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The Influence of Teachers' Wages on Student Performance in Mathematics and Reading at Urban and Rural Primary Schools in Burkina Faso

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Abstract
This paper aims to analyze the influence of public teachers' wages on student test scores in mathematics and reading. A linear model was estimated using endogenous variables on data from the 2014 Programme for the Analysis of Educational Systems survey in Burkina Faso. Teachers' wages have differentiated, mixed, and heterogeneous influences on student performance in urban areas and negative influences in rural. Good academic performance requires accounting for geographical aspects when setting teachers' wages. This study will determine the effects of teachers' non-wages earning activities combined with other factors on academic performance.

Keywords: Achievement, Inequalities, Rural, Scores, Urban, Wages

1. Introduction

The balance between teachers' wages and student academic performance is a concern for education systems (Britton & Propper, 2016; Hanushek, 2002). Wages comprise a significant portion of school resources (Hanushek & Ettema, 2017). Teachers' wage aims at the quality of education of better student performance with less heterogeneity.

The influence of different factors on educational outcomes is determined by establishing the link between the resource inputs[1] with educational outcomes.[2] Smaller class sizes and a teacher's educational background, rather than boosting student performance, often have negative effects. Shrinking class size increases the demand for teachers, while credentialing requirements, which do not ensure quality, limit the supply of candidates. The combined effect is that the teachers of school districts who end up hiring are often low-performing (Cabrera & Webbink, 2018).

[1] Examples include pupil-to-teacher ratios, technology, amount of homework, teacher experience, teacher education, teacher salary, school expenditure, teacher/pupil ratio, and class size.
[2] Such as reading and math test scores, CGPA, and the Scholastic Assessment Test (SAT).

Teachers' credentials, responsibilities, experience and qualifications differentiate wages; however, these factors are weak predictors of student learning outcomes (Neal, 2011; Aaronson, Barrow, & Sander 2007). Thus, pay-for-performance is an often-suggested solution (Bond & Mumford, 2018). However, this leads to heterogeneities in student performance and exacerbates inequalities (Filmer, Habyarimana, & Sabarwal, 2020). Likewise, teachers' certifications show little evidence for suggesting a strong relationship between teacher quality and student achievement.

The differences in the academic performance of students linked to a school are limited to the extent of the size of the class, heterogeneity of the pupils, and initial pedagogical training of the teacher. However, differences in factors that influence the teacher effect have a far greater influence on student performance (Mingat, 1991). However, teachers who elicit academic gains from their students are not rewarded for their achievements. Borgen, Kirkeboen, Kotsadam, and Raaum (2021) found their effects on the student's perspective; however, they were not substantial enough to induce any meaningful effects on academic outcomes. Coleman et al. (1966) found that school differences did not explain differences in achievement once the family background was controlled for. Nevertheless, urban and rural educational inequalities are pervasive. This begs the question, do public teachers' wages influence student performance at the same level in school urban and rural areas?

Teachers' wages have positive effects on student achievement in English-speaking countries in Africa (Wachira, 2018). Francophone teachers' pay is considered low (Farges, Guidi, & Métais, 2018). The variability in students' primary school performance indicates a 'teacher effect' (Mingat, 1991). Over 4% of GDP in Francophone African countries is attributed to the education sector. Also, wage expenditures account for up to 60% of the budgets of educational ministries in these countries.

In Burkina Faso, 73.7% of the population lives in rural areas (INSD, 2020). Rural students represent 71.9%[3] of the primary school students and teachers in rural areas comprise 77.09% of public employees (MENAPLN/DGESS, 2021). The wage bill for education staff is 41% of the national budget and salaries reach nearly 65% of the budget of the ministry in charge of national education (IMF, 2018). Public school teachers' wages are a constant controversy in Burkina Faso because protests and strikes suggest that pay is low, while comparisons to the average national income per capita suggest that it is high (Evan, Yuan, & Filmer, 2022). In 1996, the minimum level of proficiency for primary students was 44% for reading and 46% for mathematics. These levels are 37.4% and 36.8% in mathematics from 2008 to 2018, and in reading 58.8% and 56.9% in the same period (PASEC, 1996; Global Partnership for Education, 2019).

Understanding the influence of public-school teachers' wages on student academic performance according to area is crucial, as it contributes to education quality improvement and wage reform. However, there has been no research on the relationship between primary school teachers' wages and student achievement in Burkina Faso. Educational policy officials must make relevant wage decisions in primary schools under the threat of teachers' strikes, with wage increases often at the centre of demands in the context of financial and fiscal constraints. Research in other countries has found that wages can have a positive or negative influence on student academic performance (Britton & Propper, 2016; Hendricks, 2014). However, the estimated models in these studies suffer from data limitations and omitted endogeneity variables. Furthermore, the studies did not consider the locations of the schools (i.e., urban or rural areas).

This paper analyses the influence of public school teachers' wages on student performance in mathematics and reading at urban and rural primary schools in Burkina Faso to account for omitted variables and endogeneity. The assumption is that teacher wages positively influence student performance in rural settings and negatively in urban ones. Using data from the 2014 Programme for the Analysis of Educational Systems (PASEC) survey, a general linear model with endogenous variables is created. The results show that teachers' wages have differentiated, mixed, and heterogeneous influences both within and between areas according to levels of pay. In addition, academic performance is influenced by variables linked to the family, classroom, student and teacher gender, etc.

[3] There were 3,289,736 primary students in 2021.

This performance is the result of the interaction between students, teacher wages, family, school, and educational policies from theoretical and methodological perspectives.

The remainder of this paper is organized as follows. Section 2 is a literature review that focuses on the effect of teachers' wages on educational outcomes. Section 3 reports on the wages of public school teachers in Burkina Faso. Section 4 explains the estimation strategy. Section 5 presents the results and discusses them. Last, Section 6 provides concluding remarks.

2. Literature review

Providing better educational outcomes is the duty and responsibility of educators; wages factor greatly into this. Several meta-analyses indicate that only 20% of studies establish a statistically significant positive relationship between teachers' pay and students' performance, while 7% are negative, and 73% are non-significant (Hanushek, 2006, 2003, 1997).

2.1. Teachers' wages positively influence student performance

Several experimental or quasi-experimental studies have found a positive effect of teachers' wages on student performance. For example, Hendricks (2014), Dolton, Marcenaro-Gutierrez, Pistaferi, and Algan (2011), and Woessmann (2011) found a positive influence of teacher compensation on student achievement. This indicates that increasing teachers' pay improves students' performance through incentive effects. High pay helps retain effective teachers, increases their average experience, and attracts more talented teachers to public schools, thereby encouraging greater effort at work.

Individual wage 'redistributions, while being a source of motivation, recognition, and sustenance are a tangible reward for services performed' (Villanueva, and Gonzalez, 2005). Educational production functions estimated at both the individual student and country levels confirm this (Dolton et al., 2011; Menezes-Filho & Pazello, 2007). The magnitude of this positive effect varies between 0.6% and 25%. The range of results indicates differentiated influences by other factors according to country, student level, study period, salary adjustment, and years of experience of the teacher (Lafortune, Rothstein, & Whitmore, 2018; Glewwe, Ilias, & Kremer, 2010). However, the individualized and differentiated wage is less about the quality of education as measured by academic test achievement. The relative wage of teachers is a very good proxy for their average quality. In addition, the studies did not compare the performance of students in rural to those in urban areas and did not consider school materials, health, or the socioeconomic status of students' families.

2.2. Teachers' wages negatively influence student performance

Bond and Munford (2018) and Britton and Propper (2016) found negative effects of teachers' pay on educational outcomes. Large and unconditional wage increases do not lead to improved student performance in public schools with 'permanent' civil service employment contracts, under which teachers have a low probability of being fired for non-performance (De Ree, Muralidharan, Pradhan, & Rogers, 2018). in fact, wage dispersion increased in the non-teaching sector decreases teachers' abilities and failure to account for non-pecuniary job attributes and alternative wage opportunities that affect the cost of choosing to teach (Britton, & Propper, 2016; Loeb & Page, 2000). In addition, relative wage comparisons decrease teacher productivity and result in mixed student results. Therefore, performance pay is advocated.

2.3. Partial and inappropriate alternatives: pay-for-performance and financial transfer.

Pay-for-performance programs have yielded positive results in student performance for low-income and low-performing schools (Bond & Munford, 2018). However, students with very high socioeconomic status and those in already high-performing schools show no effect of these programmes. Thus, pay-for-performance programmes do not affect academic performance or have a little short-term effect on teacher productivity, as measured by

student performance on standardised tests (Glazerman & Seifullah, 2012; Matthew et al., 2010). The same is true of teachers' self-reported practices (Yuan, Williams, Fang, & Ye, 2012).

