PAWEŁ BUKOWSKI[*]
MARTYNA KOBUS[**]

Educational Equality of Opportunity in Poland

Introduction

Equalizing opportunities in the early stages of life is arguably one of the most effective instrument in promoting equity in the society. Although equity and efficiency are traditionally viewed in the economics literature as competing objectives, educational policy, in particular in its early stages, is considered both fair and efficient. "A large body of data from economics, biology and psychology shows that educational equity is more than a social justice imperative; it is an economic imperative that has far-reaching implications for our nations'' [Heckman 2011]. Not only does educational policy benefit the children and families who receive support but also it creates nation-wide spillover effects that result in economic and social benefits to the whole society. The evidence shows that well-designed and well-targeted educational policy is a powerful equalizer. Every dollar invested in high-quality early stage education gives from 7 to 10 percent return on the investment [Heckman *et al.* 2010]. Societies that invest most in the education have most literate populations, best health status and lowest health inequality in the world. Promoting higher quality education is associated with lower crime rate and reduces overall social costs.

The equality of opportunity has been the theme of one of the most profound and in-depth discussions in the field of philosophy, economics, sociology, psychology and nowadays in cognitive sciences. Roughly speaking, the theories of equality of opportunity distinguish between determinants of individual outcomes that are beyond and within a person's control. On one hand each of us

[*] Paweł Bukowski, MA: Central European University, Department of Economics, Budapest, Hungary; e-mail: bukowski_pawel@ceu-budapest.edu

[**] Martyna Kobus, MA: Educational Research Institute, Warsaw, Poland, email: m.kobus@ibe.edu.pl; Warsaw University, Faculty of Economic Sciences, Warsaw, Poland; email: mkobus@wne.uw.edu.pl

is born into circumstances that we cannot control. On the other hand, each of us has some capacity to make one's own decisions. By nature, circumstances are unequal. We inherit different cultural and economic resources, lifestyle and habits from our families. These resources determine career paths and life prospects. Therefore it is often a goal of educational policy to promote equality of opportunity, and so it is the situation in Poland.

In this paper we evaluate educational equality of opportunity in Poland. We use the data from PISA (Programme for International Student Assessment run by OECD), in particular its 2003 wave, which provides the most reliable proxies for variables such as individual effort and circumstances. We concentrate mostly on student own learning time as an effort variable and parental education as the main circumstance. Whereas the latter is a widely used variable, the former may seem controversial. Our proxy of effort has many drawbacks. Most importantly, longer learning time may be simply due to the fact that a student needs more time to understand the material. Yet let us notice that even if the reason for a student to exert high level of self-study time is the lower level of abilities he or she possesses, it is still justifiable to say that a student works hard and the same can be said about a student who spends the same amount of time for different reasons (i.e. own ambition). In other words, it is valid to say about a group of students who have the same value of learning time that they work equally hard. For it is the results they achieve with this level of effort that differentiate them all. Our model does in fact distinguish between slow and fast learners who exert the same level of effort; this will be explained in Section 1. Moreover, a little ahead of the explanation of the model we use, our goal will be to compare distributions of results based on circumstances, therefore our results will say that a certain distribution (e.g. lower parental educational attainments) is worse than another distribution for all individuals who exert a particular level of effort, no matter what the individual justification for this particular level is. Although we call it effort it is mainly for the purposes of clarity, to distinguish a variable which is at student's own discretion from circumstances which are certainly not. We do not claim to study pure effort as this is largely unobservable, neither do we claim we study all effort there is i.e. quite obviously students with higher family status may spend more time on private lessons instead of self-study. All we say is that for individuals that spent particular amount of time on self-study (called effort for the purposes just described) certain regularities emerge when we combine them with parental background. Despite all these drawbacks of self-learning time we decided to use this information, since it is often the case that individual responsibility parameters are very much present in the theory of equality of opportunity, but because of measurement problems empirical literature is usually forced to rely on circumstances only.

In the concept of equality of opportunity we distinguish between effort, circumstances and luck. Following equality of opportunity models used in economics literature [Lefranc *et al.* 2009; Roemer 1998], we postulate that inequalities that arise due to differences in circumstances are not legitimate and their impact on outcomes should be even-handed. On the other hand, equal

opportunity policy should not try to liquidate differences in outcomes generated by different effort on the part of individuals. Luck should be treated neutrally, that is, at given effort, individuals with different circumstances should face the same prospects for outcomes.

Equality of educational opportunities is a very broad topic, therefore it is important to note that we admit a specific perspective in this article, namely, firstly as it was mentioned in the previous paragraph we follow a particular model of equality of opportunity, secondly the analysis we conduct is based on the tools taken from decision theory under risk. On the other hand, to the best of our knowledge it is the first application of stochastic dominance tools to Polish education data (and one of the first applications to Polish data and to education data in general) and it is a fairly general method as it enables us to compare the whole distributions; in particular, it is far more general than using the indices of inequality. It is well-known that if confronted with a lottery, under mild assumptions on the preferences, a person would choose distribution of outcomes A over B if A stochastically dominates B in the first order. Consequently, we check whether for individuals who exert the same level of effort it is the case that the distribution of outcomes for parents with a given educational background stochastically dominates other distribution for parents with different educational background. For instance, we study if among the kids who have ten-hour weekly learning time, kids with parents who have university degree dominate in terms of results in mathematics kids with parents whose highest level of education is high school. What should be stressed is that this is a much more powerful conclusion than the one that comes from comparing expected outcomes between two distributions, because the fact that expected outcome is higher in one distribution than in the other is not a sufficient condition for stochastic dominance. Ranking distributions with regard to stochastic dominance requires more than simply comparing the means of the distributions. In particular, if distribution A dominates B in the first order then *for every* outcome A gives lower chance of having this outcome and outcomes that are lower. In our case, this means that for a given level of performance in mathematics there is greater chance to fall behind this particular level (and having exactly this level) in distribution B than A.

Our analysis of Polish dataset reveals that for all considered levels of effort a clear ranking of distributions emerges, so equality of opportunity does not hold, or in other words, parental education determines student outcomes to a large extent. What is interesting, however, is that with higher levels of effort this tendency becomes weaker and for some levels of parental education it even disappears. Children with better educated parents are privileged but among those who try hard their relative advantage has a tendency to vanish. This pattern emerges also with 2006 PISA wave. Now depending on whether effort proxy we use reflects fast but hard-working learners (Effort I) or slower learners (Effort II) two interpretations are possible. In the Effort I case the pattern we observe means that by exerting more effort a child from disadvantaged family can diminish the negative impact of low parental inputs on the outcomes. In the Effort II case the highest learning time

is attributed to those with lowest abilities, so the pattern we observe means that for this lowest level parental influence on results is diminished, in a sense that low level of abilities is the main determinant. This would further imply that advantageous parental inputs have the most impact for fast-learners and that possibly for low achievers the impact of school education can be higher than we would expect. In fact, self-study variable contains probably the mixture of both Effort I and Effort II type of students. Then it might be that the phenomenon of distributions getting closer with higher learning time is due to changing proportions of slow and fast learners i.e. for lower learning time values there are relatively more slow learners in the distribution of low parental educational attainment whereas for higher learning time values proportions of slow and fast learners are more or less the same in both better and less educated parents distributions.

The change of inequality is rather cardinal in nature, the ranking does not change but the degree of equality of opportunity does. This tendency is confirmed when we use alternative definitions of circumstances, such as: the possession of own room, computer and the Internet connection; number of books in the house; mother occupational status. Moreover, the effort distribution is better among children from less favorable background than among children from better educated families, that is, the first histogram is shifted rightward. Children with worse endowment try harder.

