minorities are under-represented in the various job categories of the employers work force relative to their general availability in the relevant job market.
1991-Congress passed extensive amendments in the Civil Rights Act.	Congress prohibits discriminatory adjustment of test scores, limits challenges to judicially affirmed affirmative action plans, allows for jury trials, defines time to challenge seniority systems and allows damages for intentional discrimination.

With the change in attitudes and law, firms within industries may no longer be able to practice discrimination; they may be forced to hire more women and close the wage gap. Finally, women have been attaining higher educational levels over time. In 1960, almost twice as many males as females

[8]Executive Order 11246, 26 Federal Register 2477, 41 CFR parts 60-1 and parts 60-2.

were enrolled in college. Thirty years later, the number of women outnumber the men as shown in Table 3.

Table 3: College Enrollment, by Sex and Level (in millions)[9]

Year	Male	Female
1960	2.3	1.2
1990	6.2	7.4

If education is, in fact, a measure of productivity, and if all employees within the same industry and occupation have the same quality and years of schooling, then females should be equally productive as males and would thus be expected to receive the same compensation.

Despite these historical trends, evidence shows that wage differentials still occur between men and women within the same occupations and across industries. It is the purpose of this paper to examine male/female wage differentials and the relative number of men and women, across both occupations and industries. The role of market power within a particular industry as well as productivity differences such as education, will be considered as possible determinants of the existing differences.

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[9]Statistical Abstract of the United States, 1994, Table No. 231, pg. 156. Data for college represent degree-credit enrollment.

This study is an extension of one by Sharon Oster (1975) who examined industry market power as a possible determinant of industry-specific discrimination against women. In her regressions, Oster uses 1960 data and examines the relative number of men and women hired. She finds that the coefficients on the market power variable are of the right sign, but almost all are insignificant.[10] This paper will re-estimate Oster's model using data from 1990 and then build upon Oster's original model to make it more theoretically complete. The remainder of this paper is organized as follows: Section II reviews the literature on male/female labor market differences. Theoretical issues are examined in section III. Oster's empirical model is presented, re-estimated and revised in section IV. Section V discusses the data used. Empirical results are presented in section VI followed by conclusions.

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[10]For the market power coefficients, a negative sign is expected.

II. Survey of Literature

Studies comparing the earnings of men and women have persistently found a pay differential favoring men. Adjusting for both supply and demand side factors reduces the observed differential but does not eliminate it [Hartmann and Treiman (1981), Cain (1986)]. Most economic literature attributes the causes of labor market wage and employment differentials by sex to three major factors (which are often inter-connected): 1) Differences in personal characteristics such as education or experience which lead to differences in quality or productivity as described by human-capital theories, 2) The psychic costs men experience when working with women, "taste discrimination" as discussed for example by Becker (1957), Alchian-Kessel (1962) and Arrow (1971), and 3) Women's relative lack of job choice resulting in a poorer bargaining position and monopsonistic exploitation in the labor market.

Much literature and research has been based on the "human capital" approach which suggests that investment in human beings produce an intangible form of capital that is significant in production. The theory implies that investments in human capital increase labor productivity and thus are one of the more valuable labor characteristics to employers. Most studies find that both education and training

contribute to greater earnings (Eck, 1993). In order for males and females to earn equal wages, both parties must receive the same quality and quantity of education and training, or productivity differences will warrant unequal wages.

Polachek (1978) and Gerhart (1990) find that men and women are unequally distributed across fields of study in college that have different average starting salaries. Blau and Ferber (1991) find that women anticipate considerably lower earnings in subsequent years, even under the assumption of continuous employment. Rudd and Sanik (1983) find that work plans are related to education. Therefore, at least some earnings differentials may be explained by unequal investment in human capital (Malkiel and Malkiel, 1973, Ayers, 1978 and Polachek, 1975).

Supply side arguments also complement the human capital model. For example, it is argued that women are at a disadvantage in career advancement because they do not have the same priorities as men. Due to the traditional division of labor in the family, women may seek jobs requiring less effort (Becker, 1985). It is argued that women are less concerned with professional progress and intellectual challenges and more with comfort, flexible hours and a pleasant work environment [Filer (1985), Daymont and Adriani (1988)]. Lower anticipated earnings for equally qualified women, regardless of their cause, are likely to introduce feedback effects as suggested by Gronau (1981) and Blau &

Ferber (1986). Thus, women may plan to get less education and spend less time in the labor market in part because of lower expected rewards. These, in turn, further depress female earnings.

> Existing studies [Oaxaco (1973)] consistently find that, even after controlling for differences in human capital, there is still a wage gap that might be explained by discrimination. Prejudice or preference for not associating with women under some circumstances may interact with market forces to produce discrimination against women. The form of the observed discrimination may be either unequal numbers of women and men hired, or unequal wages. (Please refer to section III.) Becker (1957) and Alchian and Kessel (1962) have argued that the extent of discrimination by employers is related to the degree of market power such firms possess.[11] In recent empirical testing of the hypothesis either employment or wage discrimination is presumed to vary by market structure. Typically, the portion of minority employment in an industry is regressed against a variety of industry characteristics including concentration ratio. Most models use the following industry characteristics: percentage of unionization,

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[11]Oaxaco (1973) applied Becker's theory and pioneered the residual method of measuring market discrimination. Using the residual approach, the wage gap is decomposed into 1) the earnings gap that the minority receives in the absence of discrimination given their set of income-earning characteristics and 2) the unexplained "residual" amount represents the portion of the earnings gap which occurs due to market discrimination and cannot be attributed to productivity differences.

regional variables indicating the percentage of industry employment by geographical area, firm size and occasionally experience and education between majority and minority employees. Almost every study examines the black versus white racial issue. Most studies find a negative coefficient on the concentration measure, but existing empirical tests are ambiguous.

Comanor (1973) finds that estimated measures of racial discrimination are generally higher in more skilled occupations, more profitable industries, and in industries located in large metropolitan areas. He finds discrimination is the greatest in the most profitable industries. Haessel and Palmer (1978) suggest a trade-off exists between employment discrimination and the equalization of wages. They use wages to find that firms in more highly concentrated industries hire fewer minorities than do firms in less concentrated industries. Heywood (1987) shows a measure of wage discrimination to be approximately twice as great for minority workers in concentrated industries as for minorities in unconcentrated industries.

Shepherd and Levine (1973), using a sample of leading firms, find that market share makes little or no difference in the minority employment of white-collar workers. Similarly, Fujii and Trapani (1978) and Johnson (1978) find no systematic relationship between wage discrimination in concentrated and unconcentrated industries.

The results on sex discrimination are not clear. Haessel and Palmer (1978) suggest that firms with more monopoly power tend to discriminate in favor of women, especially in clerical and personnel service occupations. Luksetich (1979) also finds a significant negative coefficient on the concentration measure as do Ashenfelter and Hannan (1986) who examine employment differentials due to sex discrimination in the banking industry. Oster (1975) finds that industry concentration has no effect on the proportion of women employees in an industry.

Interestingly, studies which do not include relative wages in their econometric models find some marginal statistical significance for regional variables with the model [Oster (1975) and Shepherd & Levin (1973)]. Comanor finds the regional variables to be insignificant in explaining relative wage differentials for minorities.

The final explanation of potential wage discrimination occurs when prejudice is the result of group behavior, rather than its cause (Madden, 1975). Discrimination in this form occurs due to limited job opportunities or immobility in the labor market that has been manifested by male economic power. This case is different from the human-capital theory approach because it suggests women are actually geographically less mobile than men. Luksetich (1979) argues that men collude in

sex discrimination because of their own self-interests.[12] Likewise, Jacobs (1982) shows that males have power over female occupational choices in many different ways such as place of residence being dictated by the husband's job, legislation that bars women from certain jobs, and male workers who refuse to work alongside female workers. Thus, women may face a monopsonistic employment situation more often than men.

Joan Robinson (1934) developed the case of a discriminating monopsonist, a single buyer of labor who hires labor up to the point where marginal labor cost equals the marginal revenue product. The monopsonist pays workers a wage less than their value contribution to the firm; the wage-value contribution differential measures worker exploitation because it shows that workers are not paid their "worth."

Unfortunately, little empirical evidence exists on how monopsony actually influences the wages of men and women and how sources of economic immobility (e.g. occupational segregation, geographic factors) affect the degree of monopsonistic exploitation among both genders.[13] However, two major studies show that women's wages appear to be

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[12]This may or may not include the disutilites men experience when working with women.

[13]Most studies center on monopsonistic discrimination with in a specific industry and a regional labor market (Landon and Baird, 1971, Malkiel and Malkiel, 1973, Hoffman, 1976, Ferber and Kordick, 1978, Luizer & Thorton, 1986, and Monk-Turner and Turner, 1994).

significantly more affected by monopsony than men's wages [Gordon & Morton (1974) and Cardwell & Rosenzweig (1980)].

There exists no empirical study that develops a model to examine the impact of all of these factors on the female/male wage differential. It is the purpose of this study to fill that gap in the literature.

Recently there has been a wave of inter-industry studies of wage differentials both in the US and other countries.[14] For example, Luski and Weinblatt (1994) examine concentration ratios and the inter-industry wage structure of the Israeli manufacturing sector and find a positive relationship between wages and the degree of monopolization. Lucifora (1993) finds that both inter-industry and occupational wage differentials in Italy can be explained by either unmeasured workers' characteristics or by compensating wage differentials. In the US, there is a growing body of literature which suggests that concentration generally has a positive effect on wages, especially when the studies have examined the effects of inter-industry wage differences [Dalton and Ford (1977), Jenny (1978), Pugel (1980), Long (1983), Kwoka (1983), Martin (1984), and Brush & Crane (1989)]. Finally, Bell and Freeman (1991) find interindustry wage dispersion is increasing and attribute about 60% of the rise to competitive market forces

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[14]Most studies use manufacturing industries because the data is available for industries in the manufacturing sector and is well suited to test the regression models (Jones and Walsh, 1991).

such as changes in the demographic and occupational mix of the industrial sectors.

Instead of examining average aggregate inter-industry male/female wage and employment differences, this study looks at these differences for individual occupations across industries. The hypothesis is that male/female differences will be greater for the same occupation when market power is present. This allows for a more precise separation into occupation specific wage differences which may be caused by differences in human capital requirements, and the market power/discrimination causes of male/female differentials.

III. Theoretical Framework/Model

Becker (1957) first suggested the employer-based model of discrimination in his study of black-white labor market differences. This model can be applied to the analysis of discrimination against women. Discrimination here involves a disutility that occurs when one has contact with a member of the minority. If an individual has a "taste for discrimination," he acts as if he were willing to pay extra to associate with men instead of women.[15] The concept of a discrimination coefficient (d_i) is used in order to define each employer's individual taste for discrimination. If employers can hire an employee for wage y, then an employer is assumed to act as if $y(1+d_i)$ were the net cost of hiring a women. Hence, hiring a women increases net costs of an employer more than hiring a man. The d_i represents a non-pecuniary element that can be positive or negative depending upon whether the non-pecuniary element is "good" or "bad.")

