Human Capital and Shocks:
Evidence on Education, Health and Nutrition

Elizabeth Frankenberg
Duke University

Duncan Thomas
Duke University

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Abstract

Human capital, including health and nutrition, has played a key role in the literature on poverty traps. Economic shocks that affect human capital during early life are thought to translate into permanently reduced levels of human capital and, thereby, push individuals into poverty. Three potential concerns in this literature are explored with empirical evidence drawn from primary longitudinal survey data collected before and after two major shocks in Indonesia: the 1998 financial crisis and the 2004 Indian Ocean tsunami. First, it is very hard to identify shocks that are unanticipated and uncorrelated with other factors that affect human capital outcomes. Second, and related, there is abundant evidence that individuals, families and communities invest in strategies that are designed to mitigate the impact of such shocks. The nature and effectiveness of the myriad array of these behaviors vary with the context in ways that are not straightforward to measure or model. Third, the impacts of shocks on human capital outcomes in the short and longer-term may differ precisely because of the behavioral changes of individuals and their families so that drawing inferences about the longer-term impacts based on negative impacts in the short term can be very misleading. The picture of remarkable resilience that emerges from investigating the impacts of major shocks on child health and human capital in Indonesia is nothing short of stunning.

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1. Introduction

Nutrition, health and human capital have played a key role in the literature on poverty traps. The nutrition wage hypothesis posits that agricultural workers could earn a wage that was so low they would be trapped in a recurring cycle of poverty in which they were unable to feed themselves sufficiently well to sustain the productivity necessary to be able to climb out of the poverty trap. The model was among the early descriptions of poverty traps and underlies the larger literature on the efficiency wage hypothesis (Liebenstein, 1957; Mazumdar, 1959; Shapiro and Stiglitz, 1984). Investments in human capital, broadly defined to include nutrition, health, education and cognition, have been shown to be central mechanisms through which an individual, family, community and state may be lifted out of poverty and out of enduring poverty traps.

A large theoretical and empirical literature links shocks to poverty and poverty traps. The loss of resources because of an unanticipated negative shock results in a spiral down into ever greater poverty because of a loss of earnings capacity (due to, for example, a health shock), a greater debt burden (to cover the costs of the losses associated with the shock) or the loss of a productive asset that an individual simply cannot replace (because of a lack of liquidity or credit markets or because the asset is not worth the replacement cost).

The goal of this research is to evaluate some of the evidence on the links between shocks, on one hand, and health and human capital outcomes, on the other hand. We focus on the impact of shocks on human capital during early life and examine the extent to which the human capital of populations and population sub-groups display resilience in the face of an adverse economic shock.

Three main points emerge. First, it is very hard to identify shocks that are unanticipated and uncorrelated with other factors that affect human capital investments and outcomes. One reason is that investing in child human capital is universally recognized as important and individuals and families are likely to attempt to mitigate the impact of shocks on the human capital of the next generation. This is our second point: establishing generalizable evidence on the impact of a shock is complicated by the fact that there may be behavioral responses to mitigate the impact of the shock and the nature and effectiveness of those behaviors will vary with the context in ways that are not straightforward to predict or model. Third, even in cases that seem relatively straightforward to model, the impacts of shocks on child human capital outcomes in the short and longer-term may differ precisely because of the behavioral changes of

individuals, families and communities it response to the shock. As a result, drawing inferences about the longer-term impacts based on negative impacts in the short term can be very misleading.

2. Early life shocks and human capital in later life

Many studies have investigated impacts of early life shocks on later life outcomes. The earliest shocks an individual will experience, those that occur in utero, have been linked to health in adulthood. Building on a foundation in biology, and drawing on evidence from animal and human models, in a very creative body of research, Barker describes the impact on the fetus of nutrition insults at specific times during the pregnancy. As an example, he elucidates pathways from a shock at the time when arteries are being developed in utero to hardened arteries and coronary heart disease in mid- life (Barker, 1995). Links between in utero shocks, birthweight, adult health and premature mortality have all been widely documented.

For example, influential research has exploited the timing of ration restrictions because of the Nazi occupation of the Netherlands during the second World War to establish the impact of nutrition shocks on health and well-being in adulthood. Critically important for this research on the Dutch Hunger is that rations were restricted in areas where the resistance was active but rations were not changed in other areas, so that women who were pregnant and living in the resistance areas experienced a negative nutrition shock while pregnant women in other areas served as controls. The restriction of rations in the resistance areas was not anticipated and short-lived; there was very limited scope for moving to avoid the restrictions. Assuming women who were pregnant at the time and living in the resistance areas are exchangeable with pregnant women living in other areas in the Netherlands, it is possible to identify a casual effect of in utero nutrition shocks through comparisons of birth and later health outcomes of those who were in utero at the time.

Moreover, as predicted by Barker, the precise timing of the nutrition insults plays a key role. Research on the impact of the Dutch Hunger finds that those who were exposed early during the fetal period were at elevated risks of obesity, lipid dysregulation, cardio-vascular disease and premature mortality. They were also less likely to be working in their fifties although there does not appear to have been any impact on earnings of those who were working. In contrast, those who were exposed only towards the end of the gestation period were more likely to be born small but there is little evidence that adult health or economic outcomes were affected,

(Ravelli et al, 1998; Ravelli et al, 1999; Roseboom et al, 2001; Rooij et al, 2010, Scholte et al, 2015).

This evidence is consistent with programming in utero to develop a "thrifty phenotype" as an adaptive response to nutrition insults (Hales and Barker, 1992). Specifically, nutrition deprivation early during gestation programs the fetus to adapt to the environment and extract all the nutrients possible from the placenta. Having been programmed to do this in utero, the body continues to maximize nutrient absorption after birth which results in poor health outcomes in later life. Nutrition deprivation towards the end of gestation does not cause the same type of re-programming.

Many studies have investigated the longer-term consequences of in utero insults using, for example, variation in rainfall, famines, infectious disease prevalence or virulence (such as zika, ebola or influenza), terrorist attacks, civil conflicts and, weather-related and other natural disasters. The key issue with any natural experiment is that the variation underlying identification of the causal effect must be outside the control of the mother, her family and society more broadly. In some cases, this calls for strong assumptions.

As an example, studies have exploited the timing of Ramadan, the month of fasting in the Muslim calendar, to identify a causal effect of nutrition deprivation in utero (Almond and Mazumder, 2011; Almond, Mazumder and van Ewijk, 2015; van Ewijk, 2011). There are at least three concerns with this line of inquiry. First, Ramadan occurs on an established calendar and, give or take a day or two, its timing is known years in advance. In societies where contraception is widespread, pregnancy timing is, at least in part, a choice. Second, it is permissible for pregnant women not to fast if their own health or that of their baby is at risk. It is, therefore, difficult to test whether the assumptions underlying the identification strategy of a causal impact of in utero calorie restriction are met in the study populations. This is important because, in general, studies in this literature report intent to treat estimates and if adherence to fasting is not universal, it is not clear how to generalize the results. Moreover, the majority of these studies use census or register data and thus examine very large samples in which case it is not clear that it is appropriate to rely on a classical testing strategy that fixes the probability of rejecting the null when it is correct at, say, 5 percent, so that the probability of rejecting the alternate when it is correct becomes infinitesimally small. If these studies were to adopt an information-based criterion for model selection that trades off Type I and Type II errors, such as the Schwarz criterion (Schwarz, 1978), then the estimated effects of Ramadan are typically not statistically significant. Taking this and the fact that estimated effects are typically modest in magnitude, the

evidence that Ramadan affects later life cognition or education seems weaker than claimed in the literature.

In a widely-cited and very influential study, Almond (2006) examines the impact of in utero exposure to the 1918 influenza pandemic on education, work and income in adulthood among those born in the U.S. This creative study combines the unanticipated nature of the influenza pandemic in the fall of 1918 with census data and compares outcomes of birth cohorts exposed to the pandemic in utero with surrounding birth cohorts. Almond concludes that males who were exposed in utero completed fewer years of education, had lower income, poorer socio-economic status, received more in public transfers and were more likely to have physical disabilities. Studies conducted in other countries have drawn similar conclusions.

A difficulty with this identification strategy is that there may be other, unobserved differences between the affected cohort and the surrounding cohorts. This would seem plausible given that the fall of 1918 was also the end of World War I. This point is made in Brown and Thomas (2016) who demonstrate that the fathers of those who were in utero in the U.S. at the time of the influenza pandemic tend to be lower SES than the fathers of the surrounding birth cohorts. They also show that the same pattern is observed in other countries and likely explains at least some of those results.

These examples are not intended to imply that there are no long-term consequences of in utero shocks. Clearly, there are. Rather, the point is that even seemingly well-identified studies may not be as well identified as they seem. Importantly, whereas several studies have established that early life shocks have long term consequences on health, establishing that in utero shocks have long-term impacts on education and socio-economic status, and, thus on poverty, has proven to be somewhat more difficult to establish.

3. Financial shocks, human capital and behavioral responses

A second concern that arises with interpreting results of studies of the impact of shocks on human capital outcomes is that even if a shock is truly unanticipated and did not coincide with other events that affected human capital, the impact of the shock may be mitigated by behavioral responses of individuals, their families and their communities. This is important since there is considerable evidence that children who are born into disadvantaged environments are not necessarily destined to have poor human capital outcomes in adulthood. (See, for example, Heckman, 2006.)

There are at least two concerns with inferences drawn under the assumption that there are no behavioral responses to a shock. First, if individuals and their families invest in behaviors that mitigate the impact of the shock on, say, human capital, the finding that the shock had no impact on human capital outcomes in the immediate term may be misleading if the mitigating behaviors affect future investments. For example, if a household liquidates assets when prices are relatively low in order to keep a child in school, it is possible that the reduced long-run wealth will have negative impacts on future well-being. Moreover, it is important to trace out these types of responses in order to develop a fuller understanding of the impacts of shocks on human capital.

Second, if some individuals and families are more able to smooth the impact of a shock than others, distributional impacts of the shock on human capital outcomes at a point in time may not be informative about the incidence of the initial impact of the shock or about the longer-term consequences of the shock.

These concerns are illustrated using empirical evidence from one example of the global financial crisis that occurred at the end of the 20th century. Specifically, we focus on Indonesia, the country that experienced the most disruption as a result of the East Asian financial crisis and draw on longitudinal data that we collected specifically to measure the impact of the crisis on individual, household and family behavior as well as trace out behavioral responses to the crisis. For a discussion of other external shocks see, for example, Darnto-Hill and Cogill (2010).

