Monopsony, Mobility and Sex Differences in Pay: Missouri School Teachers

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Abstract

In this paper we examine the sex differences in the pay of school teachers in Missouri. In almost all Missouri school districts, pay is determined by reference to a salary schedule that maps the teaching experience and education level of an individual to a salary level. In spite of this apparently mechanical rule for determining pay, we find that female teachers earn less than male teachers, even after controlling for experience and education. We explore how such a difference could arise from differential job mobility and find some evidence to support this idea. However, we also find that there is considerable deviation from pay schedules, and that this is a more important source of differences in pay between men and women.

I. Introduction

A variety of theories have been proposed to explain the difference in pay that is commonly observed between men and women who appear to have identical productivity characteristics. These include theories based on prejudice, such as Becker's (1971), and those based on statistical discrimination as in Arrow (1973) and Phelps (1972). In one of the earliest explanations of the "gender gap" in wages, Joan Robinson (1969, pp. 224-27) showed that if an employer is a monopsonist and the elasticities of labor supply of equally productive men and women differ, it is profitable for employers to engage in wage discrimination, paying higher wages to the group with the higher elasticity of supply.

The Robinson model has not often been adopted as an explanation for sex differences, however, as it is a model of a labor market with a single employer. But some recent literature argues that even in markets where there are many competitors, individual employers may enjoy some market power due to search frictions, for example. Manning (2003) adapts the search model of Burdett and Mortenson (1998) to develop a model of monopsonistic labor markets. Using these modern theories of labor market monopsony, Hirsch, Schank and Schnabel (2010) and Ransom and Oaxaca (2010) try to explain sex differences in pay, although neither looks at the market for school teachers. Ransom and Sims (2010) apply Manning's approach to attempt to measure the degree of monopsony power of school districts in Missouri, and estimate that Missouri school districts have substantial market power. Falch (2010) takes advantage of a natural experiment in Norway and also finds a large degree of market power in the market for Norwegian school teachers.

However, while Missouri school districts may have significant power to set wages, it appears that they have chosen not to discriminate on the basis of sex, since most districts have adopted pay scales that map an individual's teaching experience and education to a salary level. One interesting model that allows for sex differences in pay even when individual employers do not discriminate is the search model of Bowlus (1997). In her model, which is also an adaptation of the Burdett-Mortensen search model, each employer pays the same wage to all of its employees, but there is wage dispersion across employers. If female employees receive outside job offers at a lower rate than men, or if they are more likely to separate from employment, then they will be more likely to work for low-wage employers, so that a market wage difference may arise, even though each employer treats all employees identically. That is, in this model, sorting across employers leads to lower average pay for women. This is a promising model to explore in the context of school teachers.

II. Salary Schedules for Missouri School Districts

Missouri State Teachers Association (1989) provides an overview of practices in Missouri school districts regarding salary schedules and also summarizes a survey of schedules for Missouri districts for the 1988-89 school year. We discuss these practices in the following paragraphs.

First, in all districts, elementary and secondary school teachers are compensated according to the same schedule. The typical schedule specifies a base salary for a given education level, along with the salary steps associated with additional seniority. In the simplest case, the schedule would be piecewise linear—a fixed dollar amount for each year of seniority, up to a maximum. For example, for one district in the survey, the base salary was $17,000 for a teacher with a bachelor degree and no experience, and there were 7 steps of $295. Thus, a teacher with two years of service with the district would be paid $17,590, and so on. In this example, a teacher with 8 years of service would be paid the same as a teacher with 20 years experience. The number and size of salary steps varies greatly across districts, with some districts providing a schedule with more than 20 steps. In some districts, the steps are uneven. For example, the step after the fifth year might be much larger than for the first through fourth years of service, or an increment in pay might come only after a certain number of years of service.