The discrimination coefficient can also be measured by the difference between the wage that would be offered to a woman relative to an equally qualified male majority worker. Consequently, the ith employer will have a discrimination coefficient, $d_i = Y/Y_w - 1$ where Y_w = the wage the employer is

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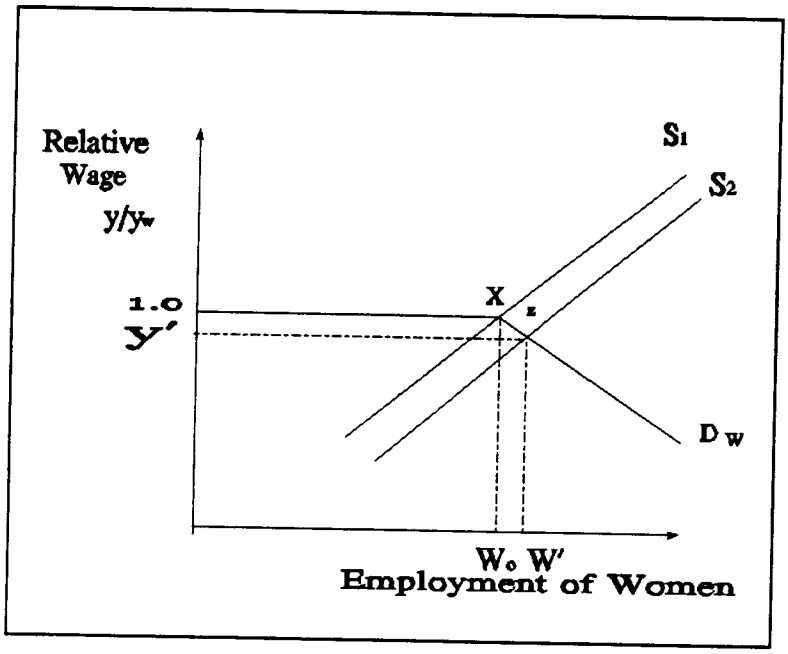
[15]The employer may be willing to pay either directly or in the form of reduced income (Becker, 1971).

willing to offer a woman. Employers who refuse to hire a woman at any wage, have an infinitely large d_i. If $d_i < 0$ then the employer is willing to pay more to an otherwise identical female worker and thus discriminates in favor of women workers. A more complete extension of this model specifies d_{ij} where j represents the jth occupation (Hameresh and Rees, 1993). The extent to which employers discriminate differs not only from employer to employer, but also according to the nature of the work. In this case, there may be discrimination in favor of the minority by majority employers. For example, some employers prefer having female secretaries and would be offended by having a male worker doing clerical work. At the same time, the employers prefer not to hire women for executive positions.

As shown in the figure that follows, the demand curve D_w shows the total number of minority workers that will be demanded by employers at various wage rates. The shape of the demand curve, D_w is determined by arranging the job offers of employers by the size of their discrimination coefficients, d_i's; employers with the smallest d_i's are placed furthest to the left. The horizontal portion of D_w represents the labor demand of nondiscriminating employers ($d_i = 0$) since, if majority and minority workers are assumed to be equally productive, nondiscriminatory employers would be willing to hire minority workers whenever Y_w is less than or equal to Y_m. Beyond the kink point (point X), the remaining employers have

increasing amounts of prejudice ($d_i > 0$) and will only hire women at successively lower relative wages. Finally, if some women (or liberal male employers) practiced favoritism towards females, their d_i would be negative and the initial part of the demand curve would then lie above 1.0.



The theory suggests that the size of the wage differential between majority and minority workers depends on two factors. First is the size of the minority group. Other things being equal, the larger the supply of minority workers in the market, the lower their relative wage should be. For example, if the supply curve were S_1, females could all find jobs with nondiscriminating employers and wages between the two groups would be equal (point X). With a larger supply of

S_2, the relative wage of female workers must fall, Y′ to some point Z in order to induce prejudiced employers to hire women. Note, the wage paid by employers who do not practice discrimination will also be Y′ since this is where supply and demand are equal.

A second factor in determining the size of the wage differential between men and women is the extent of prejudice that exists among employers. If all employers are nondiscriminatory, then the female to male wage ratio would equal to 1.0 and equal wages would exist in the market regardless of the supply conditions (Kaufman, 1994).

An important implication of Becker's model is that the nondiscriminating firm will have lower labor costs than the discriminators because the nondiscriminating firm will hire equally productive women for lower wages. If a firm discriminates, it will have costs that are greater than the lowest possible costs in the long run in a competitive economy. Thus, the firms will have negative profits and will be forced out of the market via entry of nonprejudiced employers. However, a monopoly has positive economic profits. If a monopolist discriminates, the firm's cost is greater than the lowest cost possible. But, the monopolist can still have profits greater than zero. Barriers to entry keep nonprejudiced employers out. Thus, an increase in market power means there is more likely a potential to discriminate

and firms can continue to discriminate even in the long run (Kaufman, 1994).

Firms may also have an alternate source of market power in the input market that stems from monopsony power and the geographical immobility of female workers. If an industry or a group of industries is the only employer of a particular occupation, then employees have little choice within the occupation but to work with that particular group of industries. Since only a few industries need that specific occupation, firms within these specific industries can exercise more power in the input labor market and may indulge in discrimination. There would be a greater effect if firms within an industry possessed high market power in both input and output markets.

IV. Empirical Model:

Oster (1975) uses Becker's hypothesis to empirically test the monopoly-discrimination relationship. Oster identifies eight occupations and then examines the relative number of men and women in these occupations across industries. The model Oster uses is as follows:

$$(\frac{W}{M})=\beta_0+\beta_1(\frac{A}{M})+\beta_2(MP)+\beta_3(GRT)+\beta_4(E)+\beta_5(WT)+\beta_6(SD)+\beta_7(NCD)$$

where A = Dummy with values -- 0 when the number of women > 0
and 1 when the number of women = 0

M = Number of men in the industry i in the occupation a
W = Number of women in the industry i in the occupation a
MP = Concentration ratio of industry output
GRT = Growth rate
E = Number of employees per establishment
WT = Percentage of the industry employment in the West
= Number of Employees in industry i in the West/Number of Employees in industry i for the entire US.
SD = Percentage of the industry employment in the South
= Number of Employees in industry i in the South/Number of Employees in industry i for the entire US.
NCD = Percentage of the industry employment in the North Central region
= Number of Employees in industry i in the North Central region/Number of Employees in industry i for the entire US.

In testing the monopoly model, Oster used 1960 data on professional workers since employers are most likely to discriminate against women of higher status who pose the greatest "threat" to their status. Within the class of professional workers, some industries hire more women while others hire less women. Therefore, eight occupations --

accountants, designers, natural scientists, personnel workers, technicians, engineers, draftsmen and managers were chosen because 1) none was a typically female job and 2) the occupations were not overly industry-specific and therefore gave a large sample size.

The sample included a maximum of fifty-six manufacturing industries. Four-firm concentration ratios were used to measure market power and were obtained by aggregating the four-digit ratios by share in employment to the appropriate Census industry level. A dummy variable was used to differentiate between those firms with no women and a lot of men and those firms with no women and only a few men. As the value of A moves from 0 to 1, W moves to 0 and W/M decreases; thus the β_1 coefficient is expected to be negative.

On the other hand, the market power coefficient, β_2 is expected to be negative because monopoly power enables economic profits to be greater than zero. An increase in market power (MP) means firms with greater monopoly power do not have to hire as many women. As market power is increased, the ratio of relative number of women to men moves closer to zero.

The growth rate variable (GRT) indicates the change in average employment over a period of time. As the growth rate of an industry is increasing, by definition, the industry is hiring more people. An increase in the numbers hired, along with changes in attitudes, the law and the supply of women,

would suggest that over time there would also be an increase in the number of women hired in proportion to men. This variable is expected to be significant and have a positive relationship with the relative number of women hired making the coefficient β_3 positive. However, for the 1960's data, the opposite is expected to be true; β_3 is expected to be negative because firms in the 1960's did not have the same public pressures that they do in the 1990's. In addition, larger firms before the 1960's faced labor laws that did not pressure establishments to increase the relative number of women hired.

For the 1960's data, the coefficient β_4 (relating to the number of employees per establishment) is expected to be negative. However since then, larger firms are pressured by law to increase the relative number of women hired and in the recent data set, a positive coefficient, β_4 is expected for the number of employees per establishment (average) and the relative number of women hired.

Finally, the South (SD), West (WT), and North Central variables (NCD) were used by Oster in an attempt to compensate for regional variations in the supply of women workers.

Oster's results are shown in Table 4. The market power coefficients are mostly of the expected signs, but almost all are insignificant. The R^2's are low for all eight of the occupations chosen, ranging from 0.0302 to 0.2788. All growth rate (GRT) and employees per establishment (E) coefficients

are insignificant. Most of the coefficients for A/M, MP, GRT, and E are of the expected signs. While, the regional variables (WT, SD, and NCD) are mostly of mixed signs and on the most part only half of the NCD (North Central) regional variable coefficients are significant.

In order to see how results have changed after thirty years, a re-evaluation of Oster's original work has been conducted using 1990 data. (Refer to Appendix, Section A1 for a discussion of the data used for the 1990 sample.) Since, it is not possible to tell precisely what definitions Oster used, the best possible proxy has been found for some variables (see Section V). Heteroskedicity has been corrected for using weighted least squares (wls) as suggested by Kmenta (1986).[16] Table 5 presents a summary of Oster's model that has been estimated using the more current data. The ordinary least squares results are in Appendix, A8.[17]

The re-estimation shows that the parameter estimates are usually of the expected signs. The A/M term could not be used in many of the models. This is a reflection of the changes in times: due to increased entry of women into traditional male occupations, the dummy variable in most cases was 0, regardless of the industry. This created a collinearity

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[16]Oster did not correct for heteroskedicity in her original work, even though at least one form of heteroskedistic variance existed.

[17]The ordinary least squares results are provided for a true comparison against Oster's results; her original work did not correct for heteroskedicity.

Table 4: Original Estimation

Occupation	Intercept	A/M	MP	GRT	E	WT	SD	NCD
Accountants	26.87	-20.16	-0.003	-4.36	-0.006	-0.028	-0.215	-0.129
t(48)	(4.06)***	(-4.01)	(-0.039)	(-0.572)	(-1.13)	(-0.202)	(-2.20)**	(1.20)
R^2=0.3080								
Engineers	-0.024	-0.016	-0.008	-2.16	-0.006	-0.002	0.031	0.046
t(48)	(-0.008)***	(-0.292)**	(-0.203)	(-0.546)	(-0.194)	(-0.026)	(0.652)	(0.900)
R^2=0.0302								
Managers	17.27	-----	-0.051	-4.65	-0.002	-0.161	-0.111	-0.096
t(49)	(6.414)***		(-1.217)	(-1.339)	(-1.022)	(-2.633)**	(-2.631)	(2.114)**
R^2=0.2788								
Personnel	61.26	-10.616	-0.597	38.936	-0.002	-0.664	-0.206	-0.607
t(46)	(3.086)***	(-2.707)***	(-2.107)**	(1.537)	(-0.112)	(-1.567)	(-0.669)	(-1.848)**
R^2=0.2696								
Draftsmen	23.42	-5.547	-0.289	8.675	0.004	-0.365	0.143	-0.280
t(45)	(2.212)***	(-2.499)**	(-2.119)**	(0.682)	(0.475)	(-1.611)	(0.938)	(-1.691)**
R^2=0.2757								
Natural Scientists	-0.035	-3.539	0.145	-7.331	-0.007	-0.108	0.061	-0.223
t(44)	(-0.005)	(-2.462)**	(1.475)	(-0.843)	(-1.115)	(0.653)	(0.597)	(-2.026)**
R^2=0.2214								
Designers	68.82	-6.426	-0.067	-52.546	-0.022	-1.290	0.157	-0.434
t(38)	(20.32)***	(-1.402)	(-0.131)	(-1.290)	(-0.765)	(-1.650)	(0.294)	(-0.823)
R^2=0.2136								
Technicians	16.25	-26.829	-0.575	34.625	-0.013	1.662	0.812	-0.233
t(47)	(0.422)	(-2.193)**	(-1.010)	(0.676)	(-0.359)	(1.701)	(1.324)	(-0.357)
R^2=0.1598								

Source: Oster, 1975

*Statistically significant at the .05 level, **at the 0.025 level, ***at the 0.005 level (Rt-tailed tests)

problem and thus the variable could no longer be used. The 1990 results are different than Oster's results in that many more variables are significant. The market power coefficient, β_2, was significant in three of the models: accountants, managers and technicians. Growth rate was significant in four of the models: engineers, managers, personnel service and computer scientists and operators. Similarly, the variable, E, was significant in three occupations: computer scientists and operators, managers, and technicians. Out of the three regional variable, the coefficients of WT and NCD were the most significant in four out of the eight models. Interestingly, market power was significant in accountants and in managers, whereas in Oster's study, market power was significant in personnel workers and draftsmen.

