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How far the apple falls from the tree: Intergenerational transmission of educational attainment in Indonesia

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ABSTRACT

We use five waves of the Indonesian Family Life Survey (IFLS) to create unique father-son matched data of the male population (aged 25–53). Using this data, we investigate the evolution of intergenerational transmission of educational attainment in Indonesia over time, by ethnicities (six major ethnic groups), and by regions (twelve provinces). To estimate the persistence in education (measured as schooling years of the father as a predictor of schooling years of the son), we use coefficient of correlation and regression coefficient methods. Our results from the regression coefficient suggest that persistence in Indonesia is declined over time. Whereas, the results from the coefficient of correlation reveals no secular trend in education persistence over time. Thus, to understand the reason behind the secular trend in the correlation coefficient we decompose the correlation following Checchi and García-Peñalosa (2008). The decomposed intergenerational correlation shows that although the persistence is declined at the lower-end of fathers' education distribution, it is increased at the top-end of the distribution. Therefore, we argue that the coefficient of correlation should be used with caution while analyzing the education policy particularly the persistence in education. Thereafter, we document the stationary distribution and find the conclusive evidence of non-convergence in educational attainment over time among both, ethnicities and regions.

1. Introduction

Over the last few years, the concept of equal opportunity has become a core subject of every in-depth theoretical and empirical development in economic literature. Unlike the traditional theories that stresses on the outcome of inequality as a change in consumption, wealth, and income, recent literature focuses on equality of opportunity through the prism of circumstances and effort on individual outcomes (Roemer, 1998). Factors for which individuals cannot be held responsible are defined as circumstances such as economic background, birthplace, and ethnic group. Whereas, factors which are variables and can be controlled by individual exertion are categorized as individual efforts. Years of schooling and labor supply decisions are two examples. Roemer (1998) defined that the objective of policy equalizing opportunities is to eliminate the biased opportunities which came into being as an impact of circumstances on outcomes, but those outcomes that are sensitive to the effort. Hence the concept of equality of opportunities is supported by the majority of the policymakers, think tanks, and the general public[1].

One of the key apparatuses to analyze the inequality of opportunities or the welfare of the people in an economy is through intergenerational persistence in economic status. Higher persistence in economic outcomes across generations will aggravate the inequality problem. Persistence may differ across the ethnic groups, genders, and regions. Such a persistence implies the disparity of opportunities among different groups. Thus, policymakers need to quantify the transmission of economic status from one generation to another[2]. Education is a prime determinant of economic success over the longer time horizon and is a pivotal mechanism to social mobility. It is a well-documented fact that parental schooling significantly affects children's schooling (Hertz et al., 2007). But children's educational attainment is also affected by other

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[1] "In policy and political discourse, "equality of opportunity" is the new motherhood and apple pie. In its strongest form, the position is that equality of outcomes should be irrelevant to policy; what matters is equality of opportunity" (Kanbur and Wagstaff, 2014)

[2] Some of the recent studies presents the international evidence on the transmission mechanism of educational attainment, implications of persistence and methodological development in this regard, see, see Azam and Bhatt (2015); Black et al. (2011), and Hertz et al (2007).

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factors like economic resources, ethnic groups, and regions (Azam and Bhatt, 2015; Huang, 2013; Björklund and Salvanes, 2011). Transmission of education from one generation to another, or from parents to children, is considered as a focal indicator of education mobility. Therefore, higher persistence of educational attainment, or lower intergenerational mobility of education, is regarded as an obstacle to opportunities in the labor market (Black et al., 2011).

In this paper, we thoroughly study the intergenerational education persistence in Indonesia and track changes in intergenerational persistence in education across different birth cohorts from as early as 1940 using two widely used measures of educational persistence: a correlation coefficient (ρ) and regression coefficient (β). It is noteworthy that many studies used regression coefficients argued that a "causal relationship" suffers from two major drawbacks. Firstly, they do not account for average schooling across generations. Secondly and more importantly, they do not allow us to analyze the sources of intergenerational mobility with respect to subgroups of population. Checchi et al. (2013) argued that the beta coefficient might decrease in a given cohort but this finding cannot explain that this stems from either compulsory education or upward mobility of educated fathers dominating uneducated fathers. Since our aim in this study is to analyze the effect of different educational attainment categories of the father on son's educational outcomes, we adopted this methodology based on the correlation coefficient which allows us to decompose the demographic sources of mobility. Nonetheless, we put beta coefficients in nation-wide and cohort-wise results for basic comparison between causal and non-causal approach but the focus of our analysis remains on correlation coefficient and decomposition exercise which is non-causal in nature.

Unlike previous studies on this topic, which relied on coresidence to identify father-son pairs, our first contribution is to show bias in persistence when limiting our data to co-residence parents. We observe the trend in correlation estimates was not clear, however, over the period of time, starting from 1941−1945 it was 0.49 but reduced to 0.44 in 1986−1990. This unclarity in the trend of the coefficient of correlation do not exist in regression coefficients which shows clear decline in persistence over 50 years. Thus, in order to understand this discrepancy in the trend, we further focus our analysis on correlation decomposition. Through correlation decomposition we found in some of the education groups, persistence increased remarkably but in other groups it reasonably curtailed. For example, we observed persistence between unschooled fathers and sons declined but for the university education group it increased substantially over time.

Thereafter, we analyzed the six major ethnicities of Indonesia and found higher persistence in bigger ethnic groups in comparison to rest. In particular, we found higher and significant increase in educational persistence for Javanese, Sundanese, and Other Sumatrans. But, in upward mobility Index we observe an increase in all the ethnic groups suggesting an increase in probability that son will attain more education than his father. It is important to note that our findings on ethnicities are only suggestive since IFLS is not ethnicity representative data of Indonesia. Later on, we obtained the stationary distribution for long run probability to attain any particular education level. We observe the existence of long run differential in probabilities such as for Minang probability of university education is 0.65 but for Batak it is 0.52 which shows the existence of inequality among various ethnic groups. This could be due to the fact we observe higher upward mobility for Batak in comparison to Minang. Even from our descriptive statistics, we observe higher educational attainment in Batak for the most recent cohort while comparing it to Minang. This could be due to many reasons but one of the most important reasons is that Batak are treated as native descendants of Indonesia and they have certain advantages regardless of they are less in number and this encourages Batak people to attain higher societal positions via education and jobs (Prasiwi and Susandari, 2015; Ramdani et al., 2015).

Similarly, we add regional dimension to our analysis and we captured the persistence estimates, conditional probabilities and stationary distribution for 12 provinces of Indonesia. We institute, small persistence exists in higher asset holdings regions of Indonesia such as Jakarta, where persistence remains lower than 0.40 overtime. Furthermore, we document in regions with less asset holdings, long term probability suggests that sons are more likely to obtain a university degree in comparison to higher asset holding regions such as Jakarta and South Sumatra.

In last few years, intergenerational mobility has become an active area of research due to the economic implication of persistence between parent's and child's education. The literature on intergenerational and social mobility focuses primarily on income, education and occupational choices. Majority of the empirical evidence pertains to North American or Northern European data, but interest in this issue has increased lately among development economists as well (cf. World Bank, 2005). Hertz et al. (2007) argued that it is not feasible, given the existing data in developing economies, to estimate the intergenerational persistence of permanent income. Thus, they suggested using education as an alternative to study the transmission over generations. One of the key benefits of using education is that it represents more or less permanent characteristics in adulthood. Thus, one of the greatest attempts in this regard is attributed to (Hertz et al., 2007) who analyzed 42 countries with over 50 years of data. They found large regional differences in educational persistence such as Nordic countries shows the least education persistence and Latin America displays the highest education persistence among those 42 countries. They conclude the average correlation between parents' and child's education remains 0.42 in 1920–1980. Likewise, Daude (2011) used the cross-country dataset for 18 Latin American countries and ascertained no significant change in persistence measure.

Indonesia serves as an excellent case study to explore intergenerational mobility for various reasons. Firstly, Indonesian education system often categorized as high volume, low-quality enterprise which could not achieve country's ambition to be internationally competitive (Rosser, 2018). Secondly, It has been well-known for being afflicted by serious ethnic, regional, and other forms of communal conflicts. One of the key examples is brutal ethno-riots after the collapse of the Suharto regime. Though the ethnic hard lining is tamed over the period of time through the policy measures taken by the Government of Indonesia (Aspinall and Klinken, 2011), still ethnic identity remains an important cause of social exclusion in Indonesia. This implies that ethnic identity may affect the labor market outcome as well and as we have discussed earlier that education is a prime determinant of long terms success in to the labor market.

For example, Bennington and Habir (2003) investigated the human resource management in Indonesia and found the existence of ethnic discrimination in the labor market. There are at least 200 ethnic groups, but only four are considered to be significant numerically: Javanese (45 %), Sundanese (14 %), Madurese (7.5 %) and Coastal Malays (7.5 %) (Levinson, 1998). Chinese represents less than 5% of the population but reportedly controls bigger share of economic activity (Tan et al., 2008). This is regardless of the fact that right after the independence in 1945, the Government of Indonesia provided everyone with constitutional rights as mentioned in the constitution of Indonesia (Article, 28D) *"everyone is equal before the law, have right to work and equal opportunities in government."*

Moreover, Indonesia has achieved remarkable growth over the last few decades, but this growth greatly varies across regions. Balisacan et al. (2003) argued that despite of sustained growth over two decades and rise in provincial GDP, the growth-poverty nexus appears strong at aggregate level. However, the picture is entirely different at regional level with the existing regional disparities. They documented the critical factors that are responsible for such disparity and they include infrastructure, technology, and human capital. Hill (2008) found that the growth performance of the resource-rich provinces of Indonesia varied considerably over the period of 30 years. Likewise, thirdly, Inequality of opportunities in different provinces of Indonesia is yet another

important dimension for research. Similarly, India is also a diverse country from an ethnic and regional point of view, thus (Azam and Bhatt, 2015) used the Indian Human Development Survey to document the persistence over time from 1940 to 1985 and they further documented the persistence across ethnicities and regions. Their findings ascertained no decline in persistence estimates, however, conditional probabilities show a shift towards the attainment of higher education. But based on conditional probabilities they do not find evidence of convergence among various ethnic groups. In comparison to their paper, instead of relying on conditional probabilities to observe convergence, we rely on stationary distribution for regions and ethnicities.

Education policy in Indonesia is mainly controlled by the central government under the ministry of education and culture. The Regional Autonomy Law (22 and 25) in 1999, the 2003 Education Law, and subsequent regulations (e-g Government Regulation 38 of 2007) establishes the responsibilities of various levels of government in the provision of education services. The central government keeps its role in formulating education policies, establishing curriculum frameworks, and setting national education standards. The district governments are given responsibility for all primary and secondary education organizations, appointment and placement of teachers, the authority to establish new schools and maintain registration of existing schools.

