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Who benefits from homework assignments?

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ABSTRACT

Using Dutch data on pupils in elementary school this paper is the first empirical study to analyze whether assigning homework has a heterogeneous impact on pupil achievement. Addressing potential biases by using a difference-in-difference approach, 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 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.

1. Introduction

Homework is commonly assigned to pupils in elementary school because it is believed to improve their performance. However, this belief is 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 (see also Cooper, 1989b; Cooper, Civey, & Patall, 2006).[1]

Younger pupils, especially those in elementary education, have less well-developed study habits (Dufresne & Kobasigawa, 1989) and may be less able than older children to ignore irrelevant information in their home environment (Lane & Pearson, 1982; Plude, Enns, & Brodeur, 1994). The extent to which they learn from homework may therefore depend on how much help they get from their parents. However, the time spent on child care varies 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 better educated mothers spend more time with their children than less educated mothers. More recent empirical work can be found in Todd and Wolpin (2006),Kimmel and Connelly (2007),Houtenville and Smith Conway (2008); and Guryan, Hurst, and Kearney (2008). The latter study is the only one that considers educational child care (including homework assignments). One of their findings is that better educated parents spend more time on educational child care than less 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

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[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 NELS8 program, and Grove and Wasserman (2006) for students participating in a microeconometrics course at Syracuse University.

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backgrounds. Although it is mentioned by some education researchers as a potential adverse effect of assigning homework to young pupils (Baker, LeTendre, & Akiba, 2005; Cooper, 1994; McDermott, Goldman, & Varenne, 1984), 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. For a measure of 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. Also 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. Also because 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 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) is that by the time children enter first grade, there already exist significant differences in verbal and mathematical competence 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 the equality of opportunity in education (Leuven, Lindahl, Oosterbeek, & Webbink, 2007). If the intention of assigning homework is to reinforce 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 the 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, as it takes learning out of the home environment at an early age. Using the same data as those used by the current paper, Leuven, Lindahl, Oosterbeek, and Webbink (2009) find that expanding enrollment opportunities around age four has a positive effect on the achievement of disadvantaged pupils and has 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 to 5 years old and finish when they are 11 to 12 years old. Every teacher covers all the subjects in the class. In the period under investigation, schools did not have catchment areas and school choice was unrestricted. Grade repetition is also fairly common in the Netherlands (about 20 percent of the pupils in primary school repeat grades).

The paper uses data from the Dutch PRIMA survey. This is a biannual survey which contains information on about 10 percent of the Dutch pupils who were enrolled in grades 2, 4, 6 and 8 during the 1994–95, 1996–97, 1998–99, 2000–01 and 2002–03 school years. Several actors contributed to the collection of the data: the pupils' parents; the pupils' teachers; the schools' principals; and the pupils themselves. The fact that the PRIMA survey samples pupils from grades and not from cohorts involves substantial selection issues, as pupils who repeat grades or change schools cannot be followed over the years. The panel structure of the data will not be exploited in the paper.

Due to disparities in information on homework, the first wave of the PRIMA survey (1994–95) will only be used in the section that looks at complementarities between homework and the home environment (Section 3). The main analysis (Sections 4 and 5) is based on data from the remaining four waves.

In the Netherlands, homework is typically assigned on language-related tasks such as reading and writing. For a measure of pupil outcome, I use scores on a cognitive language-test. This test was identical across schools and

[2] Also Grove and Wasserman (2006) use a close-to-random assignment to estimate the impact of homework assignments on grades. However it is 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 however are not completely autonomous, which sets the current paper apart from the study by Grove and Wasserman.

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

	Grade		
	4	6	8
Hardly or never	48.4	38.6	15.4
Only weak pupils	30.5	27.4	10.1
Only good pupils	0.1	0.2	0.5
Entire class	21.0	33.8	74.0

for the four last PRIMA waves and was graded externally.[3] In the empirical analysis, I standardize the test scores to mean zero and standard deviation one (by grade and year) for comparability reasons.

Information on homework is provided by the four last waves of the PRIMA survey. Teachers in grades 4, 6 and 8 were asked about their homework practice and could choose between four answers: i) I hardly or never give homework to anyone in my class; ii) I only give homework to the weak pupils in my class; iii) I only give homework to the good pupils in my class; and iv) I give homework to everybody in my class. An overview of the teachers' answers is given in Table 1. In grade 4, about half of the teachers do not give homework. If homework is given, it tends to be remedial, as a majority of the teachers who assign homework do so to the weaker pupils. 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 entire class. Hardly any teachers only give homework to the good pupils. The data contains no information on how often the pupils get homework, but based on anecdotal evidence, homework is typically given regularly, but not daily. Second graders are excluded from this paper, as their teachers were not asked about their use of homework.

