Covert Inequity: Gender Discrimination through Occupational Categorization

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Introduction

One of the most fundamental research questions explored by labor economists is "What determines the wage of an individual worker in the United States?" A person's gender has become widely recognized and published as a significant determinant of an individual's wage. The wide dissemination of these ideas has elicited important policies to combat labor market inequity based in gender. Ideas like the "glass ceiling," for example, have led policymakers to combat gender discrimination and equalize wages paid to men and women. Most labor economists would agree that as a result of these actions, wage discrimination has diminished over time.

Our research closely examined the U.S. labor market from 1971-2006 to better understand the affect of gender on wages. Our analysis centered around a dataset entitled the Current Population Survey (CPS) during these years. This data is compiled annually by the Bureau of Labor Statistics using a random sampling of the entire country. These datasets also permitted us to utilize a giant sample size in our analysis, as each year of the CPS contains tens of thousands of observations. The sheer magnitude and careful compilation of CPS results, therefore, provided us with a wealth of information useful in statistical regression analysis.

Using STATA statistical software and this data, we began to explore the influence of an individual's gender on their wages. The model we created, in conjunction with the significant time-series under our analysis, provided fascinating results. These findings stand to potentially reshape our understanding of gender discrimination in labor markets today.

The Model

Our regression model is grounded in many independent variables typically specified in a wage regression model. These variables are listed below, and all of them were employed as categorical dummy variables (0 or 1).

- **Years of Education**: This variable accounts for the years of education completed by an individual. Each year of education was treated separately from 10 or fewer to 18 or more. Education years 13-15 receive one category based on the nature of the CPS data.
- **Potential Experience**: This variable examines the potential level of work experience for an individual upon finishing their education. Since *actual* work experience is not in the survey, we calculate *potential* experience by comparing an individual's years of education to their age.
- **Class of Job:** The sector of an individual's employment makes up this variable It accounts for employment in the private sector, the government, self-employment, or unpaid family business work.
- **Marital Status:** This variable accounts for the marital status of an individual in the labor force.
- **Weeks Worked Per Year:** This variable tells the number of weeks an individual worked during the past year.
- **Hours Worked Per Day:** This variable explains the number of hours an individual works in a typical week.

In addition to a standard model, we created and added two very important variables. These variables are also categorical dummy variables and are both based on a detailed occupation list of over 500 occupations given by the CPS. These categories are rarely used in regression analysis, making our results new and exciting.

- **Average Occupation Education:** This variable accounts for the average years of education for individuals in any given occupational category (of the 500 given by the CPS). For example, if someone's occupation was classified as a paralegal/legal assistant , and the mean years of education of all individuals in the same category was 14.1, this individual's "Average Occupation Education" value would be 14.1. This important variable allows us to go beyond the simple relationship of education and wages to explain how *occupations* with various levels of education affect wages.
- **Fraction Female:** This variable calculates the ratio of men to women in each of the more than 500 occupational classes provided by the CPS. For example, an occupational category in our sample comprised of 71 percent men and 29 percent women would have a fraction female variable value of .29. A variable like this permits us the opportunity to examine trends in wages beyond the individual level, extending that analysis to "gendered professions" comprised mainly of males or females. The tables below provides a few examples of occupations within each decile of fraction female to clarify its definition.

Fraction Female for some Major Occupations	population size	frac fem
0-10% female		
804 Truck drivers	2,871,425	0.06
567 Carpenters	1,345,055	0.02
869 Construction laborers	911,822	0.03
505 automobile mechanics	700,412	0.01
10-20% female		
628 Supervisors, production occupations	998,149	0.19
883 Freight, stock, and material handlers,	357,076	0.10
418 Police and detectives, public service	535,388	0.13
176 Clergy	325,999	0.16
20-30% female		
064 Computer systems analysts and scient	1,783,197	0.30
274 Sales reps., mining, manuf., & wholesa	1,369,688	0.26
889 Laborers, except construction	1,004,066	0.23
229 Computer programmers	376,410	0.28
30-40% female		
243 Supervisors & proprietors sales occup	4,130,098	0.39
453 Janitors and cleaners	1,807,281	0.39

