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# Critical periods and the long-run effects of income shocks on education: evidence from Indonesia

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*Preliminary version, please do not quote.*

## Abstract

This paper examines how adverse shocks experienced by households, such as natural disasters, crop or job losses, or deaths, influence the acquisition of human capital of children, in the long run, and investigates whether some periods of childhood appear to be more critical in the sense that shocks during those have more lasting impacts. We use data from the four waves of the Indonesian Family Life Surveys (1993, 1997, 2000 and 2007), and follow a panel of siblings from early ages into young adulthood. Our preliminary results exhibit heterogeneities by areas and types of shocks: in the long-run, natural disasters, deaths and market shocks are found to negatively affect educational attainments of children in urban households, while crop losses have a similar long-lasting effect in rural areas. Moreover, we find little evidence in this sample that shocks experienced earlier in life have more lasting impacts than later ones. Finally, our preliminary findings do not indicate that locality-level negative shocks have direct effects on human capital investments beyond the direct losses suffered by households. This study is still ongoing, and an important progress under way is the use of objective data on shocks using meteorological data on natural disasters, and notably earthquakes, that occurred in Indonesia over the last 20 years or so.

**Keywords:** human capital, income shocks, critical periods, natural disasters, Indonesia.

**JEL codes:** D13, I25, J13, O15.

# 1 Introduction

This paper investigates the long-run effects of shocks on households on the acquisition of human capital using data for a panel of siblings in Indonesia followed from early ages into young adulthood from 1993 to 2007.

There is extensive evidence that, in many settings, shocks and fluctuations in parental income affect investments in human capital. Three channels have been emphasized. First, income shocks may generate early deficiencies in nutrition and health, which in turn affect human capital investments, notably in education. Second, high levels of ambient risk may induce ex-ante precautionary household behaviors that discourage investments (Carroll (1997), Kazianga and Udry (2006)). Third, variations in school enrollment and child labor may be used by households to cope with unanticipated shocks (Kochar (1995, 1999); Jacoby and Skoufias (1997)). Those effects are most likely to emerge when households lack access to insurance and credit.<sup>1</sup>

Nevertheless, several questions remain unsettled concerning how parental income shocks affect children's outcomes, and which strategies households rely upon to cope with those. First there is still limited evidence on the long-run effects of income shocks. In particular, if recent evidence tends to confirm that early shocks often have long-run effects (Maccini and Yang (2009); Alderman et al. (2006)), whether, and in under what circumstances, the disturbance of school enrollment can have lasting effects is debated.

Second, although there is a lot of emphasis in the literature on the importance of nutrition and health in the first years or months of life - or even of prenatal health -, the question of identifying the possible critical periods remains unsettled.<sup>2</sup> Along with the notion that early years are critical, it has also been argued that early compensation can reduce the impacts of early shocks, while later compensation is costly. In this case, parents may also be more prone to compensate for early shocks, so that later ones need not have less lasting effects.

Third, there is very little evidence on the way the ex-ante need to mitigate the effects of risks affects investments in human capital (Kazianga (2007); Fitzsimons (2007)). On one hand, investments in schooling and education could constitute a form of insurance allowing notably rural households to diversify their future income streams through non-agricultural activities or migration to urban areas. Human capital investments may in this sense be less exposed to loss than the ones in physical capital. On the other hand, the indivisibility and increasing returns (with returns from higher education being larger than those from primary or secondary education) of formal education may increase the associated level of risk and discourage households to perform these investments, if they do not pay enough at low or intermediate levels.

To address those questions, this study investigates the long-run effects of negative shocks on parental income that occur at different periods of childhood in the context of

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<sup>1</sup>Already note that it is often difficult to isolate the effects of fluctuations of family income induced by shocks from those of drops in income.

<sup>2</sup>Cunha et al. elaborate on the concept of critical periods, which emphasizes that some inputs in the production of human capital are consequential at some periods but not others. This relates to the notions of self-productivity and complementarities in human capital production: the first stresses that early skills increase later ones, e.g. early early cognitive development may facilitate later learning at school, and the second that different skills are complementary inputs in generating later ones, e.g. nutritional status and early cognitive development may both be necessary for subsequent learning.

Indonesia during the 1990s and 2000s. For this purpose, we exploit the very rich panel data of the Indonesian Family Life Survey collected by the Rand Corporation in 1993, 1997, 2000, 2007. The interesting features of this data are the long time-span of 14 years and the tracking of individuals over time.

To examine the effects of shocks, we must deal with the usual concern that the exposure to shocks may be endogenous. Our main strategy consists in controlling for sibships fixed effects; we therefore compare the outcomes of siblings that were exposed to shocks at different ages. These intra-sibship comparisons address the issue of omitted family variables that may determine the outcomes of children, and bias the estimates of the effects of shocks, to the extent that those do not vary over time. One limitation of this approach is that the fixed effects also capture the component of the effects of shocks that is common to the siblings, thus minimizing their importance; however, some estimates of the fixed effects can be recovered and may serve to investigate the distribution of the impacts of shocks among siblings.

The information on shocks we use in the current version this paper was measured by the IFLS survey at both household and locality level. (However, as explained below, the next version of this paper will incorporate objective measures of natural disasters based on meteorological data.) Household shocks are self-reported and include natural disasters, crop losses, job and business losses, market shocks and deaths. Shock incidence is provided together with the dates of occurrence of shocks. Locality shocks are adverse events that are reported by local representatives to have affected a number of inhabitants and also include natural disasters, as well as droughts and famines. Controlling for household-level shocks, the effects of locality-level ones are likely to capture the extent to which investments in human capital are discouraged ex-ante by a high ambient uncertainty. We examine the effects of those shocks first in the short-run on school enrollment and employment, and second in the long-run on educational attainments.