We also study the reasons for the observed dominance relations. The determinants of stochastic dominance ranking are both differences in expected performance and the degree of risk embedded in the given distributions. For lower effort levels, mean test score is around 20 percent higher in the most advantaged type distribution than in the most disadvantaged one, and there is also less risk in the former distribution. Hence clear dominance exist. For higher levels of effort the degrees of risk become similar, whereas difference in means is around 11 percent. Hence we still observe dominance, but it is much weaker and in the comparison between most disadvantaged type (lowest education level of parents) with medium type there are no evident differences in means and degree of risk.

In Section 1 we present the concept of equality of opportunity and describe the empirical strategy for its measurement. In Section 2 we describe the PISA dataset. Results are presented in Section 3, and results based on alternative definitions of effort and circumstances are presented in Section 4. Finally we conclude.

1. Equality of opportunity: concept and measurement

1.1. The concept of equality of opportunity

Before we proceed with the evaluation of educational equality of opportunity in Poland we will shortly review the recently received literature on the topic, in particular Roemer [1998] and Lefranc *et al.* [2009].

In the basic model of equality of opportunity it is assumed that individual achievements are determined by circumstances and effort, where by the former we understand all the factors beyond individual control and by the latter we understand all the factors within individual control. The examples of circumstances include race and socioeconomic status of parents. Equality of opportunity principle states that inequalities in achievements that arise due to circumstances should be removed, whereas inequalities due to effort are perfectly legit. With respect to education, the variable of interest, the so called achievement or outcome can be student test scores, the circumstances can be their parents socioeconomic or occupational status, and the effort can be learning time. In Roemer's view all the factors that influence individual success which are excluded from circumstances, constitute effort. Therefore, all the random factors are implicitly assumed as being at the discretion of an individual. There is lack of agreement in the literature on the role of luck in the definition of equal opportunity policy. It can be argued that the impact of luck should be fully neutralized, fully respected or decorrelated. In an alternative model of equality of opportunity proposed by Trannoy *et al.* [2009] luck is seen as a legitimate source of inequalities as long as, given circumstances and effort, it affects individual achievements in a neutral way. Effort includes also random factors that are considered rightful cause of inequality. Henceforth, we will employ the model of Lefranc *et al.* [2009], as Roemer's model is its specific example.

Let y be the individual outcome variable and $F()$ its continuous cumulative distribution function. A type is a set of individuals with the same circumstances, whereas a variety denotes the set of individuals with similar circumstances and effort. Given such a setting, the distribution of outcome conditional on circumstances and effort, $F(y|c, e)$ summarizes ex ante prospects available to the individuals in a given variety. In our case, outcome variable will be performance in mathematics, a type is a set of individuals whose highest education level of a parent is the same (circumstances), effort is measured by declared learning time of pupils (except for school time and out-of-school lessons), luck means that in a given variety, that is among students with the same education level of parents and the same learning time, students that enjoy higher outcomes are luckier.

Further this means that in Lefranc *et al.* [2009] model luck includes also inborn abilities. This is important given that our proxy for effort is self-learning time and this in part depends on individual abilities, that is, in a group of individuals who exert effort equal to, say, 2 hours per day of self-study as we said we will have both Effort I and Effort II type of students. How does one distinguish then between the two? In Lefranc *et al.* model [2009] slow-learners are considered as less lucky ones and they occupy lower position in the distribution of results, whereas fast-learners are lucky ones and with this level of effort it is enough for them to be at the top of the distribution.

As we already mentioned, the EOP principle states that inequalities related to effort are acceptable, whereas inequalities arising from circumstances are not.

If we adopt the view that luck should be treated neutrally or in other words that individuals with the same effort should have the same possibilities, we agree that EOP obtains when the following condition holds.

Definition 1. ***Equality of opportunity EOP1***

$$\forall_{c,c'} \forall_e F(. \mid c,e) = F(. \mid c',e).$$

In Roemer's model, luck is attributed to effort, therefore $F(.|c', e)$ degenerates to a mass point at $y(c, e)$. Here all individuals with the same effort (i.e. effort that includes luck as well) are entitled to the same outcome as opposed to the same prospects of outcome.

In definition 1 we employ an absolutist view of effort (denoted by e). On the other hand, Roemer argues that one should adopt a relativist view of effort. The distribution of effort can also be considered characteristic of a type; therefore if we do not hold individuals accountable for their circumstances, we should also claim that it was beyond their responsibility to be in a particular distribution of effort and, in consequence, it is a relative position in this distribution that really reflects their work. If the rank in the distribution of absolute effort given circumstances is taken as a measure of relativist effort (denoted e^R), then by definition e^R is distributed independent of circumstances and thus we obtain another definition of EOP.

Defnition 2. ***Equality of opportunity EOP2***

$$\forall_{c,c'} F(. \mid c) = F(. \mid c').$$

1.2. The measurement of equality of opportunity

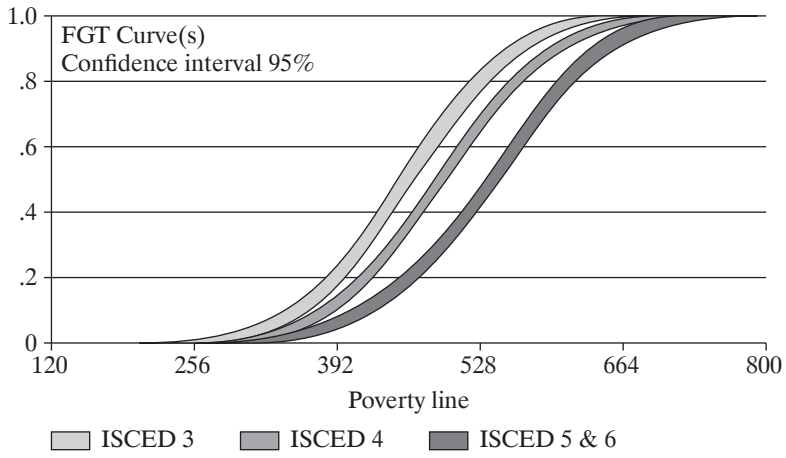
The measurement of equality of opportunity is based on the theory of decision under risk. Consider an individual who exerts effort e and has to choose between circumstances c and c' and does not know which position he will occupy in the distribution of outcomes. In other words, he does not know whether he will be lucky or not i.e. he is behind Rawlasian veil of ignorance. Now, if for every degree of luck, one distribution, e.g. c, always gives equal or higher outcome than distribution related to c', it is reasonable to assume, decision theory states, that the person would rather choose to be in c than in c'. This is the case of first order stochastic dominance, which we denote by $F(. \mid c,e) \succ_1 F(. \mid c,e)$. If one distribution stochastically dominates the other then we have a clear ranking of circumstances with respect to individual preferences[1]. This can be seen in Figure 1, where we see the cummulative distribution functions (cdf's or FGT's) of the results in mathematics (based on Programme for International Student Assessment (PISA) survey) depending on whether the highest level of parental educational attainment is elementary school (ISCED3 – 11 years of education), post – secondary school (ISCED4 – 12 years of education) or university (ISCED 5 &6 – over 16 years of education) or university (Group 16–16 years of education). Clearly, kids with better educated parents dominate kids with worse educated parents. In other words, we see that Assuming

[1] Assuming only some consistency about preferences toward risk.

only some consistency about preferences toward risk. ISCED3 is everywhere above ISCED5&6, that is for every level of results the percentage of teenagers having this particular level and less is higher for ISCED3 and than for ISCED5&6. This is exactly the case of clear first order stochastic dominance.

