The Effect of Family Background on Student Effort

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Abstract

Students from more advantageous family backgrounds tend to perform better than those from less advantageous backgrounds. But it is not clear that they exert more effort. We build a model of students, schools, and employers to study the interaction of family background and effort exerted by the student in the education process. Two factors turn out to be key in determining the relationship between effort and family background: (i) the student's attitude towards risk and (ii) the dependence of the student's marginal productivity of effort on her family background. We show that if the degree of risk aversion is relatively low (high) compared to the sensitivity of the marginal productivity of effort, students from more advantageous family backgrounds exert more (less) effort. Empirically, we find that if parental education was reduced from holding a university degree to incomplete compulsory education, primary and secondary school students would exert around 21-23% less effort (approximately equal to a reduction of 2 hours in weekly homework). For primary school students we also find that marginal productivities of effort are higher for those from less advantageous family backgrounds.

JEL classification: I21, I28, D81.
Keywords: student effort, family background, risk aversion, educational standards.

1 Introduction

The influence of parental resources on the academic performance of children has received a great deal of attention in the economics literature. For the UK, Ermisch and Francesconi [2001] find that students' performance in school is strongly associated with parental educational attainments. According to a literature review by Haveman and Wolfe [1995], the strong correlation between parental income and student's scholarly achievements is one of the major findings in the literature on the determinants of children's attainments. However, the fact that children of parents with high levels of schooling or income perform better compared to those from less advantageous backgrounds does not necessarily imply that they exert more effort. As effort and talent constitute the centerpieces of a meritocratic society, the question of how effort and family background relate is in our view of great interest. The current paper advances - both on theoretical and empirical grounds - in the understanding of the determinants of effort exerted by the student in the education process, and its relationship with family background. We build a model of students, schools, and employers where academic qualifications - which entail an income premium in the labor market - are noisily determined by effort, the student's family background, and her innate talent. We test our theoretical model using data for Spanish students of different age groups.

For given levels of ability, student effort is one of the most important input factors for education. Different from other inputs like teacher quality, school autonomy, or class size, student effort is an individual decision variable. However, in the theoretical and empirical literature, student effort has received only limited attention. One of the few works in the theoretical literature, is an undeservingly little noticed paper by Correa and Gruver [1987] that analyzes teacher-student interactions in a game theoretical framework. More recently De Fraja and Landeras [2006] have shown that increasing the power of incentives and the effectiveness of competition in schools may have the counterintuitive effect of lowering student effort. Landeras [2009] compares a standard grading system to a competitive grading system (tournament) in terms of the level of student effort each system is able to induce. The author demonstrates that each system's relative advantage depends crucially on the distribution of the noise that distorts academic achievement. The model by Lin and Lai [1996] shows that if leisure is a normal good and students are given monetary rewards unrelated to their academic performance they will be less diligent.

Given the difficulty to obtain an independent measure of effort, empirical studies rarely include student effort into estimations of education production functions. Among the few papers that provide measures of effort and estimate its effects on schooling attainment

is a recent paper by Eren and Henderson [2011]. The authors use teachers' opinion on whether the reference textbook provides good homework suggestions, as an independent measure of homework time. They find a positive effect of the amount of assigned math homework on students' math test scores. Another example is Bonesrønning [2004] who finds that for Norwegian secondary schools parental effort in education decreases as class size increases, indicating that parental effort and class size are complementary inputs to education. Cooley [2010] estimates how peers' effort and achievement influence students' scholarly performance by taking advantage of an exogenous policy change that raised peer effort and achievement but did not affect individuals' achievement directly. De Fraja et al. [2010] provide a theoretical model of effort by students, parents, and schools. Empirically they find parental effort to be more decisive for students' achievement than students' own effort or schools' effort. Stinebrickner and Stinebrickner [2008] use information on college roommates who own computer games or video consoles as instruments for individual study time. The authors find that more study time can make up for lower ability, measured by scores in college entrance exams. Another interesting paper is Metcalfe et al [2011] who exploit an exogenous increase in the value of leisure during international football tournaments every other year. The authors estimate the effect of the resulting reduction in effort on students' academic achievement.

The current paper also highlights the role of risk aversion for students' educational choices. When making educational choices and when deciding their level of effort, students are faced with various types of risks, related to labor market returns and opportunity costs of education. Only few works in the literature have taken into account students' attitudes towards risk and the effects on schooling choices. Theoretical models like De Fraja [2002] address the importance of risk aversion for educational choices, but empirical evidence regarding students' risk aversion is still limited. In particular the magnitude of income risk effects on educational choices is highly disputed. For instance, Nielsen and Vissing-Jorgersen [2006] use a structural model of life-time utility maximization and estimate a relative risk aversion coefficient of around 5. On the other hand, empirical studies such as Belzil and Leonardi [2007], Brodaty et al [2006], and Belzil and Hansen [2004] all suggest lower degrees of students' relative risk aversion of around 0.5, 0.75, and 0.93 respectively. Belzil and Hansen [2004] also find that an increase in the degree of risk aversion increases schooling attainments. The same holds true in our model where risk aversion plays a central role for the student's optimal decision of effort because qualifications that entail an income premium in the labor market are noisily determined by effort, the student's family background and her innate talent. According to a variety of empirical studies in the psychology literature, children and adolescents are less risk averse than adults. While some like Paulsen at al [2011] find risk aversion to increase with age, others like Steinberg [2007] emphasize that different from children or adults, adolescents display risk seeking attitudes.

Our theoretical results show that if schools can set the optimal passing standard, two factors turn out to be key in determining the relationship between effort and family background: (i) the student's attitude towards risk and (ii) the dependence of the student's marginal productivity of effort on her family background. We show that if the degree of risk aversion is relatively low compared to the sensitivity of the marginal productivity of effort, the relationship between effort and family background is positive and students from more advantageous family backgrounds exert more effort. On the other hand, when the degree of risk aversion is relatively high, students from less advantageous family backgrounds exert more effort. Empirically, we find support for the first case. Considering Spanish data for students from the Madrid region ("Prueba de Conocimientos y Destrezas Indispensables," CDI) we find that if parental education was reduced from holding a university degree to incomplete compulsory education, 12 year old primary school students would exert around 23% less effort (approximately equal to a reduction of 2 hours in weekly homework). Our results are similar when we use data for 15 year old secondary school students. The same reduction in parental education is associated with a decrease in effort of 21%. These empirical findings support our theoretical results that effort exerted by students differs by family background. In the case of younger students we also find a negative relationship between family background and marginal productivity of effort. Effort by students from less advantageous backgrounds seems to be more productive. Unresolved problems of endogeneity and reversed causality in our estimation call for caution when interpreting these last results. Nevertheless, if our results hold, their interpretation in the context of our theoretical model suggests that 12 year old primary school students display a risk seeking attitude. On the other hand, when considering data for 15 year old students, no clear relationships between effort, educational outcome, or marginal productivity of effort by parental background emerge.

The remainder of the paper is organized as follows. Section 2 describes our model, the student's choice of the optimal level of effort as well as the school's decision regarding the optimal passing standard. In Section 3 we then analyze in greater detail the effect of family background on student effort. Section 4 provides an empirical test of our theoretical model. Section 5 concludes.

2 The model

We consider a model of education with three groups of agents: students, schools, and employers. Our model is an extension of Landeras [2009], taking into account interde-

pendencies between family background and student effort, as well as interdependencies between risk aversion and student effort.

Students Students differ in terms of their innate talent θ, family background and household income and wealth. A student's family background is defined by parental education, social class, and social connectedness/networks (b). Higher parental education and/or social class and connectedness are associated with higher household income and wealth (H), where $H = H(b)$, with $H_b > 0$ (in its most simple form $H = b$). A student decides about the effort she exerts at school $e \in E \subseteq \mathbb{R}_+$, i.e. the time she spends studying, how diligent she is, how hard she works, etc. Exerting effort implies a utility cost measured by the function $\psi(e)$, increasing and convex, $\psi'(e) > 0$, $\psi''(e) > 0$. The student's utility function $U(H(b), w, e)$, is additively separable in these utility costs and the utility from the sum of family resources, $H(b)$ and her potential labor market income w.[1] Formally,

$$U(H(b), w, e) = u(H(b) + w) - \psi(e), \tag{2.1}$$

assumed to satisfy $u'(\cdot) > 0$.

Schools Schools are homogenous. They do not charge tuition nor select their students. Schools are thus endowed with a random selection of students. Schools issue qualifications $q \in Q \subseteq \mathbb{R}_+$. Formally we define a qualification issued by a school for a student as,

$$q = \xi(b, \theta, e) + \epsilon. \tag{2.2}$$

Hence, a student's qualification is the sum of her true educational attainment $\xi(\cdot)$ and a random variable ε, which is distributed according to $\Phi[\varepsilon]$, differentiable, symmetric, and single-peaked with $\Phi'[\varepsilon] = \phi[\varepsilon]$, and with a positive support on the real line. Qualifications measure academic achievement imperfectly. A student's true attainment $\xi(\cdot)$ depends on her effort e, on her innate talent θ, and on her parental background b.[2] We assume $\xi_b(\cdot) > 0$, $\xi_\theta(\cdot) > 0$, and $\xi_e(\cdot) > 0$; a student is more productive if she has a higher innate talent and/or comes from a higher parental educational or social background, and/or if she exerts more effort. We also assume decreasing returns to scale in all input factors, hence $\xi_{bb}(\cdot) < 0$, $\xi_{\theta\theta}(\cdot) < 0$, and $\xi_{ee}(\cdot) < 0$. In addition we assume

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[1] An alternative modeling choice for the individual's cost of education can be found in Nielsen and Vissing-Jorgensen [2006] where instead of an utility cost of effort forgone wages imply a trade-off between further education and working.

[2] Feinstein and Symons [1999] establish parental interest – through motivation, discipline, and support – to be one of the major determinants for children's academic achievements.

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$\xi_{e\theta}(\cdot) > 0$, i.e. effort increases attainment more for students of higher innate talent.

Furthermore, we denote by $\widehat{q}$ the passing standard, i.e. the level of qualification required for a binary credential. Only students who receive a qualification q greater or equal than $\widehat{q}$ obtain a degree. The probability of obtaining a degree is thus given by

$$Prob\,(q \geq \widehat{q}) = 1 - \Phi\,(\widehat{q} - \xi\,(b, \theta, e))\,. \tag{2.3}$$

Employers Before entering the labor market all individuals attend school and an individual's income in the labor market depends on her academic qualifications. Accordingly, the labor market income or return to education in the labor market w, can be defined by the following scheme:

$$w = \begin{cases} x & \text{if} \quad \text{the student obtained a degree} \quad q \geq \widehat{q} \\ 0 & \text{else} \end{cases} \tag{2.4}$$

where x is the labor market premium for the academic qualification.

2.1 The student's optimal choice of effort

Given her family background, her innate talent, and the school's passing standard the student chooses her optimal level of effort e, such as to maximize her expected utility

$$EU = [1 - \Phi\,(\cdot)]\,u\,(H(b) + x) + \Phi\,(\cdot)\,u\,(H(b)) - \psi\,(e)\,. \tag{2.5}$$

First and second order conditions for the maximization of Equation 2.5 with respect to effort e, are given by:

$$EU' = \phi\,(\cdot)\,\xi_e\,(\cdot)\,A - \psi'\,(e) = 0, \tag{2.6}$$

$$EU'' = \left(-\phi\prime\,(\cdot)\,\xi_e\,(\cdot)^2 + \phi\,(\cdot)\,\xi_{ee}\,(\cdot)\right)A - \psi''\,(e) < 0, \tag{2.7}$$

where $A = [u\,(H(b) + x) - u\,(H(b))]$ denotes the utility gain from passing.[3] The first order condition (2.6) implicitly defines $e^* = e\,(\widehat{q}, x, b, \theta)$, i.e. the student's expected effort reaction function to changes in (i) the passing standard $\widehat{q}$, (ii) the labor market premium x, and (iii) her family background b, given her innate talent θ. We define $A_x = u'\,(H(b) + x)$, the derivative of the utility gain from passing with respect to the labor market premium, x and state the following lemma.

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[3]We assume that $\phi\prime\,(\cdot) > 0$ and $\phi\prime\,(\cdot) > \frac{\phi(\cdot)\xi_{ee}(\cdot)A - \psi''(e)}{\xi_e(\cdot)^2 A}$ for any e, such that $EU'' < 0$ holds.

Lemma 2.1. *An increase in the labor market premium x, leads to an increase in the student's effort, e.*

Proof. Totally differentiating Equation 2.6 with respect to the labor market premium, x yields

$$\frac{de}{dx} = \frac{\phi\left(\cdot\right)\xi_e\left(\cdot\right)A_x}{-EU''\left(\cdot\right)}. \tag{2.8}$$

Since $-EU''\left(\cdot\right) > 0$, the sign of the above derivative depends on A_x, the marginal utility gain. Given that $A_x > 0$, Equation 2.8 is also positive and hence, as the labor market premium increases, the student exerts more effort. This establishes the lemma. $\square$

Lemma 2.1 captures the fact that a higher labor market premium increases the marginal utility gain of effort, making it worthwhile for the student to work harder to meet the passing standard. Additionally, schools can also affect a student's effort through the level of qualification required to obtain a degree. Given a random selection of students, effort is the only input to academic achievement that schools can affect. Therefore in order to obtain the best possible academic results from their random selection of students, schools set the passing standard such as to maximize students' effort. The next result is an extension of Landeras [2009] and it characterizes the school's optimal decision regarding the passing standard, $\widehat{q}^*$.

Proposition 2.2. *There exists a choice for the school's passing standard $\widehat{q}$, say $\widehat{q}^*$, that maximizes student effort $e^*\left(\widehat{q}, x, b, \theta\right)$. This occurs when $\phi\prime\left(\widehat{q} - \xi\left(b, \theta, e\right)\right) = 0$ which requires $\widehat{q} = \xi\left(\cdot\right)$.*

Proof. Totally differentiating Equation 2.6 with respect to the school's passing standard $\widehat{q}$, we obtain

$$\frac{de}{d\widehat{q}} = \frac{\phi\prime\left(\cdot\right)\xi_e\left(\cdot\right)A}{-EU''\left(\cdot\right)}. \tag{2.9}$$

Given that the denominator is positive, the sign of the above derivative depends on the sign of the derivative of the density function $\phi\prime\left(\cdot\right)$. For $\phi\prime\left(\cdot\right) > 0$, the school's passing standard is lower than the student's true attainment, $\widehat{q} < \xi\left(\cdot\right)$. In this case, the probability of passing, $\left(1 - \Phi\left(\cdot\right)\right)$, is relatively high (greater than 0.5 for $\Phi\left[\varepsilon\right]$ symmetric). The student works thus harder when the passing standard is increased, $\frac{de}{d\widehat{q}} > 0$. However, for $\phi\prime\left(\cdot\right) < 0$, the passing standard $\widehat{q}$ is relatively high which implies that the probability of failure is also high. In this case an increase in $\widehat{q}$ reduces the optimal level of effort, $\frac{de}{d\widehat{q}} < 0$. Finally, for $\phi\prime\left(\cdot\right) = 0$, which implies $\widehat{q} = \xi\left(\cdot\right)$, we can determine the value of $\widehat{q}^*$ that maximizes $e^*\left(\widehat{q}, x, b, \theta\right)$. Hence, the optimal passing standard, $\widehat{q}^*$ assures that the

level of effort chosen by the student e^*, is the highest given the student's endowments of innate talent and family background and the labor market premium.[4]   □

Figure 2.1 depicts Proposition 2.2. The upper graph represents the student's effort reaction function $e^*(\widehat{q}, x, b, \theta)$. The relationship between student effort and passing standard is non-monotonous. The student's optimal effort level increases first and then decreases as the passing standard is raised. When the passing standard is low, students initially tend to work harder. However, when the passing standard is too high, students lose motivation because the marginal cost of effort is too high compared to the expected utility gain from the labor market premium. The student's reaction function attains a maximum, which corresponds to the optimal passing standard chosen by schools, $\widehat{q}^*$. This standard is set such as to induce the highest optimal effort the student is willing to exert. It is implicitly determined by the intersection of the marginal cost of effort $\psi'(e)$ and the marginal benefit of effort $A\phi(\cdot)\xi_e(\cdot)$ (see lower graph of Figure 2.1). This intersection thus implicitly determines the optimal passing standard; when $\phi\prime(\cdot) = 0$, the student's true attainment is equal to the passing standard, $\xi(\cdot) = \widehat{q}$. Hence, the optimal passing standard eliminates any noise between a student's true attainment and the school's passing standard.

