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Childhood Post Traumatic Stress Disorder and Later-Life Outcomes: A Hidden Consequence of the 1989 Typhoon Gay

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Abstract

In human capital literature, it is established that skills are cross-productive and that the production technology is dynamic. This study looks at a case of Thailand and shows that a damage of mental health capital early on in life has a significant adverse effect on schooling attainment. We take the event of Typhoon Gay in 1989 in Thailand's South-Eastern region as a random trigger of Post-Traumatic Stress Disorder prevalence amongst young children in the disaster area. Using both micro datasets and a unique survey, we find strong evidence that disaster affected children suffered from a long-term undetected reduction in their mental health capital and thus worse accumulation of skills in other dimensions.

JEL: I15, I26, Q5

Keywords: Natural Disaster, Post Traumatic Stress Disorder, Human Capital Formation, Schooling

1. Introduction

The paper aims to shed more light on two closely related questions in human capital development. First of all, it will explore the relationship between health capital and cognitive capital. More precisely, it will focus on the inter-temporal dimension of the relationship by looking at the impacts of health capital conditions in childhood on adult outcomes, in particular the accumulation of cognitive capital. Given the multi-dimensionality of health capital, the paper will restrict the attention on the aspect of natural disaster related mental health. Despite the rich collection of economics literatures that recognise the impediment of childhood physical health conditions on adult human capital accumulation and other outcomes, there remains a lack of the attention on the implication of mental health problem. In this study, we will exploit the exogeneity and randomness feature of nature disasters as the main identification strategy, in hope to provide additional insights into the mechanisms of human capital development. Given the scopes and the magnitude of its impacts, the issues surrounding natural disasters deserve a special attention of its own right. In that, we also hope to offer some insights of a hidden long-term impact of natural disaster on mental health problem amongst exposed individuals.

The mental health problem being focused here is post traumatic stress disaster (PTSD hereafter). We will examine the effect of PTSD on individuals being affected during their primary school age (around 5- 12 years old) on schooling outcomes measured two decades after the exposure to the shock. The pool of individuals being considered are those who lived in the affected areas in 1989, the year of the event. On the 4^{th} of November 1989, two districts in the province of Chumpon in Thailand were hit by Typhoon Gay [1]. Despite having annually experienced monsoons in general, it was the first time in nearly 50 years that the country experienced such an event (Thailand Meteorological Department, 1989; EM-DAT, 2012). The study will exploit this unexpected shock on individuals and households as if it had been a random assignment of PTSD shock on affected individuals. We will examine the causality of a childhood mental health shock and adult schooling outcomes using a unique household survey.

A simple summary statistics using four Thailand census dataset (Thailand IPUMS subsamples of 1970, 1980, 1990 and 2000) shows that among the age cohorts who would have been contemporarily affected by the shock during their school years (in particular

[1] Typhoons are the regional equivalent of hurricanes: they have wind speed over 120 kilometers per hour.

around the primary school ages), those from Chumpon are found to have achieved fewer years of schooling than their peers. In contrast, the older cohorts, who were also exposed to the Typhoon but had already passed their schooling ages at the time are found to have no effect on their schooling outcomes. This is done by taking location of birth as a proxy for the PTSD shock exposure and using the comparable population from the neighbouring province of Surat-Thani as the *unexposed* control group. Figure 1 depicts the schooling outcome comparison over time. We use this as a supporting evidence to deepen our examination of the issue.

We conduct our empirical analysis by using the data from the 2011 unique survey of a sample of Typhoon Gay's exposed population. This allows us to identify the PTSD mental health, which is resulted from the Typhoon exposure at childhood as a main pathway. This dataset allows us to utilise the measured scale of PTSD to identify the treatment effect of the natural disaster exposure at the intensive margin. In our OLS analysis, we find that for males, a PTSD shock is related to a reduction of 1.4 years of total schooling. Taken into account heterogeneity of age at the time of the shock, we find that years of schooling of individuals at their early stage of primary school were insignificantly affected. In fact, the negative effect concentrated among those who were at the end of their primary school age in 1989. For them, having a PTSD symptom is related to almost 2 fewer years of schooling. In other schooling aspects, having a PTSD symptom also relates to a smaller likelihood of attaining a high school qualification. For other adult outcomes, individuals with PTSD are less likely to have a healthy physical index (measured by the body mass index). However, they are less like to have children and also be married during their teen.