Our preliminary findings are threefold. First, they suggest that some specific household shocks, notably natural disasters and job losses in urban areas, do reduce school enrollment and increase child labor in the short run. Second, they indicate that several types of household shocks, notably natural disasters, deaths and market shocks in urban areas and crop losses in rural zones, negatively affect educational attainments. However, in contradiction to several studies, we find little evidence that earlier shocks have more lasting impacts than later ones. Third, locality-level shocks are found to have limited impacts, although some effects are present in urban areas. Nevertheless, ex-ante effects might not vary a lot with time and be common to siblings, in which case our estimates would not capture those. Moreover, we may not presently be using the most adequate measure of local risk.

This study is still ongoing. The main development under is way the use of objective rather than self-reported data on shocks using objective meteorological data. More specifically, we are currently associating, to the IFLS data, external sources with information on natural disasters from the Global Risk Data Platform, a multiple agencies effort to share spatial data information on global risk. We use data on earthquakes for the period 1980 - 2007 as collected by the United States Geological Survey; this source contains information on epicenter location, magnitude and depth of earthquakes worldwide and Indonesia is actually one of the region of the world most severely hit by those.

The other developments in progress include notably a more detailed analysis of the

effects of shocks happening in early years (distinguishing the effects that happen for instance from 0 to 2 years old), a more precise isolation of the ex-ante effects of shocks, including their effects in the short run, and the analysis of other outcomes, including health, nutrition, and learning achievement.

Our study relates to several literatures. A first one concerns the long-run impacts of shocks on early nutrition and health (Maccini and Yang (2009); Alderman et al. (2006)). Those studies tend to find that early shocks on nutrition do affect subsequent health and cognitive development. A second related literature focuses on the effects of parental income shocks on schooling and child labor (Jacoby and Skoufias (1997); Jensen (2000); Sawada (2003); Beegle et al. (2006); Cogneau and Jedwab (2008); Duryea et al. (2007)) and the alternative coping strategies households may rely upon (Jacoby (1994); Dehejia and Gatti (2005); Beegle et al. (2006)). The empirical evidence on the effects of income shocks on school attendance and medium-term attainments provides mixed findings, with for instance Jacoby and Skoufias (1997) showing significant but rather negligible effects in rural India, while Beegle et al. (2006) find significant reductions of attainments over 5-years periods in a panel from Tanzania. A third more recent literature tests the assumption that local uncertainty and induced costly precautionary (over-) savings effectively discourage potentially profitable investments in applications to human capital investments (Fitzsimons (2007); Kazianga (2007); Cameron and Shah (2010)). The findings of those few studies suggest that the ex-ante effects of shocks might be larger, for investments in education, than the ones they have ex-post. A fourth older, but still evolving, literature investigates the extent to which intra-household allocations alter the effects of shocks and their distribution between siblings, and notably whether specific shocks are compensated by parents or not. For instance, Yamauchi (2008) finds that earlier shocks are more likely to be compensated. Finally, some studies examine the evidence for critical periods in the acquisition of human capital (see Cunha et al. (2006) for a survey, as well as a larger child development literature), but the focus has mainly been on early ages (Glewwe et al. (2001); Paxson and Schady (2007); Currie (2009) among others).

The paper is organized as follows. Section 2 presents the data and describes the main patterns for the occurrence of shocks, the associated changes in welfare, and the educational outcomes of the sample of siblings. Section 3 discusses the empirical strategy and presents the main results for the short and long-run effects of shocks on investments in education. Section 4 discusses the results and concludes.

## 2 Data

### 2.1 A panel of siblings from the IFLS

The data used in this study are from the four waves of the Indonesia Family Life Survey (IFLS), a large-scale longitudinal household survey that collects information on the livelihood of individuals, their households and family members, and the communities in which they live. The first wave was conducted in 1993 (IFLS1), and full follow-ups in 1997 (IFLS2), 2000 (IFLS3), and 2007 (IFLS4). A total of 7,224 households were interviewed in IFLS1, representing about 83% of the Indonesian population living in 13 of

the nation's 26 provinces.<sup>3</sup> Subsequent waves attempted to reinterview these households and households to which previous household members had moved. The total number of households interviewed, including the split-off households, was 7,698 in IFLS2, 10,435 in IFLS3 and 13,535 (with 43,649 individuals) in IFLS4.

Note that tracking the movers has helped to keep attrition rates in IFLS surveys low. Overall, 87.6% of households that participated in IFLS1 are interviewed in each of the subsequent three waves.<sup>4</sup> In terms of individuals within households and for cost reasons, not all were interviewed in 1993 (in particular, not all children were included). However, from 1997 onwards, individuals aged 26 and more in 1993 and all their children were tracked, and in 2000 and 2007 tracking was complete for all members of 1993 households.

In this study, we construct a panel of siblings followed from 1997 to 2007. We limit our sample to a balanced panel of 11,906 individuals in 3,958 sibships with at least two siblings, one of which is aged 15 or less, and still living with their parents in 1997. Note that information on enrollment and educational attainment is available not only for children in the household, but also for those that have left the household. Using this information, only 1.8% of the 1997 sample is lost in 2000 and 3.9% in 2007.

Table 1 describes our sample of siblings by year and by rural or urban location. Of the 3,958 sibships observed, 55% live in rural households and represent 54% of total number of individuals. The average age of siblings in 1997 is almost 11 years old in rural areas and almost 12 in urban zones (thus, only slightly larger). Average ages of youngest and oldest sibling in 1997 are 7 and 15 years old. In 2007, they are 17 to 26 respectively.

## 2.2 Household and locality-level shocks

In order to yield insights into how negative economic shocks affect individuals and households and into how they respond to those shocks in terms of human capital investment across siblings, three sets of variables are called up in our analysis: data on types and intensity of shocks experienced by households, household welfare measures and educational outcomes of individuals.

The four IFLS surveys contain a specific section where households are asked if they faced any economic shock or hardship during the past five years, such as a death of a household or family member, crop loss, household or business loss due to a natural disaster, job loss or business failure of a family member and market shocks (the latter defined as a decrease in household income due to a decrease of production or very low price of products).

Similar information concerning adverse shocks is also available at the locality level since 1988. In particular locality-level negative shocks due to epidemics, crop losses (droughts or famines) and natural disasters (fire, flood, earthquake or volcanic eruption) will be also considered in this study.