Figure 1

FGT Curves: no effort



However, often two distributions cross and first order dominance criterion is inconclusive then. We can then resort to the second order dominance which is more restrictive in a sense that it provides a clear ranking of circumstances for individuals whose preferences exhibit risk aversion[2]. This is denoted as $F(. \mid c,e) \succ_2 F(. \mid c,e)$.

Slightly modifying definitions given in Lefranc *et al.* [2009] we assume that EOP1 holds if the following is satisfied:

$$\forall_{c \neq c'} \forall_e \, F(. \mid c,e) \not\succ_1 F(. \mid c,e). \tag{1}$$

Less formally speaking, EOP1 holds if no matter what the value of effort is it is never possible to rank circumstances using first order dominance. Similarly, EOP2 is satisfied when

$$\forall_{c \neq c'} \, F(. \mid c) \not\succ_1 F(. \mid c). \tag{2}$$

Statistical inference is based on the stochastic dominance tests developed in Davidson and Duclos [2000] and implemented using DASP Stata module written by Araar and Duclos [2009]. Stochastic dominance of order j is evaluated through comparison of dominance curves:

$$D_j(z) = \frac{1}{(j-1)!} \int_0^z (z-y)^{j-1} dF(y),$$

[2] Equivalently, for all concave utility functions if preferences are represented via utility functions rather than preference relations.

In this paper y is performance in mathematics and z is some given level of it. Further $\Delta^j(z) = D_j^c(z) - D_j^{c'}(z)$. We say that distribution attributed to circumstances c dominates distribution c' for the order j if

$$\forall_{z \in [0,\infty]} \Delta^j(z) > 0.$$

This is the same as the comparison of the well-known FGT curves [Foster, Greer and Thorbecke 1984], namely $D_j(z) = \frac{1}{(j-1)!} P(\alpha, z)$, where $P(\alpha, z)$ is an FGT index with parameter $\alpha = j - 1$. We used 0.95 confidence interval everywhere.

2. Data

We use the individual-level data on students from the Programme for International Student Assessment (PISA) organized by the OECD for 2003 (second wave). The survey focuses on student competences in the key subject areas of reading, mathematics and science and its aims at providing results which are comparable between countries. The survey is based on the sample of fifteen-year old students from 32 countries in 2003. The database was additionally enriched by the set of variables describing the social and school background. We restrict the PISA sample to the observations from Poland and exclude those with missing observations. Finally our data consists of 4209 observations in 2003 which is around 0.7 percent of the population of fifteen-year old.

The PISA sample has the two-stage cluster type of design, where at the first stage schools (Primary Sample Unit) were randomly drawn from the complete list of schools containing the student population of interest. Then at the second stage, the simple random sample of 35 fifteen-year old students was randomly selected from within the selected school[3]. Thus this particular design has to be accounted for in all computation and the balanced repeated replication was used to provide unbiased estimations of sampling errors.

PISA reports student performance through plausible values. For detailed description we refer the readers to PISA Manual Data Analysis [OECD 2009]. Generating plausible values consists of drawing random numbers from the posterior distribution of an education test. As noted by Wu and Adams [2002], "Plausible values can be understood as a representation of a range of abilities that a student may reasonably have. (...) Instead of directly estimating each student's ability θ, a probability distribution for student's θ is estimated. That is, instead of obtaining a point estimate for θ (...), a range of possible values for a student's θ with an associated probability for each of these values is estimated. Plausible values are random draws from this (estimated) distribution for student's θ".

[3] In the case when less than 35 15-year old students attended a selected school, all of the students were invited to participate.

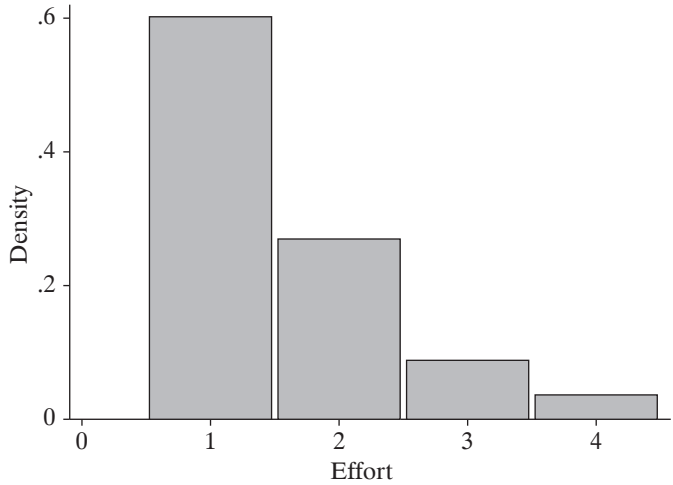
Our goal are mostly comparisons and the outcome variable we present is the first plausible value from the mathematic test. The conclusions are however the same if other plausible values are used, the presentation of which we skip for the purposes of the exposition clarity. Variable that represents circumstances faced by students is the highest parental education in years. It takes three possible values: 11 for the ISCED 3 level (so called liceum, technikum), 12 for the ISCED 4 level (so called szkoły policealne) and 16 for the ISCED 5 and 6 levels (higher education). It has to be mentioned that the parents' educational attainment was reported by the students. In 2003, the question concerning effort is that the students strictly specify the time spent each week on doing homework set by the mathematics teacher. This was the reason we chose this wave of PISA study as later waves lack such exact information on self-learning time. Since it has quasi-continuous nature, we decoded the original variable into the ordinal variable in which the following values are 5-hour intervals of the time spent on a homework.

3. Results

We begin our analysis with the case when no effort is considered as it is usually studied in the literature due to the unobservability of effort. The underlying assumption here that will be checked in the next sections is that the distribution of effort is independent on the circumstances.

Figure 2

Histogram for effort conditional on ISCED 3



It is clear from Figure 1 above (poverty line denotes the PISA score) that equality of opportunity is not fulfilled since we obtain a clear ranking of distributions

with respect to parental education: ISCED 4 dominates ISCED 3 and is dominated by ISCED 5 and 6 which dominates them all. In other words, we say that inequality of opportunity is very strong indeed; EOP2 does not hold.

Now we relax the assumption that the distribution of effort is independent from the circumstances. In fact, it is not, which can be seen from Figures 2 and 3. The effort distribution is better among children from disadvantaged family than among children with better educated parents.

Figure 3

Histogram for effort conditional on ISCED 5 and 6

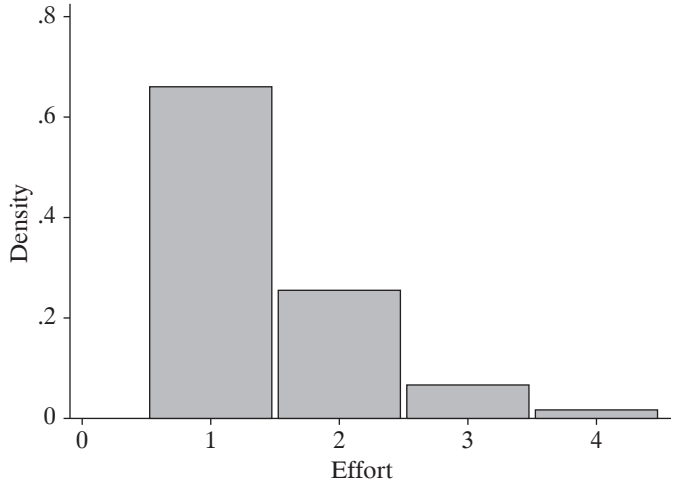
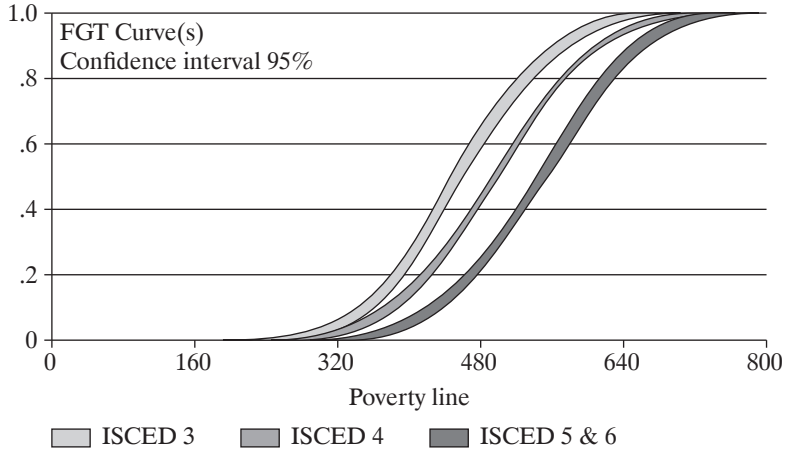