Fraction Female for some Major Occupations	population size	frac fem
178 Lawyers	736,771	0.31
013 Managers, mkting., advertising, & publ	708,492	0.37
40-50% female		
436 Cooks	1,383,183	0.46
785 Assemblers	1,068,681	0.41
877 Stock handlers and baggers	643,141	0.45
253 Insurance sales occupations	498,497	0.47
50-60% female		
023 Accountants and auditors	1,342,052	0.56
157 Teachers, secondary school	1,292,794	0.58
007 Financial managers	771,752	0.53
185 Designers	712,737	0.56
60-70% female		
014 Administrators, education & related fie	787,827	0.67
303 Supervisors, general office	360,707	0.68
888 Hand packers and packagers	288,296	0.68

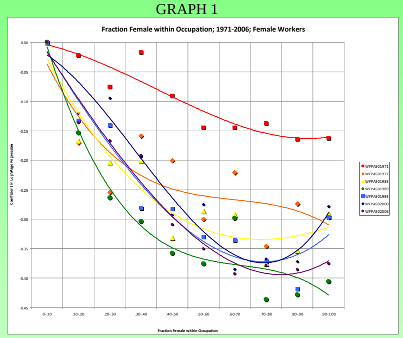
Fraction Female for some Major Occupations	population size	frac fem
683 Electrical and electronic equipment ass	260,732	0.63
70-80% female		
274 Sales workers, other commodities	922,878	0.70
015 Managers, medicine and health	829,172	0.77
174 Social workers	737,638	0.73
435 Waiters and waitresses	741,076	0.77
80-90% female		
156 Teachers, elementary school	2,309,988	0.83
447 Nursing aides, orderlies, & attendants	1,858,863	0.88
276 Cashiers	1,328,029	0.85
379 General office clerks	748,200	0.89
90-100% female		
095 Registered nurses	2,004,930	0.94
313 Secretaries	1,870,734	0.98
337 Bookkeepers, accounting, & auditing c	1,398,272	0.92
468 Family child care providers	968,624	0.97

To minimize the skewing caused by outlier wages, we limited our analysis to individuals earning between $2 and $200 per hour. In addition, in an attempt to characterize the core of the American labor force, we limited our observations to "prime age" individuals – those falling between 25 and 50 years of age. Finally, to avoid incidentally picking up any impact of race on our results, we limited our regression analysis to only account for white men and women. The table below details the regression output of this model for all the years of our analysis for females at the .50 quantile.

