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School Quality and the Distribution of Male Earnings in Canada

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ABSTRACT

Using quantile regressions, this paper provides evidence that the relationship between school quality and wages varies across points in the conditional wage distribution and educational attainment levels. Although smaller classes generally have a positive return for individuals at high quantiles, they have a negative impact at low quantiles. Similarly, while more highly paid teachers benefit drop-outs at high quantiles and graduates at low quantiles, they have a negative return for all other quantile-education groups. The results presented in this paper also suggest that the optimal school for high school graduates is likely smaller than for high school drop-outs.

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Keywords: School quality, Quantiles, Wages
JEL: I2 and J3

1. Introduction

The relationship between school quality and student achievement has been debated for decades.[1] In his survey of the evidence, Hanushek (1986) finds little or no relationship between school quality and student achievement on standardized tests. On the other hand, several studies have found a significant relationship between school quality and subsequent wages (Welch 1966; Morgan and Sirageldin 1968; Johnson and Stafford 1973; Wachtel 1976; Rizzuto and Wachtel 1980; Card and Krueger 1992). This discrepancy is not simply a consequence of different outcome measures, since still other studies have found no significant relationship between school inputs and earnings (Ribich and Murphy, 1975; Akin and Garfinkel, 1977; Betts, 1995).

Although the school quality debate has re-surfaced several times, attention has generally focused on the relationship between school inputs and average wages. For example, linking 1980 earnings in the U.S. census to average state of birth school quality measures for three cohorts born between 1920 and 1949, Card and Krueger (1992) find that school inputs, such as pupil-teacher ratios, relative teacher wages, and school term duration, are related to subsequent earnings. In contrast, Betts (1995) finds no statistically significant relationship between mean wages and similar school quality measures using National Longitudinal of Youth (NLSY) data.

It is possible, however, for school inputs and wages to be related at some points in the conditional wage distribution even if there is no statistically significant relationship on average. School inputs and student outcomes may therefore be significantly related even if school inputs and average outcomes are not. Brown and Saks (1979) argue that a school input is productive if it affects any student. Characterizing the distribution of student outcomes by its mean and

[1] There is also a parallel literature exploring the relationship between college quality and earnings (James, Alsalam, Conaty, and To, 1989; Daniel, Black and Smith, 1997; and Loury and Garman, 1995 are recent examples).

variance, an input is productive if it affects either moment. Regressing the mean and standard deviation of standardized test scores on school inputs, they find that the standard deviation is significantly related to school inputs, but mean test scores are not. In a similar vein, Eide and Showalter (1998) find that school inputs affect test score gains at some points in the conditional test score distribution without impacting the mean.

Departing from the Card and Krueger (1992) framework, I explore the relationship between school inputs and the entire distribution of wages. Using quantile regressions and linking 1981, 1986, and 1991 Canadian Census data to provincial school quality data from 1932 to 1970, this paper presents an extensive analysis of the relationship between school inputs - measured by class size (pupil-teacher ratio), school size (teacher-school ratio), and relative teacher pay - and the distribution of wages. I estimate the returns to school inputs at the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} quantiles of the conditional wage distribution. I show that the significance and direction of these relationships vary across points in the conditional wage distribution. More specifically, the returns to any given input tend to be of opposite sign at opposing ends of the distribution. Given the structure of the returns to school inputs across quantiles, it is not surprising that many studies have been unable to find a statistically significant relationship between school inputs and average wages.

2. Estimation

All regressions are of a standard Mincerian/education production function form.

$$\ln w_i = b_0 + Zb_Z + S_i b_S + Q_i b_Q + S_i Q_i b_{SQ} + u_i \quad (1)$$

Observable characteristics, *Z*, include a quadratic function of experience and sets of dummy

variables for birth cohorts, province of birth, and census years. School quantity, *S*, is a three component vector measuring years of public school, university, and post-secondary technical training. Due to data restrictions, public school quantity is further divided into three variables: dummies for less than five years (G4) and between five and eight years (G58) of schooling, as well as actual years for those with more than eight years of public education (ED). School inputs[2] (or quality), *Q*, includes the pupil-teacher ratio, teacher-school ratio, and relative teacher wage. Class size and teacher pay enter all regressions directly. School size is divided into three groups: small, medium, and large (less than 4, between 4 and 8, and 8 or more instructors). The two latter dummy variables are included in all regressions.

This specification allows school inputs to affect the return to schooling (the slope of the earnings function) and the intercept. This formulation is similar to that of Betts (1995) and differs from both Card and Krueger (1992) and Johnson and Stafford (1973). Card and Krueger focus on the impact that inputs have on the slope of the earnings function and Johnson and Stafford focus on the intercept.

The quantile regression technique allows us to estimate the relationship between school inputs and earnings at various points in the conditional wage distribution. Following Koenker and Bassett (1978) the quantile regression model can be written as:

$$\ln w_i = X_i b_q + u_{qi} \qquad \text{with} \quad \text{Quantile}_q(\ln w_i \mid X_i) = X_i b_q \quad i = 1, \ldots, n$$

(2)

where the X_i includes all variables defined in (1).

