Discussion Papers No. 566, November 2008
Statistics Norway, Research Department

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Who benefits from homework assignments?

Abstract:
Using Dutch data on pupils in elementary school this paper is the first empirical study that analyzes whether assigning homework has an heterogeneous impact on pupil achievement. Addressing potential biases that arise from unobserved school quality, pupil selection by exploiting different methods, I find that the test score gap is larger in classes where everybody gets homework than in classes where nobody gets homework. More precisely pupils belonging to the upper part of the socioeconomic status scale perform better when homework is given, whereas pupils from the lowest part are unaffected. At the same time more disadvantaged children get less help from their parents with their homework. Homework can therefore amplify existing inequalities through complementarities with home inputs.

Keywords: pupil performance; school inputs; home-environment

JEL classification: I20; I21; I29

Acknowledgement: Financial support from EEEPE (Economics of Education and Education Policy in Europe) is gratefully acknowledged. This paper has benefited from valuable suggestions and comments from Edwin Leuven. I would also like to thank Lars-Erik Borge, Monique De Haan, Torberg Falch, Gregory Jolivet, Helen Ladd, Erica Lindahl, Oddbjørn Raaum, Bjarne Strøm and seminary participants in Amsterdam, Padova and London for comments.

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1 Introduction

If part of the learning is substituted from the classroom to the home- environment, and the conductiveness to learning varies across home- environments, we may end up in a situation where the quality on education (unintentionally) differs between pupils from different socioeconomic backgrounds. By focusing on homework assignments to elementary school pupils, the current paper takes a closer look at this possibility.

Homework is commonly assigned to pupils in elementary school because it is believed to improve their performance. This belief is however not confirmed by the education literature where both results and opinions on the effectiveness of homework are contradictory (see Sharp et al., 2001 for an overview of different studies on homework). One of the most substantial empirical reviews on homework is conducted by Cooper (1989a) who collected nearly 120 empirical studies concerning the effect of homework on pupil outcome. His conclusion is that for elementary school pupils the effect of homework on achievement is negligible, if it exists at all (see also Cooper, 1989b and Cooper et al., 2006).[1]

Younger pupils, especially those in elementary education, have less well-developed study habits (Dufresne and Kobasigawa, 1989) and may be less able than older children to ignore irrelevant information in their home- environment (Lane and Pearson, 1982; Plude et al., 1994). The extent to which they learn from homework may therefore depend on how much help they get from their parents. Time spent on child care varies however across families and is typically found to be positively correlated with socioeconomic background. Two early empirical studies on this topic are Leibowitz (1974) and Hill and Stafford (1974) who both find that higher educated mothers spend more time with their children than lower educated mothers. More recent empirical work can be found in Todd and Wolpin (2006); Kimmel and

[1] In the same study Cooper points out that the effect of homework on achievement is grade dependent. For high school students and also junior high school students homework has a positive effect. Other studies that find a positive effect of homework on student achievement in higher grades are; Aksoy and Link (2000) for US high school students from the NELS88 program; and Grove and Wasserman (2006) for students participating in a microeconometric course at the Syracuse University.

Connelly (2007); Houtenville and Smith Conway (2008); and Guryan et al. (2008). The latter study is the only one that considers educational child care (including homework assignments). One of their findings is that higher educated parents spend more time on educational child care than lower educated parents.

If the effectiveness of assigning homework to young pupils depends on parental input, pupils from advantaged family backgrounds may learn more from their homework assignments than pupils from disadvantaged family backgrounds. Although it is mentioned by some education researchers as a potential adverse effect of assigning homework to young pupils (Baker, Le-Tendre and Akiba, 2005; Cooper, 1994), this aspect of homework has received surprisingly little attention in the empirical literature. Using Dutch survey data on pupils and teachers in elementary school, this paper is the first study that empirically analyzes whether the effect of assigning homework on pupil achievement differs across pupils from different socioeconomic backgrounds. As a measure on homework I use information on whether the teacher gives homework to everybody or nobody in the class. I conjecture that if students from advantaged family backgrounds learn more from homework assignments than students from disadvantaged family backgrounds, inequalities should be larger in homework-classes than in non homework-classes everything else equal.

Endogenous variation in the assignment of homework may arise because of several reasons and the primary objective in the empirical analysis is to eliminate sources of bias that possibly contaminate the results. First of all, potential biases caused by unobserved school quality and pupil selection are taken out by exploiting variation within schools. And in order to distinguish the effect of homework from unobserved teacher, class and pupil effects, I proceed by comparing within class differences in test scores in classes where everybody gets homework to within class differences in test scores in classes where nobody gets homework. This empirical strategy is comparable to a difference in difference approach. The advantage of looking at inequalities at the class level is that confounding effects of unobserved teacher and class characteristics drop out as long as they are homogeneous across pupils within

a class. And since everybody in the class either gets homework or does not get homework this approach also rules out within class correlations between homework and unobserved individual pupil effects.[2]

I find that the difference between high and low achievers is larger in classes where everybody gets homework than in classes where nobody gets homework. More precisely, pupils belonging to the upper part of the socioeconomic status scale gain from homework, whereas pupils from the lowest part are unaffected which is consistent with an interaction effect between home inputs and homework assignments.