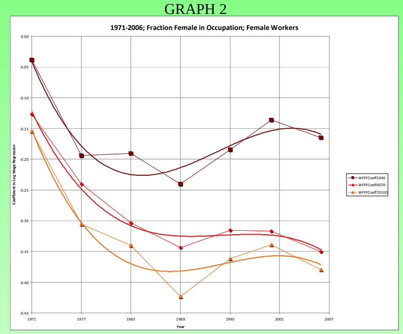
	White Female age: 25-50 .50 Quantile R sqd.= 0.176 March 1971		White Female age: 25-50 .50 Quantile R sqd.= 0.1566 March 1977		White Female age: 25-50 .50 Quantile R sqd.= 0.1611 March 1983		White Female age: 25-50 .50 Quantile R sqd.= 0.1999 March 1989		White Female age: 25-50 .50 Quantile R sqd.= 0.2035 March 1994		White Female age: 25-50 .50 Quantile R sqd.= 0.2122 March 2000		White Female age: 25-50 .50 Quantile R sqd.= 0.212 March 2006	
	Coeff.	T-Stat	Coeff.	T-Stat	Coeff.	T-Stat	Coeff.	T-Stat	Coeff.	T-Stat	Coeff.	T-Stat	Coeff.	T-Stat
education: 0-10 years	0.000		0.000		0.000		0.000		0.000		0.000		0.000	
education: 11 years	0.068	3.030	0.060	2.600	0.018	0.580	0.064	2.250	0.042	1.370	0.061	1.740	0.087	3.160
education: 12 years	0.106	7.980	0.142	10.380	0.091	5.200	0.178	10.870	0.180	9.010	0.206	8.940	0.190	10.380
education: 13-15 years	0.191	10.600	0.199	11.860	0.181	9.010	0.304	16.770	0.272	12.950	0.313	12.940	0.281	14.810
education: 16 years	0.328	13.700	0.295	14.460	0.294	12.590	0.434	21.570	0.446	19.370	0.523	20.020	0.462	22.640
education: 17 years	0.387	10.620	0.388	13.060	0.393	12.670	0.463	16.250	0.626	23.240	0.715	23.020	0.603	25.020
education: 18 or more years	0.483	13.070	0.488	17.580	0.477	16.200	0.614	25.200	0.816	17.790	0.809	15.630	0.709	19.170
potential experience: 0-5 years	0.000		0.000		0.000		0.000		0.000		0.000		0.000	
potexp: 6-10 years	0.068	2.210	0.126	5.550	0.141	5.440	0.082	3.430	0.189	6.810	0.150	4.380	0.107	3.910
potexp: 11-15 years	0.092	3.000	0.177	7.590	0.171	6.500	0.183	7.700	0.264	9.500	0.235	6.870	0.185	6.760
potexp: 16-25 years	0.088	2.950	0.162	7.080	0.191	7.260	0.199	8.460	0.299	10.940	0.277	8.280	0.229	8.550
potexp: 26-35 years	0.125	4.090	0.195	8.200	0.210	7.580	0.240	9.670	0.312	11.000	0.298	8.640	0.254	9.230
potexp: 36-40 years	0.056	1.210	0.142	3.280	0.181	3.090	0.263	4.500	0.240	3.560	0.264	3.520	0.186	3.170
potexp: 41-45 years	-0.141	-1.040	0.029	0.260	0.187	1.370	0.190	1.380	0.151	1.030	-0.040	-0.300	0.014	0.080
class of job: private sector	0.000		0.00		0.00		0.00		0.00		0.00		0.00	
class of job: government sector	0.013	1.040	0.038	3.450	0.023	1.880	0.007	0.680	-0.007	-0.590	-0.006	-0.400	-0.045	-4.240
class of job: self-employed	-0.217	-9.050	-0.107	-5.170	-0.186	-9.240	-0.125	-7.760	-0.164	-10.180	-0.156	-7.850	-0.099	-6.870
class of job: family business	-0.297	-2.950	-0.572	-6.090	-0.699	-6.170	0.158	1.140	-1.147	-5.850	0.408	20.990	-1.055	-6.310