Twelve years of education is compulsory for everyone; however, private education institutions operate parallel to public institutions. In the early' 70 s, the Government of Indonesia started a massive school expansion program throughout the country due to which enrollment rate share of a private school at the primary level and secondary level is over 10 % and 18 % since 2000, respectively. The objective of this policy was to reduce the education differential among the various regions and provide an equal opportunity of education to everyone in Indonesia. In this regard, Hertz and Jayasundera (2007) investigated the policy outcome of school expansion programs on intergenerational mobility in Indonesia. They documented that higher mobility is attributed to the exposure to new schools under this policy by younger cohorts whose fathers are educated. However, they used only one wave of Indonesian Family Life Survey (IFLS) and their research design and objectives are different from this study. Their study focuses on the impacts of school expansion program and this paper focuses on decomposition and long run evolution of persistence.

Even though it has been argued here earlier, but understanding the issue of intergeneration mobility from the mentioned perspective is important in Indonesia and this has received relatively less attention mainly due to the availability of suitable data. In the absence of longitudinal panel data, the majority of the studies focused on those household members who coreside with their parents. This restriction significantly reduces the observations and generates a serious sample selection issue, because the distribution of both generations' education is different i.e. who lives with parents might attain higher education in contrast to those who are living outside. Alternatively, it can be argued as well, in order to acquire higher education sons do relocate to other place like big cities or abroad, thus, they obtain more education than parents.

We discuss this issue in the data section after limiting our sample to coresiding household members, which amounts to only 35 % of the observations in the data. The sample-based on coresidence restriction does not allow us to perform the cohort wise analysis and long-term trend in intergeneration transmission because such as condition will only be satisfied for younger adults (Azam and Bhatt, 2015). We focus our analysis on sons due to early marriages and relocation of daughters with lower tracking rate. Additionally, men are considered breadwinners for the family due to their stereotypical roles in a traditional society and developing country like Indonesia, thus, analyzing the inequality of opportunities for breadwinners is even desirable from research perspective. Although, we performed the analysis for daughters as well and we observed the similar results, thus, in the interest of brevity we present the results for sons' sample.

2. Analytical framework

Intergenerational transmission of education is captured by the following regression:

$$S^S_{i,c} = \alpha + \rho S^P_{i,c} + \varepsilon_{i,c} \tag{1}$$

S^S_i represents the years of schooling of male individual i belonging to cohort c, whereas, S^P_i is the years of schooling individual i' s parent. Years of schooling for parents and son are both normalized to have a standard deviation of 1. We construct matched father-son samples and run the estimation by the cohort of the son separately in each sample. We consider 10 cohort groups: 1941–1990 for our nation wide analysis but for ethnicity and regions we consider 3 cohort groups: 1946−1990. For brevity, we focus our discussions on the results from the father-son sample.[3]

The coefficient ρ is the parameter of interest and the ordinary least square estimate of ρ is interpreted as a measure of intergenerational persistence of educational attainment. Moreover, changes in ρ not only captures father-son education transmission but a different phenomenon such as the secular rise in schooling and changes in compulsory education. Thus, changes in ρ may reflect changes in the education policy among other things, therefore, it is referred to as an absolute measure of intergenerational transmission of education. The correlation coefficient can be re-written as:

$$\rho = \int \underbrace{(S^S_i - E(S^S_i))(S^P_i - E(S^P_i))}_{A}\underbrace{P(S^S_i|S^P_i)}_{B}\underbrace{P(S^P_i)}_{C}. \tag{2}$$

Consequently, as shown in term (A) of the above equation, the correlation coefficient can change over time because of dispersion of son's and parent's education (standardized) around their respective means, or because of educational attainment of sons condition on the parents education (conditional probability) as shown in term (B) and term (C), which is unconditional probability of parent's education. In order to investigate the stability of coefficient of correlation, we further decompose the correlation coefficient by using the empirical analogue of Eq. (2).

$$\widehat{\rho} = \sum_{S^S}\sum_{S^P}\underbrace{(S^S_i - E(S^S_i))(S^P_i - E(S^P_i))}_{A}\underbrace{P(S^S_i|S^P_i)}_{B}\underbrace{P(S^P_i)}_{C} = \sum_{S^S}\sum_{S^P} r_{S,P} \tag{3}$$

where $S^S, S^P \in \{0,\ 1,\ 2,\ \cdots,\ 16\}$ representing a maximum of 16 years of schooling, and thus $\widehat{\rho}$ for each cohort is the sum of 289 elements. In the empirical literature, it has been argued that change in term A could be attributed to convergence towards higher level of education (Azam and Bhatt, 2015), thus, since the term B shows the changes in sons' education conditional on the education of their fathers, it can be tracked by policymakers. For example, decreasing of the term signals that policies enforcing schooling improve equality of opportunities. Moreover, with the passage of time, the country develops and if education is a normal good, one can expect an increase in the educational level of parents across generations. Term C represents the changes, which are independent of fathers' education. It is related with the development and institutional infrastructure of a country (Checci, Firorio & Leonardi, 2013). Now we focus on conditional probability (term B) as shown in Eq. (3) to obtain the decomposed conditional probability.

With the conditional probabilities, $\Pr(S^S_i|S^P_i)$, we construct two indices for upward and downward mobility respectively. The reason these indices rely on the conditional probabilities (term B's) is that they purely capture the probability that a son obtains the educational level above (or below) his father. For $t, j \in \{0, 1\ldots, E\}$, The upward mobility

[3] We obtain similar results from the mother-son sample, which we can provide upon request.

Table 1
Descriptive statistics nation wide.

Cohorts	Father's Years of Schooling	Son's Years of Schooling
1941–1945	5.48	7.17
1946–1950	6.06	7.70
1951–1955	6.39	8.03
1956–1960	6.52	8.10
1961–1965	6.76	8.72
1966–1970	6.96	9.44
1971–1975	7.26	9.71
1976–1980	7.52	10.34
1981–1985	7.55	10.58
1986–1990	7.57	10.70

Source: Author's calculation from IFLS (Notes: We calculated cohort wise average years of schooling for both fathers' and sons' distribution by using all five wave of Indonesian Family Life Survey).

index is defined as

$$\sum_{j>t} pr(S_i^S = j | S_i^P = t) \tag{4}$$

and the downward mobility index is defined as

$$\sum_{j<t} pr(S_i^S = j | S_i^P = t). \tag{5}$$

The upward mobility index basically represents the cumulative sum of conditional probability that a son attains higher education in comparison to his parents. Whereas, the downward mobility index is the cumulative sum of a son attaining less education than his parents.

Lastly, we built 5-by5 transition matrices based on regrouped years of schooling into five different categories of education attained such as no schooling, primary, middle, senior high and university. To keep the analysis precise, we focused on educational attainment categories here instead of years of schooling. We compute the long-run stationary distribution over educational outcomes implied by these transition matrices to assess the possibility of long-run convergence.

3. Data

We used all five waves of the Indonesia Family Life Survey (IFLS) from 1993 to 2014. The IFLS is an ongoing longitudinal survey of Indonesia, which is representative of over 80 % percent of the Indonesian population and contains 30,000 individuals living in 13 provinces. It contains a wealth of information on education, ethnicity, geographic location, consumption, labor supply, income, migration, and health of the household. Although, IFLS is a rich dataset in terms of covariates which could certainly strengthen the analysis but our father-son matching is unique in a way that we created it. For example, we used different data files related to the available information about parents, children, and siblings to construct this matching but not all the information about the covariates are consistently available in all the files. Thus, adding covariates would reduce our sample size for this unique father-son matching. This is the reason many studies including (Aydemir and Yazici, 2019; Azam and Bhatt, 2015; Checci, Firorio & Leonardi, 2013) model this relationship without any covariates. Our sample includes those who were between the ages of 25 and 53 during the five waves of IFLS, therefore, our sample was born between 1941 and 1990. It is important to note data limitation occurs when surveys are limited to co-residing households. Fortunately, IFLS allows us to track the non-coresiding household member, therefore, we do not suffer with potential bias in the estimates.

Francesconi and Nicoletti (2006) studied 11 waves of the British Household Panel Survey (BHPS) and investigated occupational prestige. They used coresident data and argued the existing bias in persistence estimates for occupational prestige if one rely upon coresident parents because such a condition is more likely to be satisfied for young adults who live in the same household. Thus, they captured the bias in intergenerational elasticities and it was 12%–39% as identified by the parent-child pairs only on coresidence information. When we restrict the data to coresident pairs, we observed that 65 % of the observations dropped in both father-son and mother-son samples. We have performed the same analysis on the mother-son pairs as well but in the interest of brevity in this paper we focus on father-son pairs. This could be the reason that our estimates also differ in both full and coresident samples as in Table 1 we observe that our intergenerational elasticity estimates are underestimated when imposing the coresident condition. Therefore, it is the advantage in IFLS that it enables us to make father-son and mother-son pairs without being contingent on children residing with parents. Head of the household or any other householder over 18 years of age is asked to provide the information on non-co-residing house members deceased or alive. Information on education, sex, birth year is collected for three types of non-co-residing household members which include parents, siblings and children.

Unlike Azam and Bhatt (2015), we are able to track non-coresiding fathers, children and siblings as well over five waves which cover over 21 years of data, and all this makes our sample bigger and interesting. By tracking the siblings and children we matched the information with the father dead or alive. This enables us to track almost all the members associated with house whether living in or out of the house and make father-son pairs. This certainly increases the predictive power of our estimates. Moreover, when it comes to years of schooling, it is not readily available, the common estimation strategy is to replace the level of attained education by the number of regular years needed to obtain (Black and Devereux, 2010). Fortunately, IFLS allows us to impute years of schooling based on two questions *(AR16 and AR17)* which clearly asks the respondents about highest level of schooling attended and whether they have graduated from that level or not, if not then how many years they spent in that particular level. In addition to this, IFLS further provides us information on ethnic affiliation (DL01) and residence status (SC01) due to which we are able to capture the ethnic and regional dimension concerning persistence in education. Although, IFLS data is not designed to be a representative of ethnicities but still it helps to provide some important insights about various demographics and existing inequality between different ethnicities present in IFLS. Thus, we put our estimates concerning major ethnicities in Indonesia in Appendix A and this objective can be investigated further in the future with help of ethnicities representative data.

For region-wise estimates, IFLS is a representative of the 13 original IFLS provinces in 1993, collectively (the population of which constituted of 83 % of Indonesia in 1993). The cross-sectional weights constructed in each wave help bring it back to be representative- of the original provinces for that particular year. The end result is a weight that makes the IFLS of each round representative of 13 original provinces and one needs to exclude the households located outside the original provinces and combine the post-1993 split provinces. We have done this exercise which makes our key variables close to SUSENAS but for later rounds regardless of adjusting for over and under-sampling, the representation issue remains which makes it problematic to use IFLS for province-level comparisons. We have tried to address this issue by separately using the first wave of IFLS which is the provincial representative of Indonesia in 1993 as a robustness check for the entire analysis using all five waves. We outline our results for provinces from wave 1 in Appendix-B Tables B1 and B2.