Figure 2.1 also illustrates the effect of an increase in the labor market premium on student effort (see Lemma 2.1). A higher labor market premium x, leads to an upward shift of the student's effort reaction function (dotted line). This implies a new intersection of the marginal cost $\psi'(e)$, and the marginal benefit of effort $A'\phi(\cdot)\xi_e(\cdot)$, and hence a new optimal passing standard. A higher labor market return increases the marginal benefits of effort, but due to the adjusted passing standard the final increase in student effort goes beyond the initial increase caused by the higher labor market premium.

A student's optimal choice of effort also depends on her innate talent. The following lemma captures this.

Lemma 2.3. *When the passing standard is optimal or higher, a more able student exerts more effort, i.e. $\frac{de}{d\theta} \geq 0$ when $\phi\prime(\cdot) \leq 0$.*

Proof. Totally differentiating Equation 2.6 with respect to the student's innate talent θ, yields

$$\frac{de}{d\theta} = \frac{(-\phi\prime(\cdot)\xi_\theta(\cdot)\xi_e(\cdot) + \phi(\cdot)\xi_{e\theta}(\cdot))A}{-EU''(\cdot)}. \tag{2.10}$$

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[4]The second order differential of effort e, with respect to the passing standard is: $d^2e/d\widehat{q}^2 = [(\phi''(\cdot)\xi_e(\cdot)A)(\psi''(e) - \phi(\cdot)\xi_{ee}(\cdot)A)]/[-EU''(\cdot)]^2$. This ratio is negative if and only if $\phi''(\cdot) < 0$. Note that this condition is satisfied only if $\phi(\cdot)$ is concave near the mode.

Figure 2.1: The Optimal Passing Standard, $\widehat{q}^*$
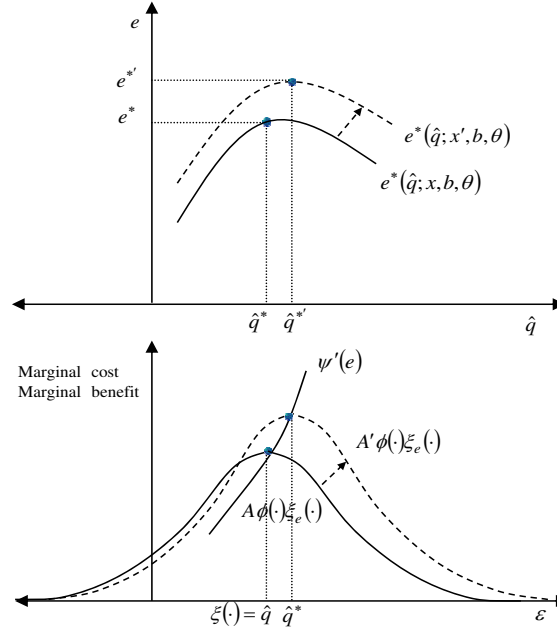
Given that the denominator is positive the sign of the above derivative depends on the sign of the derivative of the density function $\phi\prime(\cdot)$. Note that all other terms in the numerator are positive. Thus, when $\phi\prime(\cdot) \leq 0$, Equation 2.10 is positive and hence, a more able student exerts more effort. The opposite does not necessarily hold true. When $\phi\prime(\cdot) > 0$, Equation 2.10 may be positive or negative. This establishes the lemma. $\qquad\square$

When the passing standard is high, $(\widehat{q} > \widehat{q}^*)$ by Proposition 2.2 students lose motivation because marginal costs of effort are too high compared to the expected utility gain from the labor market premium. According to Lemma 2.3 in such cases, students endowed with higher innate talent will exert more effort in order to meet the passing standard. Hence, innate talent influences achievement positively both directly $(\xi_{h\theta}(\cdot) > 0)$ as well as indirectly through additional effort $(\xi_{e\theta}(\cdot) > 0)$.

3 Student effort and family background

A student's family background affects her potential income through three channels: (i) directly through household income and resources $(H(b))$, (ii) indirectly through the effect

of higher parental education and social background on academic achievement (i.e. more advantageous families enable their children to learn more effectively, they show more interest in their academic achievement, are better able to monitor it) and (iii) indirectly through more student effort (parents of more advantageous backgrounds may induce their children to study more). In this section we consider in particular the third channel: how family background affects student effort, and consequently the student's academic attainment and qualification, and her potential income.

3.1 A benchmark case: $\xi(\theta, e)$

We first consider a situation where family background does not affect the student's true attainment. In this case the probability of passing the school's standard is given by $Prob(q \geq \widehat{q}) = 1 - \Phi(\widehat{q} - \xi(\theta, e))$. We denote by $A_b = [u'(H(b) + x) - u'(H(b))] H_b$ the derivative of the utility gain from passing with respect to a student's family background b, and we state the following lemma.

Lemma 3.1. *If the student exhibits risk aversion, that is if $u''(\cdot) < 0$ and thus $A_b < 0$, then positive changes in her family background lead to reductions in student effort. On the other hand, if the student is risk-seeking, that is if $u''(\cdot) > 0$ and thus $A_b > 0$, then positive changes in her family background lead to more student effort.*

Proof. Totally differentiating Equation 2.6 with respect to family background, b yields

$$\frac{de}{db} = \frac{\phi(\cdot)\xi_e(\cdot)A_b}{-EU''(\cdot)}. \tag{3.11}$$

Since $-EU''(\cdot) > 0$, $\phi(\cdot) > 0$ and $\xi_e(\cdot) > 0$, the sign of the above derivative depends on the sign of A_b. As $A_b < 0$ for the case that the student exhibits risk aversion, Equation 3.11 is negative and hence, students from more advantageous family backgrounds (those with higher b) will exert less effort. For the case that students are risk-seeking and $A_b > 0$, Equation 3.11 is positive. This establishes the lemma. ☐

Given our noisy academic context, by Lemma 2.1, an increase in the reward for learning - a higher labor market premium x - will induce an increase in effort. However, if the student is risk averse and as she becomes better-off the incentive to work harder is reduced and she exerts less effort. It is easy to see that if the student is risk neutral, $(A_b = 0)$, her family background b, has no effect on her optimal choice of effort e. The risk aversion hypothesis is thus key for a negative relationship between effort e, and family background b, to arise. On the other hand, in case of students with a risk-seeking attitude a more advantageous family background is associated with less effort. However, if the student's

true attainment is directly affected by the student's family background these relationship might no longer hold.

3.2 The case: $\xi(b, \theta, e)$

When a student's true attainment is directly affected by her family background, the relationship between effort and family background is altered. In this case, the probability of passing the school's standard is given by $Prob(q \geq \widehat{q}) = 1 - \Phi(\widehat{q} - \xi(b, \theta, e))$. We totally differentiate Equation 2.6 with respect to family background b, to analyze the conditions for the student's optimal choice of effort:

$$\frac{de}{db} = \frac{-\phi\prime(\cdot)\xi_b(\cdot)\xi_e(\cdot)A + \phi(\cdot)\xi_{eb}(\cdot)A + \phi(\cdot)\xi_e(\cdot)A_b}{-EU''(\cdot)}. \tag{3.12}$$

There are four effects in play, a risk effect A_b, a direct productivity effect related to family background $\xi_b(\cdot)$, a direct productivity effect related to effort $\xi_e(\cdot)$, and a cross productivity effect $\xi_{eb}(\cdot)$. If the cross-productivity effect is positive, $\xi_{eb}(\cdot) > 0$, then effort increases attainment more for students from more advantageous family backgrounds. On the other hand, if the cross-productivity effect is negative, $\xi_{eb}(\cdot) < 0$, students from less advantageous family backgrounds gain more from an increase in effort. Hence, the above derivative can have either sign. In order to obtain tractable results, we define a student's expected income $y = H(b) + w$ and let $\eta_b(\xi_e) = |\frac{\xi_{eb}(\cdot)b}{\xi_e(\cdot)}|$ and $\eta_b(A) = |\frac{A_b b}{A}|$ be the elasticities of ξ_e and A with respect to b. We state the following lemma.

Lemma 3.2. *In general, for x sufficiently small and $u''(\cdot) < 0$, $\eta_b(A)$ converges to the coefficient of relative risk aversion $RRA(b) = \frac{-u_{yy}(\cdot)}{u_y(\cdot)}b$.*

Proof. For $y_b = y_x = 1$, $\underset{x \to 0}{Lim}\left(\frac{A_b}{A}\right) = \underset{x \to 0}{Lim}\left(\frac{u_y(H(b)+x)y_{H(b)}H_b - u_y(H(b))y_{H(b)}H_b}{u(H(b)+x)-u(H(b))}\right) =$
$= \underset{x \to 0}{Lim}\left(\frac{u_{yy}(H(b)+x)y_{H(b)}H_b}{u_y(H(b)+x)y_{H(b)}H_b}\right) = \frac{u_{yy}(H(b))}{u_y(H(b))}$, which proves convergence of $\eta_b(A)$ to $RRA(b)$. In particular, for functional forms of the utility such as $u(y) = -\exp^{-\beta y}$ (which displays constant absolute risk aversion), $\eta_b(A) = \beta = RRA$, irrespectively of the size of x. This establishes the lemma. $\square$

The elasticity $\eta_b(A)$ relates to the shape of the utility function and provides a measure for the student's attitude towards risk. In particular for $u''(\cdot) > 0$, $RRA < 0$. The elasticity $\eta_b(\xi_e)$ measures the dependence of the marginal productivity of effort on family background b. Lemma 3.2 allows us to state the next result.

Proposition 3.3. *Suppose Proposition 2.2 holds and schools can set the optimal passing standard, then the relationship between student effort and parental background can be characterized by the following four cases:*

Case 1: If $A_b > 0$ and $\xi_{eb}(\cdot) > 0$, i.e. if students are risk seeking and the cross-productivity effect is positive, then $\frac{de}{db} > 0$.

Case 2: If $A_b < 0$ and $\xi_{eb}(\cdot) < 0$, i.e. if students are risk averse and the cross-productivity effect is negative, then $\frac{de}{db} < 0$.

Case 3: If $A_b < 0$ and $\xi_{eb}(\cdot) > 0$, and if the risk aversion effect is larger (smaller) than the cross productivity effect $(\eta_b(A) \gtreqqless \eta_b(\xi_e))$ then student effort and family background will relate negatively (positively) $(\frac{de^*}{db} \lesseqqgtr 0)$.

Case 4: If $A_b > 0$ and $\xi_{eb}(\cdot) < 0$, and if the risk effect is larger (smaller) than the cross productivity effect $(\eta_b(A) \gtreqqless \eta_b(\xi_e))$ then student effort and family background will relate positively (negatively) $(\frac{de^*}{db} \gtreqqless 0)$.

Proof. With Proposition 2.2 holding, i.e. $\phi\prime(\cdot) = 0$, Equation 3.12 becomes

$$\frac{de^*}{db} = \frac{\phi(\cdot)\,\xi_{eb}(\cdot)\,A + \phi(\cdot)\,\xi_e(\cdot)\,A_b}{-EU''(\cdot)}, \tag{3.13}$$

where the denominator is positive. Hence, for the first two cases the sign of Equation 3.13 is determined by the signs of A_b and $\xi_{eb}(\cdot)$. For cases 3 and 4 where A_b and $\xi_{eb}(\cdot)$ are of opposite signs, the sign of Equation 3.13 is determined by the sign of $(\eta_b(\xi_e) - \eta_b(A))$. This establishes the proposition. $\square$

Given Proposition 3.3, when students are sufficiently risk averse and the cross-productivity effect is positive (Case 3), and given a low elasticity of student effort with respect to family background, those from less advantageous family backgrounds exert more effort. In this case, the more risk averse the student is, the more likely she will be to reduce her level of effort as she becomes better-off. This case is depicted in Graph a) of Figure 3.2.

On the other hand, if the degree of risk aversion is relatively low compared to the elasticity of the marginal productivity of effort with respect to family background, effort and family background are positively related. Students from more advantageous family backgrounds will exert more effort (see Graph c) of Figure 3.2). In this case, the less risk-averse the student is, the more likely she will be to increase her level of effort as she becomes better-off. There also exists the possibility of a non-monotonous relationship between family background and effort. Graph b) of Figure 3.2 shows that if for low levels of family background the degree of risk aversion is higher than the elasticity regarding the student's

Figure 3.2: Effort and Family Background, when $\widehat{q} = \widehat{q}^*$ and $A_b < 0$ and $\xi_{eb}(\cdot) > 0$.
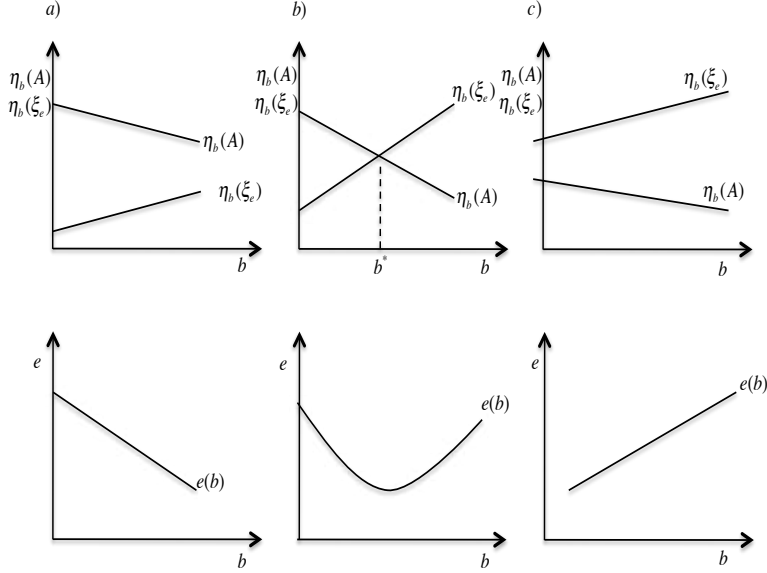
marginal productivity of effort, effort decreases in family background b. However, as the two functions cross at b^*, the effect of family background on the choice of effort starts to turn positive. As the degree of risk aversion is reduced furthermore and the elasticity related to the marginal productivity of effort increases, students from more advantageous family backgrounds will exert more effort. In case students are risk-seeking and the cross-productivity effect is negative results are reversed, see Case 4 of Proposition 3.3.

4   Empirical Test

Given our theoretical results and the lack of conclusive empirical evidence regarding the relationship between student effort and family background, we consider an empirical test of our theoretical model.[5] We first look at the relationship between family background and student effort. In particular we want to test empirically if students from more advantageous family backgrounds exert more effort compared to those from less advantageous backgrounds. In our theoretical model the way student effort and family background

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[5]The only other empirical analysis that considers the relationship between student effort and family background we are aware of is De Fraja et al [2010]. Different from our results, the authors find that children from different backgrounds do not differ significantly in their propensity to exert effort.

relate is determined by the relationship between the student's attitude towards risk and the elasticity of the marginal productivity of the student's effort by family background. Hence, in a second step we try to test if and how this elasticity varies with a student's family background.