The inconsistent effects of these pay-for-performance programs show that teacher incentives create a culture of prioritizing 'teaching to the test' (Glewwe, Hanushek, Humpage, & Ravina, 2010). Unwanted externalities in India are the extension of positive impacts of incentives to non-incentivized subjects (Muralidharan & Sundararaman, 2009). Moreover, in middle- and high-income settings, pay-for-performance incentives induce cheating (Behrman & Vélez-Grajales 2015; Jacob & Levitt 2003). Systems that link teacher incentives to student outcomes could be corrupted in various ways (Jennings & Beveridge 2009; Jacob & Lefgren, 2007).[4]

Ultimately, the use of incentive pay systems as a means to improve school performance faces the challenge of identifying the causal effect. Moreover, the pay increase is a financial transfer to teachers without a discernible impact on student outcomes (De Ree, Muralidharan, Pradhan, & Rogers, 2018). Doubling teacher pay in Indonesian schools significantly improved teachers' income satisfaction and reduced their moonlighting and their self-reported financial stress. However, after two to three years, the pay increase did not lead to any improvement in teachers' subject knowledge test scores, nor did it increase their attendance or number of teaching hours. Student learning outcomes in language, math, and science in primary and secondary schools in the treatment group did not differ from those in the control group. In Gambia, providing a 30%–40% salary bonus to primary school teachers due to the difficulty or drudgery of the job in areas far from the capital did not affect average student achievement or student performance (Pugatch & Schroeder, 2014).

Therefore, increases in salary allowances increase the number of teachers but do not affect teacher characteristics or student test scores (Grieve, Pelletier, & Masshekwa, 2019). Hanushek (2003) reaffirmed the limited empirical support for the teacher pay system in influencing educational outcomes. Nonetheless, few studies have examined the influence of teachers' wages on student achievement test scores (math, language, and science) in developing francophone African countries, where most students live in rural areas, do not use their mother tongue to study, have low student competency assessment results and teachers demand higher wages.

2.4. Endogeneity and omitted variables are not often considered in the estimates

Most specifications do not consider possible endogenous variables (Menezes-Filho & Pazello, 2007). Given that education is cumulative and final exam scores depend on the education a student has received over all the years he or she has been in school, the long-run effect of payoffs likely has an omitted variable bias because education pursues cognitive, physical, moral, civic, social and cooperative goals (Imberman, 2015). Furthermore, most of the extant studies use the production function to understand the combination of school inputs that influence education outcomes (Espinosa, 2017). With few exceptions, schools are not considered profit-maximising firms, especially public or private non-profit ones. To analyse the effects of school input on outcomes in education, the regression used in this research includes parametric,[5] non-parametric,[6] and semi-parametric models.

Estimates of the effects used in cross-sectional data are usually plagued by problems of endogeneity and omitted variables. However, the socioeconomic level of a student's household is a factor that affects learning, which in turn affects test scores. These endogeneities are likely to bias the estimated wages upwards. Non-pecuniary characteristics of the job, such as the security of the school, working conditions, and the level of parental involvement also vary from school to school and account for the variation in the opportunity cost of teaching in a particular school. In addition, differences in school infrastructure, such as the existence of a school canteen,

[4] This is because of the difficulties of assessing school outcomes, the difficulties of identifying who within schools is responsible for the variation in outcomes, and the high stakes involved in the process of assessing outcomes that create undesirable reallocations of resources between different types of learning activities within schools.

[5] Linear ordinary least squares (OLS) regression model, Tobit, Heckman, and Double hurdle regression models, univariate probit and logit regression models, ordered and multinomial regression models, multivariate binary models, fixed effect regression, mixed model, random effects regression, generalized method of moments regression, regression model with count dependent data, multilevel regression model, structural equation model, latent class analysis, machine learning regressions, etc.

[6] Kernel smoothing regression, locally weighted scatterplot smoothing (LOWESS), local regression (LESS), and robust weighted local regression relaxed the stringent assumptions of the parametric models.

lighting, or drinking water, all influence student learning. Teachers sometimes have other streams of income from one or more secondary activities that could lead to an underestimation of the effects of wages on test scores. Thus, the geographic variation in teacher wage levels that is typically used to identify the effects of teacher wages may not accurately reflect the geographic variation in the opportunity cost of choosing to teach.

If school differences in non-pecuniary characteristics produce offsetting differentials, then estimates of the effects of teacher wages that do not control for these characteristics will suffer from negative bias due to omitted variables (Kenny & Denslow, 1980).

Table A1 Appendix A summarises some of the research on the effects of teachers' salaries on student achievement, including authors, countries where the research was conducted, empirical methodologies used, and results obtained.

3. Teachers' wages in Burkina Faso

This study focuses on the wages of public primary school teachers and student test scores in mathematics and reading in Burkina Faso. In Burkina Faso, civil servant jobs are classified and divided according to their recruitment level into six categories[7] designated in descending hierarchical order by the letters P, A, B, C, D, and E corresponding to diplomas, titles, or their equivalents (Appendix B). The categories A, B, C, D, and E are further divided into three scales designated in descending hierarchical order by the numbers 1, 2, and 3. Each post has a first, second, and third grade (Appendix C). For the same level of recruitment, the number of steps is the same for all categories.

This categorization of civil servants corresponds not only to the distribution of tasks but also to the remuneration awarded. Public school teachers are in categories B and C. The decision to regulate wages is most often made unilaterally by the government without consultation or participation of teachers' representatives or unions. Collective bargaining is used for wage adjustments. The government establishes and regulates the structure of teachers' pay grades and steps in relation to other public sector employees (directly or indirectly) to ensure equity. Primary school teachers' wages include basic salary, family allowances, residence allowance, housing allowance, technical allowance, duty allowance, responsibility allowance, civil pension, and one-off salary tax. For each teacher, this one is a predetermined succession of wage levels corresponding to different categories of the teaching profession, each subdivided into steps. Wages depend on the characteristics of the teacher according to predefined criteria such as diploma, level of qualification, certification, degree of responsibility associated with his or her position, number of years of experience, number of children (limited to 6), and living space (urban or rural).

Wages do not account for the size or level of the class taught or the academic results or efforts made. Only allowances awarded depend on the area (urban, semi-urban, and rural) and the category of the teacher while the more substantial basic salary is standardized according to category (Appendix D). Every two years, public teachers receive an indexed wage corresponding to their category, plus a promotion or seniority bonus based on a professional assessment by their line manager. Teachers also receive benefits in kind and one-off items such as a retirement allowance, incentive bonuses, and decorations. They are entitled to social security protection in the form of a pension and to social protection for occupational hazards, old age insurance, and health care. Female teachers are entitled to maternity leave for a total of 14 weeks, starting no earlier than eight weeks and no later than four weeks before the expected date of delivery.

4. Estimation strategy

This study uses a linear model to determine the influence of teachers' wages (quantitative independent variable) on student performance (quantitative dependent variable). It also examines how factors specific to the class and the school in the locality, and individual student characteristics (qualitative independent variable) affect this performance.

[7] Burkina Faso/CNT, 2015

4.1. Econometric modeling

The relationship between student performance and teachers' wages is as follows:

$$Y = f\left(W, Z, G\right) + \mu \qquad (1)$$

where $Y =$ student academic achievement; $W =$ teachers' wages, $Z =$ student class-specific factors, $G =$ individual student characteristics and $\mu =$ the random variable.

The linear function is as follows:

$$Y_{ijk} = \alpha + \beta W_{ijk} + \rho Z_{ijk} + \gamma G_{ijk} + \mu_i \qquad (2)$$

where Y_{ijk} is the simple arithmetic mean of the reading and math test scores of the student i in class j in locality k; W_{ijk} is the pay of teacher i in class j in locality k; Z_{jlk} represents the class-specific factors j of school l in locality k; G_{ijk} represents the individual characteristics of student i in class j in locality k; and μ_i is the error term.

4.2. Variables

The dependent variable Y_{ijk} is the simple arithmetic mean of students' reading and math test scores. The independent variables are as follows:

- W_{ijk} : Average annual net wage received by the teacher in the class. The wage of teachers is a very good indicator of their average quality in relation to student performance on international assessments in OECD countries (Dolton et al., 2011);
- Z_{jik} : Factors specific to the class and the school in the locality:
  - Z_1 : Classroom learning resource index;
  - Z_2 : School location;
  - Z_4 : School's pedagogical resources index;
  - Z_5 : School's infrastructure index;
  - Z_{10} : Teacher's gender;
  - Z_{11}: Management of classes;
  - Z_{14}: Index of the master's perception of social benefits;
  - Z_{15} : Seating for students;
  - Z_{17} : Classroom functionality;
  - Z_{18} : Latrines and toilets.
- G_{ijk} : Individual student characteristics:
  - Z_6 : Student's gender;
  - Z_7 : Reading textbook;
  - Z_8 : Mathematics textbook;
  - Z_9 : Student's family socioeconomic index;

- Z_{19} : Class repetition;
- Z_{20} : Medical visit: visual or auditory or visual and auditory;
- Z_{21} : Disability;
- $Z_{.221}$: Feel hungry in class;
- μ_i : Random term.

Variable names, meanings and their expected effects are in Appendix E.

4.3. Data source

Data are from the 2014 of Programme for the Analysis of Educational Systems survey (PASEC) for public, private and confessionary schools in Burkina Faso, in which sixth-grade students from 182 schools were questioned. The sample is representative of the school population of the surveyed grades (PASEC, 1994). First, for sampling, schools are selected according to a systematic procedure where the probability of selection is proportional to the number of students enrolled in Grade 6. Second, for each selected school, a class of 6th graders was selected using a simple random procedure. Third, a sample of 20 students was randomly drawn from each selected class.