In the robustness checks, we employ a propensity score matching technique to get us closer to a causal inference. Our results show that average treatment effect on the treated from the PTSD shock was 2 years reduction of schooling for those at the end of their primary school age. We also take into account the recall bias problem in our dataset. We find that our results remain robust when the sample is restricted to only those who scored high in the recall assessment.

The paper is structured as follows: Section 2. discuss related literatures on human capital formation and on natural disasters and Section 3. discusses some theoretical framework related to childhood mental health shock and human capital formation. Section 4. describes surrounding contexts of the Typhoon Gay event in 1989., the unique survey and datasets used in this study. Section 5. presents our empirical design and Section 6. shows

the main findings. Section 7. provides some robustness checks and Section 8. concludes.

2. Background

2.1. Literature on human capital formation

The link between health and schooling has been a main focus in a large number of economics literatures. In his seminar paper, Grossman (1972) sees health as a stock that can be accumulated and invested over time via the self-productivity structure of the process. Further, individuals enjoy and accumulate human capital in form of health capital as well as schooling capital. If health capital is invested and accumulated early on in life, it also leads to higher accumulation of income-generated schooling capital. The Grossman proposition points to a direct causal effect of health stock on schoolings (Grossman, 2000). The more parametric functional form of health and schooling capital are examined in depth in recent literature of early development (see for example Cunha and Heckman (2007) and Conti, Heckman and Urzua (2010)) where the process of human capital formation consists of additional key features, namely cross-productivity and dynamic complementarity (Cunha, Heckman and Schennach, 2010). With those, the causal relationship between early-stage health capital and later-life schooling capital is highly emphasised.

Typically, the empirical examinations on the impact of exogenous conditions during childhood on adult outcome make use of some natural events to conduct a quasi-experiment design. Almond and Mazumder (2005) find that U.S. cohorts who were *in utero* during the height of the 1918 influenza pandemic fared worse as they aged than cohorts born just before and after the pandemic in terms of educational attainment, physical disability, socio-economic status and mortality. Yang and Maccini (2009) provide evidence of the adverse outcome of infant health at the critical-period by looking at the effect of rainfall in Indonesia around the year of birth on adult height and other health measures.

In the attempt to identify the causal effect of childhood mental health shock on adult outcomes, many studies however resorted to exploit the panel data analysis from longitudinal surveys. Currie and Stabile (2006) study the effect of childhood mental health in the form of Attention Deficit and Hyperactivity Disorders (ADHD) on adult outcomes. Using the data from Canadian and American Longitudinal Survey of Youth, they find large negative effects on test score and school attainment. Similar results are found in the effect of mental health condition when it was classified as misbehaviour conducts during

childhood (Farmer 1993, 1995; Gregg and Machin, 1998; Caspi et al., 1998).

Our study shares a similar goal of identifying the causal effect of mental health problem at childhood on adult outcomes. As a departure, our research question focus on a specific case of natural-disaster-induced mental health condition. In that, our empirical design exploit the exogeneity property of a natural disaster as the main identification strategy, so as to trace out the direction and magnitude of the causal effect on childhood chronic mental health condition on outcomes later on, particularly of schoolings.

2.2. Natural disaster, PTSD and its effects on cognitive development

The causal relationship between having experienced a natural disaster and the clinically development of PTSD symptom is well documented in the psychological and medical literatures. According to the Diagnostic and Statistics Manual of Mental Disorder 4^{th} Edition (DSM-IV, 1994), a person being exposed to an extreme stressor or traumatic event to which she responded with fear, helplessness or horror and to have three distinct types of symptoms (re-experiencing of the event, avoidance of reminders and hyper-arousal) for at least one month after the event are at increased risk of being diagnosed with PTSD. Norris et al. (2002) report PTSD as the most commonly psychological condition among 60,000 disaster victims surveyed. The study by World Health Organisation on the 2004 Asian Tsunami victims estimates that after disaster incidence, the overall prevalence rate of mild, moderate and severe mental disorder was approximately 20%, 3% and 4% among the affected population (WHO, 2005).

Some of the studies on the persistence of PTSD provide evidences for a long-term of effect of mass trauma-exposure on mental health condition later on in life. Non-natural disaster studies illustrate the potential for long-term morbidity of PTSD over 10 years after the incidence [2]. (Hull et al., 2002; Kessler et al. 1995) For natural disaster induced-PTSD, the long-term rate is found around 10- 20% when measured at 2 years or more since the exposure [3] (Cao, McFarlane and Klimidis, 2003; Norris et al., 2004; Galante and Foa 1996). A study in Thailand on children population age 7-14 years old that were exposed to the 2004 Tsunami finds that the prevalence rates of PTSD symptoms were 13% at 2 months after the trauma. And the rate did not decrease when they were re-measured after

[2]Analysing the event of the 1988 Piper Alpha Oil disaster, Hull et al. (2002) find a prevalence rate of 21% at 10 years. Using a National Comorbidity survey, Kessler et al. (1995) find that 29% still met PTSD criteria 33 years after.

