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Educational Opportunities in Indonesia: Are Factors Outside Individual Responsibility Persistent Over Time?

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ABSTRACT *Not all sources of inequality in educational achievements are fair. But how strong and persistent is the burden of unequal opportunities that each person carries on in their life? In this paper, we define individual indices of the burden of circumstances, which measure the effect that the accumulation of factors outside individual control, has on individual educational achievements in the short and long run. As our findings suggest, the effect of these circumstances tends to persist over time. This effect has been particularly strong for the generation of students who experienced the 1997 Asian Financial Crisis. Lastly, we do not find evidence of a sizeable effect of local non-routine education expenditure on the inequality of opportunity, causing us to question the effectiveness of educational policies in accurately targeting equity.*

1. Introduction

It has been well recognised that a person's educational achievement is not only a key dimension of their human development in its own right but also represents a fundamental input for the realisation of other human development goals, such as wealth, health, employment, and political participation. Moreover, as shown in a number of recent cross-country and case studies, inequalities in education are likely to be reflected in disparities in other dimensions. The existence of such correlations has raised political and academic interest in the topic of inequality of education. In particular, two questions have emerged: (1) which factors are driving these inequalities? And (2) are all of them 'unfair'?

The theory of inequality of opportunity can provide an answer to these questions as it finds its main rationale in the idea that inequality itself can have different sources, but not all of these can be equally objectionable. As theoretically conceptualised by Roemer (1993), differences on certain socio-economic outcomes may be attributed partly to individual choices, innate ability, talent and effort and partly to socio-economic endowments ('circumstances') which are exogenous to the person.

While inequalities in education that are due to personal responsibility are fair and do not necessarily need to be suppressed, disparities in educational achievements, which result from factors beyond an individual's control are, without doubt, inequitable and, as such, require equal-opportunity policy interventions.

Among developing countries, empirical evidence based on PISA scores in 2006 placed Indonesia in the lower half of cross-country distribution of inequality in educational opportunity (Ferreira & Gignoux, 2014). However, there are still two important challenges that the country

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needs to face: firstly, the increasing trend of income inequality and inequality of opportunity in the health dimension (World Bank, 2014) and secondly, the large disparities within and between provinces and regions in many quantitative and qualitative indicators of school achievement (OECD & ADB, 2015).

In this paper, we use survey-based household data from the Indonesian Family Life Survey (IFLS) to quantify the role that the accumulation of pre-determined circumstances has played in influencing future education outcomes and in generating inequality in educational opportunities over the period 1997–2014.

We contribute to the previous literature by devising an individual index of the 'burden of circumstances', which explains the influence that the accumulation of pre-determined circumstances has on individual educational achievements. This allows us to see how persistent these circumstances or endowments can be over the individual life's course and, thus, how sticky current levels of inequality of opportunities can be.

Next, by evaluating the association between our aggregate inequality of opportunity index and public expenditure in education, we seek to understand the role that local and central government policies had in influencing inequality of opportunity in education.

The remainder of this paper is organised as follows: Section 2 provides a review of the literature in this field, and Section 3 discusses methodological issues involved in measuring inequality of educational opportunity and the specific choices we have made. In Section 4 we report descriptive statistics and in Section 5 we discuss our empirical findings. Section 6 is our conclusion.

2. Inequality of opportunity: conceptual underpinnings and empirical applications

The concept of inequality in educational opportunity finds its roots in the mid-60s when the Coleman Report (Coleman, Campbell, Hobson, & Macpartland, 1966) started the debate on what is meant by equality of opportunity and how to achieve it. This report questioned the effectiveness (in terms of a fairer distribution of outputs or educational achievements) of policies aimed at equalising benefits between students or at granting full access to education and argued that socio-economic conditions and family background are important factors that drive most of the variation in students' achievements.

The debate on the meaning of equality of opportunity in various income and wealth-related outcomes was enriched by the contributions of important philosophers and economists (such as Arneson, 1989; Dworkin, 1981a, 1981b; Nozick, 1974; Rawls, 1971; Sen, 1980, 1985). They posited the importance of compensating individuals' different situations, especially in cases outside of an individual's personal responsibility.

It was only at the end of the 1990s that this concept was explicitly addressed, described and translated into a mathematical formulation in John Roemer's (1993) and Fleurbaey's (1995) seminal works on equality of opportunity. The main argument of Roemer was based on the distinction between unchosen, pre-determined 'circumstances' and individual effort. While the latter is attributed to personal responsibility, the former are inherited by the individual and are beyond his or her control. As argued by Fleurbaey (1995), differences in individual outcomes that are attributable to circumstances are ethically unjustified, while outcome inequalities due to individual choices and personal responsibility can be ethically accepted because they represent the natural reward of individual effort.

Two methodological approaches are suggested to quantify the extent to which a given society is unequal. The utilitarian 'ex-ante' perspective (van der Gaer, 1993) considers outcome differences between types prior to the realisation of their effort level. The 'ex-post' approach looks at the opportunity set granted to individuals who exert the same degree of effort (Checchi & Peragine, 2010; Roemer, 1998).[1]

Most of the applied studies on the measurement of inequality of opportunity have focused on the opportunities for the acquisition of income. Relatively fewer empirical studies appear in the domain of education. In this field, three main strands of research have emerged so far in the empirical literature: the first strand has applied the 'education production function' framework to directly estimate the effect of specific socio-economic variables on educational outcomes (Fertig, 2000;

Hanushek, 1979; Wößmann, 2003) and to directly, as well as indirectly, consider intergenerational mobility in educational achievements outcomes (Behrman, Gaviria, & Székely, 2001; Dahan & Gaviria, 2001; Lam & Schoeni, 1993).