This study focuses on public schools because teachers' wages are formal, harmonised, and the legal framework is the same as other government public civil employees. Private and confessionary school teachers' wages do not have these characteristics. Public schools in urban and rural areas are the responsibility of the government and 80% are surveyed. The sample size of public-school students surveyed is 1353, of which 809 were from rural areas and 554 were from urban areas. The descriptive statistic of the variable is in Appendix F.

Indices were constructed based on several questions administered to students, teachers, and headmasters. The results of the indices are reported on an international scale with a mean of 50 and a standard deviation of 10 (PASEC, 1994).

5. Results and discussion

This section presents the results of the diagnostic tests and estimations before discussion.

5.1. Diagnostics tests

5.1.1. Correlation and covariance test

Correlation and covariance test results show positive or negative correlated variables and all variables have correlations of less than 60%. Some of them are significant at 5%. (Appendix G).

5.1.2. Heteroskedastic test

Table 1 reports the results of the Heteroskedastic robustness test and shows that the variance of the model residuals is constant in urban and rural areas.

Table 1: Heteroskedastic robustness test

Urban area	
Heteroskedastic linear regression	Number of obs = 544
ML estimation	
Wald chi2(19) = 167.94	
Log pseudolikelihood = -3051.826	Prob > chi2 = 0.0000
Wald test of lnsigma2 = 0 : chi2(17) = 50.11	Prob > chi2 = 0.0000

Rural area	
Heteroskedastic linear regression	Number of obs = 809
ML estimation	
Wald chi2(19) = 207.05	
Log pseudolikelihood = -4549.093	Prob > chi2 = 0.0000
Wald test of lnsigma2=0 : chi2(17) = 61.73	Prob > chi2 = 0.0000

Source: Author, 2023

5.1.3. Specification test

Table 2 reports the results of the specification test and shows that Hatsq is not significant. Thus, there is no specification error

Table 2: Linkage test of variable specification

Source	SS		Df		MS	
	Urban	Rural	Urban	Rural	Urban	Rural
Model	656377.38	566704.42	2	2	328188.69	283352.21
Residual	3362679.29	5460772.26	687	1,043	4894.73	5235.64
Total	4019056.67	6027476.68	689	1,045	5833.17	5767.92

	Urban	Rural
Number of obs	690	1,046
F(2, 1043)		54.12
F(2, 687)	67.05	
Prob > F	0.0000	0.0000
R-squared	0.16	0.09
Adj R-squared	0.16	0.09
Root MSE	69.96	72.36

Y	Coef.		Std. Err.		T		P>|t|		[95% Conf. Interval]			
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban		Rural	
_hat	2.82	3.17	2.09	2.19	1.35	1.45	0.17	0.15	-1.28	6.91	-1.12	7.46
_hatsq	-0.002	-0.00	0.002	0.00	-0.87	-0.99	0.38	0.32	-0.005	0.002	-0.006	0.002
_cons	−552.38	-625.89	635.36	632.10	-0.87	-0.99	0.38	0.32	-1799.86	695.10	-1865.64	613.86

Source: Author, 2023

5.1.4. Omitted variables test

Table 3 reports the results of the omitted variables test and shows that the model omits relevant variables.

Table 3: Ramsey RESERT test of the powers of the fitted values of Y

	Urban	Rural
F(3, 671)	3.16	
F(3,1027)		1.43
Prob > F	0.02	0.23

Source: Author, 2023

The correction of these omitted variables used the minimum values of the Akaiké Information Criterion (AIC) and Bayesian Information Criterion (BIC) of several models to obtain the lowest values of the information criteria. Thus, the model is as follows:

$$Y_i = \alpha + \beta_1 W_{ijk} + \beta_2 Z_1 + \beta_3 Z_4 + \beta_4 Z_5 + \beta_5 Z_6 + \beta_6 Z_7 + \beta_7 Z_8 + \beta_8 Z_9 + \beta_9 Z_{10} + \beta_{10} Z_{11} + \beta_{11} Z_{13} + \beta_{112} Z_{14} + \beta_{13} Z_{15} + \beta_{14} Z_{18} + \beta_{15} Z_{19} + \beta_{16} Z_{21} + \beta_{17} Z_{30} + \beta_{18} Z_{31} + \beta_{19} Z_{221} + \mu_i \quad (3)$$

5.1.5. Endogeneity test

The probability associated with the test Prob > chi2 = 0.0000 is less than 10% (Table 5). Thus, in urban areas, the independent variables Z_1 (Classroom learning resource index), Z_7 (Reading textbook), and Z_8 (Mathematics textbook) have respectively as instrumental variables Z_{13} (Index of perception by the teacher of working conditions), Z_{17} (Classroom functionality), and Z_{221}(Feel hungry in class) as instruments. About, rural areas, the instrument variables are Z_{13} (Index of perception by the teacher of working conditions), Z_{15} (Seating), Z_{17} (Classroom functionality), and Z_{18} (Latrines and toilets) respectively for the rural the independent variables Z_1 (Classroom Learning Resource Index), Z_4 (School's pedagogical resources index), Z_5 (School's infrastructure index), and Z_8 (Mathematics textbook).

Indeed, Teachers' perceptions of working conditions influence teaching resources used in the classroom. Thus, Z_{13} (Index of perception by the teacher of working conditions) affects Z_1 (Classroom learning resources index). As for reading and mathematics textbooks, the quantitative distribution is linked to the number of students in each school. The readiness of students to learn the contents of these books is conditioned by the nutritional state of students in a class (presence or absence of feeling hunger). Learning requires concentration, especially in mathematics where activities are preceded by comprehensive reading; a hungry student lacks the physical and mental energy to concentrate. Thus, Z_{17} (Classroom functionality) and Z_{221} (Feeling hungry in class) affect Z_7 (Reading textbook). Learning requires equipment such as student benches (Z_{15} [Seating]) which affects Z_4 (School's pedagogical resources index). Furthermore, Z_5 (School's infrastructure index) is influenced by Z_{17} (Classroom functionality) which also affects Z_7 (Reading textbook) and, in turn, Z_8 (Mathematics textbook) as reading comprehension is a prerequisite for doing mathematics work. In addition, math class is held in the late morning. At this time, students like to satisfy their sanitary needs; therefore, Z18 (latrines and toilets) has an effect on Z8 (maths textbook).

The instruments used for robust estimation indicate that the model is globally significant and satisfactory. The distribution of the parameters estimated is very well approximated by its asymptotic distribution because correlations between the endogenous variables and the error term and between the endogenous variables and their instruments are reasonable. Thus, there is no problem with weak instruments.

Table 4: Instrumental variables (2SLS) regression

Instrumental variables (2SLS) regression	
Urban area	**Rural area**
Number of obs = 544	Number of obs = 809
Wald chi2(24) = 5659.73	Wald chi2(22) = 762.05
Prob > chi2 = 0.0000	Prob > chi2 = 0.0000
R-squared = 0.2131	R-squared[8] = .
Root MSE = 67.501	Root MSE = 167.77

5.2. Results

Table 5 reports the estimation results of the model.

[8] The calculated R2 is negative at times for large samples that Stata does not report.

Table 5: Estimation results

Variable		Robust	
		Coef.	
		Urban	Rural
Instrumental variables			
Classroom learning resource index (Z1)		4.25** (2.04)	12.61** (6.14)
School's pedagogical resources index (Z4)		-0.9716** (0.41)	-8.72* (5.17)
School's infrastructure index (Z5)		2.80* (1.57)	6.48* (3.93)
Reading textbook (Z7)		-36.90 (77.027)	-185.69 (181.56)
Mathematics textbook (Z8)		9.31 (53.79)	610.70 (546.67)
Common Variables			
Wages (W)			
	25 $ and 49 $	33.59 (66.81)	0 (empty)
	50 $ and 99 $	84.81*** (30.35)	-435.92*** (134.06)
	100 $ and 149 $	-18.23 (41.71)	-103.52** (52.06)
	150 $ and 199 $	-36.21** (18.08)	-35.42 (36.95)
	200 $ and 249 $	36.66** (16.80)	-49.63 (43.44)
	250 $ and 332 $	59.94*** (13.04)	-51.93 (41.17)
Student's family socioeconomic index (Z9)		1.40*** (0.46)	-2.08 (1.47)
Teacher's gender (Z10)	Man	5.93 (10.97)	57.53* (34.57)
Management of multigrade classes (Z11)	No	11.16 (11.55)	19.45 (32.65)
Index of perception by the teacher of social benefits (Z14)		-0.08 (.51)	-1.44 (0.98)
Student's gender (Z6)	Boys	28.07*** (6.82)	10.10 (12.15)
Seating (Z15)		0.39** (0.18)	
Latrines and toilets (Z18)	Yes	87.35*** (13.87)	
Class repetition (Z19)			
	Once	172.15*** (25.81)	-232.59 (244.96)
	Twice	204.64*** (21.82)	-129.87 (195.19)
	Three times	212.56 *** (21.81)	-134.19 (211.05)
Disability (Z21)	Yes	12.70 (15.44)	-33.7** (17.20)
Attended nursery school, kindergarten, or preschool (Z30)	No	18.59** (8.93)	37.82 (30.34)
Make homework (Z31)	No	-47.80** (22.03)	26.14 (60.74)

Variable		Robust	
		Coef.	
		Urban	Rural
Feeling hungry in class (Z221)	Yes		30.97* (18.83)
_cons		-93.11866 (135.30)	485.12** (187.17)

*Note: ***, ** and * indicate statistical significance at 1%, 5%, and 10%, respectively. The numbers in parentheses are standard errors.*
Source: Author, 2023

5.3. Discussion

The model is globally significant at 5% (Table 5). This study found mixed results regarding the influence of teachers' wages on educational outcomes. In rural areas, wages have a negative significant influence on the mean test scores at the 1% and 5% levels for wages between $50 to $99, and $100 to $149, respectively. The opportunity costs of identical experience and degree requirements in non-teaching professions (Southwick & Gill, 1997) or the presence of new teachers (Cabrera & Dinand, 2018) explain this negative influence. Rural school teachers are young with little teaching experience and lower wages, and most older teachers with little dynamism and higher wages. Indeed, Younger teachers need an adjustment period to become acclimated to the teaching profession and learn other aspects of the job (Hanushek, Kain, & Rivkin, 2004). After that, they are posted to the urban and news younger teachers for rural against. Meanwhile, older teachers are more concerned about preparing for their retirement and do not have adequate physical fitness. That is why wages have a negative influence on students' test scores.