Tables 2 and 3 report the occurrence of household-level and locality-level shocks re-

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<sup>3</sup>The 1993 sample was elaborated by randomly selecting 321 villages from the 1993 National economic Survey (SUSENAS), spread among 13 Indonesian provinces, in particular, four provinces from Sumatra (North Sumatra, West Sumatra, South Sumatra, and Lampung), all five of Java and four from the remaining islands (Bali, West Nusa Tenggara, South Kalimantan, and South Sulawesi).

<sup>4</sup>For more detailed discussions on IFLS attrition rates, see Strauss and M. (2009) and Thomas et al. (2010).

spectively by survey year and rural/urban area. Independently of the survey year used, households and localities situated in rural areas regularly experience more shocks. Table 2 shows that the most common type of shock in rural households concerns crop losses no matter which survey year is used. Among urban households, the most common type of shock in 2000 concerns job loss or business failure (before this date, death of a household head or a family member had the lead). Natural disasters are more rare but still suffered by between 2 and 4% of the sample. At the locality level (Table 3), we see that epidemics, which was the most common type of shock in rural areas in the first survey, has since then become insignificant. Crop losses (droughts or famines) lead the course in rural areas and natural disasters (fire, flood, earthquake or volcanic eruption) in urban zones.

Tables 4 to 7 dig into the sibship characteristics that relate to exposure to shocks, in particular, characteristics on parental education, age and occupation; household and sibship size; and household per capita income and expenditure levels. The descriptive statistics shown in these tables suggest that shocks are not random. We present these statistics by occurrence –or not– of crop losses in rural areas (table 4) and job losses in urban zones (table 6). We also consider the occurrence –or not– of natural disasters in both rural (table 5) and urban (table 7) households, because even if less frequent, these shocks have considerable welfare effects on the household. Our calculations suggest that shocks, which were not equally geographically distributed, are also not randomly distributed across households within location. Rural households who undergo crop losses, as well as urban households who undergo job losses, are less educated, larger and poorer than other households in the same geographical location who did not suffer these types of shocks. However, in both rural and urban areas, households who undergo natural disasters do not differ that much from other households (if anything, households living in Jakarta, the capital, seem to be significantly more concerned by this type of shock).

## 2.3 Household welfare

To capture household welfare levels, the IFLS surveys provide detailed data on household income and consumption. Real monthly per capita household consumption is calculated as the sum of food and nonfood consumption, both bought and self-produced. Real monthly per capita household income is calculated as the sum of earnings, asset income, transfers, and other income (which includes pensions, scholarships, insurance payments, and winnings). In order to examine the robustness of results to different measures of economic status, we further disaggregate and look at food and non-food consumption as well as labor and non-labor income separately.

Tables 8 and 9 provide preliminary evidence on the effects of shocks on household welfare in, respectively, our urban and rural samples of siblings' households in 1997 and 2000. We estimate linear regressions on the log of per capita household total monthly income or expenditure, and use as covariates the types of shocks, controlling for mother's education, father's age education and occupation, and initial (as of 1993, date of our first survey) household size, province of residence, per capita expenditure. Household head fixed effect and year dummies are also included. Results show that job losses and natural disasters appear associated with declines in urban household's incomes. Natural disasters appear associated with a marginally significant decrease in rural households' income, and crop losses show up a negative but statistically insignificant effect on rural households'

incomes. The fact that crop losses do not seem to have a significant effect on incomes may hide the fact that households try to smooth and cope for those types of shocks.

## 2.4 Educational outcomes

In this study we want to focus on the effects of shocks on educational attainments and intra-sibship inequality. It is useful to start by briefly providing basic information concerning the school system in Indonesia. Most children enter school in Indonesia at age six or seven. The education system in this country has four basic levels. Primary schooling (covering grades 1 to 6), concerns children until the age of 11-12 years old approximately; junior secondary school (grades 7 to 9), concerns children typically aged from 12-13 up to 14-15 years old; senior secondary school (grades 10 to 12) for ages between 15-16 and 17-18; and postsecondary education, covering grades and ages onward.

Table 10 provides enrollment and re-entry rates of our sample of children in 1997, 2000 and 2007, separately for rural and urban areas. We can see that while Indonesia has achieved nearly universal primary school enrollment (in 2007 96-97% of observed children are enrolled by the age of 10-12 years old, enrollment proportions drop rapidly at ages associated with junior secondary and senior secondary enrollment, specially in rural areas. If urban-rural disparities in enrollment start being practically insignificant at starting ages, they become rather large as children grow (for children age 16 to 18 enrollment rates go down to 45% in rural areas in 2007 and 70% in urban zones). If we focus on the evolution of enrollment rates over time, we observe a significant drop in enrollment beyond primary schooling from 1997 to 2000, specially in urban areas. Rates of return to school after having dropped out are calculated for all age ranges and they show up to be quite low (about one half at ages 10-12 and one fourth at higher ages).

Table 11 provides information concerning educational attainments of children and the degree of intra-sibship inequality observed in attainment at years 1997, 2000 and 2007. We distinguish between urban households having experienced –or not– job losses or business failures and rural households having suffered –or not– crop losses, since these two types of shocks were the most common in each geographic area. Living in rural areas implies, for all year surveys a lag in attainment of almost two years of schooling. For both urban and rural households, having experienced negative shocks implies lower average educational attainments at any year. In terms of intra-sibship educational inequality, measured by the intra-class correlation of attainment net of gender, age and year effects, we observe that siblings that live in households having suffered negatives shocks end up having a lower intra- class correlation persistent across years.