We have presented our descriptive statistics related tables in Tables and Figures section. In Table 1 we have descriptive statistics showing nationwide average years of schooling over ten successive cohorts. Here we see a clear increase in average years of schooling for all sons and fathers over time. Average years of schooling among Indonesians above the age of 25 doubled since 1980 (EDUCATION SYSTEM PROFILES, 2019) we observe the similar trend in our data as well. We have used broad categorization for cohorts in ethnic and regional dimension because in older cohorts for some of the ethnic groups we

Table 2
Intergenerational persistence in education attainment, full sample versus coresidence sample.

Father-Son Pairs	Full Sample	Coresident Sample
Father's years of schooling ($\widehat{\rho}$)	0.49** (0.004)	0.53**(0.007)
Father's years of schooling ($\widehat{\beta}$)	0.52** (0.004)	0.47**(0.006)
R^2	0.222	0.262
observation	41,275	14,518
S.D in Son's Years of Schooling (σ_s)	4.007	3.647
S.D in Father's Years of Schooling (σ_f)	3.767	4.125
σ_s/σ_f	1.063	0.884
$\chi^2 = 229.37$ with p value = 0.000 for equality of ($\widehat{\rho}$) in both samples.		
$\chi^2 = 416.61$ with p value = 0.000 for equality of ($\widehat{\beta}$) in both samples		

Robust standard errors in parentheses.
** p < 0.01, * p < 0.05, + p < 0.1.

have low observations. Thus, using fifteen years cohorts we are able to address this issue.

4. Empirical results

This section presents our empirical results. We first present our findings for pooled sample and then we present cohort wise intergeneration persistence in educational attainment, at aggregate level, by major ethnicities and by major provinces in Indonesia.

4.1. Intergenerational educational persistence in Indonesia

We outlined our pooled results in Table 2, where in two different columns we show our estimates for full sample and coresident sample. As argued earlier, one of the major benefits of using IFLS is that it enables us not to be contingent on parents residing with child. So in order to illustrate the consequence, we exploited this data restriction to co-resident households and found that only 35 % of the observations were present in coresident sample in contrast to full sample. In addition to this, we compare two measures of the persistence of intergenerational education attainment: the regression coefficient $\widehat{\beta}$ and the coefficient of correlation $\widehat{\rho}$. The discrepancy between beta and correlation coefficients is evident in Table 2 for our nationwide results. Moreover, in the same table, we observe the differences in the estimates when imposing the coresident condition which validates the finding of Francesconi and Nicoletti (2006) as we see that the restricting data to co-residents created a downward bias in intergenerational elasticity estimates.

The value of the regression coefficient is 0.47 and the correlation coefficient is 0.53 for the coresident sample which implies that regression coefficients are roughly 6% lower in the coresident sample. Whereas, the value of regression coefficient is 0.52 and correlation coefficient is 0.49 in the full sample which means correlation coefficients are 3% lower in the full sample, which is also consistent with previous work by Azam and Bhatt (2015). The differences we observe are statistically significant as suggested by joint equality test. It is also evident that standard deviation in son's years of schooling is higher in full sample, whereas in co-resident sample it significantly low, whereas the opposite is true for standard deviation in father's years of schooling. Ratios of standard deviations are much smaller in co-resident sample, which causes the estimated correlation to be much closer in both samples.

Moreover, we found those sons who coreside with their parents have significantly higher persistence in comparison to entire sample. As discussed earlier when limiting data to coresidents we are more likely to analyze the young adults, therefore, it can be argued over time for attainment of higher education children moves out or relocate to other cities or countries. Thus, in our case we infer, when we limit the data to coresidents we are more likely to analyze the young children where education attainment is similar to their parents. Hence, we observe higher persistence in the coresident sample as we document 4% overestimation in correlation estimates. We have also performed the joint equality test and it suggests that estimates from both samples are not the same. Therefore, it is right to argue about the existing bias in estimates from coresident sample.

4.2. Nationwide cohort analysis of intergenerational education mobility in Indonesia

In Table 3, we further analyze the pooled sample with 10 distinct cohorts to capture the change in persistence over time. Interestingly, starting from 1941–1990, except for three cohorts between 1951–1965 we observe a visible overall decline in intergenerational elasticity estimates but an unclear trend in the coefficient of correlation estimates especially in the middle cohorts starting from 1960 to 1980. On the whole, we document persistence estimates decline in the context of the correlation coefficient from 0.49 to 0.44 which means 5% decline in 50 years, and for intergenerational elasticity estimates, we observe 19 % decline. But we do not observe any secular trend in the coefficient of correlation since time variation is not clear. A joint equality test of coefficients rejects the null hypothesis that the coefficients are constant across cohorts. This implies, while there is no secular trend in the intergenerational transmission of education from father to son over time, there are significant swings. As we show next in the decomposition

Table 3
Cohort wise mobility estimates.

Variables	1941–1945	1946–1950	1951–1955	1956–1960	1961–1965	1966–1970	1971–1975	1976–1980	1981–1985	1986–1990
$\widehat{\rho}$	0.495** (0.023)	0.418** (0.021)	0.417** (0.017)	0.408** (0.015)	0.425** (0.012)	0.434** (0.010)	0.455** (0.010)	0.524** (0.011)	0.494** (0.012)	0.443** (0.014)
$\widehat{\beta}$	0.601** (0.028)	0.577** (0.029)	0.560** (0.023)	0.556** (0.020)	0.564** (0.016)	0.527** (0.012)	0.496** (0.011)	0.510** (0.011)	0.456** (0.011)	0.413** (0.013)
σ_s	4.253	4.085	3.938	4.008	4.090	3.840	3.621	3.633	3.428	3.646
σ_f	3.498	2.956	2.927	2.944	3.086	3.170	3.315	3.7367	3.712	3.917
R^2	0.235	0.184	0.175	0.174	0.190	0.206	0.219	0.274	0.240	0.194
Observations	1562	1855	2740	3714	4787	5755	5980	4936	5406	4507

χ^2 = 82.21 with p value = 0.000 for equality of.
($\widehat{\rho}$) in all cohorts.
χ^2 = 115.61 with p value = 0.000 for equality of.
($\widehat{\beta}$) in both samples.
Robust standard errors in parentheses.
** p < 0.01, * p < 0.05, + p < 0.1.

Table 4
Decomposed correlation.

Decomposed ρ	1941–1945	1946–1950	1951–1955	1956–1960	1961–1965	1966–1970	1971–1975	1976–1980	1981–1985	1986–1990
Father: No Schooling										
Son: No Schooling	0.208	0.139	0.101	0.089	0.076	0.047	0.024	0.025	0.026	0.034
Son: Primary	0.100	0.095	0.093	0.080	0.070	0.089	0.083	0.112	0.099	0.091
Son: Middle	−0.004	0.000	0.000	0.000	0.003	0.004	0.007	0.015	0.019	0.015
Son: Senior High	−0.016	−0.015	−0.020	−0.009	−0.012	−0.013	−0.014	−0.009	−0.008	−0.011
Son: University	−0.017	−0.012	−0.007	−0.013	−0.005	−0.004	−0.004	−0.007	−0.011	−0.010
Percentage of Group Contribution to Correlation	55.0 %	49.5 %	40.1 %	36.3 %	31.1 %	28.3 %	21.1 %	26.1 %	25.4 %	27.0 %
Father: Primary										
Son: No Schooling	−0.004	0.001	0.004	0.006	0.011	0.009	0.007	0.005	0.005	0.009
Son: Primary	−0.023	0.011	0.036	0.045	0.069	0.083	0.103	0.095	0.086	0.078
Son: Middle	0.002	0.000	0.000	0.000	0.004	0.011	0.018	0.023	0.034	0.033
Son: Senior High	0.012	−0.005	−0.019	−0.024	−0.034	−0.040	−0.044	−0.032	−0.034	−0.030
Son: University	0.016	−0.006	−0.018	−0.019	−0.025	−0.026	−0.027	−0.026	−0.027	−0.034
Percentage of Group Contribution to Correlation	0.6 %	0.2 %	0.7 %	2.0 %	5.9 %	8.5 %	12.5 %	12.5 %	13.0 %	12.7 %
Father: Middle										
Son: No Schooling	−0.006	−0.005	−0.002	———	−0.001	−0.005	−0.002	−0.001	0.000	−0.001
Son: Primary	−0.008	−0.009	−0.018	−0.012	−0.013	−0.009	−0.009	−0.007	−0.006	−0.005
Son: Middle	0.002	0.000	−0.001	0.000	−0.002	−0.007	−0.006	−0.004	−0.004	−0.003
Son: Senior High	0.033	0.031	0.034	0.023	0.021	0.021	0.018	0.009	0.010	0.007
Son: University	0.039	0.039	0.047	0.040	0.032	0.025	0.022	0.020	0.017	0.012
Percentage of Group Contribution to Correlation	12.2 %	13.4 %	14.4 %	12.6 %	8.7 %	5.8 %	5.1 %	3.3 %	3.5 %	2.3 %
Father: Senior High										
Son: No Schooling	———	———	———	−0.002	−0.002	−0.004	−0.003	−0.001	−0.003	−0.008
Son: Primary	−0.008	−0.007	−0.011	−0.011	−0.009	−0.010	−0.017	−0.009	−0.012	−0.016
Son: Middle	0.002	0.000	0.000	0.000	−0.003	−0.005	−0.006	−0.007	−0.008	−0.006
Son: Senior High	0.040	0.041	0.044	0.042	0.041	0.045	0.044	0.032	0.030	0.026
Son: University	0.089	0.071	0.093	0.095	0.093	0.098	0.098	0.113	0.106	0.096
Percentage of Group Contribution to Correlation	24.9 %	25.1 %	30.3 %	30.6 %	28.2 %	28.6 %	25.5 %	24.6 %	23.0 %	20.9 %
Father: University										
Son: No Schooling	———	———	———	−0.002	———	———	———	−0.001	−0.003	−0.007
Son: Primary	−0.003	−0.001	−0.002	−0.003	−0.002	−0.002	−0.002	−0.006	−0.005	−0.012
Son: Middle	0.001	0.004	0.007	0.003	−0.004	−0.004	−0.001	−0.001	−0.003	−0.005
Son: Senior High	0.010	0.006	0.011	0.015	0.014	0.012	0.021	0.013	0.015	0.012
Son: University	0.028	0.040	0.044	0.062	0.103	0.119	0.145	0.170	0.169	0.176
Percentage of Group Contribution to Correlation	7.3 %	11.7 %	14.4 %	18.5 %	26.1 %	28.8 %	35.8 %	33.6 %	35.2 %	37.2 %
Correlation coefficient	**0.493**	**0.418**	**0.416**	**0.405**	**0.425**	**0.434**	**0.455**	**0.521**	**0.492**	**0.441**

Notes: Years of schooling is grouped to refer to attended stages of schooling. No schooling: 0 years; Primary: 1–6; Middle: 7–9 years; Senior High: 10–12; and University: 13 years or more.

exercise of the correlation coefficient, the lack of secular trend in the transmission masks differences in what is driving the correlation in older versus younger cohorts. Therefore, following section is related with counteraction forces of correlation coefficient which beta coefficient cannot deepen. To do this, we decompose the correlation coefficient and obtain conditional correlations which shows extent to which a child's education is affected by father's education as given. We also estimated this coefficient for regions and obtained upward and downward mobility indices.