In urban areas, wages between $50 to $99 and $250 to $332 have a positive significant influence at the 1% level. This result is in line with the Sousa (2022), and Gjefsen (2020) results. Urban areas require better performance because the high level of students' parents leads to competition between teachers. $150 to $199 wages have a negative and significant influence at the 5% level because teachers are mid-career and have other income-generating activities. The contradictory and heterogenous influences of wages are explained by inequalities of opportunities in the living environment, and professional seniority without the performance of wages categorization.

Students' family socioeconomic index has a positive significant influence on test scores in urban areas at the 1% level. It[9] facilitates and encourages children's consumption of school knowledge (Belley & Lochner, 2007). The most disadvantaged students have very low achievement levels that prevent them from continuing their education and getting good jobs (Haycock & Hanushek, 2010). These students need the highest quality teaching; however, they receive the lowest quality. The geographical distribution of the socioeconomic index reinforces the inequality of student performance to the detriment of rural areas.

The classroom learning resource index has a positive influence at the 5% level in rural and urban areas. Teaching resources are linked to their availability and teacher quality (Rivkin, Hanushek, & Kain, 2005). However, a school's pedagogical resources index has a negative influence on test scores at the 10% level. The small amount of resources leads to competition between classes to use school resources. Thus, improving student outcomes through collective school resource policies offers little hope.

A school's infrastructure index has a positive influence on test scores in urban areas and a negative influence in rural areas at the 10% level. Rural schools are sometimes constructed out of precarious materials while academic performance should be improved by convenable infrastructure building to teach. Learning or self-sacrifice and commitment to learning in order to achieve better results evolve in the same direction as the psychologically considered value of the quality of the school infrastructure.

[9]Knowledge acquisition is conditioned by the Payments of schooling costs (clothing, meals, support courses, supplies, payment of the tutor, etc.) and the standard of living of the families depending on the living environment.

The availability of seats has a positive influence on urban areas. Seating is a primary condition for enrolment in a school in urban areas. However, in rural areas, schooling demand is low. In addition, latrines and toilets, attendance at a kindergarten or preschool, and class repetition influence positively test scores. They provide privacy and influence children's health, improve pupils' hygiene knowledge and behaviour, reduce absences due to diarrhoea, and instil the value of hygiene in pupils.

Contrary to the findings of Tazouti et al. (2011), this study found that no attendance at a preschool or kindergarten has a positive and significant influence on the test scores of urban students. Students from wealthy families are much more likely to attend preschool or kindergarten than pupils from poor families because of the high costs of attendance. Preschools or kindergartens have a possible short-term influence (1–3 years). Furthermore, they are almost non-existence in rural areas.

Regarding student gender, being male has a positive and significant influence on student performance at the 1% level in urban areas and a non-significant influence in rural areas. Perceptions of the value of a girl's education influence girls' investment and performance. Gender inequality is a more pronounced reality in urban schools than in rural schools and is to the disadvantage of girls. In addition, male teachers have a positive and significant influence on student performance at the 10% level in rural areas. However, their influence is not significant in urban areas. More men than women are teachers in rural areas. Meanwhile, in rural, the number of female students is increasing.

Disability and a history of medical visits concerning a visual and/or hearing disability have a negative and significant influence at the 5% level in rural areas. Health facilities, health specialists, and specialized educational facilities are concentrated in urban areas, while the school environment, curricula, and teaching practices are not adapted to visual and/or hearing impairment. Targeted health promotion programmes are needed to untangle the clinical challenges in rural areas.

Class repetition has a significant and positive influence at the 1% level in urban areas. Repeating has been widely used as a remediation tool for low achievers. The positive influences are consistent with the study by Aduda, Kodero, and Sichari (2019). An experience effect with regard to coefficients according to the number of repetitions is noted. However, class repetition consistently has a larger negative influence on rural students from disadvantaged backgrounds. Students who have repeated a year are driven by feelings of shame, anger, anxiety, and boredom, all of which are negative academic emotions that impact class attendance, learning, and exam preparation (Erhun, Jegede, & Ojelabi, 2022).

Not making students do homework has a 5% negative and significant influence on performance in urban schools while its influence is positive and insignificant in rural areas. Although consistent with the findings of Fernández-Alonso et al. (2019), the influence of homework is linked to teacher preparation and planning, homework adapted to students' ability, attention and skill levels, attention and motivation, and appropriate parental involvement. Homework time, free-time management, homework quality, student attitudes, teacher practices, parent abilities and resources, student psychology and parent attitudes influence test scores.

Not feeling hungry in class has a positive influence on test scores. Farzana, Bidisha, and Rohini (2019) show that hunger is a major barrier to well-being affecting a child's growth and development, including performance in the classroom. Hunger impacts health, learning, physical work, sporting activities, school attendance, and level of concentration. Improving short-term classroom attention and effort due to school-provided meals can improve learning outcomes in the longer term.

6. Conclusion

This study analyzed the influences of public teachers' wages on students' scores test in mathematics and reading in urban and rural public primary schools in Burkina Faso and examined the diverse influences between and within areas. Influences are mixed, heterogeneous, and differentiated according to experience and seniority. In rural areas,

teachers' wages have a negative significant influence on students' average mathematics and reading scores only for teachers with lower wages. In contrast, in urban areas, a significant positive influence is shown for low and high-wage earners. However, a negative influence is observed for teachers earning wages in the middle. The heterogeneous and differentiated influence of wages in rural and urban areas, between them, would require a readjustment and revision of wage criteria. Wages could be an incentive for young and old teachers in urban areas with close monitoring of practical pedagogical training.

The classroom learning resource index has positive significant influences in urban and rural areas. The socioeconomic index of a student's family has a positive significant influence in urban areas. Mathematics and reading scores tests vary based on the family's standard of living and income. No attendance at a preschool or kindergarten has a positive significant influence in urban areas because of the number of facilities and out-of-school support courses for families. The positive influence of class repetition shows a memory effect and a feeling or decision to have better performance than the previous year. In addition, seating, toilets and latrines, and infrastructure index support and facilitate learning and have a positive influence on scores tests. Not making students do homework has a negative influence on test scores in urban areas.

In rural areas, a school's educational resources index and disabilities have a significantly negative influence on student performance. However, not feeling hungry in class and male teachers show positive influences. This is due to a lack of gender inequality in the acquisition of academic performance because male students have a non-significant influence in rural areas. This indicates that female teachers are concentrated in urban schools.

The results of this study imply a complex interaction of several factors that influence students' performances. In rural areas, teachers' working conditions, and improving and developing school health care, and nutrition are factors in student performance. Preschool education should be prioritized to reduce inequalities in schooling. Thus, the impact of the 'no repetition' policy on school behaviour and achievement needs to be further investigated through geographical and socioeconomic research. Education quality achievement implies the provision of teaching materials to classes in rural schools and an equitable distribution of teachers throughout the country.

This study has some limitations. Data from scores taken before the 2014 PASEC survey are not available for comparison. In addition, the effects of stimulating or inhibiting, or incentives on the test announcement or information in advance were not considered. Furthermore, school governance the headmaster's management, and peer effects were not analyzed. These areas could be explored in future research.

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References

Aaronson, D., Barrow, L., & Sander, W. (2007). Teachers and student achievement in the Chicago public high schools. *Journal of Labor Economics*, *25*(1), 95–135. http://dx.doi.org/10.1086/508733

Aduda P. O., Hezborn M. N. K., & Manson S. (2019). The effect of class repetition on the academic performance of pupils in lower primary schools in Homa-Bay. *International Journal For Research In Educational Studies*, 5(9), 37–54.

Angrist, J.D., & Lavy, V. (2009). The effect of high stakes high school achievement awards: Evidence from a randomized trial. *American Economic Review*, *99*(4), 1384–1414.

Arain, A. A., Iftikhar, H. J., Ramzan, M., & Dan, H. A. (2014). Evaluation the impact of teacher's remuneration on the performance of students: Evidence from PISA. *International Journal of Science and Research, 3*(5), 674–1683.