The more recent second strand addresses the Roemer's theory more explicitly and attempted to operationalise the concept of inequality of opportunity theory in the domain of education. Some notable contributions are the cross-countries analyses by Ferreira and Gignoux (2014) and Gamboa and Waltenberg (2012) and the Indian case studies by Asadullah and Yalonetzky (2012), Singh (2012).

Lastly, the third strand of the literature (Iatarola & Stiefel, 2003; Mongan, Santin, & Valiño, 2011; Waltenberg & Vandenberghe, 2007) has instead focused more on policy-oriented research objectives and has evaluated the opportunity-equalising effects of education policies.

This paper connects these three strands by considering the distribution of educational opportunities across provinces and over time, assessing the role that both circumstances and individual responsibility play in education outcomes in the short and long run, and evaluating the effect of educational policies on the inequality of opportunity.

3. Methods

3.1. Measuring inequality of opportunity in education

To measure the educational inequality of opportunity, we build upon Roemer's utilitarian principle, according to which inequality between individuals determined by different degrees of effort is fair. We thus pursue the ex-ante approach that considers inequality of opportunity as a between-type inequality.[2] For the main educational outcome variable, we focus on educational attainment, which- in order to avoid measurement error (that is, the same real year of schooling could reflect different educational levels) – is measured as completed years of schooling defined by the last grade the individual achieved.

Following Bourguignon, Ferreira, and Walton (2007) and Ferreira and Gignoux (2014), we apply a parametric methodology to construct our aggregate indices of the inequality of opportunity in education. After estimating a reduced form of an Ordinary Least Squares (OLS) regression of the individual's educational achievement, given by the years of schooling,[3] (s) on a vector X of individual endowments or circumstances:

$$s_i = \alpha + \beta X_i + \varepsilon_i \tag{1}$$

the predicted values $\left(c_i = \hat{\beta} X_i\right)$ can be used in order to obtain an absolute measure of inequality of opportunity, such as $I(c_i)$.

The relative measure of inequality $(\hat{\theta}_{IOp})$ is obtained as the ratio between $I\ (c_i)$ and the total level of inequality, $I\ (\hat{S}_i)$. By adopting the variance as inequality measure, we have that:

$$\hat{\theta}_{IOp} = \frac{Var(X_i \widehat{\beta})}{Var(\hat{S}_i)} \tag{2}$$

where the numerator is the squared sum of the residuals ($\sum^{(s_i - c_i)^2}$) while the denominator is the total sum of squares ($\sum^{(s_i - \bar{s})^2}$). Therefore $\hat{\theta}_{IOp}$ is simply the R-squared of the model denoted in Equation (1).

Among the pre-determined circumstances available, we stick to core variables that are more likely to be truly 'pre-determined' and exogenous and have a small rate of missing values to keep the attrition rate low. Those are gender, parents' years of education,[4] height and a dummy for female-headed households.[5]

We study two different cohorts of adolescents: a younger cohort with pupils aged between 11 and 14 years and an older cohort with pupils in the age range of 15–18 years. The grouping is intended to magnify the sample size in the analysis for each cohort, yet still achieve the acceptable level of age homogeneity.[6]

Age is not included as one of the explanatory variables of educational attainments. Regardless of whether age is truly exogenous and pre-determined, the inclusion of age as one of the explanatory variables in the OLS regressions will considerably inflate the R^2, but it would make very little sense to consider it as a source of unfair inequality, like any other socio-economic circumstance.

It is important to note that since all the variables included in this analysis are not all of the possible pre-determined circumstances, $\hat{\theta}_{IOp}$ should be interpreted as the lower bound of educational inequality of opportunity.[7]

After having obtained our aggregate indices of inequality of opportunity for all the Indonesian provinces sampled in the surveys in four different time periods (1997, 2000, 2007 and 2014), we are able to analyse time trends and differences among provinces in inequality of opportunity of education and to assess the contribution of education policies in equalising opportunities among students.

3.2. Measuring the long-term contribution of circumstances and personal responsibility to educational gains

While the R^2 can measure the extent to which educational opportunities are distributed among given groups at the aggregate level, there is one important question left. To what extent can we, as researchers, use this measure? As discussed above, the R^2 of pre-determined circumstances explaining years of education in each province can be related to educational policy variables. While the approach is useful in describing the opportunity-equalising effects of several policies, it has the drawback that an aggregate measure cannot explain the effect of inequality of opportunity at the individual level.

It might be, indeed, of crucial importance to explain if and how the 'burden' of unequal opportunities in education carried by each person will affect their future life achievements, such as final educational attainment, wage, occupation, income, productivity or non-cognitive ability to name a few. This part of the analysis, aimed at addressing this research question, is developed in two consecutive stages. First, we develop an alternative measure of inequality of opportunity that captures for each student the separate influences exerted by circumstances and by personal effort and ability. In the latter stage, we use this index to explain long-term educational outcomes and analyse intra-generational mobility.

We fully exploit the longitudinal dimension of our micro-level data and modify Equation (1) as:

$$s_{ict} = \alpha + \beta X_{ict} + \lambda_{ct} + u_{ict} \tag{3}$$

where λ_{ct}, represented by the time dummies, accounts for time-specific characteristics, such as age, which are common across individuals of the same cohort *c*.

Excluding the time effect,[8] the fitted values of each individual *i,* $i = 1, \ldots, n$ at time *t,* $t = 1, \ldots, T$ for each cohort *c*[9] are simply given by:

$$\hat{s}_{itc} = \alpha + \hat{\beta} X_{ict} \, . \tag{4}$$

On the one hand, the R^2 informs us of the extent to which the variation of X explains the variation in s for all individuals i over time. The fitted value $\hat{s}_{itc}$, on the other hand, is the part of educational attainment s of individual i at time t that is specifically influenced by the X circumstances experienced by individual i at time t, with α and β governing the average magnitude of the relationship over time and across individuals.