One of the important findings in the Coleman Report (1966) was that by the time children enter first grade, already significant differences in verbal and mathematical competence exist among them. Also Carneiro, Heckman and Masterov (2005) report that test score gaps between white and black children already emerge by the age of school entry and tend to widen with age. The findings in the current paper are therefore of interest because they inform us about an early source of such inequalities. Moreover, the Netherlands is a country with a longstanding tradition in attempting to promote equality of opportunity in education (Leuven et al., 2007). If the intention of assigning homework is to reinforce the children's learning process at home (and thereby benefit from it) and families are unequal to the task, the pupils will not receive the same quality of education.

Although focus in this paper is on homework assignments, the underlying mechanisms may exist in all types of elementary school policies where learning is substituted from the class room to the home environment and vice versa. Another good example is the effect on pupil achievement of early childhood education programs (Currie, 2001) such as starting school at young ages which may be more beneficial for disadvantaged pupils since it takes learning out of the home environment at an early age. Using the same data as the current paper, Leuven et al. (2006) find that expanding enrollment opportu-

[2]Also Grove and Wasserman (2006) use a close to random assignment to estimate the impact of homework assignments on grades. It is however important to point out that they look at homework assignments in college where complementarities with home inputs are more unlikely to be important. Children in elementary school on the other hand are not completely autonomous which sets apart the current paper from theirs.

nities around age 4 has a positive effect on the achievement of disadvantaged pupils and no effect on the achievement of non-disadvantaged pupils.

The structure of the paper is as follows; Section 2 describes the data; Section 3 takes a closer look at homework and the home environment; the empirical approach is lined out in Section 4; Section 5 presents the results; and Section 6 concludes.

2 Institutional settings and data

Elementary school in the Netherlands consists of eight grades. Children start school when they are 4/5 years old and finish when they are 11/12 years old. Every teacher covers all the subjects in the class. In the period under investigation, schools did not have catchment areas and there was free school choice.

The empirical analysis in this paper builds on data from the four last waves of the Dutch PRIMA survey. This is a biannual survey which samples schools and contains information on about 10 percent of the Dutch pupils in grade 2, 4, 6 and 8. The first survey took place in the school year 1995/1996 and the last wave used in this paper is for the school year 2001/2002. Several actors contributed to the collection of the data: The pupil's parents; the pupil's teachers; the school's principals; and the pupils themselves.

In the Netherlands homework is typically assigned on language related tasks such as reading and writing. To measure pupil outcomes I therefore use test scores from a language-test.[3] This test is identical across schools and for all the four last PRIMA waves and graded externally. I standardize test scores so that they have zero mean and standard deviation equal to one by grade and year for comparability reasons.

Information on homework comes from the teacher questionnaires. Teachers in grades 4, 6 and 8 were asked how often they assign homework and could

[3]The test was taken halfway during the school years. There are some small differences regarding the responsible staff in the class room when the test was taken. In the second wave the test was monitored by an external examiner, while in the three reminding waves the teacher of the class was in charge during the test. Year dummies are added in the regression analysis.

Table 1: Teachers' homework assignments in language (percentages)

	Grade		
	4	6	8
Hardly or never	48.4	38.6	15.4
Weak pupils only	30.5	27.4	10.1
Good pupils only	0.1	0.2	0.5
Everybody	21.0	33.8	74.0

choose between four answers: i) hardly or never to anyone in my class; ii) only to the weak students in class; iii) only to the good students in class; and iv) to everybody in my class. An overview of teachers' homework practices in language is given in Table 1. In grade 4, about 50 percent of the teachers hardly ever gives homework, and if teachers assign homework it tends to be remedial in the sense that the majority of the teachers in grade 4 that assign homework, do this to the weaker students. Homework becomes less remedial and more inclusive in the higher grades, and by the time pupils reach grade 8 a majority of the teachers give homework to the whole class. Hardly any teacher gives homework to the good pupils only. The data contain no information on how often the pupils get homework, but based on anecdotal evidence homework is typically given regularly, but not every day.

In the empirical analysis, I will compare classes that get homework (homework-classes) to classes that do not get homework (non-homework classes) and will therefore drop classes where only weak or good pupils get homework. This amounts to 1,681 classes and 31,638 pupils.