[3]Cao et al. (2003) look at the 1988 Yunnan Earthquake; Norris et al. (2004) analyse the 1999 flood in Mexico.

9 months (Thienkrua et al., 2006).

There are a number of biological evidences which strongly indicate the direct effect of PTSD condition on cognitive development. Patients with chronic PTSD condition were found to have increased level of thyroid, which are the hormones typically released under stressful condition. Other studies found an increase in the sensitivity of the negative feedback system of the Hypothalamic-Pituitary-Adrenal. This neural section is directly linked to the functionality of the hippocampal in the brain, which is believed to be responsible strongly for memory process (Schuff et al., 2001; Mason and Southwick, 1994; Wang et al., 2010). Overall, the literature lend a supporting evidence to how a disturbance to mental health status can negatively hinder cognitive development and schooling outcomes subsequently .

3. Conceptual Framework

The conceptual framework, which motivates this study, follows a typical household's capital investment decision. A household composes of a parent and a young child. The parent is altruistic, in that she enjoys the quality of her own child. In this static framework, there are two periods: the first period is when the child is an infant and the second period when he is at school. The parent's utility is a function of consumption, durable physical capital (for example housing and agricultural machinery) and the child's quality (i.e. his human capital stock). In disaggregate level, the *quality* of a child consists of his health and schooling capital. Under income borrowing constraints, a rational parent makes optimal investment decisions for both physical and human capital to maximise the household's utility over time.

Following Grossman (1972) and Cunha and Heckman (2007), the efficiency of the production function of human capital will depends on the current accumulated stock of the multi-dimension human capital. Therefore, an optimal decision of the parent is to invest early in the childhood state rather than later. Given a production function (followed a Cobb-Douglas specification), the cost of investment will get more expensive if they decide to make a compensatory investment later on in life (Cunha, Heckman and Schennach, 2010).

If there is an idiosyncratic shock on the early stock of human capital (in childhood), the child whose human capital suffers more loss is predicted to receive less future investment

from the parent who cares more about efficiency (than equity) when compared to other similar children [4].

Provided that all capitals (physical, health and education) are quasi-substitutable in the household preferences, the relative price effects are also expect to dictate the optimal level of investment among them. Taking every other factor constant and assuming that all capitals are normal goods, the one which sees an increase in its price will face a negative outcome of its optimal investment level. On the whole, the literature offers some hypotheses to our empirical design as following:

Hypothesis (1): If the household is an efficient-leaning type, a shock that reduces the level of existing capital stock will lead to a decrease in an optimal investment level any time after that. And this leads to a lower optimal stock in the long run. And if there is cross-productivity between health capital and cognitive capital (i.e. schooling), a lower investment in health capital will also result in a lower stock of cognitive capital over time.

Hypothesis (2): If the household is an equity-leaning type, a shock that reduces the level of existing capital stock will lead to an over-investment on that capital. And this should prevent a lower optimal stock in the long run. Assuming cross-productivity between health capital and cognitive capital (i.e. schooling), an initial shock that decrease the stock level in health capital will have an indifferent effect on stock of cognitive capital over time.

Hypothesis (3): If health and cognitive capitals are normal goods, a negative price effect on a normal good would also exacerbate the adverse effect on optimal investment decision. A rise in the price on a capital will lead to a lower optimal level of investment. Therefore given an assumption a self-productivity, the capital that receives a lower investment early on will also end up with a lower stock level accumulated in the long run.

[4] Becker and Thomes (1976) began the discussion on quantity-quality trade-off in human capital investment decisions. For recent literature, see for example Aizer and Cunha (2012), Adhvaryu and Nyshadham (2014), Carneiro et al (2015) for a discussion on the effect of child skill endowment and household's human capital investment behaviours between parents who care more about efficiency and parents who care more about equity.

4. Study Design

4.1. The 1989 Typhoon Gay and its impacts on mental health

Typhoon Gay hit the south-eastern coast of Thailand on the 4^{th} November 1989. Two provinces were reported to be broadly affected by the event [5]. Nevertheless, only two districts from Chumpon province that were directly under the path of the Typhoon, therefore they were resulted in damaging outcomes, much more than other areas. In general, Thailand is a tropical-climate country thus the country typically experiences seasonal monsoons from one year to another. Monsoons bring rainfalls which can be heavy at time, but hardly a very strong wind speed. When Typhoon Gay reached the mainland of Thailand's southern coast in 1989, it was the first time in nearly 50 years since the nation faced with an event of such magnitude. Given the confusion and puzzled responses from both the central government and local population the event was considerably unexpected [6].