avg. occup. educ: 0-10 years	0.000		0.000		0.000		0.000		0.000		0.000		0.000	
avg. occup. educ: 10-11 years	0.061	3.460	-0.037	-1.670	0.040	1.060	0.035	1.020	0.031	0.540	0.116	1.700	0.261	3.560
avg. occup. educ: 11-12 years	0.042	2.410	-0.023	-1.140	0.140	3.680	0.173	5.410	0.032	0.580	0.149	2.270	0.217	3.290
avg. occup. educ: 12-12.5 years	0.239	13.590	0.120	5.570	0.174	4.370	0.166	4.970	0.129	2.270	0.182	2.720	0.282	4.240
avg. occup. educ: 12.5-13 years	0.236	8.610	0.178	8.650	0.279	7.480	0.366	11.790	0.156	2.770	0.224	3.380	0.341	5.130
avg. occup. educ: 13-13.5 years	0.286	8.120	0.259	8.810	0.329	7.980	0.362	10.700	0.375	6.630	0.428	6.490	0.536	8.100
avg. occup. educ: 13.5-14 years	0.499	19.020	0.221	6.730	0.421	10.560	0.539	15.880	0.386	6.840	0.569	8.550	0.637	9.620
avg. occup. educ: 14-14.5 years	0.405	12.030	0.429	16.550	0.467	10.860	0.542	15.320	0.545	9.600	0.652	9.740	0.752	11.320
avg. occup. educ: 14.5-15 years	0.318	6.810	0.361	8.850	0.593	14.620	0.548	14.920	0.563	9.790	0.741	10.990	0.792	11.890
avg. occup. educ: 15-16 years	0.394	12.420	0.340	11.190	0.445	10.510	0.708	21.160	0.726	12.750	0.692	10.460	0.981	14.810
avg. occup. educ: 16-17 years	0.346	9.070	0.307	10.620	0.386	8.860	0.532	14.750	0.551	9.350	0.570	8.280	0.769	11.310
avg. occup. educ: 17-18 years	0.407	6.430	0.365	7.810	0.462	8.380	0.708	14.840	0.605	8.260	0.794	9.360	1.098	14.420
Fraction Female 0-.10	0.000		0.000		0.000		0.000		0.000		0.000		0.000	
Fraction Female .10-.20	-0.022	-0.670	-0.170	-4.920	-0.168	-4.150	-0.153	-4.190	-0.054	-1.380	-0.120	-2.270	-0.136	-3.490
Fraction Female .20-.30	-0.075	-1.960	-0.254	-7.740	-0.204	-5.100	-0.264	-7.750	-0.058	-1.550	-0.095	-2.010	-0.167	-5.040
Fraction Female .30-.40	-0.017	-0.490	-0.159	-4.990	-0.201	-5.300	-0.303	-10.080	-0.149	-4.440	-0.193	-4.220	-0.192	-5.930
Fraction Female .40-.50	-0.091	-2.720	-0.201	-6.310	-0.332	-8.770	-0.358	-11.770	-0.179	-5.120	-0.292	-6.380	-0.309	-9.930
Fraction Female .50-.60	-0.145	-3.870	-0.300	-9.700	-0.286	-7.660	-0.376	-12.060	-0.223	-6.650	-0.275	-6.100	-0.350	-11.250
Fraction Female .60-70	-0.145	-4.180	-0.221	-6.670	-0.292	-7.640	-0.298	-9.330	-0.276	-7.920	-0.384	-8.390	-0.392	-12.480
Fraction Female .70-.80	-0.137	-4.220	-0.346	-10.700	-0.376	-9.870	-0.436	-14.030	-0.212	-6.230	-0.367	-8.310	-0.378	-12.130
Fraction Female .80-.90	-0.164	-5.190	-0.274	-9.360	-0.354	-10.000	-0.428	-14.580	-0.308	-9.400	-0.372	-8.430	-0.385	-12.300