The higher value of pre-determined circumstances in the model, hence the higher the fitted values $\hat{s}_{itc}$, the stronger the *direct*[10] contribution of the (observed) pre-determined circumstances as the source of inequality of opportunity at the individual level.

This one-to-one relationship is more understandable when the fitted values are tailored to the normalised range [0,100].[11] Normalised fitted values of zero represent individuals that had the lowest

effect of pre-determined circumstances. Meanwhile, score one hundred maps the ones with the highest effect of pre-determined circumstances.[12]

These normalised fitted values obtained from Equation (3) can be used to obtain an absolute index of the 'burden' of circumstances, such as $I(\hat{s}^L)$.

Analogously to the $\hat{\theta}_{IOp}$ estimated from Equation (2), this measure, that cannot account for the effect of unobserved fixed and time-varying circumstances, is likely to be a *lower bound* estimate of the true contribution of circumstances to any relative 'unfair' educational gain attained by each individual over time.

Moreover, estimation of (3) implies that, individual time-varying effort as well as luck and any possible unobserved time-invariant and time-varying circumstances are part of the residual term, which can be interpreted as an *upper bound* index (("$I(\varepsilon^{\sim U})$") of all the sources of fair or ethically acceptable inequality in education achievements. Analogously to $I(\hat{s}^L)$, for the sake of interpretation, this index is normalised in the range [0,100].

It has to be noted that although the set of variables included in the vector X has been limited to household-level variables mostly influenced by adults' preferences and behaviour, not all are perfectly exogenous to our two cohorts of students. Household formation processes, for example, might be influenced by the needs of their children. Moreover, it might be questioned that although factors such as the genetic health endowment (as proxied by height) are 'given' and outside individual control, they are related to innate ability and, as such, might not be considered as 'unfair' sources of inequality and so they should not be accounted for in the burden of circumstances index.

For this reason, we develop a two-way fixed effect model where the two only observed circumstances are gender (which is absorbed by the individual dummies) and parents' education[13] (*PS*):

$$s_{ict} = \alpha + \beta PS_{ict} + \gamma_{ic} + \lambda_{ct} + u_{ict} \tag{5}$$

The predicted values obtained from this equation account for the effect of only one observed exogenous circumstance that can be considered as a truly unfair source of inequality in education, which is amenable to public policy. As such they represent the *lowest bound* absolute index of the 'burden' of truly exogenous circumstances, such as $I(\hat{s}^{L*})$.

The idiosyncratic error term of model (5) represents all the remaining part of educational achievement that it is explained not only by unobserved time-varying effort but also by any unobserved time-varying socio-economic circumstances. Moreover, the prediction $\hat{\gamma}_{ic}$of the fixed effects component of Equation (5) can be used to measure the effect of time-invariant individual specific and unobserved endowments, such as innate ability.

From this perspective, we can construct an index $I\left(\tilde{\varepsilon}^{U*}\right)$, that is given by:

$$I\left(\tilde{\varepsilon}^{U*}\right) = \hat{\gamma}_{i,c} + \hat{u}_{i,c,t} \tag{6}$$

which can be interpreted as the *upmost bound* measure of the contribution of personal responsibility and innate ability to the individual educational achievement.[14]

Turning to the second stage of our analysis we assess whether and to what extent the educational gains obtained over time through the separated influences of circumstances and personal responsibility and ability persist and contribute to long-term educational achievements.

We therefore use our individual lower and lowest bound indices of the burden of circumstances ($I\left(\hat{s}^L\right)$ and $I\left(\hat{s}^{L*}\right)$) and upper and upmost bound indices of personal responsibility ($I(\tilde{\varepsilon}^U)$ and $I(\tilde{\varepsilon}^{U*})$) extracted from models (3) and (5) for the t years 1997, 2000 and 2007 to explain two long-term educational outcomes, measured by the final level of education attained by the last survey available ($S_{i,c,2014}$") and by the probability of enrolling in tertiary education ("$E_{i,c,2014}$"):

$$S_{i,c,2014} = \beta_0 + \beta_1 I\left(\hat{s}^{L}\right)_{i,c,t} + \beta_2 I(\tilde{\varepsilon}^{U})_{i,c,t} + \beta_3 D_{i,c,2014} + u_{i,c} \tag{7a}$$

$$S_{i,c,2014} = \beta_0 + \beta_1 I\left(\hat{s}^{L*}\right)_{i,c,t} + \beta_2 I(\tilde{\varepsilon}^{U*})_{i,c,t} + \beta_3 D_{i,c,2014} + u_{i,c} \tag{7b}$$

$$E_{i,c,2014} = \beta_0 + \beta_1 I\left(\hat{s}^{L}\right)_{i,c,t} + \beta_2 I(\tilde{\varepsilon}^{U})_{i,c,t} + \beta_3 D_{i,c,2014} + u_{i,c} \tag{8a}$$

$$E_{i,c,2014} = \beta_0 + \beta_1 I\left(\hat{s}^{L*}\right)_{i,c,t} + \beta_2 I(\tilde{\varepsilon}^{U*})_{i,c,t} + \beta_3 D_{i,c,2014} + u_{i,c} \tag{8b}$$

In order to keep the rate of attrition as low as possible, we also include observations that have not yet left school in 2014, but we include the binary dummy '*D*' to control for their presence in the sample.

4. Data and descriptive analysis

4.1. Data

Our main data comes from the 1997, 2000, 2007, and 2014 waves of the Indonesia Family Life Survey (IFLS) which is a longitudinal individual and household survey data conducted in 13 Indonesian provinces spread out in the islands of Sumatra, Java, Kalimantan, Sulawesi, Bali and West Nusa Tenggara.[15]

For the measurement of the long-term contribution of the burden of circumstances, we fully rely on the longitudinal dimension of our data, and we get for each of the two cohorts three balanced sets of observations depending on the year where the students are initially observed (see Table 1).