## 3 Main results

### 3.1 Empirical strategy

Our empirical analysis relies on linear regression estimates with fixed effects for sibships. To introduce those, consider the following relation between a single shock variable, e.g. the occurrence of a shock during early ages  $S_{ih}$ , and a later outcome, e.g. educational attainment,  $y_{ih}$  of child  $i$  of household  $h$ :



$$y_{ih} = \beta_S S_{ih} + \beta_Z Z_{ih} + u_{ih} \quad (1)$$

where  $Z_{ih}$  is a set of controls for individual and family characteristics. If some components of  $Z_{ih}$  are unobserved or measured with error and are correlated with  $S_{ih}$ , i.e.  $cov(S_{ih}, u_{ih}) \neq 0$ , then the OLS estimator  $\hat{\beta}_S$  is inconsistent.

If omitted variables are persistent and common to all siblings, within-family estimates, that is controlling for sibship fixed effects, can eliminate the bias (Griliches 1979). Distinguishing fixed  $\alpha_{ih}^f$  (e.g. parental education or ethnicity) from variable  $\alpha_{ih}^v$  (e.g. family composition or time allocation) family or child characteristics, the relation above can be rewritten:

$$y_{ih} = \beta_S S_{ih} + \beta_Z Z_{ih} + \alpha_{ih}^f + \alpha_{ih}^v + \varepsilon_{ih} \quad (2)$$

Taking averages within sibships and subtracting the averaged equation from the individual one, we obtain:

$$y_{ih} - y_{.h} = \beta_S (S_{ih} - S_{.h}) + (\alpha_{ih}^v - \alpha_{.h}^v) + (\varepsilon_{ih} - \varepsilon_{.h}) \quad (3)$$

The parameter estimates of the individual effects of shocks  $\hat{\beta}_S$  will be consistent under the assumption that differences between siblings in variable and unobserved individual or family characteristics are independent from differences in exposure to shocks, i.e.  $cov(S_{ih} - S_{.h}, \alpha_{ih}^v - \alpha_{.h}^v) = 0$ . Note that this parameter captures the differential effect across siblings of being exposed to a shock at a given age, while the sibship fixed effects capture the component of the shocks effect that is common to all siblings.

Some variable household characteristics, e.g. family composition or assets changes, may still confound the estimated effects of shocks if those are correlated with the occurrence of shocks. To provide some sense of the robustness to alternative identifying assumptions, we compare the fixed-effects estimates to those obtained with regressions with controls. The observables controlled for in those estimates are age, gender, birth rank, a set of household characteristics concerning location and size as well as education, age and occupation of the household head.

Now, to investigate whether some periods of childhood and adolescence are more critical than others, we introduce in the above specification the occurrence of shocks at several life-cycle periods or ages  $a$ :

$$y_{ih} - y_{.h} = \sum_a \beta_S^a (S_{ih}^a - S_{.h}^a) + (\alpha_{ih}^v - \alpha_{.h}^v) + (\varepsilon_{ih} - \varepsilon_{.h}) \quad (4)$$

In our analysis, we distinguish shocks occurring at four different age periods, namely 0 to 6 years old or early and pre-schooling age, 7 to 12 or primary schooling age, 13 to 18 or secondary schooling age, and 19 and more or early adulthood. The independent variables of interest in our estimates are thus the occurrences of household-level shocks interacted with the age of the children at the occurrence date.

### 3.2 Short-run effects of shocks on schooling and labor

Turning to the results, we first investigate the effects of shocks in the short-run on siblings' enrollment and labor supply. Tables 12 and 14 show our estimates of the effects of

household-level shocks on enrollment in 1997 and 2000. We exclude crop losses from the analysis for the urban sample and job losses from the ones for the rural samples as those shocks concern small shares of those populations. We present those results separately for the two samples of siblings who used to live, in 1997, in urban and rural areas.

For urban households, the results in table 12 show evidence of statistically significant negative effects on enrollment of natural disasters and market shocks at both early and primary schooling ages, as well as of job losses at secondary schooling ages. The fixed effects estimates suggest that a child who experiences a natural disaster when he is less than 7 years old has a 8 points lower probability to be enrolled in school, while this effect increases to 11 points when the child experiences such a disaster when he is 7 to 12 years old. The difference between the effects of shocks at those two periods is not significant. At the opposite natural disasters apparently do not disturb the enrollment of older children. Similar estimates show that market shocks experienced by children aged less than 7 or 7 to 12 also reduce their enrollment by about 6 points, again with no statistically significant difference between the effects of shocks at the two periods. At the opposite, parental job losses apparently do not disturb school enrollment if they happen when children are young, but do have statistically significant negative effects and reduce enrollment by about 6 points of children of secondary schooling ages. We do not find much evidence that deaths disturb school enrollment, with some effects for children experiencing those at primary school age in the regression specification but not robust to the fixed-effects specification.

Table 13 provides similar estimates for employment. The effects of shocks on employment are consistent with those on enrollment with natural disasters and market shocks increasing the probability of working among children who experienced those at young or primary schooling age - the point estimates are large but not statistically significant for natural disasters at primary schooling age though. The effects of job losses are not statistically significant although again the point estimate is large and positive for children experiencing those at secondary schooling age.

For rural households, the results in table 14, do not provide any evidence of statistically significant effects of shocks on enrollment. However, the results in table 15 suggest that crop losses do increase the labor of children who experience those at early or primary-schooling age. The obtained point estimates also indicate large effects of natural disasters occurring when children are less than 7, but these effects are not statistically significant.

Overall, the results suggest that household shocks, in particular natural disasters, market shocks and job losses, disturb the schooling and increase the employment of children that experience those either at early or primary-schooling age in urban areas, but less so in rural areas, where crop losses that occur before children are 12 only are found to increase employment. One potential explanation for these different findings for different areas could be that, whereas as the age at which children are affected matters in urban areas, the shocks that occur in rural areas tend to affect all the siblings so that their timing matters less.

### 3.3 Long-run effects on educational attainments

Let us now turn to the long-run effects by examining how the shocks that occur between 1987 and 2000 affect educational attainments in 2007. We investigate those using the same econometric model with fixed effects for siblings stated in equation 4, and also provide the OLS estimates.