4.1   Description of the Data

For our empirical test we consider data for 12 and 15 year old students. Data come from the "Prueba de Conocimientos y Destrezas Indispensables," (CDI) test carried out in the Madrid region. As mentioned before, empirical evidence suggests differences in attitudes towards risk by age. This makes the use of data for students from different age groups particularly interesting.

4.1.1   CDI

The CDI is a standardized test that 6th graders (12 years) and 9th graders (15 years) in all primary and secondary schools of the Madrid region have to take each year.[6] The test has been carried out since 2004/2005 in primary schools and since 2008/2009 in secondary schools. We use the 2009/2010 wave for both groups of students because it is the first one in which primary school students were asked questions about their effort - homework habits. The outcome of this standardized test does not have any academic consequences for students. It simply provides information to the education authorities. The test for primary school students consists of two parts, each of 45 minutes length. The first part tests students' reading, language, and general skills, and it also includes a dictation. The second part of the test concerns mathematical skills. For secondary school students each part of the test last for 1 hour and a half and tests mathematical and language skills respectively.[7] In addition to the test, each student is asked to fill out a questionnaire regarding individual aspects, family characteristics, and homework habits.

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[6]Access to this data set is restricted which is one of the reasons that it has been used little. One exception is Anghel and Cabrales [2010].

[7]For both test scores on language and mathematics, deviations from the sample mean score have been obtained and they have been divided by the standard deviation of the sample. In order to avoid zero scores unsuitable for a logarithmic scale, scores have been adjusted to an IQ scale, multiplying the result by 15 and summing one hundred points. To obtain one unified test score we take the mean of both standardized scores.

Sample   In 2009/2010, a total of 57,080 and 50,003 students were enrolled in 6th and 9th grade in the Madrid region. However, we only have test scores for 53,972 and 46,394 students respectively. Missing data from questionnaires further restricts our samples to 45,850 students in 1,222 primary schools and 41,956 students in 755 secondary schools.

Descriptive Statistics   Table A-3 of the Appendix A provides the descriptive statistics for our sample of primary school students. Regarding a student's family background, we consider the highest' degree of education and the highest occupational category among parents. Almost half of all students have at least one parent who holds a university degree and 12% has at least one parent who has completed an apprenticeship. In the case of 18% and 17% of students, at least one parent has finished upper or lower secondary education, respectively. Only 5% of students are children of parents who have not completed compulsory education. Considering the maximum number of years of schooling among mothers and fathers, parents have received approximately 13 years of schooling.[8] Mothers tend to have slightly more years of schooling than fathers. In order to classify parents' occupations, we follow the ISCO-88 classification adopted by the International Labor Organization [1990].[9]   According to this classification, parental occupations are grouped into: (i) high white collar (ii) low white collar (iii) high blue collar, and (iv) low blue collar.[10]   Considering the highest occupational category among both parents, 57% and 25% of students have at least one parent whose occupation is categorized as high or low white collar, respectively. Only 14% and 4% of students are children of high or low blue collar workers.

Students in primary school spend on average 8 hours and 47 minutes per week doing homework, with some reporting up to 40 hours. Most receive some help with their home-

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[8]We have transformed categorical variables on parents' education into years of schooling assuming that individuals do not repeat courses; see Table A-1 of the Appendix A for years of schooling for each educational category.

[9]According to this division, individuals with occupations as legislators, senior official, managers, professionals, technicians, and associate professionals are considered as belonging to the high white collar group. Those working as clerks, service workers and market sales workers are grouped as low white collar individuals. Occupations such as skilled agricultural and fishery workers and craft and related trades workers are classified as high blue collar jobs. Individuals working as plant and machine operators and assemblers or in elementary occupations are regarded as low blue collar workers.

[10]For our data these groups include the following: (i) high white collar: administrative workers, professional or technical worker (for example: professor, scientist, doctor, engineer, lawyer, economist, psychologist, artist), manages a firm, works in a Ministry, works for the regional government, or works in the town hall, (ii) low white collar: military, secretary, works in a restaurant or hotel, policeman, fire-fighter, sales-man, shop assistant, cashier, (iii) high blue collar: works on construction site, maintenance worker, carpenter, works in a factory, (iv) low blue collar: works in somebody' else household, security guard, cleaning service, janitor.

work. Only 28% report to do their homework by themselves. Around 27% of all students receive homework help from their mothers, followed by mothers and fathers, and fathers. Only few students receive help from private teachers (5%). Regarding the extent of homework help, 17 % of students do not receive any help at all from their parents, while most students (63%) receive a little help. Additional variables in our data set are students' test scores, sex, age, country of birth, age at school entry, and disability. We also know if students have repeated a grade, if they are "special needs" students, with whom they live, and who is at home when they return from school.

Descriptive statistics for secondary school students (age 15) are displayed in Table A-4 of the Appendix A. The distribution of students according to parental education and occupation is similar to that of primary school students. Considering homework habits, secondary school students spend more time doing homework than primary school students, in total almost 9 hours and 38 minutes. The large majority, 41%, does not receive any help with their homework. Homework help from private teachers is more common among secondary school students (9%).

Descriptive Relations: Effort, Family Background and Educational Outcome
Before conducting a formal test of our model, we consider descriptive statistics of effort - weekly homework time - and educational outcome - test scores - by family background. To this end, we combine highest educational and occupational parental background and construct twenty groups of parental background; i.e. (i) those with parents who have a university education and a high white collar occupation, (ii) university and low white collar background.. etc[11] Table 4.1 shows weekly hours of homework and test scores for primary and secondary school students by these twenty groups. Students of higher parental background, i.e. students whose parents have received more years of education and who hold higher classified occupations tend to achieve higher test scores. However, while among primary school students there is a strong positive correlation between hours spend doing homework and tests scores by family background, among secondary school students this relationship is much weaker.

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[11]Table A-2 of the Appendix A displays the distribution of students according to these combined groups of parental background.

Table 4.1: Test Scores and Weekly Hours of Homework by Parental Background

Parental Background	Primary School Students		Secondary School Students	
	Test Score	Homework	Test Score	Homework
University & High White Collar	106.03	9.26	100.82	10.71
University & Low White Collar	98.77	8.51	100.02	9.71
University & High Blue Collar	94.33	8.20	99.34	9.08
University & Low Blue Collar	94.78	7.47	99.79	8.96
Higher Secondary & High White Collar	101.96	8.97	99.89	9.86
Higher Secondary & Low White Collar	97.95	8.54	100.07	9.04
Higher Secondary & High Blue Collar	95.99	8.56	99.24	8.83
Higher Secondary& Low Blue Collar	93.86	8.39	98.74	8.70
Lower Secondary & High White Collar	99.06	8.69	99.51	8.80
Lower Secondary & Low White Collar	97.10	8.31	99.67	8.32
Lower Secondary & High Blue Collar	95.28	8.08	99.47	8.03
Lower Secondary &Low Blue Collar	95.48	7.87	99.16	8.20
Apprenticeship & High White Collar	102.81	9.27	99.75	9.65
Apprenticeship & Low White Collar	99.48	8.76	98.75	9.36
Apprenticeship & High Blue Collar	98.23	9.09	99.90	8.65
Apprenticeship & Low Blue Collar	95.35	8.87	97.54	8.63
Compulsory education not completed & High White Collar	92.02	7.21	98.14	8.07
Compulsory education not completed & Low White Collar	89.33	7.35	99.40	7.34
Compulsory education not completed & High Blue Collar	88.68	7.28	99.85	7.20
Compulsory education not completed & Low Blue Collar	85.33	6.79	99.90	7.41
Correlation Coefficient		0.90		0.31
R^2		0.81		0.09

4.2 Effort and Family Background

In order to test empirically if students from more advantageous family backgrounds exert more effort compared to those from less advantageous backgrounds, we estimate the following regression of student effort ($e_{i,j}$) on family background ($b_{i,j}$),

$$log(e_{i,j}) = \beta_o + \beta_1 b_{i,j} + \beta_2 x_{i,j} + a_j, \tag{4.14}$$

controlling for individual characteristics of the student, homework habits, and her household situation ($x_{i,j}$) as well as for school fixed effects (a_j), with i and j being subindexes for the student and the school respectively. To estimate Equation 4.14 we run an OLS regression with school fixed effects and standard errors clustered at the school level. School fixed effects allow us to control for a possible bias that might arise from the sorting of students according to their family background into schools. If schools with students from more advantageous family backgrounds systematically assign more homework, these students will report on average more weekly homework time. If we estimated an OLS regression without school fixed effects, the coefficient of the variable for parental background would also pick up a school's policy of assigning more homework. Hence by introducing school fixed effects into the regression we can shut off any effects of different school policies and focus on the direct effects of a student's parental background on effort.

As a measure of effort ($e_{i,j}$) we consider hours of homework per week.[12] As measures for the student's family background ($b_{i,j}$) we include the highest occupational and educational

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[12] To deal with students who report zero hours of homework on a logarithmic scale, we follow Hu [1972] substituting these values by 0.000001.

category among parents. We approximate a student's innate talent (θ) by using dummy variables for students who have repeated a grade as well as for disabled or "special needs" students. As students' individual variables we include gender, age, country of birth, age when starting school, situation at home, and help with homework.[13] Tables 4.2 and 4.3 present our estimation results. Our coefficient of interest is β_1, measuring the effect of parental background on student effort.

We find that for both groups of students, higher parental education is clearly related to more hours of homework, i.e. students from educationally more advantageous background exert more effort. Results in column 3 of Table 4.2 show that comparing a 12 year old student with a parent who graduated from university to a student whose parent has not finished any compulsory education, if the former dedicates 8.79 hours (mean value) a week to homework, the latter studies 6.72 hours per week, 2 hours or 23.5% less. In case of older students results displayed in column 3 of Table 4.3 are similar. The same change in parental education is associated with 21.7% less homework, i.e. respective to the mean, 2 hours and 5 minutes less weekly homework time. For primary school students we also find a significant difference in homework time between students with a parent who graduated from university and those with a parent who only has lower secondary education.[14] When considering other aspects of parental background, like occupational categories, coefficients for younger students point into the same direction. Compared to children of high white collar employees, children of parents with low white collar occupations spend significantly fewer hours per week doing homework, 7.8%. However, the remaining coefficients of parental occupational categories as well as those for older students are not significant at the 10% level. Overall, parental educational and occupational backgrounds seems to be somewhat more important for determining student effort of primary school students compared to secondary school students.

Coefficients of variables related to individual characteristics show the expected signs. Girls in primary and even more so in secondary school spend more time doing homework. Receiving homework help from somebody increases time dedicated to it. Students who have repeated a grade dedicate less time to homework.

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[13]Our data set does not provide all information needed to estimate our theoretical student's effort best response function ($e^* = e\left(\widehat{q}, x, b, \theta\right)$). In particular, we lack information about the labor market premium (x), as well as the passing standard ($\widehat{q}$), given that scores from neither test have any academic consequences for students.

[14]While there might exist an endogeneity problem regressing homework habits on hours of homework, we consider it of secondary nature given that it only operates through the effect of homework on achievement. In addition, coefficients change little when including homework habits, i.e. when moving from column 1 to columns 2, 3 or 4.

Table 4.2: Coefficients from School Fixed Effects Regression for Log Hours of Homework - Primary School Students

	1		2		3		4	
Educational category parents:								
Apprenticeship	0.041	(0.031)	0.047	(0.031)	0.038	(0.031)	0.038	(0.031)
Higher secondary	-0.000	(0.029)	0.008	(0.028)	0.009	(0.028)	0.009	(0.028)
Lower secondary	-0.098***	(0.034)	-0.072**	(0.033)	-0.067**	(0.033)	-0.069**	(0.033)
Incomplete compulsory	-0.443***	(0.075)	-0.276***	(0.074)	-0.231***	(0.074)	-0.235***	(0.074)
Occupational category parents:								
Low white collar	-0.128***	(0.027)	-0.080***	(0.027)	-0.076***	(0.027)	-0.078***	(0.027)
High blue collar	-0.072**	(0.037)	-0.013	(0.037)	-0.014	(0.037)	-0.015	(0.037)
Low blue collar	-0.188***	(0.063)	-0.089	(0.062)	-0.090	(0.062)	-0.092	(0.062)
Individual Characteristics:								
Has repeated grade			-0.493***	(0.173)	-0.519***	(0.172)		
Age			0.146	(0.164)	0.169	(0.162)	-0.299***	(0.043)
With special needs			-0.564***	(0.074)	-0.572***	(0.074)	-0.586***	(0.074)
Disabled			-0.954***	(0.130)	-0.971***	(0.129)	-0.975***	(0.130)
Girl			0.069***	(0.020)	0.036*	(0.020)	0.037*	(0.020)
Started school:								
between 3 and 5			-0.025	(0.022)	-0.030	(0.022)	-0.030	(0.022)
age 6			-0.159*	(0.096)	-0.145	(0.096)	-0.147	(0.096)
age 7			-0.232*	(0.136)	-0.231*	(0.136)	-0.225	(0.137)
Born in:								
Latin America			0.030	(0.045)	0.026	(0.045)	0.023	(0.045)
Romania			0.250***	(0.082)	0.274***	(0.082)	0.271***	(0.082)
Morocco			0.389***	(0.143)	0.446***	(0.142)	0.445***	(0.142)
China			0.032	(0.225)	0.143	(0.226)	0.135	(0.227)
elsewhere			-0.011	(0.053)	-0.001	(0.054)	-0.003	(0.054)
Lives with:								
Mother only			-0.110**	(0.046)	-0.115**	(0.046)	-0.118***	(0.046)
Mother and one sibling			0.003	(0.047)	0.013	(0.047)	0.009	(0.047)
Mother and more than one sibling			-0.010	(0.075)	0.005	(0.075)	-0.001	(0.075)
Mother and father only			-0.021	(0.030)	-0.032	(0.030)	-0.031	(0.030)
Mother, father, and more than one sibling			-0.039*	(0.029)	-0.027	(0.029)	-0.027	(0.029)
Different living arrangement			-0.029	(0.036)	-0.014	(0.036)	-0.017	(0.036)
At home when returning from school:								
Father			0.074**	(0.033)	0.075**	(0.033)	0.076	(0.033)
Mother and father			0.062**	(0.029)	0.053*	(0.029)	0.053*	(0.029)
Others			0.114***	(0.027)	0.121	(0.027)	0.121***	(0.027)
Nobody			0.031	(0.044)	0.065	(0.045)	0.064	(0.045)
Homework help from:								
Mother					0.096***	(0.030)	0.097***	(0.030)
Father					0.052	(0.036)	0.053	(0.036)
Mother and father					0.101***	(0.032)	0.101***	(0.032)
Private teacher					0.166***	(0.048)	0.162***	(0.048)
Others					0.106**	(0.044)	0.105**	(0.044)
Homework help from parents:								
A little					0.463***	(0.045)	0.462***	(0.046)
Quite some					0.403***	(0.053)	0.399***	(0.053)
Much					0.446***	(0.063)	0.442***	(0.063)
All					0.191	(0.157)	0.192	(0.156)
Constant	1.756***	(0.013)	0.021	(1.970)	-0.689	(1.948)	4.931***	(0.522)
Observations	45,850		45,850		45,850		45,850	
R-squared	0.003		0.018		0.026		0.026	
Number of Schools	1,222		1,222		1,222		1,222	

Robust standard errors - clustered at school level - in parentheses: ***p<0.01, **p<0.05, *p<0.1. Reference group: Boy born in Spain who started school before the age of 3 who lives with parents (white high collar employees with university degree) and one sibling whose mother is at home when he returns from school and who does not receive any homework help from anybody.

