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# School efficiency and accountability reforms: Evidence from Norwegian primary and lower secondary schools 2007-2010

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*Abstract*

Accomplishing accountability for student outcomes is held to be one of the fundamental tools for improving school performance. Holding school administrators and teachers accountable for students' achievements should provide incentives for the former to deliver better teaching and overall learning environments. Nevertheless, empirical assessments of specific accountability reforms are in practice fraught with difficulty. Specifically, accurate evaluations of reforms hinges on two fundamental requirements: First, the impact of school-level factors must be disentangled from factors that are attributable to the individual student. Second, the impact of the reform effort itself must be identified. Field data will usually not contain all relevant information on important organizational resources that are correlated both with school districts' reform efforts and student outcomes, or even relevant information on the reform effort itself. In practice, analysis will often suffer from endogeneity problems, and the researcher will have to rely on more advanced methods that, more or less successfully, render variation in reform efforts as exogenous (e.g. instrumental variables methods).

The present study attempts to evaluate school accountability reforms implemented by Norwegian school districts, i.e. municipalities, during the previous decade. It makes use of data from Norwegian *National Tests* in mathematics, reading and English, administered first to fifth graders in 2007, and then to the same students in 2010 as they (usually) change schools and enter eighth grade. Thus, various school efficiency measures (school fixed effects) may be estimated from *value-added* methods in which students' initial performance levels are taken into account. In a second stage of the analysis, school efficiency measures are regressed on school district and school level characteristics. Importantly, the reform variable as reported by municiplaities in the present study – i.e. *whether districts have set up formal leadership agreements with school principals* – is an imprecise measure in that it does not say anything about the *contents* of the reform (real incentivizing aspects of contracts, delineation of real result areas etc.). The analysis seeks to overcome this obvious drawback, and such problems as discussed above, by utilizing data on school districts' present and previous organizational choices going back ten years as well as extensive data on municipalities' demographic and political features. The main result is that a setup with a formal leadership contract is moderately associated with better results: In terms of atandardized achievement scores, school districts that set up formal leadership agreements with their principals can stand to gain 5-10 per cent of a student standard deviation. However, this outcome hinges on the adoption of a wider municipal regime of results oriented contracts and incentivizing arrangements, suggesting that agreements out of the context of at least some "hard" end results may be of little worth.

*Keywords*
school leadership, accountability reforms, value-added methods, school efficiency

## Introduction

The present paper evaluates recent school accountability reforms that have been implemented to varying degrees by Norwegian municipalities. Specifically, during the latter half of the previous decade, some primary level school districts – i.e. municipalities – have set up formalized leadership agreements with their schools' principals. In theory, this should at the very least establish some *focus* on accountability for student outcomes: leadership agreements may be rich in their description of various results areas to be monitored and scrutinized, but may in practice be less concerned with any punitive measures (against principals or teachers) in the wake of poor school performance. While leadership agreements in themselves may be quite short on 'hard incentives', the present analysis nevertheless seeks to assess empirically how reformed municipalities compare to municipalities without formalized leadership agreements. The finer question is whether a formalized leadership agreement may be viewed as specific *tool* for enhancing school performance, either by way of instilling some basic focus on achievement or by way of providing a focal point for incentivizing principals and teachers. In any case, since the main variable of interest – the implermentation of leadership agreements – does not in itself say anything about *how* principals are to be held accountable, if at all, the more important the question of the context within which such agreemenst are set up. The analyses puts to use as outcome data results from nationally standardized tests in mathematics, reading and English administered to fifth graders in 2007 and then again to the same students in eighth grade in 2010. The tests data is matched to municipal top executives' responses to a survey question on the adoption of leadership agreements (Statistics Norway/Norwegian Business School in 2010/2011) and to survey data on municipalities' previous and present use of results oriented contracts and incentivizing schemes across several service sectors (Ministry of Local Government and Regional Development).

The next section of the article briefly reviews previous research and results in the field. The subsequent section outlines the institutional setup in the Norwegian primary school sector and proceeds to present the data that is put to use and the research design. The following section presents the results from the statistical analyses and the final section offers some brief concluding remarks.

## Literature review: measuring school efficiency and assessing the impact of school leadership

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Bonesrønning et al. (2011): Norwgeian National Test scores rise by 0.30-0.80 $\sigma$ in testscores with reform in pre-post design and ca. 0.10 in DiD-design (differences between cohorts in selected treatment and control cases).

Naper (2010): 2-4 percent efficiency gain (in teacher hours per sdudent returns to grades) in DEA design from decentralized (school level) hiring practices in Norwegian compulsory schools.

Webbink and Chorny (2010): DiD effect of Amsterdam accountability reform in 1995 (against selected control group) 0.30-0.40 $\sigma$ in testscores.

Abdulkadiroglu et al. (2010): Difference between Boston Charter and public schools (w/ lottery assigned students) approx. 0.30-0.40 $\sigma$.

Other issues: E.g. Hanushek (1979)

## The Norwegian primary school setting, student data and research design

In Norway, municipalities are charged with the responsibility for primary and lower level secondary education, along with other important services – such as care for the elderly, primary health care, local roads and infrastructure among others. Municipalities – i.e. locally elected councils – decide upon the organization of the local education sector (school structure, relations with schools' management etc.) and students normally start their compulsory school career at the age of six and usually *either* attend all grades (one through ten) in a combined primary and lower secondary levels school; *or* they complete grades one through seven in a designated primary school (first-to-seventh grade) school and then proceed to grades eight through ten in either a designated lower secondary school *or* a combined levels school. In other words, students at both levels usually attend *catchment schools* according to their place of residence, i.e. they do not choose schools freely even within a school district (municipality), although some students will of course relocate in the course of their school career or otherwise be assigned to a new school (and thereby "choose" schools outside the regular pattern).

The data put to use in the present study records at different points in time

1) the primary level school at which each student was tested in 5$^{th}$ grade (2007),

2) the primary level school from which each student came entering 8$^{th}$ grade (the lower secondary grades) and

3) the lower secondary level school at which each student was tested in 8$^{th}$ grade (2010).

From this one may plausibly infer whether a student attends a lower secondary level catchment school or not by looking at the relative frequencies of students from each primary level school attending different lower secondary level schools.[1] Here a simple *mode measure* is put to use, i.e. lower secondary level school A is defined as the catchment school of students from primary level school B if a plurality of students from school B go on to school A. Analytically speaking, in this case students from school B that do *not* go on to school A

[1] Since specific knowledge on local catchment areas are lacking in the present case. In addition one may logically infer that a student attending a combined school in primary level grades and a designated lower secondary school in higher level grades does *not* go on to his or her catchment school (since the former school is its own catchment school).

thus follow an irregular pattern. Also, students who have attended two (or more) schools in primary level years (i.e. the school at point in time 1) is different from the school at point 2) above) may also be said to follow an irregular career pattern.[2] Finally, school careers that cross district (municipality) borders are of course also 'irregular' following the above definitions, since such students with such careers necessarily move from one catchment area to another.[3] Table 1 shows that among the totality of students tested in 2007 and 2010 (N=58437) the above notion of 'irregular' school careers clearly carries over in a statistical sense:

[Table 1 here]

While most students (93 per cent) have school careers within a single municipality, most students (83 per cent) also have regular school careers as defined above. Thus, since the ensuing analysis needs to couple a (unique) municipality's decision on leadership agreement adoption to performance measures of schools within its jurisdiction, it makes use of the said 93 per cent of the total population (N=54187). Furthermore, since municipalities vary with respect to their local school structure – i.e. the distribution of school careers within a school district, regular or irregular – a convenient way to move forward is to estimate *school career efficiency effects* rather than school effects as such. In this way the analysis of school district decisions and performance offers relevant control for school structure whilst also identifying the compound institutional unit (the unique career) to which each student is exposed.[4]