As mentioned, the province of Chumpon was the main province suffering from the impact. Chumpon is a coastal province, with fisheries and plantation-style agriculture as its main economic activities. Locating on the south-eastern coastline, the province faces a typical monsoon season during September to November annually. The seasonality has also dictated the types of plants and agricultural product being cultivated in the area. Two districts of Chumpon were badly hit by the 1989 Typhoon, with some surrounding districts being moderately affected (see Figure 2. With the exception, the district of Lamae, which lies much further south along the coast, was virtually untouched by the Typhoon [7]. We will explore this particular feature of the typhoon paths and damages as it is a very useful element for the empirical design later on.

For the core purpose of the analysis and the identification assumption, two conditions must be satisfied. The first condition is that the Typhoon would have needed to hit the areas and missed other areas in a random manner. The second condition relies on that fact that such an exposure to the Typhoon must have led to a development of PTSD

[5] Supporting evidence includes official damage statistics (various ministerial sources, 1989) and meteorological database (Thailand Meteorological Department, 1989).

[6] Contemporary documents from both official and news reports depicted a picture of unprepared responses from the government for the aftermath. This includes a subsequent protest from the affected residences because of the dissatisfaction of the lack of assistance from the central government as well as an erroneous television announcement by the Prime Minister that the incidence was a result of an ordinary stormy condition.

[7] Official damage statistics (various ministerial sources, 1989) and meteorological database (Thailand Meteorological Department, 1989)

morbidity among the exposed population. The second condition is important in order to make claim of a random assignment of the mental health shock as a consequence of the Typhoon. On the one hand, it could be argued that all Typhoon-exposed individuals were equally likely to develop the PTSD shock. On the other hand, the intensity of the shock among individuals depends strongly on a number of attributes. Namely, they are the intensity of individual's exposure to the event, controllability, magnitude of various losses and individual traits (age and gender) (Norris et al., 2002). The analysis in the next section will consider the human capital development implication of such a PTSD shock exposure.

4.2. The unique household survey

The unique survey to be used in the study is described as follows. It was initiated by the motivation to disentangle multitude of mechanisms of which a natural disaster could affect human capital development. In order to overcome the macro-economic effects of natural disaster, we decided to focus on only the population of the affected province. It is based on the assumption that population within the same province would have been under the influences of similar local prices, labour market conditions and most important, contemporary humanitarian efforts post the disaster. The survey was conducted in 2011 during the month of July to September, under the supervision of Chumpon Provincial Public Health Office, Ministry of Public Health.

We aimed to enrol a sample of two 500 persons from the geographically exposed and geographically unexposed areas within Chumpon province. The sample size was calculated by following a finding from the literature that in general, 15% of individuals who have been exposed to natural disasters will develop a long-term PTSD incidence (Chang et al., 2005; Thienkrua et al., 2006). We drew a multi-stage cluster sample from households currently resided in Chumpon. At the first stage, we referred to the meteorological evidence of the Typhoon Gay and official damage reports to identify exposed and unexposed districts [8]. The district of Patil and Tasae were Typhoon Gay-exposed areas while Lamae was the Typhoon Gay-unexposed area [9]. See Figure 2 for an illustration of the locations of these selected districts.

In the second stage, 33% of all subdistricts were randomly sampled for the exposed

[8] Every province in Thailand is organised at the district, subdistrict and village levels.

[9] In this survey, 5 other districts in Chumpon were not considered in order to avoid a potential contamination problem from having located in close proximity to the directly affected regions.

district cluster, consisting of four medium-size and one small subdistricts, measured by population (TNSO, 2000). For Lamae, all four subdistricts were sampled, so as to balance out the dataset. Each village in the selected subdistricts was included in the sampling, to maximise the sample size of the survey. Household units were used as the final sampling unit. The targeting was not random in the sense that we intentionally searched for households with individuals of primary school ages (5-12 years old) in 1989. In order to be eligible for the survey, individuals must also have been born in one of the three assigned districts. Households were approached by village volunteers from the Ministry of Public Health. Our aim was to enrol the sample with the sample ratio of 0.1, for each gender-age group at each sub-district level. Table 1 compares the share of population between the target and the actual sample of the population.