The 1998 Indonesian financial crisis

After almost three decades of sustained economic growth, of all the East Asian countries Indonesia was hit the hardest by the 1997 financial crisis. As shown in Figure 1a, the Indonesian rupiah came under pressure in the last half of 1997 when the exchange rate began showing signs of weakness. The rupiah fell from around 2,400 per US$ in the middle of the year to about 4,800 per US$ by the end of 1997. In January 1998, the rupiah collapsed. Over the course of a few days, the exchange rate fell by a factor of three to Rp 15,000 per US$. Although it soon recovered, by the middle of the year the rupiah had slumped back to the lows of January, 1998. By the end of 1998, the rupiah had strengthened to around Rp 8,000 per US$. No other East Asian country experienced as deep or as prolonged a decline in the exchange rate.

Interest rates in Indonesia behaved much like the exchange rate: they spiked in August 1997 -- when they quadrupled -- and they remained extremely volatile through all of 1998. Chaos reigned in the banking sector and several major banks were taken over by the Indonesian Bank

Restructuring Agency. All of this turmoil has wreaked havoc with both the confidence of investors and the availability of credit. Asset prices collapsed – both in the stock market and real asset including land.

Simultaneously, there was dramatic transformation in the political sector. Protests across the country that began in January 1998 culminated in May 1998 with Suharto's resignation after three decades in power. Uncertainty in the country was widespread and while the incoming president, Habibie, declared that multi-party elections would be held, it was very difficult to predict whether the elections would, in fact, be held, whether the outcome would result in further turmoil and whether there would be any fundamental change in the political sphere. It turned out that Suharto's resignation presaged the ushering in of democracy in Indonesia – an outcome that few predicted at the time (Fisman, 2001).

The 1998 financial and political crisis was a major shock. Overall, GDP per capita in 1998 was about 15% below its level in 1997 (Figure 1b). This downturn is about the same magnitude as the Great Depression in the U.S.; by contrast, GDP per capita declined by less than 5% during the 2008 Great Recession. The Indonesian crisis was not only large; it was also largely unanticipated and, certainly, its severity was a shock both inside and outside the country.

In January 1998, the IMF described Indonesia's economic situation as "worrisome" (IMF, 1998) and, at the same, the Indonesian government announced policies to address the situation, predicting economic growth for 1998 would be zero. Indeed, the president of the World Bank summed up the situation in July 1998 saying "we were caught up in the enthusiasm of Indonesia. I am not alone in thinking that 12 months ago, Indonesia was on a very good path."

One way to summarize the impact of the crisis on the lives of Indonesians is through its impact on prices. Prices of many commodities spiraled upwards during the first three quarters of 1998. As shown in Figure 2, according to Statistics Indonesia, annual inflation was between 5 and 10% from the early 1980s to 1997. In 1998 inflation rocketed to an unprecedented 80% in a matter of months. Subsidies were removed from several key goods, most notably rice, oil and fuel, the prices of which were pegged by the government at levels below world prices. As the rupiah collapsed, those subsidies became unsustainable and were scaled back along with other public expenditures. Food prices, driven primarily by the rise in the price of the staple, rice, rose by 120%, which is about 50% more than the general price index.

Net food consumers were severely impacted by the crisis whereas net food producers either received some protection or possibly benefited from the crisis. The financial crisis provided new

opportunities in the export sector, but it was a major negative shock for those on fixed incomes and those outside the tradeable sector.

Immediate impacts on child health and education

To provide empirical evidence on the immediate impacts of the shock on human capital outcomes, we draw on data from the Indonesia Family Life Survey (IFLS) that were specifically designed to provide evidence on this question. The second wave, IFLS2, was fielded between August 1997 and February 1998. The main fieldwork was completed by mid-December 1997 and a small number of very difficult tracking cases were completed in January and February, 1998. Because of the political and financial crisis, we decided to conduct a special rapid-response survey, IFLS2+, between August and December 1998 in order to provide a snap-shot of the immediate impact of the shock (Frankenberg and Thomas, 2000).

It was imperative to put IFLS2+ in the field without delay in order to measure the impact of the onset of the crisis. Since it was not possible to mount an entire wave of IFLS in a short time-frame, for IFLS2+ we selected a sample of one in four enumeration areas that were included in the 1993 IFLS baseline. IFLS2+ collected information from all the respondents who were living in those enumeration areas at the baseline, including those who had moved away. This is important because migration was a potential response to the crisis.

IFLS2 returned to the baseline enumeration area and interviewed every member of the baseline households in the community. Baseline respondents who had moved were tracked and interviewed in the new location, along with the members of their new household. IFS2 re-interviewed at least one member of 94% of the baseline households (Thomas, Frankenberg and Smith, 2001).

IFLS2+ followed the same protocols, returning to the location of each household interviewed in IFLS2, interviewing all members and tracking movers to their new locations. IFLS2+ interviewed at least one member of over 99% of the households interviewed in IFLS2 and over 96% of all baseline households. (Frankenberg, Thomas and Beegle, 1999).

Data from IFLS2 and IFLS2+ provide a useful description of the magnitude of the shock that households experienced. The ILO predicted that millions would join the ranks of the unemployed because of the crisis and called for public works programs. Wage employment did decline – but only by 2% -- and it was more than offset by an increase in the number of people working in self-employment, particularly females who joined family businesses. With the dramatic

increase in the price of rice, the number of people working in the agricultural sector rose and there was considerable migration from urban to rural areas. While the drama of the crisis was not reflected in employment, it was reflected in hourly earnings.

Between 1986 and 1997, in the market sector, real hourly wages grew by over 40% on average. In 1998, all of those gains were wiped out: real wages declined by 40% because nominal wages did not keep up with rising prices. In the self-employed sector, hourly earnings declined by 40% in urban areas. In rural areas, hourly earnings of females declined by 40% but those of males were little changed. To some extent, this reflects the impact of the price of rice (and food) and also the contributions of unpaid family workers (who contributed more work on the farm in 1998 on average than in 1997). Overall, household income declined by 30% between 1997 and 1998, a substantively very large and statistically significant change. (Smith et al, 2002).

There is some evidence that households smoothed these real income declines as real household per capita expenditure (PCE) declined 23%, with the biggest declines occurring among those who were best off prior to the crisis. Using the PCE distribution from 1993, the households at the 75th percentile reduced PCE by 30%, whereas the decline was 15% for the households at the 25th percentile of the 1993 PCE distribution. The crisis appears to have hit PCE of those who were better off the most although, to be sure, the declines are very large and statistically significant throughout the pre-crisis distribution of PCE. (Frankenberg, Smith and Thomas, 2003).

What was the impact on human capital of children over the short term? We first examine anthropometric outcomes and then turn to education. Anthropometry is measured for all household respondents in IFLS. Figure 3 displays the z score of height for age (in the upper panel) and weight for height (in the lower panel) of all children age 9 and under measured in IFLS2, before the onset of the financial crisis, and in IFLS2+, after the onset of the financial crisis. Height for age is a longer-run indicator of nutritional status and an important marker of health in and of itself. In addition, length during the first few years of life has been shown to be affected by health and disease-related shocks and it is thought that length by around 24 or 30 months is a very good predictor of attained adult height which, in turn, is predictive of longevity, improved health, educational attainment and socio-economic success. Weight-for-height is a measure of shorter-run nutritional status and is likely to reflect the impact of recent health inputs including food intake and disease insults. (Martorell and Habicht, 1986; Alderman, Hoddinott and Kinsey, 2006; Hoddinott et al., 2008; Maluccio et al., 2009; Hoddinott et al., 2013).

There is no evidence that child height for age was deleteriously impacted by the financial crisis. Specifically, there are no significant differences in height for age for any of the age groups

although the sample size for the very youngest, and arguably the most vulnerable, is too small to be informative. The evidence on weight for height is less clear for children age under 36 months with these children having lower weight, given height, in the 1998 survey relative to the 1997 survey. The difference, however, is not statistically significant and, importantly, the deficits in weight for height for the youngest children are not evident in height for age.

Figure 3 is based on all children in both surveys, including new entrants into the 1998 survey in order to capture new births and mitigate the costs of the relatively small sample size. There were few new entrants and with 99% recontact, attrition is ignorable. The figures restricted to panel children are essentially the same. While the samples are small, separating rural from urban households does not suggest differential effects across these sectors in anthropometric outcomes.

Results for school enrollment are displayed in Table 1. Among children who, in 1997, were aged 13 to 16 years old, 25.6% were not enrolled in school in 1997, whereas in 1998, 25.1% of the children in that age group were not enrolled: with the onset of the crisis, the fraction not in school decreased by 2%. However, among children age 7 to 12, 3.1% were not enrolled in school in 1997 and 5.9% were not enrolled in 1998: a 90% increase in non-enrollment. This gap was largest for the poorest households: for the households in the bottom quartile of PCE (in 1997), 4.9% of the children were not enrolled in school in 1997 and 10.7% were not enrolled in 1997: an almost 120% increase in non-enrollment. Further, for poor children in this age group, having an older sibling who was enrolled in school was associated with a greater chance of not being enrolled. And, conversely, older poor children whose younger siblings who were not in school in 1998 were themselves more likely to be enrolled in 1998. We find no differences between urban and rural children or between male and female children (Thomas et al, 2004).

Why would older children in the poorest households stay in school when their younger siblings were not enrolled? There are at least two plausible reasons. First, if a 13 to 16 year old does not enroll in school in a year, that child is not likely to return to school in the future. However, for younger children, being out of school for a year, say, is less likely to have long-term consequences because dispersion in the ages of children in each grade is enormous and so re-entering when the child is a year older is not difficult. This reflects the combination of a great deal of variation in the age at which children start school and the high rates of repetition of grades in primary school. Second, the labor market returns to primary school education are very low in Indonesia whereas the returns to secondary school and college are substantial and thus the long-term economic costs of not completing secondary school likely weighed on family decision-making. It turned out that keeping older children in school was a good choice: by 1999, a

scholarship program had been implemented so that the costs of enrollment were forgiven if families were unable to afford them. These included the costs of fees, uniforms, transport costs and examination charges. By 2000, enrollment rates and disparities across the income distribution had all returned to their pre-crisis levels (and disparities had been reduced).

Intra-household substitution favoring school enrollment of older children over younger children is one mechanism that families used to mitigate the impact of the shock on human capital. There is evidence that adults literally tightened their belts to assure that the growth of the young children did not falter in the face of the crisis. Figure 4 displays the body mass index (BMI), which is weight (in kgs) divided by the square of height (in m) of males (in the upper panel) and females (in the lower panel) by age in 1997 and 1998. BMI rises with age until around the mid-forties and then declines. Height does not change for prime age adults and so this reflects changes in weight. The remarkable result is the dramatic decline in BMI across the entire age distribution for males and females between 1997 and 1998. On average, the declines are slightly smaller among adults who were living in rural areas prior to the crisis. However, overall, it is the oldest females whose weight declined the most: among females age 60 and older in 1997, weight declined by 15% in one year. This is unlikely to reflect the impact of energy expenditure and so we conclude that these women reduced their food intake of favor of their grandchildren. Block et al (2004) draw similar conclusions that child nutritional status was protected at the expense of the nutritional status of female adults using data collected in rural Central Java.