4.3. Correlation decomposition

We decompose the correlation to investigate the liable factors underlying the trend of the estimates of persistence, according to Eq. (3). In Table 4, we present the results. For this exercise, we group years of schooling into five distinct education attainment categories: no schooling, primary, middle, senior high and university education. In the decomposition table, we put the correlation between the educational attainment of sons' condition on their father's education group. For instance first group in the table shows the correlation of unschooled fathers with all five education attainment categories of sons.

The last row of Table 4, titled "Correlation coefficient," corresponds to $\sum_{S^s}\sum_{S^p} r_{S,P}$, which is the correlation coefficient estimated by cohort. Every row in this table corresponds to $r_{S,P}$ as stated in Eq. (3) it is a component of the correlation coefficient linking sons' education while holding to parent's educational category constant and sum of all the rows gives us a decomposed estimation correlation which is equal to our persistence estimates in Table 2.[4] For every category of father's education we obtained the group contribution of that category to the total correlation. It is interesting to see group contribution of fathers with no schooling declined over the period of time. As we observe in the first cohort unschooled fathers were contributing 55 % to the total correlation which reduces to 27 % in the last cohort. In fact, to shed light on the study of Akresh et al. (2018) further, we can see from this decomposition

[4] In Table 2 we used years of schooling to capture the educational persistence but in Table 3 we used 5 education categories to obtain the decomposed persistence estimates, thus we observe small differences in the estimates because of this difference.

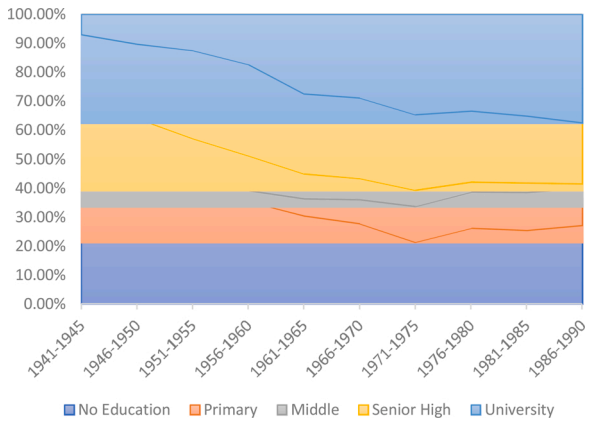

Fig. 1. Transmission Rate (father to son).

exercise that the 1973 school construction program had a strong negative intergenerational effect on 1966–1970 and 1971–1975 cohorts with uneducated fathers. The probability of having an uneducated son in these periods declined significantly compared to previous periods. Contrary, the probability of having a primary degree of a son with an uneducated father increased in these cohorts. In later cohorts, the probability of having middle or senior high level with same level father slightly declined. This may be explained that the construction program has lagged effects on post-primary education. But on the other hand, we see this decline is compensated by the group of fathers with university education which was 7% in the first cohort and increased to 37 % in the last cohort. Thus, the steady trend in correlation coefficient we estimate by cohort in Table 3 reflects two countervailing forces. While the major contributor to intergenerational persistence in educational outcomes comes from unschooled fathers in older cohorts, in younger cohorts the persistent is mainly driven by fathers with university education.

To make it clearer, we plot in Fig. 1, the computed the percentage of group contribution to the coefficient of correlation from the same education category of father-son pairs. Hence we call it transmission rate, by transmission we mean the flow of same education attainment from fathers to sons. In Fig. 1, it is evident that the fathers with a university education were transmitting less than 8% of their education to their sons but this increases to 37 % in the last cohort. However, another major change occurred for unschooled father's education transmission to their sons where we see the transmission rate decline from 54 % to 27 % over the all ten cohorts. The third major change in transmission rate is evident from fathers with primary education which started with less than 1% in the oldest cohort to 12 % in the youngest cohort.

We extended the analysis further by obtaining the term B in Eq. (3) which is the conditional probabilities of son achieving various levels of educations. Checchi and García-Peñalosa (2008, 2013) discussed that term B in Eq. (3) is the correct measure for examining the transmission of education. To summarize their story, a system will achieve the equality of opportunities if the probability of attaining a particular degree for the son was independent of the father's educational achievement. In the last panel of Fig. 2, we see a major decline in the probability of a son achieving no education given father is unschooled. This proves the universalization of education towards a higher level as it can also be seen in the first panel as well. Whereas the probability of a son achieving university education increases given father is having a university education.

In Fig. 3, we plot the stationary distribution by cohorts. First, we construct the transition matrices and later we solve them in order to obtain stationary distribution. For each cohort, we have a 5×5 matrix corresponding to 5 stages of education attainment for son and father. Here it is evident that we do not observe the long-run convergence but probability suggests the substantial decline in the first three education stages over the period of time. Here we observe the distribution of educational attainment clearly improves for younger cohorts, since we more masses in university education and fewer masses in primary or middle. This can be explained as an implication emerging from education policies in Indonesia as we document the evidence that long-run probability for the attainment of university education increased and a clear decrease in no-schooling, primary and middle stages of education.

4.4. Cohort analysis over regions

For region-wise analysis, first, we plot various characteristics and indicators in order to understand the existing regional differences in Indonesia. Indonesia has 34 different provinces of Indonesia and 8 of which are created in 1999. Thus, to avoid the split off issue we rely on 12 provinces consistently covered in IFLS out of 13. In Fig. 4 we plot the percentage of the population in IFLS residing in the concerned provinces. We found an extremely skewed concentration of population in some of the regions such as 19 % of the observations belongs to West Java, 12 % from Central Java and 9% from Jakarta. Moreover, in Fig. 5 we plot region-wise total asset holdings (in USD) using all five waves of IFLS. We define asset as sum of reported value of house, other physical asset and financial assets such as receivables, bonds etc. There we observed highest asset holdings are in Jakarta followed by Bali and West Nusa Tenggara stands last among the concerned regions. We computed the average asset holdings to better understand about wealthier and least wealthy regions. This enables us to observe how the educational persistence evolves in these regions. Thus, to maintain the brevity and to better visualize the result for stationary distribution we kept our analysis limited to Jakarta, two medium asset holding regions like South Sumatra and Yogyakarta, and the region with the least asset holdings which is West Nusa Tenggara.

In addition to this, we outline the computed years of schooling for concerned regions of Indonesia in Table 5. There we observe 8.97 average years of schooling for fathers in Jakarta which is the highest in among all the regions in the most recent cohort. Whereas, in Bali we observed 7.38 years of schooling which is least among all the regions in the most recent cohort. It is surprising to see in a region like Yogyakarta, where average asset holding is lesser than Jakarta and Bali, we observe remarkable progression in years of schooling for sons. In fact, highest average years of schooling are 12.26 years in the most recent cohort.

We estimate the educational persistence for each region using 3 cohorts with fifteen years gap starting from 1946 and ending in 1990. As we have mentioned earlier in the data section that only the first wave of IFLS is actually representative of the provincial population originally covered in IFLS. For the later-rounds representation remains a contentious issue so we have performed our analysis by using all five waves and only first wave separately as a robustness check. In Table B1 we present our estimates for provinces by using first wave only and while doing this exercise we keep in our mind that we will have a lower number of observations, so, some of our estimates may be imprecisely estimated relative to our main results. Table B2 shows the direction of estimates over regions in different cohorts by using all five waves and first wave only. It was really interesting to see for the majority of provinces (except three provinces where we observe the different direction of estimates across cohorts) we observe the similar direction of estimates across all three cohorts.

Table 6 shows the results for this objective and it is evident that persistence estimates vary substantially among all the regions for all the cohorts; although, just like our estimates in ethnicity analysis we observe somewhat unclear trends in some of the regions. But in some regions like North Sumatra, Jakarta, West Nusa Tenggara, and Yogyakarta we document a significant increase in persistence over time. It is interesting to document an increase in persistence in the highest asset holding and lowest asset holdings regions of the country. This raises important questions about existing inequality in these regions or why these two regions behave similarly when it comes to persistence in education. In the rest of the regions, we do not observe a clear trend in persistence