Figure 4

FGT curves: effort 1



We compare the distributions of student test scores conditionally on effort and circumstances. It is evident that students from the family with at least one parent

with 16 years of education (ISCED 5 or 6) face better prospects at each level of effort comparing to students with other family background. At first glance, students with parent who completed 12 years of education (ISCED 4) also face better opportunities than students with less educated parents (11 years, ISCED 3). Yet with higher effort dominance becomes weaker or even disappears (see Figures 4, 5, 6). These basic results suggest that although parental education is a strong predictor of student outcomes, inequalities diminish with higher level of effort. As it was already mentioned this indicates that either trying harder counteracts the disadvantageous impact of the social background or that for low-ability students higher education of parents does help but not as much as for higher ability students.

Figure 5

FGT curves: effort 2

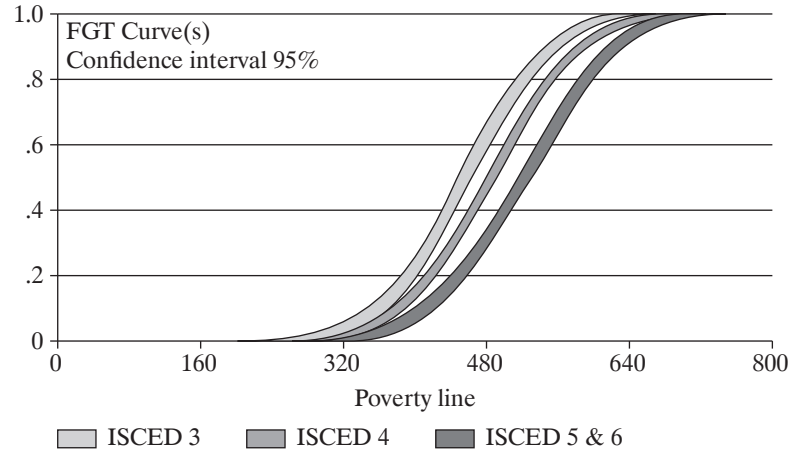


Figure 6

FGT curves: effort 3

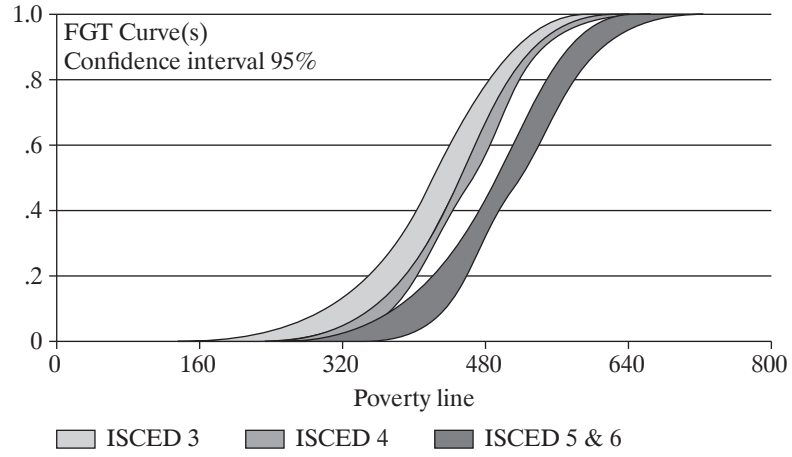
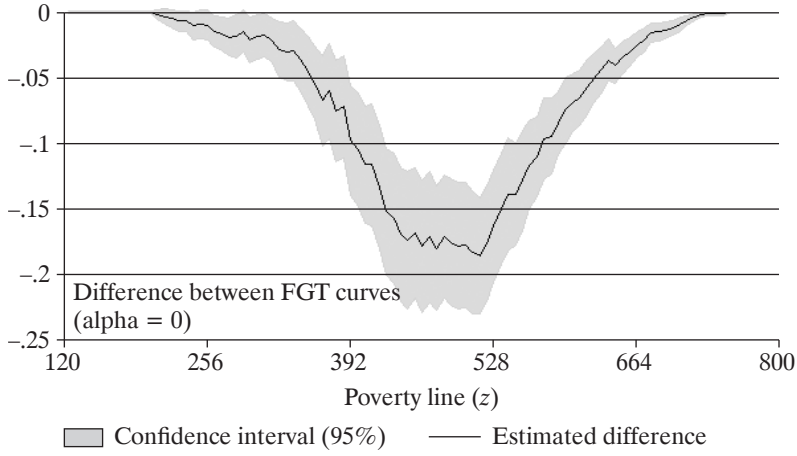


Figure 7

ISCED 3 vs. 4: effort 1



Since the qualitative comparison of the FGT curves does not give us clear statistical robustness, we run separately stochastic dominance tests for each pair of circumstances conditionally on the level of effort.

For the first level of effort which denotes the time spent on mathematics between 0 and 5 hours, the upper bound of the difference between the distribution of student test scores with the less educated parents (ISCED 3) and the distribution for those with parents from ISCED 4 is negative at almost the whole range of test scores (see Figure 7). Similarly students with the most educated parents stochastically dominate those with parents from ISCED 4 (see Figure 8).

Figure 8

ISCED 4 vs. 5 and 6: effort 1

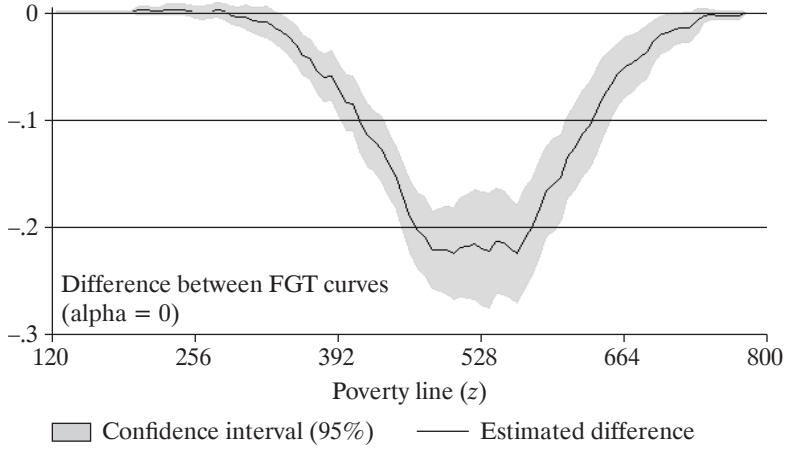
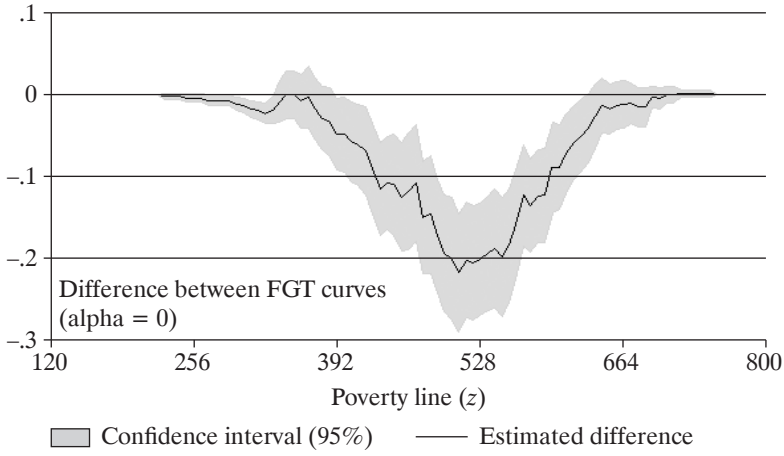