$\text{Quantile}_q(\ln w_i \mid X_i)$ denotes the q^{th} quantile of $\ln w$ given *X*. The q^{th} quantile regression

[2] Note that school input measures are for years of public school rather than total schooling. Card and Krueger(1992) and Betts (1995) apply public school input measures to total education rather than to public

estimator for b, denoted b_q, is the solution to the following minimization problem:

$$\min_{b}\left[+\sum_{\{i|\ln w_i \geq X_i b\}} q\left|\ln w_i - X_i b\right| + \sum_{\{i|\ln w_i < X_i b\}} (1-q)\left|\ln w_i - X_i b\right|\right].$$

(3)

Stated somewhat differently, the quantile regression estimates result from minimizing the weighted sum of the absolute value of errors, where the weights assigned to positive and negative errors determine the quantile.

3. Data

All wage and educational attainment data are from the 1981, 1986, and 1991 *Census of Canada; Public Use Microdata File on Individuals.* The sample includes men born in Quebec, Ontario, Manitoba, Alberta, or British Columbia between 1926 and 1952.[3] The sample is restricted to non-agricultural employees earning at least $40 per week in 1986 dollars.[4] All nominal variables are deflated to 1986 dollars using the CPI. The sample contains 73,337 men: 27,832 in 1981, 21,101 in 1986, and 24,404 in 1991.

The wage and educational attainment data are linked to province of birth specific school input measures.[5] Individuals are assigned the average provincial class size (pupil-teacher ratio),

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schooling.

[3] New Brunswick, Nova Scotia, Newfoundland, and Prince Edward Island are excluded due to small sample sizes. Saskatchewan is excluded because school size data are unavailable. There are no individuals born in Quebec beyond 1948 because I was unable to locate school input measures beyond 1960.

[4] This sampling criteria is identical to that of Card and Krueger (1992). Relaxing the sampling rule to include male employees earning less than $40 per week in 1986 dollars does not significantly alter any of the results.

[5] This assumes that individuals attend school in their province of birth. Although this assumption is less than desirable, Heckman, Layne-Farrar and Todd (1996) show that non-random migration biases the school quality estimates unless all relevant factors are included in the earning equation, it is difficult to adjust for child migration. Further, Card and Krueger (1992) find that adjusting for the inter-state mobility of American children born between 1920 and 1949 has only a minor impact on the estimated relationship between average earnings and school quality.

school size (teacher-school ratio), and the relative pay of teachers during their potential period of enrollment.[6,7] More specifically, each school input measure is a province of birth and enrollment period specific moving average.

$$Q_{p_{kij}} = \sum_{d=i}^{i+11} \frac{Q_{kij}}{12} \qquad (4)$$

where p denotes public school, k = pupil-teacher ratio, teacher-school ratio, or relative teacher pay, and i = year of school entry (school years are numbered using the June year).

Men born between 1926 and 1952 entered school between 1932 and 1958, with the youngest individuals completing grade thirteen in 1970. The period 1932 to 1970 was selected for two reasons. First, the provincial education systems exhibit substantial variation across provinces at any given point in time, and within provinces over time during this period. Secondly, by 1970 most provinces had relinquished a significant degree of educational control to local school districts. Reduced provincial control coincided with a decrease in provincially published school data.

3.1 School Quality Measures from 1932-70

While there was a general trend towards smaller classes in all provinces over the period of interest, the speed and pattern of changes varied substantially across provinces (Figure 1 graphs the school quality measures by province from 1932-70). For example, the time path of the Ontario pupil-teacher ratio has three distinct phases: declining size from 1932 to 1941, relative

[6] Public school enrollment is assumed to be continuous from the point of entry.
[7] All school input data are averaged across provincially regulated elementary and secondary schools. Provincially regulated institutions may be fully or partially supported by public funds. For example, during the period of interest all Quebec schools were partially supported by religious denominations, but were provincially regulated.

stability with between 28 to 31 students per instructor until the early 1960s, and then rapid decline to 21.8 students per teacher by 1970. In contrast, the relatively small Quebec classes, at an average size of 27.3 in 1932, declined slowly, but continuously, to 22.9 in 1960.

The importance of disentangling school and class size is most apparent for Alberta. Enrollment declines during the Great Depression led to smaller classes, but had no effect on the teacher-school ratio. In contrast, the larger schools created by urban school expansion and rural school amalgamation between 1945 and 1949 were accompanied by larger classes. Finally, by the early 1950s the average class began to shrink while the growth of urban schools and the consolidation of small rural schools into larger regional institutions continued at a rapid pace. It is during this era that school growth was accompanied by dramatic classroom composition changes. Multi-grade classes became less common, course selection diversified, and the availability of special services (learning assistance for example) increased. While the pace of school size expansion was not as rapid in other provinces, schools in all provinces grew from 2 or 3 teachers per school in the 1930/40s to 13-19 teachers per school by 1970.

The five provinces included in this study are economically diverse and geographically vast; significant inter-provincial cost of living, wage, and occupational opportunity differences have always existed. For these reasons, it is unlikely that teacher salaries are an adequate index of instructor quality. I therefore use the average annual teacher salary in each province relative to the average annual electrician's salary in the province's largest city.[8]

There are three noteworthy salary trends. First, relative teacher salaries were substantially higher in British Columbia than in other provinces until the 1960s, by which time British

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Fully private schools are excluded.

[8] The average wage of electricians is not available for Calgary or Edmonton, the Winnipeg average is used instead. Electrician salaries were chosen because they are available throughout the period.