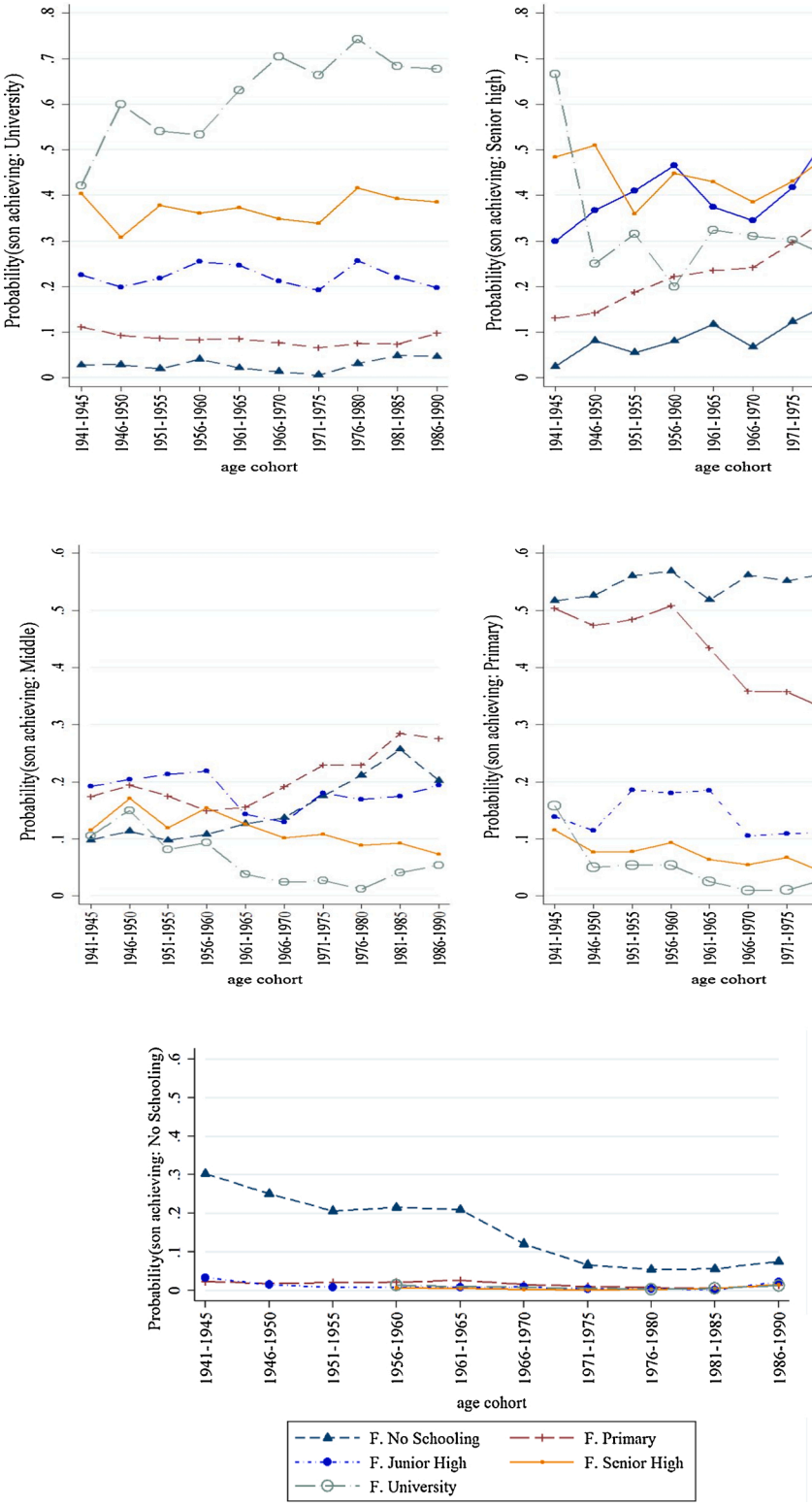

Fig. 2. Probability of son attaining various levels of education conditional on father's education.

estimates. We have also presented our estimates from first wave by keeping in mind that we will have a lower number of observations, so, some of our estimates may be imprecisely estimated relative to our main results. It was really interesting to see for the majority of provinces (except three provinces where we observe the different directions of estimates across cohorts using all 5 waves and only first wave) we observe the similar direction of estimates across all three cohorts.

Thereafter we plot the upward and downward mobility index constructed from Eqs. (4) and (5) respectively. As we can see in Fig. 6, again observe reduced margins between the probability of different regions that son will achieve higher education than his father in 1961−1975. Although, we do not observe a close convergence here but overtime for all the regions we see a positive trend in the upward mobility index except West Nusa Tenggara. In Fig. 7, we see an increase in downward

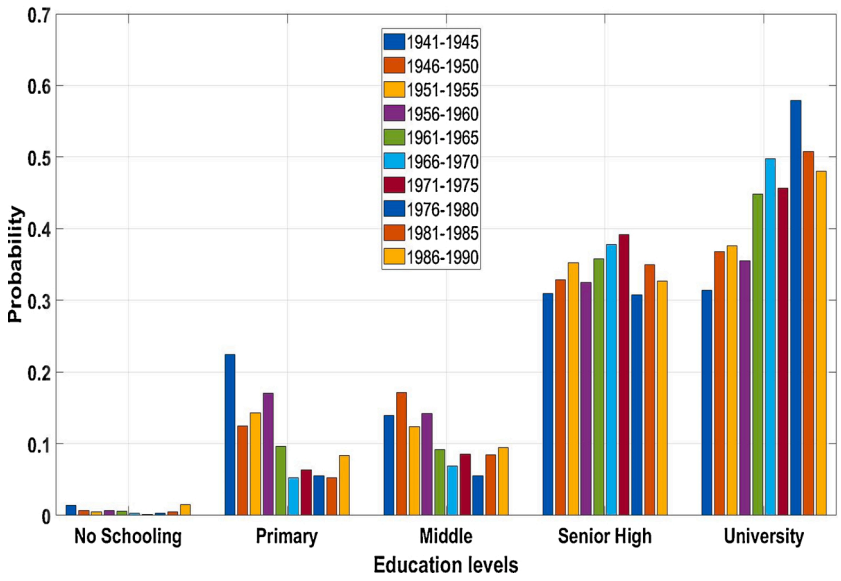

Fig. 3. Stationary Distribution Plot over Cohort.

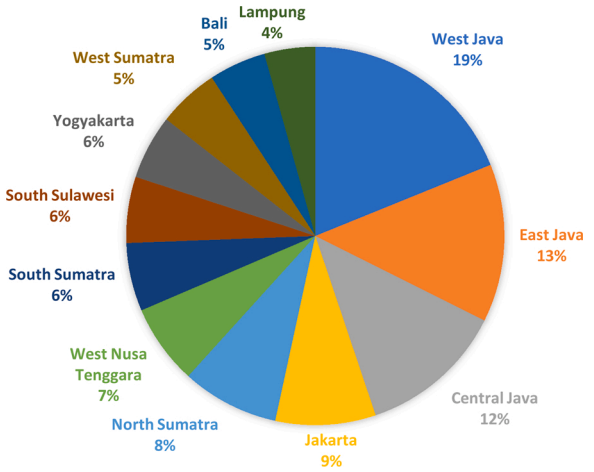

Fig. 4. Region wise population percentage.
Source: Author's calculation from IFLS (Notes: We calculated percentage of population distribution by province using all five wave of Indonesian Family Life Survey).

mobility for North Sumatra but again we observe the change in middle cohort and it eventually declined. Similarly, for Central Java we observe a steep decline in downward mobility after 1961−1975. Regardless of differential patterns, it can be argued we observed an overall decline in downward mobility for all the regions.

Lastly, as discussed earlier we obtained the stationary distribution for four different regions. This classification is based on what we observed in the data so we picked one region which has the biggest asset holdings, two mid asset holding regions and last one is the least asset holding region. In Fig. 8 we plot our stationary distribution results. In Jakarta we conclude there is not much variation about the probability of attaining university or higher secondary education from 1946−1960 and 1975−1990. However, in the middle cohort we observe a substantial increase in the chances of attainment of university education and a decline in senior higher secondary education. In Yogyakarta and West Nusa Tenggara, we observe a noteworthy increase in stationary distribution over time suggesting higher rate that son will achieve university education in long run in comparison to the rest of the regions. Furthermore, we observe the shift in the stationary distribution for all education stages for instance we found in all the regions chances are higher that son will achieve university education, and the trend for no schooling, primary and middle declines over time. Although, we found similar variations in different regions but it cannot be argued as convergence across regions.

5. Conclusion

In this paper, we thoroughly investigate the long-term persistence of education attainment in Indonesia. We exploit the long panel of IFLS and document the educational persistence and contributed to the literature by decomposing the correlation followed by an attempt to investigate the long-run convergence with the help of stationary distribution. Using IFLS enabled us to track 41,275 father-son pairs which certainly increases the reliability of our estimates. In addition to this, IFLS enabled us to observe the evolution of historic differential in years of schooling by ethnicities and by regions.

We investigate the educational persistence in Indonesia with three different objectives. First, we capture the degree of education persistence in Indonesia without adding a time dimension. We compared two different samples and found those sons who co-reside with their parents have a significantly higher coefficient of correlation in comparison to the entire sample which implies higher persistence in the coresident sample. Thus, we document 4% overestimation in correlation estimates for the coresident sample of IFLS. We further analyze the pooled sample with 10 successive cohorts to capture the change in persistence over time. From 1941–1990, we do not find a clear time trend in the coefficient of correlation estimates. However, after decomposing the correlation of coefficient estimates, we uncover that the correlation at the lower end of fathers' education distribution is offset by the increase at the top end of fathers' education distribution. More specifically, the correlation between unschooled fathers to unschooled sons decline from 0.20 to 0.03 in 50 years but on the other hand, the correlation between the university education group of fathers and sons increased from 0.02 to 0.17. In other words, the general trend of the correlation coefficient masks two opposite time trends of correlation between the least educated fathers and their sons and the most educated fathers and their sons.

Our results have noteworthy implications for policy in Indonesia. For instance, the decline in persistence at the lower end of fathers' education shows that public education is progressively able to compensate for the lack of education inputs in the family. We also document the significant

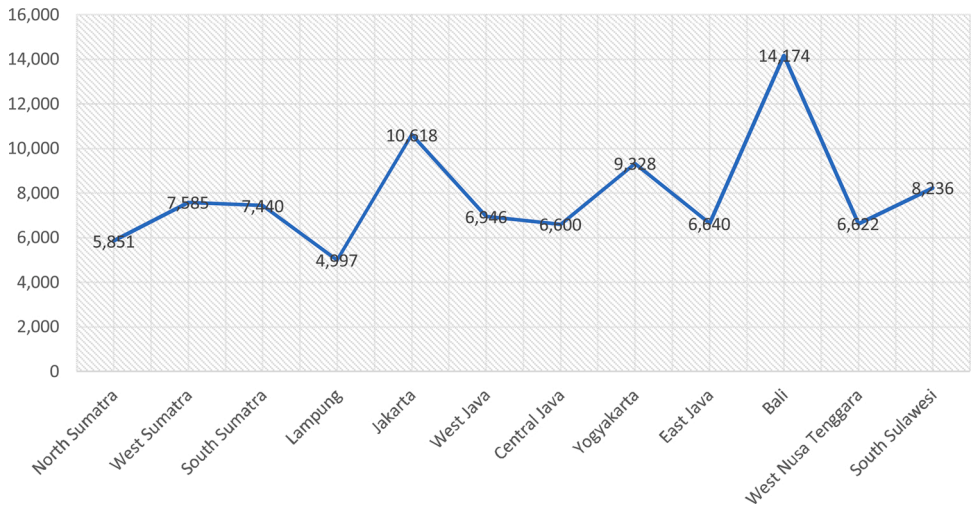

Fig. 5. Region wise average asset holdings (in USD).
Source: Author's calculation from IFLS (Notes: We calculated average asset holdings by regions using all five wave of Indonesian Family Life Survey).

differences in attaining various levels of education for sons conditioning on father's education especially for higher secondary or above. From conditional probabilities, we can see the policies which are able to transport those sons of less-educated fathers to advanced level of education are not able to move those sons to advanced level where fathers have higher education. For instance, if the father has senior higher secondary education, the probability son will have a university education remains constant. Our findings are in line with some of the international evidence such as for Canada (Latif, 2019), Latin America Region (Neidhöfer et al., 2018), India (Azam, 2016), Australia (Ranasinghe, 2015) and South Africa (Kwenda et al., 2015). Though governments of these countries have managed to reduce the persistence in primary to tertiary education, but university education has higher persistence to parent's education for various reasons. However, these studies point to economic performance and public spending in education is a key to accelerate the mobility of younger cohorts to a college degree. In this sense, income inequality, poverty, economic growth, and assortative mating are determinants to explain cross-country differences of educational persistence at the top end of education distributions (Neidhöfer et al., 2018).