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Table 4.3: Coefficients from School Fixed Effects Regression for Log Hours of Homework - Secondary School Students

	1		2		3		4	
Educational category parents:								
Apprenticeship	0.000	(0.037)	0.023	(0.037)	0.040	(0.037)	0.036	(0.037)
Higher secondary	-0.054*	(0.033)	0.006	(0.032)	0.025	(0.032)	0.023	(0.032)
Lower secondary	-0.190***	(0.040)	-0.102**	(0.040)	-0.046	(0.040)	-0.052	(0.040)
Incomplete compulsory	-0.506***	(0.093)	-0.327***	(0.095)	-0.214**	(0.095)	-0.217**	(0.095)
Occupational category parents:								
Low white collar	-0.141***	(0.034)	-0.070**	(0.034)	-0.052	(0.034)	-0.053	(0.034)
High blue collar	-0.089**	(0.042)	-0.009	(0.044)	0.006	(0.044)	0.003	(0.044)
Low blue collar	-0.238***	(0.071)	-0.124*	(0.071)	-0.091	(0.071)	-0.093	(0.071)
Individual Characteristics:								
Has repeated grade			-0.268***	(0.088)	-0.294***	(0.087)		
Age			-0.230***	(0.063)	-0.205***	(0.062)	-0.383***	(0.024)
With special needs			-0.080	(0.080)	-0.085	(0.081)	-0.084	(0.081)
Disabled			0.041	(0.041)	0.032	(0.041)	0.032	(0.041)
Girl			0.300***	(0.025)	0.267***	(0.024)	0.269***	(0.024)
Started school:								
between 3 and 5			0.002	(0.023)	-0.003	(0.023)	-0.005	(0.023)
age 6			-0.079	(0.098)	-0.064	(0.097)	-0.067	(0.098)
age 7			-0.036	(0.192)	-0.050	(0.190)	-0.044	(0.0189)
Born in:								
Latin America			-0.045*	(0.047)	-0.012	(0.047)	-0.022	(0.047)
Romania			0.126	(0.117)	0.225*	(0.116)	0.206*	(0.116)
Morocco			0.143	(0.194)	0.242	(0.192)	0.248	(0.193)
China			-0.813***	(0.297)	-0.701**	(0.296)	-0.714**	(0.296)
elsewhere			-0.073	(0.066)	-0.024	(0.067)	-0.032	(0.066)
Lives with:								
Mother only			-0.264***	(0.056)	-0.231***	(0.056)	0.240***	(0.056)
Mother and one sibling			-0.108*	(0.057)	-0.063	(0.057)	-0.064	(0.057)
Mother and more than one sibling			-0.101	(0.084)	-0.032	(0.084)	-0.039	(0.085)
Mother and father only			-0.011	(0.030)	-0.026	(0.031)	-0.027	(0.031)
Mother, father, and more than one sibling			-0.111***	(0.031)	-0.086***	(0.031)	-0.088***	(0.031)
Different living arrangement			-0.130***	(0.043)	-0.095**	(0.043)	-0.100**	(0.043)
At home when returning from school:								
Father			0.069*	(0.038)	0.063*	(0.038)	0.061	(0.038)
Mother and father			0.136***	(0.033)	0.113***	(0.033)	0.113***	(0.033)
Others			0.040	(0.034)	0.043	(0.034)	0.043	(0.034)
Nobody			0.079**	(0.037)	0.129***	(0.037)	0.130***	(0.037)
Homework help from:								
Mother					0.164***	(0.031)	0.165***	(0.031)
Father					0.127***	(0.038)	0.128***	(0.038)
Mother and father					0.176***	(0.031)	0.181***	(0.031)
Private teacher					0.258***	(0.035)	0.249***	(0.034)
Others					0.221***	(0.038)	0.220***	(0.038)
Homework help from parents:								
A little					0.461***	(0.032)	0.460***	(0.032)
Quite some					0.482***	(0.040)	0.477***	(0.040)
Much					0.429***	(0.079)	0.421***	(0.079)
All					-0.487	(0.306)	-0.485	(0.306)
Constant	1.849***	(0.015)	5.293***	(0.944)	4.451***	(0.935)	7.119***	(0.368)
Observations	41,956		41,956		41,956		41,956	
R-squared	0.004		0.0625		0.040		0.039	
Number of Schools	755		755		755		755	

Robust standard errors - clustered at school level - in parentheses: ***p<0.01, **p<0.05, *p<0.1. Reference group: Boy born in Spain who started school before the age of 3 who lives with parents (white high collar employees with university degree) and one sibling whose mother is at home when he returns from school and who does not receive any homework help from anybody.

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If repeating a grade is a reflection of low innate talent this confirms our theoretical result of more able students exerting more effort, see Lemma 2.3. However, note that results on effort and parental background are not driven by repeaters. The last columns of Tables 4.2 and 4.3 show our estimations without controlling for students who repeat a grade. Coefficients, especially those related to parental background are very similar.

4.2.1 Robustness Check

We check the robustness of our results using the maximum years of schooling among parents instead of educational categories. Results are a little weaker. A reduction in parental education from 16 (university) to 5 (incomplete compulsory education) years of schooling is associated with a decrease of 13.2% and 11% in student effort for primary and secondary school students respectively (see Tables A-5 and A-6 of the Appendix). Again parental occupational background matters more for effort exerted by primary school students. Some results in the literature suggest a different influence of mothers' and fathers' education on children's outcomes (see Behrman [1997] for a survey of this literature). When including mothers' and fathers' education and occupation separately, results for primary school students remain almost unchanged. In addition, no clear differences in the effect of educational attainment by mothers or fathers on student effort are found. This is in line with Behrman [1997] who points out that the conventional wisdom that mother's education matters more for children's outcomes than father's education is not supported by empirical studies. For secondary school students most results are similar to our benchmark estimation but coefficients loose significance.

Our empirical findings suggest that students from more advantageous occupational and educational family backgrounds exert more effort compared to those from less advantageous backgrounds. In our theoretical model, according to Proposition 3.3, depending on students' risk attitude and the sign of the cross-productivity effect, the result that students from more advantageous family backgrounds exert more effort ($\frac{de}{db} > 0$) is due to $\eta_b(\xi_e) \gtrless \eta_b(A)$.[15] An empirical test of our theoretical result thus requires information on students' risk attitude and/or on the elasticity of the marginal productivity of student effort by family background. Given our data set we cannot directly test for students' attitudes towards risk. However, the marginal productivity of student effort with respect to family background can be estimated. In particular, we can test for the sign of the cross-productivity effect. In addition we also test our assumptions on a positive direct

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[15]Note that this result is strongly determined by our assumption that costs of effort are independent of parental background.

productivity effect related to family background $\xi_b(\cdot)$ and a positive direct productivity effect related to effort $\xi_e(\cdot)$. The next section performs these tests.

4.3   Marginal Productivity of Effort and Family Background

We specify the following student achievement function

$$log(q_{i,j}) = \beta_o + \beta_1 b_{i,j} + \beta_2 e_{i,j} + \beta_3 e_{i,j}^2 + \beta_4 b_{i,j} e_{i,j} + \beta_5 b_{i,j} e_{i,j}^2 + \beta_6 x_{i,j} + \beta_7 x_{i,j} b_{i,j} + a_j, \quad (4.15)$$

where as before $(e_{i,j})$ denotes student effort, which we also include squared to test for possible decreasing returns to scale. Family background variables are denoted by $(b_{i,j})$ and $(x_{i,j})$ are variables of individual characteristics and (a_j) are school fixed effects, with i and j being subindexes for the student and the school respectively. We include interaction terms between parental background variables and student effort in order to test our theoretical assumption of a possible distinct impact of student effort on achievement according to family background $(\beta_4 \neq 0)$. We also include a term interacting family background and effort squared to test for differences in returns to scale along family backgrounds. The term $(x_{i,j} b_{i,j})$ interacts dummy variables regarding homework help with the educational categories of the mother and/or father who is reported to help with homework.[16] Specifying $q_{i,j}$ as the student's test score we estimate Equation 4.15 using an OLS regression with school fixed effects. Again we cluster standard errors at the school level. School fixed effects are of additional importance in this estimation given possible differences in passing standards across schools. In addition, sorting of students into schools according to family background, in combination with differences in schools' resources that might affect academic achievement of students differently (number and quality of teachers, finance etc) could lead to a bias in an estimation without fixed effects.

Estimation of Equation 4.15 faces two main problems. Student ability is an omitted variable in our estimation. We try to address this problem by using dummy variables to capture students' ability, i.e. if a student has repeated a grade, if he or she has "special needs" or is disabled. But in addition there is also a problem of reversed causality. The time students spend doing homework not only determines their achievement, but it is possibly also affected by their past achievement which in turn is highly correlated with current achievement. We thus cannot conclude anything about the causal relationship between family background and student effort on achievement. However, we argue that

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[16]In case the student indicates that both mother and father usually help with homework we use highest educational category among both parents. In case students report neither help by fathers nor mothers we set the interaction term to zero, independently of information on parental education being provided.

we are able to say something about how the relationship between effort and achievement differs according to family background and for different age groups.

Tables 4.4 and 4.5 show our estimation results. Our coefficients of interest are β_4 and β_5 related to the cross-productivity effect, as well as β_1, β_2, and β_3 that indicate direct productivities of parental background and effort respectively. In line with our theory, for primary school students we find a positive marginal productivity of effort. One additional hour of homework time is associated with an increase in the student's test score of 0.5%; i.e. 3% of one standard deviation, $\xi_e > 0$. We also find empirical evidence for a positive direct productivity effect of family background on achievement, $\xi_b > 0$. Regarding marginal productivities of effort by family background - contrary to our expectations - students whose parents are high or low blue collar employees have a slightly higher productivity of effort compared to those whose parents are high white collar employees, $\xi_{eb} < 0$. According to Proposition 3.3 the result $\frac{de}{db} > 0$ in combination with $\xi_{eb} < 0$, requires $A_b > 0$, a risk seeking attitude by 12 year old primary school students.

When we estimate Equation 4.15 using data for older students, we find no significant effect of homework time on test scores nor any differences in marginal productivities of effort by parental background, $\xi_e^{Secondary} \approx 0$ and $\xi_{eb}^{Secondary} \approx 0$. We do find a direct productivity effect of family background on achievement, $\xi_b^{Secondary} > 0$, but much smaller than the one found for primary school students. Regarding other variables, coefficients show the expected signs. The overall explanatory power of our regressors is much higher for test scores of younger students.

4.3.1   Robustness Check

Given that some of our results differ from the initial expectations, we run some robustness checks (see Tables A-7 to A-10 of the Appendix A). Findings in the literature suggest important differences in risk attitudes across gender, see Eckel and Grossman [2008] for an overview of empirical results on this matter. Hence, we estimate our regression separately for boys and girls. We find a positive marginal productivity of effort and differences in marginal productivities by family background for both boys and girls for primary school students only. We also look at native and foreign students who might have different attitudes towards risk. Results for native primary school students are very much in line with those for the full sample. The sample size for immigrants is quite small which might explain the loss of significance of coefficients regarding differences in marginal productivities by family background. Given that the marginal productivity of effort may vary with achievement, we group students according to their test score.

Table 4.4: Coefficients from School-Fixed Effects Regression for Log Test Score-Primary School Students

	1		2		3		4	
Hours of homework	0.010***	(0.000)	0.008***	(0.000)	0.006***	(0.000)	0.005***	(0.000)
Hours of homework^2	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)
Educational category parents:								
Apprenticeship	-0.011***	(0.002)	-0.014**	(0.005)	-0.013***	(0.004)	-0.011**	(0.004)
Upper secondary	-0.015***	(0.002)	-0.025***	(0.005)	-0.015***	(0.004)	-0.014***	(0.004)
Lower secondary	-0.023***	(0.002)	-0.033***	(0.005)	-0.019***	(0.004)	-0.017***	(0.004)
Incomplete compulsory	-0.086***	(0.004)	-0.102***	(0.008)	-0.046***	(0.006)	-0.042***	(0.006)
Occupational category parents:								
Low white collar	-0.033***	(0.002)	-0.052***	(0.004)	-0.025***	(0.003)	-0.024***	(0.004)
High blue collar	-0.044***	(0.002)	-0.070***	(0.006)	-0.036***	(0.004)	-0.035***	(0.004)
Low blue collar	-0.056***	(0.004)	-0.085***	(0.008)	-0.041***	(0.007)	-0.039***	(0.007)
Interaction: Hours Homework*Educational category parents:								
Hwk*Apprenticeship			0.000	(0.001)	0.001	(0.001)	0.001	(0.001)
Hwk*Upper secondary			0.002*	(0.001)	0.001	(0.001)	0.001	(0.001)
Hwk*Lower secondary			0.001*	(0.001)	-0.000	(0.001)	-0.000	(0.001)
Hwk*Incomplete compulsory			0.003*	(0.002)	0.001	(0.001)	0.001	(0.001)
Interaction: Hours Homework*Occupational category parents:								
Hwk*Low white collar			0.003***	(0.001)	0.001	(0.001)	0.001	(0.001)
Hwk*High blue collar			0.004***	(0.001)	0.002***	(0.001)	0.002***	(0.001)
Hwk*Low blue collar			0.005***	(0.001)	0.002**	(0.001)	0.002**	(0.001)
Interaction: Hours Homework^2**Educational category parents:								
Hwk^2*Apprenticeship			-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)
Hwk^2*Upper secondary			-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)
Hwk^2*Lower secondary			-0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Hwk^2*Incomplete compulsory			-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)
Interaction: Hours Homework^2*Occupational category parents								
Hwk^2*Low white collar			-0.000**	(0.000)	-0.000	(0.000)	-0.000	(0.000)
Hwk^2*High blue collar			-0.000*	(0.000)	-0.000	(0.000)	-0.000	(0.000)
Hwk^2*Low blue collar			-0.000*	(0.00)	-0.000	(0.000)	-0.000	(0.000)
Homework help from:								
Mother					-0.018***	(0.002)	-0.015***	(0.002)
Father					-0.013***	(0.002)	-0.006**	(0.003)
Mother and father					-0.007***	(0.002)	-0.004**	(0.002)
Private teacher					-0.065***	(0.003)	-0.066***	(0.003)
Others					-0.016***	(0.002)	-0.016***	(0.002)
Homework help from parents:								
A little					-0.018***	(0.002)	-0.018***	(0.002)
Quite some					-0.047***	(0.002)	-0.047***	(0.002)
Much					-0.061***	(0.003)	-0.060***	(0.003)
All					-0.086***	(0.007)	-0.086***	(0.007)
Started school								
between 3 and 5					-0.005***	(0.001)	-0.005***	(0.001)
age 6					-0.025***	(0.004)	-0.025***	(0.004)
age 7					-0.049***	(0.006)	-0.050***	(0.006)
Born in:								
Latin America					-0.024***	(0.002)	-0.023***	(0.002)
Romania					0.011**	(0.004)	0.010**	(0.004)
Morocco					-0.020***	(0.007)	-0.021***	(0.007)
in China					0.006	(0.009)	0.005	(0.009)
elsewhere					-0.005**	(0.003)	-0.005**	(0.003)
Individual Characteristics:								
With special needs					-0.149***	(0.004)	-0.149***	(0.004)
Disabled					-0.204***	(0.005)	-0.204***	(0.005)
Girl					-0.008***	(0.001)	-0.008***	(0.001)
Has repeated grade					-0.106***	(0.008)	-0.106***	(0.008)
Age					0.031***	(0.008)	0.031***	(0.008)
At home when returning from school:								
Father					-0.004**	(0.002)	-0.004**	(0.002)
Mother and father					-0.001	(0.001)	-0.001	(0.001)
Others					0.003*	(0.001)	0.003*	(0.001)
Nobody					-0.003	(0.002)	-0.003	(0.002)
Lives with:								
Mother only					-0.032***	(0.002)	-0.032***	(0.002)
Mother and one sibling					-0.008***	(0.003)	-0.008***	(0.003)
Mother and more than one sibling					-0.016***	(0.004)	-0.016***	(0.004)
Mother and father only					-0.011***	(0.001)	-0.011***	(0.001)
Mother, father, and more than one sibling					-0.005***	(0.001)	-0.005***	(0.001)
Different living arrangement					-0.012***	(0.002)	-0.012***	(0.002)
Interaction terms: Homework help by mother and/or father								
with educational and occupational background respectively	no		no		no		yes	
Constant	4.578***	(0.002)	4.594***	(0.003)	4.292***	(0.093)	4.294***	(0.093)
Observations	45,850		45,850		45,850		45,850	
R-squared	0.094		0.097		0.373		0.374	
Number of Schools	1,222		1,222		1,222		1,222	

Robust standard errors - clustered at school level - in parentheses: ***p<0.01, **p<0.05, *p<0.1 Reference group:Boy born in Spain who started school before the age of 3 who lives with parents (high white collar workers with university education) and one sibling whose mother is at home when he returns and who does not receive any homework help from anybody.