Columbia, Alberta and Ontario teacher salaries had converged. Secondly, Manitoba teachers were the only Canadian instructors who did not experience a wage decline during World War Two. In every other province the relative wage earned by teachers fell during the early 1940s and then rose as the war drew to a close. Thirdly, Quebec schools were religiously affiliated, mostly Catholic[9], and largely staffed by Nuns and religious brothers[10] throughout the period of interest. As the remuneration received by religiously affiliated instructors was much lower than their layperson counterparts, the average salary of Quebec teachers was substantially lower than in other provinces. [11]

4. Results

Table 2 presents the estimates (for the specification described in Section 2) for the coefficients on class size, school size, and teacher pay on wages later in life at the 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} quantiles. The OLS estimates are also reported for comparative purposes.

While class size and earnings are not statistically significantly related on average, they are significantly related, at conventional levels, for all quantiles except the 25^{th}. The pupil-teacher ratio has the most economically significant impact on earnings at more extreme levels of public school completion and points in the wage distribution. High school drop-outs at high quantiles benefit the most from smaller classes while drop-outs at low quantiles benefit from larger classes. For example, a decrease in the pupil-teacher ratio of 10 students is associated with an 18% wage decrease for individuals with 10 years of education at the 10^{th} quantile and a 5% wage increase for

[9] The quality indices used in this paper are based on Catholic schools exclusively. Protestant school data are not available for all years. Since approximately 90 percent of Quebec students attended Roman Catholic institutions, omitting Protestant school data is inconsequential. For example, 87% and 91% of Quebec students were enrolled in Catholic schools in 1932 and 1960 respectively.

[10] Nuns and brothers account for 60%, 32%, and 31% of teachers in 1935, 1945, and 1955 respectively.

individuals with 10 years of education at the 90th quantile. While smaller classes might benefit more able students because teachers have time to develop specialized enrichment programs, run multiple reading groups, and so forth, it is possible that less able students may benefit from larger classes. Levin (1993) argues that "disadvantaged" students benefit from high instructor expectations, deadlines, and interaction with "advantaged" pupils. Larger classes may encourage this type of environment because teachers are forced to rely more heavily on group work and student mentoring.

In contrast to class size, the relationship between school size and subsequent earnings tends to be strongest at more central points in the wage distribution. The large school indicator and its interaction with public school variables are jointly significant, with probability values of 0.06, 0.00, 0.02, 0.01, and 0.07 at the 10th quantile, 25th quantile, median, mean, and 75th quantile respectively. Large schools have a negative impact on individuals who drop-out before the ninth grade, a positive impact on high school drop-outs and a negative impact on graduates. It is also interesting to note that the relationship between school size and earnings does not vary across points in the conditional wage distribution to the same degree as class size and teacher salaries.

In order for the average school size to rise above eight teachers per school, high schools must have a relatively large number of classes at each grade level.[12] The introduction of vocational and other non-academic courses that coincided with secondary school growth, was beneficial for less academically oriented high school drop-outs. The positive return to school growth enjoyed by this group may be a function of more relevant course material. However, the

[11] All results are similar when Quebec is excluded.

[12] This is true for two reasons. First, high schools typically include only a small number of grades. Schools containing grades eight through twelve, nine through thirteen, and eight through ten, are just a few examples of Canadian high school configurations. Secondly, while elementary schools with more than two classes per grade existed during the period of interest, schools with no more than one were predominant in many regions.

introduction of non-academic programs may actually divert resources away from academically oriented high school students.

The correlation between teacher salaries and subsequent wages is most precisely measured at more extreme quantiles; the joint probability values for relative teacher salary and its interaction with public school are 0.00, 0.06, 0.13, 0.39, 0.00, and 0.00 at the 10^{th} quantile, 25^{th} quantile, median, mean, and 75^{th} quantile, and 90^{th} quantile respectively. Higher teacher salaries and subsequent wages are positively related for those with more than ten years of years of public schooling at the 10^{th} quantile, less than twelve years of schooling at the 75^{th} quantile, and less than eleven years of public education at the 90^{th} quantile. The relationship between teacher wages and subsequent male earnings is positive for all other education groups at the 10^{th}, 25^{th}, 75^{th}, and 90^{th} quantiles.

Tables 3 and 4 expand the set of explanatory variables to include urban/rural residence, marital status, occupation,[13] and post-secondary field of study[14] dummy variables to ensure that their inclusion does not substantially alter the estimated impact of school quality measures. Table 3 reports the results for the model expanded to include urban/rural residence, marital status, and occupation. While there are some differences between Tables 2 and 3, most notably that the large school variables are no longer jointly significant at the 75^{th} quantile and neither the class size nor teacher salary variables are jointly significant at the 25^{th} quantile, the general patterns are very similar. Table 4 further expands the set of explanatory variables to include post-secondary major

[13] The occupations are based on the 1980 Canadian occupation categories: management; engineering, mathematics, sciences, and medicine; social sciences, teaching, art, literature, and recreation; clerical; sales; services; processing; machining, fabricating, assembling, and repairing; construction; transportation and equipment operating; and other.

[14] Major field of study is collapsed into three groups: education, fine arts, humanities, and social sciences; commerce and business administration; and sciences, engineering, health professions, and mathematics, for cell size reasons.

fields of study. Unfortunately, the major field of study is not reported in 1981, this restriction reduces the sample size to 45,500, and eliminates the first nine-year cohort from the analysis. The estimates reported in Table 4 differ from those in Table 2 in two important ways. First, the large school variables are no longer jointly significant at any quantile. Secondly, the teacher salary variables are jointly insignificant at the 75th quantile. With these exceptions, the statistical significance and pattern of results are again similar.