To scrutinise the educational budget policy, we extracted lagged annual revenue data from The Indonesian Ministry of Finance (1997, 2009) and compute the sum of district development education budget share (over total budget) in each province. Data for 1996/1997 combine the budget of education, youth, sport and faith under the same umbrella, while data in 2002 and 2009 has a specific section for educational budget. With decentralisation that started in 1999, the flow and allocation of fiscal resources have been largely shifted – by law- from central to district governments.

As it emerges from Table A3 in the Appendix, the budget share devoted to development education expenses has substantially decreased, pointing to a surprisingly little degree of discretion that local governments have, despite decentralisation, in managing funds in key education sectors (World Bank, 2008). The shares are also very limited compared to the minimum 20 per cent that the new education law has set as the benchmark rule for local level's education expenses other than teacher salaries.

Data on central government expenditures to education assistance programmes are extracted from the IFLS. We compute for each province and cohort the lagged shares of students receiving this type of financial assistance by identifying all the individuals in our sample that stated to have received in the previous year any educational grant from the government, including direct financial assistance received directly from the schools using the 'Bantuan Operasional Sekolah' (BOS) grant and/or any 'Beasiswa untuk Siswa Miskin' (BSM) and 'Bidik Misi' funding. By using the information gathered at the individual level, we consider a specific component of the BOS grant. This is the part of the

Table 1. Description of sample sets

Observations from IFLS sample	Cohort (c)	Time (t)	Number of observations	Attrition
IFLS 2 (1997)	11–14	1997,2000,2007,2014	1571	20.01%
	15–18	1997,2000,2007,2014	885	22.98%
IFLS 3 (2000)	11–14	2000,2007,2014	1534	22.95%
	15–18	2000,2007,2014	1042	26.46%
IFLS 4 (2007)	11–14	2007,2014	1792	18.58%
	15–18	2007,2014	1062	19.73%

funds that school principals can discretionary allocate directly to the neediest students to cover part of their school's costs (such as transport costs and learning materials). The BSM and Bidik Misi funding are instead scholarships that target poor students from primary to tertiary education levels. Key summary statistics, reported in Table A4 in the Appendix, point to an increasing trend, accompanied by growing cross-province disparity, in the proportion of students benefiting from this policy.

4.2. Levels and trends of inequality of opportunity in education in indonesia

Table 2 shows our estimates of the inequality of educational opportunity, measured as the R^2 of a set of several regressions run separately for each province, year and cohort. On average these figures suggest that while pre-determined circumstances account for a relatively low and declining portion of the total variance of education attainment[16] in the 15–18 year old groups of students, their role is substantially larger (and stable over time) for the group of junior secondary school-aged children.

It can also be observed that in most of the Indonesian provinces inequality of opportunity has decreased over the 17-year period considered.[17] While Central Java and West Nusa Tenggara made the largest contribution to this equalising trend, there are also some notable exceptions. There are cases like Lampung, East Java and South Sumatera where, for the youngest groups of students, the portion of overall inequality in educational attainments, accounted for by inherited circumstances, has

Table 2. Inequality of opportunity in education: aggregate indexes

Year	1997		2000		2007		2014	
Cohort	11–14	15–18	11–14	15–18	11–14	15–18	11–14	15–18
Indonesia	0.407	0.205	0.401	0.193	0.242	0.151	0.359	0.072
	(2023)	(1195)	(2037)	(1413)	(2111)	(1259)	(2853)	(1617)
North Sumatera	0.415	0.182	0.507	0.274	0.530	0.113	0.415	0.209
	(164)	(108)	(165)	(126)	(196)	(101)	(267)	(131)
West Sumatera	0.364	0.139	0.332	0.149	0.326	0.166	0.234	0.146
	(119)	(88)	(118)	(97)	(115)	(62)	(133)	(99)
South Sumatera	0.400	0.214	0.513	0.212	0.398	0.114	0.458	0.144
	(106)	(58)	(127)	(80)	(77)	(53)	(157)	(62)
Lampung	0.292	0.172	0.399	0.061	0.215	0.150	0.469	0.112
	(116)	(52)	(109)	(61)	(104)	(58)	(118)	(65)
DKI Jakarta	0.332	0.200	0.272	0.123	0.173	0.081	0.320	0.019
	(173)	(154)	(154)	(153)	(119)	(78)	(141)	(85)
West Java	0.542	0.257	0.393	0.249	0.244	0.213	0.487	0.168
	(312)	(167)	(345)	(196)	(338)	(166)	(386)	(239)
Central Java	0.469	0.228	0.442	0.156	0.242	0.118	0.351	0.070
	(269)	(156)	(260)	(152)	(248)	(144)	(351)	(202)
DI Yogyakarta	0.435	0.203	0.470	0.178	0.220	0.090	0.393	0.109
	(97)	(87)	(82)	(92)	(89)	(87)	(115)	(80)
East Java	0.309	0.173	0.437	0.187	0.224	0.357	0.387	0.077
	(265)	(131)	(230)	(203)	(262)	(157)	(326)	(200)
Bali	0.480	0.282	0.428	0.172	0.372	0.157	0.337	0.051
	(93)	(58)	(104)	(64)	(104)	(74)	(158)	(82)
West Nusa Tenggara	0.458	0.259	0.391	0.386	0.353	0.074	0.331	0.066
	(142)	(55)	(159)	(89)	(171)	(113)	(234)	(140)
South Kalimantan	0.363	0.331	0.205	0.500	0.198	0.187	0.356	0.201
	(75)	(36)	(76)	(37)	(88)	(38)	(136)	(68)
South Sulawesi	0.314	0.047	0.349	0.213	0.517	0.222	0.363	0.008
	(92)	(45)	(104)	(60)	(116)	(69)	(162)	(82)

Note: Own computation based on IFLS data. Number of observations is reported in parentheses.

grown from its 1997 levels. In North Sumatera, instead, the distribution of opportunities has remained quite unequal over time and, between 2007 and 2014 it has even worsened for the group of senior secondary school-age children.[18]

5. Estimation results

5.1. Persistence of unequal educational opportunities

We now turn to the inferential part of our analysis which aims at unravelling the consequences that unequal opportunities quantified in our indices of the burden of circumstances have on a person's future education outcomes.