Figure 9

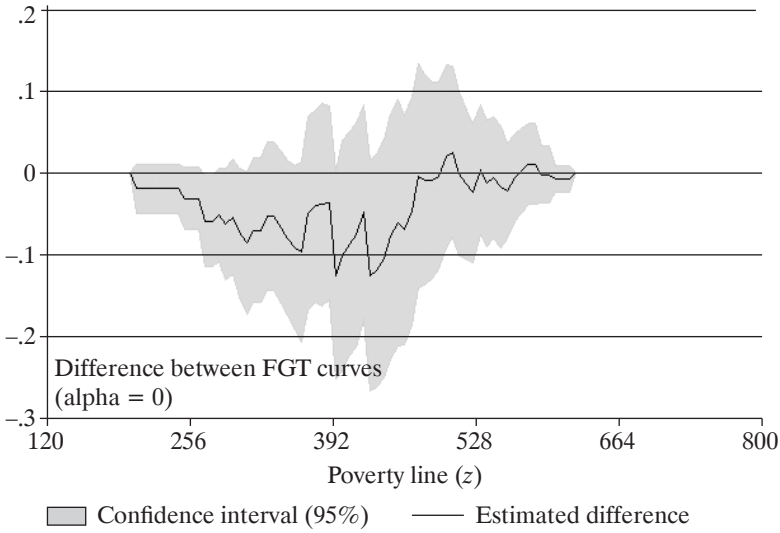
ISCED 4 vs. 5 and 6: effort 2



In the case of the second level of effort, between 5 (included) and 10 hours, we can see the similar pattern as described in the previous paragraph. However now the dominance is less visible as it is in case of, for example, the analysis of the differences between the circumstances described by the parental ISCED 5 and 6 with the ISCED 4 (see Figure 9).

Figure 10

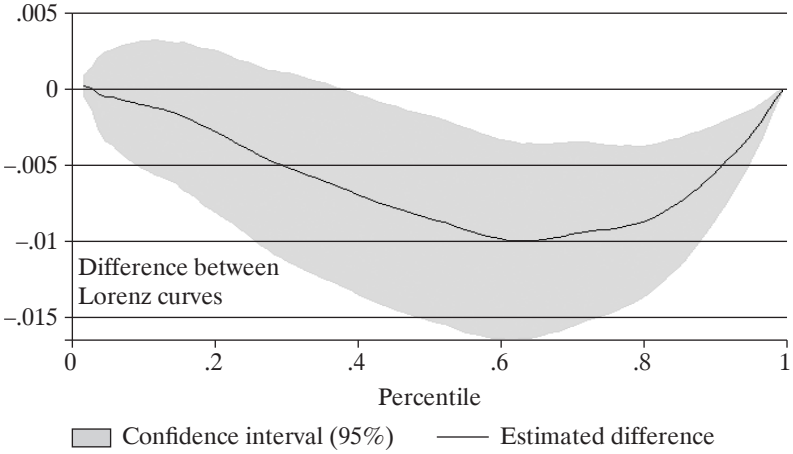
ISCED 4 vs. 5 and 6: effort 3



In the third level of effort (between 10 and 15 hours) dominance becomes even weaker and in fact we do not find the evidence of dominance between ISCED 4 over ISCED 3 (Figure 10). Also, there is no dominance of the second order.

Figure 11

Lorenz dominance: effort 1; ISCED 3 vs. 5 and 6



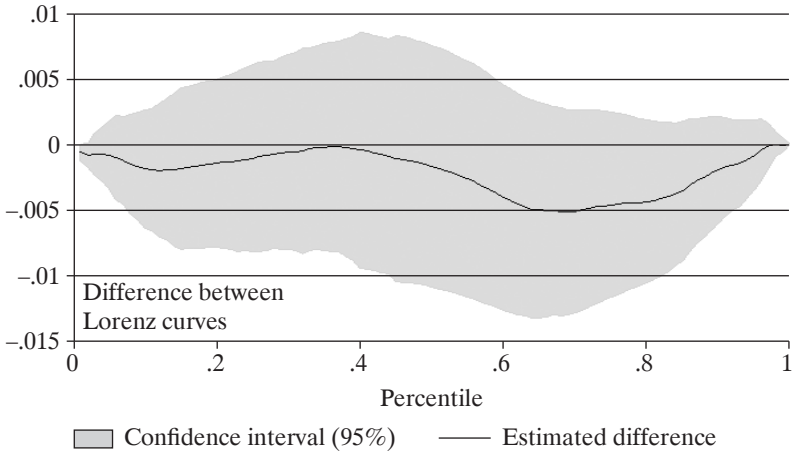
Since the effort distribution for children with less educated parents is better than for those with better educated parents it is possible that while comparing kids who exert the same level of absolute effort in two distributions we do not compare apples to apples. In other words, if effort distribution is characteristic of the type, it is relatively easier to exert certain level of effort while being in the better effort distribution than being in the worse effort distribution. For instance, it is relatively easier to exert effort level 2 while being a child with less educated parents than to exert effort level 2 while being a child with better educated parents because the distribution of effort is better among kids with disadvantaged background. Therefore, if somebody exerts effort level 2 in ISCED 5 and 6 distribution he may be considered a hard working student comparing to other students in his type, whereas a student who exerts effort 2 in ISCED 3 may be considered a lazy student, since most of the students in his type exert effort level 2 or higher. Students exerting the same level of effort in different types may thus differ with respect to other traits which influence test scores and are not observable. This problem can be partially resolved by adhering to relative effort. Following Roemer [1998], we now claim that students who sit at the same decile of their effort distribution exert the same effort and we compare their outcomes conditional on family background. With this definition in mind, we find that students who exert effort 1 and 2 in ISCED 3 sit at the same decile as those who exert effort 1 in ISCED 5 and 6. Previously we compared only those who exert effort 1 and we found evidence for clear dominance of ISCED 5 and 6, however this dominance may be too strong given that we only took the worst individuals from ISCED 3. The results however are the same as in the absolute effort case (results available upon request), which is possibly due to the fact that although we observe differences in absolute effort distribution among types, they are not as large as to produce evident changes in the relative effort case.

As to the reasons for the observed dominance, these can be either differences in the expected outcome or the degree of risk between the two distributions. The

degree of risk can be summarized via Lorenz distribution. One distribution Lorenz dominates the other, i.e. it has less inequality, when one's Lorenz curve is above the other. For effort level 1 we find that there is more risk in ISCED 3 than in ISCED 5 and 6 (Figure 11) and in addition the mean in ISCED 5 and 6 is around 20 percent higher than in ISCED 3, hence we obtained clear stochastic dominance previously. With higher levels of effort, the differences in risk disappear and the differences in means are smaller too (the ratio drops to 1.11) and also the dominance is thus weaker (Figure 12).