To this point all regressions have treated educational attainment as exogenous. However, it is possible that school inputs affect earnings by influencing the length of time that people choose to remain in school, and possibly field of study, urban/rural residence, and occupation choices. To address this issue, at least in a very rough way, Table 5 presents some simple reduced form estimates of the effect that school inputs have on log earnings at various points in the conditional wage distribution. The reduced form model includes the three school input measures, province of birth effects, cohort dummies, census year dummies, age, and age squared. The estimated input effects therefore incorporate direct effects on educational attainment as well as indirect effects through school and post-secondary choices.[15]

While the results in Table 5 differ somewhat from those presented in Tables 2 through 4, there remain unique patterns across quantiles. The only statistically significant relationship between teacher salaries and wages occurs at the 50th quantile. At the median, higher teacher salaries have a positive impact on future wages. The coefficient on the large school variable is significant, and negative, at the mean, the 75th quantile, and the 90th quantile. Finally, class size has a statistically significant positive impact on wages at the mean, median, and 75th quantiles. Notice that no educational quality measure is statistically significant at the 10th or 25th quantile.

[15] This approach is similar to that of Card and Krueger (1992) and Betts (1995).

5. Conclusion

Comparing the least squares and quantile regression estimates highlights the importance of considering the entire distribution of wages when examining the return to school inputs. Class size and teacher salaries are most strongly related to earnings at more extreme quantiles and levels of educational attainment, while the relationship between school size and earnings is stronger at more central points of the conditional wage distribution. Further, the returns to class size and teacher pay at higher quantiles tend to offset those at lower quantiles. The mirror image nature of the returns to class size and teacher salaries across quantiles may help explain the inability of many previous studies to find a significant relationship between these characteristics and average wages.

The results presented in this paper add to the current debate about the effectiveness of school inputs by documenting the differential impact of school resources across points in the conditional wage distribution. More specifically, the estimates suggest that additional spending to reduce class size or raise teacher salaries is generally beneficial for individuals at high quantiles and detrimental for individuals at low quantiles. In contrast, Eide and Showalter (1998) find that school enrollment and per-pupil expenditures have the biggest impact on test score gains at low quantiles, while a longer school year has the biggest return at high quantiles.

Welch (1966) suggests that the returns to school size are initially positive, but may become negative if schools become too large. In a similar vein, the results presented in this paper hint that an optimal school size concept may exist; while high school drop-outs benefit from large schools high school graduates do not.[16] The apparent interaction, or tradeoff between class and

[16] While large schools generate a positive return for high school drop-outs, it is important to remember that the average school size does not exceed 11.3. At the individual school level there may well be urban schools that are sufficiently large to generate a negative return for these students as well.

school size may therefore be a fruitful avenue for future research. Modeling school hierarchy - administration, teachers, and students - in an environment where player interactions determine optimal school and class size decisions may yield significant insight into good school system design.

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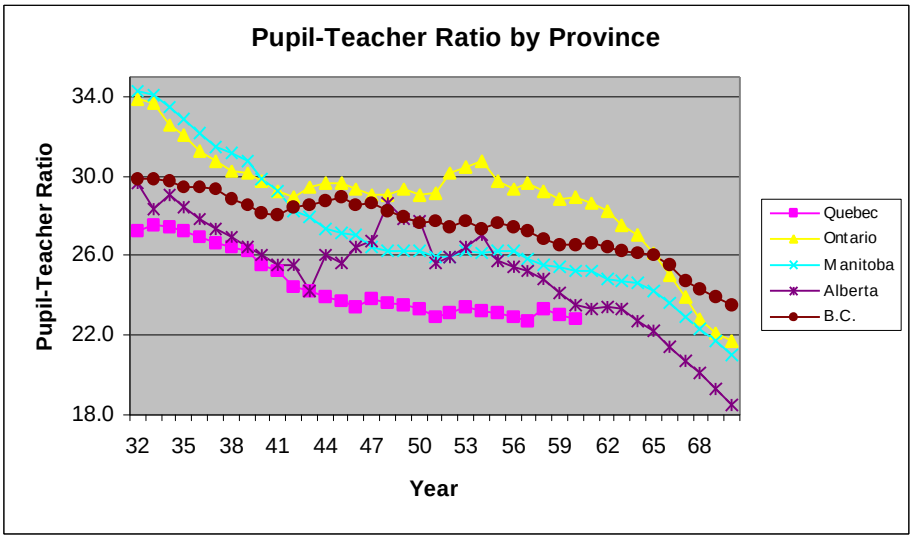
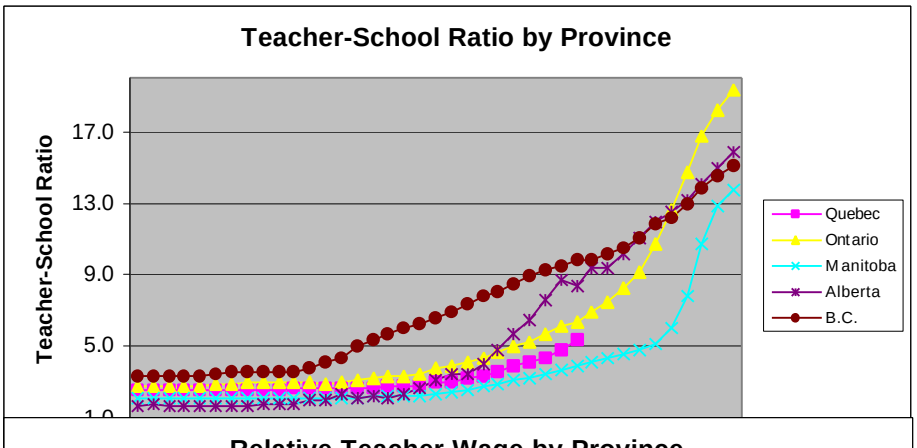
Figure 1. School Inputs by Province Across Time