In our data we observe the total years of teaching experience, years of tenure with current district, and degree held. In most cases, this does not provide sufficient information to know an individual's actual scheduled salary, for a number of reasons. First is the treatment of teaching experience outside the district. Some districts grant full credit to newly hired teachers for teaching experience in other districts. However, the most common practice is to limit this—typically to five years. Thus, a teacher with ten years of previous experience would be placed on the sixth step when hired by a district. The second reason is the treatment of education. In some districts, teachers may be credited with partial completion of a degree. Thus, someone with a bachelor's degree and 30 credits of work toward a master's degree may receive a premium that reflects the additional coursework, even though the actual degree held is a bachelor's degree.

Furthermore, some teachers are paid off scale because of extra duty. Duties such as club sponsors or coaches may be paid for work that extends beyond the regular school day. Also, some districts my pay teachers above scale because they have specialized skills, or because the district is unable to fill the position at the scheduled pay.

III. Data

The data we analyze here come primarily from two data sources. The first is an administrative data base from the Missouri Department of Elementary and Secondary Education (MSDESE) for the 1989-90 school year. This is essentially a census of public school teachers in Missouri that contains salary, fraction of time employed (full-time equivalent), years total teaching experience, years tenure in current district, and highest educational degree held, along with a unique identification number for each teacher.[1] We have supplemented the information in this database with some additional geographical and demographic information from the 1990 United States Census. These census data have been aggregated from census geographical units to match the school district boundaries by the Office of Social and Education Data Analysis of

[1] We are grateful to Paul Beck for providing this data which he collected for his dissertation research (Beck, 1993).

the Missouri State Census Data Center. There were a total of 50,384 teachers in the MSDESE data for the 1989-90 school year, of which 515 had a full-time equivalent (FTE) of less than 0.5, or missing, which we have eliminated from our sample. We have also dropped a handful of observations of individual teachers without reported values for education or experience. These exclusions represent only about 1 percent of the original sample. Appendix Table 1 (available from the authors) summarizes the individual-level data that we analyze.

The second data source we analyze comes from the Public Use Micro Sample for the 1990 United States Census, which contains individual responses to long-form questionnaires (Ruggles, et. al., 2004). It provides self-reported earnings for the 1989 calendar year, along with information about an individual's age, and education. Our sample contains all individuals who lived in Missouri who reported their occupation as a teacher and their employer as an elementary or secondary school. However, these data do not allow us to identify the school district that employs the teacher, although we can identify the metropolitan area in which a teacher works (for those who work in selected metropolitan areas).

In the administrative data, the full-time-equivalent salary is $25,856 for 1989, with a range from $1,200 to $117,408. Slightly more than 50 percent of all teachers work for districts located in the St. Louis or Kansas City metropolitan areas. The average teacher teaches in a district that contains about 10,000 students, although the number of students in a district ranges in value from 14 to 46,128 and is highly skewed in distribution.

Figure 1 displays the geographical boundaries of school districts in Missouri and shows the relative size in terms of number of students enrolled. The map also outlines the boundaries of the six Metropolitan Statistical Areas (MSAs) in Missouri. It is clear from the map that almost all districts in Missouri are quite small in terms of enrollments. The few large districts are typically located in the principal cities of MSAs, However, even the largest metropolitan areas of the state contain some small school districts.

IV. Sex Differences in Pay

In analyzing the administrative date, we measure the sex gap using simple regression models that control for quadratics in tenure within current district and total teaching experience, and a set of indicators for the education level. We proxy the cost of living index by including a set of geographical variables such as population density and the fraction of the district's population that live in "rural areas" as defined by the Census Bureau. Urban economic models of location choice, such as the "open city" model in Mills and Hamilton (1989, p. 115), explain differences in wages across geographical areas as compensating differences for the higher cost of housing and/or the longer commutes required of those who live in larger cities. Since in locational equilibrium the cost of living is the same for everyone living in the same city, and because all of those living outside of metropolitan areas experience roughly the same cost of living, these models suggest another candidate index for the geographical variation in cost of living can be captured with a set of dummy variables that identify the major cities of the state, so we include these, as well.