Behrman, J.R., & Vélez-Grajales, V. (2015). *Intergenerational mobility patterns for schooling, occupation and household wealth: The case of Mexico*. Centro de Estudios Espinosa Yglesina. Documento de Trabajo. https://ceey.org.mx/wp-content/uploads/2018/06/09-Behrman-V%C3%A9lez-2015.pdf

Belley, P., & Lochner, L. (2007). *The changing role of family income and ability in determining educational achievement*. NBER Working Paper 13527. http://www.nber.org/papers/w13527.

Bond, T. N. & Mumford, K. J. (2018). *Teacher performance pay in the United States: Incidence and adult outcomes*. IZA DP, No 11432.

Borgen, N. T., Kirkebøen, L. J., Kotsadam, A., & Oddbjørn, R. (2021, September 3–4). *Do funds for more teachers improve student performance?* CESifo Area Conferences on Economics of Education 2021, Munich, Germany.

Britton, J., & Propper, C. (2016). Teacher pay and school productivity: Exploiting wage regulation. *Journal of Public Economics*, *133*, 75–89. https://doi.org/10.1016/j.jpubeco.2015.12.004

Burkina Faso/CNT, (2015). Loi n°081-2015/CNT portant statut général de la fonction publique d'Etat.

Cabrera, M. J., & Webbink, D. (2018). Do higher salaries yield better teachers and better student outcomes? *MPRA, Paper* No. 86972. https://mpra.ub.uni-muechen.de/86972/.

Coleman, J.S. et al. (1966). *Equality of opportunity*. Washington, U.S. Department of Health, Education and Welfare.

Dan, G., & Walch, J. (2012). Strategic pay reform: A student outcomes-based evaluation of Denver's ProComp teacher pay initiative. *Economics of Education Review*, *31*(6),1067–1083.

De Ree, J. Muralidharan, K., Pradhan, M. & Rogers, H. (2018). Double for nothing? Experimental evidence on an unconditional teacher salary increase in Indonesia. *Quarterly Journal of Economics*, *133*(2), 993–1039. https://doi.org/10.1093/qje/qjx040

Dolton, P., Marcenaro-Gutierrez, O., Pistaferi, L., & Algan, Y. (2011). If you pay peanuts do you get monkeys? A cross-country analysis of teacher pay and pupil performance. *Economic Policy*, 26(65), 5, 7–55. http://onlinelibrary.wiley.com/doi/10.1111/j.1468-0327.2010.00257.x/full

Erhun, W.O., Jegede, A. O., & Ojelabi, J. A. (2022). Implications of failure on students who have repeated a class in a faculty of pharmacy. *Currents in Pharmacy Teaching and Learning*. *14*(2), 166–172.

Espinosa F. M. (2017). Financial management practices of school heads: Teachers' perspectives. *Skyline Business Journal*, *XIII* (1-2017-2018), 33–44.

Evan, D.K, Yuan, F., & Filmer, D. (2022). Teacher pay in Africa: Evidence from 15 countries. *World Development*, 155, Article 105893.

Farges, G., Guidi, P. & Métais, J. (2018). Les conditions enseignantes. *Cahiers de la Recherche sur l'Education et les savoirs*, 7/2018, 1–20.

Farzana, A., Bidisha, B., & Rohini, S. (2019). *Hunger and Performance in the Classroom*. IZA. Discussion Papers, No. 12627. Institute of Labor Economics (IZA), Bonn.

Fernández-Alonso, R., Woitschach, P., Álvarez-Díaz, M., González-López, A. M., Cuesta, M., & Muñiz, J. (2019). Homework and academic achievement in Latin America: A multilevel approach. Front. Psychol., 01 February 2019. Sec. Educational Psychology; Volume 10 - 2019 | https://doi.org/10.3389/fpsyg.2019.00095

Filmer, D., Habyarimana, J., & Sabarwal, S. (2020). Teacher Performance-Based Incentives and Learning Inequality. *Policy Research Working Paper*s, No. 9382. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/34468

FMI (2018). *Burkina Faso : Gestion de la masse salariale et réforme de la fonction publique*. Rapport d'assistance technique. Rapport du FMI No 19/15.

Gjefsen, M. (2020). Wages, teacher recruitment, and student achievement. *Labour Economics*, *65*, Article 101848.

Glazerman, St., & Seifullah, A. (2012). An Evaluation of the Chicago Teacher Advancement Program (Chicago TAP) after four years. *Mathematica Policy Research*. Final report. p.106.

Glewwe, P., Ilias, N. & Kremer, M. (2010). Teacher incentives. *American Economic Journal: Applied Economics*, *2*(3), 205–227.

Glewwe, P. W., Hanushek, A. E., Humpage, S. D., & Ravina, R. (2010). School resources and educational outcomes in developing countries: A review of the literature from 1990 to 2010. *NBER Working Paper Series* No 17554. http://www.nber.org/papers/w17554

Global Partnership for Education, (2019). Results Report 2019. Office Locations: 1850 K Street NW Suite 625 Washington D.C. 20006 and Avenue Marnix 17, 2nd floor B-1000, Brussels Belgium.

Goldhaber, D. and Walch, J. (2012). Strategic pay reform: A student outcomes-based evaluation of Denver's ProComp teacher pay initiative. *Economics of Education Review*, *31*(6), 1067–1083.

Grieve, C., Pellicer, M., & Maboshe, M. (2019). Teacher pay and educational outcomes: evidence from the rural hardship allowance in Zambia. *South African Journal of Economics*, *0*(0). https://doi.org/10.1111/saje.12227

Hanushek, A. E., & Ettema, E. (2017). Defining Productivity in Education: Issues and Illustrations. *The American Economist*, *62*(2), 165–183.

Hanushek, A. E. (1997). Assessing the effects of school resources on student performance: an Update. *Education Evaluation and policy analysis*, *19*(2), 141–164.

Hanushek, E. A (2002). Publicly provided education. NBER Working Paper 8799. http://www.nber.org/papers/w8799

Hanushek, A. E. (2003). The failure of input-based schooling policies. *The Economic Journal*.

Hanushek, A. E. (2006). *School Resources*. Chapter 14 in Handbook of the Economics of Education, 2, 865-908. Edited by Eric A. Hanushek and Finis Welch. Elsevier B.V. https://doi.org/10.1016/S1574-0692(06)02014-9

Hanushek, E. A., Kain, J. F., & Rivkin, S. G. (2004). *Why public schools lose teachers.* Working Paper 8599. http://www.nber.org/papers/w8599

Haycock, K., & Hanushek. E. A. (2010). An effective teacher in every classroom: A lofty goal, but how to do it? *Education Next*, *10*(3), 46+. link.gale.com/apps/doc/A245037870/AONE?u=anon~961e97a4&sid=googleScholar&xid=892ce55c

Hendricks, D. M. (2014). Does it pay to pay teachers more? Evidence from Texas? *Journal of Public Economics,109*(C), 50–63. https://doi.org/10.1016/j.jpubeco.2013.11.001

Hendricks, D. M. (2015). Towards an optimal teacher salary schedule: Designing base salary to attract and retain effective teachers. *Economics of Education Review*, *47*(C) 143–167.

Hill, A. J., & Jones, D. B. (2019). The impacts of performance pay on teacher effectiveness and retention does teacher gender matter? *The Journal of Human Resources*, *55*(1), 349–385. https://doi.org/10.1080/08832320903449550

Imberman, S. A. (2015*). How effective are financial incentives for teachers?* IZA World of Labor. http://wol.iza.org/articles/how-effective-are-financial-incentives-for-teachers

IMF, (2018). Burkina Faso: Demande d'un accord triennal au titre de la facilité élargie de crédit. Rapport du FMI No. 18/81.

INSD, (2020). *Cinquième Recensement Général de la Population et de l'Habitat*. Ministère des Finances et l'Aménagement du Territoire du Burkina Faso.

Jacob, B. A. & Lefgren, L. (2007). What do parents' value in education: an empirical investigation of parents' revealed preferences for teachers. *The Quarterly Journal of Economics,122*(4), 1603–1637.

Jacob, B.A., & Levitt, S. D. (2003). Rotten apples: An investigation of the prevalence and predictors of teacher cheating. *The Quarterly Journal of Economics*, *118*(3), 843–877.

Jennings, J. L., Andrew A., & Beveridge, A. A. (2009). How does test exemption affect schools' and students' academic performance? *Educational Evaluation and Policy Analysis*, *31*(2),153–175. https://doi.org/10.3102/0162373708328468

Kenny, L.W., & Denslow, D. A., Jr. (1980). Compensating differentials in teachers' salaries. *Journal of Urban Economics*. *7*(2), 198–207.

Lafortune, J., Rothstein, J., & Whitmore, S. D. (2018). School finance reform and the distribution of student achievement. *American Economic Journal*: *Applied Economics*, *10(*2), 1–26.

Leigh, A. (2012). Teacher pay and teacher aptitude. *Economics of Education Review*, *31*(3), 41–53. https://doi.org/10.1016/j.econedurev.2012.02.001

Loeb, S., & Page, M. E. (2000). Examining the link between teacher wages and student outcomes: The importance of alternative labor market opportunities and non-pecuniary variation. *Review of Economics and Statistics*, *82*(3), 393–408.

Hendricks, M. D. (2014) Does it pay to pay teachers more? Evidence from Texas. *Journal of Public Economics*. 50–63.