The estimates of the effects of shocks on the educational attainments in 2007 of the siblings of the urban sample are given in table 16. The fixed-effects estimates indicate that natural disasters do have lasting with a statistically significant reduction of 0.9 years in the attainments of children that experienced those at primary-schooling age. However, point estimates suggest that natural disaster also reduce educational attainments for children impacted at early or secondary-school ages with reductions of 0.6 and 0.8 years of education, and those effects are not significantly different from those of disasters at primary-schooling ages. Those estimates are robust to the alternative OLS specification. The fixed effects estimates also indicate that market shocks and deaths that occur at secondary-schooling age do reduce significantly educational attainments with reductions of respectively 0.6 and 1.1 years of education, although those effects are not robust to the OLS specification. At the opposite we do not find evidence of significant effects of job losses in the long run. This is in contrast with the estimates for the short-run effects, and might suggest that the late disturbances of schooling generated by those employment shocks are either limited or coped with by households in the long run.

The estimates for the siblings of the rural sample are given in table 17. The fixed effects estimates indicate that crop losses do reduce in the long run the educational attainments of children who experience those at primary schooling ages, with an estimated reduction of 0.4 years of education. The effects of crop losses for children of early or secondary-school age at their occurrence are not statistically significant. Point estimates also indicate large negative effects of natural disasters for children of primary-schooling age, with reduction of 0.6 years of education, but these estimates are not statistically significant - although they are in the OLS specification. Similarly, deaths are found to reduce educational attainments, when they happen at primary or secondary schooling ages, but these effects are only statistically significant in the OLS specification.

Overall, those estimates for the long-term effects of household shocks on educational attainments give no indication that earlier shocks have more lasting impacts. If job losses, market shocks and deaths in urban areas, and crop losses in rural areas, seem to significantly reduce attainments in the long-run, the effects of those shocks are not significantly larger when they impact children at early ages than at primary or secondary schooling ages.

### 3.4 Effects of locality vs household shocks

The occurrence of locality-level shocks, be they natural disasters or crop losses, is likely to be associated with perceptions of local levels of risks. If this is the case, the effects of those locality shocks should provide some indication of the ex-ante costly precautionary behaviors in terms of lower investments that ambient risk may generate. To investigate this question, and provide a first test of the relative strengths of ex-ante and ex-post effects of shocks, we estimate the effects of locality-level shocks on educational attainments controlling for the occurrence of shocks at the household level. Those results are still very

preliminary and should be improved in several ways. In particular, the measures of the occurrence of shocks at the local level should be improved by taking averages of their incidence over some periods of time. Also, siblings fixed-effects estimates may not be appropriate for capturing the ex-ante of shocks to the extent that the perceived levels of local risks do not vary across siblings.

Despite those caveats, estimates of the relative effects of shocks at the locality and household levels are presented in table 18. In those estimates, we aggregate drought and famines into a single category that we label “crop losses”, but we must acknowledge that it does not match perfectly with the crop losses reported at the household level. Otherwise, as for household shocks, we interact the occurrence of locality-level shocks with the age of children at their occurrence. The results show little evidence that shocks at the level of localities do have direct effects on human capital investments beyond the effects of the household. While the undergoing by the household of a natural disasters in urban areas - and maybe in rural areas but this result is not statistically significant - and of a crop loss in rural areas is again found to reduce educational attainments, the occurrence of comparable shocks in the locality have, according to these estimates, few effects on those investments. Only natural disasters in urban areas are found to be associated with substantial point estimates and reductions of attainments by respectively 0.6 and 1.3 years of education for children of secondary-schooling and older age groups.

## 4 Preliminary conclusions

This paper examines how adverse shocks experienced by households, such as natural disasters, crop or job losses, or deaths, influence the acquisition of human capital of children, with a focus on their effects in the long run. For this purpose we use data from the four waves of the Indonesian Family Life Surveys (1993, 1997, 2000 and 2007), and follow a panel of siblings from early ages into young adulthood.

Our preliminary results exhibit some heterogeneity by areas and types of shocks. In the short run, if natural disasters and job losses suffered by urban households are found to reduce school enrollment and increase child labor, the effects of shocks are less obvious, or may affect all siblings, for rural households. In the long-run, natural disasters, deaths and market shocks negatively affect educational attainments in urban households, and crop losses have a similar long-lasting effect in rural areas. We investigated whether some periods of childhood appear to be more critical, and found little evidence, in this sample, that shocks experienced earlier in life have more lasting impacts than later ones. Finally, our preliminary findings do not indicate that locality-level negative shocks have direct effects on human capital investments beyond the direct losses suffered by households. Only natural disasters in urban areas are found to be associated with substantial point estimates and reductions of attainments.

This study is still ongoing and is a first step towards understanding the long-run effects of negative shocks on human capital investment, and their interaction with allocations within sibships, in Indonesia. The main development under way is the use of objective data on shocks using meteorological data on natural disasters, and notably earthquakes, that occurred in Indonesia over the last 20 years or so. Other improvements include a more detailed analysis of the effects of shocks happening in early years (distinguishing

the effects that happen for instance from 0 to 2 years old), a more precise isolation of the ex-ante effects of shocks, including their effects in the short run, and the analysis of other outcomes, including health, nutrition, and learning achievement.

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Table 1: Sample of siblings

	rural 1997	rural 2000	rural 2007	urban 1997	urban 2000	urban 2007
number of siblings	2.984	2.984	2.984	3.038	3.038	3.038
(s.d.)	1.377	1.377	1.377	1.434	1.434	1.434
age of youngest sibling	6.533	9.315	17.16	7.481	10.25	17.66
average age of siblings	10.68	13.48	21.31	11.63	14.43	21.84
age of oldest sibling	14.71	17.53	25.37	15.51	18.32	25.74
number of sibships	2163	2163	2163	1795	1795	1795
number if individuals	6454	6454	6454	5453	5453	5453

Note: averages across sibships, by rural/urban in 1997 and year.