Table 1 reports results of our analysis of the administrative salary data. Column I shows the unadjusted wage gap, which is about 9.4 percent. Adjusting for education and teaching experience (column II) reduces the gap to about 5.5 percent. Adding in the cost-of-living variables (column III) increases it again to about 6.3 percent. The explanatory variables affect salaries in the expected manner—higher education and work experience result in higher predicted salaries. Teaching experience with the current school district is valued more than experience in other school districts. Although the explanatory power of our regression models is quite high, even with all of our controls we are able to explain only about 72 percent of the variation in individual salaries.[2]

Our analysis of the 1990 census data requires a somewhat different model. Since the census does not collect work experience, we control for age only. We also have more limited geographical information, but we are able to identify individuals who work in most of the large metropolitan areas. However, with the census data we can also examine the role of marital status. The salary concept that we use is average weekly salary, which we construct from annual wage and salary income for 1989 divided by number of weeks worked in 1989. Appendix Table 2 provides summary statistics for the sample that we analyze.

Table 2 displays the results of our regression analysis. The raw wage difference in the census data is about 15.5 percent—roughly 50 percent higher than in our administrative data. With controls for age and education, the gap falls to about 10.5 percent. Adding indicators for metropolitan areas increases the gap slightly to about 11 percent. While the magnitude of the gap is larger in the census data, the relative magnitudes are comparable when compared across the different models. However, the explanatory power of the models in these regressions is substantially less than in our analysis of the administrative data, as might be expected given that salaries are self reported.

The analysis of marital status reveals a very interesting pattern. We include an indicator for "married" status, along with an interaction between "married" and "female." Thus, our reference group in this analysis is single men. Relative to single men, single women earn about 5.6 percent more. However, married men earn about 14.6 percent more.[3] Married women earn about 1.1 percent less than single men. So, the wage gap between men and women arises primarily due to the relatively high pay of married men relative to women. Unmarried men earn

[2]Given the nonlinear nature of district salary schedules, we might expect additional nonlinear terms to provide a much better fit. However, specifications with higher order polynomial terms for tenure and experience, or with many interval dummies, provide virtually no additional explanatory power.

[3] The magnitude of the marriage wage premium is similar to what others have found, such as Koreman and Neumark (1991).

roughly the same as women—slightly more than married women and somewhat less than single women.

V. Sorting as a Source of the Sex Gap in Pay

These results document the puzzle that we are trying to solve--districts pay teachers according to a scale based on education and teaching experience, without regard to sex, but sex differences in pay exist, even after controlling for differences in experience, seniority and education.

One way to explain this is with a dynamic model in which workers move across districts in response to differences in pay. If women and men have different rates of mobility, this could lead to women working in districts that pay lower salaries, on average. What evidence is there for such and argument?

Certainly, a model with differential mobility is consistent with higher moving costs for a married couple than for a single person. Married women would be disadvantaged if the wife earns less than the husband. Ransom and Sims (2010), who analyzed the same administrative data set that we use here, found that the separation elasticity with respect to the wage was much lower in magnitude for women than for men—about -1.5 versus about -2.25. Thus, men in low pay districts are relatively more likely to quit than women in low pay districts. This pattern suggests that low pay districts should have a higher proportion of female employees.

Figure 2 shows that this is the case. On the vertical axis is the average log wage for a district, after adjusting for the characteristics teachers and cost-of-living variables. Basically, this is the error term from the regression in Table 1 (column III), averaged for the district. The lines in Figure 2 represent the regression of the district adjusted mean log wage against the fraction of the district's teachers who are female. The green line is unweighted; the red line is a weighted regression with weights corresponding to the number of teachers in the district. While the lowest paid districts are much more female, very few teachers work in such districts. Thus, the sorting effect we examine is able to explain a relatively small part of the sex difference in pay. In fact, if we simply reestimate the regressions in Table 1 and include a dummy variable for each district, the change in the estimated wage gap is tiny. Thus, while we do see evidence that sorting leads to smaller pay for female teachers, it explains only a small part of the observed wage gap.

VI. Other explanations

Thus, it appears that the source of the wage gap is that men and women are treated differently within the same district. Salary practices allow teachers to be paid off scale. Presumably, this is most common when the teacher is assigned extra duties. The extent to which this occurs is illustrated in Figures 2 and 3, which show the salary levels for full-time teachers who hold a bachelor's degree, for two medium-sized school districts in our sample. It is apparent that off-scale pay is common. It is also clear that in these districts, male teachers tend to be paid more than female teachers with the same experience level.