MENAPLN/DGESS. (2021). *Rapport de suivi annuel 2020 du Programme de développement stratégique de l'éducation de base (PDSEB)*

Menezes-Filho, N., & Pazello, E. (2007). Do teachers' wages matter for proficiency? Evidence from a funding reform in Brazil. *Economics of Education Review*, *26*(6), 660–672.

Mingat, A. (1991). Expliquer la variété des acquisitions au cours préparatoire: Les rôles de l'enfant, la famille et l'école. *Revue française de pédagogie, 1991(*95), 47–63.

Moehlman, A. B. (1927). Public school accounting. *Review of Educational Research*, *2*(2), 99–104. https://doi.org/10.2307/1167547

Muralidharan, K., & Venkatesh, S. (2009). Teacher performance pay: Experimental evidence from India. *NBER Working Paper Series* No 15323.

Neal, Derek. (2011). *The design of performance pay in education. In Handbook of the economics of education*, vol. 4, chap. 6, ed. Eric A. Hanushek, Stephen Machin, and Ludger Woessmann, 495–550.

PASEC (2016). *Performances du système éducatif burkinabé: Compétences et facteurs de réussite au primaire en 2014*. PASEC. CONFEMEN. Dakar

Pugatch, T., & Schroeder, E. (2014) *Teacher pay and student performance: Evidence from the Gambian hardship allowance*. IZA Discussion Papers, No. 8621.

Rivkin, G. S., Hanushek, A. E., & Kain, J. F. (2005). Teachers, schools, and academic achievement. *Econometrica*, *73*(2), 417–458. https://doi.org/10.1111/j.1468-0262.2005.00584.x

Sousa, J. (2022) Average high school teacher salaries VS student performance on standardized tests: A correlation analysis of Northern New Jersey High Schools. *The Younger* Researcher, *6*(1), 46–58.

Southwick, L., Jr., & Gill, S. I. (1997). Unified salary schedule and student SAT scores: Adverse effects of adverse selection in the market for secondary school teachers. *Economics of Education Review*, *16*(2), 143–153.

Tazouti, Y., Viriot-Goeldel, C., Matter, C., Geiger-Jaillet, A., Carol, R., & Deviterne, D. (2011). French nursery schools and German kindergartens: Effects of individual and contextual variables on early learning. *European Journal of Psychology of Education*, *26*(2), 199–213. https://doi.org/10.1007/s10212-010-0043-4

UNESCO et ONU Femmes. Orientations mondiales dans la lutte conte la violence sexiste en milieu scolaire.

Villanueva, M. A., & Flores-Gonzalez, N. (2005). Popularity versus respect : School structure, peer groups, and Latino academic achievement. *International Journal of Qualitative Studies in Education*, *18*(5), 625–642. https://doi.org/10.1080/09518390500224945

Wachira, C. (2018). *Effect of Government funding on the operational efficiency of public universities in Kenya*. Doctoral dissertation. The University of Nairobi.

Woessmann, L. (2010). Institutional determinants of school efficiency and equity: German states as a microcosm for OECD countries. *Jahrbücher für Nationalökonomie und Statistik*, *230*(2), 234–270.

Woessmann, L. (2011). Cross-country evidence on teacher performance pay. *Economics of Education Review*, *30*(3), 404–418. http://www.sciencedirect.com/science/article/pii/S0272-7757(10)00173-1

Worthington, A. (2001). An Empirical Survey of Frontier Efficiency Measurement Techniques in Education. *Education Economics*, *9*(3), 245–268.

Yuan, H. B., Beverly, A. W., Jin, B. F., & Qian, H.Y. (2012). A systematic review of selected evidence on improving knowledge and skills through high-fidelity simulation. *Nurse Education Today*, *32*(3), 294–298.

APPENDIX

APPENDIX A

Table A1: Some synthetic research on the effect of pay on educational outcomes

Authors	Countries	Empirical Methods	Results
Britton, Jack and Propper, Carol (2016)	England	Value-added method. Difference-in-differences.	A 10% shock to the wage gap between the local labour market and teacher wages results in an average loss of approximately 2% in average school performance in the key exams taken at the end of compulsory schooling.
Woessmann, Ludger (2011)	OECD member countries	Fixed effects model. Difference-in-differences.	Teacher salary adjustments for outstanding performance are significantly associated with math, science and reading achievement across countries. Scores in countries with performance-related pay are approximately one-quarter standard deviation higher.
Hendricks, Matthew D. (2014)	USA	Ordinary least squares. Difference-in-differences. Fixed effects model.	Turnover elasticity of −1.4 effect is the greatest for inexperienced teachers, declines with experience and disappears at around 19 years of experience. Paying teachers more improves student achievement through higher retention rates. No evidence that pay effects vary by the teacher's gender or subject taught.
Leigh, Andrew (2012)	Australia	Instrumental variables.	A 1% rise in the salary of a starting teacher boosts the average aptitude of students entering teacher education courses by 0.6 percentile ranks, with the effect being strongest for those at the median. More pay dispersion in the non-teaching sector lowers the aptitude of potential teachers.
Goldhaber, Dan and Walch, Joe (2012)	USA	Matching method.	Student achievement increased during the years Professional Compensation System for Teachers (ProComp) was implemented. However, but these gains were observed for students taught by teachers enrolled in ProComp's alternative compensation system as well as non-participating teachers. While the findings are not consistent across grades and subjects, there is some evidence that teachers voluntarily opting into ProComp are more effective than those who do not volunteer. Some ProComp bonuses were well targeted towards value-added measures of teacher effectiveness while others were not.
Hendricks, Matthew D. (2015)	USA	Value-added method.	A 1% increase in base salary for teachers of a particular experience level increases the proportion of the targeted teachers hired by 0.04–0.08 percentage points. Pay increases have the greatest effect on hire rates among teachers with 2–3 years of experience and the effect

			diminishes with experience. Higher teacher salaries provide a dual benefit of retaining and attracting a more effective distribution of teachers. Districts may also improve student achievement growth at no cost by reshaping their salary schedules so that they are increasing and concave to teacher experience.
De Ree Joppe, Karthik; Muralidharan, Menno Pradhan; and Halsey Rogers (2018)	Indonesia	Statistic comparison. Instrumental variable. Difference-in-differences.	Doubling pay significantly improved teacher satisfaction with their income, reduced the incidence of teachers holding outside jobs, and reduced self-reported financial stress. Nevertheless, after two and three years, the doubling in pay led to no improvements in measures of teacher effort and had no impact whatsoever on student learning outcomes. Large unconditional increases in salaries of incumbent teachers had no meaningful positive impact on student learning.
Imberman, Scott A. (2015)	developing countries and developed countries	Direct comparisons of the group and individual incentives.	Incentives can effectively improve student performance if they are designed well. In developing countries, paying teachers for student performance is highly effective at a low cost. Incentives based on the collective performance of small groups of teachers strike a balance between loss of effectiveness from free-riding teachers and gains in effectiveness from teachers cooperating. Innovative incentive mechanisms based on loss rather than gain or relative student performance show promise for high effectiveness but are yet to be rigorously evaluated.
Bond, Timothy N. and Mumford, Kevin J. (2018).	USA	Difference-in-differences.	Cohorts with more exposure are more likely to graduate from high school and earn higher wages as adults. The positive effect is concentrated in Grades 1–3 and on programmes that targeted schools with a higher fraction of students who are eligible for free and reduced lunch.
Hill, Andrew and Jones, Daniel B. (2019)	USA	Difference-in-differences.	Teachers respond to performance pay by allocating additional effort towards the students they (possibly mistakenly) perceive as high-ability to increase average class achievement.
Menezes-Filho, Naércio and Pazello, Elaine (2007)	Brazil	Differences-in-differences.	Raising the relative wages of public-school teachers improved the proficiency of public school students.
Cabrera, Maria José and Webbink, Dinand (2018)	Uruguay	Discontinuity regression.	The policy was especially successful in hiring experience from other schools but also increased tenure. However, the effect on student outcomes appears to be small. Keeping teachers appears to be more beneficial for students than hiring

			experienced teachers. The policy had a better effect on schools that replaced teachers with less than five years of experience.
Glewwe, Paul; Ilias, Nauman; and Kremer, Michael (2010)	Kenya	Model of productive and signalling effort.	The dropout rate was unchanged. Instead, exam participation increased among enrolled students. Test scores increased on exams linked to the incentives, but not on other, unrelated exams. Teacher attendance and homework assignments were unaffected, but test preparation sessions increased. The programme increased government exam participation. It did not increase scores in the first year, but treatment scores rose by 0.14 standard deviations (SDs) relative to controls in the second year. However, this improvement did not persist after the completion of the programme and there were no improvements on parallel low-stakes NGO exams.
Arain, Ali Amjad; Jafri, Iftikhar Hussain; Ramzan, Muhammad; and Ali, Hyder (2017)	PISA countries	Ordinary least squares.	A positive impact of teacher remuneration on students' performance was observed.
Filmer, Deon; Habyarimana, James; and Sabarwal, Shwetlena (2020)	Tanzania	Two-phased randomised control trial. Quantile regressions.	Incentives for teachers led to modest average improvements in student achievement across different subjects. Withdrawing incentives did not lead to a 'discouragement effect' (once incentives were withdrawn, student performance did not fall below pre-baseline levels). Impacts on learning were sustained beyond the intervention period. Incentives may have exacerbated learning inequality within and across schools. Increases in learning were concentrated among initially better-performing schools and students. At the same time, learning outcomes may have decreased for schools and students that were lower-performing at baseline. Incentivising students without simultaneously incentivising teachers did not produce observable learning gains.
Grieve, Chelwa; Pellicer, Miquel; and Maboshe, Mashekwa (2019).	Zambia	Fuzzy regression discontinuity.	Crossing the threshold increases the share of teachers obtaining the allowance by 40%. Because of some non-compliance with the allocation rule, the estimates are fairly imprecise. Focusing on provinces with better compliance, Grieve et al. find some, albeit weak, evidence that the allowance increases the stock of teachers. However, Grieve et al. find no effects on teacher

			characteristics or student tests effect of the rural allowance on student outcomes.