How did households smooth consumption? There are three key mechanisms. First, people moved. Urban dwellers moved to the rural sector. As the rupiah collapsed, the non-tradeable sector took the greatest toll with construction and other services being especially hard hit. Workers in these sectors were more likely to be in urban areas. In contrast, the tradeable sector was a relative beneficiary with the farming sector benefitting from the very large increase in the price of food (particularly rice). Thus, relative to the urban sector, the rural sector was to some extent protected from the impact of the crisis and so urban workers moved to the rural sector where there were there were opportunities to earn income from working on a farm. In addition, since the cost of living is lower in the rural sector, family members who were not working also moved from the urban to the rural sector. Furthermore, household members moved in together to benefit from economies of scale of living arrangements. As shown in Table 2, overall, household size increased significantly from 4.33 to 4.53 members, with the increase being slightly (and not significantly) greater in rural areas (because of urban to rural migration).

Second, whereas, on average, the percentage decline in real household per capita expenditures was 23%, food expenditures were protected and the average percentage decline was 9%. This reflects the combination of reduced food intake and increased price of food. Households cut spending on two classes of goods. First, spending on clothing, furniture and ceremonies was reduced by 35% ; we call these items 'deferable' because delaying spending on these items for the short term is unlikely to have the same impact on welfare as reduced spending on, for example, staples. (See Browning and Crossly, 1997, for a discussion of deferred spending.) Second, spending on health and education fell by 37%. The reduction in education spending reflects the combination of young children not attending school and parents cutting back on school expenditures (including paying fees). The reduction in spending on health is reflected in a dramatic reduction in use of health care during the year after the onset of the financial crisis relative to before the crisis. Whether these cuts in spending have longer-term consequences for welfare depends on the longevity of the cut, whether delayed care will have result in poor health in the future and whether the child's schooling is affected over the longer term. All of these changes in spending are statistically significant.

Third, households are likely to draw down savings or sell off assets to mitigate the impact of the crisis (Deaton, 1992; Browning and Lusardi, 1996). The value of that strategy was limited by the fact that many assets collapsed in value. Savings in cash lost value as inflation rocketed. The Jakarta stock exchange had lost 75% of its pre-crisis value by the middle of 1998. Land and housing markets dried up along with credit markets. One important asset rose in value: gold. The price of gold is set in world terms and so as the rupiah fell to below half its pre-crisis level, the value of gold more than doubled. There is an active market for gold which is sold by weight and according to the IFLS community survey, there is a gold seller within half an hour travel time of every IFLS community. In 1997, over half the households owned gold and the vast majority of this gold was in the hands of women. By 1998, a substantial fraction of the gold had been sold. In regression models of that link changes in budget shares to pre-crisis assets, we find that spending on health and education are protected the most by gold ownership, an effect that is not only statistically significant but also substantively important(Frankenberg, Smith and Thomas, 2003).

We conclude that even in the face of a very large financial shock, Indonesian households and families sought to protect the human capital of the next generation through every means possible: they migrated, moved in together, took up work, particularly in family businesses, cut spending, especially on deferrable items, reduced spending on some members in favor of others

and spent down savings, primarily gold. In so doing, the immediate impact of the financial crisis on the nutrition and schooling of children were minimized.

Longer-term impacts on child health and education

While there is little evidence of large, negative impacts of the financial crisis in the short-term, the fact that households sold assets, particularly gold, and shifted spending to sustain human capital investments suggests that over the longer-term the crisis may have resulted in worse health and education outcomes for those that were affected. IFLS is a long-term panel study that has followed the same respondents since the financial crisis with the third wave conducted in 2000, the fourth wave in 2007/8 and the fifth wave in 2014/15 (Strauss et al, 2004, 2009, 2016).

Using data from the 2000 and 2007/8 waves, it is possible to trace the evolution of nutritional status of children exposed to the financial crisis. The relationships between height for age and age of the child at the time of the survey are displayed in Figure 5 for all children in panel A, and separated by whether the child was living in an urban or rural area in 1997, prior to the crisis, in panel B. Sector of residence is a proxy for the magnitude of the negative shock which took a greater toll on urban households.

Height for age of children prior to the crisis in 1997 is displayed by the solid blue line. Children at greatest risk of being stunted in the long-run are those who were age 30 months or younger at the time of the crisis (the red dashed line) and would be age 2 through 4.5 years old in the 2000 wave (the black dashed line). Children in this age group are not only taller than those of the same age in 1998 but even those of the same age in 1997, prior to the crisis. This is true for all children in the age group (in the upper panel) and for urban and rural children, separately (in the lower panel), indicating that the crisis did not have a negative impact on linear growth of this cohort. Height for age eight years later in 2008 (in the green broken line) is greater for every age than in any other year. For the cohort that was exposed to the financial crisis in the first 30 months of life (age 9 through 11.5 years at the time of the 2008 survey), height for age is the same as its level in 2000 as would be expected if height for age is largely determined by 30 months. Since height in 2008 is likely to be a very good predictor of attained height as an adult, we conclude there is no evidence that height of children was deleteriously impacted by the financial crisis and the short-run evidence indicating that child height was protected by family responses carries through to the longer-term.

Figure 6 displays results for BMI for the same cohorts of children. In this case, it is not only those children age less than 30 months who are at risk of being impacted by reduced resources because of the crisis since, unlike height, weight does vary over the entire life course depending on current net energy intake and nutrient absorption. The relationship between BMI and age is remarkably similar for all children in the 1997, 1998 and 2000 waves of IFLS. By 2008, children in every age are heavier, given height. We conclude that nutrition outcomes were also not deleteriously affected by the financial crisis over the longer term; see also Strauss, Beegle, Dwiyanto et al. (2004); Thomas and Frankenberg (2007).

Exploiting the long-term panel dimension of IFLS, we investigate completed years of education in 2014, sixteen years after the onset of the financial crisis, of respondents who were interviewed in IFLS2 in 1997, before the crisis. We focus on respondents who were age 5 through 21 in 1997 and thus age 22 through 38 in 2014. The vast majority of these respondents will have completed their schooling by 2014 and so the number of completed years of education at that time is indicative of the human capital the respondents will carry with them for the rest of their lives.

As discussed above, and shown in Table 1, children age 13 through 16 were no less likely to be enrolled in school in 1998 relative to 1997 but young children, age 7 through 12 and especially those from poor households (from the bottom quartile of the distribution of PCE) were significantly less likely to be in school. What were the longer-run consequences for education?

Figure 7 displays mean years of completed schooling in 2014 for each age cohort stratified by sector of residence and level of household resources, all measured in 1997. The respondents are separated into those who were living in households in the bottom quartile of PCE and those living in other households. As shown by the linear trends in age, estimated separately for each of the four groups, completed years of schooling has risen for each successive birth cohort included in the figure. While children from the poorest households complete less schooling than those from better off households, the gap has remained approximately constant for rural dwellers but in urban areas, the rate of growth is faster among the poorest children and so those children in the youngest cohort have almost caught up with their same age peers in better off urban households.

There is no evidence that educational attainment of children who were age 7 through 12 years and living in the poorest households in 1997 was lower than predicted by the linear trend; in fact they completed slightly more education than predicted.[1] Nor is there evidence that protection

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[1] On average, 7 to 12 year olds in the poorest households completed 0.002 years of education more than predicted (standard error=0.17) and the same age children in better off households completed 0.04 years more education than predicted (standard error=0.14).

of 13 to 16 year olds at the time of the financial crisis resulted in significantly higher levels of completed education on average for that cohort.[2]

It is clear from the figure, however, that there is one birth cohort for whom completed schooling deviates from its predicted level: those age 8 years living in households in the lowest quartile of PCE in urban areas in 1997. The gap, almost 2 years of education, is both large in magnitude and statistically significant (the standard error is 0.6 years of education) and pushes this cohort back to the same level of education as the cohort born eight years earlier.

This evidence is summarized in panel 1 of Table 3 which reports the relationship between completed years of schooling and age, with indicator variables for the cohort age 8 years old in 1997 and gender of the child. The rate of growth in educational attainment by birth cohort is displayed in the first row of panel 1 of the table and the difference from the expected education and actual education for the eight year old cohort is in the second row. In contrast with eight year olds in poor urban households, those in better off urban households and those in rural households were not disadvantaged by the financial crisis. Since there is no evidence that the education of children from urban households in the top three quartiles of PCE at the time of the financial crisis was disrupted by the financial crisis, those children provide a useful comparison group for the poorest urban children. The gap in educational attainment between the poorest and better off children in urban areas is displayed in column 3 of the table: it is also significant. An additional contrast is drawn between the poorest and better off eight year olds in rural areas: there is no difference in their educational attainment. (The difference in difference between poorer and better off eight year olds in urban and rural areas is large and statistically significant; it is 1.97 years with a standard error of 0.87 years.)

Household composition and resources mattered for schooling at the time of the crisis. In panel 2 of the table, the models include ln(PCE) and detailed controls for the number of household members in fine age groups (for children) and larger age groups (for adults). The estimated differences between 8 year olds and other children are little changed.

It is possible that there are other household characteristics that are not included in the model that drive this difference and so, in panel 3 of the table, the models include household fixed effects. The gap for eight year olds is reduced by 40% and significant at only a 10% size of test (which is also the case for the difference between the better off and poorest urban children). This

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[2] Children age 13 to 16 years in 1997 in the poorest households completed 0.06 (se=0.18) more years of schooling and those in better of households completed 0.16 (se=0.12) more years of schooling. Neither effect is large or statistically significant.

suggests that there are time-varying household-level characteristics that enabled the families to smooth the educational attainment of 8 year olds in the poorest urban households.

These results suggest that among the children who were most likely to be out of school at the time of the financial crisis, specifically those children who were age 7-12 years and living in the poorest households in 1997, the vast majority have not been deleteriously affected in terms of their educational attainment in 2014. The only exception is 8 year olds in poor, rural households, who account for one in six of children age 7 through 12 in poor households and, even, among these children, the evidence suggests that the deleterious impact on their education was mitigated by time-varying household-level characteristics or behaviors related to those characteristics. The modest impact of the financial crisis on educational attainment of poor children in Indonesia may be a reflection of the temporary scholarship program that was instituted soon after the financial crisis.

The extent of resilience of child human capital outcomes after a shock that rivals the Great Depression in the United States in magnitude and occurred in a low income setting is nothing short of remarkable. This is not to argue that the shock had no welfare consequences for children and their families: it did. Poverty rates rose, wealth declined, the physical and psycho-social health of adults worsened, and it took several years for Indonesia to regain the lost ground. The impacts on human capital of children, however, are at most, very muted.