Before the conduct of the survey, we relied on key informants (official persons presented at the affected area in 1989, community leaders and school teachers) and contemporary studies about the local socio-economic structure, traumatic experiences from the typhoon, government humanitarian efforts and mental health related statistics to construct the survey (Pracharawan, 1991; Ministry of Public Health 1990). A main goal of the questionnaire was to inspect the potential development of PTSD among individuals being exposed to the Typhoon trauma. And secondly, it is to examine causal effects of PTSD shock on later-life human capital outcomes.

We created a module followed the *Harvard Trauma Questionnaire* (HTQ) to assess Typhoon Gay-specific trauma events (Harvard Program in Refugee Trauma, 1995). We followed the questionnaire format used by Thailand' Department of Mental Health, the *Psychological Impact Scale for Crisis Events (PISCES-18)*, to detect and measure PTSD severity among individuals (MoPH, 2004). *PISCES-18* is a Likert-type scale to address frequency or severity, ranging from not-at-all (0) to extremely (3). It is a self reported questionnaire, consisting of four subscales: behavioural, emotional, thought process and physical [10] (see the Appendix). Of the total score from 18 questions, the score of 13 points or above indicates the likelihood of having a PTSD. We added a short statement immediately *before* the *PISCES-18* assessment, to probe the surveyed individuals into reminiscing the event of 1989. This is to strengthen the link between the 1989 traumatic

[10] Alternatively, PTSD *Symptom Scale Interview* (PSS-I) (Foa et al., 1993) or the combination of HTQ and the *Hopkins Checklist-25* (HSCL-25) can be used to detect PTSD (Mollica et al., 1992). We decided to use *PISCES-18* because it is more suitable for non-clinical administration when the trauma occurs more than 3 months ago. Additionally, it has been developed for the Thai population specifically. All questionnaires focussed on measuring three main criteria of PTSD: re-experiencing, avoidance, and arousal.

experiences with the PTSD assessment in 2011 and to best minimise the contamination from other traumatic experiences which we were not able to capture.

Given that the recall period in this survey is approximately 22 years, we set aside two additional sections in the questionnaire to account for the problem. The first section is a questionnaire module which aims to screen for the precision of individuals' memory of the 1989 event [11]. The subsequent section is a paragraph of the 1989 Typhoon Gay event summary, including its affected location and its catastrophic implications (Mohan et al., 2000). We realise that the reliability of retrospective data, therefore most of the questions are designed to look for the answers in a non-detailed fashion (Loftus et al., 1991; Hardt and Rutter, 2004). Unlike a food diary-type situation, it is argued that individuals are able to more accurately recall their experiences when the event is a less mundane (Hardt and Rutter, 2004; Lalande and Bonanno, 2011). We paid special attention at the sequential order of each section in the questionnaire. The first section is the questionnaire module on individuals' characteristics and outcome. This is followed by the recall screening, the event paragraph and lastly the PTSD detection section.

5. Empirical Strategies

To examine the relationship between childhood mental health shock and adult outcomes, we will exploit the mental health shock induced by Typhoon Gay in 1989. The population of interest are those who were at their primary school ages in 1989 (aged 5-12 years old). Potential affected population are those who resided in the affected locations at the time. The initial step of our empirical analysis is to validate an assumption that the Typhoon indeed triggered a mental health shock, in the form of PTSD, among the residents in the affected areas. Provided that it directly led to a random assignment of the shock, the effect of the mental shock on adult outcomes will be examined using the empirical strategies closely related to that a random assignment.

5.1. Estimating the effect of the exposure to the Typhoon and PTSD shock

Among individuals in our sample, we categorise those whose birthplace was in the district of Tasae and Patil as the *exposed* group whilst those whose of Lamae as the *unexposed*

[11] Questions include date and location of the event, and yes-or-no questions on detailed incidences at the time. Also, there was a self-assessed question on one's own ability to recall the 1989 event.

group. The birth-cohorts of interest aged 5-12 years old in 1989, which makes them 27-34 years old at the time of the interview in 2011. Table 2 provides a summary statistics of individuals' characteristics and the scale of the exposure to the Typhoon (constructed from the HTQ module). A Balancing Test between the *exposed* and *unexposed* group shows that both groups are, on average, comparable on the observable characteristics. This indicates that the likelihood of having been exposed to Typhoon Gay did not depend on these traits. However, they were different in term of the magnitude of exposure and damage.