Table 4.5: Coefficients from School-Fixed Effects Regression for Log Test
Score-Secondary School Students

	1		2		3		4	
Hours of homework	-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)
Hours of homework^2	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Educational category parents:								
Apprenticeship	-0.005*	(0.002)	-0.008	(0.005)	-0.006	(0.005)	-0.008*	(0.005)
Upper secondary	-0.000	(0.002)	0.000	(0.004)	0.001	(0.004)	0.002	(0.004)
Lower secondary	-0.002	(0.002)	-0.005	(0.005)	-0.003	(0.004)	-0.004	(0.004)
Incomplete compulsory	-0.002	(0.003)	-0.006	(0.007)	-0.004	(0.007)	-0.005	(0.007)
Occupational category parents:								
Low white collar	0.002	(0.002)	0.001	(0.004)	-0.000	(0.004)	-0.000	(0.004)
High blue collar	-0.001	(0.002)	-0.001	(0.005)	-0.002	(0.005)	-0.002	(0.005)
Low blue collar	-0.005	(0.003)	-0.002	(0.006)	-0.002	(0.006)	-0.000	(0.006)
Interaction: Hours Homework*Educational category parents:								
Hwk*Apprenticeship			0.001	(0.001)	0.000	(0.001)	0.000	(0.001)
Hwk*Upper secondary			-0.000	(0.001)	-0.000	(0.001)	-0.000	(0.001)
Hwk*Lower secondary			0.001	(0.001)	0.000	(0.001)	0.000	(0.001)
Hwk*Incomplete compulsory			0.000	(0.001)	0.000	(0.001)	0.000	(0.001)
Interaction: Hours Homework*Occupational category parents:								
Hwk*Low white collar			0.000	(0.001)	0.000	(0.001)	0.000	(0.001)
Hwk*High blue collar			0.000	(0.001)	0.000	(0.001)	0.000	(0.001)
Hwk*Low blue collar			-0.001	(0.001)	-0.001	(0.001)	-0.000	(0.001)
Interaction: Hours Homework^2**Educational category parents:								
Hwk^2*Apprenticeship			-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)
Hwk^2*Upper secondary			0.000	(0.000)	-0.000	(0.000)	- 0.000	(0.000)
Hwk^2*Lower secondary			-0.000	(0.000)	-0.003	(0.002)	-0.000	(0.000)
Hwk^2*Incomplete compulsory			0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Interaction: Hours Homework^2*Occupational category parents								
Hwk^2*Low white collar			0.000	(0.000)	-0.000	(0.000)	- 0.000	(0.000)
Hwk^2*High blue collar			-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)
Hwk^2*Low blue collar			0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Homework help from:								
Mother					-0.001	(0.002)	-0.003	(0.002)
Father					0.002	(0.002)	0.003	(0.003)
Mother and father					0.001	(0.002)	0.002	(0.002)
Private teacher					0.000	(0.002)	0.000	(0.002)
Others					0.002	(0.002)	0.002	(0.002)
Homework help from parents:								
A little					-0.000	(0.001)	-0.000	(0.001)
Quite some					-0.000	(0.002)	-0.000	(0.002)
Much					-0.002	(0.004)	-0.002	(0.004)
All					0.014	(0.009)	0.014	(0.009)
Started school								
between 3 and 5					-0.001	(0.001)	-0.001	(0.001)
age 6					0.002	(0.004)	0.002	(0.004)
age 7					-0.003	(0.007)	-0.003	(0.007)
Born in:								
Latin America					0.001	(0.002)	0.001	(0.002)
Romania					-0.002	(0.005)	-0.002	(0.005)
Morocco					0.005	(0.007)	0.005	(0.007)
in China					-0.005	(0.008)	-0.005	(0.008)
elsewhere					-0.000	(0.003)	-0.000	(0.003)
Individual Characteristics:								
With special needs					-0.187***	(0.005)	-0.187***	(0.005)
Disabled					-0.144***	(0.003)	-0.144***	(0.003)
Girl					-0.000	(0.001)	-0.000	(0.001)
Has repeated grade					-0.001	(0.003)	-0.001	(0.003)
Age					0.000	(0.002)	0.000	(0.002)
At home when returning from school:								
Father					0.000	(0.002)	0.000	(0.002)
Mother and father					-0.003	(0.002)	-0.002	(0.002)
Others					0.000	(0.002)	0.000	(0.002)
Nobody					-0.000	(0.002)	-0.000	(0.002)
Lives with:								
Mother only					0.001	(0.002)	0.001	(0.002)
Mother and one sibling					-0.001	(0.003)	-0.001	(0.003)
Mother and more than one sibling					-0.003	(0.004)	-0.003	(0.004)
Mother and father only					-0.003*	(0.002)	-0.003*	(0.002)
Mother, father, and more than one sibling					0.001	(0.002)	0.001	(0.002)
Different living arrangement					-0.002	(0.002)	-0.002	(0.002)
Interaction terms: Homework help by mother and/or father								
with educational and occupational background respectively	no		no		no		yes	
Constant	4.600***	(0.002)	4.601***	(0.002)	4.615***	(0.033)	4.616***	(0.033)
Observations	41,956		41,956		41,956		41,956	
R-squared	0.000		0.000		0.141		0.142	
Number of Schools	755		755		755		755	

Robust standard errors - clustered at school level - in parentheses: ***p<0.01, **p<0.05, *p<0.1 Reference group:Boy born in Spain who started school before the age of 3 who lives with parents (high white collar workers with university education) and one sibling whose mother is at home when he returns and who does not receive any homework help from anybody.

When considering students with test scores below the lowest or above the highest quartile, differences in results on marginal productivity of effort between younger and older students remain for those with test scores below the lowest quartile. Coefficients related to marginal productivity of effort by parental background loose insignificance. We also consider a sample without repeaters, disabled, and "special needs" students. We observe little changes in results for secondary school students, while for primary school students we find that having a parent with a low white collar occupation is related to a lower marginal productivity of effort compared to having a parent with a university degree.

We can only conjecture why 12 year old students from less advantageous family backgrounds seem to somehow be better equipped to turn hours of homework (effort) into higher test scores (better achievements). Self-motivation might play a more important role for those from less advantageous family backgrounds, and students who decide to study by themselves may be more productive than those being encouraged by their parents. We check if our results hold when we disregard those students who receive help with their homework from parents, private teachers, or others. We thus run our regressions for students who study by themselves and who we expect to be more self-motivated. If the higher marginal productivity of effort by students of less advantageous family background was explained for by the differences in encouragement by parents, we would expect differences in marginal productivities to disappear. However, this is not the case. While marginal productivities of effort for this group of students differ by parental educational instead of occupational background, effort by students from less advantageous backgrounds continues to be more productive. For secondary school students results for this group of students does not differ from the overall results.

Similarly selection effects related to differences in innate talent might explain the higher marginal productivity of effort by students from less advantageous family backgrounds. Children from less advantageous backgrounds who spend many hours doing homework may be of greater innate talent (and/or self motivation) than those studying similar amounts of time from more advantageous family backgrounds. However, given the lack of data on measures of innate talent we cannot test for this hypothesis. An alternative explanation might be related to other inputs to education like educational software, computers, and textbooks. If these are complements to effort and if there are decreasing returns to scale in inputs to education, then hours of homework by students from less advantageous backgrounds who dispose of less additional inputs to education will be more productive.

In the context of our theoretical model this last result together with our previous empirical findings suggests that 12 year old primary school students display a risk seeking

attitude. However, our achievement function is likely to suffer from endogeneity problems and hence results have to be interpreted with caution. A different interpretation of our results that is outside of the scope of our theoretical model is linked to heterogeneity in attitudes towards risk and the intergenerational transmission of risk attitudes (see for instance Dohmen et al [2012]). If parents are risk averse, and risk aversion is linked to higher educational attainment as found by Belzil and Hansen [2004] which in turn provides access to a better occupation, then – with risk aversion being passed on from parents to children – there will be an ambiguous effect of more advantageous parental background on student's risk aversion. On the one hand, the higher parental background guarantees an income, independent of the choice of effort made, making students less risk averse. On the other hand, genetics will render students of higher parental background more risk averse. Similarly students from less advantageous family backgrounds could be more risk seeking which might explain why they do not spend more time doing homework despite their higher marginal productivities of effort.

5 Conclusion

In the theoretical model presented in this paper, academic attainment which entails an income premium in the labor market is noisily determined by effort and the student's family background and her innate talent. We show that if schools can set the optimal passing standard the relation between effort and family background is positive (negative) when the degree of risk aversion is smaller (larger) than the elasticity measuring the sensitivity of marginal productivity of the student's effort with respect to her family background. Given that the empirical literature regarding student effort and family background is quite scarce we analyze this question empirically. We find that if parental education was reduced from holding a university degree to incomplete compulsory education, students would exert around 21-23% less effort (approximately equal to a reduction of 2 hours in weekly homework time). For primary school students we also find that marginal productivities of effort are higher for those from less advantageous family backgrounds.

Our results come with a caveat. In the context of our theoretical model both empirical findings suggest that 12 year old primary school students display a risk seeking attitude. This suggests that effort choices by primary school students do not exactly mimic the decision making process suggested by our theoretical model, i.e fully taking into account the labor market consequences of exerting more or less effort. Given that we find no differences in marginal productivity by family background and zero marginal productivity of effort for older students, our empirical findings are silent on the risk attitudes of this

group of students. Both results clearly restrict the possibility to generalize the positive relationship between effort and family background found to other groups (university students, postgraduate students). The effort decision of university or postgraduate students might be more similar to our theoretical model and their notion of risk aversion more closely related to that of adults. Thus, it could even be the case that for them, the risk aversion effect could dominate the cross productivity effect, possibly reversing our result regarding a positive relationship between family background and student effort. Findings by the empirical literature on higher education achievement of private school students doing worse conditional on measures of prior achievement may point into this direction. For instance according to Smith and Nylor [2001a], students who attended private secondary school are 4 percentage points less likely to complete their degree compared to students who attended a state school. In a different paper the same authors, Smith and Naylor [2001b] find a similar result for degree achievement, namely that attendance of private secondary schools has a negative effect on degree performance for economics graduates. On the other hand, while our data set has the shortcoming discussed here, considering students at a younger age in compulsory education avoids problems of selection that might occur at higher levels of schooling, with those who exert very little effort dropping out of school.[17] If the majority of drop-outs come from less privileged backgrounds, the relationship between family background and effort could possibly change from an initial positive relationship in primary school to a negative one at university.

Given that these doubts about the relationship between family background and student effort remain, the paper highlights the importance of future empirical research to illustrate the degree of income risk effects on educational choices, and particularly on student effort for different age groups. As discussed before, our empirical finding are far from conclusive and are also clearly confined by the endogeneity that arises when regressing achievement on effort. Finally, one interesting aspect in terms of policy design would be to develop mechanisms that are able to induce students to exert optimal levels of effort.

References

Anghel, Brindusa and Antonio Cabrales(2010): "The Determination of Success in Primary Education in Spain," FEDEA, Documento de Trabajo 2010-20.

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[17]Note that results for secondary school students in 9th grade are not likely to be driven by drop-outs. Two-thirds to 80% of students who drop out - i.e. leave school without any academic qualification - do so after the age of 16, see Fernández Enguita et al. [2010]. Students in 9th grade would have to have repeated courses twice to be over 16.

Belzil, Christian and Jörgen Hansen(2004): "Earnings Dispersion, Risk Aversion and Education," *Research in Labor Economics,* 23, pp. 335-358.

Belzil, Christian and Marco Leonardi(2007): "Can Risk Aversion Explain Schooling Attainments. Evidence from Italy," *Labour Economics,* 14(6), pp. 957-970.

Behrman, Jere R.(1997): "Mother's Schooling and Child Education: A Survey," PIER Working Paper 97-025.

Bønesronning, Hans(2004): "The Determinants of Parental Effort in Education Production: Do Parents Respond to Changes in Class Size?," *Economics of Education Review,* 23, pp.1-9.

Brodaty, Thomas; Gary-Bobo, Robert and Ana Prieto(2006): 'Risk Aversion, Expected Earnings and Opportunity Costs: a Structural Econometric Model of Human Capital Investment," CEPR Discussion Paper No. 5694.

Cooley, Jane(2010): "Desegregation and the Achievement Gap: Do Diverse Peers Help?," Department of Economics, Duke University.

Correa, Hector and Gene W. Gruver(1987): "Teacher-Student Interaction: A Game Theoretic Extension of the Economic Theory of Education," *Mathematical Social Sciences,* 13(1), pp. 19-47.

De Fraja, Gianni(2002): "The Design of Optimal Education Policies," *Review of Economic Studies,* 69(2), pp. 437-466.

De Fraja, Gianni and Pedro Landeras(2006): "Could Do Better: The Effectiveness of Incentives and Competition in Schools," *Journal of Public Economics,* 90(1-2), pp. 189-213.

De Fraja, Gianni; Oliveira, Tania and Luis Zanchi(2010): "Must Try Harder. Evaluating the Role of Effort on Examination Results," *Review of Economics and Statistics,* 92(3), pp. 577-597.

Dohmen, Thomas; Falk, Armin; Huffmann, David and Uwe Sunde(2012): "The Intergenerational Transmission of Risk and Trust Attitudes," *Review of Economic Studies,* 79, pp. 645-677.

Eckel, Catherina C. and Philip J. Grossman (2008): "Men, Women and Risk Aversion: Experimental Evidence," in *Handbook of Experimental Economics Results,* edited by Kenneth Arrow and Michael Intriligator, pp.1061-1073.

Eren, Ozkan and Daniel J. Henderson (2011): "Are we wasting our children's time by giving them more homework?," *Economics of Education Review*, 30, 950-961.

Ermisch, John and Marco Francesconi(2001): "Family Matters: Impacts of Family Background on Educational Attainments," *Economica*, 68(270), pp. 137-156.

Feinstein, Leon and James Symons(1999): "Attainment in Secondary School," *Oxford Economic Papers*, 51(2), pp. 300-321.

Fernández Enguita, Mariano; Mena Martínnez, Luis and Jaime Riviere Gomez(2001): "Fracaso y abandono escolar en España," Obra Social La Caixa, Colección Estudios Sociales,Vol.29.

Haveman, Robert and Barbara Wolfe(1995): "The Determinants of Children's Attainments: a Review of Methods and Findings," *Journal of Economic Literature*, 33(4), pp. 1829-1878.

Hu, The-wei(1972): "The Fitting of Log-Regression Equation When Some Observations in the Regressand are Zero or Negative," *Metroeconomica*, 24(1), pp. 86-90.

International Labor Organization (1990): International Standard Classification of Occupations. International Labor Office, Geneva.

Landeras, Pedro(2009): "Student Effort: Standards vs. Tournaments," *Applied Economics Letters*, 16, pp. 965-969.

Lin, Chung-Cheng and Ching-Ching Lai(1996): "Why Parents and Teachers May Prefer Punishment to Encouragement for Child Education?," *Southern Economic Journal*, 63(1), pp. 244-247.