Table 5
Region wise descriptive stats.

Father-Son Sample			
Regions	1946–1960	1961–1975	1976–1990
West Java			
Father's Years of Schooling	7.05	7.33	7.56
Son's Years of Schooling	8.14	9.27	10.15
Central Java			
Father's Years of Schooling	6.19	6.60	7.08
Son's Years of Schooling	7.54	8.74	10.18
North Sumatra			
Father's Years of Schooling	6.75	7.22	7.68
Son's Years of Schooling	8.51	9.73	10.94
Jakarta			
Father's Years of Schooling	7.22	7.96	8.97
Son's Years of Schooling	9.51	10.63	11.88
South Sulawesi			
Father's Years of Schooling	5.30	6.47	7.32
Son's Years of Schooling	6.59	8.63	10.10
Lampung			
Father's Years of Schooling	5.92	6.18	7.17
Son's Years of Schooling	7.17	8.44	9.76
South Sumatra			
Father's Years of Schooling	6.96	7.22	7.99
Son's Years of Schooling	8.27	9.37	10.43
West Sumatra			
Father's Years of Schooling	7.11	7.43	8.54
Son's Years of Schooling	8.43	9.84	11.66
West Nusa Tenggara			
Father's Years of Schooling	6.290	6.46	6.74
Son's Years of Schooling	6.95	8.71	10.43
Yogyakarta			
Father's Years of Schooling	6.60	8.14	8.34
Son's Years of Schooling	9.47	10.97	12.26
Bali			
Father's Years of Schooling	5.94	6.51	7.38
Son's Years of Schooling	7.11	9.51	10.88
East Java			
Father's Years of Schooling	6.23	6.20	7.38
Son's Years of Schooling	7.54	8.74	9.18

Source: Author's calculation from IFLS

For ethnicities, we present our estimates in Appendix A and we observe people belonging to Batak and Sundanese have fewer chances of obtaining a university education in comparison to the rest of the ethnicities. Thus, ethnic identity remains an important factor for policymakers to address these differences in Indonesia. Thus, it could be argued that policy should be more focused on social inclusion considering the persistence in education in major ethnicities of Indonesia. OECD (2015) recommended that there is a need to expand the provision of education beyond basic level to disadvantaged groups in Indonesia in order to achieve the high-income status.

In our region-wise analysis, we found significant differences at the regional level because in some of the regions we see higher persistence but in some of the regions trends in persistence estimates is not clear. We documented that Jakarta, Yogyakarta, and West Sumatra have the least persistence in education or in other words these are most mobile regions which imply lower inequality of opportunities in these regions. This fact is further validated with the economic size of these three regions as Jakarta is the commercial and official capital of Indonesia and whereas two other regions have a higher human development index in comparison to the rest of the regions. Among these provinces, Sleman regency of Yogyakarta has remarkable success in terms of education policies, according to the Indonesian Local Education Governance (ILEG) index developed by Al-Samarrai (2013)[5] . In contrast, South Sumatra, West Java, and Central Java are the most immobile regions, along with low

[5] Al-Samarrai (2013) assigned a ILEG score to a randomly selected 50 regencis in Indonesia. Components of education governance are following: i) education services provision standards ii) transparency and accountability iii) management control systems iv) management information systems v) efficient resource use. Since the scope of the regencies was subject to eight regions and three of them is matched with our study, we limited our assessments with these regions.

Table 6
Mobility estimates over regions.

Father-Son Sample			
Regions	1946−1960	1961−1975	1976−1990
West Java			
$\widehat{\rho}$	0.502** (0.021)	0.505** (0.013)	0.559** (0.015)
R^2	0.240	0.265	0.312
Observations	1502	3128	2531
Central Java			
$\widehat{\rho}$	0.555** (0.018)	0.494** (0.018)	0.555** (0.018)
R^2	0.285	0.232	0.285
Observations	1701	1867	1701
North Sumatra			
$\widehat{\rho}$	0.235** (0.042)	0.310** (0.027)	0.398** (0.033)
R^2	0.056	0.096	0.131
Observations	597	1236	1260
Jakarta			
$\widehat{\rho}$	0.341** (0.033)	0.359** (0.018)	0.373** (0.023)
R^2	0.115	0.179	0.198
Observations	765	1613	1129
South Sulawesi			
$\widehat{\rho}$	0.326** (0.035)	0.311** (0.027)	0.401** (0.033)
R^2	0.094	0.096	0.132
Observations	799	1235	1258
Lampung			
$\widehat{\rho}$	0.366** (0.065)	0.358** (0.046)	0.421** (0.035)
R^2	0.117	0.095	0.169
Observations	236	616	725
South Sumatra			
$\widehat{\rho}$	0.478** (0.063)	0.480** (0.036)	0.597** (0.029)
R^2	0.141	0.177	0.285
Observations	438	886	912
West Sumatra			
$\widehat{\rho}$	0.391** (0.052)	0.339** (0.032)	0.281** (0.037)
R^2	0.155	0.102	0.081
Observations	432	843	761
West Nusa Tenggara			
$\widehat{\rho}$	0.387** (0.050)	0.411** (0.027)	0.462** (0.024)
R^2	0.152	0.188	0.232
Observations	311	861	1034
Yogyakarta			
$\widehat{\rho}$	0.248** (0.046)	0.330** (0.020)	0.355** (0.024)
R^2	0.061	0.192	0.217
Observations	458	859	596
Bali			
$\widehat{\rho}$	0.435** (0.044)	0.335** (0.038)	0.433** (0.032)
R^2	0.153	0.097	0.215
Observations	257	619	645
East Jave			
$\widehat{\rho}$	0.548** (0.030)	0.512** (0.020)	0.502** (0.020)
R^2	0.237	0.326	0.218
Observations	1048	2019	1820

Robust standard errors in parentheses.
** p < 0.01, * p < 0.05, + p < 0.1.

HDI scores[6] . Even though some regencies in Central Java such as Kebumen, Wonogiri, Purvorejo, Wonosobo, and Sragen have a high ILEG Index score, these education policies should spread to other regencies. Besides, the intergenerational effects of policies of these municipalities may take time to realize because Education Law and subsequent regulations allowing local governments to implement their education policies are recent developments (2003 and later). Ranasinghe (2015) documented the similar trends in persistence across different regions of Australia as they find regions with higher economic growth have lower persistence estimates. Thus, in this case, we suggest the redistribution policy by the government on spending related to human development. This will certainly facilitate more immobile regions to obtain higher mobility or lower persistence in education which will reduce the problem arising from inequality of opportunities.

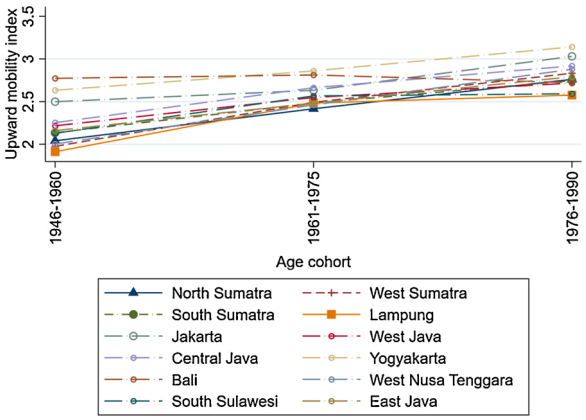

Fig. 6. Upward Mobility Index over Regions.

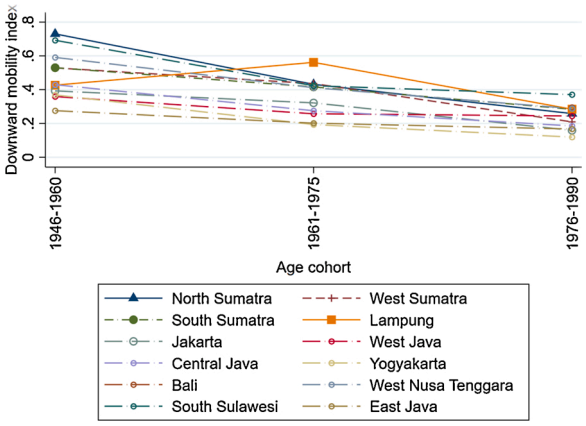

Fig. 7. Downward Mobility Index over Regions.

Moreover, mobility index and stationary distribution results also suggest no convergence for the attainment of higher secondary or above education among the regions. But when plotting stationary distribution, we observe more masses in to university education for least asset holding regions like Yogyakarta and West Nusa Tenggara which suggest the education-related policy is able to uplift the people towards university education in these regions. Chetty et al. (2014) correlated the regional variation in their intergenerational mobility measure for the United States along with local area characteristics. They concluded regional variation in public funding of education may be associated with the observed regional variation in intergenerational mobility in income. Similarly, it could be the topic of interest in the future to evaluate the role of public expenditures in education to understand the existing regional differences in persistence for Indonesia.

Author statement

We hereby confirm that the corresponding author Dr. Syed Hassan Raza proposed the idea, worked on relevant literature, and wrote the paper. Whereas, the second author Dr. Ugur Aytun managed the entire work related to data management such as data clearing, estimations, and most importantly helped the corresponding author to address the reviewer's comments.