Fraction Female .90-1.00	-0.163	-5.330	-0.297	-10.370	-0.291	-8.070	-0.406	-13.820	-0.241	-7.240	-0.278	-6.270	-0.375	-12.270
married, spouse present	0.000		0.00		0.00		0.00		0.00		0.00		0.00	
married, spouse absent	-0.059	-1.350	-0.051	-1.180	-0.080	-1.430	-0.019	-0.380	0.007	0.170	0.019	0.460	-0.041	-1.220
married, legally separated	0.001	0.050	-0.033	-1.380	0.023	0.890	-0.034	-1.450	0.019	0.790	-0.025	-0.870	-0.044	-2.010
marital status: divorced	0.074	4.430	0.047	3.670	0.029	2.180	0.006	0.560	0.014	1.230	0.013	0.300	0.011	1.020
marital status: widowed	-0.005	-0.210	-0.023	-0.810	-0.001	-0.010	-0.072	-2.330	-0.066	-1.880	0.007	0.530	-0.046	-1.330
marital status: never married	0.092	5.750	0.069	4.870	0.081	5.700	0.022	1.930	0.030	2.490	0.018	1.340	-0.005	-0.510
usual work week: 0-5 hours	0.00		0.00		0.00		0.00		0.00		0.00		0.00	
usual work week: 6-10 hours	-0.43	-9.9	0.10	3.8	0.05	1.7	0.10	3.6	0.14	4.4	0.13	3.2	0.14	5.0
usual work week: 11-20 hours	-0.87	-25.3	-0.02	-0.9	0.00	-0.1	-0.01	-0.7	0.00	0.1	-0.04	-1.4	0.03	1.3
usual work week: 21-30 hours	-0.71	-19.8	-0.05	-2.0	-0.02	-0.8	-0.04	-2.0	0.00	0.0	0.04	1.2	0.07	3.1
usual work week: 31-37 hours	-0.71	-20.2	0.05	2.6	0.05	2.4	0.04	1.9	0.06	2.8	0.03	1.2	0.05	2.5
usual work week: 38-42 hours	-0.73	-21.9	0.05	2.8	0.10	5.2	0.09	5.0	0.08	4.3	0.04	2.0	0.07	4.4
usual work week: 43-49 hours	-0.88	-24.9	-0.02	-0.8	0.09	3.5	0.08	3.8	0.05	2.3	0.08	3.0	0.12	5.5
usual work week: 50-59 hours	-1.05	-27.4	-0.14	-5.2	-0.01	-0.3	-0.03	-1.5	-0.01	-0.3	0.00	0.0	0.00	-0.1
usual work week: 60-69 hours	-1.15	-28.7	-0.25	-5.5	-0.21	-4.8	-0.19	-5.8	-0.16	-5.2	-0.21	-5.7	-0.15	-5.2
usual work week: 70 or more hours	-1.33	-17.0	-0.36	-6.2	-0.44	-7.6	-0.40	-8.0	-0.51	-11.1	-0.40	-7.3	-0.37	-8.6
work last year: 0-10 weeks	0.00		0.00		0.00		0.00		0.00		0.00		0.00	
work last year: 11-20 weeks	-0.44	-14.7	0.03	1.6	0.05	2.1	0.01	0.4	-0.09	-3.2	-0.09	-2.4	-0.01	-0.4
work last year: 21-30 weeks	0.09	4.5	0.12	5.9	0.10	4.1	0.10	4.1	0.08	3.0	0.01	0.3	0.08	3.0
work last year: 31-40 weeks	0.00	0.1	0.07	3.8	0.11	4.6	0.14	6.0	0.06	2.5	0.05	1.4	0.07	2.7
work last year: 41-48 weeks	0.02	1.0	0.10	4.8	0.17	6.6	0.17	6.9	0.06	2.4	0.01	0.2	0.11	4.0
work last year: 49-52 weeks	0.13	8.3	0.22	13.8	0.22	10.8	0.22	10.7	0.14	6.6	0.07	2.4	0.14	5.8
_cons	2.54	45.8	1.78	39.3	1.62	27.0	1.60	29.9	1.45	19.9	1.57	17.5	1.90	23.7