There are several possible problems with Oster's model. First, Oster used the relative number of men and women instead of wage differentials. She did this for two reasons. First, wage differentials by both industry and occupation were not available in 1960. Second, she argued that large, concentrated firms were more likely to have no differences in wages due to standardized wage scales and would thus engage in quantity discrimination. However, this may be incorrect for many firms. Even though the relative number of women may be greater than men, women may be systematically receiving lower wages than men for equally productive jobs that are comparable.

Table 5: Re-estimation of Oster's Model Using 1990 Data and WLS

Occupation	Intercept	A/M	MP	GRT	E	WT	SD	NCD
Accountants	15.93	-----	-0.077	0.005	0.0019	-15.62	3.893	-13.81
t(35)	(4.361)***		(-2.237)**	(0.158)	(0.759)	(-2.183)**	(0.833)	(-2.792)***
R^2=0.8126, $\bar{R}^2$=0.7804								
Engineers	1.1351	-0.097	0.00249	0.0086	0.000017	-1.798	0.2877	-0.5753
t(46)	(7.109)***	(-0.279)	(0.978)	(5.933)***	(0.122)	(-5.239)***	(1.231)	(-1.961)*
R^2=0.6719, $\bar{R}^2$=0.6220								
Managers	2.3404	-----	0.02234	0.01567	-0.000965	-1.5754	-0.08567	-1.3866
t(49)	(6.386)***		(7.601)***	(6.287)***	(-4.184)***	(-2.506)**	(-0.167)	(-2.563)**
R^2=0.8384, $\bar{R}^2$=0.8186								
Personnel	6.6493	-----	0.0069	0.08494	-0.0005	-6.058	5.063	-2.1441
t(31)	(2.110)**		(0.213)	(2.503)**	(-0.164)	(-0.890)	(1.142)	(-0.464)
R^2=0.2575, $\bar{R}^2$=0.1138								
Computer Scientists and Operators	0.0815	-1.731	0.0033	0.01	-0.0035	6.8374	3.506	-1.087
t(41)	(0.090)	(-5.330)***	(0.408)	(1.784)*	(-5.294)***	(3.098)***	(3.176)***	(-1.017)
R^2=0.7623, $\bar{R}^2$=0.7217								
Natural Scientists	4.8503	-2.015	0.0206	0.0372	-0.0015	-6.811	-2.478	-4.2424
t(19)	(1.558)	(-2.006) *	(0.915)	(1.758)	(-1.105)	(-1.664)	(-0.666)	(-0.996)
R^2=0.4536, $\bar{R}^2$=0.2523								
Designers	2.4494	-----	0.00632	-0.0133	0.0017	-6.166	6.415	-6.932
t(24)	(1.135)		(0.364)	(-0.760)	(0.903)	(-1.485)	(4.642)	(-2.018)*
R^2=0.3173, $\bar{R}^2$=0.1466								
Technicians	-1.7865	-----	0.038	0.0099	-0.002	2.4052	7.572	1.771
t(49)	(-1.633)		(3.126)***	(1.185)	(-2.307)**	(1.359)	(6.089)***	(1.510)
R^2=0.5091, $\bar{R}^2$=0.4489								

*Statistically significant at the .05 level, **at the 0.025 level, ***at the 0.005 level (Rt-tailed tests)

Arguments have been made that employers are able to successfully bypass the law by changing job titles for positions that are comparable in value to pay women less for doing the same job without being detected. This could result in increases in the relative number of women but not in the relative wage. The inclusion of wages into the model would take into account additional information and the ratio of relative wages is used here as the dependent variable.[18]

Oster's model also ignores the power firms possess in the input market (labor market), allowing firms to practice discrimination. Suppose firms in an industry have market power in the output market (a high concentration ratio). Firms within this industry may not be able to discriminate if they have to compete for skilled labor with firms in more competitive industries. Therefore, firms will have to hire both women as well as men, at higher wages otherwise the firm will risk losing their labor supply to other firms. However, firms within an industry may have market power in both the input and output markets. Here firms can indulge in discrimination because of the additional market power.

In this study, it is assumed that the labor market for highly skilled labor is national. It is proposed that a variable defined as the number of employees within a

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[18]Becker's original model called for using the relative number of men and women instead of wages because in the long run, only competitive, nondiscriminatory firms would be able to exists. In the long run, wages would be equal. (Becker, 1957)

particular occupation and industry divided by the number of employees within the particular occupation for the U.S. be added to the model to determine the potential for monopsony power in the input market and its effect on wages.

Finally, Oster's low R^2's may reflect the fact that she does not correct for heteroskedasticity. A low R^2 may also indicate omission of variables. Hartmann and Treiman (1981) cite a number of studies which show women may have been exposed to pre-market discrimination which causes women to receive lower level of education. According to the human-capital theory discussed earlier, education determines productivity and hence determines wages. If this is true within specific occupations, wages for women will be lower due to educational attainment. Hence, in order to accurately examine the portion of male-female wage differential due to discrimination, educational differences within occupations as well as industries must be controlled for. In addition, we correct for heteroskedicity.

Experience is another variable that would add information to the model. If women have less experience than men, relative wages would obviously be lower regardless of discrimination. Unfortunately, data available on experience is not available in the Census data being used. The level of educational attainment thus must proxy for a dimension of human capital.

Modified Oster's Model: The model developed here will use wage differentials while trying to capture the effects of pre-

market discrimination as well as market power in both the input and output markets. The goal will be to test whether market power has the hypothesized discriminatory effects on wage differences. The model is as follows:

$$(\frac{Y_f}{Y_m}) = \beta_0 + \beta_1(\frac{W}{TOT}) + \beta_2(MP) + \beta_3(ICR) + \beta_4(\frac{ED_f}{ED_m}) + \beta_5(E) + \beta_6(GRT)$$

where

Y_f/Y_m = The relative wage differential of females to males
= Average income of females/Average income of males

This variable has been substituted for the relative number of women/men hired which in part will be accounted for by the W/TOT variable.

W/TOT = Number of women in industry i, occupation a/ Number of men and women in the industry i, occupation a.

This variable is needed to describe the percent of women as compared to men. It has been substituted for the A/M variable to avoid the use of the dummy variable and to instead use a more descriptive variable.

MP = Concentration ratio of industry output

ICR = Input concentration ratio
= Number of all people in occupation a in industry i/Number of all people hired for occupation a for all industries (all i)

This variable has been included to analyze market power in the labor market.

ED_f / ED_m = The ratio of mean educational attainment of females to the mean educational attainment of males.

where ED_f = Sum of $YEARSCH_f$/Number of Females
and ED_m = Sum of $YEARSCH_m$/Number of Males

This variable has been added to capture pre-market discrimination as evident by differences in educational attainment of females to males.

E = Dummy with values -- 0 when the number of employees<15 and 1 when the number of employees>15

The variable, E has been changed to a dummy variable to incorporate the changes in law since the 1960's. Employers of small firms (less than fifteen employees) are not subject to the equal opportunity laws as are the large firms.

GRT = Percentage change in the annual average, industry employment between 1980 and 1990. The particular ten year period (between 1980 and 1990) is used to look at long term trends and because by 1980, the data of industry employment will reflect changes in the law. Under the new law, the industry will hire both men and women.

The dependent variable is Y_f/Y_m which is the ratio of wages of females to wages of males. If $Y_f/Y_m < 1$ then females on an average are paid less than men within industry and occupation. The variables WT, SD, and NCD have been eliminated. Oster found them insignificant and there is reason to expect a change in the regional attitudes towards sex discrimination. In particular, attitudes towards the role of women in the work place have changed since the 1960's. The increase in media and mobility of workers has most likely

contributed to a more homogeneous national attitude towards women.

For W/TOT to increase, the number of women W, has to increase relative to the total number of men and women (TOT). If W/TOT increases, more women are hired relative to men. Becker's theory predicts that an increase in the number of women should increase the wage differential if employers are discriminators, *ceteris paribus*. (As more women enter the industry, the supply curve shifts to the right lowering the wages, suggesting a negative coefficient for β_1.) An increase in W/TOT is consequently expected to result in a decrease in the ratio of female to male wages, Y_f/Y_m. It is expected that the coefficient, β_1 will be negative.

As in Oster's model, a negative relationship is expected between market power and relative wages for discriminatory employers. An increase in market power means firms can continue to pay male labor more and thus the wage differential should be greater.

As discussed above, women's wages may be more affected by monopsony power than are men's wages. Consequently, an increase in ICR should move the wage ratio closer to zero, implying a negative coefficient for β_3.

Human capital theory suggests that even in the absence of discrimination, a positive relationship should exist between the ratio of mean educational attainment and the ratio of wages. (An increase in $YEARSCH_f$ and a decrease in $YEARSCH_m$

should lead to an increase in Y_f/Y_m.) It is expected that there exists a positive coefficient β_4 between the between the relative educational attainment and wages. Given the upward trend in female education, it is expected that Y_f/Y_m has increased over time.

Firms with fewer than 15 employees (E=0) are not subject to the same law as firms with greater than 15 employees (E=1). Thus, as E moves from value 0 to value 1, the relative number of women hired by firms is expected to be increased due to the law's requirements only in the absence of discrimination. An assumption can also be made that large manufacturing companies have standardized hiring practices and wage scales and consequently do not discriminate.[19] Therefore, a positive coefficient for β_5 is predicted between the number of employees and the ratio of female to male.

A positive relationship is expected in the growth of an industry and the relative wages. If the growth rate is positive, it means that the industry is growing and can hire more women relative to men. As these women are hired, the employers will be pressured to pay women higher wages due to changes in times.[20] Moreover, as an industry grows so does

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[19]It is curious to also ponder who really is the employer in such large manufacturing firms-many managers or a few discriminatory employers.

[20]However, the following argument could apply here too: as companies hire more women, they may change job titles or hire women for different occupations.

the demand for labor. If most men are already hired, discriminating firms may be forced to start hiring women.