This difference may have arisen because men are more likely to be assigned to extra duties. The marriage difference might arise if married women are unwilling to accept extra duty assignments because of more domestic responsibilities. On the other hand, it is possible that women teachers are excluded disproportionately from extra pay activities—perhaps women teachers want the opportunities but are denied them.

Another possible interpretation is that salary schedules are largely ignored, and that men are able to negotiate better salaries than women.

VII. Summary

We set out to explain how a sex gap in pay could arise in a market where employers pay according to a schedule. We find evidence that women are less sensitive to wage differences, and that this results in sorting—women are more likely to work in low-paid districts. However, this sorting effect can explain only a small part of the observed sex difference in pay.

Most of the difference in pay occurs because comparable female teachers are paid less than male teachers within the districts in which they work. This could arise because men are more likely to be assigned to “extra” duties; however, assignments could be discriminatory (women are denied opportunities that they would like for extra duty) or could arise due to choice. The fact that married female teachers are the lowest paid group hints that part of the source of the wage difference is because women do not seek extra duties because of domestic responsibilities.

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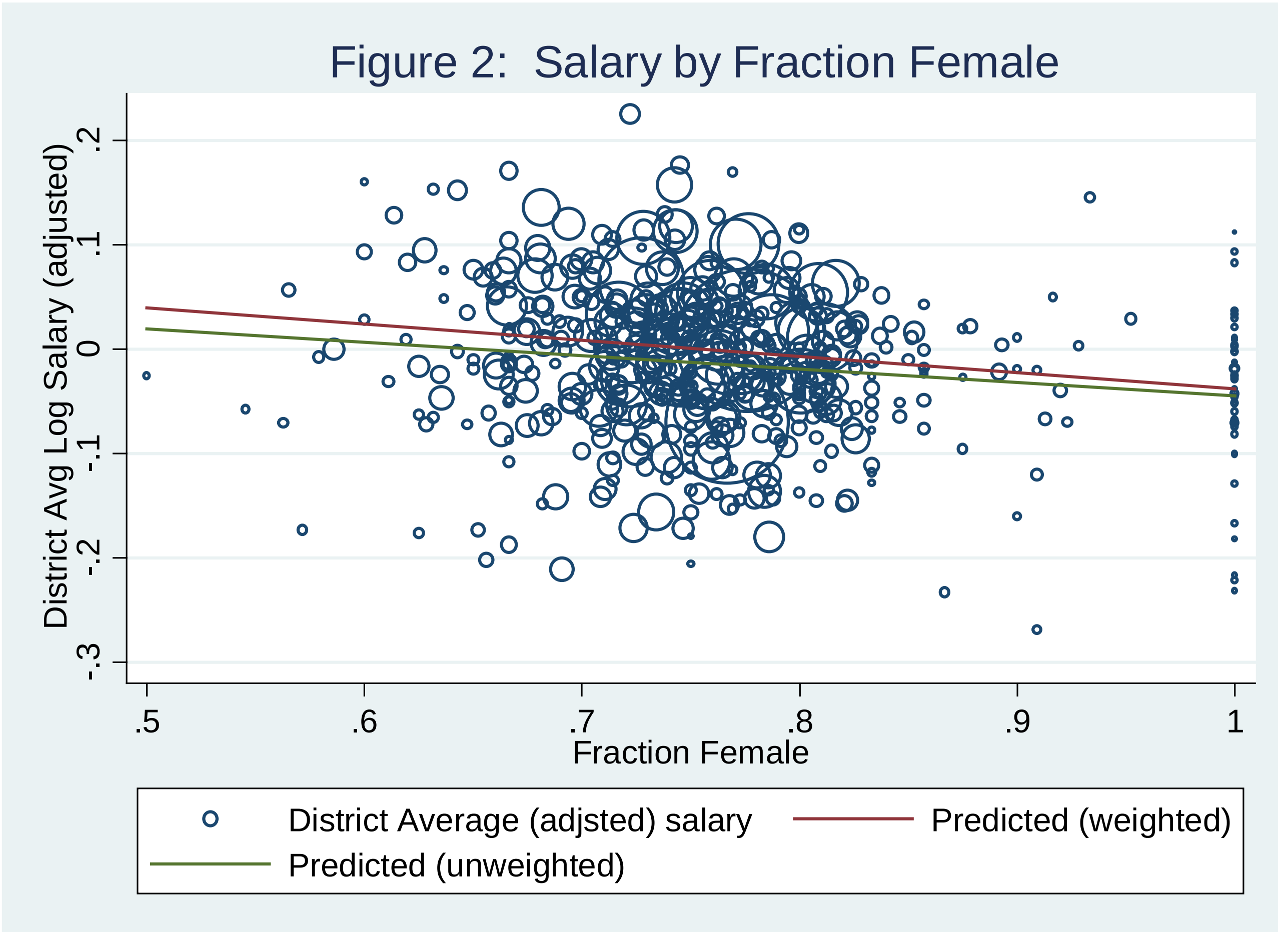