The parent questionnaires provide information on the pupil's age, gender, the education levels of the parents and whether the pupil has a non-Western migrant background.[4] I divide parent's education level into primary education, lower vocational, upper secondary/intermediate vocational and university/higher vocational. In the analysis I will also control for class level characteristics such as the teacher's experience, gender and log of class size. These variables come from the teacher questionnaires. Since each teacher

[4]This variable is derived from the funding scheme for Dutch primary schools that gives students with an ethnic minority background a weight equal to 1.9.

teaches all the subjects in the class, I can not separate teacher from and class effects. For simplicity, the term "class characteristics" will therefore refer to both characteristics of the class and the teacher in the remainder of the paper.

Table 2 gives a descriptive overview of the explanatory variables used in the empirical analysis. About half of the pupils are girls, the average age is 10 years and 24 percent come from a non-Western migrant background. Furthermore, 18 (14) percent of the mothers (fathers) have primary education, 32 (32) percent have lower vocational, 30 (24) percent have upper secondary/intermediate vocational and 12 (16) percent have higher vocational/university. Concerning the class characteristics, the average teacher has 18.4 years with experience and teaches a class consisting of 23 pupils. 54 percent of the teachers are females.

Homework is not distributed randomly in the population. This is illustrated by Table 3 which presents estimates from a linear probability model obtained from regressing the indicator variable for homework on observed pupil and class characteristics. The probability of getting homework is typically higher for older pupils and pupils from non-Western migrant backgrounds. With respect to parental education, pupils whose mother's education is higher than or equal to upper secondary are less likely to get homework than pupils with a lower vocational educated mother. And pupils with a primary (upper secondary) educated father are more (less) likely to get homework than pupils with a lower vocational educated father. The chances for homework assignments are also higher if the teacher is a woman. These findings show that homework is strongly correlated with observed characteristics that correlate with achievement. Moreover, they illustrate that there is a remedial aspect connected to giving homework since it is the weakest pupils who get homework, and potential endogeneity problems must be addressed.

3 Homework and the home environment

Parental time spent on child care varies across families and is typically positively correlated with family background (see references in section 1).

Table 2: Sample summary statistics

	Mean	s.d.
Individual Characteristics (N = 96,925)		
Girl	0.47	0.50
Age	10.02	1.78
Non-Western migrant background	0.24	0.43
Mother's education		
- Primary	0.18	0.38
- Lower vocational	0.32	0.47
- Upper secondary/intermediate vocational	0.30	0.46
- University/higher vocational (higher education)	0.12	0.33
- Missing	0.08	0.27
Father's education		
- Primary	0.14	0.35
- Lower vocational	0.32	0.47
- Upper secondary/intermediate vocational	0.24	0.43
- University/higher vocational (higher education)	0.16	0.36
- Missing	0.14	0.35
Class Characteristics (N = 5,549)		
Class size	24.40	5.70
Teacher's experience	18.30	10.60
Female teacher	0.53	0.50

Missing information: student's gender (5.43%); student's age (1.10%); female teacher (1%); class size (0.56%); teacher experience (0.32%)

Table 3: The determinants for assigning homework

	(1)
Individual characteristics	
Girl	0.0012
	(0.0030)
Age	0.0070
	(0.0030)**
Non-Western migrant	0.0888
	(0.0095)***
Mother's education (ref = Low. Voc.)	
- Primary	−0.0005
	(0.0077)
- Upper secondary	−0.0119
	(0.0053)**
- Higher education	−0.0306
	(0.0075)***
Father's education (ref = Low. Voc.)	
- Primary	0.0184
	(0.0080)**
- Upper secondary	−0.0146
	(0.0052)***
- Higher education	−0.0082
	(0.0076)
Class characteristics	
Log of class size	−0.0222
	(0.0244)
Female teacher	0.0310
	(0.0142)**
Teacher experience	−0.0005
	(0.0006)
R-squared	0.2337
	96,925

Note: Reported are OLS coefficients. Standard errors are heteroscedastic robust and corrected for class level clustering. Included are also a constant term, year and grade dummies, dummy variables for missing information on the pupil's gender and age and parental education, missing information on class size, teacher's gender and experience. *, ** and *** denote statistical significance at the 10, 5 and 1 percent level respectively.

Table 4: Parental help with homework (percentages)

	Mother	Father
Almost never	7.8	19.6
Sometimes	44.5	58.8
Often	47.8	21.6

Note: 4,344 observations on maternal help with homework and 3,425 observations on paternal help with homework.

This section sets out to shed some further light on the relationship between parental help with homework and parental background using the PRIMA data.