Table 6 summarizes the results for the modified model. Again, most of the variables are of the expected signs. This model too has been corrected for heteroskedicity as outlined by Kmenta (1986). The market power coefficient, β_2 is negative as expected and significant in four of the eight occupations: accountants, natural scientist, and technicians. Interestingly, the market power coefficient for ICR, β_3 is significant for the other three out of four models: managers, personnel service, and designers. The coefficient on educational attainment of females relative to men is positive as expected and significant for six occupations. For designers, there is an unexpected negative relation and an insignificant relationship for natural scientists. This is not surprising since the data for natural scientists show the mean educational attainment for males and females to be almost identical at 13.47 years and 13.55 years. The coefficient on E is only significant for designers, indicating that legal changes may have had an impact as hypothesized. The growth rate is significant in managers, natural scientists, and designers.

Table 6: Estimation of Modified Model

Occupation	Intercept	W/TOT	MP	ICR	ED_f/ED_m	E	GRT
Accountants	-1.1295	0.7919	-0.0013	-1.5535	1.4599	-0.0023	0.00113
t(35)	(-5.049)***	(4.003)***	(-1.743)*	(-1.303)	(7.366)***	(-0.031)	(1.170)
R^2=0.7888, $\bar{R}^2$=0.7526							
Engineers	0.07877	-0.1434	-0.002157	0.0894	0.94372	-0.04071	0.00037
t(45)	(0.470)	(-0.952)	(-2.757)***	(0.233)	(5.128)***	(-0.062)	(0.378)
R^2=0.4192, $\bar{R}^2$=0.3417							
Managers	0.7771	-0.51411	0.000922	-1.1267	0.1808	0.0319	0.0027
t(49)	(4.020)***	(-3.783)***	(1.590)	(-1.904)*	(0.925)	(1.435)	(4.446)***
R^2=0.3960, $\bar{R}^2$=0.3221							
Personnel	-11.905	6.3922	0.0289	-35.25	7.404	0.4931	0.0106
t(31)	(-2.676)**	(2.033)*	(1.472)	(-2.229)**	(3.014)***	(0.826)	(1.122)
R^2=0.2443, $\bar{R}^2$=0.0980							
Computer Scientists and Operators	0.1408	0.1165	-0.0019	-0.6033	0.8023	-0.0083	0.00009
t(30)	(0.608)	(1.976)*	(-1.577)	(-0.306)	(3.391)***	(0.206)	(0.090)
R^2=0.4404, $\bar{R}^2$=0.3285							
Natural Scientists	1.212	-0.01074	-0.0091	-0.6503	0.053991	0.14932	-0.00436
t(16)	(2.318)**	(-0.040)	(-5.607)***	(-1.525)	(0.131)	(1.636)	(-5.932)***
R^2=0.8866, $\bar{R}^2$=0.8441							
Designers	1.60245	0.71831	-0.0034	-3.8366	-0.43897	-0.37514	-0.0033
t(23)	(3.689)***	(2.330)**	(-1.225)	(-1.835)*	(-1.818)*	(-1.939)*	(-2.091)**
R^2=0.3924, $\bar{R}^2$=0.2339							
Technicians	0.27342	0.11967	-0.00186	-0.0722	0.58857	0.0584	0.00039
t(49)	(1.416)	(1.257)	(-2.320)**	(-0.135)	(3.240)***	(1.645)	(0.520)
R^2=0.3991, $\bar{R}^2$=0.3255							

*Statistically significant at the .05 level, **at the 0.025 level, ***at the 0.005 level (Rt-tailed tests)

V. Conclusion

The data shows the relative number of women is greater than men in almost every occupation (see Appendix, section A9). At the same time, wages for women are lower in every occupation than are men's wages (see Appendix, section A9). Therefore based on relative numbers, it seems females are either given preference over males or the supply of females workers relative to male workers is larger in certain occupations. But, wage discrimination still seems to persist. Consequently, analyzing inter-industry differences provides additional information.

The fact that the inter-industry ratio for the relative number of women to men ranges from <1 to >1 suggests women are favored in some industries and occupations. But thirty years ago, Oster's study showed that the relative number of men was greater than women. Market power is significant in more of the occupations than in Oster's study. In light of the legal changes it is not surprising to see the growth rate and the number of employees per firm significant in explaining the relative number of females to males hired. The significance of these variables indicates that legal changes may have had an impact in certain occupations. Finally, despite social changes, the regional variables are significant more now than in Oster's model.

Regardless of whether more women are hired than men or vice versa, wage discrimination still persists. That is, for the most part, women are paid less within industry and occupation. This study shows that market power in the output product market does lead to a difference in the ratio of wages for four of the eight occupations. Out of the remaining four, three occupations illustrate market power in the input market as significant. This finding indicates that firms with substantial market power can in fact have some degree of influence over hiring practices especially in regards to compensation as Becker's theory suggests. The policy implication is therefore that competition needs to work smoothly. The fact that the mean educational ratio is significant in six out of the eight occupations suggests that despite social changes in attitudes, much more attention is needed for females before they enter the labor market.

Future research may capitalize on the findings presented here and re-examine specific occupation and industries for an in-dept analysis. Alternatively, future research can use these results to isolate significant variables when studying the relative number females to males hired and their wage ratios within industries. The final goal being to equalize both relative number of females to males and their wage ratios within industries and across occupations.

VI. Data Sources

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Appendix

A1. Data:

The original sample has been taken from the 1990 Census of Population and Housing CD's from the 5% sample of the Public Use Micro-data Sample using the occupations and industries described below as well as listed in sections A3 and A4 in the Appendix.[21]

Since all occupations used have been professional occupations, taking the differences in physical ability of men and women into account is not important. In order to compare results with Oster and in order to keep a fairly large sample size, the occupations used have been as follows:

1) Accountants and Auditors
2) Engineers
3) Administrative Support and Managerial Occupations
4) Personnel Service Workers
5) Computer Scientists and Operators
6) Natural Scientists
7) Designers
8) Technicians and Related Support Occupations

Economists, lawyers, draftsmen, social scientists, and urban planners and mathematical scientists had to be dropped due to insufficient observations within the manufacturing industries.

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[21]In order to do this, the Ascii files from the CD's were transferred to a temporary directory at an Anonymous FTP site from which a SAS program ran and extrapolated the original sample. A maximum number of 57 manufacturing industries on the three digit industry level were used on which there was data available for both growth rates as well as concentration ratios. All miscellaneous industries have been eliminated.

The original sample containing data from the Population and Housing CD was organized on the individual level and had to be aggregated into the industry level. In order to get the data into working condition, all individuals working part time and/or part year were dropped from the sample.[22] After adjusting for full time, full-year workers, 18,225 individual observations were left in the data set.

The original sample was next separated into two groups: males and females. It was sorted by occupations into the 8 different occupations listed above and the observations from the 57 industries were pooled so the data had the following format:

Men:

Occupation 1:

OBS 1 all individual observations pooled within Industry 1 with variables calculated
OBS 2 all individual observations pooled within Industry 2 with variables calculated
OBS 3 all individual observations pooled within Industry 3 with variables calculated
. .
. .
. .
OBS 57 all individual observations pooled within Industry 57 with variables calculated

The same format was used to organize the data for women.

In the final working sample as shall be explained later,

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[22]All individuals working less than 34 hours a week and less than 47 weeks a year were dropped.

the females outnumbered the men in every occupation except Engineers.

All variables were calculated using the Census of Population and Housing Data except for MP, GRT and E. Four-firm concentration ratios coordinating with the appropriate Census industry level were obtained from the Census of Manufacturing, 1987 for the four digit level. The 1987 figure is the most current available at this time and should be the most accurate means of calculating ratios because as 1) the 1990 industry variable corresponds with the 1987 Census of Manufacturing and 2) concentration is relatively stable over short periods of time.

Since, concentration ratios were only available by 4-digit SIC code, they were aggregated in order to get them into the 3-digit form which corresponded to the Census of Population and Housing data. The value of shipments in dollars ($) by 4-digit SIC code was used to calculate a weight by which the 4-digit concentration ratio was multiplied. Finally, these concentration ratios were aggregated to correspond with the 3-digit Census code to obtain the variable MP. (The actual data calculation is shown in the Appendix).

Growth rates have been calculated using the differences in annual average employment between the years 1980 and 1990 based on 4-digit SIC codes corresponding to the 1987 SIC codes. A ten year growth rate should be accurate for this

measure because changes in the law take time to implement as well as to enforce. Unlike the data on concentration ratios, annual average employment data was available on the 3-digit SIC level. But, many of the Census codes include several 3-digit SIC codes. So, these SIC codes had to be aggregated and weights were used to do this in the same way the Concentration ratios were calculated. (Actual data calculation is in the Appendix.)

The average number of employees per establishment (E) was calculated by dividing the number of employees per 3 digit SIC code by the total number of companies within the 3 digit SIC code. (See Section A7 in the Appendix.)

For the relative wage differential of females to males (Y_f/Y_m), the variable income1 from the census data was used even though hourly income could be easily calculated using the number of weeks worked and hours worked.[23] Salary income seemed to be a more accurate measure for wage for the following reasons:

1) Since, only professional occupations have been used, most workers probably have been paid in salary form where individuals who work over-time are not compensated directly for the additional time spent. 2) Studies show that individuals consistently overestimate the number of hours they

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[23]The variable called Income1=Wages or Salary Income in 1989 (signed) was taken from the 1990 Census of Population and Housing.

work (Morin, 1985). As a result of the above arguments, only full time, full year workers were used.

The final working sample had the following totals for each occupation.

Table 7: Totals of the Final Working Sample

Occupation	Males	Females
Natural Scientists	179	400
Accountants and Auditors	192	1513
Designers	153	288
Personnel Service Workers	130	925
Engineers	1248	748
Computer Scientists and Operators	360	1592
Technicians and Related Support	1149	2087
Administrative Support and Managerial Occupations	2310	4951

These numbers are quite surprising and at first glance raise the concern for the need to test for discrimination when clearly women outnumber men in almost every occupation. Another puzzling sight is that engineers are the only occupation where men outnumber women. Moreover, for accountants and auditors there are almost eight times the number of women as men!

Since it is fairly certain the sample obtained is of high quality, three other possible explanations are presented here. First as discussed in section 1.3, the data may simply represent reflections of changing times where women are now obtaining higher paying positions, there exist absences in discrimination against women or where employers are actually favoring women. If either is the case, both Oster's and the modified models should still predict useful results. In the absence of discrimination, relative wages should also be equal or greater than 1.

Second, occupational segregation may have changed over time. It may be that now these professional jobs are not as "high-status, male-oriented" positions as they used to be in the 1960's. This may be possible for designers, since many are employed in typically "female" industries. Yet, it seems unlikely for natural scientists. Again, both models are clearly useful to study the effects of occupational segregation.

The third and most sensible explanation seems to be that the data is indicative of the occupations chosen. Within each broad category, occupations are broken down into different census codes; the number indicates the status, class of workers, type of tasks involved in the job, etc... For example, 009 is not is the "same class" as is 303. In fact, the 000 series consists of higher paid positions that require

higher levels of formal education and training as compared to the 300 series. (Please refer to Appendix, section A3.)