Effects of Fraction Female

GRAPH 1



GRAPH 2

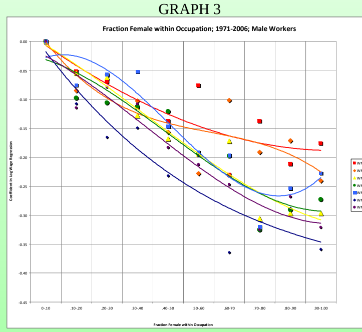


The two graphs above depict the changes in an individual female's wage as she moves into occupational categories that are comprised of a higher proportion of females. Graph #1 shows the percentage change in wage resulting from a female moving into an occupation within a higher decile of female concentration. All comparisons are with the base (fraction female = 0-.1) category, representing occupations with the smallest proportion of females. The various colors represent different years. Graph #2 attempts to mitigate the complexity of the first graph and reveal a clearer trend across time. This graph has time along its X-axis, with the percentage change in wage (relative to the base) on the Y-axis. The different lines paint more generalized fraction female trends, in broader categories of female concentration measurements. Three interesting findings are evident in these graphs:

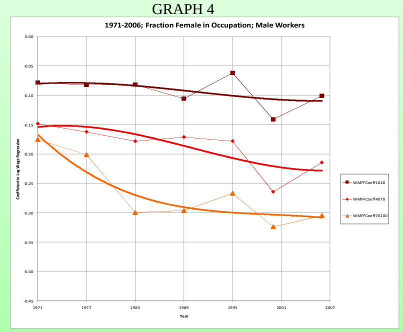
- First, it is clear, all else constant, that females moving into occupations with higher ratios of women are paid lower wages. In addition, as an occupation's concentration of females increases, the more the relative wage of an individual female worker in that occupation decreases. This is evidenced by the generally downward-sloping lines in Graph #1 and the relative position of the three lines in Graph #2. In other words, relative to occupations with the lowest concentrations of female workers, the wage paid a worker in an occupation with a higher concentration of females is lower, and decreases as the proportion of females (fraction female) in that occupation increases.
- Second, and more striking, the relative degree of these changes has increased over time. To see changes over time, comparing the position of the various lines in Graph #1 or the slopes of the lines in Graph #2 provides the framework of analysis. Examining these lines, it becomes immediately apparent, especially in the deciles composed of the highest proportion of women, that the percentage decline in wages for women in female-dominated occupations is higher today than in the 1970s.
- Finally, the trend lines in graph #2 indicate that in most deciles of occupational categories based on female concentration, this pattern is continuing. Each of these lines bends downward between 2000 and 2006, showing a continuing and increasing of this trend. In fact, among all 9 deciles, the continued downward shift of these trend lines appears in 7. It appears that instead of improving these discrepancies, this issue of paying lower wages to occupations comprised of higher proportions of women is increasing over time.

Male vs. Female

GRAPH 3



GRAPH 4

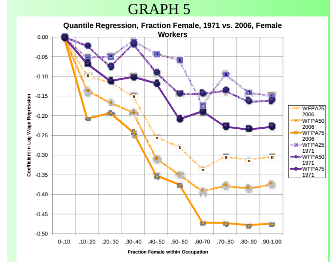


Graphs #3 and #4 depict the same relationship as the above section, this time analyzing the effects of our fraction female variable on an individual male's wage. Like Graph #1, Graph #3 shows the percentage change in wage resulting from a **male** moving into an occupation within higher deciles of female concentration. Graph #4, like Graph #2, highlights trends across time with much broader categories of the fraction female variable. Again, all comparisons are with the base (fraction female = 0-.1) category, representing occupations with the smallest proportion of females. These graphs highlight three interesting trends when compared to Graph #1 and Graph #2 above.

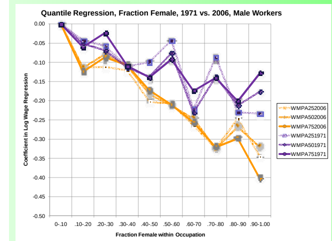
- First, these graphs show that while controlling for the other variables in our model, males are also paid lower wages when moving into occupational categories that fall into a higher decile of female concentration. This trend appears in the downward sloping lines for all deciles in Graph #2 and the relative positions of the lines in Graph #4. This finding, in conjunction with the above section, supports the assertion that regardless of the effects of an individual's gender on wages, the gender composition of an individual's occupation can cause relative wage levels to decrease.
- Second, these graphs reveal that relative to females, the decrease in wage levels caused by moving to an occupation with a higher concentration of females is not as severe with males. In Graph #3, for instance, the lowest decile of fraction female (in year 2000) reaches approximately a 34 percent decrease for a **male's** wage relative to those in occupations with the lowest concentrations of females. For **females** , on the other hand, four of the years in our analysis have at least one decile exhibiting a wage decrease of over 35 percent. The lines in Graph #4 also supports this assertion, as the relative position of each line is higher than the corresponding line in Graph #2.
- Third, the dramatic increase in the effects of fraction female across time is not as pronounced in the male-focused graphs as was evident with females. This seems to show that over time, while females in female-dominated occupations have seen large wages decreases relative to females in male-dominated occupations, **males** in female-dominated occupations have experienced less severe declines relative to males in male-dominated occupations. Graph #3 evidences this by displaying much less variation across all seven "year" lines than Graph #1, while Graph #4 clearly shows this by exhibiting much flatter lines than those in Graph #2.