Metcalfe, Robert; Burgess, Simon, and Steven Proud (2011): "Student effort and educational attainment: Using the England football team to identify the education production function", CMPO (Centre for Market and Public Organisation) Working Paper No. 11/276.

Nielsen, Helena Skyt and Annette Vissing-Jorgensen(2006): "The Impact of Labor Income Risk on Educational Choices: Estimates and Implied Risk Aversion," Unpublished Manuscript, Department of Economics, University of Aarhus.

Paulsen, David J.; PLatt, Michael L.; Huettel, Scott A. and Elizabeth M. Brannon(2011): "Decision-making under risk in children, adolescents and young adults," *frontier in Psychology*, 2(72), pp. 1-6.

Smith, Jeremy and Robin Naylor(2001a): "Dropping out of University: A Statistical Analysis of the Probability of Withdrawal for UK University Students," *Journal of the Royal Statistical Society,* 164, pp. 389-405.

Smith, Jeremy and Robin Naylor(2001b): "Determinants of degree performance in UK universities: a statistical analysis of the 1993 student cohort," *Oxford Bulletin of Economics and Statistics,* 63(1), pp. 29-60.

Steinberg, Laurence(2007): "Risk Taking in Adolescence New Perspectives From Brain and Behavioral Science," *Current Directions in Psychological Science,* 16(2), pp.55-59.

Stinebrickner, Ralph and Toodd R. Stinebrickner(2008): "The Causal Effect of Studying on Academic Performance," *B.E. Journal of Economic Analysis & Policy,* 8/1 (Frontiers), pp. 1-54.

A   Appendix

Table A-1: Equivalence of educational categories and years of schooling

CDI	
Category	Mean Years of Schooling
University	16
Apprenticeship	12.5
Higher secondary education	12
Lower secondary education	8
Compulsory education not completed	5

Table A-2: Distribution of students by parental background: Primary/Secondary School Students

Education/Occupation	High White Collar	Low White Collar	High Blue Collar	Low Blue Collar
University	17530/16366	2989/ 1804	1084/541	307/261
Apprenticeship	3187/2723	1483/1419	685/743	157/ 201
Higher secondary education	3160/3886	3145/2780	1617/1291	432/474
Lower secondary education	2006/2039	3043/2877	2199/2280	600/726
Compulsory education not completed	225/157	723/421	946/ 710	332/257

Table A-3: Summary Statistics: Primary School Students, 2009/2010

Variable	Mean (St.D)	Variable	Mean (St.D)
Overall test score	100.9 (13.1) (Min 60 Max 121)		
Score girls (N=22,354)	100.7 (12.8) (Min 60 Max 121)	Highest occupation among parents:	
Score boys (N=23,496)	101.1 (13.5) (Min 60 Max 121)	High white collar	0.57 (0.50)
Girl	0.49 (0.50)	Low white collar	0.25 (0.43)
Age	12.13 (0.36) (Min: 11 Max: 14)	High blue collar	0.14 (0.35)
Repeating grades	0.13 (0.34)	Low blue collar	0.04 (0.20)
Disabled student	0.02 (0.15)	Lives with:	
Student with special needs	0.05 (0.23)	Mother	0.07 (0.26)
Attending:		Mother and one sibling	0.04 (0.20)
Public school	0.51 (0.50)	Mother and more than one sibling	0.02 (0.13)
Private school	0.10 (0.31)	Mother and father	0.16 (0.36)
Charter school	0.38 (0.49)	Mother, father, one sibling	0.42 (0.49)
Born in:		Mother and father and more than one sibling	0.17 (0.37)
Spain	0.82 (0.38)	Different living arrangement	0.12 (0.33)
Spanish speaking Latin America	0.10 (0.29)	When returning from school, awaited by:	
Morocco	0.01 (0.10)	Mother	0.52 (0.50)
Rumania	0.02 (0.15)	Father	0.10 (0.30)
China	0.005 (0.07)	Mother and father	0.17 (0.37)
elsewhere	0.04 (0.20)	Others	0.15 (0.36)
Started school		Nobody	0.06 (0.24)
before age 3	0.55 (0.50)	Homework habits:	
age 3-5	0.42 (0.49)	Weekly hours of homework	8.79 (5.95)(Min 0 Max 40)
age 6	0.02 (0.14)	Help from mother	0.27 (0.45)
age 7	0.01 (0.10)	Help from father	0.10 (0.30)
Highest education among parents:		Help from mother and father	0.23 (0.42)
University	0.48 (0.50)	Help from private teacher	0.05 (0.21)
Apprenticeship	0.12 (0.33)	Help from others	0.06 (0.25)
Upper secondary education	0.18 (0.39)	Help from nobody	0.28 (0.45)
Lower secondary education	0.17 (0.38)	No help form parents	0.17 (0.37)
Without compulsory education	0.05 (0.21)	A little help form parents	0.63 (0.48)
Years of schooling	12.95 (3.45)(Min 5 Max 16)	Quite some help form parents	0.15 (0.35)
Years of schooling mother	12.28 (3.69)(Min 5 Max 16)	Much help form parents	0.05 (0.21)
Years of schooling father	12.19 (3.71)(Min 5 Max 16)	All help from parents	0.008 (0.09)
Schools	1,222	Schools	1,222
Students	45,850	Students	45,850

Table A-4: Summary Statistics: CDI Secondary School Students, 2009/2010

Variable	Mean (St.D)	Variable	Mean (St.D)
Overall test score	100.1 (13.2) (Min 68 Max 131)		
Score girls (N=20,869)	100.1 (13.3) (Min 68 Max 131)	Highest occupation among parents:	
Score boys (N=21,087)	100.1 (13.2) (Min 68 Max 131)	High white collar	0.60 (0.49)
Girl	0.50 (0.50)	Low white collar	0.22 (0.42)
Age	15.42 (0.68) (Min: 14 Max: 18)	High blue collar	0.13 (0.34)
Repeating grades	0.32 (0.46)	Low blue collar	0.05 (0.21)
Disabled student	0.02 (0.14)	Lives with:	
Student with special needs	0.09 (0.28)	Mother	0.07 (0.26)
Attending:		Mother and one sibling	0.04 (0.21)
Public school	0.49 (0.50)	Mother and more than one sibling	0.02 (0.14)
Private school	0.11 (0.31)	Mother and father	0.15 (0.36)
Charter school	0.40 (0.49)	Mother, father, one sibling	0.43 (0.50)
Born in:		Mother and father and more than one sibling	0.16 (0.37)
Spain	0.82 (0.38)	Different living arrangement	0.11 (0.32)
Spanish speaking Latin America	0.10 (0.30)	When returning from school, awaited by:	
Morocco	0.008 (0.09)	Mother	0.47 (0.50)
Rumania	0.02 (0.13)	Father	0.11 (0.31)
China	0.005 (0.07)	Mother and father	0.14 (0.35)
elsewhere	0.05 (0.21)	Others	0.14 (0.35)
Started school		Nobody	0.14 (0.34)
before age 3	0.47 (0.50)	Homework habits:	
age 3-5	0.50 (0.50)	Weekly hours of homework	9.64 (6.55)(Min 0 Max 40)
age 6	0.02 (0.15)	Help from mother	0.17 (0.38)
age 7	0.007 (0.08)	Help from father	0.08 (0.27)
Highest education among parents:		Help from mother and father	0.15 (0.36)
University	0.45 (0.50)	Help from private teacher	0.09 (0.29)
Apprenticeship	0.12 (0.33)	Help from others	0.08 (0.28)
Upper secondary education	0.20 (0.40)	Help from nobody	0.41 (0.49)
Lower secondary education	0.19 (0.39)	No help form parents	0.31 (0.46)
Without compulsory education	0.04 (0.19)	A little help form parents	0.54 (0.50)
Years of schooling	12.86 (3.37)(Min 5 Max 16)	Quite some help form parents	0.12 (0.33)
Years of schooling mother	12.03(3.63)(Min 5 Max 16)	Much help form parents	0.02 (0.14)
Years of schooling father	11.98 (3.69)(Min 5 Max 16)	All help from parents	0.004 (0.06)
Schools	755	Schools	755
Students	41,956	Students	41,956

Table A-5: School Fixed Effects Regression for Log Hours of Homework - Primary
School Students: Robustness Check

	1		2		3	
Years parental schooling	0.012***	(0.004)				
Years of father's schooling			0.008*	(0.004)		
Years of mother's schooling			0.008*	(0.004)		
Educational category father: Apprenticeship					0.067**	(0.034)
Higher secondary					0.031	(0.034)
Lower secondary					0.019	(0.039)
Incomplete compulsory					-0.178***	(0.063)
Educational category mother: Apprenticeship					-0.013	(0.037)
Higher secondary					-0.006	(0.033)
Lower secondary					-0.063	(0.039)
Incomplete compulsory					-0.115*	(0.065)
Occupational category parents: Low white collar	-0.068**	(0.027)				
High blue collar	-0.013	(0.037)				
Low blue collar	-0.094	(0.062)				
Occupational category father: Low white collar			-0.044	(0.029)	-0.053*	(0.029)
High blue collar			0.002	(0.032)	-0.003	(0.032)
Low blue collar			-0.058	(0.055)	-0.067	(0.055)
Occupational category mother: Low white collar			-0.030	(0.027)	-0.040	(0.027)
High blue collar			-0.080	(0.068)	-0.085	(0.068)
Low blue collar			0.027	(0.032)	0.026	(0.032)
Individual Characteristics:						
Has repeated grade	-0.524***	(0.171)	-0.541***	(0.162)	-0.531***	(0.163)
Age	0.172	(0.162)	0.188	(0.149)	0.183	(0.150)
With special needs	-0.583***	(0.075)	-0.563***	(0.082)	-0.549***	(0.082)
Disabled	-0.981***	(0.130)	-0.741***	(0.133)	-0.725***	(0.133)
Girl	0.035*	(0.020)	0.035*	(0.020)	0.036*	(0.020)
Started School between 3 and 5	-0.029	(0.022)	-0.012	(0.021)	-0.013	(0.021)
age 6	-0.151	(0.096)	-0.165	(0.105)	-0.156	(0.105)
age 7	-0.240*	(0.136)	-0.222	(0.144)	-0.206	(0.145)
Born in Latin America	0.023	(0.045)	-0.010	(0.046)	-0.003	(0.045)
Romania	0.283***	(0.082)	0.196**	(0.083)	0.178**	(0.082)
Morocco	0.403***	(0.139)	0.448***	(0.172)	0.494***	(0.171)
China	0.132	(0.226)	0.226	(0.232)	0.245	(0.231)
elsewhere	-0.002	(0.054)	-0.016	(0.057)	-0.013	(0.057)
Lives with: Mother only	-0.116**	(0.046)	-0.080*	(0.048)	-0.080*	(0.048)
Mother and one sibling	0.013	(0.047)	0.025	(0.046)	0.024	(0.046)
Mother and more than one sibling	-0.001	(0.075)	-0.070	(0.087)	-0.063	(0.087)
Mother and father only	-0.032	(0.030)	-0.011	(0.029)	-0.010	(0.029)
Mother, father, and more than one sibling	-0.033	(0.029)	-0.027	(0.029)	-0.020	(0.029)
Different living arrangement	-0.014	(0.036)	-0.011	(0.037)	-0.010	(0.037)
At home when returning from school: Father	0.075**	(0.033)	0.060*	(0.035)	0.060*	(0.035)
Mother and father	0.051*	(0.029)	0.033	(0.029)	0.034	(0.029)
Others	0.120***	(0.027)	0.091***	(0.028)	0.094***	(0.028)
Nobody	0.063	(0.045)	0.045	(0.045)	0.048	(0.045)
Homework Help from: Mother	0.097***	(0.030)	0.072**	(0.032)	0.071**	(0.032)
Father	0.054	(0.036)	0.054	(0.037)	0.053	(0.037
Mother and father	0.102***	(0.032)	0.087***	(0.033)	0.086**	(0.033)
Private teacher	0.167***	(0.048)	0.135***	(0.051)	0.135***	(0.051)
Others	0.104**	(0.044)	0.123***	(0.046)	0.125***	(0.046)
Homework help from parents: A little	0.466***	(0.046)	0.412***	(0.046)	0.408***	(0.046)
Quite some	0.407***	(0.053)	0.374***	(0.054)	0.369***	(0.054)
Much	0.449***	(0.064)	0.385***	(0.065)	0.380***	(0.065)
All	0.196	(0.156)	0.200	(0.160)	0.199	(0.160)
Constant	-0.895	(1.945)	-1.054	(1.790)	-0.772	(1.795)
Observations	45,850		39,475		39,475	
R-squared	0.026		0.021		0.022	
Number of Schools	1,222		1,221		1,221	

Robust standard errors - clustered at school level - in parentheses: ***p<0.01, **p<0.05, *p<0.1. Reference group: Boy born in Spain who started school before the age of 3 who lives with parents (white high collar employees with university education) and one sibling whose mother is at home when he returns from school and who does not receive any homework help from anybody.

Table A-6: School Fixed Effects Regression for Log Hours of Homework - Secondary School Students: Robustness Check

	1		2		3	
Years parental schooling	0.010**	(0.005)				
Years of father's schooling			0.008*	(0.005)		
Years of mother's schooling			0.006	(0.005)		
Educational category father: Apprenticeship					0.024	(0.041)
Higher secondary					0.055	(0.034)
Lower secondary					-0.037	(0.043)
Incomplete compulsory					-0.118	(0.073)
Educational category mother: Apprenticeship					-0.006	(0.041)
Higher secondary					-0.037	(0.037)
Lower secondary					-0.037	(0.043)
Incomplete compulsory					-0.090	(0.077)
Occupational category parents: Low white collar	-0.041	(0.034)				
High blue collar	0.005	(0.044)				
Low blue collar	-0.092	(0.071)				
Occupational category father: Low white collar			-0.020	(0.034)	-0.030	(0.034)
High blue collar			-0.030	(0.038)	-0.033	(0.039)
Low blue collar			-0.075	(0.063)	-0.080	(0.063)
Occupational category mother: Low white collar			0.003	(0.033)	-0.002	(0.033)
High blue collar			0.141*	(0.077)	0.137*	(0.077)
Low blue collar			0.038	(0.039)	0.036	(0.039)
Individual Characteristics:						
Has repeated grade	-0.291***	(0.087)	-0.314***	(0.094)	-0.314***	(0.094)
Age	-0.206***	(0.063)	-0.181***	(0.069)	-0.181***	(0.069)
With special needs	-0.084	(0.081)	-0.122	(0.092)	-0.121	(0.092)
Disabled	0.032	(0.041)	0.028	(0.042)	0.029	(0.042)
Girl	0.266***	(0.024)	0.254***	(0.025)	0.255***	(0.025)
Started School between 3 and 5	-0.001	(0.023)	0.008	(0.024)	0.007	(0.024)
age 6	-0.068	(0.097)	0.016	(0.109)	0.016	(0.110)
age 7	-0.060	(0.190)	0.138	(0.198)	0.147	(0.198)
Born in Latin America	-0.016	(0.047)	-0.061	(0.051)	-0.057	(0.051)
Romania	0.243**	(0.116)	0.275**	(0.118)	0.254**	(0.118)
Morocco	0.179	(0.189)	0.068	(0.292)	0.104	(0.294)
China	-0.712**	(0.296)	-0.860**	(0.335)	-0.854**	(0.336)
elsewhere	-0.027	(0.067)	-0.057	(0.077)	-0.055	(0.076)
Lives with: Mother only	-0.234***	(0.056)	-0.232***	(0.059)	-0.232***	(0.059)
Mother and one sibling	-0.066	(0.057)	-0.081	(0.059)	-0.081	(0.059)
Mother and more than one sibling	-0.038	(0.084)	-0.115	(0.098)	-0.113	(0.098)
Mother and father only	-0.026	(0.031)	-0.030	(0.032)	-0.030	(0.032)
Mother, father, and more than one sibling	-0.091***	(0.031)	-0115***	(0.033)	-0.111***	(0.033)
Different living arrangement	-0.097**	(0.043)	-0.118**	(0.048)	-0.117**	(0.048)
At home when returning from school: Father	0.062*	(0.038)	0.070*	(0.040)	0.070*	(0.040)
Mother and father	0.112***	(0.033)	0.124***	(0.033)	0.124***	(0.033)
Others	0.041	(0.034)	0.041	(0.036)	0.043	(0.036)
Nobody	0.127***	(0.037)	0.105***	(0.038)	0.107***	(0.038)
Homework Help from: Mother	0.165***	(0.031)	0.152***	(0.032)	0.152***	(0.032)
Father	0.127***	(0.038)	0.079*	(0.042)	0.080*	(0.042)
Mother and father	0.176***	(0.031)	0.168***	(0.033)	0.168***	(0.033)
Private teacher	0.261***	(0.035)	0.252***	(0.037)	0.249***	(0.037)
Others	0.222***	(0.038)	0.222***	(0.038)	0.222***	(0.038)
Homework help from parents: A little	0.463***	(0.032)	0.453***	(0.035)	0.451***	(0.035)
Quite some	0.484***	(0.040)	0.474***	(0.043)	0.471***	(0.043)
Much	0.432***	(0.079)	0.455***	(0.082)	0.453***	(0.082)
All	-0.485	(0.306)	-0.102	(0.273)	-0.102	(0.273)
Constant	4.337***	(0.932)	3.938***	(1.035)	4.150***	(1.035)
Observations	41,956		35,997		35,997	
R-squared	0.039		0.040		0.040	
Number of Schools	755		754		754	

Robust standard errors - clustered at school level - in parentheses: ***p<0.01, **p<0.05, *p<0.1. Reference group: Boy born in Spain who started school before the age of 3 who lives with parents (white high collar employees with university education) and one sibling whose mother is at home when he returns from school and who does not receive any homework help from anybody.