[6] https://www.bps.go.id/dynamictable/2020/02/18/1772/indeks-pembangunan-manusia-menurut-provinsi-metode-baru-2010−2019.html

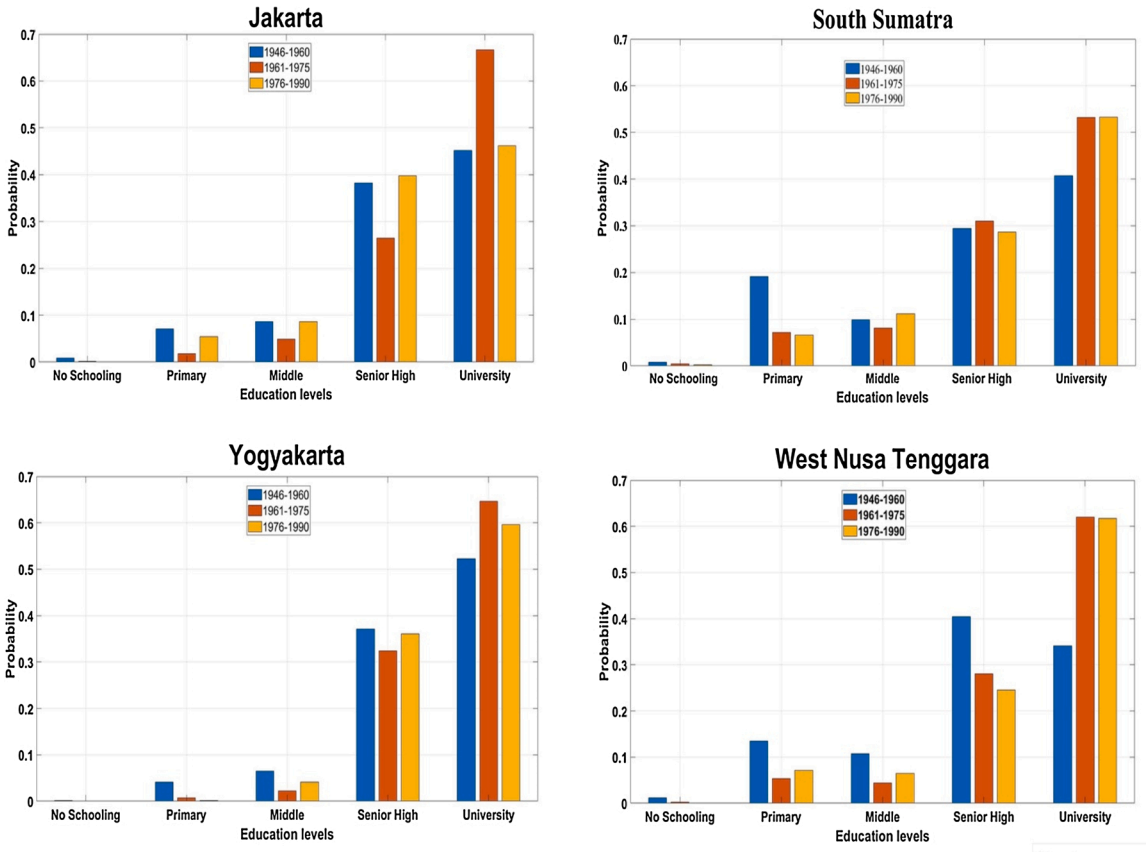

Fig. 8. Stationary Distribution over Regions.

Declaration of Competing Interest

The authors report no declarations of interest.

Appendix A

Cohort Analysis by ethnicity

We moved our intergenerational mobility analysis to ethnicity since the development history of Indonesia is also subject to the problems rooted in ethnic differences such as national integration of minorities and common language which are closely related to educational outcomes. For example, in rural areas, ethnic languages had been widely used. According to a survey conducted in 1976 showed that only 26 % of Indonesian school children used the Indonesian national language at home (Mani, 1980). Besides, anecdotal evidences based on challenges Chinese Indonesians faced such as sudden changes in language of instruction in 1965 (Suryadinata, 1988) and being non-native to the Indonesian national language among other ethnicities may affect their educational outcomes across generations[7]. On the other hand, different assimilation policies between the indigenous population (amalgamation model) and minorities (absorption model) might have led to creating different intergenerational persistence patterns, especially for those born between 1950 and 1970.

For this part of the analysis, we used the broader cohort range as it has three major benefits, first it makes the analysis less complicated and secondly we are able to have more observations and lastly it helps us to visualize the result in a precise way. We focus on six major ethnicities

Table A1
Descriptive statistics on ethnic groups in Indonesia.

Father-Son Sample			
Variables	1946–1960	1961–1975	1976–1990
Javanese			
Father's Years of schooling	6.28	6.89	7.45
Son's Years of schooling	8.02	9.66	10.61
Sundanese			
Father's Years of schooling	6.59	7.36	7.69
Son's Years of schooling	8.03	9.92	10.21
Other Southern Sumatrans			
Father's Years of schooling	6.45	7.92	7.84
Son's Years of schooling	8.19	10.15	10.13
Batak			
Father's Years of schooling	7.59	7.83	8.50
Son's Years of schooling	8.71	11.05	11.67
Betawi			
Father's Years of schooling	5.03	6.97	7.39
Son's Years of schooling	7.87	10.10	10.88
Minang			
Father's Years of schooling	7.04	7.68	8.67
Son's Years of schooling	8.76	10.43	11.98
Other Ethinicities			
Father's Years of schooling	6.24	6.49	7.27
Son's Years of schooling	7.65	9.45	10.42

Source: Author's calculation from IFLS (Notes: We used broader cohorts here and calculated average years of schooling for both fathers' and sons' education distribution by ethnicity).

[7] In our ethnicity analysis we do not examine the Chinese Indonesians due to lower number of observations.

Table A2
Mobility estimates on ethnic groups.

Father-Son Sample			
Variables	1946–1960	1961–1975	1976–1990
Javanese			
$\widehat{\rho}$	0.404** (0.043)	0.435**(0.012)	0.520**(0.010)
R^2	0.119	0.250	0.271
Observations	610	2946	5866
Sundanese			
$\widehat{\rho}$	0.469**(0.071)	0.424**(0.023)	0.563**(0.044)
R^2	0.136	0.225	0.312
Observations	241	924	1663
Other Southern Sumatrans			
$\widehat{\rho}$	0.112 (0.379)	0.337**(0.058)	0.574**(0.036)
R^2	0.004	0.139	0.264
Observations	47	189	528
Batak			
$\widehat{\rho}$	0.066(0.122)	0.298**(0.051)	0.365**(0.036)
R^2	0.005	0.099	0.151
Observations	52	300	704
Betawi			
$\widehat{\rho}$	0.354** (0.117)	0.349**(0.036)	0.362** (0.033)
R^2	0.138	0.178	0.145
Observations	46	282	664
Minang			
$\widehat{\rho}$	0.198 (0.175)	0.266** (0.044)	0.323**(0.030)
R^2	0.027	0.082	0.126
Observations	77	366	802
Other Ethinicities			
$\widehat{\rho}$	0.382** (0.051)	0.402** (0.018)	0.468** (0.012)
R^2	0.141	0.204	0.244
Observations	395	1962	4578

Robust standard errors in parentheses.
** p < 0.01, * p < 0.05, + p < 0.1.

where we have enough observations and rest of the ethnic groups are grouped as other ethnicities. For each ethnicity we have three cohorts, each with 15 years gap starting from 1946 to 1990. As per native Indonesian (Census, 2009) Javanese constitutes the biggest chunk of Indonesian population which is 40.2 %, followed by 15.4 % Sundanese and rest of the ethnic group remains less than 4%. Since IFLS is not ethnicity representative of Indonesia so our estimates from this part of the analysis can not be generalized. Although estimates can not be

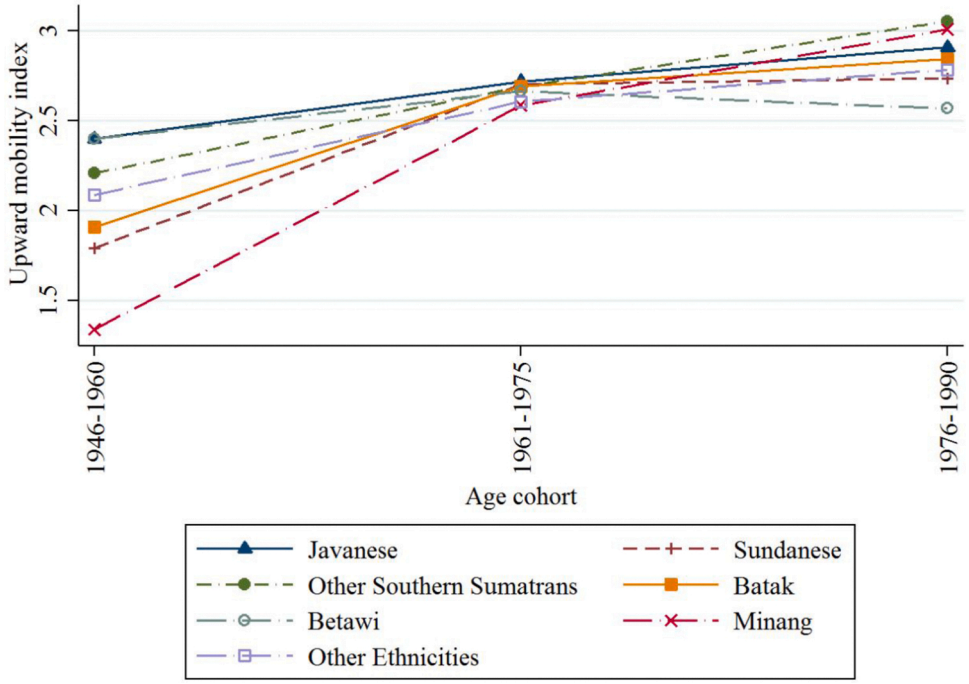

Fig. A1. Upward Mobility Index over Ethnicities.

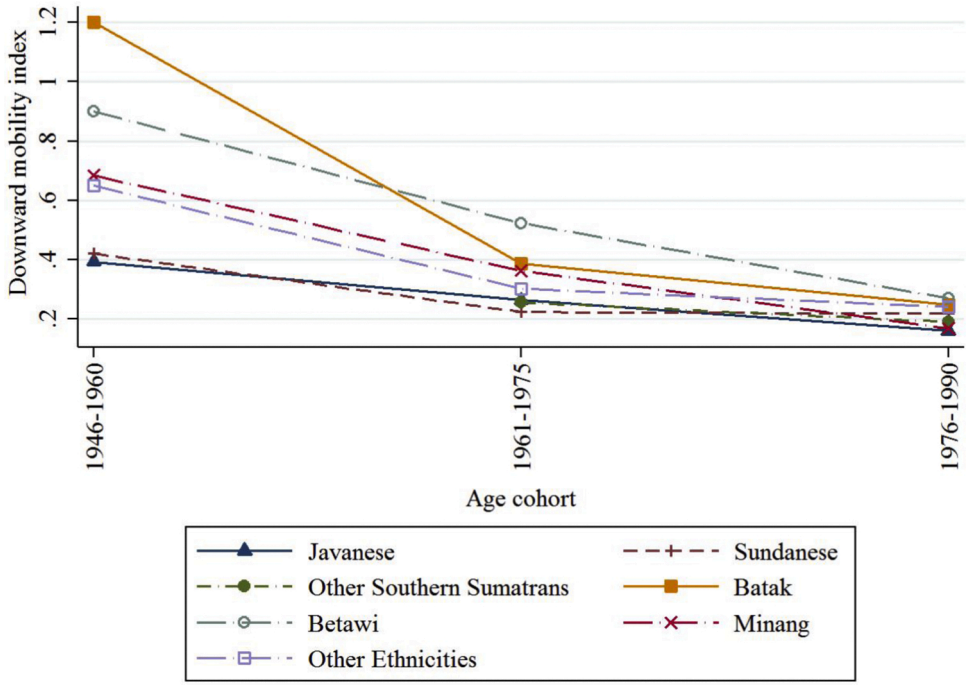

Fig. A2. Downward Mobility Index over Ethnicities.