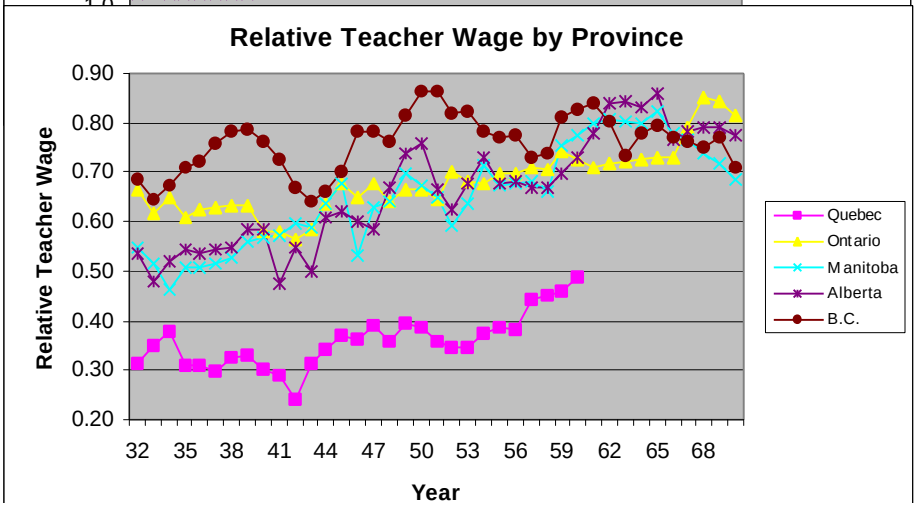


Table 1. Summary Statistics

	Mean	Standard Deviation
Log Weekly Earnings	6.3932	0.5257
Experience	27.5606	8.3511
Schooling		
<5 Years of Public Schooling (G4)	0.0101	0.1001
5-8 Years of Public Schooling (G58)	0.1326	0.3391
Years of Public Schooling (ED)	9.8921	4.2007
Years of University	0.9413	1.8325
Years of Technical Training	0.6343	1.1474
Province of Birth		
Born in Quebec	0.2318	0.4220
Born in Ontario	0.4829	0.4997
Born in Manitoba	0.0882	0.2836
Born in Alberta	0.0999	0.2999
Born in B.C.	0.0972	0.2962
Provincial Public School Inputs		
Class Size	26.8943	2.3856
Small Sized School	0.4866	0.4998
Medium Sized School	0.3172	0.4654
Large Sized School	0.1961	0.3971
Relative Teacher Pay	0.6255	0.1515