4. Natural disasters and human capital

In some cases, shocks are so devastating that mitigating their impact in the short-term is beyond the reach of even the most resourceful families. It is useful to contrast the immediate and longer-term impact on health and human capital of children of such shocks relative to shocks like the financial crisis. The 2004 Indian Ocean earthquake and tsunami provides a platform for this investigation.

2004 Indian Ocean earthquake and tsunami

The 2004 Sumatra-Andaman earthquake occurred at 8am on Sunday December 26, 2004, and registered 9.3 on the Richter scale. One of the strongest earthquakes in recorded history, it shifted the North Pole by several centimeters, caused a 1200 km rupture along the floor of the Indian Ocean and results in a tsunami that was felt across the entire Indian Ocean. The epicenter of the earthquake was about 150 kms off the west coast of the province of Aceh on the northern

tip of the island of Sumatra, Indonesia. Since the tsunami surge was greater than 800 km/hour, its impact was felt along the Acehnese coast within 15 minutes of the earthquake.

At the time, the Indian Ocean was not thought to be prone to tsunamis and there were no warning buoys or an early warning system (in contrast with the Pacific Ocean). According to archaeological data, there had not been a tsunami on the coast of Aceh for over 600 years.

The impact of the tsunami depended on a combination of the wave height, which reached up to 15 meters in some areas, the wave direction and the topography of the land. Areas that were low-lying (such as river basins) that faced the wave were devastated: in some areas water and mud reached up to 6 kms inland. Nearby areas that were higher up (because of a cliff, for example) or were protected from the wave by a promontory were not directly affected.

In the SUSENAS survey conducted by Statistics Indonesia in February/March 2004, about 10 months before the tsunami, fewer than 3% of all respondents in Aceh thought that it was likely they would experience a natural disaster such as an earthquake, tsunami or volcanic eruption and that fraction did not differ depending on whether their community was in fact directly affected by the tsunami. In sum, the tsunami was unanticipated; it was impossible to predict where it would hit along the Acehnese coast, and few people living in Aceh expected a large-scale natural disaster.

The tsunami was not only unanticipated; it was also a major shock. It is estimated that in Aceh, the earthquake and tsunami killed about 170,000 people which is about 5% of the total population of the province. About three-quarters of a million people (about 20% of the population) were displaced because their homes were destroyed or damaged. In addition to the loss of home, there was massive physical destruction. Roads and infrastructure were severely damaged and over 40,000 hectares of agricultural land were affected, with crop destruction and death of livestock. The World Bank estimated there was about $4.5 billion in property damage (Doocy et al, 2007; Frankenberg et at, 2008; Gray et al, 2012; Cossee, Hermes, and Mezhoud 2006).

There are at least three important dimensions to the shock from the perspective of examining the impact on child human capital. First, many lost assets, livelihoods, and members of their networks as their income-earning opportunities were wiped out and as family members were killed in the tsunami. Second, the destruction to roads and bridges reduced access to markets, which resulted in increases in the price of food, and the loss of housing resulted in increased rents. On both counts, those who were net sellers of food or housing benefited from the shock. Third, the loss of family and friends in the tsunami and the destruction and loss of livelihoods affected the psycho-social health and well-being of the population (Frankenberg et al,

2008). It is difficult to credibly disentangle the income (and asset) shock, price shock and psycho-social (stress) shock.

The tsunami was followed by the largest influx of aid after a natural disaster in any developing country up to that point. It is estimated that the combination of domestic and international aid from government and non-government sources totaled some $7.2 billion in assistance that was directed to recovery efforts in Aceh and North Sumatra. Initially, aid efforts focused on providing food and temporary shelter and it took several months for regular provision systems to be put in place. Food had to be transported by air or ship to reach many of the most devastated communities as the roads were impassable. Camps were constructed and a small number of displaced moved into camps within three months of the disaster, but the vast majority of camps were not constructed until later in 2005. After these needs were met, aid efforts focused on infrastructure investments – roads, bridges, public building and housing. The goal was to "build back better".

In short, in December 2004, there was a major shock that affected the lives of those living along the coast of Aceh at the time. It was followed by one of the most successful recovery programs conducted in a developing country. How did child human capital fare?

To answer this question, we draw on data from the Study of the Tsunami Aftermath and Recovery (STAR). The baseline sample is drawn from the 2004 SUSENAS conducted 10 months before the tsunami and includes all respondents who were living at the time in a kabupaten (district) along the coast of Aceh. SUSENAS is designed to be population-representative at the kabupaten level and so the baseline is representative of the pre-tsunami population that was affected, to varying degrees, by the tsunami. There are over 25,000 respondents in more than 6,000 households in some 400 communities.

We conducted the first follow-up of the SUSENAS respondents between May 2005 and June 2006 and we refer to that survey as STARB. Thereafter, we conducted four additional annual follow-ups (STAR C, D E and F) and have completed a 10 year follow-up (STAR G). In the first follow-up, finding and interviewing every survivor was critically important and extremely difficult. We have determined the survival status of over 98% of the baseline respondents. In most cases, we have found one or more of the surviving baseline household members and obtained survival status from those respondents. In some cases, however, no one in the household survived and in those cases we used multiple reports from neighbors, community leaders and service providers (in the health and education sectors) to assure that our designations are correct.

Post-tsunami follow-up of survivors has been very challenging. On the one hand, in areas that were severely damaged, all (or in some cases almost all) the survivors were displaced with about half moving to camps and the other half moving to private homes. Lack of infrastructure and damage to roads compounded the difficulty of tracking and interviewing the survivors. Over 96% of the survivors have been interviewed in at least one of the STAR follow-ups.

SUSENAS does not collect data on height of respondents. Given the complexity of the fieldwork, identifying, finding and interviewing surviving respondents in the first follow-up, we chose to not also burden the enumerators with the equipment necessary to measure height and weight and conduct other health assessments in that follow-up. Measurement of anthropometry along with the collection of other biomarkers was added in the second follow-up, STARC, which was in the field between July 2006 and June 2007. Anthropometry was measured in all subsequent waves. Those data are used in our analyses of child nutrition. (Frankenberg, Friedman, Ingwersen and Thomas, 2016).

In utero exposure to the tsunami and child height

We focus on the height for age of children who were in utero at the time of the tsunami and exclude all children born in areas that were very heavily damaged by the tsunami and where there were very high death tolls because of the tsunami. There are very few births in the nine months following the tsunami among women who were living in those areas and so the exclusion of those births has no perceptible impact on the estimates discussed below. Their exclusion assures that none of the results are contaminated by selective survival of the strongest mothers since women who were pregnant were much more likely to have died when they were swept away by the water than were women who were not pregnant.

The average height given age of this cohort at the time of the second follow up when the child was, on average about 15 months old is 1.76 standard deviations below the CDC norm. We compare the height for age of this cohort with the cohort born in 2002 since, according to the nutrition literature, the growth trajectory of the height of those children is thought to be largely determined by the time of the tsunami. Conception date is not known for children in STAR and so we examine children by quarter of birth and assume that those born in the first quarter of 2005 were in the third trimester at the time of the tsunami, those born in the second quarter were in the second trimester and those born in the third quarter were in the first trimester. Each birth cohort

is compared with the same quarter of birth cohort in the reference cohort.[3] The gap in the z-score of height for age of those exposed to the tsunami in utero in the second STAR follow-up (in 2006-7) is displayed in the first column of Table 4. All models also control gender of the child, month of interview and birth order. Children in the second or third trimesters of the pregnancy at the time of the tsunami are shorter than the reference cohort and the gap is large and statistically significant for those born in the second quarter of 2005. Based on this evidence, the unanticipated shock of the tsunami resulted in reduced linear growth of the children who were in utero at the time of the tsunami by the time they were, on average, 18 months old. This likely reflects the combination of the nutrition shock (because of the rise in the price of food and access to markets), the income shock (because of the loss of livelihoods) and the stress shock (associated with exposure to the horror of the tsunami).

One year later, however, the estimated gaps are smaller and after two years none of the gaps between the exposed and reference cohort is significantly different from zero. As shown in column 4, five years after the tsunami, the cohort exposed to the tsunami in utero is taller than the 2002 cohort and the differences are statistically significant for those born in the first and third quarters of the year. Growth in height for age between 2006/7 and 2009/10, relative to the reference cohort, is displayed in the fifth column of the table, restricting attention to those children measured in both waves: all of the exposed children have grown much faster, relative to the CDC norms than the reference cohort and the growth is greatest for those who had the largest disadvantage in 2006/7, those born in the second quarter. That group of children has grown over 1 standard deviation more than the reference cohort.[4]

It is possible that the growth trajectory of the reference cohort was affected by the tsunami; children in the reference cohort were born in 2002 and so were, on average, age 30 months at the time of the tsunami. The 2001 birth cohort was potentially affected by the 1998 financial crisis and so comparison with that cohort may be compromised. Results using this cohort as the reference are displayed in column 6 of the table and the results are not substantially affected. The cohort that was in utero at the time of the tsunami was born with very substantial deficits in length but have more than made up those deficits by age 4.

Nutrition and stress insults in utero are likely to have resulted in some fetuses being miscarried. It is possible to investigate this issue by comparing the impact of the in utero

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[3] It is important to note that it is likely that more of the children who were in utero at the time of the tsunami were born prematurely relative to the reference cohort and this effect is captured in the comparison of height for age.
[4] Results using the WHO norms are essentially identical. Recall that comparisons are made between standardized height for age of the exposed cohort with standardized height for age of the reference cohort.

exposure to the tsunami on males and females. Overall, miscarriages are more common for males largely because males are far more likely to be miscarried early in the pregnancy whereas females are more likely to be miscarried later in the pregnancy. Thus, males who were in the first or second trimester of the pregnancy at the time of the tsunami are more likely to have been miscarried, relative to males in the third trimester and so we expect the impact of the tsunami to be greatest on third trimester males who are most likely to be born in the first quarter of 2005. For females, those in the third trimester are more likely to be miscarried and so, among these fetuses, only the strongest are likely to have survived. Impacts of the tsunami are likely to be greatest on the fetuses exposed earlier in the pregnancy. These predictions are consistent with the data. The impact of in utero exposure is greatest for males in the third trimester of the pregnancy and females in the first and second trimesters at the time of the tsunami. There are two main conclusions. First, this establishes that miscarriage plays an important role and the estimated effects of the tsunami on child height should be interpreted with this in mind. Second, the fact that the evidence is consistent with the predictions of a biological model of miscarriage suggests that the results are unlikely to be driven by unobserved differences between the cohorts. It is, however, possible to test that hypothesis by estimating dose-response effects that compare the heights of children whose mothers had different exposures to the tsunami.