Table 2: Occurrence of household-level shocks in past 5 years

	Rural, 1993	Rural, 1997	Rural, 2000	Urban, 1993	Urban, 1997	Urban, 2000
death of a hh or family member	0.0799	0.145	0.0666	0.0578	0.156	0.0653
crop loss	0.183	0.202	0.192	0.0341	0.0301	0.0378
hh/business loss due to natural disaster	0.0207	0.0201	0.0113	0.0424	0.0318	0.0264
job loss or business fail	0.0238	0.0330	0.0412	0.0458	0.0645	0.0703
any household level shock	0.277	0.348	0.279	0.159	0.245	0.188
observations	6454	6454	6454	5453	5453	5453

Note: by year and rural/urban.  
Mean of each variable.

Table 3: Occurrence of Locality-level shocks in past 5 years

	Rural, 1997 (t-10,t-6)	Rural, 1997	Rural, 2000	Urban, 1997 (t-10,t-6)	Urban, 1997	Urban, 2000
any adverse locality shock	0.0595	0.242	0.181	0.00789	0.121	0.0932
natural disaster	0.0223	0.0813	0.0532	0.00403	0.0845	0.0699
crop loss	0.0129	0.153	0.139	0.00385	0.0365	0.0206
epidemic	0.0243	0.0169	0	0	0	0
observations	6454	6454	6454	5453	5453	5453

Note: by year and rural/urban.  
Mean of each variable.

Table 4: Household characteristics by occurrence of a crop loss in 1997: rural sample

	rural, no crop loss	rural, crop loss
father's education	3.946	3.681
mother's education	3.613	2.859
father's age	43.07	44.70
mother's age	36.42	36.89
father agricultural worker	0.403	0.713
father industry worker	0.236	0.0969
household size	6.627	6.732
number of siblings	3.444	3.576
per capital hh labor income	174616.8	179124.7
per capital hh other income	11000.4	6916.7
per capita hh expenditure	329081.9	299663.0

Note: by year and rural/urban.

Table 5: Household characteristics by occurrence of a natural disaster in 1997: rural sample

	rural, no natural disaster	rural, natural disaster
father's education	3.896	3.756
mother's education	3.461	3.686
father's age	43.40	44.22
mother's age	36.47	39.08
father agricultural worker	0.462	0.625
father industry worker	0.210	0.0863
household size	6.648	6.672
number of siblings	3.473	3.308
per capital hh labor income	173860.6	278446.6
per capital hh other income	10275.9	5176.0
per capita hh expenditure	323210.4	326341.0

Note: by year and rural/urban.

Table 6: Household characteristics by occurrence of a job loss in 1997: urban sample

	urban, no job loss	rural, job loss
father's education	6.120	5.817
mother's education	5.552	5.318
father's age	43.58	43.97
mother's age	37.55	37.17
father agricultural worker	0.0900	0.0614
father industry worker	0.376	0.349
household size	6.955	7.655
number of siblings	3.506	3.812
per capital hh labor income	300289.2	248437.9
per capital hh other income	15483.3	6166.5
per capita hh expenditure	577413.4	465828.5
jakarta	0.126	0.297

Note: by year and rural/urban.

Table 7: Household characteristics by occurrence of a natural disaster in 1997: urban sample

	urban, no natural disaster	urban, natural disaster
father's education	6.120	5.817
mother's education	5.552	5.318
father's age	43.58	43.97
mother's age	37.55	37.17
father agricultural worker	0.0900	0.0614
father industry worker	0.376	0.349
household size	6.955	7.655
number of siblings	3.506	3.812
per capital hh labor income	300289.2	248437.9
per capital hh other income	15483.3	6166.5
per capita hh expenditure	577413.4	465828.5
jakarta	0.126	0.297

Note: by year and rural/urban.

Table 8: Household-level shocks in 5 previous years and welfare: urban sample

	(1)	(2)	(3)	(4)	(5)
	labor income	non labor income	total expenditure	food expenditure	non food expend.
death of a hh or family member	-0.005 (0.37)	0.026 (0.61)	0.067*** (0.05)	0.047*** (0.05)	0.060*** (0.06)
hh/business loss due to natural disaster	-0.007 (0.77)	-0.031* (0.76)	0.028** (0.06)	0.029** (0.07)	0.022* (0.09)
job loss or business fail	-0.047** (0.56)	-0.026 (0.64)	-0.019 (0.06)	0.009 (0.06)	-0.026 (0.08)
market shock	0.004 (0.58)	-0.003 (0.78)	0.002 (0.07)	-0.012 (0.06)	0.012 (0.08)
Observations	3943	3943	4062	3936	3935

Standardized beta coefficients; Standard errors in parentheses

Head fixed effects. Sample of siblings' households in 1997 and 2000. OUTCOME: log of household total per capita.

CONTROLS: father's and mother's education, father's age, father's occupation, hh size 93, province of residence 93, per capita expenditure 93, year.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 9: Household-level shocks in 5 previous years and welfare: rural sample

	(1)	(2)	(3)	(4)	(5)
	labor income	non labor income	total expenditure	food expenditure	non food expend.
death of a hh or family member	0.006 (0.39)	0.017 (0.48)	0.036** (0.04)	0.040** (0.04)	0.014 (0.06)
crop loss	-0.018 (0.27)	-0.010 (0.29)	-0.010 (0.03)	-0.012 (0.03)	-0.002 (0.04)
hh/business loss due to natural disaster	-0.042* (1.14)	-0.002 (0.63)	-0.007 (0.08)	-0.014 (0.08)	0.007 (0.13)
job loss or business fail	0.008 (0.54)	0.063** (0.84)	0.004 (0.07)	0.012 (0.08)	-0.014 (0.09)
market shock	-0.012 (0.35)	0.049** (0.39)	-0.000 (0.04)	-0.028 (0.07)	-0.004 (0.06)
Observations	4465	4465	4644	4458	4453

Standardized beta coefficients; Standard errors in parentheses

Head fixed effects. Sample of siblings' households in 1997 and 2000. OUTCOME: log of household total per capita.