Table 2. Quantile and OLS Results

	10th Quantile	25th Quantile	Median	75th Quantile	90th Quantile	OLS
Years of Public School (ED)	**0.1368**	0.0216	-0.0292	**-0.0394**	**-0.1092**	-0.0039
	(0.0506)	(0.0230)	(0.0157)	(0.0195)	(0.0304)	(0.0209)
Dummy for <5 Years of Public School (G4)	0.1034	-0.0341	**-0.8791**	-0.4698	**-1.1885**	-0.6192
	(0.8105)	(0.3737)	(0.2576)	(0.3230)	(0.5007)	(0.3428)
Dummy for 5-8 Years of Public School (G58)	0.8999	-0.1768	**-0.6321**	**-0.4231**	**-1.0540**	-0.3109
	(0.6018)	(0.2733)	(0.1865)	(0.2317)	(0.3604)	(0.2478)
Years of University	**0.0606**	**0.0655**	**0.0577**	**0.0581**	**0.0634**	**0.0601**
	(0.0028)	(0.0013)	(0.0009)	(0.0011)	(0.0016)	(0.0011)
Years of Technical Training	**0.0277**	**0.0252**	**0.0238**	**0.0212**	**0.0152**	**0.0227**
	(0.0040)	(0.0018)	(0.0012)	(0.0016)	(0.0025)	(0.0016)
Pupil-Teacher Ratio (PTR)	**0.0800**	0.0106	**-0.0389**	**-0.0514**	**-0.1099**	-0.0178
	(0.0318)	(0.0143)	(0.0097)	(0.0120)	(0.0188)	(0.0129)
PTR*ED	**-0.0062**	0.0002	**0.0038**	**0.0050**	**0.0095**	0.0019
	(0.0025)	(0.0011)	(0.0008)	(0.0010)	(0.0015)	(0.0010)
PTR*G4	-0.0030	0.0071	**0.0593**	**0.0424**	**0.0901**	**0.0392**
	(0.0420)	(0.0190)	(0.0129)	(0.0162)	(0.0256)	(0.0172)
PTR*G58	-0.0425	0.0134	**0.0459**	**0.0431**	**0.0852**	**0.0255**
	(0.0303)	(0.0137)	(0.0093)	(0.0115)	(0.0180)	(0.0123)
Dummy for Medium School (TSR2)	-0.0811	0.1021	0.0422	0.0749	0.0264	0.0380
	(0.1317)	(0.0599)	(0.0415)	(0.0523)	(0.0817)	(0.0551)
TSR2*ED	0.0077	-0.0096	-0.0036	-0.0073	-0.0028	-0.0033
	(0.0113)	(0.0051)	(0.0036)	(0.0045)	(0.0070)	(0.0047)
TSR2*G4	-0.2695	**-0.2313**	0.0541	-0.1235	-0.0590	-0.0778
	(0.2283)	(0.1019)	(0.0695)	(0.0865)	(0.1354)	(0.0927)
TSR2*G58	0.0315	**-0.1532**	-0.0484	-0.0881	-0.0234	-0.0553
	(0.1371)	(0.0622)	(0.0430)	(0.0541)	(0.0845)	(0.0571)
Dummy for Large School (TSR3)	0.1360	**0.2970**	**0.1625**	0.1102	0.1161	**0.2163**
	(0.1986)	(0.0893)	(0.0603)	(0.0754)	(0.1187)	(0.0802)
TSR3*ED	-0.0136	**-0.0273**	**-0.0140**	-0.0099	-0.0107	**-0.0197**
	(0.0169)	(0.0076)	(0.0051)	(0.0064)	(0.0101)	(0.0068)
TSR3*G4	-0.1435	**-0.4125**	-0.1154	**-0.3218**	-0.2359	**-0.2754**
	(0.3528)	(0.1521)	(0.1023)	(0.1276)	(0.2064)	(0.1370)
TSR3*G58	-0.3591	**-0.4214**	**-0.2045**	-0.1528	-0.1538	**-0.2918**
	(0.2102)	(0.0944)	(0.0638)	(0.0796)	(0.1250)	(0.0848)
Relative Teacher Wage (RTW)	**-1.4479**	**-0.7990**	0.1334	**0.6984**	**1.3959**	-0.3871
	(0.7164)	(0.3232)	(0.2181)	(0.2719)	(0.4220)	(0.2897)
RTW*ED	**0.1390**	**0.0581**	-0.0182	**-0.0612**	**-0.1398**	0.0227
	(0.0533)	(0.0240)	(0.0161)	(0.0201)	(0.0313)	(0.0214)
RTW*G4	0.2004	0.3432	**-0.5755**	-0.3070	**-1.2043**	-0.0714
	(0.8931)	(0.3867)	(0.2557)	(0.3224)	(0.5214)	(0.3403)
RTW*G58	1.0563	**0.5511**	-0.1626	-0.3997	**-1.1985**	0.1978
	(0.6304)	(0.2827)	(0.1904)	(0.2369)	(0.3689)	(0.2530)
Psuedo R-Squared/R-Squared	0.0423	0.0765	0.1014	0.1042	0.0984	0.1251

All regressions include a quadratic function of experience, dummies for census year, nine year birth cohorts, and province of birth, and a constant. Standard errors are in parentheses and coefficients that are individually statistically significant at the 5% level are bold. Schools with teacher-school ratios of 4-8 are designated medium and large schools have teacher-school ratios of 8 or more. The sample size for all regressions is 73,337.

Table 3. Quantile and OLS Results Including Urban/Rural, Marital Status, and Occupation Variables