We then perform regression analysis on the determinants of individuals' incidence of the PTSD shock. Individuals are classified by their likelihood of PTSD development, measured by the self-assessed *PIECES-18* [12]. We assign a binary variable for our PTSD measurement. It equals to 1 when an individual displayed some clinical evidence of the PTSD incidence and zero otherwise. This gives us a preferred measure of mental health shock than the alternative of using the birth location as an indicator of the treatment. The PTSD index takes into account the heterogeneity of responses by individuals to natural disaster events, given the same geographic shock. However, it must be noted that the level of PTSD obtained in this questionnaire is not exactly the intensity of PTSD at the time the individuals were exposed to the Typhoon. Thus, our assessed PTSD index is best thought as the proxy for the actual contemporary shock [13]. In the empirical analysis, we include both the scale and scope of exposure to the disaster as main variables dictating the intensity of PTSD. Additionally, individuals' traits are also included in the empirical exercise. Hence, the parametrically-imposed relationship can be written as

$$PTSD_{i,l,1989} = \alpha_1 + \alpha_2 EXPOSURE_{i,l,1989} + X'_{i,l}\pi + \epsilon_l + \epsilon_i \tag{1}$$

where $PTSD_{i,l,1989}$ is a binary variable of a post traumatic stress disorder shock which the individual i from locality l experienced at the time immediately after the typhoon in 1989 but measured in 2011; $EXPOSURE_{i,l,1989}$ is a vector of measures of the damages incurred to the individual and/or her family in 1989 but recalled in 2011. This includes own injuries, death or injuries in the family, implications on parental occupation, displacement

[12] The total score of *PIECES-18* is 54. If an individual scores 13 points or above, she is classified as having a PTSD symptom (Thailand Ministry of Public Health, 2004).

[13] According to the literature, over time the level of PTSD tends to reduce in a monotonically convex manner. That is it reduces more rapidly during the periods more immediate after the trauma event, but it will become more or less stable in the long run. Potentially, there is an issue of measurement error. However, the measurement error at the dependent variable does not lead to biases of the estimates (Greene, 2008).

and schooling issues; $X'_{i,l}$ is a vector of the time-invariant characteristics of himself and his family; ϵ_l is error term at locality and ϵ_i is the classical error term. In Equation 1, we assume that the common impact of the exposure to the Typhoon is negative, and increasing with the intensity and the proximity to the trauma experience. The magnitude of α_2 indicates the effect of each type of experience on the probability of developing a PTDS incidence.

5.2. Estimating the effect of PTSD shock at childhood on adult's schooling outcomes

From the theoretical framework, a PTSD shock at childhood would discourage investment in schooling contemporarily, and this would result in a decrease in human capital stock at the end. The accumulation of human capital shock would experience more adverse impact if the relative price of human capital is higher than the alternative (the physical capital, in our case). In this section, we use the Chumpon data set to examine the ways in which the intensity of PTSD shock at childhood may impact schooling outcomes later on in life. Provided that the *injection* of the PTSD shock and its intensity are exogeneous and random on the observables, the estimation specification can be written as:

$$SCHOOL_{i,l,2011} = \beta_1 + \beta_2 PTSD_{i,l,1989} + X'_{i,l}\gamma + \mu_l + \mu_i \tag{2}$$

where i is an individual; $SCHOOL_{i,l,2011}$ is a schooling achievement at adult; $PTSD_{i,l,1989}$ is as explained [14]. At initial, we focus on total years of schooling as the main adult outcome variable. The reduced-form linear relationship estimation is used to obtain the scale of the treatment effect of PTSD mental health shock on the treated group (β_2). Recall that our measure of PTSD symptom is a proxy for the contemporary PTSD condition of young individuals in 1989, just after having experienced the Typhoon. Therefore, we control for $X'_{i,l}$ as some of factors (including the individual's fixed traits, past and contemporary family characteristics and school-related variables at 1989) to account for their potential correlation with the error terms.

We also test for the effect on the PTSD shock on some alternative schooling outcomes. The alternative is the probability of graduating with a high school qualification or equiva-

[14] For the 2011 assessed level of PTSD to reflect the 1989 level of PTSD, we rely on the key assumption that it is a monotonic relationship between the 2011 measure and the actual 1989 shock magnitude.

lence [15]. Given the national statistics relevant to the age cohorts in this analysis, around 99 percent have completed primary school level, with a subsequent 80 percent progressed to the middle school level. Lastly, there are around 60% of the cohorts eventually obtained a completed high school qualification or equivalence (Thailand Ministry of Education, 2015; UNESCO, 2011). The outcome variable equals to 1 if the highest qualification of an individual is of high school or higher, and zero otherwise.