CONTROLS: father's and mother's education, father's age, father's occupation, hh size 93, province of residence 93, per capita expenditure 93, year.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$



Table 10: Enrollment and reentry rates

	rural 1997	rural 2000	rural 2007	urban 1997	urban 2000	urban 2007
7-9 y.o.	0.910	0.932	1	0.976	0.989	1
7-9 y.o.	0	0.606	.	0	0	.
10-12 y.o.	0.939	0.942	0.961	0.973	0.971	0.972
10-12 y.o.	0.0404	0.485	.	0	0.510	.
13-15 y.o.	0.733	0.715	0.780	0.888	0.862	0.900
13-15 y.o.	0.112	0.233	.	0.180	0.259	.
16-18 y.o.	0.422	0.397	0.455	0.657	0.612	0.700
16-18 y.o.	0.123	0.135	.	0.222	0.257	.
19-23 y.o.	0.0824	0.0820	0.101	0.166	0.218	0.205
19-23 y.o.	0.126	0.140	.	0.168	0.125	.
observations	6454	6454	6454	5453	5453	5453

Note: by year and rural/urban.

Table 11: Shock occurrence and intra-sibship inequality in attainments

	no shock 1997	no shock 2000	no shock 2007	shock 1997	shock 2000	shock 2007
<u>Urban sample: job losses</u>						
average attainment	5.198	7.091	10.23	4.760	6.615	9.829
standard deviation of attainment	4.479	4.415	3.400	4.133	4.162	3.129
intraclass correlations	0.334	0.433	0.551	0.243	0.364	0.464
observations	4813	4813	4813	637	637	637
<u>Rural sample: crop losses</u>						
average attainment	3.582	5.335	8.430	3.368	5.147	8.217
standard deviation of attainment	3.645	3.784	3.243	3.470	3.590	3.003
intraclass correlations	0.285	0.394	0.508	0.224	0.328	0.402
observations	4489	4489	4489	1952	1952	1952

Note: by year and shock occurrence in 1992-2000. Mean and standard deviation of attainment.  
Intraclass correlation of attainment net of gender, age and year effects.

Table 12: Household shocks and enrollment in 1997-2000: effects by child age at occurrence, urban sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	death: ols	death: fe	disaster: ols	disaster: fe	job loss: ols	job loss: fe	market: ols	market: fe
shock at 0-6 y.o.	-0.007 (0.01)	0.001 (0.02)	-0.031 (0.02)	-0.084** (0.04)	-0.000 (0.02)	-0.000 (0.03)	0.016 (0.02)	-0.065** (0.03)
shock at 7-12 y.o.	-0.031* (0.02)	-0.016 (0.03)	-0.093*** (0.03)	-0.110*** (0.04)	-0.039* (0.02)	-0.012 (0.03)	-0.002 (0.02)	-0.059* (0.03)
shock at 13-18 y.o.	-0.015 (0.02)	-0.037 (0.03)	-0.063* (0.04)	0.022 (0.05)	-0.071*** (0.03)	-0.057* (0.03)	0.057* (0.03)	-0.030 (0.04)
shock at 19+ y.o.	0.013 (0.02)	-0.017 (0.03)	-0.028 (0.04)	0.049 (0.06)	-0.035 (0.03)	-0.015 (0.03)	0.041 (0.04)	0.016 (0.05)
Observations	10626	10626	10626	10626	10626	10626	10626	10626

Standard errors in parentheses

Notes: ols and sibling fixed-effects estimates; data from IFLS surveys 1993-2000; sample of siblings in 1997-2000;

controls: age, gender, birth rank, set of hh charact. in ols.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 13: Household shocks and employment in 1997-2000: effects by child age at occurrence, urban sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	death: ols	death: fe	disaster: ols	disaster: fe	job loss: ols	job loss: fe	market: ols	market: fe
shock at 0-6 y.o.	0.173 (0.12)	0.102 (0.15)	0.436* (0.22)	0.595** (0.24)	0.130 (0.12)	0.011 (0.22)	0.006 (0.21)	0.067* (0.04)
shock at 7-12 y.o.	0.007 (0.03)	-0.022 (0.07)	0.137** (0.05)	0.133 (0.15)	0.062 (0.04)	-0.037 (0.09)	0.121** (0.05)	0.253** (0.10)
shock at 13-18 y.o.	0.062*** (0.02)	0.079 (0.05)	0.053 (0.05)	0.044 (0.14)	0.079** (0.03)	0.064 (0.07)	0.004 (0.03)	0.107 (0.07)
shock at 19+ y.o.	-0.057* (0.03)	-0.008 (0.06)	0.088 (0.07)	0.045 (0.13)	-0.038 (0.04)	-0.049 (0.06)	-0.024 (0.05)	0.047 (0.08)
Observations	4550	4550	4550	4550	4550	4550	4550	4550

Standard errors in parentheses

Notes: ols and sibship fixed-effects estimates; data from IFLS surveys 1993-2000; sample of siblings in 1997-2000;

controls: age, gender, birth rank, set of hh charact. in ols.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 14: Household shocks and enrollment in 1997-2000: effects by child age at occurrence, rural sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	death: ols	death: fe	disaster: ols	disaster: fe	crop: ols	crop: fe	market: ols	market: fe
shock at 0-6 y.o.	-0.006 (0.01)	0.030 (0.02)	-0.002 (0.02)	0.057 (0.04)	-0.014 (0.01)	-0.002 (0.01)	-0.002 (0.01)	-0.014 (0.02)
shock at 7-12 y.o.	-0.014 (0.02)	0.030 (0.02)	-0.057 (0.04)	-0.002 (0.04)	0.011 (0.01)	0.015 (0.01)	0.014 (0.01)	0.018 (0.02)
shock at 13-18 y.o.	-0.019 (0.02)	0.011 (0.03)	0.036 (0.04)	0.065 (0.05)	0.004 (0.02)	0.013 (0.02)	0.055*** (0.02)	0.047* (0.03)
shock at 19+ y.o.	-0.003 (0.02)	-0.004 (0.03)	0.001 (0.03)	0.067 (0.07)	0.001 (0.01)	0.045** (0.02)	0.008 (0.02)	0.006 (0.03)
Observations	12512	12512	12512	12512	12512	12512	12512	12512