Figure 2: Salary by Fraction Female
District Avg Log Salary (adjusted)
.2
.1
0
-.1
-.2
-.3
.5
.6
.7
.8
.9
1
Fraction Female
District Average (adjsted) salary
Predicted (weighted)
Predicted (unweighted)

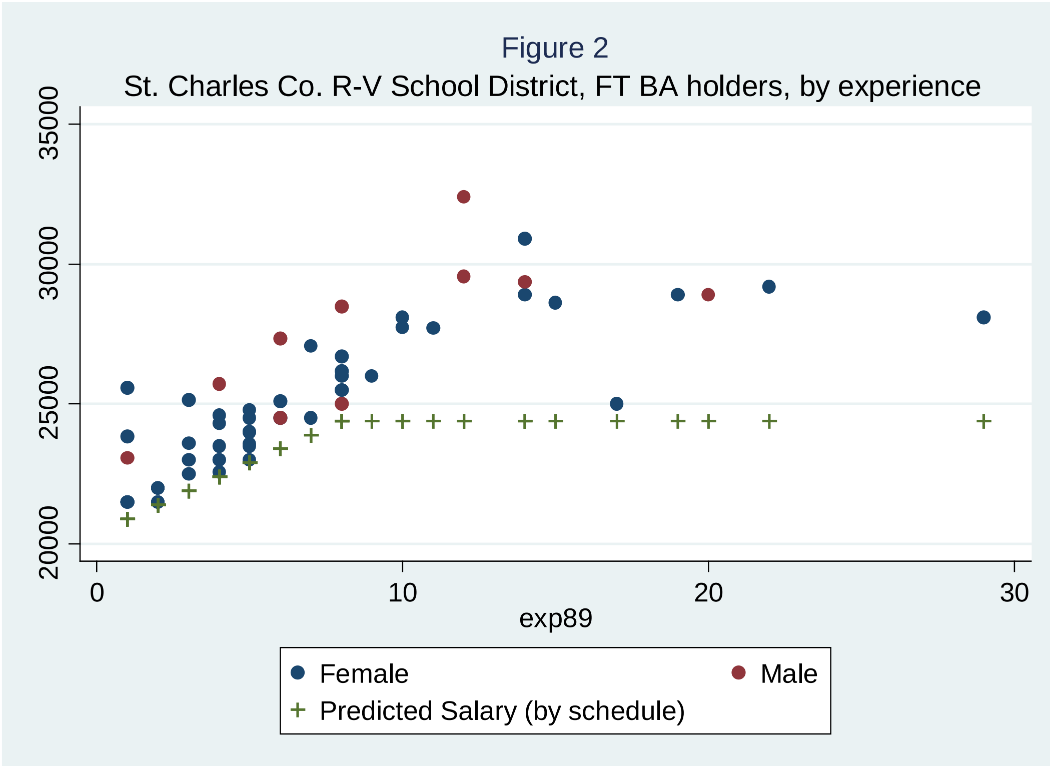
Figure 2
St. Charles Co. R-V School District, FT BA holders, by experience
20000
25000
30000
35000
0
10
20
30
exp89
Female
Male
Predicted Salary (by schedule)