The occupations: personnel service workers; computer scientist and operators; and administrative support and managerial occupations each include mixed suboccupations of both the 000 and 300 series. The large number of women appearing in the sample within these three occupations may be a reflection of broad definitions picked. For instance, within the sample of personnel workers included is census code 328-personnel clerks, except payroll and timekeeping. In 1989, 91.2% of all employed within this occupation have been female. In contrast, only 52.6% of all personnel and labor relations managers (also included in personnel service occupations) have been female.[24] Similarly, computer scientists and operators included computer operators (64.2% of which are female); computer systems analysts, scientists (of which only 32.4% are female); and operations and systems researchers and analysts (of which 41.1% are female).[25] Finally in 1989, females comprised of 80% of all administrative support, including clerical occupations held. A striking contrast, only 25.9% of all purchasing managers are

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[24]Statistical Abstract of the United States, 1991, pg. 395-397, table no 653.

[25]ibid.

women.[26] Both have been included into the broad category of administrative support and managerial occupations.

In retrospect it is evident, that the data sample should have restrained from using a cross of census codes within each occupation. The variable, YEARSCH (a measure of educational attainment differences between males and females) should account for any productivity and skill differences within each suboccupation to allow for the modified model to still be useful in analyzing wages.

A2. Regional Variables (NCD, SD, and WT):

Census divisions are groupings of states that are subdivisions of the four census regions. There are nine divisions which the Census Bureau adopted in 1910 for the presentation of data. They are as follows:

Northeast Region:

Maine
New Hampshire
Rhode Island
New York
Pennsylvania
Vermont
Massachusetts
Connecticut
New Jersey

Midwest Region (NCD):

Ohio
Indiana
Illinois
Michigan
Wisconsin
Minnesota

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[26]ibid.

Iowa
Missouri
North Dakota
South Dakota
Nebraska
Kansas

South Region (SD):

Delaware
Maryland
District of Columbia
Virginia
West Virginia
North Carolina
South Carolina
Georgia
Florida
Kentucky
Tennessee
Alabama
Mississippi
Arkansas
Louisiana
Oklahoma
Texas

West Region (WT):

Montana
Idaho
Wyoming
Colorado
New Mexico
Arizona
Utah
Nevada
Washington
Oregon
California
Alaska
Hawaii

A3. List of Occupations:

For additional information about each category in the industrial and occupational and classification system, the individual titles that constitute the category, please refer to Bureau of the Census, 1990 Census of Population and Housing, Classified Index of Industries and Occupations, Sudocs Number: C 3.223/22:90-R-4.

Census Code	Occupation

Natural Scientists:

069 Physicists and Astronomers
073 Chemists (except Biochemists)
074 Atmospheric and Space Scientists
075 Geologists and Geodesists
076 Physical Scientists, n.e.c
077 Agricultural and Food Scientists
078 Biological and Life Scientists
079 Forestry and Conservation Scientists
083 Medical Scientists

023 Accountants and Auditors

(Includes occupations such as Account Auditor, Bank Accountant, Cost Expediter, Field Auditor, Inspector, Payroll Accountant and Tax Expert.)

185 Designers

(Includes occupations such as Commercial Designer, Decorator, Design Maker, Displayer, Dress Designer, Display Manager, Style Advisor and Textile Designer.)

Personnel Service Workers:

008 Personnel and Labor Relations Managers
027 Personnel, Training and Labor Relations Specialists
328 Personnel Clerks, except Payroll and Timekeeping

Engineers:

043 Architects
044 Aerospace
045 Metallurgical and materials
046 Mining
047 Petroleum
048 Chemical
049 Nuclear
053 Civil
054 Agricultural
055 Electrical and electronic
056 Industrial
057 Mechanical
058 Marine and naval architects
059 Engineers, n.e.c.
063 Surveyors and mapping scientists

Computer Scientists and Operators:

064 Computer Systems Analysts and Scientists
065 Operations and Systems Researchers and Analysts
308 Computer Operators

Technicians and Related Support Occupations:

213 Electrical and Electronic Technicians
214 Industrial Engineering Technicians
215 Mechanical Engineering Technicians
216 Engineering Technicians, n.e.c.
217 Drafting Occupations
218 Surveying and Mapping Technicians
223 Biological Technicians
224 Chemical Technicians
225 Science Technicians, n.e.c.
226 Airplane Pilots and Navigators
227 Air Traffic Controllers
228 Broadcast Equipment Operators
229 Computer Programmers
233 Tool Programmers, numerical control
234 Legal Assistants
235 Technicians, n.e.c.

Administrative Support and Managerial Occupations:

303 Supervisors, General Office
304 Supervisors, Computer Equipment Operators
305 Supervisors, Financial Records Processing
307 Supervisors; Distribution, Scheduling, and Adjusting Clerks
007 Financial Managers
009 Purchasing Managers
013 Managers, Marketing, Advertising, and Public Relations
015 Managers, Medicine and Health
017 Managers, Food Serving and Lodging Establishments
018 Managers, Properties and Real Estate
021 Managers, Service Organizations, n.e.c.
022 Managers and Administrators, n.e.c.

A4. List of Manufacturing Industries Used:

This classification is developed from the 1987 Standard Industrial Classification. "n.e.c." is the abbreviation for not elsewhere classified.

1990 Census Code	Industry Category
100	Meat products
101	Dairy products
102	Canned, frozen, and preserved fruits and vegetables
110	Grain mill products
111	Bakery products
112	Sugar and confectionery products
120	Beverage products
121	Miscellaneous food preparations and kindred products
130	Tobacco manufactures
132	Knitting mills
140	Dyeing and finishing textiles, except wool and knit goods
141	Carpets and rugs
142	Yarn, thread, and fabric mills
150	Miscellaneous textile mill products
152	Miscellaneous fabricated textile products
161	Miscellaneous paper and pulp products
162	Paperboard containers and boxes
171	Newspaper publishing and printing
180	Plastics, synthetics, and resins
181	Drugs
182	Soaps and cosmetics
190	Paints, varnishes, and related products
191	Agricultural chemicals
192	Industrial and miscellaneous chemicals
200	Petroleum refining
220	Leather tanning and finishing
230	Logging
231	Sawmills, planing mills, and millwork
241	Miscellaneous wood products
242	Furniture and fixtures
250	Glass and glass products
251	Cement, concrete, gypsum, and plaster products
252	Structural clay products
261	Pottery and related products
270	Blast furnaces, steelworks, rolling and finishing mills
271	Iron and steel foundries
281	Cutlery, handtools, and general hardware
282	Fabricated structural metal products
290	Screw machine products
291	Metal forging and stamping
292	Ordnance

300 Miscellaneous fabricated metal products
310 Engines and turbines
311 Farm machinery and equipment
312 Construction and material handling machines
320 Metalworking machinery
331 Machinery, except electrical, n.e.c.
340 Household appliances
351 Motor vehicles and motor vehicle equipment
352 Aircraft and parts
360 Ship and boat building and repairing
361 Railroad locomotives and equipment
362 Guided missiles, space vehicles, and parts
380 Photographic equipment and supplies
381 Watches, clocks, and clockwork operated devices
390 Toys, amusement, and sporting goods
391 Miscellaneous manufacturing industries

Section A5. Calculation of Concentration Ratios:

Census 90 Code	SIC Codes	SIC 4digit	Four firm CR
100	201	2011	32
		2013	26
		2015	28
101	202	2021	40
		2022	43
		2023	45
		2024	25
		2026	21
102	203	2032	59
		2033	29
		2034	39
		2035	43
		2037	31
		2038	43
110	204	2041	44
		2043	87
		2044	56
		2045	43
		2046	74
		2047	61
		2048	20
111	205	2051	34
		2052	58
		2053	59
112	206	2061	48
		2062	87
		2063	72
		2064	45
		2066	69
		2067	96
		2068	43
120	208	2083	64
		2084	37
		2085	53
		2086	30
		2087	65
121	207	2074	43

Calculation of Concentration Ratios (Continued):

		2075	71
		2076	74
		2077	35
		2079	45
	209	2091	26
		2092	18
		2095	66
		2096	
		2097	19
		2098	73
		2099	26
130	21	2111	92
		2121	73
		2131	85
		2141	66
132	225	2251	61
		2252	24
		2253	24
		2254	64
		2257	30
		2258	36
		2259	51
140	226	2261	25
		2262	58
		2269	28
141	227	2273	34
142	221	2211	42
	222	2221	35
	223	2231	55
	224	2241	19
	228	2281	22
		2282	49
		2284	58
150	229	2295	22
		2296	91
		2297	35
		2298	28
		2299	21
152	239	2391	27
		2392	27
		2393	18
		2394	21

Calculation of Concentration Ratios (Continued):

		2395	21
		2396	49
		2397	30
		2399	20
161	267	2671	33
		2672	49
		2673	32
		2674	47
		2675	38
		2676	70
		2677	31
		2678	51
		2679	21
162	265	2652	16
		2653	26
		2655	64
		2656	56
		2657	23
171	271	2711	25
180	282	2821	20
		2822	50
		2823	
		2824	76
181	283	2833	72
		2834	22
		2835	39
		2836	45
182	284	2841	65
		2842	44
		2843	38
		2844	32
190	285	2851	27
191	287	2873	33
		2874	48
		2875	16
		2879	49
192	281	2812	72
		2813	77
		2816	64
		2819	38
	286	2861	59
		2865	34

Calculation of Concentration Ratios (Continued):

		2869	31
	289	2891	23
		2892	53
		2893	45
		2895	77
		2899	23
200	291	2911	32
210	311	3111	28
230	241	2411	18
231	242	2421	15
		2426	17
		2429	18
	243	2431	20
		2434	16
		2435	22
		2436	38
		2439	13
241	244	2441	14
		2448	4
		2449	25
	249	2491	16
		2493	48
		2499	8
242	25	2511	20
		2512	24
		2514	18
		2515	33
		2517	53
		2519	43
		2521	26
		2522	48
		2531	37
		2541	7
		2542	15
		2591	46
		2599	18
250	321	3211	82
	322	3221	78
		3229	56
	323	3231	28
251	324	3241	28
	327	3271	7

Calculation of Concentration Ratios (Continued):

		3272	8
		3273	8
		3274	43
		3275	75
252	325	3251	29
		3253	65
		3255	35
		3259	39
261	326	3261	64
		3262	78
		3263	
		3264	41
		3269	28
270	331	3312	44
		3313	55
		3315	21
		3316	45
		3317	23
		3321	30
271	332	3322	73
		3324	59
		3325	18
281	342	3421	49
		3423	25
		3425	45
		3429	32
282	344	3441	11
		3442	13
		3443	13
		3444	10
		3446	13
		3448	27
		3449	27
290	345	3451	5
		3452	16
291	346	3462	22
		3463	60
		3465	59
		3466	54
		3469	9
292	348	3482	88
		3483	47

Calculation of Concentration Ratios (Continued):

		3484	54
		3489	77
300	341	3411	54
		3412	30
	343	3431	50
		3432	46
		3433	15
	347	3471	7
		3479	17
	349	3491	20
		3492	38
		3493	38
		3494	20
		3495	36
		3496	11
		3497	57
		3498	9
		3499	13
310	351	3511	80
		3519	52
311	352	3523	45
		3524	52
312	353	3531	48
		3532	22
		3533	34
		3534	52
		3535	17
		3536	19
		3537	35
320	354	3541	31
		3542	18
		3543	12
		3544	5
		3545	16
		3546	45
		3547	52
		3548	37
		3549	16
331	355	3552	20
		3553	32
		3554	30
		3555	44

Calculation of Concentration Ratios (Continued):