The analysis proceeds in two stages, with each subject (mathematics, reading and English) analyzed separately since determinants of student achievement and school performance will not necessarily be the same across subjects. First, school career fixed effects are estimated using variants of the following production function:

$$y^s_{1,ijk} = \alpha^s_1 + \alpha^s_2 y^s_{0,ijk} + \sum_m \alpha^s_m X_{m,ijk} + \gamma^s_{jk} + u^s_{ijk},\ s = \{\text{mathematics, reading, English}\}, \qquad (1)$$

where standardized 8th grade test scores in 2010 ($y_1$) in subjects (s) mathematics, reading and English for student *i* (with school career *j* in municipality *k*) are regressed on the corresponding lagged (5th grade) test scores in 2007 ($y_0$), a vector of individual characteristics specific to student *i* (the $X_m$) and a school career dummy ($\gamma$). In this way the $\gamma$ will yield a measure of school career level effects purged of influences from relevant individual level

[2] The 'irregularity measure' is of course imperfect on this point: The data records the school at three distinct points in time, between which students may change schools (and back again). However, the measure should be consistent since it is unlikely that students defined as having 'regular' careers systematically relocate more in between measuring points than do students with 'irregular careers' (i.e. those that positively attend more than one school in primary level grades).

[3] Also, careers that cross municipal borders inconvenience the analysis since student progression during the career is not easily matched with the policy or decision of any unique policy actor. In a very few applications of the 'mode measure method' some schools will have lower secondary level catchment schools in a different municipality. In the present analysis students in these schools are treated as having 'irregular' careers

[4] The analysis must necessarily sidestep important questions on wether exposure to primary school institutions (a longer but distant experience) or to lower secondary school institutions (a short spell in 8th grade but more recent) contributes more to the difference between 5th and 8th grade scores.

determinants of achievement. In particular, the lagged test score will likely offer valuable control for individual level influences – innate abilities, say – such that one may get a more consistent estimate for the $\gamma$, the *value added* of school career level influences.[5] In addition, since the lagged test score ($y_0$) likely mismeasures real achievement in subject $s$=$s_1$ – due to arbitrary circumstances on the day of the test, say – variants of the estimated model also instruments it using lagged scores in the remaining two subjects ($s \neq s_1$) (Wooldridge 2009: 525-527; see Kim et al. 2006:105 for a similar application).[6]

Next, the second stage of the analysis uses the $\gamma$ as dependent variable in variants of the following empirical model:

$$\gamma_{jk}^{s} = \beta_1^s + \beta_2^s LA_k + \beta_3^s LA_k \cdot R_k + \sum_r \beta_r^s Z_{r,jk} + v_{jk}^s,\ s = \{\text{mathematics, reading, English}\}, \quad (2)$$

where *LA* is the main variable of interest, a dummy variable measuring whether municipality *k* has set up leadership agreements with its school principals (*LA*=1) or not (*LA*=0). Furthermore, since the *LA* variable does not specify the contents of the leadership agreement, the regression model includes a *modifier variable*, *R*, tapping the wider institutional context in which the agreement is set up. With high levels of *R* signifying higher reliance on results oriented contracts and incentivizing arrangements throughout the municipal service sector, one may plausibly expect that a school principal leadership agreement is at least (de facto) buttressed by a more committed local authority and perhaps also in itself more specific on acountability aspects (results and incentives). Conversely, with lower levels of *R*, the setting up of a leadership agreement with a school principal may entail little more than a signal that the local authority is serious about school results. More precisely, one may plausibly expect that local authorities to a lesser extent *intend* for the leadership agreement to work as an accountability system as such. Since *R* (>0) works as a modifier variable in this way, and *if* acountability mechanisms are effective and truly at work, the main expectation with respect to the model as specified above (2) is that

$$\beta_2^s + \beta_3^s \cdot R_H > 0\ (> \beta_2^s + \beta_3^s \cdot R_L).^7 \quad (3)$$

The regressions also include a vector of relevant school district level and school career level characteristics (the *Z*; e.g. municipal revenues and political orientation and school career type at the school career level). Obviously, one may question the exogeneity of the organizational choices tapped by the *LA* and the *LA*·*R* variables. While the included control variables may tap important and relevant (exogenous) determinants of organizational choices and constraints, it might still be argued that omitted variables is an issue. Specifically, local

[5] The $\gamma$ is of course a school career *level* effect (eg. it can tap a peer effect at the career level), and not necessarily an institutional schools effect. In varaints of the second stage of the analysis – where the $\gamma$ themselves are analysed – this is taken into account by including school career level aggregates of individual student characteristics.

[6] Tests in the different subjects are held on different days.

[7] In the empirical analysis the *R* variable does not enter as a continuous measure, but is rather represented by a set of categorical variables measuring combinations of discrete responses to questions on results orintation in contracts and incentive systems.

authorities, i.e. school districts, may very well believe in and rely on working acoountability mechanisms. If this (plausibly) correlates with unmeasured "seriousness" about outcomes – coming out as local authority control and monitoring of municipal services, outside the acountability mechanism – this may very well be the explanation for the observed correlation between positive acountability measures and outcomes. To check the robustness of the regression results, variants of the model (2) adresses this potential problem by including (in $Z$) a measure of previous reliance on acountability systems, i.e. lagged values of $R$, supposedly unrelated to present outcomes. The idea is the following: If the adoption of accountability measures is a mere indication or perhaps even by-product of "seriousness", in itself a plausible cause of outcome gains as explained above, then including lagged $R$ as indicators of innate "seriousness" should tap this and take away from the observed effect of current accountability reforms.[8]

## Results

Table 2 demonstrates that different estimates of school career fixed effects vary considerably according to which version of model (1) one applies. While fixed effects ($\gamma$) from a rudimentary equation, without the lagged 5$^{th}$ grade score, are quite different from fixed effects using other specifications (correlations between r=0.74 and r=0.29 in columns I), estimated fixed effects from other specifications generally correlate highly with one another (correlations between r=0.85 and r=0.99 in the rest of the table). In other words, there is reason to believe that the inclusion of the lagged score in particular is important in order to estimate accurate institutional effects.

[Table 2 here]

Figure 1 displays the distribution of school career fixed effects estimated in different ways for the three subjects under study. Generally, specifications that include the lagged score yield a contraction of the distribution (the non-solid curves). In other words, specifications that do not include the lagged score will likely overestimate the potential for institutional effects (on the underlying student level standardized scale). In one specification (III in the figure) an indicator for having a lagged score is added on top of the lagged score, since one may worry that certain schools exclude particularly low achieving students from being tested. While students who are tested at both points in time (i.e. have 'lagged indicator'=1) generally seem to score higher in 2010 (see Table A1 in the Appendix), this does not seem to alter either the distribution of institutional effects, nor the estimated effects themselves (cf. correlations in Table 2, columns II where r>0.85). In other words, there does not seem be any strong indication that certain schools (or school careers) successfully engineer their value-added scores by way of censoring test participation.

[8] Current and lagged values of the $R$ variable are from the Minsitry of Local and Regional Affairs *Organisasjondatabasen* (Organizational Database), a survey on political and administrative organization going regularly to municipalities since the the mid-nineties. See http://www.regjeringen.no/nb/dep/krd/tema/databaser-og-registre/organisasjonsdatabasen2008.html?id=546533.