Tables 3 and 4 show the results for the effects that inequality of educational opportunity experienced in the past has on future school achievements measured by the highest grade completed by 2014 and on the probability of enrolling in tertiary education. In panel A, we report the coefficients on the lower bounds of the index of the burden of circumstances and on the upper bound of the index of the contribution of effort and ability.

Coefficients reported in Panel B are instead obtained from the estimation of Equations (7b) and (8b) that take the contribution of parental education as the only truly exogenous observed circumstance.[19]

We mainly use clustered standard error at provincial level to account for the heterogeneity of educational policies across provinces. For robustness check on the inference to population in Tables 3 and 4, we replicated the analysis using strata and finite population correction (see Tables S3, S5, S7 and S9 in the Supplementary Materials). Both approaches include sampling weights. In terms of significance, they exhibit identical results.

As the results suggest, a significant cumulated and persistent effect of pre-determined circumstances seems to exist. The more educational opportunities that are granted to a person based on her inherited circumstances, the larger her educational reward in the near future will be.

The coefficients reported in Panel A of Table 3 on the effect of the burden of circumstances index (*lower-bound*) indicate that the difference between the observations with the lowest support of pre-determined circumstances and the observations with the highest ones is pretty large. It ranges from around 10 years for the youngest cohorts aged 11–14 in 2000 to around 6 years for the 15–18 cohorts in 2000.

Table 3. Linear regressions: long-term effect of fair and unfair sources of educational inequality on schooling achievements

	Sample	Cohort	Burden of circumstances		Ability and effort		Observations
Panel A	1997	11–14	0.093***	(0.006)	0.032***	(0.006)	1483
	2000	11–14	0.102***	(0.007)	0.024***	(0.005)	1464
	2007	11–14	0.096***	(0.006)	0.092***	(0.005)	1656
	1997	15–18	0.073***	(0.004)	0.056***	(0.005)	817
	2000	15–18	0.060***	(0.004)	0.043***	(0.004)	997
	2007	15–18	0.078***	(0.005)	0.054***	(0.004)	975
Panel B	1997	11–14	0.075***	(0.006)	0.057***	(0.006)	1571
	2000	11–14	0.108***	(0.007)	0.060***	(0.007)	1534
	2007	11–14	0.049***	(0.002)	0.078***	(0.003)	1792
	1997	15–18	0.048***	(0.002)	0.068***	(0.005)	885
	2000	15–18	0.058***	(0.003)	0.060***	(0.005)	1042
	2007	15–18	0.043***	(0.002)	0.088***	(0.004)	1061

Notes: Coefficients reported in Panel A and Panel B are based on the estimation of Eq. 7a and 7b respectively. Robust standard error clustered at provincial level are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4. Probit regression: long-term effect of fair and unfair sources of educational inequality on enrolment in tertiary education

	Sample	Cohort	Burden of circumstances		Ability and effort		Observations
Panel A	1997	11–14	0.025***	(0.002)	0.002***	(0.002)	963
	2000	11–14	0.029***	(0.003)	−0.010***	(0.003)	978
	2007	11–14	0.051***	(0.012)	0.034***	(0.008)	1080
	1997	15–18	0.032***	(0.002)	0.009***	(0.005)	684
	2000	15–18	0.031***	(0.003)	0.014***	(0.004)	867
	2007	15–18	0.070***	(0.007)	0.036***	(0.005)	877
Panel B	1997	11–14	0.023***	(0.002)	0.011***	(0.003)	1024
	2000	11–14	0.035***	(0.002)	0.004***	(0.004)	1028
	2007	11–14	0.029***	(0.006)	0.035***	(0.006)	1171
	1997	15–18	0.021***	(0.002)	0.014***	(0.006)	745
	2000	15–18	0.031***	(0.003)	0.021***	(0.005)	901
	2007	15–18	0.037***	(0.004)	0.059***	(0.008)	955

Notes: Coefficients reported in Panel A and Panel B are based on the estimation of Eq. 8a and 8b respectively. Robust standard error clustered at the provincial level are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Focusing on the effect of parental education only (Panel B), we observe that for most of the cohorts the contribution of this variable as the only unfair source of inequality is around 5 additional years of schooling. For the young cohorts of the late 1990s and early 2000s, this effect has been relatively larger accounting for around 6 to 10 additional years of schooling.

This result, as confirmed in the regressions for enrolment in tertiary education (Table 4), adds an interesting reading on the long-term consequences of the late 1997 Indonesian economic crisis.[20] It suggests indeed that, for that generation of school-age students, the final educational attainment is significantly higher for those students whose secondary education was largely influenced by their parents' education.

Interestingly, for the latest generations of our sample, we observe that effort and ability have mattered more than in other cohorts. Within the cohorts of individuals aged 11–14 in 2007, we observe that the difference in the final educational achievement between students who had the largest and the smallest support of personal responsibility in previous schooling outcomes corresponds to around 9 years of education. For the cohorts of students aged 11–14 in 2000, this difference accounts to only 2.4 final years of education.

This finding that echoes back the equalising trend in our aggregate figures on the inequality of opportunity suggests that Indonesian students have recently started to experience fairer and merit-based reward mechanisms at school. Family background might have influenced short-term educational outcomes. Yet, students that did not receive any support from their family circumstances were also probably the most motivated to make it through successive steps of their education career.