		3556	28
		3559	9
	356	3561	19
		3562	58
		3563	36
		3564	14
		3565	19
		3566	26
		3567	14
		3568	29
		3569	11
	358	3581	52
		3582	36
		3585	31
		3586	57
		3589	12
	359	3592	51
		3593	49
		3594	40
		3596	40
		3599	2
340	363	3631	66
		3632	85
		3633	93
		3634	38
		3635	69
		3639	54
351	371	3711	90
		3713	29
		3714	60
		3715	36
		3716	56
352	372	3721	72
		3724	77
		3728	42
360	373	3731	49
		3732	33
361	374	3743	52
362	376	3761	58
		3764	73
		3769	62
380	386	3861	77

Calculation of Concentration Ratios (Continued):

381	387	3873	45
390	394	3942	34
		3944	43
		3949	13
391	39	3911	12
	excl 394	3914	57
		3915	29
		3931	31
		3951	49
		3952	54
		3953	22
		3955	37
		3961	26
		3965	33
		3991	19
		3993	6
		3995	59
		3996	82
		3999	14

D=Withheld to avoid disclosing data for individual

Calculation of Concentration Ratios (Continued):

Value of Shipments $	COl E Sums	Weights	Wt*CR
5266.9	26277.2	0.200436	6.413956
4457		0.169615	4.409983
16553.3		0.629949	17.63858
1420.4	44755.1	0.031737	1.269487
12971		0.289822	12.46233
5856.7		0.130861	5.888748
3916.5		0.08751	2.187739
20590.5		0.46007	9.66148
5350.1	36342.8	0.147212	8.685514
11889.5		0.327149	9.487312
1821.9		0.050131	1.955108
5050.3		0.138963	5.975404
6606.2		0.181775	5.635014
5624.8		0.154771	6.655139
4984.8	36736.9	0.135689	5.970324
6565.7		0.178722	15.54883
1234.9		0.033615	1.882423
2625.1		0.071457	3.072641
4788.9		0.130357	9.646394
5069.3		0.137989	8.417349
11468.2		0.312171	6.243423
16221.1	23677.3	0.685091	23.29309
6290.8		0.265689	15.40997
1165.4		0.04922	2.903988
1239.4	18886.9	0.065622	3.149866
2460.2		0.13026	11.33259
1831.5		0.096972	6.981982
6979.8		0.369558	16.6301
3107.7		0.164543	11.35344
1090.3		0.057728	5.541873
2178		0.115318	4.958675
530.9	31880.4	0.016653	1.065783
1380		0.043287	1.601611
3474.3		0.108979	5.775897
21830.4		0.684759	20.54278
4664.8		0.146322	9.510922
470.7	44996.9	0.010461	0.449811

Calculation of Concentration Ratios (Continued):

9074.1		0.201661	14.3179
431.5		0.00959	0.709627
1753.1		0.03896	1.363616
4151.1		0.092253	4.151386
767		0.017046	0.443186
5783		0.12852	2.313359
6400.6		0.142245	9.388193
5040.8		0.112025	0
289.6		0.006436	0.122284
1048.1		0.023293	1.700368
9787.3		0.217511	5.655274
17372	20757	0.836922	76.99687
191.5		0.009226	0.673484
1114.3		0.053683	4.563063
2079.2		0.100169	6.611129
1497.5	13530.6	0.110675	6.751179
1952.1		0.144273	3.462552
3264.9		0.241298	5.79114
1058.1		0.078201	5.004833
3578.5		0.264475	7.934238
1991.9		0.147214	5.299721
187.6		0.013865	0.707108
1385	7041.7	0.196685	4.917136
4391.9		0.623699	36.17453
1264.8		0.179616	5.02924
9795	9795	1	34
5508.3	26020.9	0.211688	8.890876
8048.9		0.309324	10.82635
1050.7		0.040379	2.220849
1135.7		0.043646	0.829268
7517.5		0.288902	6.355852
2124.2		0.081634	4.000085
635.6		0.024427	1.416738
1433.7	6398.3	0.224075	4.929653
1005		0.157073	14.29364
1966.1		0.307285	10.75497
541.1		0.084569	2.367941
1452.4		0.226998	4.766954
1539.6	15743.9	0.09779	2.640337
4530		0.28773	7.768723
571.5		0.0363	0.653396
1066.2		0.067721	1.422151

Calculation of Concentration Ratios (Continued):

728		0.04624	0.971043
4564.5		0.289922	14.20617
302		0.019182	0.575461
2442.1		0.155114	3.102281
2416	36164.9	0.066805	2.204569
5891.7		0.162912	7.982693
4576.9		0.126556	4.049805
2448		0.06769	3.181427
1749.3		0.04837	1.838064
11698.4		0.323474	22.64317
2598.1		0.07184	2.227052
1216.4		0.033635	1.715376
3570.1		0.098717	2.073063
436.5	25862.7	0.016878	0.270041
16104		0.622673	16.18949
1533.9		0.059309	3.795799
2083		0.080541	4.510279
5705.3		0.2206	5.07379
31850.1	31850.1	1	25
26245.5	40851.4	0.642463	12.84925
3283		0.080364	4.018222
1319.7		0.032305	0
10003.2		0.244868	18.60997
3350.2	39263.4	0.085326	6.143492
32094.1		0.817405	17.98291
2205		0.056159	2.190208
1614.1		0.04111	1.849929
11558.5	34747.5	0.332643	21.62177
5593.9		0.160987	7.083433
3002.2		0.0864	3.283217
14592.9		0.41997	13.43903
12702.4	12702.4	1	27
2447.2	14267.3	0.171525	5.660328
3819.3		0.267696	12.84941
1701.1		0.119231	1.907691
6299.7		0.441548	21.63586
1547.9	87714	0.017647	1.270593
2617.8		0.029845	2.298044
2388.3		0.027228	1.742609
13219.8		0.150715	5.727163
486.5		0.005546	0.32724
8859.4		0.101003	3.434111

Calculation of Concentration Ratios (Continued):

41812.1		0.476687	14.77729
4678.1		0.053334	1.226672
1117.8		0.012744	0.675416
2391.7		0.027267	1.227016
569.6		0.006494	0.500025
8025		0.091491	2.104282
118186.2	118186.2	1	32
2218.6	2218.6	1	28
10938.2	10938.2	1	18
17357.1	41834.3	0.414901	6.223518
1714		0.040971	0.69651
149.2		0.003566	0.064196
9326.9		0.222949	4.458973
4378.2		0.104656	1.674492
2060.5		0.049254	1.083585
4919.6		0.117597	4.468697
1928.8		0.046106	0.599374
325	10399.4	0.031252	0.437525
1496.1		0.143864	0.575456
248.3		0.023876	0.596909
2169.6		0.208627	3.338039
2864.9		0.275487	13.22338
3295.5		0.316893	2.535146
7982	37461.9	0.21307	4.261396
5263.1		0.140492	3.37181
2141.2		0.057157	1.028821
2417.3		0.064527	2.129387
351.1		0.009372	0.496726
403.9		0.010782	0.46361
2084.1		0.055633	1.446446
5453.6		0.145577	6.987708
2088.3		0.055745	2.062552
2815.9		0.075167	0.526169
2721.3		0.072642	1.089627
1780.4		0.047526	2.186178
1959.7		0.052312	0.941613
2549.3	16317.3	0.156233	12.8111
4777.9		0.292812	22.83933
3560.9		0.218229	12.2208
5429.2		0.332727	9.316345
4335.4	28762	0.150734	4.220541
2245.5		0.078072	0.546502

Calculation of Concentration Ratios (Continued):

5828.4		0.202642	1.621139
12966.3		0.450814	3.606509
715.5		0.024877	1.069693
2670.9		0.092862	6.964658
1254	2914.8	0.430218	12.47633
717.4		0.246123	15.99801
788.2		0.270413	9.464457
155.2		0.053246	2.076575
790.6	2415.9	0.327249	20.94391
298.4		0.123515	9.634174
93		0.038495	0
714.2		0.295625	12.12062
519.7		0.215117	6.023263
15804.7	36264.5	0.435817	19.17597
843.8		0.023268	1.279736
3330.3		0.091834	1.928506
5216.3		0.14384	6.472818
3856.3		0.106338	2.445778
7213.1		0.198903	5.967075
283.4	3414.6	0.082997	6.058748
1450.8		0.424881	25.068
1680.4		0.492122	8.858197
1054	13480.7	0.078186	3.831107
3605.6		0.267464	6.686596
674.9		0.050064	2.252887
8146.2		0.604286	19.33716
8678	40416.1	0.214716	2.361881
6591		0.163079	2.120021
6810.2		0.168502	2.190528
9698.9		0.239976	2.399761
2268.8		0.056136	0.729769
3137.8		0.077637	2.096209
3231.4		0.079953	2.158739
2806.2	7890.2	0.355656	1.778282
5084		0.644344	10.3095
3003.6	28409.8	0.105724	2.32593
1003.7		0.035329	2.119761
15251.6		0.536843	31.67373
819.8		0.028856	1.558237
8331.1		0.293247	2.639227
889.2	7643.6	0.116333	10.23727
3983.2		0.521116	24.49244

Calculation of Concentration Ratios (Continued):

1093.1		0.143009	7.722461
1678.1		0.219543	16.90482
11013.6	49525.7	0.222382	12.0086
1100		0.022211	0.666321
803.4		0.016222	0.811094
2355.4		0.047559	2.187721
2124		0.042887	0.643302
3866.9		0.078079	0.546551
3922.6		0.079203	1.346456
4590.6		0.092691	1.853825
2451.5		0.0495	1.880983
458.5		0.009258	0.351797
2377.3		0.048001	0.960027
1580.4		0.031911	1.148785
2720.8		0.054937	0.604308
2286.6		0.04617	2.631688
1725.5		0.03484	0.313564
6148.6		0.12415	1.613946
3447.8	14570.4	0.23663	18.93043
11122.6		0.76337	39.69522
6879.9	11474.3	0.599592	26.98165
4594.4		0.400408	20.82121
12767.7	24622.3	0.518542	24.89002
1518.1		0.061655	1.356421
2728.3		0.110806	3.767406
1084.4		0.044041	2.290152
3408.2		0.138419	2.353127
675.4		0.02743	0.521178
2440.2		0.099105	3.468685
3189.5	22003.5	0.144954	4.493581
1396.3		0.063458	1.142246
499.4		0.022696	0.272357
7550.1		0.343132	1.715659
3601		0.163656	2.618493
2161.8		0.098248	4.42116
467.8		0.02126	1.105533
2104.6		0.095648	3.538992
1033		0.046947	0.751153
1240.7	75388.5	0.016457	0.329148
884.3		0.01173	0.375357
1867.1		0.024766	0.742991
2857.8		0.037908	1.667936

Calculation of Concentration Ratios (Continued):