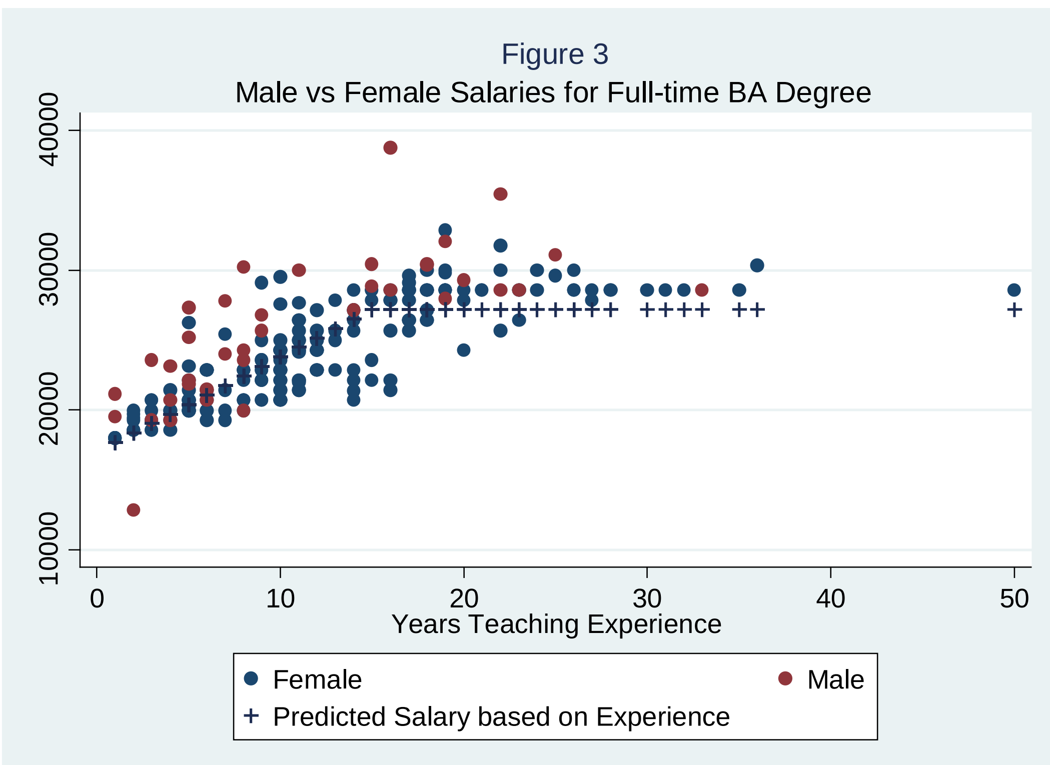
Figure 3
Male vs Female Salaries for Full-time BA Degree
10000
20000
30000
40000
0
10
20
30
40
50
Years Teaching Experience
Female
Male
Predicted Salary based on Experience

Table 1
Estimated Regression Models
(Dependent Variable is Log Annual Salary)

	I	II	III
Variable	Coefficient	Coefficient	Coefficient
Female	-0.0938	-0.0549	-0.0629
	(0.0028)	(0.0020)	(0.0016)
Experience		0.0185	0.0190
		(0.0005)	(0.0004)
$Experience^2$		-0.0004	-0.0003
		(0.00002)	(0.00001)
Tenure		0.0118	0.0120
		(0.0006)	(0.0004)
$Tenure^2$		-0.0001	-0.0002
		(0.00002)	(0.00001)
Masters Degree		0.1608	0.1219
		(0.0020)	(0.0015)
Masters Degree		0.2272	0.1414
		(0.0079)	(0.0070)
Doctorate Degree		0.3519	0.2258
		(0.0121)	(0.0092)
Percent Rural			-0.1760
			(0.0024)
Population Density			-0.0041
			(0.0005)
Kansas City MSA			0.1006
			(0.0021)
St. Louis MSA			0.1847
			(0.0021)
St. Joseph MSA			0.0374
			(0.0047)
Springfield MSA			0.0229
			(0.0026)
Joplin MSA			-0.0136
			(0.0032)
Columbia MSA			0.1146
			(0.0036)
Intercept	10.2411	9.8723	9.8885
	(0.0024)	(0.0025)	(0.0029)
R^2	0.0229	0.5103	0.7237

Notes: Standard errors in parentheses. All estimates statistically significant at 1% level.