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 involves that 1,681 classes and 31,638 pupils are removed from the sample).

The parent questionnaires provide information on the pupil's age, gender, education levels of parents and whether the pupil has a non-Western migrant background.[4] The education level of the parents is divided 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 level of experience and gender and the log of the class size. These variables are collected from the teacher questionnaires.

[3] The test was taken in February, which is approximately halfway through the school year. There are some small differences regarding the responsible staff in the classroom 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. For more information on this test, see Leuven et al. (2009).

[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.

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	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/teacher characteristics ($N = 5549$)		
Class size	24.40	5.70
Teacher's level of experience	18.30	10.60
Female teacher	0.53	0.50

Note: 5.43% and 11.1% of the pupils have missing information on gender and age. 1% and 0.32% of the teachers have missing information on gender and experience, and 0.56% of the classes have missing information on class size. Dummy variables for missing information on these variables will be included in the empirical analysis.

Table 2 gives a descriptive overview of the explanatory variables. 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 education, 30 (24) percent have upper secondary/intermediate vocational education and 12 (16) percent have higher vocational/university education. The average teacher has 18.4 years of experience and teaches a class consisting of 23 pupils. A total of 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 findings show that homework is strongly correlated with observed characteristics that correlate with achievement, such as parental education and ethnic background. They also illustrate that there is a remedial aspect connected to giving 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 the introduction). 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 are getting homework). There is separate information on

Table 3
The determinants of assigning homework, estimates from a linear probability model (OLS).

	(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/teacher characteristics	
Log of class size	−0.0222
	(0.0244)
Female teacher	0.0310
	(0.0142)**
Teacher's level of experience	−0.0005
	(0.0006)
R-squared	0.2337

Note: $N = 96,925$. The dependent variable is a dummy variable which equals one if the entire class gets homework and zero if nobody in the class gets homework. Standard errors within brackets are heteroscedastic robust and corrected for class level clustering. Included are also a constant term, year and grade dummies and dummy variables for missing information on the control variables presented in Table 2. */**/***statistically significant at the 10%, 5% and 1% level, respectively.

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 estimate a bivariate ordered probit model where both the mother's and the father's (latent) propensity to help with homework depends 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.[5] The advantage 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.

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: 4344 observations on maternal help with homework and 3425 observations on paternal help with homework.

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 within brackets. Included are also dummy variables for missing information on the pupil's gender and parent's education. ***/*statistically significant at the 1% and 10% levels, respectively.

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 1 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. Also 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 for fathers it 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.[6]

Mothers' and fathers' help with homework are 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

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

[6] Among mothers (fathers) from a non-western migrant background, 52 (42) percent have primary school or less as highest level of obtained education. Note also that 24 (28) percent of mothers (fathers) from a non-western migrant background have missing information on education.

assignments. One implicit assumption is that the quality of the parental inputs is the same across socioeconomic groups. However, it seems 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 their children with homework, children with less able parents get less help with homework.

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 outlines 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:

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

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 an advantaged family background and a disadvantaged one respectively; x_i is a vector of observed attributes of the pupil and his parents; ω_{js} is a vector of observed class and teacher characteristics (because each teacher teaches all the subjects in a class, I cannot separate teacher effects from class effects. For simplicity reasons, subscript j denotes both teacher and class); and hw_{js} is an indicator variable taking the value 1 if the entire class receives homework and 0 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.[7,8]

The central problem I face when estimating Eq. (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 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 measured at the class level, I can rule out correlations between homework and unobserved individual pupil effects (such as a pupil's unobserved number of hours devoted to homework) 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 Eq. (1):

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

This identification rests on schools with variation in homework practices between classes within grades (ψ is actually a school-grade-fixed effect). I consequently restrict the sample to those classes and schools that will identify this estimate, which amount to 4,316 pupils distributed over 254 classes. The fraction of non-Western migrant pupils, pupils of primary educated parents and female teachers is higher in this smaller sample than in the full sample, whereas class size and teacher experience appear to be slightly smaller.[9] It is important to note that the effect of interest is also identified on this reduced sample when using the full sample. This means that a regression without additional controls gives the same estimate in the full and the reduced sample. The advantage of running the regression on the reduced sample is that this avoids misspecification (i.e., if the slope in the full sample is different from the slope in the subsample) and therefore potential bias. Comparing classes within the same grade and school ensures that potential problems connected to pupil sorting across schools can be ruled out. Ammermueller and Pischke (2009) follow the same approach when estimating peer effects using the Dutch PIRLS data. Note also that 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, I will estimate Eq. (2) separately for pupils of higher and lower educated mothers.