1971.4		0.02615	0.732197
8274.7		0.109761	0.987847
3998.3		0.053036	1.007683
3723.7		0.049393	2.864822
3050.9		0.040469	1.456885
2272.4		0.030143	0.421995
2189.9		0.029048	0.551916
1569		0.020812	0.541117
1434.8		0.019032	0.266449
2041.1		0.027074	0.785158
3840.4		0.050941	0.560356
714.6		0.009479	0.492903
455.8		0.006046	0.217657
8051.1		0.106795	3.310639
1068.7		0.014176	0.808026
3960.4		0.052533	0.630399
2287.4		0.030341	1.547416
1896.6		0.025158	1.232726
1404.4		0.018629	0.745153
633		0.008397	0.33586
13700		0.181725	0.363451
3395.8	16497.7	0.205835	13.58509
3518.9		0.213296	18.13019
3034.8		0.183953	17.10762
2825.7		0.171278	6.50858
1324.2		0.080266	5.538336
2398.3		0.145372	7.850076
133345.6	205923	0.647551	58.27957
4588.7		0.022284	0.646224
62068.4		0.301416	18.08493
3433.5		0.016674	0.600253
2486.8		0.012076	0.676276
39092.7	77304.1	0.5057	36.41042
20262.1		0.262109	20.18239
17949.3		0.232191	9.752013
8504.4	13856.9	0.61373	30.07279
5352.5		0.38627	12.7469
2470.9	2470.9	1	52
21565.8	26285.1	0.820457	47.58652
3537.1		0.134567	9.823371
1182.2		0.044976	2.788515
19240.5	19240.5	1	77

Calculation of Concentration Ratios (Continued):

1220.9	1220.9	1	45
294	8798.3	0.033416	1.136129
3381.3		0.384313	16.52545
5123		0.582272	7.56953
4078.1	23213.7	0.175676	2.108117
528.7		0.022775	1.298195
947.3		0.040808	1.183426
814.1		0.03507	1.087164
818.8		0.035272	1.728341
609.3		0.026247	1.417361
442.5		0.019062	0.419364
665.3		0.02866	1.060413
1391.9		0.05996	1.558967
670		0.028862	0.952455
990.4		0.042664	0.810625
4282.6		0.184486	1.106915
839.9		0.036181	2.134692
1309.7		0.056419	4.62638
4825.1		0.207856	2.90998

Calculation of Concentration Ratios (Continued):

CR Ratios
28.46252

31.46979

38.39349

50.78139

41.60704

59.94852

38.49699

40.615

Calculation of Concentration Ratios (Continued):

88.84454

34.95077

46.12091

34
34.54002

37.11316

31.33956

Calculation of Concentration Ratios (Continued):

47.91522

29.8394

25
35.47744

28.16654

45.42746

27
42.05329

35.31046

Calculation of Concentration Ratios (Continued):

32
28
18
19.26934

20.70645

26.99204

57.18757

18.02904

Calculation of Concentration Ratios (Continued):

40.01537

48.72197

37.26988

39.98495

32.10775

14.05691

12.08778

40.31689

59.35699

Calculation of Concentration Ratios (Continued):

29.56897

58.62565

47.80286

38.64699

20.05917

22.97609

Calculation of Concentration Ratios (Continued):

68.7199

78.28726

66.34482

42.81969

52
60.19841

77

Calculation of Concentration Ratios (Continued):

68.7199

78.28726

66.34482

42.81969

52
60.19841

77

Calculation of Concentration Ratios (Continued):

68.7199

78.28726

66.34482

42.81969

52
60.19841

77

Calculation of Concentration Ratios (Continued):

45
25.23111

24.4024

Section A6. Calculation of Growth Rates:

Numbering	Census 90 Code	SIC Code	All Employees 1990
1	100	201	422
2	101	202	155.6
3	102	203	248.6
4	110	204	127.8
5	111	205	213.5
6	112	206	99.5
7	120	208	185.4
8	121	207	31.1
		209	182.4
9	130	21	49.3
10	132	225	205.8
11	140	226	62.2
12	141	227	61
13	142	221	91.3
		222	76.8
		223	17.4
		224	23.9
		228	102.6
14	150	229	51.4
15	152	239	204.9
16	161	267	242.2
17	162	265	209.6
18	171	271	475.2
19	180	282	180.5
20	181	283	237.3
21	182	284	159.8
22	190	285	61.2
23	191	287	55.8
24	192	281	138.1
		286	154.9
		289	99.9
25	200	291	117.9
26	220	311	14.8
27	230	241	84.8
28	231	242	198.1
		243	262.2
29	241	244	45.2

Calculation of Growth Rates (Continued):

		249	85.5
30	242	25	507.4
31	250	321	17
		322	83.2
		323	60.1
32	251	324	18.1
		327	206.6
33	252	325	35.8
34	261	326	38.9
35	270	331	276.4
36	271	332	132.5
37	281	342	131.4
38	282	344	427.3
39	290	345	95.9
40	291	346	225.2
41	292	348	75
42	300	341	50.2
		343	59.8
		347	120.5
		349	237.5
43	310	351	89.4
44	311	352	105.8
45	312	353	229.2
46	320	354	330.6
47	331	355	159.3
		356	247.7
		358	177.6
		359	320.8
48	340	363	124.1
49	351	371	813.1
50	352	372	712.5
51	360	373	187.8
52	361	374	33.1
53	362	376	185.1
54	380	386	99.6
55	381	387	10.9
56	390	394	103.8
57	391	39	273
		excl 394	

Calculation of Growth Rates (Continued):

All Employees 1980	Grt-10 year	% GRT	Avg DE	Col H Sums
358.4	0.1774554	17.74554	390.2	
174.8	-0.10984	-10.984	165.2	
245.5	0.0126273	1.262729	247.05	
143.7	-0.110647	-11.0647	135.75	
230.3	-0.072948	-7.29483	221.9	
108.3	-0.081256	-8.12558	103.9	
234.3	-0.208707	-20.8707	209.85	
44.1	-0.294785	-29.4785	37.6	211.25
164.9	0.1061249	10.61249	173.65	
68.9	-0.28447	-28.447	59.1	
223.9	-0.08084	-8.08397	214.85	
73.7	-0.156038	-15.6038	67.95	
54.4	0.1213235	12.13235	57.7	
150	-0.391333	-39.1333	120.65	372.65
116.2	-0.339071	-33.9071	96.5	
19.1	-0.089005	-8.90052	18.25	
23	0.0391304	3.913043	23.45	
125	-0.1792	-17.92	113.8	
62.5	-0.1776	-17.76	56.95	
175.6	0.1668565	16.68565	190.25	
219.6	0.1029144	10.29144	230.9	
204.9	0.022938	2.293802	207.25	
419.9	0.131698	13.1698	447.55	
204.8	-0.118652	-11.8652	192.65	
196.1	0.2100969	21.00969	216.7	
140.9	0.1341377	13.41377	150.35	
65.1	-0.059908	-5.99078	63.15	
72	-0.225	-22.5	63.9	
161.3	-0.143831	-14.3831	149.7	410.7
173.9	-0.109258	-10.9258	164.4	
93.3	0.0707395	7.073955	96.6	
154.8	-0.238372	-23.8372	136.35	
19.2	-0.229167	-22.9167	17	
87.5	-0.033143	-3.31429	86.05	
214.8	-0.077747	-7.77467	206.45	440.55
206	0.2728155	27.28155	234.1	
42.5	0.0635294	6.352941	43.85	130.55

Calculation of Growth Rates (Continued):

87.9	-0.027304	-2.73038	86.7	
465.8	0.0893087	8.930872	486.6	
18.3	-0.071038	-7.10383	17.65	173.85
124.3	-0.330652	-33.0652	103.75	
44.8	0.3415179	34.15179	52.45	
30.9	-0.414239	-41.4239	24.5	229.95
204.3	0.011258	1.125795	205.45	
45.6	-0.214912	-21.4912	40.7	
47.4	-0.179325	-17.9325	43.15	
511.9	-0.460051	-46.0051	394.15	
208.8	-0.365421	-36.5421	170.65	
163.7	-0.197312	-19.7312	147.55	
506.4	-0.156201	-15.6201	466.85	
108.8	-0.118566	-11.8566	102.35	
260.2	-0.134512	-13.4512	242.7	
63.4	0.1829653	18.29653	69.2	
74.9	-0.329773	-32.9773	62.55	487.35
71.1	-0.158931	-15.8931	65.45	
101.4	0.1883629	18.83629	110.95	
259.3	-0.084073	-8.40725	248.4	
135.2	-0.338757	-33.8757	112.3	
169.1	-0.374335	-37.4335	137.45	
389.3	-0.411251	-41.1251	309.25	
398.3	-0.169972	-16.9972	364.45	
194.4	-0.180556	-18.0056	176.85	955.2
299.5	-0.172955	-17.2955	273.6	
174.5	-0.017765	1.776504	176.05	
336.6	-0.04696	-4.694	328.7	
161.9	-0.233477	-23.3477	143	
788.8	0.0308063	3.080629	800.95	
633.1	0.1254146	12.54146	672.8	
220.5	-0.148299	-14.8299	204.15	
70.8	-0.532486	-53.2486	51.95	
111.3	0.6630728	66.30783	148.2	
134.6	-0.26003	-26.003	117.1	
22.3	-0.511211	-51.1211	16.6	
117	-0.112821	-11.2821	110.4	
301	-0.093023	-9.30233	287	

Calculation of Growth Rates (Continued):

Weights	GRT*Weight	% GRT
0.177988	-0.05247	3.476778
0.822012	0.087236	
0.323762	-0.1267	-27.1124
0.258956	-0.0878	
0.048974	-0.00436	
0.062928	0.002462	
0.30538	-0.05472	
0.3645	-0.05243	-7.92523
0.400292	-0.04374	
0.235208	0.016639	
0.468619	-0.03643	10.85355
0.531381	0.144969	
0.335887	0.021339	0.320589

Calculation of Growth Rates (Continued):

0.664113	-0.01813	
0.101524	-0.00721	-10.1503
0.596779	-0.19733	
0.301697	0.103035	
0.106545	-0.04414	-3.40766
0.893455	0.010058	
0.128347	-0.04233	-6.36382
0.134298	-0.02134	
0.22766	0.042883	
0.509695	-0.04285	
0.185144	-0.03343	-0.09585
0.286432	-0.04954	
0.184307	0.003274	
0.344116	-0.01615	

Calculation of E (Continued):

Section A7. Calculation of Employees per Est.(E):

Census 90 Code	SIC Codes	SIC 4digit	Employees 1990
100	201	2011	422
		2013	
		2015	
101	202	2021	155.6
		2022	
		2023	
		2024	
		2026	
102	203	2032	248.6
		2033	
		2034	
		2035	
		2037	
		2038	
110	204	2041	127.8
		2043	
		2044	
		2045	
		2046	
		2047	
		2048	
111	205	2051	213.5
		2052	
		2053	
112	206	2061	99.5
		2062	
		2063	
		2064	
		2066	
		2067	
		2068	
120	208	2083	185.4
		2084	
		2085	
		2086	
		2087	
121	207	2074	31.1

Calculation of E (Continued):

		2075	
		2076	
		2077	
		2079	
	209	2091	182.4
		2092	
		2095	
		2096	
		2097	
		2098	
		2099	
130	21	2111	49.3
		2121	
		2131	
		2141	
132	225	2251	205.8
		2252	
		2253	
		2254	
		2257	
		2258	
		2259	
140	226	2261	62.2
		2262	
		2269	
141	227	2273	61
142	221	2211	91.3
	222	2221	76.8
	223	2231	17.4
	224	2241	23.9
	228	2281	102.6
		2282	
		2284	
150	229	2295	51.4
		2296	
		2297	
		2298	
		2299	
152	239	2391	204.9
		2392	
		2393	
		2394	

Calculation of E (Continued):