In yet another specification of (1) the respective scores are instrumented by the two remaining scores, e.g. the mathematics score is instrumented by the reading and English scores. Since the single (lagged) test score likely (randomly) mismeasures real abilities, this will result in attenuation bias in effect estimates. For example: Since the score in mathematics will contain a 'general abilities component', and is thus *ipso facto* correlated with the 'general abilities' component in reading abilities, *and* since such components are *ipso facto* uncorrelated with any arbitrary factors on test day, the mathematics score is a valid instrument for the reading score. The resulting estimates may thus be interpreted with more confidence as ability scores. While this specification does not seem to result in any great alteration in institutional effects in mathematics (neither in estimates or the distribution; cf. columns III in Table 2 and curve IV in the figure), in English there does seem to be a small expansion in the distribution as compared to the situation where lagged test scores are uninstrumented. In other words, in English at least, estimating institutional effects from raw value added test scores will seem to slightly underestimate the potential for institutional *ability enhancing* effects.

In a final specification (V) a host of additional covariates tapping students' background characteristics is added, since one may worry that not only levels but also *rates of change* in abilities may be affected by a host of socio-economic factors (Ballou 2004: 38-39). Full results from this model are given in Table A1 in the Appendix. The main point in the present context is this: Even though rates of change do seem to vary significantly with students' backgrounds (cf. Table A1), inclusion of student characteristics do not seem to alter institutional level effects very much (cf. curve V vs. IV in the figure and correlations in columns IV in Table 2).[9]

[Figure 1 here]

Before the analysis proceeds to the second stage it should be noted that school career fixed effects estimates in different subjects are not highly correlated (cf. Table 3). This is perhaps to be expected since schools are staffed with departments of varying qualities. Nevertheless, an obvious initial observation is that "management cannot be all there is", since we are far from a case where schools either excel across the board or are only relatively successful in general or in the worst case lag behind in all subjects. However, even if one may expect that more moderate management level reform effects be roughly the same across subjects, the analysis leaves open the question of whether some subjects (or departments) are more responsive to management reform than others. Accordingly, the study proceeds with separate analyses for the three subjects.

[Table 3 here]

Table 4a-4c present the results from the estimations of variants of (2) in the different subjects. Since quite many school careers are sparse in the sense that they include only a few tested students,[10] effects measures ($\gamma$) are likely highly inaccurate as measures of institutional effects. Accordingly, observations are weighted in proportion to the number of tested

[9] Full results from the value added analysis (specification V of equation 1 in Table A1) also reveal a lagged score effect substantively close to one, indicating the appropriateness of the analysis.
[10] In fact, the median number of tested students is 2, while the 75th percentile value is 17.

students. Descriptive statistics for analysis variables are given in the Appendix (Tables A3a-c), where it is shown that the smaller joint sample used in the regressions is roughly comparable to the population of municipalities (N=430) on most counts.[11]

In addition to the *LA* variable from the Statistics Norway/Norwegian School of Management survey (N=277 municipalities) several control variables that have been shown to have an impact on test scores are included as control variables in several variants of the regression (Bonesrønning et al. 2011). In regressions labeled I the unconditional difference in the average school efficiency measures between municipalities with and without leadership agreements is reported – small and insignificant estimates mirroring those reported in table A3b in the Appendix. In regressions labeled II model (2) is estimated without any covariates. The *R* variable is represented by a set of four dummy variables combining binary responses to two survey questions on the use of contracts with resutlts specifications and on the use of incentive schemes in the form of results based salary and/or remuneration schemes in the local bureaucracy respectively.[12] For convenience separate *LA* difference measures for the different *R*-regimes are constructed.[13] In specifications that estimate variants of model (2) (models II to IV), significant estimates for the *LA* difference – *given high reliance on municipal accountability schemes (i.e.* $R_{11}=1$*)* – vary from 8 to 12 per cent of a test score standard deviation in the subjects of mathematics and reading, while corresponding estimates for the English effeiciency score (tabel 4c) are smaller (ca. 3-4 per cent) and insifgnificant. On the other hand, estimates for the *LA* difference given lesser reliance on accountability schemes (i.e. $R_{11}\neq 1$) is smaller in magnitude, often negative and sometimes significantly so. In other words, the hypothesized relationship (3) of accountability effects from (thorough) leadership reform seems to be observed, albeit not for oucomes in English.

Regressions in models III and IV include, first, the average school career test score since scores are more easily improved from low levels. Also, municipal exogenous revenues is included since one may expect that richer municipalities may feel less need to carry out reforms, perhaps substituting funds for organizational changes. The size of the municipality is included since larger localities may have greater capabilities for reform and also be inhabited by citizens with a greater demand for education. In addition to this, the regressions include more specific indicators for education demand: The percentage of the local population with a university degree and the share of socialists in the local council.[14] Also, a measure of the fragmentation of the local council (a Herfindahl Index) is included since a more fragmented council may adversely affect both reform capabilities and bargaining power *vis a vis* managers.[15] Finally, at the career level, the regressions include, among other things, indicators for career type, i.e. whether the particular career in question is a regular combined

[11] Moreover, this is also the main conclusion in the report documenting the Statistics Norway/Norwegian Business School survey (Revold 2011).
[12] Question 30 in the survey for 2008. See note 8.
[13] I.e.

$$LA_{R=R^*} = \begin{cases} LA \text{ if } R = R^* \\ 0 \text{ otherwise} \end{cases} .$$

[14] Since parties have different preferences for educational outcomes over outcomes in other sectors. Party labels defined as socialist comprise the Labor Party, the Socialist Left Party and the Red Electoral Alliance.
[15] The Herfindahl Index is calculated as $H=\Sigma_n p_n^2$, where $p_n$ is party n's share of seats in the council.

schools career, or one of the two regular career types involving a change of schools when progressing from primary to lower secondary grades.[16] Importantly, regression results – in mathematics and reading – are robust to the inclusion of these municipal and school level caharcteristics.

Finally, regressions labeled IV show that estimates are robust to inclusion of lagged organizational choices pertaining to previous use of accountability systems (as measured by lagged values of the *R* variable). Since this plausibly controls for the confounding effect of outcome enhancing capabilities *other* than current accountability schemes, one may more confidently attribute effects to the latter, as hypothesized in (3).

[Table 4a, b and c here]

The results from the regressions show that many of the control variables do seem to be associated with institutional results. For instance, richer and smaller municipalities seem to achieve better results (although not always significantly; see table A2b). The most robust relationships are nevertheless those between score gains and the 2007 average test score on the one hand (see table A2a; showing that value added gains are more easily achieved from lower initial levels) and the share of the municipal population with a university degree on the other (see table A2b; showing that higher education demand increases gains). Interestingly, students attending a combined levels school throughout gain significantly more than students following an irregular school career (this is so in all subjects).[17]

## Concluding remarks

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[16] For results for the full set of school career level characteristics see table A2a.
[17] Although one should be cautious in interpreting this in a causal fashion, since school structure decisions are obviously endogenous.