In the first post-tsunami survey, adults were asked a battery of questions about their exposure to the tsunami including, for example, whether they saw people die in the tsunami, whether they were swept away by the water, and whether they saw or heard the water: two-thirds of mothers who survived the tsunami saw or heard the water and one-third who did not. The children of mothers who saw or heard the water and were born in the second quarter of 2005 are about a standard deviation shorter than the reference cohort two to three years after the tsunami and are the same height as the reference cohort three to four years later. Among children in the second trimester whose mother did not see or hear the water, two to three years after the tsunami they are slightly but not significantly shorter than the reference cohort and three years later they are taller than the reference cohort. They are also taller than children in the same birth cohort whose mothers were exposed to the water. This evidence is consistent with a dose-response impact of exposure to the tsunami on length at birth and that the children whose mothers were most exposed have an enduring deficit in height for age.

In many contexts, those families with more resources at the time of a shock tend to mitigate the deleterious impact of the shock. We find no evidence that pre-tsunami resources – measured by household per capita expenditure, paternal education or maternal education – is

predictive of the magnitude of the height deficit two to three years after the tsunami or growth in height in the ensuing years.

There are several factors that potentially contribute to the fact that cohort that was in utero at the time of the tsunami grew faster than the reference cohorts. First, the success of the post-tsunami recovery effort resulted in rapid economic growth across all Aceh, providing new earnings opportunities for many families. These opportunities included reconstruction-related work such as construction and repair of roads, bridges and buildings; the opportunities also include the provision of services to the workers and firms involved in the reconstruction such as food preparation, logistics, housing and transportation. The fact that growth rates were no different for children whose mothers saw or heard the water and those who did not is consistent with the observation that the reconstruction effort benefited all the communities along the coast of Aceh rather than only those communities that were hardest hit. This reflects two forces: on the one hand, road and bridge reconstruction was spread across most of the coast of the province; on the other hand, there was substantial migration in response to the reconstruction effort.

The second factor that potentially contributed to the rapid post-tsunami growth of the affected cohort is that as parents rebuilt their livelihoods, they invested heavily in their surviving children. This would be consistent with evidence on investments by Indonesian families in the face of the 1998 financial crisis. Third, it is possible that some of the faster growth can be attributed to post-uterine growth of premature births, although much of that catch-up growth is likely to have occurred in the first few months of life.

We have investigated whether there are differences in the weight for height of the exposed cohort and the reference cohort and find none. Nor do we find any differences depending on the magnitude of exposure. These results are not surprising: the tsunami is likely to have affected the weight of all cohorts. In fact it is precisely because we are drawing on the biology of human growth and assume that the height of the reference cohort is not much affected by exposure to the tsunami, at least relative to the cohort exposed in utero, that it is possible to identify the causal impact of the tsunami on longer-term child nutrition. We have not examined the growth of children born after the tsunami because there was a very large fertility boom in the months of the tsunami and the mothers of those children tend to be younger and better educated than the mothers of the children conceived before the tsunami (Nobles, Frankenberg and Thomas, 2015).

In sum, the Indian Ocean tsunami was a large, unanticipated shock that caused unprecedented disruption in the lives of people living along the coast of Aceh at the time. The

shock took a substantial toll on the height of children who were in utero at the time of the tsunami. Had we not followed these children, we would have concluded that the tsunami likely had a significant longer-term impact on the health and well-being of the population. However, the deleterious impacts were for most of the children short-lived and the cohort that was in utero at the time of the tsunami appear to have substantially benefited from the reconstruction effort. Evidence from STAR documents that large scale, unanticipated shocks have consequences for child growth, there is scope for catch-up growth and the evidence suggests that increased resource availability because of the reconstruction efforts played a role in mitigating the consequences of these shocks.

5. Conclusions

Measurement of the casual impact of shocks on health and human capital is extremely difficult. This is not a novel insight. The goal of this research has been to provide examples of the impact of shocks on health and human capital that turn out to be much more complicated to interpret than a prime facie description of the shock would suggest.

First, it is not straightforward to identify shocks that are, in fact shocks. Many of the events that are treated as shocks in the literature are anticipated or at least potentially anticipated. Even if the exact timing may be hard to predict, the expectation that there will be, for example, a poor agricultural season periodically complicates interpretation of a poor season as a shock. It is likely that those people who are affected by a poor season will invest in behaviors that mitigate the impact of the poor season. In some cases, a shock is correlated with other changes in the environment or possibly behaviors that contaminate interpretation of estimated effects of the shock. This arises, for example, in the analysis of the 1918 influenza pandemic which occurred at the same time as WWI ended.

Second, the assumption that as shocks unfold, individuals and those in their networks, broadly defined, do not respond to the shock is not consistent with the core tenets of economics. We have shown that in the face of a large financial and political crisis in Indonesia that resulted in huge declines in resources, individuals, families and communities demonstrated extraordinary resilience and adaptability and sought to mitigate the longer-term impacts of the crisis, even as the magnitude and longevity of the crisis was being revealed. Indonesians are not unique in this regard. Stillman and Thomas (2010) establish that in the face of the collapse of oil prices and, therefore, a massive income shock in Russia, households substantially cut into food spending by

switching from more expensive calories and protein to less expensive calories and protein. While spending on food declined by about 25%, calorie and protein intake hardly changed and there is no evidence of a change in BMI.

Third, some shocks are so devastating that responses in the short-term are limited. However, as the example from the Indian Ocean earthquake and tsunami establishes, drawing conclusions from short-term impacts can be substantially misleading. Over and above evidence on the impacts on child height, we have investigated the impact of the death of one or both parents on the human capital of children who were not killed by the tsunami. Studies of parental death have established that the children of those parents tend to complete fewer years of education (Case, Paxson and Ableidinger, 2004; Beegle, De Weerdt and Dercon, 2010; Evans and Miguel, 2007). The majority of those studies are conducted in settings where parental death is due to HIV/AIDS and is treated as if it were a shock. It is not clear that assumption is correct: neither is the death likely to be a shock if there was an illness prior to the death nor are the parents who contract HIV necessarily exchangeable with those who do not. We investigate the impact of an arguably exogenous parental death (from the tsunami) on the education of children age 9 to 14 and, separately, on outcomes of children age 15 to 17 at the time of the tsunami (Cas, Frankenberg, Suriastini and Thomas, 2011). For young children (age 9-14), we find no impact of parental death of education outcomes: the evidence suggests that other family members and also members of the community rallied to the aid of these children. For older children, however, the story is completely different. Males who lost one or both parents left school earlier and started working earlier than males in the same communities who did not lose a parent. Females also left school earlier and married earlier if one or both parents died. With the new earnings opportunities that accompanied reconstruction, the longer-term consequences of these choices are not obvious; they can only be investigated with data from further follow-ups of the STAR respondents.

In sum, the picture of remarkable resilience that emerges from investigating the impacts of major shocks on child health and human capital in Indonesia is nothing short of stunning. The evidence clearly indicates that individuals, families and communities respond in manifold ways to mitigate the short and the longer-term impacts of the shocks on the next generation. The evidence suggests that individual, households, families and communities do everything they can to avoid falling into poverty traps or pulling themselves out of poverty, even in the face of large-scale and unanticipated adversity.

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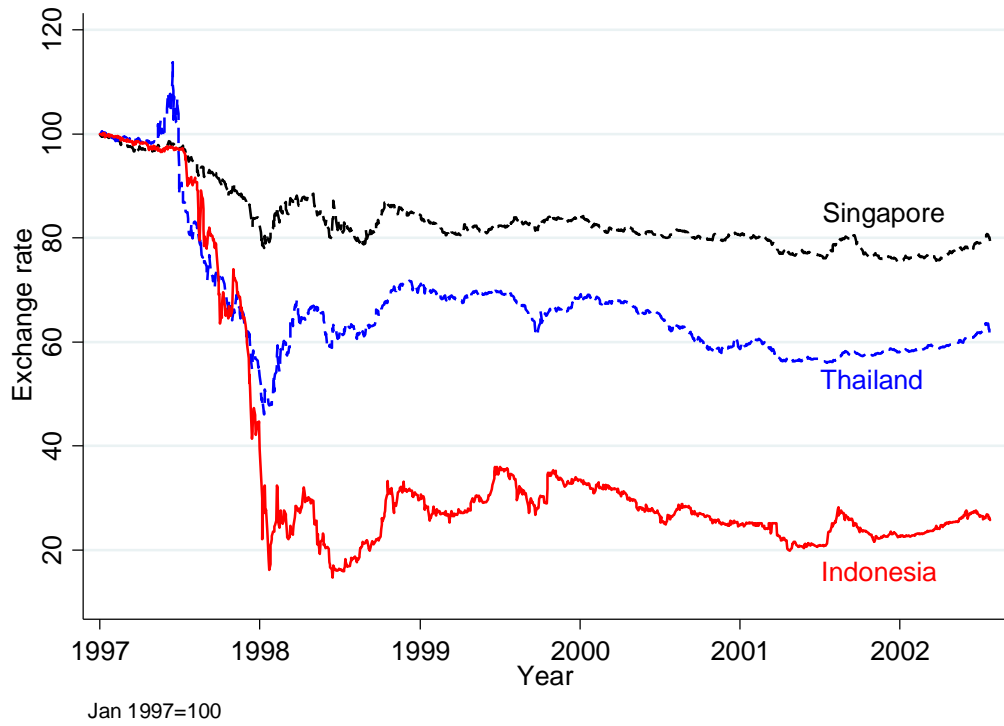Figure 1a. US$ exchange rates for Singapore, Thailand and Indonesia, 1997-2002

Jan 1997=100

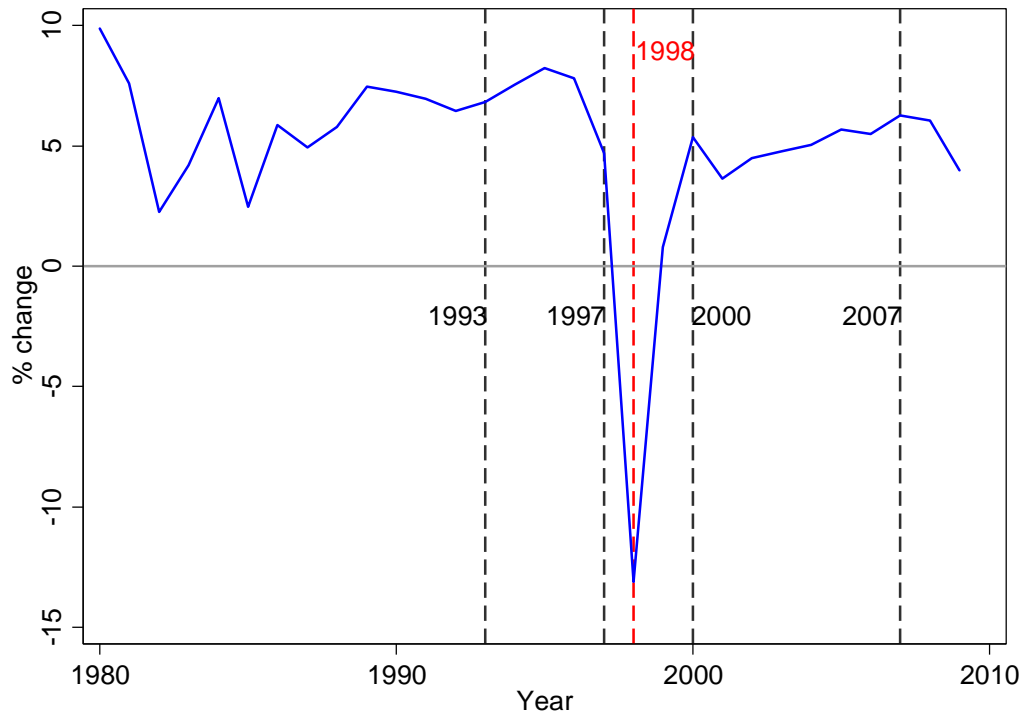Figure 1b.   Percentage change in per capita GDP in Indonesia, 1980-2010
             and timing of IFLS