Standard errors in parentheses

Notes: ols and sibship fixed-effects estimates; data from IFLS surveys 1993-2000; sample of siblings in 1997-2000;

controls: age, gender, birth rank, set of hh charact. in ols.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 15: Household shocks and employment in 1997-2000: effects by child age at occurrence, rural sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	death: ols	death: fe	disaster: ols	disaster: fe	crop: ols	crop: fe	market: ols	market: fe
shock at 0-6 y.o.	0.047 (0.10)	0.134 (0.12)	0.293 (0.29)	0.237 (0.48)	0.103 (0.09)	0.179* (0.11)	-0.074 (0.09)	0.115 (0.18)
shock at 7-12 y.o.	0.015 (0.03)	0.073 (0.07)	0.002 (0.06)	-0.067 (0.16)	0.095*** (0.02)	0.201*** (0.05)	0.051 (0.03)	0.048 (0.08)
shock at 13-18 y.o.	0.001 (0.03)	0.011 (0.06)	-0.010 (0.05)	-0.093 (0.13)	0.016 (0.02)	0.059 (0.04)	0.012 (0.03)	0.019 (0.07)
shock at 19+ y.o.	0.012 (0.03)	-0.043 (0.06)	0.013 (0.06)	-0.033 (0.16)	0.033 (0.03)	0.083** (0.04)	-0.010 (0.04)	-0.035 (0.06)
Observations	4129	4129	4129	4129	4129	4129	4129	4129

Standard errors in parentheses

Notes: ols and sibship fixed-effects estimates; data from IFLS surveys 1993-2000; sample of siblings in 1997-2000;

controls: age, gender, birth rank, set of hh charact. in ols.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 16: Household shocks and educational attainment in 2007: effects by child age at occurrence, urban sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	death: ols	death: fe	disaster: ols	disaster: fe	job loss: ols	job loss: fe	market: ols	market: fe
shock at 0-6 y.o.	-0.087 (0.14)	-0.185 (0.27)	-0.218 (0.19)	-0.583 (0.40)	-0.005 (0.15)	0.122 (0.26)	0.391** (0.19)	-0.322 (0.36)
shock at 7-12 y.o.	-0.215 (0.17)	-0.387 (0.29)	-0.461* (0.24)	-0.893** (0.43)	-0.392** (0.19)	-0.122 (0.27)	0.131 (0.18)	-0.464 (0.36)
shock at 13-18 y.o.	-0.239 (0.19)	-0.693** (0.28)	-0.790** (0.34)	-0.827 (0.51)	-0.409* (0.22)	-0.077 (0.31)	0.238 (0.24)	-1.079*** (0.37)
shock at 19+ y.o.	0.010 (0.27)	-0.653** (0.30)	0.020 (0.40)	-0.040 (0.46)	-0.171 (0.30)	0.013 (0.34)	-0.180 (0.51)	-1.085** (0.45)
Observations	5453	5453	5453	5453	5453	5453	5453	5453

Standard errors in parentheses

Notes: ols and sibling fixed-effects estimates; data from IFLS surveys 1997-2007; sample of siblings in 2007;

controls: age, gender, birth rank, set of hh charact. in ols.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 17: Household shocks and educational attainment in 2007: effects by child age at occurrence, rural sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	death: ols	death: fe	disaster: ols	disaster: fe	crop: ols	crop: fe	market: ols	market: fe
shock at 0-6 y.o.	0.095 (0.13)	0.342* (0.20)	-0.133 (0.23)	0.087 (0.42)	0.069 (0.10)	-0.065 (0.15)	0.287** (0.12)	0.118 (0.22)
shock at 7-12 y.o.	-0.345** (0.15)	-0.129 (0.22)	-0.701* (0.36)	-0.654 (0.61)	-0.124 (0.11)	-0.390** (0.15)	0.275** (0.14)	0.320 (0.23)
shock at 13-18 y.o.	-0.524*** (0.20)	-0.265 (0.27)	0.156 (0.39)	-0.025 (0.57)	0.098 (0.13)	-0.162 (0.16)	0.479*** (0.17)	0.305 (0.26)
shock at 19+ y.o.	-0.073 (0.30)	-0.459 (0.37)	0.305 (0.69)	0.546 (0.68)	-0.670*** (0.21)	-0.625*** (0.22)	0.032 (0.28)	0.004 (0.31)
Observations	6454	6454	6454	6454	6454	6454	6454	6454

Standard errors in parentheses

Notes: ols and sibship fixed-effects estimates; data from IFLS surveys 1997-2007; sample of siblings in 2007;

controls: age, gender, birth rank, set of hh charact. in ols.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$



Table 18: Household and locality shocks and educational attainment in 2007: effects by child age at occurrence, urban and rural samples

	(1)	(2)	(3)
	disaster: rural	crop loss: rural	disaster: urban
hh shock at 0-6 y.o.	0.063 (0.43)	-0.091 (0.16)	-0.599 (0.40)
hh shock at 7-12 y.o.	-0.622 (0.61)	-0.402*** (0.16)	-0.890** (0.43)
hh shock at 13-18 y.o.	0.031 (0.57)	-0.165 (0.16)	-0.796 (0.51)
hh shock at 19+ y.o.	0.657 (0.69)	-0.615*** (0.22)	0.008 (0.46)
loc shock at 0-6 y.o.	0.318 (0.27)	0.582 (0.36)	0.024 (0.32)
loc shock at 7-12 y.o.	-0.089 (0.35)	0.409 (0.36)	-0.345 (0.41)
loc shock at 13-18 y.o.	0.059 (0.40)	0.350 (0.38)	-0.652 (0.45)
loc shock at 19+ y.o.	-0.355 (0.57)	0.227 (0.46)	-1.279* (0.66)
Observations	6454	6454	5453

Standard errors in parentheses

Notes: sibship fixed-effects estimates; hh and locality-level shocks; data from IFLS surveys 1997-2007; sample of siblings in 2007; controls: age, gender, birth rank.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$