Quantile Regression

GRAPH 5



GRAPH 6



Our analysis did not employ a traditional ordinary least squares form of regression analysis. Rather, we chose to use a relatively new statistical technique called *quantile regression analysis*. This statistical approach maintained two advantages in our analytic abilities:

- First, quantile regression analysis minimizes the absolute value of residuals in computing the estimated equation. This process does not square the residual values, like the ordinary least squares method, which tends to allot too much weight to outlier values.
- Second, quantile regression analysis allows us to focus our inquiries on a particular level of the dependent variable. For example, we may wish to analyze the effects of fraction female on hourly wages, with an emphasis on high wage-earners. A quantile regression allows us to place extra weight on the .75 quantile of earners and analyze the effects of fraction female. This method, therefore, allows us to look for patterns across wage earning levels.

Our results display a very interesting trend utilizing this quantile regression approach. Graphs #5 and #6 above again depict the effects of fraction female (X-axis) on percent change in wage levels (Y-axis). The years included on these graphs are the endpoints of our analysis, 1971 and 2006 (purple and orange lines, respectively). In this case, however, each line represents the analysis with a different quantile of emphasis. The darkest lines represent the .75 quantile, the medium shades represent the .50 quantile, and the lightest lines represent the .25 quantile.

The differences in the graphs between men and women are pronounced. Even in 1971, it is clear that much more variation existed among women at different levels of wages than existed with men. Even more interesting, however, is the positioning of these lines 35 years later. The three orange lines on the women's graph never cross and are widely different. In the men's case, however, the orange lines remain very close to one another and never really separate in a clearly definable pattern.

These patterns support the theory that the wage decreases caused by employment in female-dominated occupations are much more apparent among the top quarter of female wage-earners. There is a stark division in the effects of the fraction female variable amongst females earning different wage levels. The median regressions presented earlier do not pick up this trend. In addition, although we saw that men lost wages through employment in female-dominated occupations, there is no similar *range* of decrease based on the level of wages earned by males.

Finally, this variability of the fraction female variable based on wage levels has increased and become more pronounced between 1971 and 2006. Discussions on the impacts of the proportion of females in any given occupation on wages should not omit differences in wage *levels*.

Conclusion

Our findings contain important implications for understanding gender as a determinant of an individual's wage in the U.S. labor market. Studies focusing on an individual's gender may assert that outright gender discrimination has decreased over time. These studies would commend Government policies aimed at eliminating gender discrimination. These assertions, however, miss a very subtle but important form of potential wage discrimination based on an individual's occupational classification. Wages paid to individuals employed in occupations comprised of various concentrations of male and female workers could vary in such a manner so as to form a "hidden" type of discrimination.

This form of occupational discrimination based in gender is very difficult to remedy with Government policies. While the phrase "equal pay for equal work" may seem like a practical guideline, establishing the concept of "equal work" between two very different types of employment is difficult. For example, how much should a teacher be paid relative to a computer programmer?

The answer to this question lies in considerations of the required education, degree of risk, and labor demand for each occupation. Finding and combating attempts at gender discrimination based on an individual's classification of job is both theoretically tenuous and practially challenging. In addition, as we have seen, even **males** within an occupation with a higher proportion of females are paid less than in occupations with higher concentrations of males. The level of an individual's wage, as the quantile regression models showed, complicates this pattern even further.

This form of occupational discrimination based on gender is a new finding that requires further research. Before we prematurely assume that gender discrimination is disappearing in the U.S., this trend of wage discrimination based in an individual's occupational classification must be further explored. Otherwise, this source of "covert inequity" could continue to foster further discrimination in the U.S. labor market.

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