Source: Author, 2022

APPENDIX B : Category and Qualifications for Access to the civil service job

Category	Scale	Degree
P		
	A	Doctorate or Ph.D. in Medicine. Pharmacy or Dentistry plus specialization diploma.
	B	Bachelor's degree plus 9 years of cumulative professional training.
	C	Doctorate or PhD plus 7 years of cumulative professional training.
A		
	1	Diplôme d'Etudes Approfondies (DEA) or Master II or Diplôme d'Etudes Supérieures Spécialisées (DESS) or equivalent recognised professional diplomas.
	2	Master's degree or equivalent recognized professional qualifications.
	3	Licence de l'enseignement supérieur or equivalent recognised professional qualifications.
B		
	1	DEUG II or DUT or BTS or equivalent recognized professional qualifications.
	2	Technical Baccalaureate or Technician's Certificate or equivalent recognized professional qualifications.
	3	Secondary education baccalaureate or BEP or equivalent recognized professional qualifications.
C		
	1	BEPC plus a vocational diploma requiring 2 years of training or any other title or diploma recognized as equivalent.
	2	State CAP or BEPC plus a vocational diploma requiring 1 year of training or any other title or diploma recognized as equivalent.
	3	BEPC or any other title or diploma recognized as equivalent.
D		
	1	CEPE and a vocational diploma requiring 2 years of training or any other title or diploma recognized as equivalent.
	2	CEPE and a vocational diploma requiring 1 year of training or any other title or diploma recognized as equivalent.
	3	CEPE or any other title or diploma recognized as equivalent.
E		
	1	Worker or skilled employee performing training tasks and involving responsibility.
	2	Worker or employee performing tasks requiring specialization acquired over at least 6 months.
	3	Worker without professional qualification.

Source: Law n°81-2015 on the general status of the civil service.

These posts in categories A, B, C, D, and E are divided into three scales designated in descending hierarchical order by the numbers 1, 2, and 3. Each job has three grades : first class, second class and third class (see Table 3). While the jobs in category P are designated in descending hierarchical order by the letters A, B, and C. For the same level of recruitment. the number of steps is the same for all categories.

APPENDIX C : Categories and the number of steps per grade for civil servants in Burkina Faso.

Category	First class	Second class	Third class
P	17	12	8
A	17	12	8
B	18	13	9
C. D et E	19	14	10

Source: Law n°81-2015 on the general status of the civil service.

Indeed every civil servant is entitled after service to a remuneration comprising a pensionable wage and residence allowance. The pensionable salary is defined by a coefficient known as the wage index assigned to each grade and step in the hierarchy of civil service posts. The annual amount of this salary is determined by applying the value of the index point to each of the indices of the wage scale. However, in the interests of equal treatment for equal levels of recruitment, the pensionable wage is the same for all posts.

For career development and capacity building civil servants are entitled to training. specialization and further training in accordance with the law and the need. Maternity leave is granted on the basis of a medical certificate issued by an approved doctor midwife or state midwife.

APPENDIX D : Allowances granted to teachers varying by category ($)

Category	Housing allowance for classroom teachers.	Hardship allowance for classroom teachers.			On-call allowance: for teachers in offices.
		Urban area	Semi-urban area	Rural area	
A					
B	33.33	21.67	25	33.33	33.33
C	14.17	20	20.83	25	14.17

Source : Décret n° 2008-909/PRES/PM/MEF/ MFPRE du 31 décembre 2008

APPENDIX E : Signification and expected effects of variables and in the model

Variable Name	Meaning	Expected effects
Y_{ijk} :	*students' performance* Student's performance is the simple arithmetic mean of i student's reading and math test scores in the class j in locality k This dependent variable measures the quality of education and the country's expected development. The language or reading test measures comprehension skills of Informative texts (continuous texts. excerpts from textbooks dictionaries encyclopedias etc. from fifty to three hundred words) and Documents (discontinuous texts. excerpts from explanatory diagrams advertising posters, etc. up to one hundred words). The ability to extract information from literary texts as well as the decoding of words and sentences is also assessed to a lesser extent The mathematics test measures students' performance in arithmetic geometry and measurement. The main cognitive activities measured are knowing understanding applying formulas, and reasoning about a problem.	Study variable/ Dependent variable
W_{ijk} :	*Wages* The average annual net wage received from the public school teachers in the class is 14 terms. W_{ijk} is the wage of the teacher i in the class j in a professional residence setting k. It is the average annual net wage received from the teacher in the class which is paid by the government? The wage of teachers is very good for their average quality" on student performance on international assessments. Teachers with high salaries have pedagogical teaching qualities. Thus. salary and student performance are in the same direction of variation. The 14 modalities of the variable were taken from the estimates by the centers of the net salary received by classes. *The 14 modalities of the variable taken from the estimates by the centers of the net wage received classes because the pupils in the classes covered by the study are taught by different categories of teachers whose wages are linked*	Rural (+) Urban (-)
Z_{jik} ***: Factors specific to the class and the school in the locality***		
Z_1 :	Classroom Learning Resource Index The availability and use of textbooks improve student achievement in developing countries but no such effect has been observed in high-income countries.	Rural (+) Urban (-)
Z_2 :	*School location.* The schools are either urban or rural. Urban and rural schools enjoy similar levels of infrastructure and services[10]. Rural students perform less well than urban students both at the beginning and end of schooling in language and mathematics. This is linked to the difficulties faced by the education system in reducing the disparities in performance between rural and urban schools. The value 1 is for urban and 0 for rural.	
Z_4 :	*Schools' pedagogical resources index* It is estimated on the basis of contextual variables: the number of mathematics and reading textbooks available per pupil the availability of textbooks teaching guides and reading and mathematics curricula for the teacher the availability of teaching materials (chalkboard chalk dictionary, maps of the world Africa and the country measuring materials such as square compass ruler, and clock) and the availability of classroom furniture (a desk and chair for the teacher a cupboard and shelves for books a reading corner and a sufficiently large number of benches and tables). Schools' pedagogical resources index. The availability and use of textbooks improve student achievement in low-income countries. Educational resources are supports that facilitate academic learning.	Rural (+) Urban (-)

[10] Measured by the spatial planning index based on the availability of the following goods and services : a paved road, electricity, a secondary school, a hospital, a health centre, a police station, a bank, a savings bank, a post office, a cultural centre or a library.

Variable Name	Meaning	Expected effects
	In low-income countries, the availability and use of textbooks improve student achievement (Keeves. 1995). Whereas no such effect has been observed in high-income countries.	
Z_5 :	*Schools' infrastructure index* The working conditions in the school must allow students to learn in a favorable environment. The infrastructure index is a set of contextual variables: the ratio of the number of functional classrooms to the total number of students the availability of certain facilities (a separate office for the head teacher a place to store materials a teacher's room a playground a separate sports field a fully fenced perimeter a first-aid box accommodation for teachers or head teacher running water a source of drinking water other than running water and electricity and the existence of latrines and toilets. The infrastructure index influences the academic performance of students Its value ranges from 0 to 1.	Rural (+) Urban (-)
Z_7	*Reading textbook* The availability of textbooks facilitates learning and positively influences the academic performance of pupils. The reading book contributes to the learning of the French language. especially in rural areas. Owning and using reading books improves student performance. Also, its availability facilitates the transmission of learning and also reinforces the pupil's spirit of openness. Owning reading books affects students' performance as they can practice reading. The modalities are 1 for detention and 2 otherwise.	Rural (+) Urban (+)
Z_8	*Mathematics textbook* Mathematics contributes to the structuring of the student's mind and strengthens his or her reasoning and stimulates thinking. Therefore if the pupil has a mathematics book at school the teaching of the subject is facilitated and influences academic performance. The modalities are 1 for detection and 2 for otherwise. Students' possession of a mathematics textbook with the modalities yes for detection and no otherwise. Owning and using reading books improves student performance.	Rural (+) Urban (+)
Z_{10} :	*Teachers 'gender* The gender of the teacher influences school performance. Female teachers in primary schools have a positive effect on girls especially as they approach puberty. Teachers have a stimulating role with girls and limit relationship problems with male teachers. The modalities are 1 for Males and 0 for Females.	Rural (+) Urban (0)
Z_{13}	*Index of perception by the teacher of working conditions.*	Rural (–) Urban (0)
Z_{15} :	*Seating* Seating is one of the working conditions that allow students to be in a favorable context to perform better at school. The modalities are 1 for one seat for 1 student, 2 for one seat for 2 students, and 3 for one seat for three or more students.	Rural (+) Urban (+)
Z_{16} :	*Functional library* The availability and use of books in schools improve reading learning through a variety of media and enhance the reading habits of students especially those from less privileged families who often do not have books at home. Thus, the presence of a functional bookshop influences the academic performance of students. The modalities are 1 for its presence and 2 for its absence.	Rural (-) Urban (+)
Z_{17} :	*Classroom functionality* The educational system has three types of classroom organization: - Normal classes have one full-time teacher per class ; - Multi-grade classes where pupils from several schools form a single teaching group with a single teacher; - Double-shift classes where two teaching groups alternate in the same class. Classroom' functionality is with modality 1 for normal functioning classes (full-time teacher per class). 2 multigrade classes; 3 double flow classes.	Rural (+) Urban (0)
Z_{18} :	*Latrines and toilets*	Rural (+) Urban (+)