The first wave of the PRIMA survey asked the parents of pupils in grade 4 how much they help their children with homework (conditional on that the children get homework).[5] There is separate information on mothers and fathers, and the frequency of parental help with homework is divided into three categories; "almost never"; "sometimes"; and "often". A descriptive overview of these answers is found in Table 4. More mothers than fathers "often" assist with homework, whereas more fathers than mothers "almost never" assist with homework. This finding is in line with Guryan et al. (2008) who also find that mothers spend more time on educational child care (including homework) than fathers (see also Bianchi, 2000).

To see which parents give help with homework, I proceed by estimating a bivariate ordered probit model where the (latent) propensity to help with homework of both the mother and father depend on parental characteristics and the child's gender. A bivariate ordered probit is a straightforward extension of the univariate ordered probit. The error terms in the two latent variable equations are assumed to be jointly normal, with standard deviations equal to 1 and the correlation is an estimable parameter.[6] The advantage

[5] In this wave the question about teachers' homework practice differs from the other waves. Data from this wave is therefor not used in the remaining analysis that will be lined out in section 4.

[6] For further details see Cameron and Trivedi (2005, pp.521-23).

Table 5: Relation between parental help with homework and parental background, estimates from a bivariate ordered probit model (PRIMA 1993/94).

	Mother	Father
Girl	−0.1454	−0.0596
	(0.0412)***	(0.0400)
Non-Western migrant	−0.6425	−0.3723
	(0.0833)***	(0.0787)***
Parents highest level of education (ref = Low. Voc.)		
- Primary	−0.3062	−0.1345
	(0.0833)***	(0.0842)*
- Upper secondary	0.0253	0.0628
	(0.0467)	(0.0458)
- Higher education	−0.0050	0.0065
	(0.0663)	(0.0563)

Note: N = 3212. Standard errors in (...). *** and * denote that the effect is statistically significant at the 1 and 10 percent levels respectively. Included are also dummy variables for missing information on the pupil's gender and parent's education.

of using a bivariate ordered probit is that it takes into account the ordinal nature of the homework question and jointly considers mothers' and fathers' effort. Previous studies of parental child care tend to consider mothers and fathers separately.

The results which are presented in Table 5 show that parental help with homework differs considerably across students from different socioeconomic backgrounds. First, conditional on parental education, children from non-Western migrant backgrounds get substantially less help with their homework from both mothers and fathers. The effect which is statistically significant at the one percent level for both parents amounts to 64 percent of a standard deviation for mothers and 37 percent for fathers. This is probably at least in part explained by the fact that parents from ethnic minority backgrounds are less proficient in Dutch and therefore less capable of helping their children with their Dutch homework assignments. And secondly, parents whose highest level of obtained education is primary school (or less) seem to help their children less with homework than parents belonging to the other education groups. For mothers this is 31 percent of a standard deviation, whereas it for fathers is 14 percent of a standard deviation. The effect is only statistically significant at the one percent level for mothers. Note also that girls get less help than boys.[7]

Mothers' and fathers' help with homework is not independent of each other. The estimated correlation between parents' latent propensity to help with homework is 0.52 and statistically significant at the one percent level. This points to either complementarities or important family specific effects.

This analysis shows that children from more disadvantaged backgrounds receive less help with their homework assignments. One implicit assumption is that the quality of the parental inputs is the same across socio-economic groups. It seems however likely that the (unobserved) quality of parental inputs correlates positively with the amount of human capital of the parents. This would imply that, even keeping constant the time parents spend helping

[7] Among the mothers (fathers) from a non-Western migrant background, 52 (42) percent have primary school or less as highest level of obtained education and 24 (28) percent have missing information on education.

their children with homework, children with less able parents get less help with homework. An example in place are children from ethnic minority families where the parents have limited Dutch language skills.

4 Empirical approach

To the extent that the effect of homework on student learning depends on parental inputs, the findings in the previous section are the first indications that the effect of homework may differ across students from different family backgrounds. This section lines out how to empirically identify and test whether heterogeneous effects of homework exist.

Assume that the impact of homework on the achievement (y) of pupil i in class j and school s can be explained by the following education production function:

$$y_{ijs} = x_i'\beta + \omega_{js}'\varphi + \delta_i hw_{js} + \varepsilon_{ijs} \tag{1}$$

To simplify the analysis I assume that there are only two types of pupils in this model, i.e. $i = \{a, d\}$ where a and d denote advantaged and disadvantaged family background; x_i is a vector of observed attributes of the pupil and his parents; ω_{js} is a vector of observed class characteristics; and hw_{js} is an indicator variable taking the value 1 if the class receives homework and zero if the class does not get homework. The parameter of interest is δ_i, where subscript i indicates that the effect of homework can differ between pupils. More precisely it is expected that $\delta_a > \delta_d$ which is the hypothesis this paper sets out to investigate. Since pupils from advantaged family backgrounds get more help with their homework, they may benefit more from homework assignments than pupils from disadvantaged backgrounds.[8]