Figure 2. Annual inflation in Indonesia, 1985 to 2007
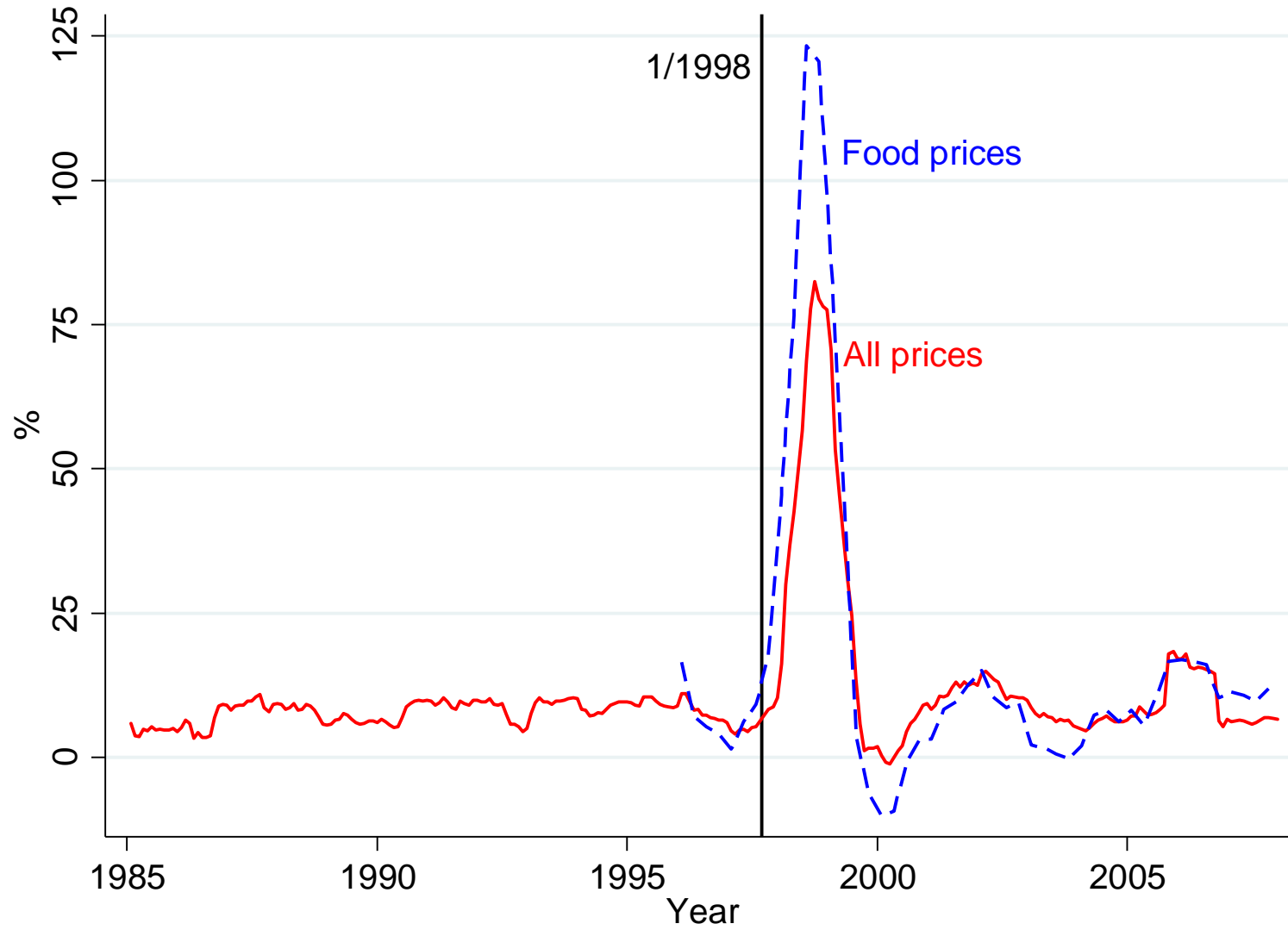All prices (by month) and food prices (by quarter)

Figure 3. Child anthropometry before and after onset of the 1998 Indonesian crisis
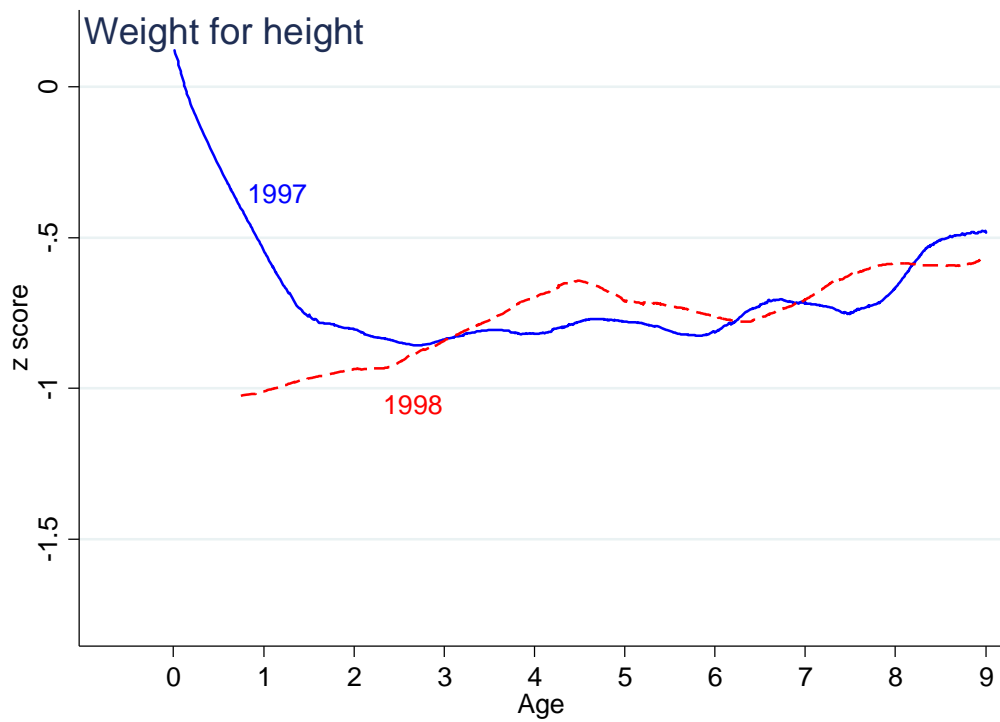