5.2. Educational inequality of opportunity and public policy

As it emerged from our results, equality of opportunity in education has tended to improve slightly over time. This finding leads us to our last research question: did educational expenditure policy play any role in evening the allocation of opportunities among the Indonesian students?

In order to answer this question, we focus on two distinct education policy measures: the local-level budget devoted to the education sector and financial assistance programs administered at the central level and aimed at improving school quality (for example, by subsidising transports cost and by granting scholarships).

We estimate therefore the following two-way fixed effects model:

$$\left(\hat{\theta}_{IOp}\right)_{p,c,t} = \beta_0 + \beta_1\left(\hat{\theta}_{IOp}\right)_{p,c,t-s} + \beta_2 budget_{p,c,t-n} + \lambda_{t,c} + \rho_{p,c} + \varepsilon_{p,c,t} \quad (9a)$$

$$\left(\hat{\theta}_{IOp}\right)_{p,c,t} = \beta_0 + \beta_1\left(\hat{\theta}_{IOp}\right)_{p,c,t-s} + \beta_2 assistance_{p,c,t-n} + \lambda_{t,c} + \rho_{p,c} + \varepsilon_{p,c,t} \quad (9b)$$

where $\left(\hat{\theta}_{IOp}\right)_{p,c,t}$ is the (lower-bound) index of inequality of opportunity measured in province p, for cohort c at time t; $\left(\hat{\theta}_{IOp}\right)_{p,c,t-s}$ is the lagged value of the index as measured in the previous survey available, $budget_{p,c,t-n}$ and $assistance_{p,c,t-n}$ are, respectively, the share of the total budget devoted to education non-routine expenditures and the proportion of students receiving financial assistance in province p at time t-n[21]; $\rho_{p,c}$ and $\lambda_{c,t}$ are province and time fixed effects, and $\varepsilon_{p,c,t}$ is the idiosyncratic error term with zero expectation.

The results, which are reported in Table 5, show that provinces that spent a higher percentage of their budget in non-routine education expenditures tend to exhibit a smaller level of inequality of opportunity. Yet, the magnitude of the effect is not statistically significantly different from zero, suggesting that the allocation of provincial budgets has not been effective.

Our descriptive statistics in Table A3 in the Appendix, point to a steady decline in the education development expenditures shares. Financial resources have been sacrificed, especially at the primary and junior high school level, to hire a greater number of teachers, assigning each teacher to teach one subject and therefore decreasing the students/teachers ratios. Yet – as remarked in various reports (OECD & ADB, 2015; Suryadarma & Jones, 2013) – this mechanism has been highly inefficient, especially for small schools that are mostly located in remote and disadvantaged areas where problems related to teachers' lack of motivation and absenteeism were more frequently observed.

However, central government education policies in the form of scholarships and financial support to education seem to have been successful in targeting the youngest students from the most disadvantaged areas. As our results suggest, provinces with high shares of beneficiaries of government education assistance programs are related indeed with a significant decrease in inequality of opportunity among the cohorts of students aged 11 to 14 years. Nevertheless, this policy did not have a significant equalising effect for the oldest cohorts.

Table 5. Education policies and inequality of opportunity

	Cohort 11–14	Cohort 15–18	Cohort 11–14	Cohort 15–18
Lagged $\hat{\theta}_{IOp}$	−0.423***	−0.339***	−0.405	−0.358**
	(0.103)	(0.078)	(0.126)	(0.144)
Lagged budget share to non-routine education expenditures	−0.008	−0.002		
	(0.011)	(0.008)		
Lagged proportion of assistance beneficiaries			−0.451**	0.097
			(0.195)	(0.363)
2007	−0.100***	−0.061*	−0.010	0.003
	(0.027)	(0.034)	(0.045)	(0.033)
2014	−0.092*	−0.139**	−0.049	−0.148***
	(0.047)	(0.049)	(0.058)	(0.033)
Constant	0.601**	0.298***	0.561***	0.291***
	(0.069)	(0.037)	(0.055)	(0.024)
Observations	39	39	36	36
R^2	0.401	0.422	0.507	0.423
Number of province fixed effects	13	13	12	12

Notes: The lags for the educational budget share are 3 years if $\hat{\theta}_{IOp}$ is observed in 2000 and 5 years for $\hat{\theta}_{IOp}$ being observed in 2007 and 2014. The lags for the proportion of students receiving assistance are 1 year. Clustered standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

6. Concluding remarks

Educational outcomes are important for achieving a wide array of important personal goals. Having the opportunity of being well educated also has its own intrinsic value, regardless of the effect education can have on other, contemporaneous or future, outcomes. Every person should be able to exert her fundamental right to being educated, but – of course- this does not necessarily imply that everybody should achieve the same level of education. However, according to both ethical and efficiency-related arguments, the only source of inequality in educational achievements should be related to the heterogeneity in effort committed to studying, and not on inherited factors that are simply outside the scope of individual responsibility.

This simple consideration has motivated the present study that contributes to the previous literature by, firstly, accruing current knowledge on the distribution of educational opportunities in Indonesia. Over the last two decades, we observe a sizeable improvement in our relative index of inequality of opportunity. However, progress in this dimension has not been homogenous over time and across provinces.

Second, we proposed an alternative measure to analyse from the individual level perspective, the extent to which the amount of inequality of opportunity experienced in the past can influence long-term achievements.

As we showed, the burden of family socio-economic circumstances significantly persists over the individual life's course. Latest generations have fared better than others. In the sample of 2007 students, we observe that long-term differences in educational achievements have been driven largely by differences in their ability and commitment.

On the other side, for the generations of school-age individuals at the time of the Indonesian financial crisis, the short-term influence of family circumstances to schooling outcomes made a significant contribution also to long-term academic achievements.