## Literature


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# Tables and figures

## Table 1. Norwegian students' school careers in lower and higher level primary school grades. 2007-2010.

| Current higher level attendance (8th through 10th grade): | Higher level school | | | | Combined levels school | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lower level attendance (1st through 7th grade): | Lower level school | | Combined levels school | | Lower level school | | Combined levels school | | Other irregular school careers | | Total | |
| | $N_{students}$ | $N_{careers}$ | $N_{students}$ | $N_{careers}$ | $N_{students}$ | $N_{careers}$ | $N_{students}$ | $N_{careers}$ | $N_{students}$ | $N_{careers}$ | $N_{students}$ | $N_{careers}$ |
| Total | 38011 | 2002 | 282 | 133 | 3254 | 469 | 9816 | 642 | 7074 | 4663 | 58437 | 7909 |
| Career in single municipality (per cent of total) | 37308 | 1738 | 219 | 73 | 3160 | 399 | 9781 | 613 | 3719 | 1977 | 54187 | 4800 |
| | (98) | (87) | (78) | (55) | (97) | (85) | (100) | (95) | (53) | (42) | (93) | (61) |
| Regular career, i.e. go to catchment school(s) (per cent of total) | 35764 | 1288 | - | - | 2811 | 252 | 9754 | 590 | - | - | 48329 | 2130 |
| | (94) | (64) | - | - | (86) | (54) | (99) | (92) | - | - | (83) | (27) |

*Note:* Students with "other irregular school careers" have attended more than one school in lower level grades. Students with a "regular career" attend one school only for lower level grades and the same-municipality catchment area school for higher level grades.

## Table 2. Correlations between different school career fixed effects estimates.

| | | I | II | III | IV |
|---|---|---|---|---|---|
| *Mathematics:* | II | 0.611 | | | |
| | | (4671) | | | |
| | III | 0.607 | 0.991 | | |
| | | (4671) | (4671) | | |
| | IV | 0.409 | 0.965 | 0.973 | |
| | | (4671) | (4671) | (4672) | |
| | V | 0.402 | 0.949 | 0.956 | 0.983 |
| | | (4501) | (4501) | (4501) | (4501) |
| *Reading:* | II | 0.722 | | | |
| | | (4542) | | | |
| | III | 0.714 | 0.986 | | |
| | | (4542) | (4543) | | |
| | IV | 0.438 | 0.929 | 0.941 | |
| | | (4542) | (4543) | (4543) | |
| | V | 0.427 | 0.919 | 0.930 | 0.990 |
| | | (4379) | (4379) | (4379) | (4379) |
| *English:* | II | 0.743 | | | |
| | | (4645) | | | |
| | III | 0.737 | 0.994 | | |
| | | (4645) | (4645) | | |
| | IV | 0.291 | 0.854 | 0.859 | |
| | | (4645) | (4645) | (4646) | |
| | V | 0.299 | 0.850 | 0.855 | 0.990 |
| | | (4479) | (4479) | (4479) | (4479) |

*Note:* School career fixed effects are estimated in regressions with I) no covariates, II) lagged (5th grade) score, III) lagged (5th grade) score and indicator for having lagged score, IV) instrumented lagged (5th grade) score and indicator for having lagged score and V) instrumented lagged (5th grade) score, indicator for having lagged score and student background characteristics (see regressions in Table 4 for complete results for student characteristics and the Appendix for definitions and descriptives).

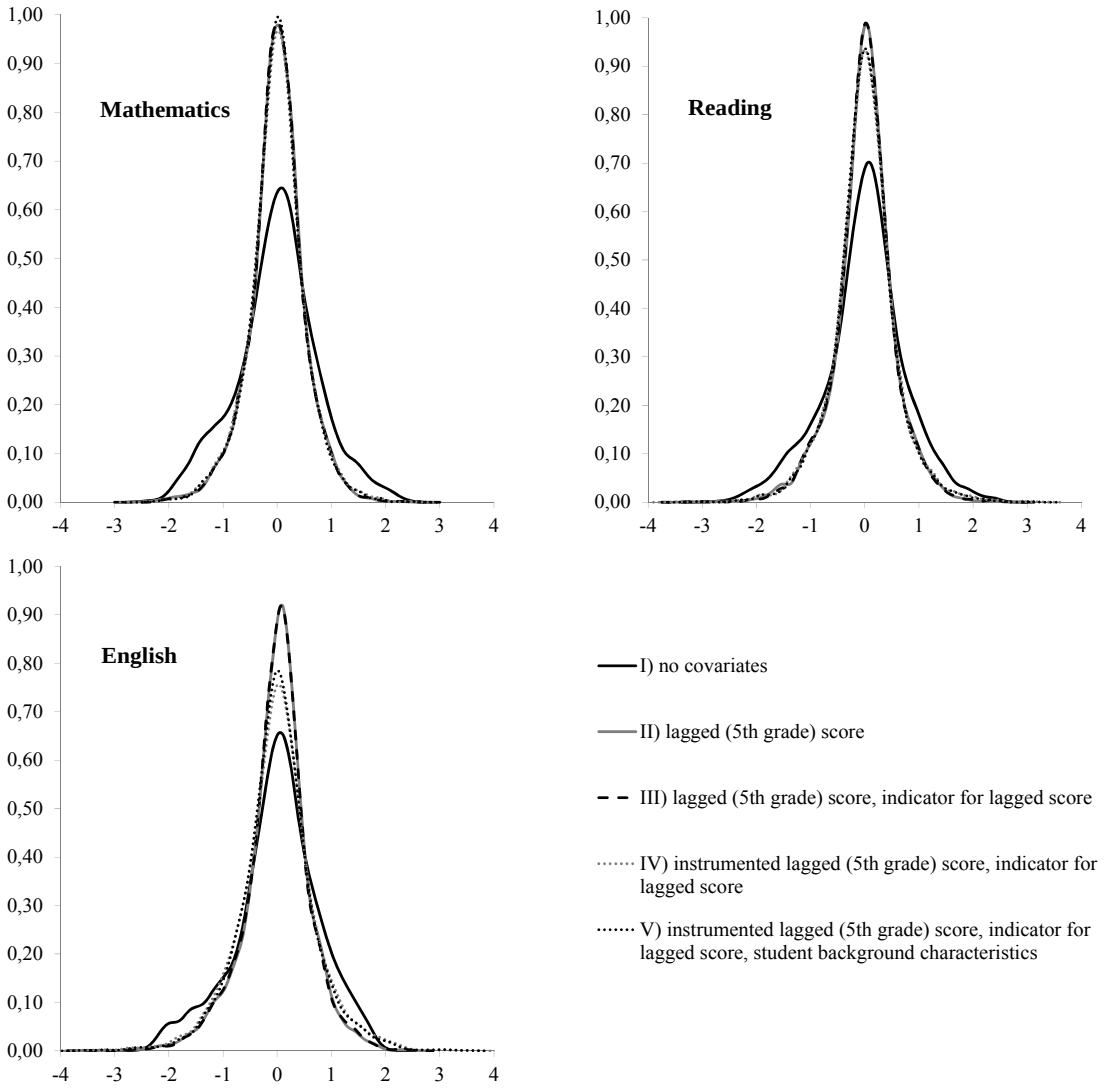


**Figure 1. Distributions of different school career fixed effects estimates.**

## Table 3. Inter-subject correlations between school career fixed effects estimates.

| | Mathematics | Reading |
|---|---|---|
| Reading | 0.248 | |
| | (4316) | |
| English | 0.198 | 0.145 |
| | (4419) | (4303) |

*Note:* School career fixed effects are estimated in regressions with instrumented lagged (5th grade) score, indicator for having lagged score and student background characteristics (see the Appendix for definitions and descriptives).