Figure 12

Lorenz dominance: effort 2; ISCED 3 vs. 5 and 6



4. Alternative measures of circumstances and effort

The analysis we carried out in Section 3 was based on learning time as an effort variable and highest level of parental education in years as a circumstance. PISA is a rich database and it allows for the study of other determinants of student performance. In this section we study one alternative measure of effort and four different circumstances.

As an alternative measure of effort we employ the time spent each week on doing homework set out by the teachers. The difference between alternative measure and the one used in the core analysis is that the latter is attributed only to the learning time in mathematics, while the former is general. Similarly, due to the quasi-continuous nature of the variable we decoded it into the ordinal variable so that we get 5-hour intervals of the time spent on a homework.

It turns out that the effort distribution for mathematics is a good approximation of the general effort distribution. The results are similar. At each level of effort the distribution of the students' test score for more educated parents stochastically dominates other distributions. Moreover, with increasing level of effort, the

stochastic dominance seems to be weaker, but this effect is not as evident as it was in the previously considered case. Specifically, in our primary analysis there was no evidence for stochastic dominance of the ISCED 4 over the ISCED 3 at the third level of effort, whereas in the case now considered we do not observe the similar effect. Although, as we already said, the tendency is also for stochastic dominance to become weaker with the rising level of effort (see Figures 13 and 14). In general, the analysis with alternative measure of effort supports the hypothesis that parents' education matters but it becomes less important for higher levels of students' learning time.

Figure 13

ISCED 3 vs. 4: effort level 1

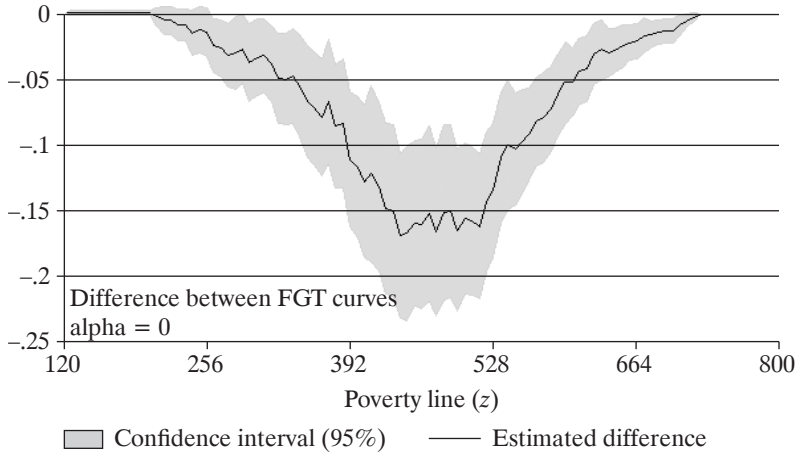
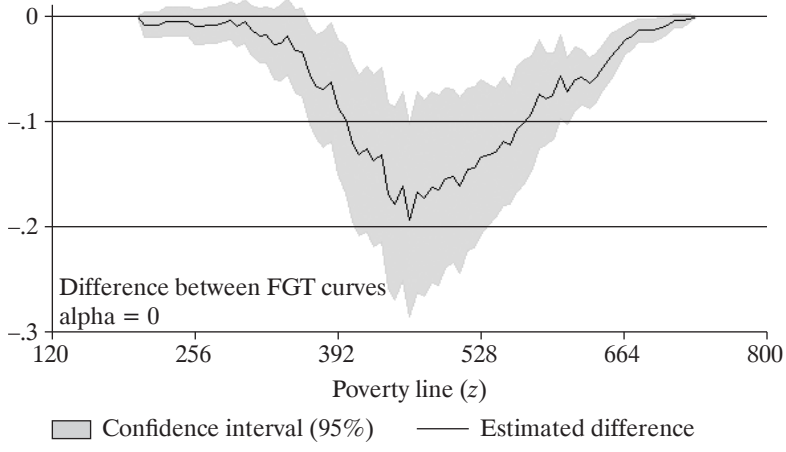


Figure 14

ISCED 3 and 4: effort level 3



As an alternative measure of circumstances we study such variables as: the possession of own room, computer and the Internet connection; having siblings; number of books in the house; mother occupational status. These circumstances, except for siblings, are correlated with parental education, therefore we expect to observe similar patterns as in the main study. Together with parental education these factors account for the picture of what can be understood as family's human capital, or more generally speaking, educational attitude of the family.

As a first circumstance we take a variable which indicates whether a student has the following things at his home: own room, a computer, a connection to the Internet. The values of the variable range from 0 to 3. In general, here also we find evidence that the possession of such things is related to better student performance, however again this effect diminishes with higher effort. This can be seen in Figures 15 and 16.

Figure 15

No things vs. all: effort level 1

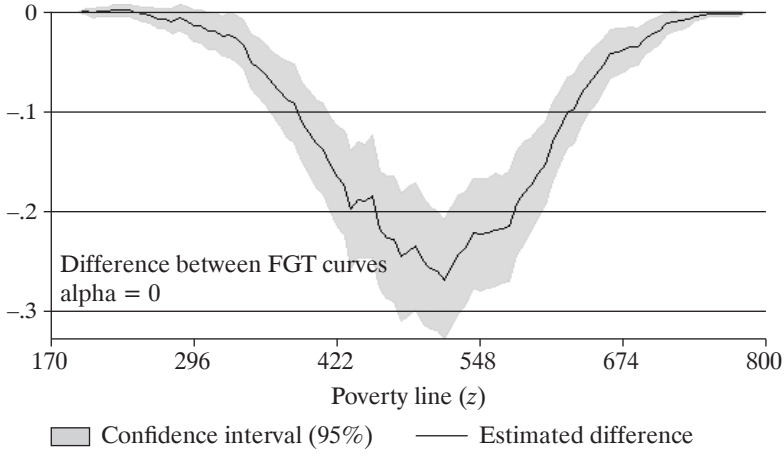
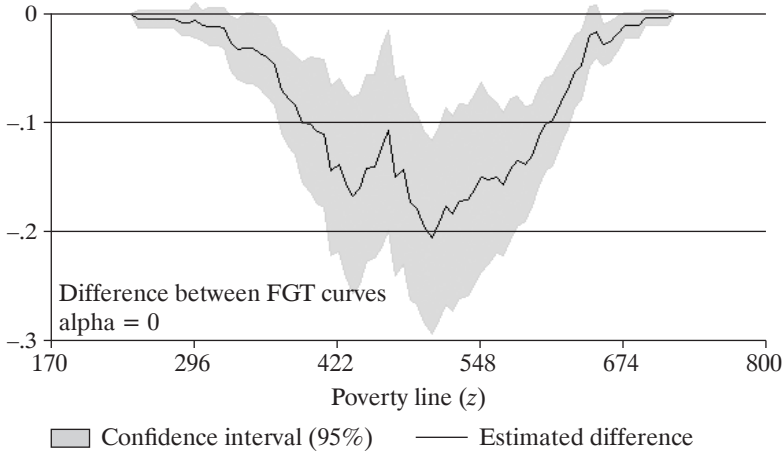


Figure 16

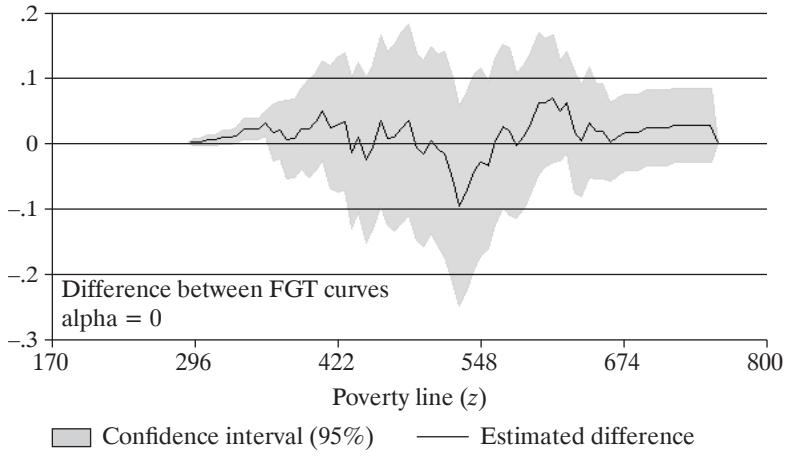
No things vs. all: effort level 2



In addition, there is no evidence of dominance for possession of all of the things over just two of them. This means that it is in fact own room that is not so important to generate the difference in the outcomes since students who possess two things are in fact those who possess computer with the connection to the Internet. This holds independently of effort level, but we present results for effort level 2 (Figure 17).