	10th Quantile	25th Quantile	Median	75th Quantile	90th Quantile	OLS
Years of Public School (ED)	**0.1399**	0.0294	-0.0114	**-0.0460**	**-0.0865**	0.0068
	(0.0411)	(0.0228)	(0.0161)	(0.0176)	(0.0300)	(0.0202)
Dummy for <5 Years of Public School (G4)	0.2768	-0.2294	**-0.6450**	**-0.6648**	-0.6095	-0.4824
	(0.6608)	(0.3641)	(0.2636)	(0.2894)	(0.4911)	(0.3314)
Dummy for 5-8 Years of Public School (G58)	**1.0495**	-0.0265	-0.3402	**-0.4280**	**-0.7357**	-0.1049
	(0.4885)	(0.2704)	(0.1915)	(0.2084)	(0.3561)	(0.2398)
Years of University	**0.0431**	**0.0530**	**0.0537**	**0.0530**	**0.0604**	**0.0506**
	(0.0028)	(0.0015)	(0.0010)	(0.0011)	(0.0019)	(0.0013)
Years of Technical Training	**0.0090**	**0.0155**	**0.0164**	**0.0154**	**0.0145**	**0.0149**
	(0.0033)	(0.0018)	(0.0013)	(0.0014)	(0.0024)	(0.0016)
Pupil-Teacher Ratio (PTR)	**0.0863**	0.0058	**-0.0246**	**-0.0487**	**-0.0806**	-0.0119
	(0.0258)	(0.0141)	(0.0099)	(0.0108)	(0.0185)	(0.0124)
PTR*ED	**-0.0070**	0.0001	**0.0025**	**0.0047**	**0.0074**	0.0012
	(0.0021)	(0.0011)	(0.0008)	(0.0009)	(0.0015)	(0.0010)
PTR*G4	-0.0139	0.0180	**0.0447**	**0.0500**	**0.0547**	**0.0334**
	(0.0342)	(0.0184)	(0.0132)	(0.0145)	(0.0251)	(0.0166)
PTR*G58	**-0.0578**	0.0079	**0.0287**	**0.0376**	**0.0613**	0.0139
	(0.0247)	(0.0135)	(0.0095)	(0.0104)	(0.0178)	(0.0119)
Dummy for Medium School (TSR2)	-0.0229	0.0382	0.0023	0.0152	0.0251	0.0174
	(0.1078)	(0.0594)	(0.0426)	(0.0470)	(0.0805)	(0.0533)
TSR2*ED	0.0026	-0.0029	-0.0008	-0.0018	-0.0018	-0.0013
	(0.0092)	(0.0051)	(0.0037)	(0.0040)	(0.0069)	(0.0046)
TSR2*G4	-0.2146	-0.0635	0.0377	-0.0186	-0.1345	-0.0821
	(0.1836)	(0.1004)	(0.0714)	(0.0780)	(0.1323)	(0.0896)
TSR2*G58	0.0020	-0.0676	-0.0143	-0.0241	-0.0269	-0.0276
	(0.1118)	(0.0616)	(0.0441)	(0.0486)	(0.0832)	(0.0553)
Dummy for Large School (TSR3)	**0.3512**	**0.1868**	**0.1438**	0.0293	0.1379	**0.1756**
	(0.1635)	(0.0880)	(0.0619)	(0.0677)	(0.1163)	(0.0775)
TSR3*ED	**-0.0312**	**-0.0156**	**-0.0136**	-0.0034	-0.0112	**-0.0157**
	(0.0139)	(0.0075)	(0.0053)	(0.0058)	(0.0099)	(0.0066)
TSR3*G4	-0.2644	-0.2383	-0.1859	-0.0968	-0.3790	-0.2472
	(0.2844)	(0.1490)	(0.1050)	(0.1146)	(0.2057)	(0.1324)
TSR3*G58	**-0.4807**	**-0.2541**	**-0.1633**	-0.0728	-0.1720	**-0.2252**
	(0.1725)	(0.0931)	(0.0655)	(0.0715)	(0.1226)	(0.0820)
Relative Teacher Wage (RTW)	**-2.1181**	-0.5794	0.1113	**0.6595**	**1.1353**	-0.3041
	(0.5861)	(0.3183)	(0.2240)	(0.2446)	(0.4175)	(0.2803)
RTW*ED	**0.1613**	0.0295	-0.0127	**-0.0618**	**-0.1163**	0.0147
	(0.0436)	(0.0236)	(0.0166)	(0.0181)	(0.0310)	(0.0207)
RTW*G4	0.5604	0.0844	-0.4172	**-0.6139**	-0.7444	-0.1519
	(0.7167)	(0.3740)	(0.2621)	(0.2872)	(0.5110)	(0.3292)
RTW*G58	**1.4505**	0.3228	-0.0698	-0.3725	**-0.9082**	0.1780
	(0.5170)	(0.2786)	(0.1955)	(0.2130)	(0.3656)	(0.2448)
Psuedo R-Squared/R-Squared	0.0986	0.1173	0.1366	0.1412	0.1394	0.1826

All regressions include a quadratic function of experience, dummies for census year, nine year birth cohorts, province of birth, occupation, residence in a city, married, and a constant. Standard errors are in parentheses and coefficients that are individually statistically significant at the 5% level are bold. Schools with teacher-school ratios of 4-8 are designated medium and large schools have teacher-school ratios of 8 or more. The sample size for all regressions is 73,337.

Table 4. Quantile and OLS Results Including Urban/Rural, Marital Status, Occupation, and Field of Study Variables