**Table 4a. The determinants of school career efficiency in mathematics (dependent variable: school career mathematics score fixed effect). OLS regressions.**

| | I | II | III | IV |
|---|---|---|---|---|
| Municipality has leadership agreements with school principals ($\boldsymbol{LA}$=1) | 0.0207 | | | |
| | (0.0241) | | | |
| Municipality has:[a] | | | | |
| Leadership contracts w/ results specification and results based renumeration/salary schemes in some or all service areas ($\boldsymbol{R}_{11}$=1) (2008) | | -0.0780 * | -0.0292 | -0.0449 |
| | | (0.0453) | (0.0432) | (0.0472) |
| Leadership contracts w/ results specification in some or all service areas and no results based renumeration/salary schemes in any service area ($\boldsymbol{R}_{10}$=1) (2008) | | -0.0257 | -0.0334 | -0.0570 |
| | | (0.1468) | (0.1065) | (0.1058) |
| No leadership contracts w/ results specification in any service area and results based renumeration/salary schemes in some or all service areas ($\boldsymbol{R}_{01}$=1) (2008) | | -0.0193 | -0.0258 | -0.0366 |
| | | (0.0503) | (0.0407) | (0.0508) |
| Effects of leadership agreements for: | | | | |
| Municipalities with $\boldsymbol{R}_{11}$=1 ($\boldsymbol{LA}_{11}$=1) | | 0.0947 *** | 0.1104 *** | 0.1279 ** |
| | | (0.0336) | (0.0388) | (0.0537) |
| Municipalities with $\boldsymbol{R}_{10}$=1 ($\boldsymbol{LA}_{10}$=1) | | 0.0472 | 0.0401 | 0.0636 |
| | | (0.1515) | (0.1173) | (0.1197) |
| Municipalities with $\boldsymbol{R}_{01}$=1 ($\boldsymbol{LA}_{01}$=1) | | -0.0563 | -0.0087 | -0.0100 |
| | | (0.0431) | (0.0326) | (0.0411) |
| Municipalities with $\boldsymbol{R}_{00}$=1 ($\boldsymbol{LA}_{00}$=1) | | -0.0631 † | -0.0568 † | -0.0729 * |
| | | (0.0397) | (0.0360) | (0.0392) |
| School career level covariates[b] | N | N | Y | Y |
| Municipality level covariates[b] | N | N | Y | Y |
| Lagged $\boldsymbol{R}_{.}$ (2004)[b] | N | N | N | Y |
| $N_{careers}$ | 3075 | 2535 | 2531 | 2284 |
| $N_{municipalities}$ | 269 | 194 | 191 | 158 |
| $R^2$ | 0.00 | 0.02 | 0.22 | 0.21 |
| $F$ | 0.74 | 3.35 | 33.09 | 33.22 |
| prob. ($F$) | 0.39 | 0.00 | 0.00 | 0.00 |

† p<0.15, * p<0.10, ** p<0.05, *** p<0.01

*Note:* Robust standard errors clustered at the municipal level in parentheses. School career observations are weighted by number of sampled students. a) Reference category is "No leadership contracts w/ results specification and no results based renumeration/salary schemes in any service area ($\boldsymbol{R}_{00}$=1). b) see table A2 for results from regression IV for municipality level and school career level covarites and lagged $\boldsymbol{R}_{.}$ values.

**Table 4b. The determinants of school career efficiency in reading (dependent variable: school career reading score fixed effect). OLS regressions.**

| | I | II | III | IV |
|---|---|---|---|---|
| Municipality has leadership agreements with school principals ($\boldsymbol{LA}$=1) | 0.0200 | | | |
| | (0.0208) | | | |
| Municipality has:[a] | | | | |
| Leadership contracts w/ results specification and results based renumeration/salary schemes in some or all service areas ($\boldsymbol{R}_{11}$=1) (2008) | | -0.0934 *** | -0.0720 ** | -0.0745 ** |
| | | (0.0308) | (0.0285) | (0.0373) |
| Leadership contracts w/ results specification in some or all service areas and no results based renumeration/salary schemes in any service area ($\boldsymbol{R}_{10}$=1) (2008) | | 0.0843 ** | 0.0219 | 0.0373 |
| | | (0.0364) | (0.0488) | (0.0467) |
| No leadership contracts w/ results specification in any service area and results based renumeration/salary schemes in some or all service areas ($\boldsymbol{R}_{01}$=1) (2008) | | -0.0228 | -0.0153 | -0.0346 |
| | | (0.0438) | (0.0352) | (0.0460) |
| Effects of leadership agreements for: | | | | |
| Municipalities with $\boldsymbol{R}_{11}$=1 ($\boldsymbol{LA}_{11}$=1) | | 0.0788 ** | 0.1077 *** | 0.1047 ** |
| | | (0.0305) | (0.0318) | (0.0441) |
| Municipalities with $\boldsymbol{R}_{10}$=1 ($\boldsymbol{LA}_{10}$=1) | | -0.0175 | 0.0733 | 0.0362 |
| | | (0.0477) | (0.0512) | (0.0532) |
| Municipalities with $\boldsymbol{R}_{01}$=1 ($\boldsymbol{LA}_{01}$=1) | | -0.0432 | -0.0333 | -0.0141 |
| | | (0.0409) | (0.0327) | (0.0416) |
| Municipalities with $\boldsymbol{R}_{00}$=1 ($\boldsymbol{LA}_{00}$=1) | | -0.0157 | 0.0083 | 0.0148 |
| | | (0.0315) | (0.0312) | (0.0334) |
| School career level covariates[b] | N | N | Y | Y |
| Municipality level covariates[b] | N | N | Y | Y |
| Lagged $\boldsymbol{R}_{.}$ (2004)[b] | N | N | N | Y |
| $N_{careers}$ | 2992 | 2472 | 2467 | 2219 |
| $N_{municipalities}$ | 264 | 191 | 187 | 154 |
| $R^2$ | 0.00 | 0.01 | 0.23 | 0.23 |
| $F$ | 0.93 | 5.54 | 32.74 | 29.86 |
| prob. ($F$) | 0.34 | 0.00 | 0.00 | 0.00 |

† p<0.15, * p<0.10, ** p<0.05, *** p<0.01

*Note:* Robust standard errors clustered at the municipal level in parentheses. School career observations are weighted by number of sampled students. a) Reference category is "No leadership contracts w/ results specification and no results based renumeration/salary schemes in any service area ($\boldsymbol{R}_{00}$=1). b) see table A2 for results from regression IV for municipality level and school career level covarites and lagged $\boldsymbol{R}_{.}$ values.