6. Main Results

The results in Table 3 from the regression exercise suggest that having been physically exposed to the traumatic typhoon (both by themselves or their family) predicts a strong positive correlation. As in the psychology literature, being a female is associated with the higher likelihood of developing the PTSD symptom. The younger they are, the more likely that they would have been affected by the PTSD-induced shock. In additional, **Columns 4 and 5** show that personal ability to have a clearer recollection of the event does not have a statistically significant effect on the likelihood of developing a PTSD.

Table 4 shows the results from the estimation with the full sample, using two alternative definitions of agricultural activities of the households. In this specification, the sample is clustered at the primary school level, in order to account for within-group correlation. Additional specifications also account for gender-specific heterogeneities in responding to the PTSD shock. Column 1 shows that, with males and females together, the schooling outcome from the male sample seems to be more negatively affected by the shock. In Column II where the sample is restricted to only males, affected males have, on average, 1.4 fewer years of schooling than the ones without PTSD. On the other hand, the effect is smaller in magnitude for the female sample and it is not statistically significant from zero. This seems to suggest that the male's schooling is more sensitive to his mental health capital.

To see whether or not the PTSD shock present a different effect to different age cohort, we separately estimate the effect for each age cohorts.In Table 5, we divide the sample in into three groups: 5-7, 8-9 and 10-12 years old (in 1989). In some sense, we aim to account for that fact that children of different maturity react differently to the trauma, de-

[15]In Thailand, it usually takes approximately 12 years to graduate with a high school qualification. There are 3 schooling tracks in which students can pursue to obtain the qualifications that are the core requirement prior to take the university entrance examination: formal general, formal vocational and non-formal. Based on this, we consider all three qualifications to be equivalent in the analysis.

pending on their recollection capacity, ability to acknowledge reality or coping mechanisms (Galante and Foa, 1996). And that the production technology during childhood is known to be age-sensitive (Lancet, 2007, 2011). Additionally, the group classification takes into consideration potential effects from financial constraints, namely costs of schooling, on the parents. Note that only after 2002 that compulsory schooling in Thailand was raised from 6 years (primary school level) to 9 years, so as to include additional 3 years of middle school (Ministry of Education, 2002). Therefore, it is more likely that the relative price effect may become a key determinant on the schooling investment for the older children than the younger ones. Further findings from the specifications in Table 5 suggest a degree of heterogeneous treatment effect among the three age groups. The PTSD shock is found to have reduced approximately 2 years of schooling of the 10-12 years old children whilst it has no significant effect on the other age groups. When we divide the 10-12 age group by gender, the result suggests that the adverse impact of the PTSD shock is found statistically significant only among the male sample.

Using an alternative measure of school attainment, we regress a probit specification of the probability of having high school qualification on PTSD. This is to relax a linear assumption imposing on the relationship between PTSD and schooling. Table 6 suggests that on average, the PTSD shock reduces the probability of having a high school qualification by approximately 8 percentage points. And the negative effect somewhat concentrates on only among the male sample. The results are also similar when considered within only the group aged 10-12 years in 1989. Recall that for younger ages, their continuation of education remained legally protected by the 6-year compulsory schooling at the time. In contrast, children aged 10-12 were most vulnerable to changes in circumstances. This is solely our conjecture, which needs further investigation.

7. Robustness Checks

7.1. Accounting for recall problem in retrospective data

We next consider a number of sensitivity checks to see if the findings so far are robust. First of all, we realise that using a retrospective data could potential pose a concern of the precision of personal recollection of the interested event. Given that it has been over 20 years since the Typhoon affected the country, a key issue of personal recollection of the events, objectively and subjectively can be problematic in a number of ways. First of all,

a bad recollection can lead to the mismatch of self-assessed experiences and subsequently a measurement error problem. Secondly, many studies in the literature (for example Macciocchi et al., 1993 and Caspi et al., 2005) argue for the substantial link between the magnitude of the memory from the trauma event and its psychological impact. With reference to the causal effect of stress condition on neuro-biological development, having persistently suffered from stress may in fact reduce the memory ability directly.

The design of the questionnaire is our first attempt to account for the recall issue in the first place. A section of the questionnaire contains a set of screening questions and other section includes a paragraph with the brief description of the typhoon event, for the sampled individuals to recap prior to answering subsequent questions. To refine the estimations so far, we make use of the screening questions in three ways. Firstly, we include the recall score indices as additional covariates in the main outcome regressions. Then the sample is restricted to only those who scored well in the recall assessment, (60% or higher) so as to check the sensitivity of the effect of PTSD shock on schooling outcomes.