Table A-7: School-Fixed Effects Regression for Log Test Score-Primary School Students: Robustness

	Girls		Boys		Natives		Immigrants	
Hours of homework	0.007***	(0.001)	0.004***	(0.000)	0.005***	(0.000)	0.009***	(0.001)
Hours of homework^2	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)	-0.000***	(0.000)
Educational category parents:								
Apprenticeship	-0.019***	(0.006)	-0.004	(0.006)	-0.018***	(0.005)	0.017	(0.013)
Upper secondary	-0.011*	(0.005)	-0.016***	(0.005)	-0.016***	(0.004)	-0.004	(0.008)
Lower secondary	-0.015*	(0.006)	-0.018***	(0.006)	-0.023***	(0.005)	0.006	(0.010)
Incomplete compulsory	-0.048***	(0.009)	-0.032***	(0.010)	-0.048***	(0.008)	-0.024**	(0.011)
Occupational category parents:								
Low white collar	-0.025***	(0.005)	-0.023**	(0.005)	-0.025***	(0.004)	-0.002	(0.008)
High blue collar	-0.023***	(0.007)	-0.047***	(0.006)	-0.038***	(0.005)	-0.013	(0.009)
Low blue collar	-0.044***	(0.010)	-0.031***	(0.010)	-0.042***	(0.009)	-0.007	(0.013)
Interaction:								
Hwk*Apprenticeship	0.001	(0.001)	0.000	(0.002)	0.001**	(0.001)	-0.002	(0.002)
Hwk*Upper secondary	0.000	(0.001)	0.001	(0.001)	0.001	(0.001)	0.001	(0.001)
Hwk*Lower secondary	-0.001	(0.001)	0.001	(0.001)	0.000	(0.000)	-0.001	(0.002)
Hwk*Incomplete compulsory	0.002	(0.002)	-0.013	(0.015)	0.002	(0.002)	-0.000	(0.002)
Hwk*Low white collar	0.001	(0.001)	0.001	(0.001)	0.001*	(0.001)	-0.002	(0.001)
Hwk*High blue collar	0.001	(0.001)	0.004***	(0.001)	0.002**	(0.001)	0.000	(0.001)
Hwk*Low blue collar	0.003**	(0.002)	0.001	(0.002)	0.002*	(0.001)	-0.001	(0.002)
Hwk^2*Apprenticeship	-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)	- 0.000	(0.000)
Hwk^2*Upper secondary	0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)
Hwk^2*Lower secondary	0.000**	(0.000)	-0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Hwk^2*Incomplete compulsory	-0.000	(0.000)	0.000	(0.000)	-0.000	(0.000)	0.000	(0.000)
Hwk^2*Low white collar	0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)	0.000	(0.000)
Hwk^2*High blue collar	0.000	(0.000)	-0.000**	(0.000)	-0.000	(0.000)	0.000	(0.000)
Hwk^2*Low blue collar	-0.000	(0.000)	0.000	(0.000)	-0.000	(0.000)	0.000	(0.000)
Homework help from:								
Mother	-0.014***	(0.003)	-0.014***	(0.003)	-0.016***	(0.002)	-0.017**	(0.008)
Father	-0.011***	(0.004)	-0.002	(0.003)	-0.006**	(0.003)	-0.006	(0.010)
Mother and father	-0.004	(0.003)	-0.003	(0.003)	-0.005**	(0.002)	-0.007	(0.007)
Private teacher	-0.064***	(0.004)	-0.066***	(0.004)	-0.069***	(0.003)	-0.047***	(0.007)
Others	-0.016***	(0.003)	-0.016***	(0.003)	-0.019***	(0.003)	-0.013***	(0.005)
Homework help from parents:								
A little	-0.014***	(0.002)	-0.021***	(0.002)	-0.017***	(0.002)	-0.017***	(0.004)
Quite some	-0.045***	(0.003)	-0.048***	(0.003)	-0.047***	(0.002)	-0.041***	(0.005)
Much	-0.057***	(0.004)	-0.063***	(0.004)	-0.063***	(0.003)	-0.048***	(0.007)
All	-0.077***	(0.010)	-0.091***	(0.009)	-0.091***	(0.008)	-0.061***	(0.013)
Started school								
between 3 and 5	-0.008***	(0.001)	-0.002*	(0.001)	-0.005***	(0.001)	-0.001	(0.003)
age 6	-0.025***	(0.006)	-0.026***	(0.006)	-0.043***	(0.007)	-0.015**	(0.006)
age 7	-0.056***	(0.009)	-0.042***	(0.008)	-0.049***	(0.012)	-0.052***	(0.007)
Born in								
Latin America	-0.026***	(0.003)	-0.021***	(0.003)			0.007	(0.008)
Romania	0.004	(0.006)	0.013**	(0.006)			0.037***	(0.009)
Morocco	-0.021**	(0.010)	-0.025***	(0.009)				
in China	0.020*	(0.011)	-0.013	(0.015)			0.031**	(0.012)
elsewhere	-0.006*	(0.004)	-0.004	(0.004)			0.031***	(0.008)
Individual Characteristics:								
With special needs	-0.149***	(0.005)	-0.149***	(0.005)	-0.147***	(0.006)	-0.157***	(0.005)
Disabled	-0.206***	(0.008)	-0.201***	(0.006)	-0.197***	(0.006)	-0.218***	(0.010)
Girl					-0.008***	(0.001)	-0.006*	(0.003)
Has repeated grade	-0.111***	(0.013)	-0.106***	(0.011)	-0.125***	(0.011)	-0.069***	(0.013)
Age	0.039***	(0.012)	0.027***	(0.010)	0.037***	(0.010)	0.017	(0.012)
At home when returning from school:								
Father	-0.006**	(0.002)	-0.002	(0.002)	-0.003*	(0.002)	-0.007*	(0.004)
Mother and father	-0.004**	(0.002)	0.002	(0.002)	-0.001	(0.001)	-0.002	(0.004)
Others	0.001	(0.002)	0.004**	(0.002)	0.002	(0.001)	0.003	(0.004)
Nobody	-0.003	(0.003)	-0.003	(0.003)	-0.004	(0.002)	0.001	(0.005)
Lives with:								
Mother only	-0.028***	(0.003)	-0.035***	(0.003)	-0.030***	(0.002)	-0.035***	(0.006)
Mother and one sibling	-0.005	(0.003)	-0.014***	(0.004)	-0.006**	(0.003)	-0.016**	(0.007)
Mother and more than one sibling	-0.018***	(0.005)	-0.016***	(0.006)	-0.016***	(0.004)	-0.021**	(0.009)
Mother and father only	-0.008***	(0.002)	-0.014***	(0.002)	-0.009***	(0.002)	-0.021***	(0.004)
Mother, father, and more than one sibling	-0.005***	(0.002)	-0.003*	(0.002)	-0.004***	(0.001)	-0.005	(0.004)
Different living arrangement	-0.012***	(0.002)	-0.011***	(0.002)	-0.012***	(0.002)	-0.011***	(0.004)
Interaction terms: Homework help by mother and/or father								
with educational and occupational background respectively	yes		yes		yes		yes	
Constant	4.177***	(0.145)	4.343***	(0.123)	4.228***	(0.123)	4.378***	(0.145)
Observations	22,354		23,496		37,734		8,116	
R-squared	0.373		0.377		0.329		0.426	
Number of Schools	1,212		1,215		1,222		1,141	

Robust standard errors - clustered at school level - in parentheses: ***p<0.01, **p<0.05, *p<0.1 Reference group:Boy born in Spain who started school before the age of 3 who lives with parents (high white collar and university) and one sibling whose mother is at home when he returns from school and who does not receive any homework help from anybody.

Table A-8: School-Fixed Effects Regression for Log Test Score-Primary School Students: Robustness continued

	Test score below 25%		Test score above 75%		No homework help		Without repeaters disabled, special needs students	
Hours of homework	0.003***	(0.001)	0.000*	(0.000)	0.001	(0.001)	0.005***	(0.000)
Hours of homework^2	-0.000***	(0.000)	-0.000*	(0.000)	-0.000	(0.000)	-0.000***	(0.000)
Educational category parents:								
Apprenticeship	0.005	(0.007)	-0.005**	(0.002)	-0.043***	(0.013)	-0.020***	(0.005)
Upper secondary	0.002	(0.005)	-0.001	(0.002)	-0.051***	(0.011)	-0.020***	(0.004)
Lower secondary	0.004	(0.005)	-0.004*	(0.002)	-0.041***	(0.012)	-0.028***	(0.005)
Incomplete compulsory	-0.015**	(0.007)	-0.013**	(0.006)	-0.068***	(0.018)	-0.043***	(0.010)
Occupational category parents:								
Low white collar	-0.003	(0.005)	-0.003	(0.002)	-0.015	(0.011)	-0.026***	(0.004)
High blue collar	-0.009*	(0.005)	-0.001	(0.003)	-0.039***	(0.013)	-0.040***	(0.005)
Low blue collar	-0.015*	(0.008)	-0.001	(0.006)	-0.076***	(0.020)	-0.047***	(0.009)
Interaction:								
Hwk*Apprenticeship	0.001	(0.001)	0.000	(0.000)	0.005**	(0.002)	0.002**	(0.001)
Hwk*Upper secondary	0.001	(0.001)	-0.000	(0.000)	0.007***	(0.002)	0.001*	(0.001)
Hwk*Lower secondary	-0.001	(0.001)	0.000	(0.000)	0.005**	(0.002)	0.001*	(0.001)
Hwk*Incomplete compulsory	0.001	(0.001)	0.001	(0.001)	0.006*	(0.003)	0.001	(0.002)
Hwk*Low white collar	0.000	(0.001)	-0.000	(0.000)	-0.000	(0.002)	-0.015**	(0.006)
Hwk*High blue collar	0.001	(0.001)	-0.000	(0.000)	0.002	(0.002)	0.001*	(0.001)
Hwk*Low blue collar	-0.001	(0.002)	0.001	(0.001)	0.005	(0.004)	0.004**	(0.001)
Hwk^2*Apprenticeship	-0.000	(0.000)	-0.000	(0.000)	-0.000**	(0.000)	-0.000	(0.000)
Hwk^2*Upper secondary	-0.000	(0.000)	0.000	(0.000)	-0.000***	(0.000)	-0.000	(0.000)
Hwk^2*Lower secondary	0.000	(0.000)	-0.002	(0.001)	-0.000**	(0.000)	-0.000	(0.000)
Hwk^2*Incomplete compulsory	-0.000	(0.000)	- 0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)
Hwk^2*Low white collar	-0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	-0.000	(0.000)
Hwk^2*High blue collar	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	-0.000	(0.000)
Hwk^2*Low blue collar	0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)
Homework help from:								
Mother	0.001	(0.005)	-0.003***	(0.001)			-0.015***	(0.002)
Father	0.008	(0.006)	-0.002	(0.001)			-0.008***	(0.003)
Mother and father	0.000	(0.004)	-0.001	(0.001)			-0.005**	(0.002)
Private teacher	-0.007**	(0.004)	-0.017***	(0.002)			-0.081***	(0.003)
Others	0.000	(0.004)	-0.005***	(0.001)			-0.018***	(0.003)
Homework help from parents:								
A little	0.002	(0.003)	-0.004***	(0.001)			-0.020***	(0.002)
Quite some	-0.003	(0.004)	-0.008***	(0.001)			-0.052***	(0.002)
Much	-0.012**	(0.005)	-0.010***	(0.002)			-0.068***	(0.003)
All	-0.027***	(0.007)	-0.004	(0.005)			-0.069***	(0.009)
Started school								
between 3 and 5	0.001	(0.002)	-0.001*	(0.001)	-0.002	(0.003)	-0.005***	(0.001)
age 6	-0.006	(0.005)	-0.008**	(0.003)	-0.028**	(0.012)	-0.036***	(0.005)
age 7	-0.026***	(0.006)	-0.009	(0.007)	-0.059***	(0.017)	-0.053***	(0.008)
Born in								
Latin America	-0.009***	(0.003)	-0.003**	(0.001)	-0.024***	(0.006)	-0.032***	(0.003)
Romania	0.009*	(0.005)	0.000	(0.002)	0.026***	(0.009)	0.000	(0.005)
Morocco	-0.018**	(0.007)	0.001	(0.004)	-0.010	(0.016)	-0.010	(0.010)
China	-0.010	(0.011)	-0.004	(0.004)	0.001	(0.020)	0.020**	(0.009)
elsewhere	0.000	(0.004)	0.002	(0.001)	0.009	(0.007)	-0.009***	(0.003)
Individual Characteristics:								
With special needs	-0.090***	(0.003)	-0.017***	(0.004)	-0.159***	(0.011)		
Disabled	-0.128***	(0.004)	0.003	(0.007)	-0.229***	(0.016)		
Girl	0.004**	(0.002)	-0.002***	(0.000)	-0.015***	(0.003)	-0.009***	(0.001)
Has repeated grade	-0.023**	(0.008)	-0.004	(0.006)	-0.080***	(0.023)		
Age	0.004	(0.008)	-0.002	(0.005)	-0.000	(0.021)	0.064***	(0.012)
At home when returning from school:								
Father	-0.002	(0.003)	-0.002**	(0.001)	0.001	(0.005)	-0.005***	(0.002)
Mother and father	-0.005*	(0.003)	-0.000	(0.001)	0.002	(0.004)	-0.000	(0.001)
Others	0.006**	(0.003)	0.001	(0.001)	0.000	(0.004)	0.000	(0.001)
Nobody	0.005	(0.004)	-0.002**	(0.001)	-0.006	(0.005)	-0.004**	(0.002)
Lives with:								
Mother only	-0.015***	(0.003)	-0.004***	(0.001)	-0.034***	(0.007)	-0.031***	(0.002)
Mother and one sibling	0.001	(0.004)	-0.003**	(0.001)	-0.013**	(0.007)	-0.011***	(0.003)
Mother and more than one sibling	-0.006	(0.007)	-0.006***	(0.002)	-0.028**	(0.013)	-0.018***	(0.004)
Mother and father only	-0.012***	(0.003)	-0.001	(0.001)	-0.014***	(0.004)	-0.008***	(0.001)
Mother, father, and more than one sibling	-0.001	(0.003)	-0.000	(0.001)	-0.008**	(0.004)	-0.004***	(0.001)
Different living arrangement	-0.010***	(0.003)	-0.002***	(0.001)	-0.016***	(0.005)	-0.011***	(0.002)
Interaction terms: Homework help by mother and/or father								
with educational and occupational background respectively	yes		yes		no		yes	
Constant	4.380***	(0.092)	4.780***	(0.060)	4.698***	(0.258)	3.908***	(0.139)
Observations	10,600		12,168		6,289		38,191	
R-squared	0.285		0.043		0.364		0.144	
Number of Schools	1,172		1,141		1,159		1,220	

Robust standard errors - clustered at school level - in parentheses: ***p<0.01, **p<0.05, *p<0.1 Reference group:Boy born in Spain who started school before the age of 3 who lives with parents (high white collar and university) and one sibling whose mother is at home when he returns from school and who does not receive any homework help from anybody.