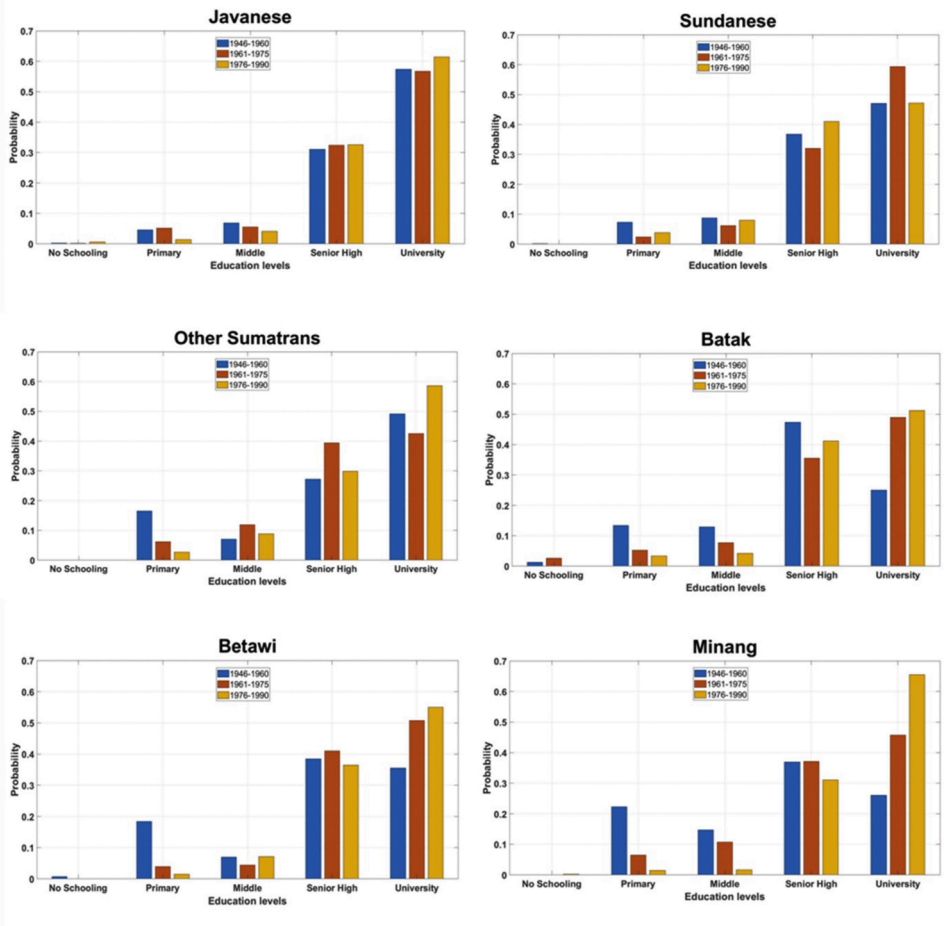

Fig. A3. Stationary Distribution Plot over Ethnicities.

generalized but this dimension of our analysis open us new area of research in context of Indonesia. Therefore, with the availability of right dataset this particular dimension can be reinvestigated in the future.

In data we observed, historically some of the ethnicities had higher asset holdings such as Other South Sumatrans but in the most recent cohort we observe Minang has higher wealth in terms of average asset holdings. Thus, in Table A1 we observe highest change for Minang in average years of schooling for sons' which is 3.22 years. Whereas, in particular two population wise biggest ethnicities which are Javanese and Sundanese for them the change in the education distribution of fathers is also not remarkable. Although, it can be argued when time started fathers in these two particular group were already located at higher end of education distribution. Moreover, we document highly educated ethnic groups for both fathers and sons education distribution is Minang, however, from 1961−1975 we observe fathers in Other South Sumatrans have highest average years of schooling.

In Table A2 we report the persistence estimates for six major ethnicities of Indonesia. In context of observing the trend in persistence, the results are very different to our estimates what we observe in nationwide sample. For example, in some of the ethnic groups such as Javanese and other ethnicities there is increasing and significant trend in persistence estimates but for some of the ethnic groups like Betawi and Sundanese we observe no such trend. We observe higher persistence in bigger ethnic groups like Javanese, Sundanese and Other Sumatrans but in small groups as we observe higher variation in the distribution of education in Table A1, thus, our persistence estimates compliment those facts because small ethnicities are least persistent. In particular to our last cohort we found Other Sumatrans to be the most persistent ethnic group with 0.574 correlation coefficient and Minang was least persistent ethnicity with 0.323 correlation coefficient.

Similar to decomposition exercise for nationwide sample here our motivation remains same due to unclear trend in persistence of different ethnic groups we obtained Term B and further by using equation (4) and (5) we construct upward and downward mobility index. In Fig. A1 we plot upward mobility index for the concerned ethnic groups. Here we observe starting with first cohort there are substantial differences in upward probabilities but during 1961−1975 we observe close convergence from all the ethnic groups. This implies that probability of son achieving more education than his father increased in all ethnic groups. It is important to note this is the same time when government of Indonesia initiated massive school expansion program and started providing free education up till higher secondary. It is also argued by Hertz and Jayasundera (2007) that school expansion policy in mid-70′s implemented by the Government of Indonesia significantly enhanced the education attainment and major contribution is driven by sons of less educated parents. Interestingly, as we move along the last cohort again we notice the differences in upward probabilities index of all the ethnicities in the analysis. In Fig. A2 we document downward mobility index and there we observe the similar change in 1961−1975 cohort which means decline in probability that son will attain less education than his father. This declining is more apparent in less-populated groups like Batak, Betawi and Minang because their initial index values are very high. From this perspective, we have concluded that education is an important factor for these minorities to be successful. Moreover, human capital upgrading of these minorities contributes to Indonesian economy. Now it has become even important to find whether there exists some long run convergence for different stages of education attainment in these ethnicities or not.

Therefore, in order to investigate the long run convergence, we plot stationary distribution in Fig. A3 for six major ethnicities. We observe increase in long run probability towards attainment of university education in all the ethnic groups. But differential patterns negate the existence of convergence about various stages of education attainment or even across ethnic groups. For example, in ethnic group Minang we observe over time decline in stationary distribution for no-schooling, primary, middle, and higher secondary but for university education there is increase in the value of stationary distribution in every cohort. Hence, we document higher stationary distribution for university education in Minang in comparison to other ethnicities. This pattern is different from rest of the ethnic groups, thus, over time stationary distribution kept on changing for every education stage and this is non-convergence.

Appendix B

Table B1
Mobility estimates over regions using wave 1.

Father-Son Sample			
Regions	1946−1960	1961−1975	1976−1990
West Java			
$\widehat{\rho}$	0.536** (0.028)	0.548** (0.024)	0.642** (0.057)
R^2	0.263	0.390	0.014 0.214
Observations	956	967	1432
Central Java			
$\widehat{\rho}$	0.429** (0.035)	0.524** (0.031)	0.162* (0.066)
R^2	0.178	0.258	0.005
Observations	742	704	1124
North Sumatra			
$\widehat{\rho}$	0.310** (0.036)	0.427** (0.042)	0.442** (0.094)
R^2	0.150	0.170	0.015
Observations	493	507	913
Jakarta			
$\widehat{\rho}$	0.429** (0.030)	0.480** (0.027)	0.122 (0.067)
R^2	0.225	0.276	0.004
Observations	638	802	863
South Sulawesi			
$\widehat{\rho}$	0.372** (0.081)	0.353** (0.046)	0.430**(0.032)
R^2	0.155	0.166	0.110
Observations	377	360	572
Lampung			
$\widehat{\rho}$	0.282** (0.059)	0.415** (0.068)	0.060 (0.118)
R^2	0.073	0.154	0.001
Observations	300	249	465
South Sumatra			
$\widehat{\rho}$	0.400** (0.047)	0.428** (0.065)	0.489** (0.098)
R^2	0.149	0.133	0.027
Observations	432	342	585
West Sumatra			
$\widehat{\rho}$	0.363** (0.057)	0.325** (0.059)	0.056 (0.109)
R^2	0.073	0.096	0.001
Observations	274	316	521
West Nusa Tenggara			
$\widehat{\rho}$	0.509** (0.048)	0.545** (0.047)	0.189* (0.081)
R^2	0.186	0.227	0.009
Observations	439	393	691
Yogyakarta			
$\widehat{\rho}$	0.299** (0.051)	0.418** (0.031)	0.442** (0.034)
R^2	0.082	0.288	0.265
Observations	374	351	380
Bali			
$\widehat{\rho}$	0.328** (0.057)	0.356** (0.027)	0.162 (0.100)
R^2	0.108	0.167	0.006
Observations	257	332	410
East Java			
$\widehat{\rho}$	0.555** (0.031)	0.510** (0.032)	0.246** (0.065)
R^2	0.224	0.249	0.014
Observations	986	851	1126

Robust standard errors in parentheses.

Table B2
Direction of mobility estimates by using all five wave and first wave (first wave is provincial representative).

	First to Second Cohort	Second to Third Cohort
West Java		
Direction of coefficient in all five waves	↑	↑
Direction of coefficient in the first wave	↑	↑
Central Java		
Direction of coefficient in all five waves	↓	↑
Direction of coefficient in the first wave	↑	↓
North Sumatra		
Direction of coefficient in all five waves	↑	↑
Direction of coefficient in the first wave	↑	↑
Jakarta		
Direction of coefficient in all five waves	↑	↑
Direction of coefficient in the first wave	↑	Inconclusive as the estimate of 3rd cohort is insignificant
South Sulawesi		
Direction of coefficient in all five waves	↓	↑
Direction of coefficient in the first wave	↓	↑
Lampung		
Direction of coefficient in all five waves	↓	↑
Direction of coefficient in the first wave	↑	Inconclusive as the estimate of 3rd cohort is insignificant
South Sumatra		
Direction of coefficient in all five waves	↑	↑
Direction of coefficient in the first wave	↑	↑
West Sumatra		
Direction of coefficient in all five waves	↓	↓
Direction of coefficient in the first wave	↓	Inconclusive as the estimate of 3rd cohort is insignificant
West Nusa Tenggara		
Direction of coefficient in all five waves	↑	↑
Direction of coefficient in the first wave	↑	Inconclusive as the estimate of 3rd cohort is insignificant
Yogyakarta		
Direction of coefficient in all five waves	↑	↑
Direction of coefficient in the first wave	↑	↑
Bali		
Direction of coefficient in all five waves	↓	↑
Direction of coefficient in the first wave	↑	Inconclusive as the estimate of 3rd cohort is insignificant
East Java		
Direction of coefficient in all five waves	↓	↓
Direction of coefficient in the first wave	↓	↓

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