Variable Name	Meaning	Expected effects
	The existence of latrines and toilets allows students to contribute to a learning climate and retention of students. This in turn leads to improved school performance. The modalities are 1 for the presence of latrines and 1 tolets within the school and 2 for their non-existence.	
G_{ijk} : ***Individual student characteristics that include***		
Z_6 :	*Student's gender* Inequalities between boys and girls are present in school performance. Differences in scores can exist to the detriment of one of the sexes. The modality 1 for male and 0 for female.	Rural (+) Urban (0)
Z_{11}:	*Management of multigrades' classes* Schools in rural areas make use of multigrade classes. which allow teachers to teach in a school where all classes exist. Knowing how to manage these classes facilitates the acquisition of students' knowledge and also helps to make annual recruitment. The modality is 1 for knowledge of class management and 0 for the opposite	Rural (+) Urban (+)
Z_{14}:	*Index of (teacher) perception of social benefits* Social benefits are a source of motivation. In rural areas. social capital is considered in the exercise of the profession and allows for good integration into the living environment. Thus, the teaching provided is well received by the pupils. Also, this social perception shows that the teacher beyond his or her profession is a model for society and especially for the pupils.	
Z_9 :	*Student's family socioeconomic index* Socioeconomic status influences students' performance as well as their educational pathways. The socio-economic index of the students' families is constructed by a model of response to the item using the students' statements in relation to the possession of a number of goods at home (number of books. Electricity, television, computer, radio, telephone, freezer, air conditioner, car, tractor, running water tap, latrine with running water, etc.). This index influences performance and schooling.	Rural (0) Urban (+)
Z_{19} :	*Classroom' repeating* Repetition is an issue that affects the quality of education. Consequently. it influences school performance. It does not allow pupils to achieve the same performance as their non-repeating peers. Also, it involves high costs to the education system Repetition is well established in pedagogical practices and has been a response to the learning difficulties of the education system. The modalities 1 for repeating and 2 for no.	Rural (-) Urban (-)
Z_{21}:	*Disability* A disability, regardless of its nature or severity has a negative impact on school performance. The modalities 1vis for a disability and 2 for no.	Rural (-) Urban (-)
Z_{20} :	*Medical visit visual or auditory or visual and auditory* Being healthy is a minimum requirement for a student to attend school for academic performance. The modality is 1 for having made a visit and 2 for no.	Rural (+) Urban (+)
Z_{221}	*Feeling hungry in class*	Rural (-) Urban (+)
Z_{30}	*Attended nursery school. kindergarten. or pre-school*	Rural (0) Urban (+)
Z_{31}	*Make homework*	Rural (+) Urban (-)

Source: Author, 2023

Appendix F: Descriptive statistic

Apendix F1 : Quantitative statistic variables

Variables	Obs		Mean		Std. Dev.		Min		Max	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Test scores	544	809	618.21	563.85	82.57	78.07	375.28	323.55	880.53	816.85
wages ($)	544	809	285	244	0.1%	0.1%	150	100	415	582
Classroom Learning Resource Index	544	809	54.74	53.47	7.44	6.72	44.32	42.59	79.23	79.23
School Learning Resource Index	544	809	50.12	47.17	7.55	4.87	45.657	45.66	74.59	68.16
School Infrastructure Index	544	809	53.50	52.51	4.82	5.41	40.88	36.76	62.40	62.40
Student's Family Socioeconomic Index	544	809	52.20	48.12	7.71	5.96	26.39	26.39	79.83	78.56

Source: Author, 2023

Appendix F2 : Qualitative statistic variables

Variables		**Localisation**		
		Urban	**Rural**	**Total**
Teacher gender	Women	12.94%	5.22%	18.16%
	Men	28.97%	52.87%	81.84%
Functional Library	Yes	2.03%	39.89%	41.92%
	No	3.98%	54.10%	58.08%
Classroom functionality	Yes	2.03%	3.98%	6.01%
	No	39.89%	54.10%	94.10%
Latrines and toilets	Yes	39.89%	52.87%	92.76%
	No	2.03%	5.22%	7.24%
Other sources of teachers' income	Yes	14.49%	7.25%	21.74%
	No	35.51%	42.75%	78.26%
Student Gender	Girls	21.25%	31.31%	52.56%
	Boys	20.67%	26.78%	47.44%
Reading textbooks	Yes	38.14%	58.00%	92.43%
	No	3.86%	3.72%	7.57%
Mathematics textbooks	Yes	37.68%	54.89%	92.57%
	No	4.30%	3.13%	7.43%
Disability	Yes	6.12%	7.36%	13.48%
	No	36.07%	50.45%	86.52%
Feeling hungry in class	Yes	28.51%	33.39%	41.97%
	No	13.45%	24.64%	58.03%
Classe repeating	Yes	20.49%	36.66%	57.16%
	No	21.42%	58.08%	42.84%

Source: Author, 2023.

APPENDIX G: Correlation and covariance test

Variable	Y	W	Z1	Z2	Z4	Z5	Z6	Z7	Z8	Z9	Z10	Z15	Z17	Z18	Z19	Z21	Z221
Average test scores	1.0000																
Average annual net wage (W)	0.2216*	1.0000															
Classroom Learning Resource Index (Z1)	0.2882*	0.2316*	1.0000														
School location (Z2)	0.3297*	0.1234*	0.1517*	1.0000													
Schools' pedagogical resources index (Z4)	0.1320*	0.0564*	0.1393*	0.2243*	1.0000												
Schools' infrastructure index (Z5)	0.2274*	0.2637*	0.4050*	0.1402*	0.0986*	1.0000											
Student's gender (Z6)	0.0643*	-0.0615*	-0.0245	0.0227	0.0207	-0.0572*	1.0000										
Reading textbook (Z7)	0.2032*	0.2226*	0.3177*	0.0282	0.0280	0.2482*	-0.0395*	1.0000									
Mathematics textbook (Z8)	0.2236*	0.3004*	0.3285*	0.0060	0.0672*	0.2970*	-0.0272	0.4463*	1.0000								
Student's family socioeconomic index (Z9)	0.2136*	0.0205	0.1548*	0.3427*	0.1469*	0.1129*	-0.0126	0.1030*	0.1122*	1.0000							
Teachers 'gender (Z10)	-0.2092*	-0.0268	-0.0781*	-0.2788*	-0.0423*	0.0022	-0.0017	-0.0357*	-0.0571*	-0.1002*	1.0000						
Seating for students (Z15)	-0.1314*	-0.1891*	-0.2845*	-0.1574*	-0.0546*	-0.4848*	0.0505*	0.1509*	0.1929*	0.0574*	-0.1065*	1.0000					
Classroom' functionality (Z17)	-0.0611*	0.0279	-0.1358*	0.0490*	-0.5543*	0.0516*	-0.0229	-0.0639*	-0.0591*	0.0092	0.0215	-0.1750*	1.0000				
Latrines and toilets (Z18)	-0.1314*	-0.1891*	-0.2845*	-0.1574*	-0.0546*	-0.4848*	0.0505*	-0.1608*	-0.2100*	-0.0986*	-0.1812*	-0.2127*	-0.0040	1.0000			
Classroom 'repeating (Z19)	0.1410*	0.0116	0.0070	-0.0218	0.0361	-0.0076	-0.0160	0.0548*	0.0317	0.0510*	-0.0462	0.0588*	-0.0187	0.0615*	1.0000		

Variable	**Y**	**W**	**Z1**	**Z2**	**Z4**	**Z5**	**Z6**	**Z7**	**Z8**	**Z9**	**Z10**	**Z15**	**Z17**	**Z18**	**Z19**	**Z21**	**Z221**
Disability (Z21)	-0.0716*	0.2471*	-0.1059*	-0.0617*	0.0040	0.0132	-0.0015	-0.0013	0.0086	-0.0676*	-0.0429*	0.0551*	0.1032*	0.0517*	0.4463*	1.0000	
Feling hungry in clas)s (Z221)	-0.0181	-0.0552*	-0.0883*	-0.1119*	-0.0121	-0.0422*	0.0252	-0.0181	-0.0552*	-0.0883*	-0.1119*	-0.0121	-0.0422*	0.0252	0.0334	-0.0496*	1.0000

*NB : *Signifiant*
Source : Author, 2023