Height for age

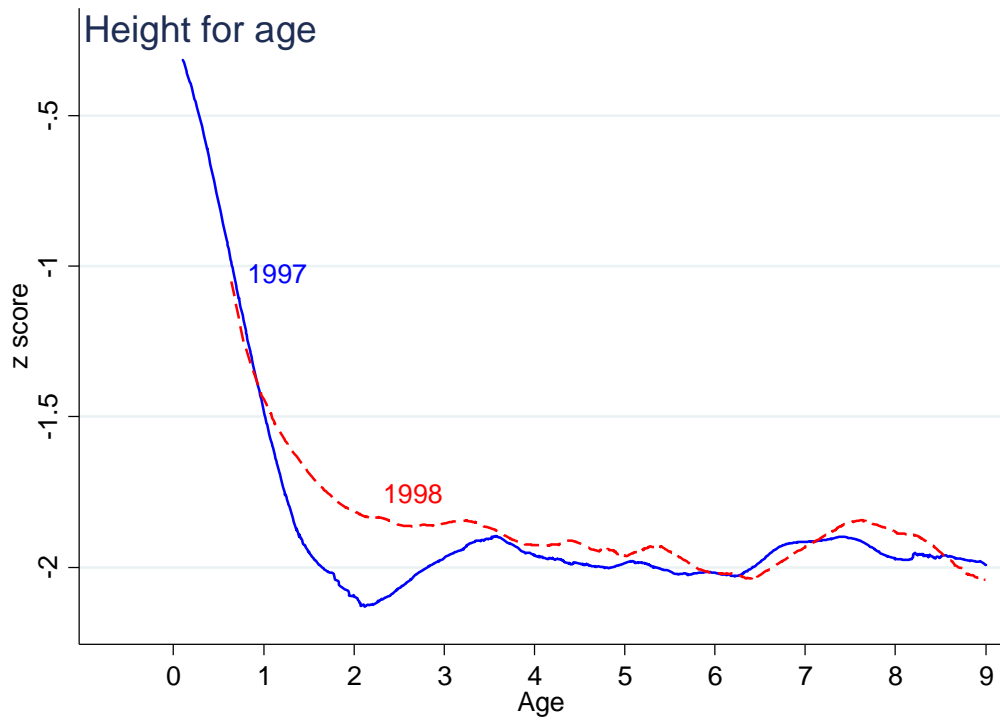1997

1998

Weight for height

1997

1998

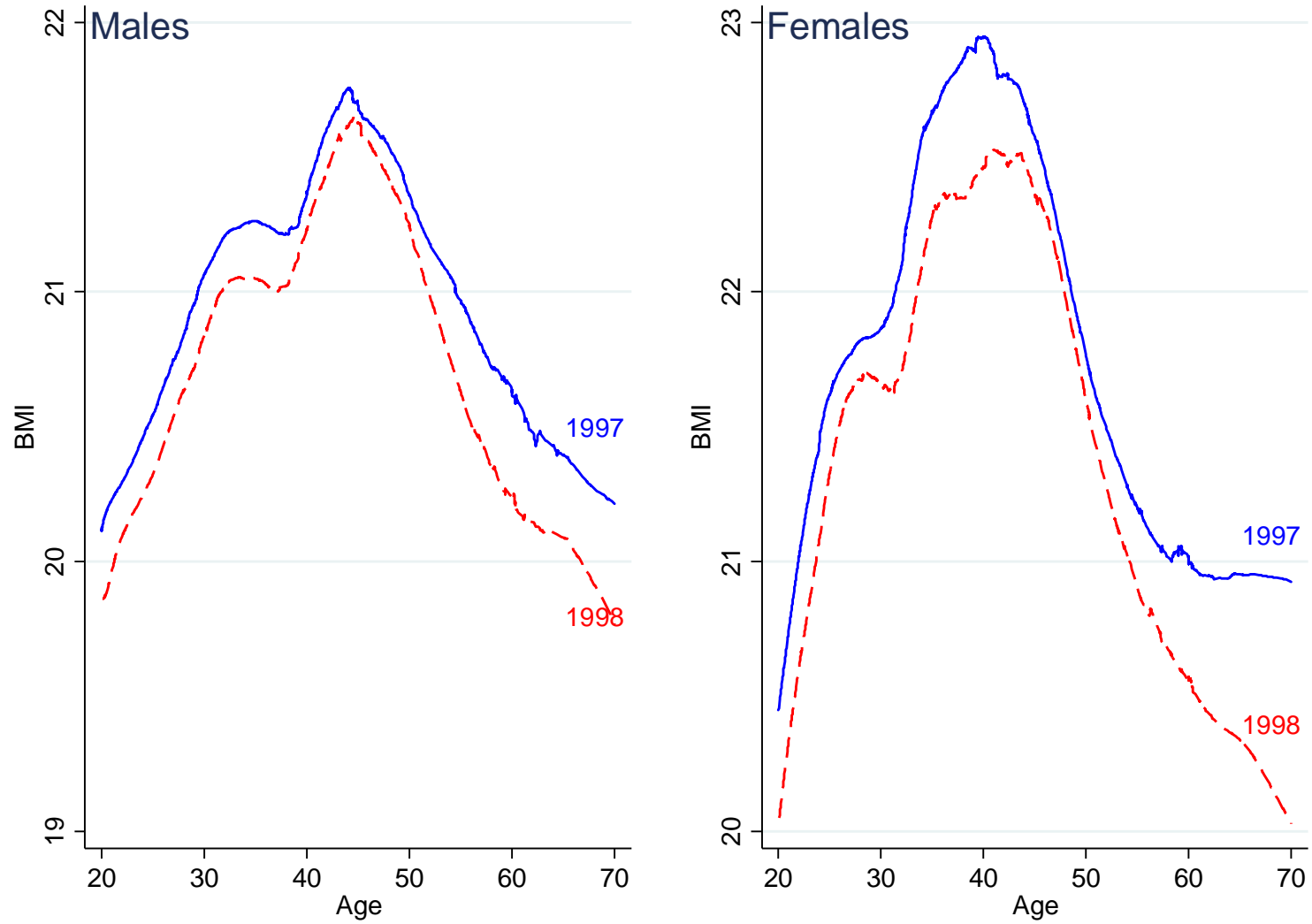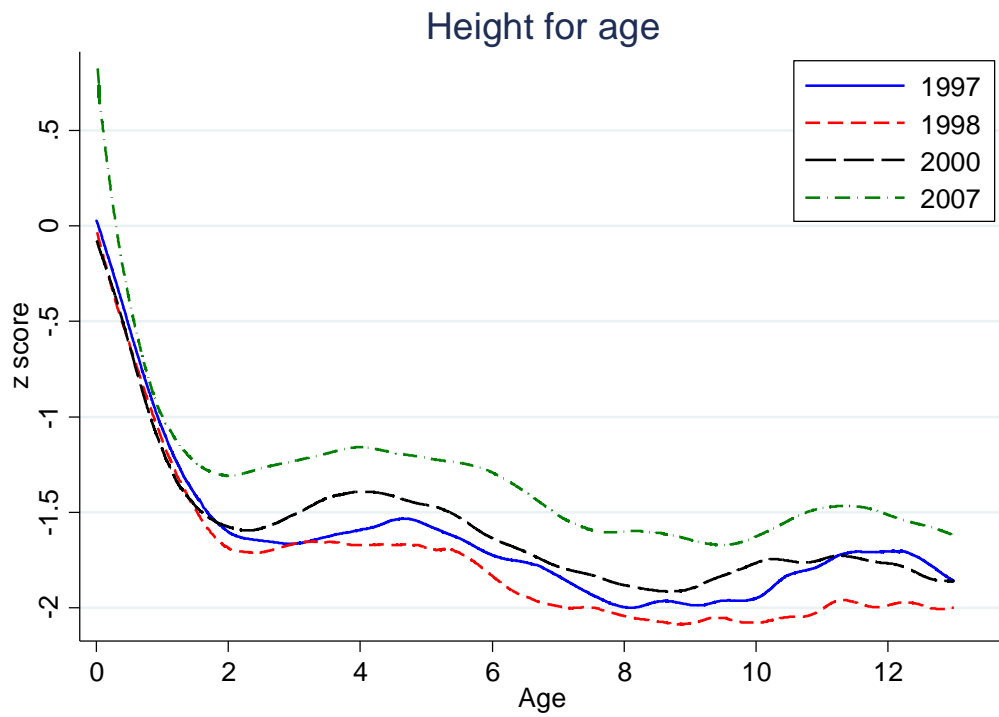Figure 4. Adult BMI before and after onset of the 1998 Indonesian crisis

Figure 5. Child height-for-age in Indonesia, 1997 through 2007
A. All Indonesia

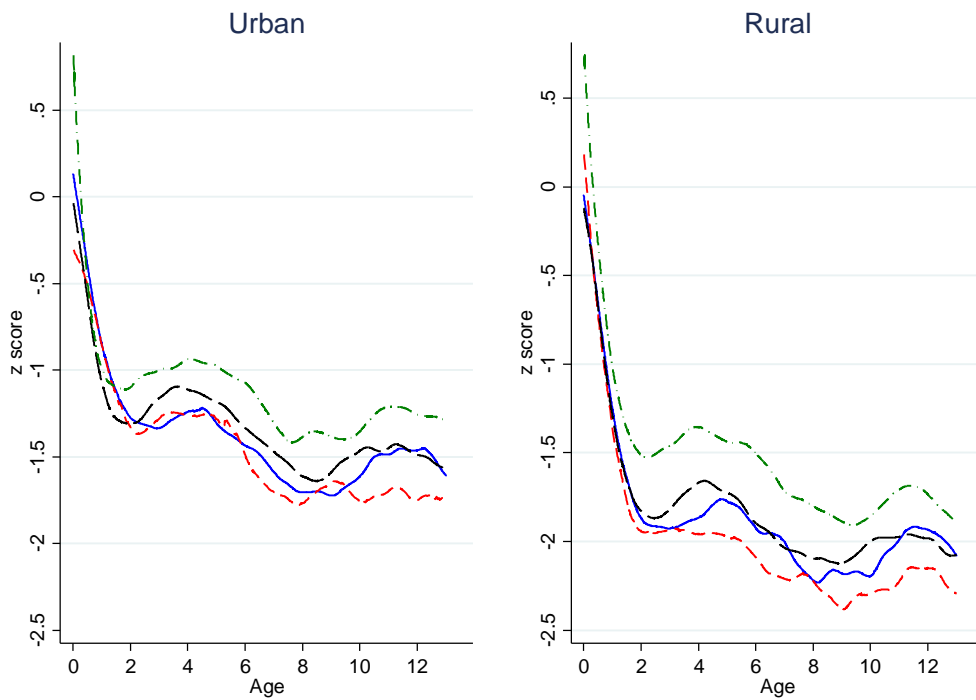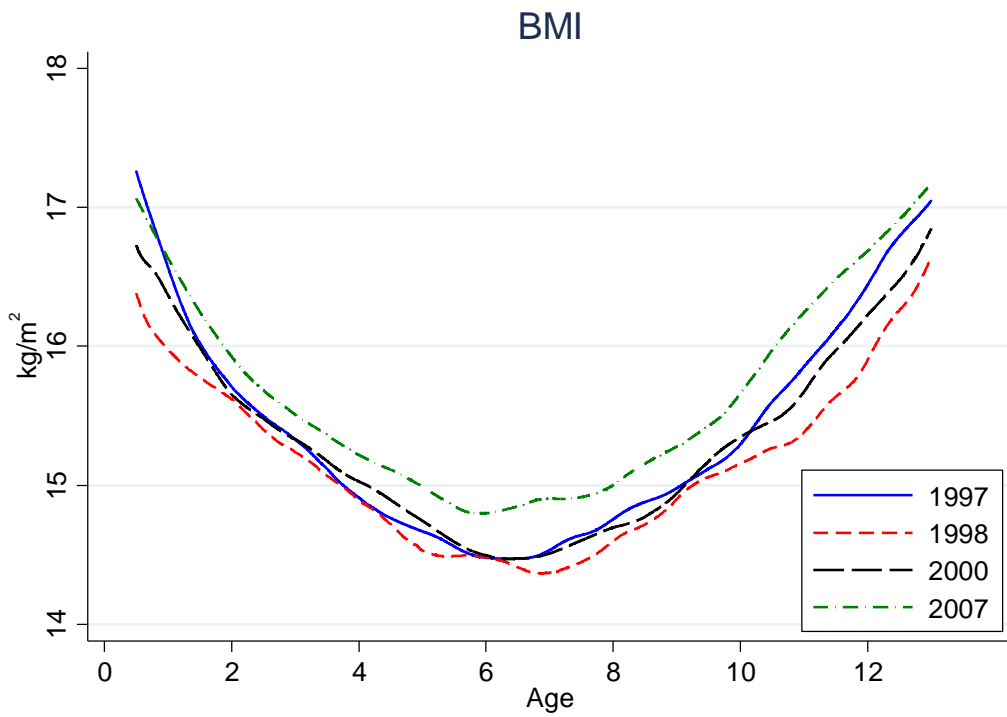B. By sector of residence of parents in 1997, pre-financial crisis