	10th Quantile	25th Quantile	Median	75th Quantile	90th Quantile	OLS
Years of Public School (ED)	**0.1469**	0.0177	-0.0342	-0.0391	-0.0618	0.0065
	(0.0570)	(0.0293)	(0.0216)	(0.0238)	(0.0358)	(0.0275)
Dummy for <5 Years of Public School (G4)	1.2016	-0.3126	**-0.9324**	-0.8094	-0.7020	-0.8220
	(1.0379)	(0.5726)	(0.4268)	(0.4668)	(0.6750)	(0.5498)
Dummy for 5-8 Years of Public School (G58)	0.8580	-0.2936	**-0.6728**	-0.5174	-0.5575	-0.2129
	(0.6881)	(0.3548)	(0.2619)	(0.2875)	(0.4312)	(0.3324)
Years of University	**0.0453**	**0.0515**	**0.0500**	**0.0497**	**0.0596**	**0.0495**
	(0.0037)	(0.0018)	(0.0013)	(0.0014)	(0.0021)	(0.0016)
Years of Technical Training	**-0.0091**	-0.0003	0.0023	0.0000	0.0003	-0.0010
	(0.0047)	(0.0024)	(0.0018)	(0.0020)	(0.0030)	(0.0023)
Pupil-Teacher Ratio (PTR)	**0.1218**	0.0076	**-0.0315**	**-0.0419**	**-0.0697**	-0.0057
	(0.0383)	(0.0195)	(0.0143)	(0.0157)	(0.0236)	(0.0181)
PTR*ED	**-0.0089**	-0.0002	**0.0029**	**0.0036**	**0.0061**	0.0005
	(0.0029)	(0.0015)	(0.0011)	(0.0012)	(0.0018)	(0.0014)
PTR*G4	-0.0724	0.0271	**0.0578**	**0.0588**	0.0550	0.0533
	(0.0556)	(0.0311)	(0.0230)	(0.0244)	(0.0349)	(0.0297)
PTR*G58	-0.0630	0.0160	**0.0391**	**0.0359**	**0.0544**	0.0134
	(0.0357)	(0.0183)	(0.0135)	(0.0148)	(0.0222)	(0.0171)
Dummy for Medium School (TSR2)	-0.0732	0.0556	0.0785	0.0553	-0.0176	0.0559
	(0.1451)	(0.0750)	(0.0559)	(0.0615)	(0.0933)	(0.0709)
TSR2*ED	0.0074	-0.0039	-0.0064	-0.0050	0.0002	-0.0040
	(0.0124)	(0.0064)	(0.0048)	(0.0053)	(0.0080)	(0.0061)
TSR2*G4	**-0.5978**	-0.1752	-0.0132	0.0816	-0.0759	-0.0882
	(0.2538)	(0.1328)	(0.0996)	(0.1047)	(0.1552)	(0.1275)
TSR2*G58	0.0947	-0.0293	-0.0511	-0.0209	0.0411	-0.0332
	(0.1507)	(0.0779)	(0.0580)	(0.0637)	(0.0962)	(0.0735)
Dummy for Large School (TSR3)	**0.4693**	**0.2713**	**0.1671**	0.0280	0.1059	0.1971
	(0.2206)	(0.1100)	(0.0811)	(0.0891)	(0.1361)	(0.1029)
TSR3*ED	**-0.0384**	**-0.0210**	**-0.0140**	-0.0035	-0.0113	-0.0165
	(0.0187)	(0.0093)	(0.0069)	(0.0075)	(0.0115)	(0.0087)
TSR3*G4	**-0.9320**	-0.1929	-0.0746	0.0211	-0.3394	-0.1078
	(0.3759)	(0.2215)	(0.1573)	(0.1587)	(0.2337)	(0.2006)
TSR3*G58	-0.4440	**-0.2390**	-0.1609	-0.0300	-0.1126	-0.1806
	(0.2312)	(0.1162)	(0.0856)	(0.0937)	(0.1420)	(0.1086)
Relative Teacher Wage (RTW)	**-2.2972**	**-0.9095**	-0.2704	0.1425	**1.2259**	-0.6052
	(0.8252)	(0.4204)	(0.3105)	(0.3419)	(0.5164)	(0.3940)
RTW*ED	**0.2321**	**0.0696**	0.0153	-0.0216	**-0.0987**	0.0499
	(0.0613)	(0.0311)	(0.0228)	(0.0252)	(0.0381)	(0.0290)
RTW*G4	1.5874	-0.3336	-0.5778	-0.8289	-0.5478	-0.5394
	(1.1347)	(0.6314)	(0.4583)	(0.4577)	(0.6624)	(0.5896)
RTW*G58	**1.9419**	0.4473	0.0781	-0.1580	**-0.9146**	0.4075
	(0.7379)	(0.3752)	(0.2754)	(0.3019)	(0.4542)	(0.3494)
Psuedo R-Squared/R-Squared	0.1015	0.1174	0.1330	0.1316	0.1307	0.1774

All regressions include a quadratic function of experience, dummies for census year, nine year birth cohorts, province of birth, occupation, residence in a city, married, university field of study, and a constant. Standard errors are in parentheses and coefficients that are individually statistically significant at the 5% level are bold. Schools with teacher-school ratios of 4-8 are designated medium and large schools have teacher-school ratios of 8 or more. The sample size for all regressions is 45,505.

Table 5. Reduced Form Results

	10th Quantile	25th Quantile	Median	75th Quantile	90th Quantile	OLS
Pupil-Teacher Ratio (PTR)	0.0159	0.0110	**0.0208**	**0.0150**	0.0109	**0.0127**
	(0.0122)	(0.0061)	(0.0050)	(0.0054)	(0.0077)	(0.0052)
Dummy for Medium School (TSR2)	0.0083	-0.0078	-0.0138	**-0.0194**	-0.0188	-0.0089
	(0.0214)	(0.0108)	(0.0089)	(0.0096)	(0.0136)	(0.0092)
Dummy for Large School (TSR3)	-0.0071	-0.0201	-0.0190	**-0.0379**	**-0.0375**	**-0.0246**
	(0.0298)	(0.0149)	(0.0124)	(0.0133)	(0.0190)	(0.0128)
Relative Teacher Wage (RTW)	0.4615	0.2317	**0.3998**	0.1718	-0.1105	0.1876
	(0.3434)	(0.1713)	(0.1415)	(0.1519)	(0.2175)	(0.1460)
Psuedo R-Squared/R-Squared	0.0068	0.0113	0.0165	0.0188	0.0104	0.0189

All regressions include a quadratic function of age, dummies for census year, nine year birth cohorts, and province of birth, and a constant. Standard errors are in parentheses and coefficients that are individually statistically significant at the 5% level are bold. Schools with teacher-school ratios of 4-8 are designated medium and large schools have teacher-school ratios of 8 or more. The sample size for all regressions is 73,337.