Figure 17

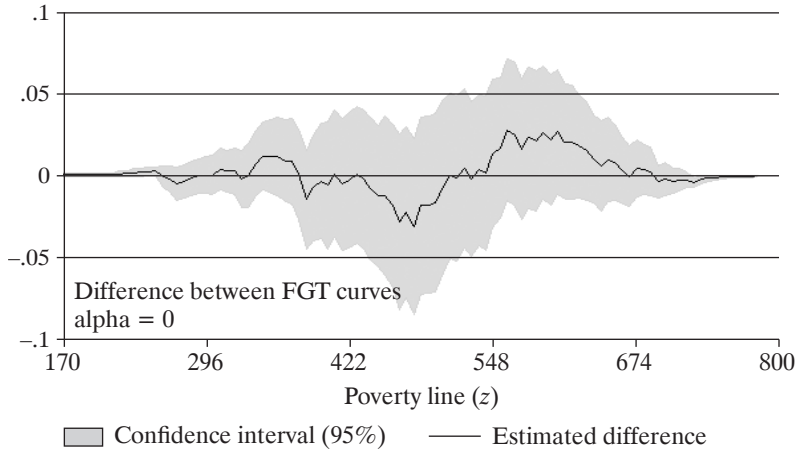
Two things vs. all: effort level 2



We also studied whether students brought up in a family with two parents and siblings perform better than students who are the only child. We do not find any evidence of stochastic dominance of order first and of order second. Here we do not account for the effort since there are too few observations to perform such comparisons (see Figure 18).

Figure 18

Only child vs. students with siblings



As a third circumstance we chose the number of books in the house, which is a variable that assigns value 1, 2, 3 to respectively, intervals (0,25), (26, 200), (more than 200). A clear ranking of distributions appears, with higher opportunities for students who have access to a richer home library (Figure 19).

Figure 19

Higher vs. lower number of books in home library

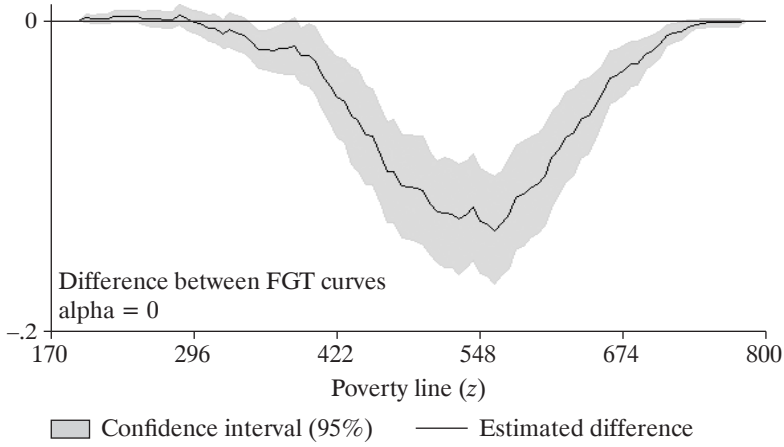
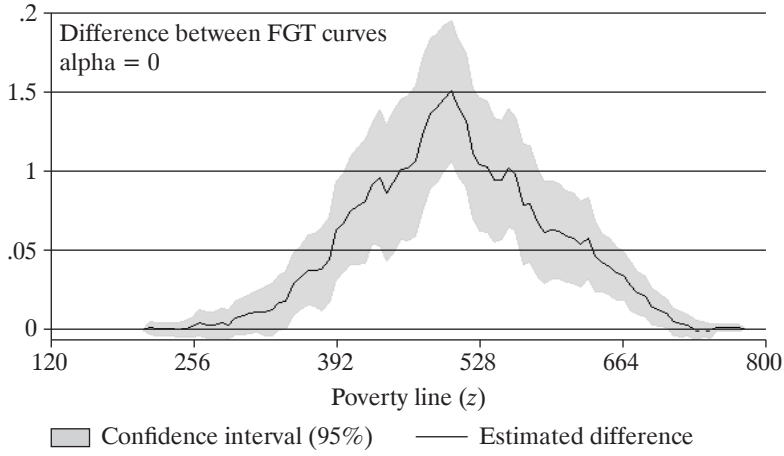


Figure 20

Full-time working mother vs. other duties mother: effort level 1



Finally, we analyze mother occupational status and its influence on student performance. Clearly, distribution of test scores for students with full-time working mothers dominates stochastically the one where students' mothers are unemployed or perform other duties (e.g. home duties, retired). On one hand, the mother who does not work has more time to be devoted to her children. On the other hand, mothers who work are likely to be better educated and also they

can afford to send their kids to out-of-school lessons. Our results suggest that the latter channel of motherly impact is might be more significant (although we cannot claim causality here). Again, with higher effort it is less important (see Figures 20, 21, 22).

Figure 21

Full-time working mother vs. other duties mother: effort level 2

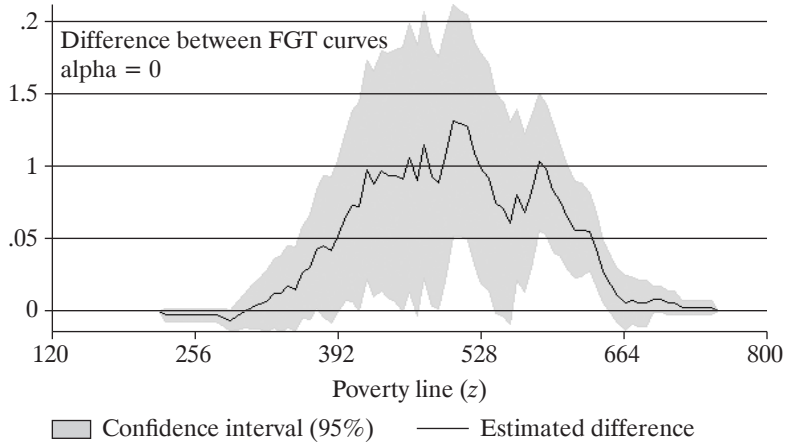
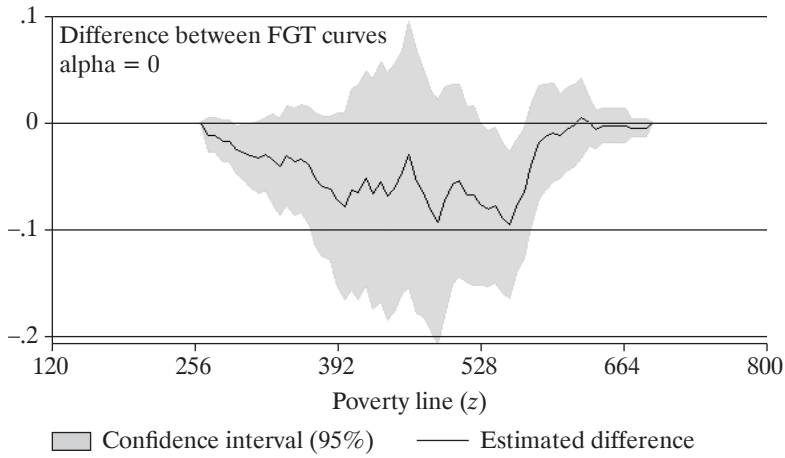


Figure 22

Full-time working mother vs. other duties mother: effort level 3



Also we do not find any difference between distributions generated by unemployed mother and mother who performs other duties. However, these categories may be as well artificially defined. It is likely that most unemployed mothers also perform home duties.