The central problem I face when estimating equation (1) by Ordinary Least squares (OLS) is that the estimate of the homework effect may be contaminated by omitted variables such as the influence of unmeasured class and teacher characteristics as well as unobserved school characteristics. Consequently, I must be careful with giving $\hat{\delta}_i$ a causal interpretation. Note that

[8] In the presence of potential measurement errors in teachers' homework practice $\hat{\delta}_i$ is underestimated.

the sign of the bias is not clear a priori. Good schools may give homework to do even better, or bad schools may give homework to make up for poor learning environments. For similar reasons, homework may be assigned to good and bad classes. Moreover, poor teachers may use homework to compensate for the lack of teaching skills, whereas good teachers may use it to achieve ambitious goals. Correlation between homework and unobserved school and class characteristics may also arise because of pupil sorting. How these correlations net out is unclear. Because in my sample homework is assigned to the whole class, I can rule out correlation between homework and unobserved individual pupil effects conditional on a class fixed effect..

Since one of the potential sources of bias is correlation between unobserved school characteristics and homework, I start out by adding a school fixed effect, ψ_{is}, to equation (1):

$$y_{ijs} = x_i'\beta + \omega_{js}'\varphi + \delta_i hw_{js} + \psi_{is} + u_{ijs} \tag{2}$$

This identification rests on schools where there is variation in homework practices between classes within grades, i. e., ψ_{is} is actually a school grade fixed effect. Moreover, ψ_{is} is allowed to vary across the two types of students indicated by subscript i. As a first attempt to check whether heterogeneous effects of homework exist equation (2) will be estimated separately for the two types of students; a and d.[9]

Although school fixed effects estimation improves on OLS, u_{ijs} may still contain unobserved characteristics of the teachers and classes, allowing within school differences in homework assignment to correlate with differences in teacher quality and attributes of the classes. A standard way to solve these problems would be to estimate a more elaborate fixed effects model and to include a teacher and a class fixed effect. Unfortunately these effects can not be identified given my data. The remainder of this section is therefore concerned with how to purge the homework estimates from the confounding

[9] When estimating Equation (2) (and also the remaining equations which I will elaborate in the remainder of this chapter), schools with no variation in homework within grades and schools are dropped. A descriptive overview over this reduced sample is shown in Appendix Table A1.

effects of these unobserved characteristics.

When focusing on within class differences in tests scores the effect of homework can arguably be separated from unobserved teacher and class effects. Consider two pupils, a and d. Subtracting y_{djs} from y_{ajs} gives the following expression:

$$\tilde{y}_{js} = \tilde{x}'_{js}\beta + \rho hw_{js} + \eta_s + \varepsilon_{js} \tag{3}$$

Where $\tilde{y}_{js} = (y_{ajs} - y_{djs})$ is an inequality measure, $\tilde{x}'_{js} = (x_{ajs} - x_{djs})$, $\rho = (\delta_a - \delta_d)$, $\eta_s = (\psi_{as} - \psi_{ds})$ and $\varepsilon_{js} = (u_{ajs} - u_{djs})$. The advantage of this procedure is that any unobserved teacher and class fixed effects, θ_j, drop out as long as they are homogeneous across pupils within class. In other words, θ_j is assumed to affect the average achievement level only. If the impact of homework on achievement is homogeneous, i.e. $\delta_a = \delta_d$, its effect on within class differences in test scores will be zero, involving that $\rho = 0$. If on the other hand pupils from more advantaged backgrounds benefit more from homework than students from disadvantage backgrounds, i.e. $\delta_a > \delta_d$, differences in test scores should be larger in classes where everybody gets homework compared to classes where nobody gets homework ($\rho > 0$). Note that I still condition on the school-grade fixed effect, η_s. This approach is therefore comparable to a difference-in-difference strategy. Comparing classes within the same grade and school ensures that potential problems connected to pupil sorting across schools can be ruled out. Since Dutch parents face free school choice and no school catchment areas it is important to take this into account.

In order to simplify the analysis I base the inequality measures $\tilde{y}_{js}$ on residuals from OLS regressions that correct test scores for observed student and class characteristics. More precisely, I start out with estimating $y_i = x'_i\beta + \upsilon_i$ with OLS and calculate $\hat{\upsilon}_i = y_i - x'_i\hat{\beta}$. The within class inequality equation that is estimated in the paper is then given by:

$$(\hat{\upsilon}_{ajs} - \hat{\upsilon}_{djs}) = \rho hw_{js} + \varphi_s + \epsilon_{js} \tag{4}$$

As a measure of $(\hat{\upsilon}_{ajs} - \hat{\upsilon}_{djs})$ I use the variance of the residuals as well

as differences between various percentiles within the class. A descriptive overview of the inequality measures are given in Appendix Table A2.