**Table 4c. The determinants of school career efficiency in English (dependent variable: school career English score fixed effect). OLS regressions.**

| | I | II | III | IV |
|---|---|---|---|---|
| Municipality has leadership agreements with school principals ($\boldsymbol{LA}$=1) | -0.0083 | | | |
| | (0.0239) | | | |
| Municipality has:[a] | | | | |
| Leadership contracts w/ results specification and results based renumeration/salary schemes in some or all service areas ($\boldsymbol{R}_{11}$=1) (2008) | | 0.0375 | -0.0097 | -0.0028 |
| | | (0.0483) | (0.0291) | (0.0342) |
| Leadership contracts w/ results specification in some or all service areas and no results based renumeration/salary schemes in any service area ($\boldsymbol{R}_{10}$=1) (2008) | | -0.0612 | -0.0695 * | -0.0890 † |
| | | (0.0503) | (0.0410) | (0.0561) |
| No leadership contracts w/ results specification in any service area and results based renumeration/salary schemes in some or all service areas ($\boldsymbol{R}_{01}$=1) (2008) | | -0.0030 | -0.0421 | -0.0410 |
| | | (0.0376) | (0.0243) * | (0.0317) |
| Effects of leadership agreements for: | | | | |
| Municipalities with $\boldsymbol{R}_{11}$=1 ($\boldsymbol{LA}_{11}$=1) | | -0.0388 | 0.0434 | 0.0307 |
| | | (0.0416) | (0.0345) | (0.0566) |
| Municipalities with $\boldsymbol{R}_{10}$=1 ($\boldsymbol{LA}_{10}$=1) | | 0.0619 | 0.1185 | 0.1107 |
| | | (0.1348) | (0.0902) | (0.1012) |
| Municipalities with $\boldsymbol{R}_{01}$=1 ($\boldsymbol{LA}_{01}$=1) | | -0.0825 *** | -0.0203 | -0.0232 |
| | | (0.0311) | (0.0264) | (0.0361) |
| Municipalities with $\boldsymbol{R}_{00}$=1 ($\boldsymbol{LA}_{00}$=1) | | 0.0061 | 0.0047 | 0.0023 |
| | | (0.0396) | (0.0265) | (0.0278) |
| School career level covariates[b] | N | N | Y | Y |
| Municipality level covariates[b] | N | N | Y | Y |
| Lagged $\boldsymbol{R}_{.}$ (2004)[b] | N | N | N | Y |
| $N_{careers}$ | 3064 | 2535 | 2528 | 1671 |
| $N_{municipalities}$ | 270 | 195 | 192 | 140 |
| $R^2$ | 0.00 | 0.01 | 0.46 | 0.49 |
| $F$ | 0.12 | 2.4 | 85.55 | 67.38 |
| prob. ($F$) | 0.73 | 0.02 | 0.00 | 0.00 |

† p<0.15, * p<0.10, ** p<0.05, *** p<0.01

*Note:* Robust standard errors clustered at the municipal level in parentheses. School career observations are weighted by number of sampled students. a) Reference category is "No leadership contracts w/ results specification and no results based renumeration/salary schemes in any service area ($\boldsymbol{R}_{00}$=1). b) see table A2 for results from regression IV for municipality level and school career level covarites and lagged $\boldsymbol{R}_{.}$ values.

# Appendix

## Table A1. National test scores 2010 (dependent variable) and student characteristics. OLS regressions with school career fixed effects (not reported).

| | Mathematics | Reading | English |
|---|---|---|---|
| Lagged (5th grade) score | 0.9208 *** | 0.9575 *** | 1.1259 *** |
| | (0.0055) | (0.0057) | (0.0072) |
| Has lagged score (=1) | 0.4250 *** | 0.5567 *** | 0.5073 *** |
| | (0.0217) | (0.0251) | (0.0333) |
| Male (=1) | 0.0583 *** | -0.0527 *** | -0.0794 *** |
| | (0.0058) | (0.0070) | (0.0077) |
| 1st generation immigrant (=1)[a] | 0.0304 | -0.0154 | -0.1827 *** |
| | (0.0224) | (0.0268) | (0.0297) |
| 2nd generation immigrant (=1)[a] | 0.0483 *** | 0.0447 ** | -0.2044 *** |
| | (0.0168) | (0.0201) | (0.0226) |
| Fathers education (0=low to 9=high) | 0.0235 *** | 0.0158 *** | 0.0108 *** |
| | (0.0020) | (0.0024) | (0.0027) |
| Mothers education (0=low to 9=high) | 0.0279 *** | 0.0181 *** | 0.0172 *** |
| | (0.0020) | (0.0024) | (0.0027) |
| Father's income (1000 NOK) | 0.00E-05 | 1.00E-05 | -2.00E-05 ** |
| | (6,48E-06) | (7,67E-06) | (8,67E-06) |
| Mother's income (1000 NOK) | 6.00E-05 *** | 4.00E-05 * | 4.00E-05 † |
| | (2,00E-05) | (2,40E-05) | (2,80E-05) |
| Lives with mother and father (married) (=1)[b] | -0.0179 ** | -0.0177 * | 0.0172 † |
| | (0.0088) | (0.0105) | (0.0118) |
| Lives with mother only (=1)[b] | -0.0523 *** | -0.0458 *** | -0.0264 ** |
| | (0.0091) | (0.0109) | (0.0122) |
| Lives with mother and stepfather (=1)[b] | -0.0940 *** | -0.0756 *** | -0.0395 ** |
| | (0.0119) | (0.0143) | (0.0161) |
| Lives with father only (=1)[b] | -0.0470 ** | -0.0381 * | 0.0216 |
| | (0.0193) | (0.0230) | (0.0258) |
| Lives with stepmother and father (=1)[b] | -0.0360 | -0.0326 | -0.0115 |
| | (0.0308) | (0.0366) | (0.0414) |
| No. of siblings | -0.0037 | -0.0055 † | -0.0119 *** |
| | (0.0032) | (0.0038) | (0.0043) |
| Parity: 1st born (=1)[c] | 0.0270 * | 0.0445 ** | 0.0003 |
| | (0.0150) | (0.0179) | (0.0201) |
| Parity: 2nd born (=1)[c] | 0.0016 | 0.0354 ** | -0.0348 * |
| | (0.0145) | (0.0174) | (0.0195) |
| Parity: 3rd born (=1)[c] | 0.0057 | 0.0422 ** | -0.0357 * |
| | (0.0143) | (0.0171) | (0.0192) |
| $N_{students}$ | 50431 | 48886 | 49946 |
| $N_{careers}$ | 4502 | 4380 | 4480 |
| $R^2$ | 0.58 | 0.54 | 0.47 |

† p<0.15, * p<0.10, ** p<0.05, *** p<0.01

*Note:* a) reference category is norwegian; b) reference category is 'lives with unmarried mother and father'; c) reference category is 'born as fourth child or later'. See table A1 for descriptive statistics. Lagged (5th grade score) in the respective subjects are instrumented by lagged (5th grade) scores in the two other subjects.

## Table A2a. School fixed effects (dependent variables) and school career level characteristics (from regression IV in table 4a, b and c). OLS regressions.