Figure 6. Child body mass index in Indonesia, 1997 through 2007
A. All Indonesia

B. By sector of residence of parents in 1997, pre-financial crisis
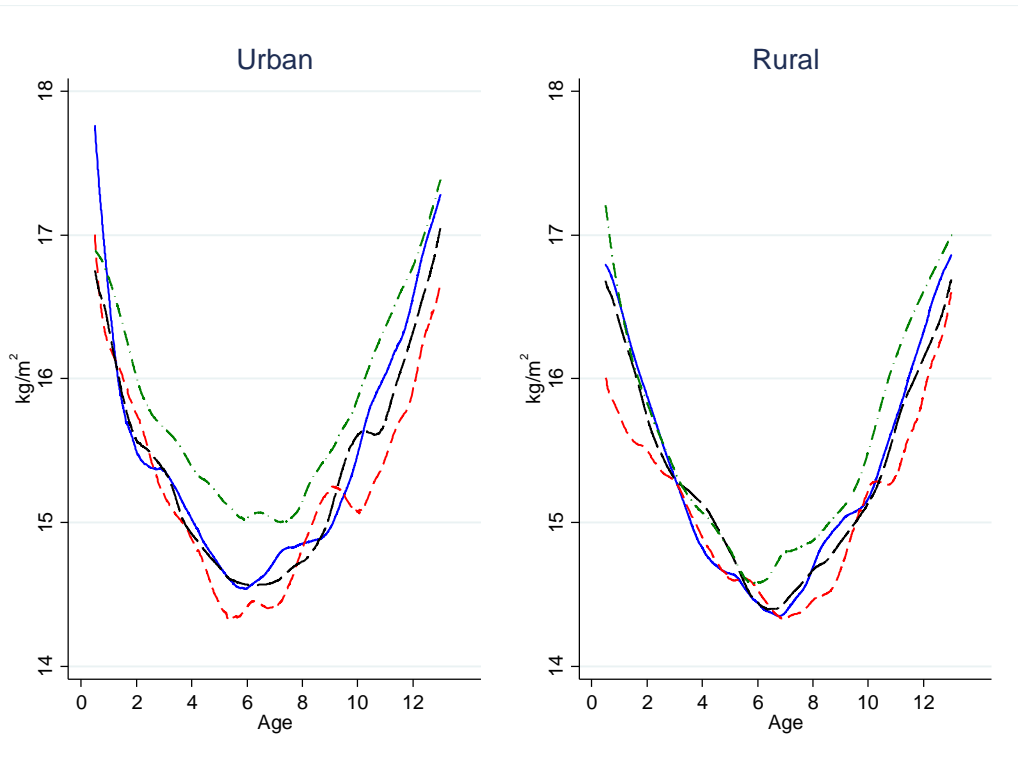
Figure 7. Completed years of education (in 2014) of Indonesian children age 5 through 21 (in 1997)
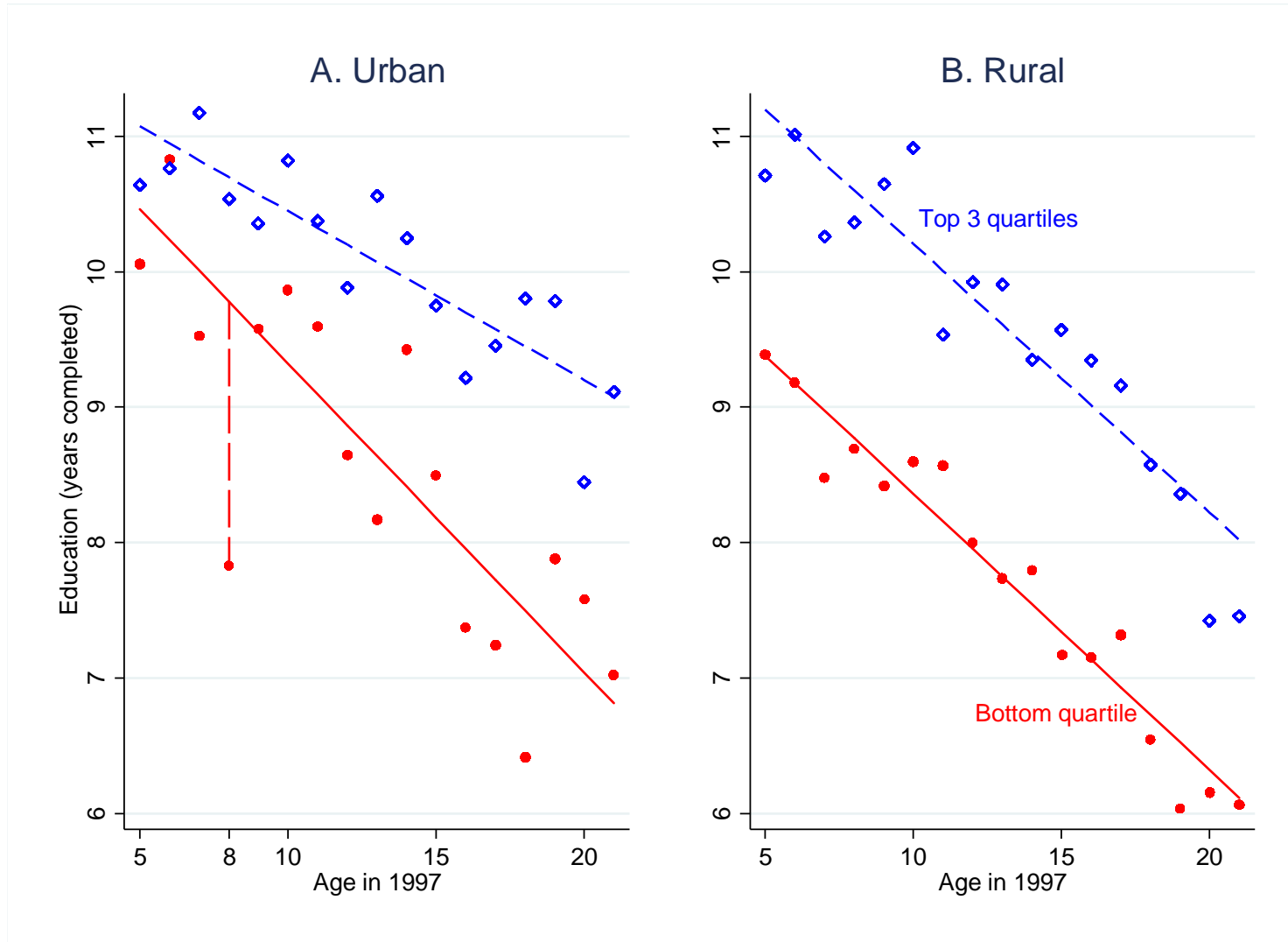By sector of residence and quartile of household PCE (both measured in 1997)

Figure displays mean years of completed education for each age and linear trend for children living in households in the bottom quartile of household PCE (red solid line and solid circles) and the top three quartiles of PCE (blue dashed line and diamonds) in urban and rural areas.

Table 1. School enrollment and the 1998 Indonesian financial crisis
Percentage of children not enrolled in school in 1997 and 1998
By age group and level of household PCE (both measured in 1997)

	1997	1998	%Δ
Percentage of children not enrolled in school			
Children age 13-16			
	25.6%	25.1%	-2%
Children age 7-12			
All	3.1%	5.9%	90%
Poor children	4.9%	10.7%	118%
(Bottom quartile of PCE in 1997)			

Notes: IFLS2 and IFLS2+. Source Thomas et al (2004).

Table 2. Consumption patterns and the 1998 Indonesian financial crisis
Household composition, household consumption and composition of consumption

1997 Rp000s	1997	1998	Average percent change
1. Household size	4.33	4.53	7
	[0.05]	[0.04]	[0.8]
2. *Per capita* household consumption	176	117	-23
	[12]	[9]	[2]
3. Composition of *per capita* household consumption			
A. Food	79.7	68.9	-9
	[4.9]	[7.4]	[2]
B. Non foods	95.2	48.4	-34
	[10.2]	[2.2]	[2]
C. Deferable items	9.1	6.4	-35
(Clothing, furniture and ceremonies)	[0.4]	[0.4]	[3]
E. Human capital investments	9	5.7	-37
(Health and education)	[0.6]	[0.3]	[3]

Notes: Consumption measured in thousands of 1997 Rupiah.
   1,971 households interviewed in 1997 and 1998 included in sample
Source: Frankenberg et al (2003)

Table 3. Completed schooling and the 1998 Indonesian financial crisis

Completed years of education (measured in 2014) of Indonesians age 5 to 21 (in 1997)
Trend for all children and deviation from trend for respondents age 8 in 1997
By quartile of household PCE and sector of residence (both measured in 1997)

Measured in 1997:						
Sector of residence	A. Urban			B. Rural		
Quartile of PCE	Bottom	Top 3	Diff	Bottom	Top 3	Diff
	[1]	[2]	[3]	[4]	[5]	[6]
1. No HH controls						
Linear trend in age	-0.23	-0.13	-0.10	-0.20	-0.20	-0.01
	[0.04]	[0.02]	[0.04]	[0.02]	[0.02]	[0.03]
(1) if resp was 8 years old	-1.95	-0.15	-1.82	-0.08	-0.23	0.16
	[0.63]	[0.38]	[0.73]	[0.31]	[0.34]	[0.46]
2. Control HH PCE and demographics						
(1) if resp was 8 years old	-2.09	-0.24	-1.86	-0.03	-0.26	0.23
	[0.66]	[0.41]	[0.77]	[0.35]	[0.35]	[0.49]
3. Control HH fixed effects						
(1) if resp was 8 years old	-1.24	0.19	-1.34	-0.23	-0.43	-0.03
	[0.69]	[0.31]	[0.78]	[0.29]	[0.31]	[0.42]
Sample size		5,900			6,644	

Notes: Mean years of education measured for each respondent in 2014 based on characteristics measured in 1997.
   Standard errors in parentheses take into account heteroskedasticity and clustering of the survey design.
Sources: IFLS2 and IFLS5

Table 4. Linear growth of children in Aceh, Indonesia, after the 2004 Indian Ocean tsunami

Height-for-age z scores by year of measurement and growth in height-for-age z scores

for children who were in utero at time of the December 2004 tsunami

Date of measurement	2006-07	2007-08	2008-09	2009-10	Growth	Growth
Reference cohort			2002		2002	2001
	[1]	[2]	[3]	[4]	[5]	[6]
Birth cohort						
2005Q1	-0.18	-0.25	0.18	0.41	0.44	0.38
	[0.21]	[0.18]	[0.17]	[0.15]	[0.22]	[0.20]
2005Q2	-0.70	-0.34	-0.10	0.31	1.09	0.74
	[0.20]	[0.16]	[0.16]	[0.14]	[0.20]	[0.19]
2005Q3	0.05	-0.28	-0.09	0.34	0.62	0.93
	[0.21]	[0.16]	[0.17]	[0.14]	[0.21]	[0.21]
Sample size	5,260	5,224	5,238	5,795	4,456	4,456
R^2	0.09	0.09	0.10	0.11	0.07	0.07
F (joint signific)	15.6	11.8	19.4	12.8	19.6	16.4
p-value	0.000	0.000	0.000	0.000	0.000	0.000

Notes

Dependent variable is standardized height for age z-score using CDC standards

Reference cohort : 2002 same quarter of birth for columns 1-5; 2001 cohort in column 6

Models include controls for gender, birth order, month of interview.

Standard errors take into account clustering at enumeration area level and heteroskedasticity

Source: Frankenberg et al. (2017)