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 assignments to correlate with differences in teacher quality and characteristics of the classes. One such measure on unobserved teacher quality could be how often a teacher assigns homework. For instance, ambitious teachers may assign homework more often than less ambitious teachers. A standard way to solve these problems would

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

[8] One potential objection to the framework outlined in this section is that the improvement of reading ability should have been considered a cumulative process, i.e., homework assignment in grade 4 affects reading capabilities two and four years later (in grades 6 and 8). Since the PRIMA survey samples pupils from grades and not from cohorts, I cannot follow pupils who repeat grades or change schools. 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.

[9] A descriptive overview over this reduced sample is shown in Appendix Table A.1.

be to estimate a more elaborate fixed-effects model and to include teacher and class fixed effects, θ_j as done in Eq. (3).

$$y_{ijs} = x_i'\beta + \omega_{js}'\varphi + \delta_i hw_{js} + \theta_j + \psi_{is} + u_{ijs} \quad (3)$$

Unfortunately θ_j cannot be identified in the PRIMA data. The remainder of this section is therefore concerned with how to purge the homework estimates from the confounding effects of these unobserved characteristics.

Consider two pupils, a and d. Subtracting y_{djs} from y_{ajs} gives the following expression:

$$\tilde{y}_{js} = \tilde{x}_{js}'\beta + \rho hw_{js} + \eta_s + \varepsilon_{js} \quad (4)$$

$\tilde{y}_{js} = (y_{ajs} - y_{djs})$ is the within-class difference in test scores between pupils from advantaged and disadvantaged family backgrounds, $\tilde{x}_{js}' = (x_{ajs} - x_{djs})$ is a vector capturing the within-class difference in parental background, $\rho = (\delta_a - \delta_d)$ is the effect on $\tilde{y}_{js}$ of giving homework to the whole class, $\eta_s = (\psi_{as} - \psi_{ds})$ is a school-fixed effect and $\varepsilon_{js} = (u_{ajs} - u_{djs})$ is a random error term. Eq. (4) is comparable to a difference-in-difference strategy. The nice feature of it is that any unobserved teacher- and class-fixed effects (θ_j) drop out as long as they are assumed to be homogeneous across pupils within a class (or only affect the average achievement level in the class). By looking at the dispersion of test scores at the class level, the effect of homework can arguably be separated from unobserved teacher- and class-fixed effects. Although missing information on the frequency of teachers' use of homework will not bias the estimates under the homogeneity assumption (because the teacher fixed effects has dropped out), it can still affect the size of $\hat{\rho}$ and the interpretation of the findings, as the effect of homework is estimated at the extensive margin. Unfortunately this cannot be investigated in this paper.

If pupils from more advantaged backgrounds benefit more from homework than students from disadvantaged backgrounds (i.e., $\hat{\delta}_a > \hat{\delta}_d$ in Eq. (1) to (3)), differences in test scores should be larger in classes where everybody gets homework compared to classes where nobody gets homework, involving $\hat{\rho} > 0$ in Eq. (4). If on the other hand, the impact of homework on achievement is homogeneous (i.e., $\hat{\delta}_a = \hat{\delta}_d$), its effect on within-class differences in test scores will be zero ($\hat{\rho} = 0$). Since I still condition on the school-grade-fixed effect, η_s, Eq. (4) also rests on schools with variation in homework across class rooms.

Although the assumptions made here are restrictive, they improve substantially on the (individual)-level equations where the homework estimate may correlate with unobserved teacher and class characteristics. However, the credibility of this assumption is strengthened if observed teacher and class characteristics also have zero impact on the inequality measure. As a check, I will estimate Eq. (4) when controlling for observed class and teacher characteristics.