Table 2
Regression Analysis of 1990 Census Data
(Dependent variable is log of average weekly earnings in 1989)
N=3,123

	I	II	III	IV
Variable	Coefficient	Coefficient	Coefficient	Coefficient
Female	-0.155	-0.104	-0.110	0.056
	(0.022)	(0.020)	(0.020)	(0.043)
Married				0.146
				(0.043)
Female × Married				-0.213
				(0.048)
Age		0.061	0.061	0.063
		(0.006)	(0.006)	(0.006)
Age^2		-0.001	-0.001	-0.001
		(0.000)	(0.000)	(0.000)
Masters Degree		0.310	0.302	0.298
		(0.018)	(0.018)	(0.018)
Professional Degree		0.051	0.066	0.066
		(0.133)	(0.133)	(0.133)
Doctors Degree		0.437	0.411	0.405
		(0.083)	(0.083)	(0.083)
Race is Black		0.065	0.021	0.015
		(0.035)	(0.036)	(0.036)
St. Louis MSA			0.103	0.101
			(0.021)	(0.021)
Kansas City MSA			0.091	0.085
			(0.025)	(0.025)
Springfield MSA			0.001	0.000
			(0.050)	(0.050)
Columbia MSA			0.008	-0.003
			(0.075)	(0.074)
Joplin MSA			0.012	0.014
			(0.056)	(0.056)
Constant	6.329	4.755	4.726	4.577
	(0.019)	(0.131)	(0.131)	(0.135)
R^2	0.0160	0.1813	0.1894	0.1947

Appendix Table 1

Summary Statistics for Missouri Administrative Data
(N=49,861)

Variable	Mean	Standard Deviation	Minimum	Maximum
Salary	$26,902.76	7,717.98	$1,200	$117,408
Log(Salary)	10.17	0.27	7.299	11.673
Female	0.75	0.43	0	1
Tenure	10.84	8.11	1	50
Experience	13.72	8.69	1	54
Bachelors Degree	0.57	0.50	0	1
Masters Degree	0.41	0.49	0	1
Specialist Degree	0.02	0.13	0	1
Doctorate Degree	0.004	0.06	0	1
Metro Area	0.64	0.48	0	1
Percent Rural	0.37	0.40	0	1
Population Density	1.42	2.10	0.003	7.143
Kansas City MSA	0.20	0.40	0	1
St Louis MSA	0.32	0.47	0	1
St Joseph MSA	0.02	0.14	0	1
Springfield MSA	0.05	0.22	0	1
Joplin MSA	0.03	0.17	0	1
Columbia MSA	0.02	0.14	0	1

Appendix Table 2

Summary Statistics for 1990 Census Sample
(N=3,123)

Variable	Mean	Standard Deviation	Minimum	Maximum
Wage & Salary Income (1989)	$23,871.46	$9,765.56	$300	$195,297
Weeks Worked (1989)	43.64	6.63	32	52
Log Average Weekly Earnings (1989)	6.21	0.53	1.75	8.57
Female	0.75	0.43	0	1
Age	40.95	9.75	23	70
Bachelor Degree	0.54	0.50	0	1
Masters Degree	0.45	0.50	0	1
Professional Degree	0.004	0.06	0	1
Doctoral Degree	0.011	0.11	0	1
Married	0.74	0.44	0	1
Female × Married	0.54	0.50	0	1
Columbia MSA	0.01	0.12	0	1
Joplin MSA	0.02	0.16	0	1
Kansas City MSA	0.16	0.36	0	1
St Louis MSA	0.30	0.46	0	1
Springfield MSA	0.03	0.17	0	1