Conclusions

Equalizing educational opportunities is one of the most important aims of the educational policy thus it is necessary to uncover circumstances which create disadvantaged environment for learning process. Following the equality of opportunity model [Lefranc *et al.* 2009; Roemer 1998], we include a variable which measures time devoted by each student to learning (we call it effort) to control for the dependence of the distribution of performance in mathematics on the family background. The application of the equality of opportunity model and the stochastic dominance method to the sample of the population of Polish 15-year students shows the following results.

Firstly, the family background measured as the highest parental education, conditional on effort, significantly influences student test scores. Specifically, we obtain a clear ranking of distributions with respect to parental education: ISCED 4 dominates ISCED 3 and is dominated by ISCED 5 and 6 which dominates them all. Thus strong inequality of opportunities emerges.

Secondly, the inequality of educational opportunities is diminishing with higher level of learning time. These results are robust after we use alternative measures of effort and circumstances. Relative measure of effort, which we use to control for possible selection bias, does not change the results. It has to be mentioned that we do not claim to provide any causal relations, thus further research is necessary.

Two main policy implications can be drawn from our results. Firstly, the importance of the family background suggests that the policy instruments should be not only student-oriented but also family-oriented, in particular for children with higher abilities as for them the differential parental background seems to have the most impact in a sense that it clearly determines their opportunities. Secondly, educational policy should encourage students to work harder and persuade them that higher efforts do help to overcome their disadvantaged conditions. However, due to the fact that we cannot infer causality, randomized experiments are needed to ensure that these instruments are effective.

We would like to thank Abdelkrim Araar, Jean-Yves Duclos, Zbigniew Sawiński and Michał Sitek for help and useful comments.

Received on 24 August 2011

Bibliography

Araar A., *Poverty, Inequality and Stochastic Dominance, Theory and Practice: The Case of Burkina Faso*, „Cahiers de recherche PMMA" 2007-08, PEP-PMMA 2007.

Araar A., Duclos J.Y., *User Manual for Stata Package DASP: Version 2.1*, PEP, World Bank, UNDP and Université Laval 2009.

Betts J.R., Roemer J., *Equalizing Opportunity through Educational Finance Reform*, Unpublished manuscript, Paper presented at the CESIfo/PEPG Conference on Schooling and Human Capital Formation in the Global Economy, Munich, September 3–4, 2004.

Davidson R., Duclos J.Y., *Statistical Inference for Stochastic Dominance and for the Measurement of Poverty and Inequality*, „Econometrica" 2000, No. 6.

Foster J., Greer J., Thorbecke E., *A Class of Decomposable Poverty Measures*, „Econometrica" 1984, No. 3.

Heckman J.J., *The Economics of Inequality. The Value of Early Childhood Education*, „American Educator" 2011, No. 35(1).

Heckman J.J., Moon S.H., Pinto R., Savelyev P.A., Yavitz A., *The rate of return to the High Scope Perry Preschool Program*, „Journal of Public Economics" 2010, No. 94.

Lefranc A., Pistolesi N., Trannoy A., *Equality of Opportunity and Luck: Definitions and Testable Conditions, with an Application to Income in France*, „Journal of Public Economics" 2009, No. 93.

OECD, *PISA Data Analysis Manual SPSS*, second edition, Paris 2009.

Roemer J., *Equality of Opportunity*, Harvard University Press, Cambridge 1998.

Wu M.L., Adams,R.J., *Plausible Values: Why They are Important*, Paper presented at the 11th International Objective Measurement Workshop, New Orleans 2002.

Równość szans edukacyjnych w Polsce

Streszczenie

Wykształcenie jest uznawane za jeden z najlepszych sposobów wyrównywania szans zawodowych. Na podstawie danych pochodzących z bazy danych PISA 2003 autorzy dokonują oceny równości szans edukacyjnych w Polsce. Równość szans występuje wówczas, gdy przy danym wysiłku edukacyjnym (czas nauki) rozkład uzyskiwanych wyników (testy z matematyki) jest niezależny od uwarunkowań rodzinnych (poziom wykształcenia rodziców). Wyniki analizy pokazują, że jest odwrotnie: niemal przy każdym poziomie indywidualnego wysiłku edukacyjnego można zaobserwować wyraźną zależność wyników uzyskiwanych w nauce od pochodzenia społecznego. Jednak przy wyższych poziomach wysiłku edukacyjnego rozkłady wyników zbliżają się do siebie, co wskazuje, że wyższy poziom wykształcenia sprzyja wyrównywaniu szans. Wydłużając okres nauki, osoby pochodzące z mniej uprzywilejowanych środowisk mogą zredukować niekorzystny wpływ swego pochodzenia na uzyskiwane wyniki. Prawidłowości te występują także przy zastosowaniu odmiennych mierników wysiłku edukacyjnego i pochodzenia.

Słowa kluczowe: równość szans edukacyjnych • dominacja stochastyczna • dominacja Lorenza • wyniki testów

Educational Equality of Opportunity in Poland

Summary

Education is considered one of the best means in improving equality of opportunity. Based on the PISA 2003 database we evaluate educational equality of opportunity in Poland. Equality of opportunity holds if with given effort (learning time) it is impossible to rank distributions of outcomes (performance in mathematics) according to circumstances (parental education level). We find that the opposite is true, clear ranking obtains for almost all effort levels. However, with higher effort levels the distributions come closer together indicating that although there is no change in the ranking itself there is a change in the degree of inequality of opportunity, namely, the higher effort the higher equality of opportunity. By trying harder children with disadvantaged background may reduce the adverse impact of their endowment on performance. This pattern emerges also with alternative measures of effort and circumstances.

Key words: Educational equity • equality of opportunity • stochastic dominance • Lorenz dominance • test scores

РАВЕНСТВО ШАНСОВ В ОБЛАСТИ ОБРАЗОВАНИЯ В ПОЛЬШЕ

Резюме

Образование считается одним из наилучших способов выравнивания профессиональных шансов. На основании базы данных PISA 2003 авторы делают оценку равенства шансов в области образования в Польше. Равенство шансов имеет место тогда, когда при данных усилиях (время обучения) получаемые результаты (тесты по математике) является независимыми от семейных обстоятельств (уровень образования родителей). Результаты анализа показывают, что реально почти при каждом уровне индивидуальных усилий в области обучения наблюдается заметная зависимость результатов учебы от социального происхождения. Однако при высших уровнях усилий результаты сближаются, что указывает на то, что более высокий уровень образования благоприятствует выравниванию шансов. Продлевая период обучения, лица из менее привилегированной среды могут уменьшить неблагоприятное влияние своего происхождения на получаемые результаты. Эти закономерности имеются также при применении других мерил усилий в области образования и происхождения.

Ключевые слова: равенство шансов в области образования • стохастическая доминация • доминация Лоренца • результаты тестов