Although the assumptions made here are restrictive they improve substantially on the (individual) level equations where δ_i correlates with θ_j.[10]

5 Results

Although homework is not randomly assigned across pupils, a useful way of starting is to look at the relation between homework and pupil achievement in a simple OLS. This is reported in Table 6. In column (1) which is obtained from a specification without covariates, the homework estimate is negative and highly significant. More precisely it indicates that pupils who get homework perform 12 percent of a standard deviation worse on average than pupils who do not get homework. As already discussed above, this effect cannot be given a causal interpretation since homework tends to be given to classes with weaker pupils. Column (2) confirms this. When controlling for individual characteristics, the effect decreases to 0.5 percent of a standard deviation and is clearly insignificant. In column (3) where I also control for class characteristics the effect is further reduced to 0.016 percent of a standard deviation. This confirms that homework is highly correlated with both individual and class characteristics, and some more elaborated strategies are essential in order to identify the effect of homework.

One such strategy is to compare pupils within schools and grades only. Table 7 presents result from estimating equation (2) with a school-grade fixed effect. The left panel (column 1 to 3) reports results from various specifications including all pupils, whereas the right panel stratifies pupils by mother's education and reports results from the most elaborate specification only (with controls for both individual and class characteristics).

[10] One potential objection to this framework is that improvement of reading ability should have been considered as a cumulative process, i.e. homework assignment in grade 4 affects reading capabilities two and four years later (in grade 6 and 8). Since the PRIMA survey samples schools every other year and only collects data in the even grades, I cannot follow individual students who repeat grades or who move to another school. This together with the fact that grade repetition is fairly common among weak students in the Netherlands complicates an empirical investigation of the cumulative process.

Table 6: The relation between homework and achievement, OLS

	(1)	(2)	(3)
Homework	−0.1206	−0.0049	−0.0016
	(0.0163)***	(0.0115)	(0.0114)
INDIVIDUAL CHARACTERISTICS			
Girl		0.0741	0.0741
		(0.0061)***	(0.0061)***
Age		−0.1664	−0.1658
		(0.0053)***	(0.0053)***
Non-Western migrant		−0.5350	−0.5228
		(0.0114)***	(0.0115)***
Mother's education (ref. = Low. Voc.)			
- Primary		−0.1350	−0.1311
		(0.0117)***	(0.0117)***
- Upper secondary		0.2100	0.2084
		(0.0085)***	(0.0084)***
- Higher education		0.3928	0.3916
		(0.0127)***	(0.0127)***
Father's education (ref. = Low. Voc.)			
- Primary		−0.0747	−0.0718
		(0.0119)***	(0.0118)***
- Upper secondary		0.1426	0.1418
		(0.0088)***	(0.0088)***
- Higher education		0.2975	0.2970
		(0.0115)***	(0.0115)***
CLASS CHARACTERISTICS			
Log of class size			0.0939
			(0.0211)***
Female teacher			−0.0135
			(0.0111)
Teacher experience			0.0028
			(0.0005)***
R-squared	0.0029	0.2026	0.2044

Note: N = 96,925. The unit of observation is the individual student. Standard errors are heteroscedastic robust and corrected for class level clustering. *** denotes that the effect is statistical significance at the 1 percent level. Included in all specifications are a constant term, grade and year dummies.

¤ The specifications which control for individual characteristics also include dummy variables for missing information on the pupil's gender and age and parental education. The specification(s) which control for class characteristics also include(s) dummy variables for missing information on class size, teacher's gender and experience.

The first thing to note in Table 7 is that the point estimates of homework change very little when including individual and class characteristics which implies that homework may not correlate with (observed) individual and class characteristics when conditioning on a school-grade fixed effect. Moreover, the effect of homework on pupil achievement is positive and amounts to about 5 percent of a standard deviation, but is only significant at the eighteen percent level (in specification (3)). Turning to the right panel, column (4) shows that pupils of mothers who at least have a lower vocational education significantly improve their achievement by 7 percent of a standard deviation when homework is given. The magnitude of this effect is comparable to Leuven et al. (2006) who, by using the same data as the current paper, find that Dutch disadvantaged pupils who get an extra month of schooling at age 4 increase their language scores at age six by 6 percent of a standard deviation. For pupils of primary educated mothers, the point estimate of homework is negative. This suggests that homework may even make these pupils perform worse. This can for instance be the case if homework is a substitute to classwork, i.e. teachers yield less effort in the classroom when homework is given compared to what they would have done otherwise. The estimated effect is however very small and insignificant.