As previously remarked, the local education budget policy has not played a significant role in equalising educational opportunities. Given the paucity of the shares that – after decentralisation- districts were able to devote to non-routine education expenditure: this finding is not surprising. Yet, it joins in the chorus of recent reports issued by several international organisations (such as World Bank, OECD and ADB) that emphasised the need of more effective policies to adequately targeting school quality in the neediest regions.

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Notes

1. As noted in Fleurbaey (2008) and Checchi and Peragine (2010) these two approaches do not necessarily generate same rankings of distributions, as compensation mechanisms within types will only affect opportunity inequality when adopting the ex-post approach (Checchi & Peragine, 2010). On the other hand, the ex-ante approach can generate a distribution that fully satisfies the utilitarian or reward principle according to which inequality of a given outcome within groups of individuals sharing the same circumstances can be fair, as long as these individuals are rewarded according to the amount of effort exerted in order to achieve a certain outcome (Donni & Pignataro, 2014).
2. The ex-ante approach is well represented in the related empirical literature and has been adopted by Bourguignon et al. (2007); Checchi and Peragine (2010); Ferreira and Gignoux (2011, 2014).
3. The 'S' years of completed schooling are computed as 'net' years of grades achieved. A student who has completed, for example, grade 1 and grade 2 of elementary school but repeated twice grade 2 will be counted as having 2 years of completed schooling.
4. In order to keep attrition low, we use parental maximum years of schooling. This allows us to keep individuals with only one parent or where information for one of the two parents is missing.
5. We exclude from the list of circumstances residence (urban/rural) and wealth variables such as household dwelling conditions and ownership of the house, of farmland, of TV or other appliances because parental decision to move and to buy these goods is likely to be influenced by the sons, especially by those belonging to the oldest cohort (15–18 years). Likewise, we do not include access to books. This choice is motivated by data availability constraints but also by endogeneity concerns (that is, parents observing efforts and school achievements of their kids might motivate them to buy more books and learning tools to satisfy the increasing needs of their keenest children).
6. Children belonging to the youngest cohort 6–10 years are excluded from the analysis, given that – because of their very young age – the role played by individual responsibility and effort might be very limited. Moreover, except for Eastern Indonesia (which is not part of the IFLS sample) enrolment rates for primary level are reasonably high (World Bank, 2015), implying that opportunities are relatively well equalised among the youngest pupils.
7. A formal proof is provided in Ferreira and Gignoux (2011). In practise, it is also crucial to check the adjusted R^2 when selecting the circumstances. The arbitrarily large disparity between R^2 and adjusted R^2 indicates that some of the explanatory variables do not significantly explain the outcomes.
8. We keep the constant in the fitted values to accommodate the possibility of dummy variables in the model as a more general formula because the intercept is the expected mean value when a dummy variable is equal to zero.
9. For each individual i belonging to cohort c when initially observed in 1997 (2000), the fitted values are derived from model (4) separately for years 1997, 2000, and 2007 (2000 and 2007).
10. The 'indirect' approach (used, for example, by Niehues & Peichl, 2014) considers instead the effect of circumstances on certain outcome variables (notably earnings) through observed 'efforts' variables.
11. The usual normalisation ranges between zero and one. However, we stretch the range in this study to show the marginal change at percentile level, instead of dummy level.
12. Concerning the importance of explanatory variables, it is crucial to note that unlike R^2, fitted values cannot be adjusted. Instead, it purely relies on the coefficients of pre-determined circumstances. If β is large, fitted values will be large too. If β is close to zero or practically insignificant, it translates into the fitted values as a very small number. This measure will potentially suffer from imprecision if β is large but the standard error is also large that makes it statistically insignificant. Therefore, we previously checked on the statistical assessment of individual coefficients such as t-test and VIF. Another issue with fitted values is related to the modelling strategy. Ordinary least square that implicitly assumes normal distribution naturally produces unrestricted fitted values. However, in many cases, educational outcomes are bounded and particularly for educational attainment the lowest value is zero. Negative fitted values, when this is the case, will violate the nature of schooling. Therefore, generally speaking, it is very important to investigate if the fitted values go beyond their innate boundaries and when it is there, one may have to look at various strategies to overcome this issue prior further analysis.
13. In our sample, parental years of education change, indeed, over time. One of the largest improvements that we observe in our data relates to the parents of the 1997's students' sample (tracked in 2000, 07 and 14). These parents gained – on average – about 2.5 years of schooling more in a time span of 17 years. The observed increasing pattern that we find in adults' years of education can be related, in the Indonesian context, to three main drivers: the expansion of tertiary education (for men and women alike) and relatively slow growth in median age at marriage; the governmental programs to raise the educational levels of public sector employees and the promotion of special adult educational non-formal packages (which is accounted for in our data).
14. We follow the syntax provided by Guimarães and Portugal (2009) to preserve the inter-group variability without having to include high dimensional fixed-effects in the estimation, either for one way or for two-way fixed-effect.
15. A selection of key summary statistics for our sample of interest is presented in Tables A1 and A2 in the Appendix.
16. This result is in line with the findings of Ferreira and Gignoux (2011), who, relying on a larger set of circumstances, estimate for 2006 a national figure of educational inequality of opportunity in PISA scores of around 0.2 for their sample of 15-year-old students.
17. It has to be noted that the provincial-level indices reported in Table 2 (and S1 in the Supplementary Materials) and in Table 5 have to be interpreted with caution. These findings are obtained by applying the cross-sectional weights. These are

necessary to take sample design into account and adjust for over-sampling in urban areas and off Java. However, the cross-sectional weights are representative of the Indonesian population across the 13 IFLS provinces as a whole at the time of the given IFLS wave. They were not done by province and thus there is some uneasiness about using them as a representative for a given province, which might affect the out-of-sample validity of our figures and findings.