| | Mathematics | Reading | English |
|---|---|---|---|
| Average school career score in National Test (2007) | -0.3437 *** | -0.4099 *** | -0.6625 *** |
| | (0.0187) | (0.0270) | (0.0273) |
| Share of male students | 0.0674 ** | -0.1300 *** | 0.0359 |
| | (0.0298) | (0.0401) | (0.0339) |
| Share of 1st generation immigrant students | -0.3195 *** | -0.2004 ** | -0.3466 *** |
| | (0.1091) | (0.0806) | (0.0827) |
| Share of 2nd generation immigrant students | -0.1267 | -0.2910 ** | -0.1223 |
| | (0.1029) | (0.1116) | (0.1117) |
| Father's education (0=low to 9=high), average | 0.0279 ** | 0.0562 *** | 0.0668 *** |
| | (0.0123) | (0.0193) | (0.0176) |
| Mother's education (0=low to 9=high), average | -0.0020 | -0.0039 | 0.0324 *** |
| | (0.0097) | (0.0116) | (0.0116) |
| Father's income (1000 NOK), average | 3.91E-05 | 8.12E-05 ** | 1.19E-04 *** |
| | (0.0000) | (0.0000) | (0.0000) |
| Mother's income (1000 NOK), average | 0.0005 ** | 0.0005 *** | 0.0003 * |
| | (0.0002) | (0.0002) | (0.0001) |
| Share of students living with mother and father (married) | -0.0728 | 0.0029 | -0.1301 ** |
| | (0.0678) | (0.0626) | (0.0608) |
| Share of students living with mother only | -0.2571 *** | -0.1454 ** | -0.0462 |
| | (0.0503) | (0.0585) | (0.0372) |
| Share of students living with mother and stepfather | -0.1296 * | -0.1280 † | 0.0007 |
| | (0.0687) | (0.0823) | (0.0851) |
| Share of students living with father only | -0.2613 * | -0.0976 | 0.0274 |
| | (0.1391) | (0.1228) | (0.1167) |
| Share of students living with stepmother and father | -0.1676 | -0.3081 | -0.2793 † |
| | (0.1787) | (0.2233) | (0.1798) |
| No. of siblings, average | 0.0099 | -0.0114 | -0.0109 |
| | (0.0259) | (0.0216) | (0.0174) |
| Share of 1st born students | 0.1446 * | 0.1656 ** | 0.0569 |
| | (0.0826) | (0.0810) | (0.0831) |
| Share of 2nd born students | -0.0096 | 0.0691 | -0.1379 † |
| | (0.0818) | (0.0878) | (0.0881) |
| Share of 3rd born students | 0.0044 | 0.0315 | 0.0840 |
| | (0.0881) | (0.0820) | (0.0860) |
| Lower level catchment school + higher level catchment school (=1) | -0.0042 | -0.0490 ** | -0.0368 * |
| | (0.0242) | (0.0220) | (0.0203) |
| Lower level catchment school + combined levels catchment school (=1) | 0.0187 | -0.0280 | -0.0603 * |
| | (0.0328) | (0.0265) | (0.0320) |
| Same combined levels catchment school throughout (=1) | 0.1036 *** | 0.0558 ** | 0.0681 *** |
| | (0.0268) | (0.0237) | (0.0221) |

† p<0.15, * p<0.10, ** p<0.05, *** p<0.01

*Note:* See table A3a, b and c for definitions and descriptive statistics.

**Table A2b. School fixed effects (dependent variables) and municipal level characteristics (from regression IV in table 4a, b and c). OLS regressions.**

| | Mathematics | Reading | English |
|---|---|---|---|
| Municipal exogenous revenue (log) (2008) | 0.0223 | 0.0587 | 0.2979 ** |
| | (0.1077) | (0.1212) | (0.1139) |
| Municipal population (log) (2007) | -0.0380 * | -0.0185 | 0.0134 |
| | (0.0199) | (0.0160) | (0.0141) |
| Pct. of municipal population w/ university degree (2007) | 0.2428 *** | 0.1478 ** | 0.0933 |
| | (0.0741) | (0.0698) | (0.0678) |
| Pct. of municipal population eligible for primary school (log) (2007) | 0.0023 | 0.0551 | 0.2630 *** |
| | (0.1218) | (0.1048) | (0.0928) |
| Share of socialists in local council (log) (2007-2011) | -0.0607 † | -0.0013 | -0.0344 |
| | (0.0383) | (0.0377) | (0.0346) |
| Party fragm. in local council: Herfindahl Index (2007-2011) | 0.1306 | 0.2457 | -0.3657 * |
| | (0.2586) | (0.1856) | (0.2037) |
| Leadership contracts and results based renumeration/salary schemes ($R_{11,2004}$=1) | -0.0327 | 0.0406 | 0.0542 |
| | (0.0451) | (0.0325) | (0.0408) |
| Leadership contracts but no results based renumeration/salary schemes ($R_{10,2004}$=1) | -0.0301 | -0.0142 | 0.0142 |
| | (0.0499) | (0.0459) | (0.0642) |
| No leadership contracts but results based renumeration/salary schemes ($R_{01,2004}$=1) | -0.0231 | 0.0235 | 0.0267 |
| | (0.0338) | (0.0273) | (0.0232) |

† p<0.15, * p<0.10, ** p<0.05, *** p<0.01

*Note:* See table A3a, b and c for definitions and descriptive statistics.

## Table A3a. Descriptive statistics for municipal level variables.

| | Population | | | | | Sample: Total sample | | | | | Sample: Municip. has leadership agreements (LA) with school principals (=0) | | | | | Sample: Municip. has leadership agreements (LA) with school principals (=1) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (N) | Min. | Mean | Max. | S. Dev. | (N) | Min. | Mean | Max. | S. Dev. | (N) | Min. | Mean | Max. | S. Dev. | (N) | Min. | Mean | Max. | S. Dev. |
| Mun. has leadership agreements (LA) with school principals | - | - | - | - | - | (277) | 0 | 0.40 | 1 | - | | 0 | 0.00 | 0 | - | | 1 | 1.00 | 1 | - |
| Municipal exogenous revenue (2008)[c, e] | (430) | 88 | 109 | 387 | 29 | (277) | 88 | 111 | 387 | 32 | (167) | 88 | 111 | 387 | 31 | (110) | 88 | 109 | 308 | 33 |
| Municipal population (2007)[c] | (430) | 214 | 11161 | 575475 | 33466 | (277) | 214 | 11964 | 575475 | 40056 | (167) | 455 | 9490 | 252051 | 21681 | (110) | 214 | 15722 | 575475 | 57648 |
| Pct. of municipal population w/ university degree (2007)[b] | (424) | 9.50 | 20.03 | 46.80 | 5.47 | (271) | 9.50 | 20.32 | 46.80 | 5.79 | (162) | 9.50 | 20.15 | 44.10 | 5.32 | (109) | 9.80 | 20.58 | 46.80 | 6.43 |
| Pct. of municipal population eligible for primary school | (424) | 0.06 | 0.14 | 0.20 | 0.02 | (271) | 0.09 | 0.14 | 0.20 | 0.01 | (162) | 0.10 | 0.14 | 0.20 | 0.01 | (109) | 0.09 | 0.14 | 0.18 | 0.01 |
| Share of socialists in local council (2007-2011)[c] | (430) | 0.00 | 0.35 | 0.81 | 0.15 | (277) | 0.00 | 0.35 | 0.81 | 0.15 | (167) | 0.00 | 0.35 | 0.81 | 0.15 | (110) | 0.00 | 0.35 | 0.76 | 0.14 |
| Party fragm. in local council: Herfindahl Index (2007-2011)[c] | (430) | 0.14 | 0.27 | 1.00 | 0.11 | (276) | 0.15 | 0.27 | 1.00 | 0.11 | (166) | 0.15 | 0.27 | 1.00 | 0.11 | (110) | 0.16 | 0.27 | 1.00 | 0.13 |

*Note:* Sources are a) Statistics Norway/Norwegian School of Mnagegement, b) Statistics Norway and c) Statistics Norway/Norwegian Social Sciences Data Service and d) Department for Local and Reional Affairs. e) municipal exogenous income is municipal taxes on income and wealth adjusted for spending needs, measured as a percentage of teh national average.