Summarized, when ruling out correlation between homework and unobserved school characteristics, I find that assigning homework has a positive effect on average pupil achievement, but the effect is not significant at any conventional level. However, when stratifying on mother's education the effect becomes larger and significant for pupils of higher educated mothers, whereas it becomes negative and insignificant for pupils of primary educated mothers.[11]

To the extent that giving homework to the whole class is systematically related to unobserved teacher and class characteristics that are also correlated with student achievement, the homework estimate in Table 7 may not imply the causal effect. The next section is concerned with whether this pattern

[11] If I do not correct for grade level clustering in Table 7, the effect of homework on average pupil achievement is statistically significant at the 10 percent level and the effect of homework on the achievement of pupils whose mother has an education beyond primary school is statistically significant at the 5 percent level.

Table 7: The effect of homework on student achievement, fixed effect estimates

				Education Mother	
				> Primary	Primary
	(1)	(2)	(3)	(4)	(5)
Homework	0.0448	0.0469	0.0520	0.0722	-0.0105
	(0.0416)	(0.0389)	(0.0385)	(0.0404)*	(0.0624)
Controls					
- Individual	No	Yes	Yes	Yes	Yes
- Class	No	No	Yes	Yes	Yes
N classes	254	254	254	254	254
N	4,316	4,316	4,316	3,349	967
R-squared	0.0006	0.0950	0.0960	0.0601	0.0533

Note: The unit of observation is the individual student. Standard errors are heteroscedastic robust and corrected for grade level clustering. * denotes that the effect is statistical significance at the 10 percent level. Included in all specifications are a constant term, grade and year dummies. See also ¤ Table 6

remains when analyzing the effect of homework on within class differences in test scores.

5.1 The effect of homework on within class differences

Table 8 presents results from estimating equation (4) which compares within class differences in test scores across class rooms within the same school and grade. Each row represents one regression. Out of totally five point estimates of homework, four are significantly different from zero at the one, five and ten percent level. And the general picture is that homework increases within class differences in test scores.

The upper panel of the table shows that both the variance as well as the distances between the 75th and the 55th and the 85th and the 15th percentiles are significantly larger in homework-classes than in non-homework classes. The point estimates amount to about 20 - 30 percent of a standard deviation.

The lower panel of Table 8 confirms the findings in Table 7 to a large

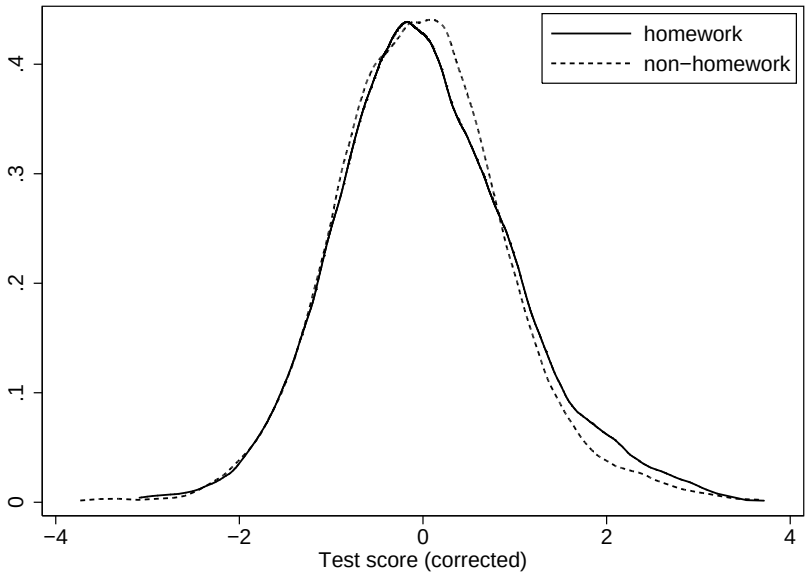

Figure 1: The distribution of test scores in homework classes and non-homework classes

Table 8: The effect of homework on within class differences in test scores, fixed effect estimates

Dependent variable	Effect	Standard error
Variance	0.0573	(0.0287)**
Percentile ranges		
75th - 25th	0.0757	(0.0443)*
85th - 15th	0.1749	(0.0695)**
85th - 50th	0.1646	(0.0535)***
50th - 15th	0.0103	(0.0396)

Note: N=254. The unit of observation is the class. Included are also a constant term and year dummies. The standard errors are robust. *, ** and *** denote statistical significance at the 10, 5 and 1 percent level respectively.

degree. Giving homework to the whole class has a positive and significant impact on the distance between the 85th percentile and the median, whereas the distance between the median and the 15th percentile is the same in homework and non-homework classes. Pupils from the upper part of the socioeconomic status scale seem to significantly benefit from homework.[12]

A non-parametric way of analyzing the same problem, is to divide the pupils into two groups depending on whether they are in homework-classes or not, and plot the density distribution of test score separately for these two groups. Since the relevant approach is a within school within grade comparison, the test scores are standardized by grade, school and year. The results is shown in Figure 1. The lower part of the distribution coincide in homework and non-homework classes implying that the weakest pupils are unaffected by homework. The upper part of the distribution is on the other hand skewed to the right in homework-classes, and confirms thereby that it is the better pupils who actually benefit from homework.