18. As a robustness check, we replicated the analysis by using a non-linear regression approach. As our dependent variable has a count nature, we apply the R^2 developed by Cameron and Windmejer (Cameron & Windmejer, 1996) for Poisson regressions. The results reported in Table S1 in the Supplementary Materials, point to an upward bias in the OLS estimates. However, the magnitude of the bias is relatively small.
19. Full regressions results are provided in Tables S2, S4, S6 and S8 in the Supplementary Materials.
20. Previous research has shown that in the aftermath of the crisis, Indonesia experienced a massive increase in dropout rates and a temporary fall in enrolment rates, especially among secondary school level students (Frankenberg, Thomas, Beegle, & Suriastini, 1999). At the same time, the public provision of education had to face several problems associated with the rising cost of books and learning supplies and with the shortage of maintenance funds that followed the abolition of BP3 students' fees for school's operation costs. The common response of most of the school was therefore that of increasing test fees, asking parents for donations and letting students share books.
21. Given data availability constraints, in Equation (3a) n is equal to 3 years if the dependent variable is observed in 2000 respectively and to 5 years for IOp measured in 2007 and 2014. In Equation (3b), *n* is equal to 1 year.

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Appendix

Table A1. Descriptive statistics. Cohort 11–14

	Panel A: IFLS 2				Panel B: IFLS 3			Panel C: IFLS 4		Panel D: IFLS 5
Cohort 11–14	1997	2000	2007	2014	2000	2007	2014	2007	2014	2014
Years of schooling	5.69	8.27	11.11	11.42	5.61	10.62	11.52	5.85	11.29	5.98
Age	12.51	15.48	22.47	29.44	12.44	19.41	26.40	12.40	19.39	12.45
Gender (female dummy)	0.50	0.50	0.50	0.50	0.47	0.47	0.47	0.50	0.50	0.49
Height (cm)	141.65	153.65	157.16	157.82	140.38	157.65	158.31	144.23	159.00	146.56
Residence (urban dummy)	0.48	0.51	0.57	0.62	0.44	0.55	0.60	0.50	0.64	0.59
Female headed HH (dummy)	0.08	0.11	0.17	0.13	0.09	0.19	0.15	0.11	0.19	0.10
Parental years of schooling	6.97	7.09	8.37	9.47	7.19	8.17	9.23	8.60	9.00	9.74
No.of observations	2205	2151	2055	1964	2300	2174	1991	2201	1003	3203

Source: Own elaboration on IFLS data.

Table A2. Descriptive statistics. Cohort 15–18

	Panel A: IFLS 2				Panel B: IFLS 3			Panel C: IFLS 4		Panel D: IFLS 5
Cohort 15–18	1997	2000	2007	2014	2000	2007	2014	2007	2014	2014
Years of schooling	9.23	11.4	12.44	12.56	9.27	12.31	12.58	9.58	9.23	11.4
Age	16.26	19.23	26.19	33.18	16.25	23.23	30.02	16.22	16.26	19.23
Gender (female dummy)	0.49	0.49	0.49	0.49	0.50	0.50	0.50	0.47	0.49	0.49
Height (cm)	155.51	158.22	157.77	158.44	155.95	157.91	158.09	156.33	155.51	158.22
Residence (urban dummy)	0.62	0.65	0.69	0.72	0.58	0.67	0.71	0.58	0.62	0.65
Female headed HH (dummy)	0.09	0.16	0.15	0.15	0.10	0.17	0.14	0.12	0.09	0.16
Parental years of schooling	7.86	8.52	9.79	10.65	8.18	9.48	10.43	8.86	7.86	8.52
No.of observations	1364	1319	1243	1149	1657	1560	1417	1485	1364	1319

Source: Own elaboration on IFLS data.

Table A3. Budget shares to the education sector (total percentage of district budget shares, by province)

	1997	2002	2009
North Sumatera	4.99	2.57	0.21
West Sumatera	5.63	0.86	0.12
South Sumatera	4.24	2.85	0.10
Lampung	3.52	2.42	0.11
DKI Jakarta	2.62	6.24	0.17
West Java	5.49	3.79	0.05
Central Java	6.52	2.81	0.05
DI Yogyakarta	4.58	1.80	0.03
East Java	5.69	3.17	0.08
Bali	3.10	2.92	0.12
West Nusa Tenggara	4.64	4.00	0.02
South Kalimantan	5.72	4.13	0.09
South Sulawesi	4.88	2.74	0.05

Source: Own elaboration on the Ministry of Finance data.

Table A4. Percentage of government education assistance beneficiaries (by cohort and province)

Year	1999		2006		2013	
Cohort	11–14	15–18	11–14	15–18	11–14	15–18
North Sumatera	1.87	2.42	10.97	6.06	26.00	29.61
West Sumatera	3.29	1.56	8.46	1.43	26.97	29.66
South Sumatera	1.21	1.90	6.59	6.25	12.21	16.00
Lampung	6.87	15.49	35.04	7.81	27.61	23.68
DKI Jakarta	0.55	2.81	11.19	5.56	30.43	20.19
West Java	0.95	4.80	15.32	7.98	16.29	19.43
Central Java	2.30	11.22	17.61	8.82	30.03	27.93
DI Yogyakarta	2.17	11.54	14.85	12.63	31.97	37.78
East Java	3.68	10.80	13.44	11.23	18.50	25.54
Bali	0.00	1.23	12.20	8.33	31.61	25.27
West Nusa Tenggara	5.45	9.09	45.92	16.08	38.00	29.14
South Kalimantan	5.15	16.00	24.00	22.92	4.64	13.58
South Sulawesi	1.55	2.53	5.22	7.69	23.96	24.00

Source: Own elaboration on IFLS data.