## Table A3b. Descriptive statistics for school career level variables.

| | Population | | | | | Sample | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Total sample | | | | | Municip. has leadership agreements with school principals (=0) | | | | | Municip. has leadership agreements with school principals (=1) | | | | |
| | (N) | Min. | Mean | Max. | S. Dev. | (N) | Min. | Mean | Max. | S. Dev. | (N) | Min. | Mean | Max. | S. Dev. | (N) | Min. | Mean | Max. | S. Dev. |
| School career FE: Mathematics score | (4502) | -2.25 | 0.11 | 2.70 | 0.31 | (3075) | -2.25 | 0.11 | 2.70 | 0.31 | (1463) | -1.96 | 0.10 | 2.04 | 0.32 | (1612) | -2.25 | 0.12 | 2.70 | 0.30 |
| School career FE: Reading score | (4380) | -3.41 | -0.31 | 2.79 | 0.31 | (2992) | -3.41 | -0.30 | 2.79 | 0.31 | (1421) | -3.41 | -0.32 | 2.79 | 0.31 | (1571) | -3.28 | -0.29 | 2.18 | 0.31 |
| School career FE: English score | (4480) | -3.71 | 0.72 | 4.21 | 0.39 | (3064) | -3.71 | 0.71 | 4.21 | 0.39 | (1457) | -2.91 | 0.72 | 4.21 | 0.39 | (1607) | -3.71 | 0.71 | 3.77 | 0.39 |
| Average school career score in National Test (2007): | (4800) | -2.94 | 0.02 | 1.84 | 0.41 | (3300) | -2.94 | 0.04 | 1.84 | 0.42 | (1555) | -2.85 | 0.00 | 1.84 | 0.39 | (1745) | -2.94 | 0.08 | 1.84 | 0.45 |
| Average school career score in National Test (2007): Reading | (4800) | -2.61 | 0.01 | 1.85 | 0.40 | (3300) | -2.61 | 0.04 | 1.85 | 0.41 | (1555) | -2.61 | -0.02 | 1.85 | 0.39 | (1745) | -2.61 | 0.09 | 1.85 | 0.43 |
| Average school career score in National Test (2007): English | (4800) | -3.21 | 0.01 | 2.20 | 0.42 | (3300) | -2.75 | 0.04 | 2.20 | 0.43 | (1555) | -2.75 | -0.02 | 2.20 | 0.40 | (1745) | -2.44 | 0.09 | 2.20 | 0.45 |
| Share of male students | (4799) | 0.00 | 0.51 | 1.00 | 0.15 | (3300) | 0.00 | 0.51 | 1.00 | 0.15 | (1555) | 0.00 | 0.51 | 1.00 | 0.15 | (1745) | 0.00 | 0.51 | 1.00 | 0.16 |
| Share of 1st generation immigrant students[a] | (4795) | 0.00 | 0.03 | 1.00 | 0.08 | (3297) | 0.00 | 0.03 | 1.00 | 0.08 | (1554) | 0.00 | 0.03 | 1.00 | 0.07 | (1743) | 0.00 | 0.03 | 1.00 | 0.09 |
| Share of 2nd generation immigrant students[a] | (4795) | 0.00 | 0.04 | 1.00 | 0.11 | (3297) | 0.00 | 0.05 | 1.00 | 0.12 | (1554) | 0.00 | 0.02 | 1.00 | 0.06 | (1743) | 0.00 | 0.07 | 1.00 | 0.16 |
| Father's education (0=low to 9=high), average | (4679) | 0.00 | 4.41 | 9.00 | 0.74 | (3212) | 0 | 4.48 | 9 | 0.79 | (1523) | 1 | 4.36 | 9 | 0.68 | (1689) | 0 | 4.60 | 9 | 0.86 |
| Mother's education (0=low to 9=high), average | (4773) | 0.00 | 4.52 | 9.00 | 0.73 | (3279) | 0 | 4.59 | 9 | 0.76 | (1541) | 0 | 4.49 | 9 | 0.67 | (1738) | 0 | 4.69 | 9 | 0.84 |

*Note:* Sources is Statistics Norway. a) Reference category is Norwegian. Weighted by number of sampled students.

## Table A3c. Descriptive statistics for school career level variables, cntd.

| | Population | | | | | Sample: Total sample | | | | | Sample: Municip. has leadership agreements with school principals (=0) | | | | | Sample: Municip. has leadership agreements with school principals (=1) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (N) | Min. | Mean | Max. | S. Dev. | (N) | Min. | Mean | Max. | S. Dev. | (N) | Min. | Mean | Max. | S. Dev. | (N) | Min. | Mean | Max. | S. Dev. |
| Father's income (1000 NOK), average | (4670) | 0 | 396 | 4556 | 151 | (3204) | 0 | 402 | 4556 | 171 | (1521) | 0 | 380 | 3967 | 92 | (1683) | 0 | 424 | 4556 | 222 |
| Mother's income (1000 NOK), average | (4781) | 0 | 276 | 2513 | 52 | (3285) | 0 | 280 | 2513 | 58 | (1545) | 0 | 271 | 2227 | 44 | (1740) | 12 | 290 | 2513 | 68 |
| Share of students living with mother and father (married)[a] | (4771) | 0.00 | 0.13 | 1.00 | 0.11 | (3279) | 0.00 | 0.14 | 1.00 | 0.11 | (1547) | 0.00 | 0.14 | 1.00 | 0.11 | (1732) | 0.00 | 0.14 | 1.00 | 0.11 |
| Share of students living with mother only[a] | (4771) | 0.00 | 0.14 | 1.00 | 0.12 | (3279) | 0.00 | 0.14 | 1.00 | 0.13 | (1547) | 0.00 | 0.13 | 1.00 | 0.12 | (1732) | 0.00 | 0.16 | 1.00 | 0.14 |
| Share of students living with mother and stepfather[a] | (4771) | 0.00 | 0.08 | 1.00 | 0.09 | (3279) | 0.00 | 0.08 | 1.00 | 0.09 | (1547) | 0.00 | 0.08 | 1.00 | 0.09 | (1732) | 0.00 | 0.07 | 1.00 | 0.09 |
| Share of students living with father only[a] | (4771) | 0.00 | 0.03 | 1.00 | 0.05 | (3279) | 0.00 | 0.03 | 1.00 | 0.05 | (1547) | 0.00 | 0.03 | 1.00 | 0.05 | (1732) | 0.00 | 0.02 | 1.00 | 0.05 |
| Share of students living with stepmother and father[a] | (4771) | 0.00 | 0.01 | 1.00 | 0.03 | (3279) | 0.00 | 0.01 | 1.00 | 0.03 | (1547) | 0.00 | 0.01 | 1.00 | 0.03 | (1732) | 0.00 | 0.01 | 1.00 | 0.03 |
| No. of siblings, average | (4798) | 0 | 1.88 | 11 | 0.46 | (3299) | 0 | 1.86 | 11 | 0.45 | (1554) | 0 | 1.89 | 11 | 0.41 | (1745) | 0 | 1.82 | 11 | 0.48 |
| Share of 1st born students[b] | (4789) | 0.00 | 0.39 | 1.00 | 0.15 | (3293) | 0.00 | 0.40 | 1.00 | 0.15 | (1552) | 0.00 | 0.38 | 1.00 | 0.15 | (1741) | 0.00 | 0.41 | 1.00 | 0.16 |
| Share of 2nd born students[b] | (4789) | 0.00 | 0.37 | 1.00 | 0.14 | (3293) | 0.00 | 0.36 | 1.00 | 0.14 | (1552) | 0.00 | 0.37 | 1.00 | 0.14 | (1741) | 0.00 | 0.36 | 1.00 | 0.15 |
| Share of 3rd born students[b] | (4789) | 0.00 | 0.18 | 1.00 | 0.12 | (3293) | 0.00 | 0.17 | 1.00 | 0.12 | (1552) | 0.00 | 0.18 | 1.00 | 0.12 | (1741) | 0.00 | 0.16 | 1.00 | 0.12 |

*Note:* Sources is Statistics Norway. a) reference category is 'lives with unmarried mother and father'. b) reference category is 'born as fourth child or later'. Weighted by number of sampled students.