6 Concluding remarks

Using Dutch data on elementary school children and their teachers this paper starts out by showing that Dutch children from the lowest part of the socioeconomic status scale receive less homework help from their parents than other children. To the extent that the effect on pupil learning of assigning homework depends on home inputs this suggests that pupils from advantaged family backgrounds may learn more from homework than pupils from disadvantaged family backgrounds.

The paper continues by showing that the point estimate of homework is very sensitive to the inclusion of explanatory variables in a simple OLS framework. I implement two empirical strategies to control for the correlation between homework and unobserved characteristics.

[12] Appendix Table A3 presents results from estimating Equation (4) when also controlling for observed class characteristics. Note that the point estimates slightly decrease, and that observed class characteristics do not have any impact on within class differences. The latter is reassuring since I have assumed that unobserved teacher/class characteristics affect the average achievement level only, and not within class differences in test scores.

The first one compares pupils within schools and grades and find that children from advantaged family backgrounds improve their achievement level if homework is given. Children from disadvantaged backgrounds on the other hand seem not to benefit from homework. On average, homework has a positive impact on pupil achievement, but this effect is not significant.

The second approach considers within class inequalities in test scores. Under the assumption that unobserved teacher and class effects are homogeneous across pupils in the same class this approach purges the estimates from the confounding effects of teacher and class fixed effects. The results are consistent with the analysis with only school fixed effects, and indicates that the test score gap is significantly larger in homework-classes than in non homework-classes. And it is the pupils belonging to the upper part of the test score distribution that perform better, whereas pupils in the lowest part of the scale are unaffected.

These findings are important because they inform us about an early source of inequality. It is well documented that pupils from disadvantage backgrounds fall behind at a very early age (even before they start school), and many education subsidies are motivated as an attempt to reduce these inequalities. It is therefore both essential and necessary to learn more about potential sources that generate or increase (already existing) inequalities.

Parents of children from disadvantaged backgrounds may be less capable to follow up instructions from schools, teachers and principals. This may involve that all school policies that aim at giving parents more responsibility for their children's learning unintentionally contributes to a situation where the quality of education differs across pupils from different socioeconomic backgrounds. As shown in this paper, giving homework to children in elementary school only improves the achievement level of pupils from advantaged family backgrounds.

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A Appendix

Table A1: Sample summary statistics, reduced sample

	Mean	s.d.
Individual Characteristics (N = 4,316)		
Girl	0.47	0.50
Boy	0.47	0.50
Age	9.53	1.70
Non-Western migrant background	0.31	0.46
Mother's education		
- Primary	0.22	0.42
- Lower vocational	0.31	0.46
- Upper secondary/intermediate vocational	0.29	0.45
- University/higher vocational (higher education)	0.12	0.33
- Missing	0.06	0.24
Father's education		
- Primary	0.17	0.38
- Lower vocational	0.30	0.46
- Upper secondary/intermediate vocational	0.23	0.42
- University/higher vocational (higher education)	0.16	0.36
- Missing	0.15	0.35
Class Characteristics (N = 254)		
Class size	22.45	5.35
Teacher's experience	16.80	10.80
Female teacher	0.60	0.49

Table A2: Descriptive statistics, different inequality measures at the class level

	Mean	s.d.
Variance	0.830	0.231
Percentile Ranges		
75th - 25th	1.050	0.355
85th - 15th	1.654	0.557
85th - 50th	0.876	0.424
50th - 15th	0.778	0.333
N	254	

Table A3: The effect of homework on within class differences in test scores, fixed effect estimates

		Percentile ranges			
	Variance	75th-25th	85th-15th	85th-50th	50th-15th
Homework	0.0485	0.0641	0.1591	0.1639	-0.0048
	(0.0284)*	(0.0432)	(0.0677)**	(0.0533)***	(0.0385)
Class characteristics					
Log of class size	-0.0233	-0.0913	0.2095	0.1433	0.0663
	(0.0736)	(0.1435)	(0.1896)	(0.1247)	(0.1081)
Female teacher	0.0170	-0.0346	0.0536	-0.0097	0.0634
	(0.0440)	(0.0617)	(0.0950)	(0.0683)	(0.0574)
Teacher experience	-0.0019	-0.0010	-0.0006	-0.0038	0.0032
	(0.0021)	(0.0027)	(0.0050)	(0.0040)	(0.0023)
R-squared	0.1412	0.1517	0.1564	0.1229	0.1348

Note: See table 8. Included are also dummy variables for missing information on class size, teacher's gender and experience.