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 by estimating $y_i = x_i'\beta + \upsilon_i$ with OLS and calculate $\hat{\upsilon}_i = y_i - x_i'\hat{\beta}$ ($\hat{\upsilon}_i$ is also derived from the reduced sample). The within-class inequality equation that is estimated in the paper is then given by:

$$(\hat{\upsilon}_{ajs} - \hat{\upsilon}_{djs}) = \rho hw_{js} + \varphi_s + \epsilon_{js} \quad (5)$$

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 A.2.

Table 6
The relation between homework and achievement, OLS estimates.

	(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/teacher characteristics			
Log of class size			0.0939
			(0.0211)***
Female teacher			−0.0135
			(0.0111)
Teacher's level of 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. The dependent variable is the pupils' test scores. Standard errors within brackets are heteroscedastic robust and corrected for class level clustering. Included in all specifications are a constant term, grade and year dummies. ***statistically significant at the 1% level.

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.

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

Table 7
The effect of homework on student achievement, FE estimates.

	(1)	(2)	(3)	Education mother	
				> Primary (4)	Primary (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/teacher	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. The dependent variable is the pupils' test scores. Standard errors within brackets are heteroscedastic robust and corrected for grade level clustering. Included in all specifications are a constant term, grade and year dummies. *statistically significance at the 10% level. See also Table 6.

discussed in Table 3, this effect cannot be given a causal interpretation, as homework tends to be correlated with the pupils' background characteristics. 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 to identify the effect of homework.

One such strategy is to compare pupils within schools and grades. Table 7 presents result from estimating Eq. (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 only reports results from the most elaborate specification. The first thing to notice in Table 7 is that the point estimates of homework is insensitive to the inclusion of individual and class characteristics, which implies that homework may not correlate with (observed) individual and class characteristics conditioning on a school-grade-fixed effect.

The effect of homework on pupil achievement is positive and amounts to about 5 percent of a standard deviation but is only statistically significant at the 18 percent level (in specification (3)). Turning to the right panel, column (4) shows that pupils of mothers who have at least 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. (2009), who, using the same data as the current paper, find that disadvantaged Dutch pupils who get an extra month of schooling at age 4 increase their language scores at age 6 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 for classwork, i.e., teachers exert 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 due to large standard errors it cannot be ruled out that the effect is statistically different from zero.

Table 8
The effect of homework on within-class differences in test scores, FE estimates.

Dependent variable	Effect	Standard error
Variance	0.0567	(0.0284)**
Percentile ranges		
75th–25th	0.0772	(0.0426)*
85th–15th	0.1800	(0.0676)**
85th–50th	0.1646	(0.0545)**
50th–15th	0.0154	(0.0385)

Note: *N* = 254. The unit of observation is the class. Included are also a constant term and year dummies. The standard errors are heteroscedastic robust. */**/***statistically significant at the 10/5/1% level, respectively.

Summarized, when ruling out correlations between homework and unobserved school characteristics, I find that assigning homework has a positive effect on average pupil achievement, but the effect is not statistically significant at any conventional level. However, when stratifying on mother's education the effect becomes larger and statistically significant for pupils of better educated mothers, whereas it becomes negative and insignificant for pupils of primary educated mothers.[10]

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 reveal the causal effect. The next section is concerned with whether this pattern 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 Eq. (5), which compares within-class differences in test scores across class rooms within the same school and grade. Each row represents one regression. Out of a total of five point esti-

[10] In practice, regressing Eq. (2) on the full sample gives nearly identical point estimates of the effect of interest. The point estimate of specification (1) is (by definition) unaltered, the point estimates of specifications (2) and (3) change to 0.0485 and 0.0462, whereas the point estimates of specifications (4) and (5) change to 0.0600 and −0.0071, respectively. The level of significance slightly decreases.