		2395	
		2396	
		2397	
		2399	
161	267	2671	242.2
		2672	
		2673	
		2674	
		2675	
		2676	
		2677	
		2678	
		2679	
162	265	2652	209.6
		2653	
		2655	
		2656	
		2657	
171	271	2711	475.2
180	282	2821	180.5
		2822	
		2823	
		2824	
181	283	2833	237.3
		2834	
		2835	
		2836	
182	284	2841	159.8
		2842	
		2843	
		2844	
190	285	2851	61.2
191	287	2873	55.8
		2874	
		2875	
		2879	
192	281	2812	138.1
		2813	
		2816	
		2819	
	286	2861	154.9
		2865	

Calculation of E (Continued):

		2869	
	289	2891	99.9
		2892	
		2893	
		2895	
		2899	
200	291	2911	117.9
210	311	3111	14.8
230	241	2411	84.6
231	242	2421	198.1
		2426	
		2429	
	243	2431	262.2
		2434	
		2435	
		2436	
		2439	
241	244	2441	45.2
		2448	
		2449	
	249	2491	85.5
		2493	
		2499	
242	25	2511	507.4
		2512	
		2514	
		2515	
		2517	
		2519	
		2521	
		2522	
		2531	
		2541	
		2542	
		2591	
		2599	
250	321	3211	17
	322	3221	83.2
		3229	
	323	3231	60.1
251	324	3241	18.1
	327	3271	206.6

Calculation of E (Continued):

		3272	
		3273	
		3274	
		3275	
252	325	3251	35.8
		3253	
		3255	
		3259	
261	326	3261	38.9
		3262	
		3263	
		3264	
		3269	
270	331	3312	276.4
		3313	
		3315	
		3316	
		3317	
		3321	
271	332	3322	132.5
		3324	
		3325	
281	342	3421	131.4
		3423	
		3425	
		3429	
282	344	3441	427.3
		3442	
		3443	
		3444	
		3446	
		3448	
		3449	
290	345	3451	95.9
		3452	
291	346	3462	225.2
		3463	
		3465	
		3466	
		3469	
292	348	3482	75
		3483	

Calculation of E (Continued):

		3484	
		3489	
300	341	3411	50.2
		3412	
	343	3431	59.8
		3432	
		3433	
	347	3471	120.5
		3479	
	349	3491	237.5
		3492	
		3493	
		3494	
		3495	
		3496	
		3497	
		3498	
		3499	
310	351	3511	89.4
		3519	
311	352	3523	105.8
		3524	
312	353	3531	229.2
		3532	
		3533	
		3534	
		3535	
		3536	
		3537	
320	354	3541	330.6
		3542	
		3543	
		3544	
		3545	
		3546	
		3547	
		3548	
		3549	
331	355	3552	159.3
		3553	
		3554	
		3555	

Calculation of E (Continued):

		3556	
		3559	
	356	3561	247.7
		3562	
		3563	
		3564	
		3565	
		3566	
		3567	
		3568	
		3569	
	358	3581	1776.6
		3582	
		3585	
		3586	
		3589	
	359	3592	320.8
		3593	
		3594	
		3596	
		3599	
340	363	3631	124.1
		3632	
		3633	
		3634	
		3635	
		3639	
351	371	3711	813.1
		3713	
		3714	
		3715	
		3716	
352	372	3721	712.5
		3724	
		3728	
360	373	3731	187.8
		3732	
361	374	3743	33.1
362	376	3761	185.1
		3764	
		3769	
380	386	3861	99.6

Calculation of E (Continued):

381	387	3873	10.9
390	394	3942	103.8
		3944	
		3949	
391	39	3911	273
	excl 394	3914	
		3915	
		3931	
		3951	
		3952	
		3953	
		3955	
		3961	
		3965	
		3991	
		3993	
		3995	
		3996	
		3999	

Calculation of E (Continued):

Number of Companies	Aggregated # of Co's.
1328	2819
1207	
284	
44	1797
508	
124	
469	
652	
183	1534
462	
107	
344	
194	
244	
237	1781
33	
48	
120	
31	
130	
1182	
1948	2367
316	
103	
31	942
14	
14	
623	
173	
8	
79	
15	1623
469	
48	
846	
245	
31	3687

Calculation of E (Continued):

47	
20	
194	
67	
153	
579	
110	
277	
503	
196	
1510	
9	110
16	
23	
62	
139	1977
375	
806	
58	
304	
216	
79	
184	605
245	
176	
419	419
246	1326
316	
106	
247	
241	
121	
49	
180	1000
9	
111	
181	
519	
1215	6946
860	
252	
1251	

Calculation of E (Continued):

682	
1535	
266	
885	
91	2528
369	
424	
76	
374	
78	
203	
170	
743	
180	1787
952	
137	
57	
461	
7473	7473
288	398
58	
6	
46	
208	1159
640	
137	
174	
683	2184
669	
184	
648	
1121	1121
117	712
55	
307	
233	
27	3512
103	
70	
427	
52	
131	

Calculation of E (Continued):

491	
537	
77	
224	
7	
1366	
200	200
311	311
11852	11852
5252	13687
696	
219	
2640	
3644	
274	
131	
831	
304	6017
1678	
198	
456	
158	
3223	
2771	10943
1030	
374	
721	
80	
175	
625	
291	
465	
1833	
566	
443	
1569	
65	1786
35	
362	
1324	
123	7670
975	

Calculation of E (Continued):

2687	
3749	
56	
80	
167	431
95	
111	
58	
48	975
32	
43	
104	
748	
271	1573
25	
274	
156	
155	
692	
27	417
120	
270	
131	2118
732	
128	
1127	
2334	11706
1428	
1584	
4078	
1300	
486	
496	
1610	2444
834	
379	3795
72	
596	
46	
2702	
75	346
66	

Calculation of E (Continued):

146	
59	
161	13149
118	
90	
161	
540	
3353	
1702	
310	
332	
144	
372	
304	
1066	
97	
679	
3720	
68	292
224	
1576	1725
149	
872	3202
293	
563	
158	
703	
165	
448	
381	11093
196	
812	
7207	
1736	
183	
83	
203	
292	
475	31901
280	
256	
408	

Calculation of E (Continued):

483	
2438	
333	
113	
223	
445	
415	
251	
342	
262	
1159	
97	
80	
746	
70	
897	
132	
331	
133	
118	
21414	
65	406
40	
11	
201	
28	
61	
352	3767
657	
2306	
308	
144	
137	1434
372	
925	
547	2655
2108	
150	150
19	107
27	
61	
717	717

Calculation of E (Continued):

213	213
191	2597
698	
1708	
2294	11547
205	
437	
402	
106	
141	
611	
108	
753	
247	
293	
3676	
213	
14	
2047	

Calculation of E (Continued):

E
149.6984746364

86.588759042849

162.05997392438

71.757439640651

90.198563582594

105.62632696391

114.23290203327

8.4350420395986

Calculation of E (Continued):

448.18181818182

104.0971168437

102.80991735537

145.58472553699
68.853695324284

51.4

29.498992225741

Calculation of E (Continued):

95.806962025316

117.29155008394

63.588920112405
453.5175879397

204.74547023296

73.168498168498

54.594112399643
78.370786516854

39.322323462415

Calculation of E (Continued):

589.5
47.588424437299
7.1380357745528
14.473588076277

7.5120491939505

46.367540893722

9.518477043673

2.3598435462842

Calculation of E (Continued):

83.062645011601

39.897435897436

175.71519389701

317.74580335731

62.039660056657

36.502648214591

39.238952536825

59.341238471673

216.76300578035

Calculation of E (Continued):

3.8177808198342

306.16438356164

61.333333333333

71.58026233604

29.80257820247

4.9935738691577

Calculation of E (Continued):

305.66502463054

215.84815503053

496.86192468619

70.734463276836

220.66666666667
1729.9065420561

138.91213389121

Calculation of E (Continued):

51.173708920188
39.96919522526

23.642504546635

Section A9: Re-estimation of Oster's Model Using Ols (Table 8)

Occupation	Intercept	A/M	MP	GRT	E	WT	SD	NCD
Accountants	16.106	-----	-0.063	-0.0027	0.002	-15.561	2.62	-13.15
t(35)	(2.536)**		(-1.091)	(-0.051)	(0.482)	(-1.298)	(0.351)	(-1.533)
R^2=0.1877, $\bar{R}^2$=0.0485								
Engineers	1.1477	-0.2978	0.0029	0.0091	-0.000005	-1.736	0.3394	-0.644
t(46)	(2.284)**	(-0.449)	(0.569)	(2.157)**	(-0.110)	(-1.649)	(0.571)	(-0.994)
R^2=0.2542, $\bar{R}^2$=0.1407								
Managers	2.3816	-----	0.02244	0.01454	-0.00089	-1.787	-0.0375	-1.463
t(49)	(2.889)***		(2.975)***	(2.317)**	(-1.468)	(-1.270)	(-0.039)	(-1.400)
R^2=0.2920, $\bar{R}^2$=0.2053								
Personnel	5.176	-----	-0.0095	0.126	-0.0015	-7.797	11.95	3.42
t(31)	(0.759)		(-0.146)	(2.067)**	(-0.290)	(-0.553)	(1.299)	(0.398)
R^2=0.1893, $\bar{R}^2$=0.0324								
Computer Scientists and Operators	0.0614	-1.791	-0.0046	0.009	-0.004	7.69	4.0136	-0.56
t(42)	(0.022)	(-1.361)	(-0.181)	(0.422)	(-1.714)*	(1.397)	(1.213)	(-0.158)
R^2=0.2050, $\bar{R}^2$=0.0693								
Natural Scientists	8.628	-3.021	0.022	0.068	-0.003	-11.82	-6.24	-7.04
t(19)	(1.432)	(-0.998)	(0.377)	(1.110)	(-0.586)	(-1.217)	(-0.888)	(-0.837)
R^2=0.1814, $\bar{R}^2$=-0.1201								
Designers	2.4147	-----	0.00775	-0.0157	0.00195	-9.836	13.2032	-9.6953
t(24)	(0.458)		(0.145)	(-0.307)	(0.476)	(-0.985)	(1.925)*	(-1.395)
R^2=0.3440, $\bar{R}^2$=0.1800								
Technicians	-0.5392	-----	0.0271	0.0093	-0.0014	1.1986	6.58	1.39
t(49)	(-0.213)		(1.045)	(0.445)	(-0.693)	(0.0269)	(2.178)**	(0.429)
R^2=0.1516, $\bar{R}^2$=0.0477								

*Statistically significant at the .05 level, **at the 0.025 level, ***at the 0.005 level (Rt-tailed tests)

A9. Inter-industry Ratios by Occupation (Table 9):

	Mean (W/M)	**Mean (Y_f/Y_m)**
Natural Scientists	1.39	0.73
Accountants and Auditors	12.86	0.82
Designers	0.94	0.87
Personnel Service Workers	5.61	0.92
Engineers	0.80	0.84
Computer Scientists and Operators	1.41	0.84
Technicians	2.48	0.92
Managers	2.62	0.63

$$where\ Mean(W/M) = \frac{\sum_{i=1}^{max\ 57} (\frac{W}{M})}{number\ of\ industries(i)}$$

and

$$Mean\ (Y_f/Y_m) = \frac{\sum_{i=1}^{max\ 57} \frac{Y_f}{Y_m}}{number\ of\ industries(i)}$$