Table A-9: School-Fixed Effects Regression for Log Test Score-Secondary School Students: Robustness

	Girls		Boys		Natives		Immigrants	
Hours of homework	-0.000	(0.001)	-0.001	(0.001)	-0.000	(0.000)	0.000	(0.001)
Hours of homework^2	0.000	(0.000)	0.000*	(0.000)	0.000	(0.000)	-0.000	(0.000)
Educational category parents:								
Apprenticeship	-0.025***	(0.007)	0.003	(0.007)	-0.011*	(0.005)	0.010	(0.011)
Upper secondary	-0.000	(0.006)	0.001	(0.005)	-0.001	(0.005)	0.009	(0.008)
Lower secondary	-0.007	(0.007)	-0.002	(0.006)	-0.003	(0.005)	0.000	(0.011)
Incomplete compulsory	-0.007	(0.009)	-0.004	(0.010)	-0.015*	(0.009)	0.016	(0.011)
Occupational category parents:								
Low white collar	0.002	(0.006)	-0.000	(0.005)	-0.004	(0.004)	0.004	(0.008)
High blue collar	0.003	(0.007)	-0.005	(0.007)	0.003	(0.006)	-0.015*	(0.009)
Low blue collar	0.006	(0.009)	-0.011	(0.009)	0.002	(0.008)	-0.009	(0.010)
Interaction:								
Hwk*Apprenticeship	0.002*	(0.001)	-0.001	(0.001)	0.001	(0.001)	-0.001	(0.002)
Hwk*Upper secondary	-0.001	(0.001)	0.000	(0.001)	0.000	(0.001)	-0.002	(0.001)
Hwk*Lower secondary	0.000	(0.002)	0.001	(0.001)	0.000	(0.001)	-0.000	(0.002)
Hwk*Incomplete compulsory	-0.000	(0.018)	0.000	(0.002)	0.002	(0.001)	-0.004*	(0.002)
Hwk*Low white collar	0.001	(0.001)	-0.000	(0.001)	0.001	(0.001)	-0.000	(0.001)
Hwk*High blue collar	-0.000	(0.001)	0.001	(0.001)	-0.000	(0.001)	0.003*	(0.002)
Hwk*Low blue collar	-0.002	(0.001)	0.002	(0.002)	0.000	(0.001)	-0.000	(0.002)
Hwk^2*Apprenticeship	-0.000	(0.000)	0.000	(0.000)	-0.000	(0.000)	0.000	(0.000)
Hwk^2*Upper secondary	0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)	0.000	(0.000)
Hwk^2*Lower secondary	0.000	(0.000)	-0.000*	(0.000)	-0.000	(0.000)	0.000	(0.000)
Hwk^2*Incomplete compulsory	0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)	0.000**	(0.000)
Hwk^2*Low white collar	-0.000	(0.000)	0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)
Hwk^2*High blue collar	-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)
Hwk^2*Low blue collar	0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)	0.000	(0.000)
Homework help from:								
Mother	-0.004	(0.004)	-0.002	(0.003)	-0.002	(0.003)	-0.011	(0.009)
Father	0.007	(0.005)	0.000	(0.004)	0.003	(0.003)	-0.001	(0.011)
Mother and father	0.004	(0.003)	0.001	(0.003)	0.002	(0.002)	-0.005	(0.008)
Private teacher	0.001	(0.003)	-0.000	(0.003)	0.001	(0.002)	-0.009	(0.006)
Others	0.007**	(0.003)	-0.004	(0.003)	0.002	(0.003)	0.002	(0.005)
Homework help from parents:								
A little	-0.002	(0.002)	0.001	(0.002)	-0.000	(0.002)	-0.002	(0.004)
Quite some	-0.001	(0.003)	0.000	(0.003)	0.001	(0.002)	-0.004	(0.005)
Much	0.000	(0.006)	-0.006	(0.006)	-0.009*	(0.005)	0.015*	(0.009)
All	0.001	(0.015)	0.023*	(0.012)	0.001	(0.011)	0.039**	(0.017)
Started school								
between 3 and 5	0.001	(0.002)	-0.002	(0.002)	-0.001	(0.001)	0.003	(0.004)
age 6	0.004	(0.006)	0.003	(0.005)	0.011	(0.007)	-0.000	(0.005)
age 7	-0.008	(0.010)	-0.006	(0.008)	0.044***	(0.014)	-0.008	(0.008)
Born in								
Latin America	-0.002	(0.003)	0.003	(0.003)			-0.008	(0.008)
Romania	-0.002	(0.006)	-0.002	(0.007)			-0.007	(0.009)
Morocco	0.014	(0.010)	-0.004	(0.009)				
in China	-0.003	(0.012)	-0.007	(0.011)			-0.010	(0.012)
elsewhere	0.004	(0.004)	-0.005	(0.004)			-0.006	(0.008)
Individual Characteristics:								
With special needs	-0.190***	(0.007)	-0.183***	(0.006)	-0.187***	(0.005)	-0.186***	(0.011)
Disabled	-0.143***	(0.003)	-0.144***	(0.003)	-0.143***	(0.003)	-0.147***	(0.005)
Girl					-0.000	(0.001)	0.001	(0.003)
Has repeated grade	0.004	(0.004)	-0.006	(0.004)	0.002	(0.004)	-0.006	(0.006)
Age	-0.005*	(0.003)	0.005*	(0.003)	-0.002	(0.003)	0.003	(0.004)
At home when returning from school:								
Father	0.002	(0.003)	-0.002	(0.003)	-0.002	(0.002)	0.009**	(0.005)
Mother and father	-0.004*	(0.002)	-0.000	(0.002)	-0.003*	(0.002)	0.002	(0.005)
Others	0.001	(0.002)	-0.001	(0.003)	0.001	(0.002)	-0.002	(0.004)
Nobody	-0.001	(0.002)	0.001	(0.002)	-0.001	(0.002)	0.003	(0.004)
Lives with:								
Mother only	0.002	(0.003)	-0.001	(0.004)	-0.003	(0.003)	0.007	(0.005)
Mother and one sibling	-0.002	(0.004)	0.001	(0.004)	-0.000	(0.003)	-0.003	(0.007)
Mother and more than one sibling	-0.010*	(0.006)	0.007	(0.006)	-0.000	(0.005)	-0.004	(0.008)
Mother and father only	-0.000	(0.002)	-0.004*	(0.002)	-0.003	(0.002)	-0.001	(0.005)
Mother, father, and more than one sibling	0.002	(0.002)	0.000	(0.003)	0.001	(0.002)	-0.000	(0.004)
Different living arrangement	-0.004	(0.003)	0.001	(0.003)	-0.003	(0.002)	0.003	(0.004)
Interaction terms: Homework help by mother and/or father								
with educational and occupational background respectively	yes		yes		yes		yes	
Constant	4.698***	(0.047)	4.535***	(0.043)	4.644***	(0.039)	4.569***	(0.056)
Observations	20,869		21,087		34,498		7,458	
R-squared	0.146		0.141		0.142		0.157	
Number of Schools	749		744		754		715	

Robust standard errors - clustered at school level - in parentheses: ***p<0.01, **p<0.05, *p<0.1 Reference group:Boy born in Spain who started school before the age of 3 who lives with parents (high white collar and university) and one sibling whose mother is at home when he returns from school and who does not receive any homework help from anybody.

Table A-10: School-Fixed Effects Regression for Log Test Score-Secondary School Students: Robustness continued

	Test score below 25%		Test score above 75%		No homework help		Without repeaters disabled, special needs students	
Hours of homework	0.000	(0.000)	-0.000	(0.000)	-0.001	(0.001)	-0.000	(0.000)
Hours of homework^2	-0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Educational category parents:								
Apprenticeship	-0.004	(0.005)	0.005	(0.004)	-0.002	(0.009)	-0.005	(0.007)
Upper secondary	-0.001	(0.004)	0.001	(0.003)	-0.002	(0.007)	0.003	(0.006)
Lower secondary	-0.001	(0.004)	0.003	(0.003)	-0.016**	(0.008)	-0.002	(0.007)
Incomplete compulsory	0.005	(0.007)	0.001	(0.005)	-0.007	(0.012)	-0.008	(0.012)
Occupational category parents:								
Low white collar	-0.001	(0.004)	-0.007***	(0.003)	0.004	(0.007)	-0.002	(0.006)
High blue collar	0.002	(0.005)	-0.005	(0.003)	-0.001	(0.009)	-0.003	(0.008)
Low blue collar	-0.000	(0.007)	-0.010**	(0.004)	-0.004	(0.010)	-0.004	(0.011)
Interaction:								
Hwk*Apprenticeship	0.001	(0.001)	-0.001	(0.001)	-0.000	(0.001)	-0.001	(0.001)
Hwk*Upper secondary	0.000	(0.001)	-0.000	(0.000)	0.001	(0.001)	-0.001	(0.001)
Hwk*Lower secondary	0.000	(0.001)	-0.000	(0.001)	0.003**	(0.001)	-0.000	(0.001)
Hwk*Incomplete compulsory	-0.001	(0.001)	-0.000	(0.001)	0.000	(0.002)	-0.001	(0.002)
Hwk*Low white collar	-0.000	(0.001)	0.001	(0.000)	-0.001	(0.001)	0.001	(0.001)
Hwk*High blue collar	-0.000	(0.001)	0.000	(0.000)	-0.001	(0.002)	0.001	(0.001)
Hwk*Low blue collar	-0.001	(0.001)	0.002**	(0.001)	-0.002	(0.002)	0.003	(0.002)
Hwk^2*Apprenticeship	-0.000	(0.000)	0.000	(0.000)	-0.000	(0.000)	0.000	(0.000)
Hwk^2*Upper secondary	-0.000	(0.000)	0.000	(0.000)	-0.000	(0.000)	0.000	(0.000)
Hwk^2*Lower secondary	-0.000	(0.000)	-0.000	(0.002)	-0.000***	(0.000)	0.000	(0.000)
Hwk^2*Incomplete compulsory	0.000	(0.000)	-0.000	(0.000)	-0.000	(0.000)	0.000	(0.000)
Hwk^2*Low white collar	0.000	(0.000)	-0.000	(0.000)	0.000	(0.000)	-0.000	(0.000)
Hwk^2*High blue collar	0.000	(0.000)	-0.000	(0.000)	0.000	(0.000)	-0.000**	(0.000)
Hwk^2*Low blue collar	0.000	(0.000)	-0.000***	(0.000)	0.000	(0.000)	-0.000**	(0.000)
Homework help from:								
Mother	0.002	(0.003)	-0.004**	(0.002)			-0.002	(0.003)
Father	-0.002	(0.004)	-0.003	(0.002)			0.006	(0.004)
Mother and father	0.001	(0.003)	-0.001	(0.002)			0.002	(0.003)
Private teacher	-0.004	(0.002)	-0.002*	(0.001)			0.002	(0.003)
Others	-0.000	(0.002)	0.001	(0.002)			0.003	(0.003)
Homework help from parents:								
A little	-0.000	(0.002)	0.001	(0.001)			-0.000	(0.002)
Quite some	0.000	(0.002)	0.002	(0.002)			-0.001	(0.003)
Much	0.000	(0.004)	0.000	(0.003)			-0.002	(0.006)
All	0.006	(0.011)	0.004	(0.005)			-0.000	(0.015)
Started school								
between 3 and 5	0.000	(0.001)	0.000	(0.001)	0.001	(0.003)	-0.002	(0.002)
age 6	0.004	(0.004)	0.001	(0.003)	-0.001	(0.007)	0.004	(0.006)
age 7	0.009	(0.007)	0.002	(0.005)	-0.010	(0.012)	0.015	(0.015)
Born in								
Latin America	0.001	(0.002)	0.000	(0.002)	-0.001	(0.004)	0.001	(0.003)
Romania	0.004	(0.005)	-0.006*	(0.003)	-0.002	(0.008)	-0.003	(0.008)
Morocco	-0.004	(0.009)	0.001	(0.004)	-0.004	(0.011)	0.014	(0.016)
China	0.008	(0.008)	0.007	(0.006)	-0.000	(0.014)	-0.007	(0.017)
elsewhere	0.001	(0.003)	-0.003	(0.002)	0.000	(0.005)	-0.003	(0.004)
Individual Characteristics:								
With special needs	-0.064***	(0.004)	-0.023**	(0.009)	-0.183***	(0.009)		
Disabled	-0.034***	(0.002)	-0.027***	(0.005)	-0.141***	(0.005)		
Girl	-0.000	(0.001)	0.001	(0.001)	0.002	(0.002)	0.001	(0.001)
Has repeated grade	-0.002	(0.003)	-0.005**	(0.002)	0.005	(0.006)		
Age	0.001	(0.002)	0.004***	(0.001)	-0.000	(0.004)	0.025	(0.022)
At home when returning from school:								
Father	-0.000	(0.002)	0.000	(0.001)	0.004	(0.004)	0.002	(0.003)
Mother and father	-0.001	(0.002)	-0.002	(0.001)	0.000	(0.004)	-0.000	(0.002)
Others	0.002	(0.002)	0.000	(0.001)	0.002	(0.003)	0.002	(0.002)
Nobody	0.002	(0.003)	0.000	(0.001)	0.002	(0.003)	-0.001	(0.002)
Lives with:								
Mother only	0.002	(0.003)	0.002	(0.002)	0.003	(0.004)	-0.001	(0.003)
Mother and one sibling	-0.001	(0.003)	-0.004*	(0.002)	0.002	(0.005)	-0.004	(0.004)
Mother and more than one sibling	0.004	(0.005)	-0.003	(0.003)	-0.004	(0.007)	-0.004	(0.006)
Mother and father only	0.001	(0.002)	0.001	(0.001)	-0.004	(0.004)	-0.000	(0.002)
Mother, father, and more than one sibling	-0.002	(0.002)	0.000	(0.001)	-0.003	(0.003)	-0.000	(0.002)
Different living arrangement	-0.001	(0.002)	-0.001	(0.001)	-0.004	(0.004)	-0.001	(0.003)
Interaction terms: Homework help by mother and/or father								
with educational and occupational background respectively	yes		yes		no		yes	
Constant	4.407***	(0.033)	4.705***	(0.022)	4.622***	(0.056)	4.249***	(0.326)
Observations	10,540		10,427		10,628		25,643	
R-squared	0.088		0.010		0.138		0.003	
Number of Schools	719		730		749		750	

Robust standard errors - clustered at school level - in parentheses: ***p<0.01, **p<0.05, *p<0.1 Reference group:Boy born in Spain who started school before the age of 3 who lives with parents (high white collar and university) and one sibling whose mother is at home when he returns from school and who does not receive any homework help from anybody.