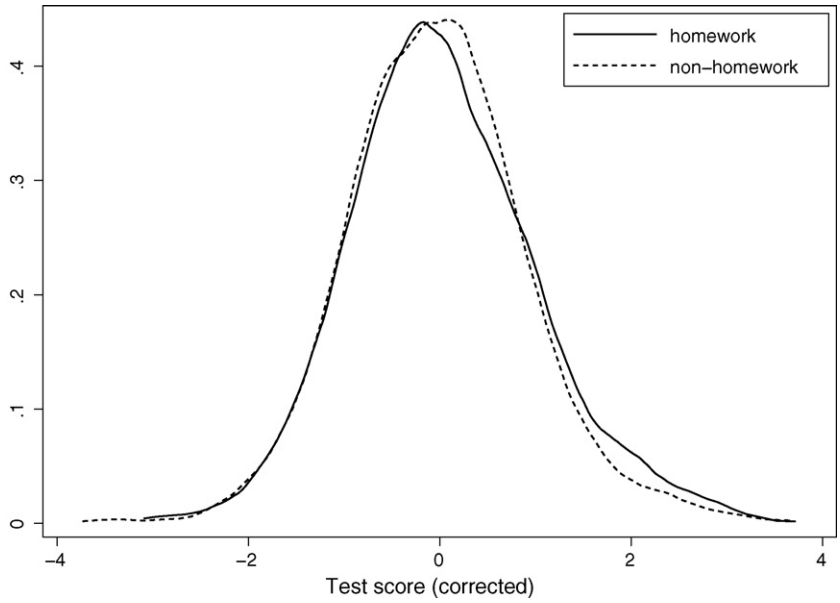

Fig. 1. The distribution of test scores in homework classes and non homework classes.

mates of homework, four are significantly different from zero at the one, five and ten percent levels. 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 percentiles, 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 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 small and statistically insignificant. Pupils from the upper part of the socioeconomic scale seem to significantly benefit from homework.[11,12]

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, and to plot the density distribution of test score separately for these two groups. Since I in the empirical analysis condition on a school-grade-fixed effect, the test scores are standardized by grade, school and year. The result is shown in Fig. 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 thereby confirms that the better pupils are the ones 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 scale receive less homework help from their parents than do 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.

The first one compares pupils within schools and grades and finds 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

[11] Appendix Table A.3 presents results from estimating Eq. (5) when also controlling for observed class characteristics. The point estimates of homework slightly decrease, and observed class characteristics have a minor impact on within-class differences. The latter is reassuring, as one crucial assumption in this paper is that unobserved teacher/class-fixed effects affect only the average achievement level and not within-class differences in test scores.

[12] As already mentioned, the residuals I use to calculate the inequality measures are derived from the reduced sample. When calculating inequality measures using residuals derived from the full sample, both the point estimates and the level of significance are basically unaltered.

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 using only school-fixed effects and indicate that the test score gap is significantly larger in homework classes than in non-homework classes. Also the pupils belonging to the upper part of the test score distribution are the ones who 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 disadvantaged backgrounds fall behind at a very early age (even before they start school), and many education subsidies are provided 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 of following up instructions from schools, teachers and principals. This may mean that school policies that aim to give 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 of pupils from advantaged family backgrounds.

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Appendix A.

See Appendix Tables A.1–A.3.

Table A.1
Sample summary statistics, reduced sample.

	Mean	s.d.
Individual characteristics ($N=4316$)		
Girl	0.47	0.50
Age	9.53	1.70
Non-western migrant	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/teacher characteristics ($N=254$)		
Class size	22.45	5.35
Teacher's level of experience	16.80	10.80
Female teacher	0.60	0.49

Table A.2
Descriptive statistics, different inequality measures at the class level.

	Mean	s.d.
Variance	0.8296	0.2312
Percentile ranges		
75th–25th	1.0475	0.3549
85th–15th	1.6520	0.5521
85th–50th	0.8748	0.4190
50th–15th	0.7773	0.3320
N	254	

Table A.3
The effect of homework on within class differences in test scores, FE estimates.

	Variance	Percentile ranges			
		75th–25th	85th–15th	85th–50th	50th–15th
Homework	0.0479	0.0642	0.1653	0.1659	−0.0006
	(0.0281)*	(0.0423)	(0.0664)**	(0.0538)***	(0.0384)
Class/teacher characteristics					
Log of class size	−0.0155	−0.0891	0.2227	0.1670	0.0557
	(0.0699)	(0.1529)	(0.1832)	(0.1236)	(0.1092)
Female teacher	0.0238	−0.0140	0.0559	−0.0117	0.0677
	(0.0431)	(0.0614)	(0.0927)	(0.0680)	(0.0551)
Teacher's level of experience	−0.0021	−0.0012	−0.0005	−0.0037	0.0032
	(0.0021)	(0.0028)	(0.0050)	(0.0040)	(0.0023)
R-squared	0.1460	0.1516	0.1586	0.1358	0.1247

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

Appendix B. Supplementary Data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.econedurev.2010.07.001.

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