The estimation results in Table 7 indicate that individuals with higher recall score did attain more years of schooling. On the other hand, the treatment effect of PTSD shock on the schooling outcome is robust and unaffected by most of the specifications. The adverse effect of PTSD shock on the male sample results in approximately 1.5 fewer years of schooling. Among the 10-12 years old, they suffer around 2 fewer years of school attainment than the male without the mental health shock. The effect remains non-established for the female sample and other younger age cohorts.

Next, we restrict our analysis to only those from the geographically typhoon-ridden area, namely those from Tasae and Patil. We discard the individuals from the unaffected district of Lamae to account for a possibility of heterogeneous response between individuals who were heavily affected and those who were not. We re-estimate the results with the full sample as well as the population with the age between 10-12 years old. The findings in Table 7 show a comparable scale of the PTSD shock on the highest years of schooling. Among them, those who also have a PTSD symptom achieved approximately 1.3 years of schooling than their counterparts and the results are insensitive even when controlled for recall scores.

7.2. Effect of childhood PTSD shock on other life outcomes

Next, we investigate potential effects of a mental health shock on some health-related outcomes at adulthood. Constrained by the choice of the variables from the survey, we decide to look at two broad measurements of physical health condition and fertility behaviours.

$$HEALTH_{i,l,2011} = \beta_{H1} + \beta_{H2} PTSD_{i,l,1989} + X'_{i,l}\gamma_H + \omega_l + \omega_i \tag{3}$$

$$FERTILITY_{i,l,2011} = \beta_{F1} + \beta_{F2} PTSD_{i,l,1989} + X'_{i,l}\gamma_F + \eta_l + \eta_i \tag{4}$$

For Equation 3, individuals' weight and height at the interview time in 2011 are used to construct a Body Mass Index as a proxy of general physical well-being status (World Health Organisation). The outcome variable $HEALTH_{i,l,2011}$ is a binary variable. It equals to one for anyone with an index between 18.5 -25 (a desired level of BMI) and zero otherwise. The analysis also split the sample into males and females, accounting for heterogeneous mechanism of the mental health effect on the physical health capital. Table 8 show that the male sample with a PTSD condition is more likely to have an unhealthy BMI index than their counterparts. Along the ages, the negative effect of PTSD shock is stronger and statistically significant among the younger age cohorts.

To examine the effect of PTSD shock on adult fertility behaviours, the analysis looks at the probability of first marriage as well as the probability of having the first child during teenage years. Approximately a half of the sample is married or have children at the time of the survey. In general, being active in fertility-related activities at these ages can be interpreted as an undesirable outcome as it usually reflects an irrational trait (Lowenstein and Furstenberg, 1991; Levine, 2001) and it possibly deters any further human capital accumulation of the individual. A plausible mechanism that a PTSD shock at childhood could influence the behaviour can be via its implications on both non-cognitive abilities and psychological conditions (Hardy and Zabin 1991).

Hence, we hypothesis that individuals with a childhood PTSD symptom, who are more possible to maintain an adverse psychological condition, are more likely to have engaged in those activities early on during the teenage years. That is, the estimated β_{F2} should have a negative relationship with $FERTILITY_{i,l,2011}$. The results from Table 9, however, are somewhat contradictory. For both male and female sample, those with a PTSD shock

are found to be less likely to have had been married or had the first born during their teenage years. Note however that given the available variables, the regression analysis may have left out many other factors which can dictate such fertility decisions (see for example, Chiappori, Iyigun and Weiss (2006) ; Browning, Chiappori and Weiss (2014) for a review on fertility decisions and human capital.) Therefore we approach this finding with cautious.

7.3. Propensity Score Matching and Balancing Tests

Even though we have provided sufficient evidence to support the assumption that the assignment of PTSD shock to children in 1989 is of a randomised manner, this empirical exercise remains a non-experimental one. Therefore, it may still be subjected to biases from the selection on the observables. Taking that into account, we decide to refine the empirical results by employing the method of propensity score matching to our study design (Rosenbaum and Rubin, 1983).

To implement the matching technique, the treatment group ($T = 1$) is again defined as the individuals with some PTSD symptom from the PSS-I assessment whilst the control group ($T = 0$) is those of no sign of PTSD. The method assumes that conditional on the propensity score, the assignment of treatment is independent to all the relevant observable characteristics (Z). Propensity score ($P(Z)$) is defined as $P(Z) = P(Z \mid T = 1)$, the probability of being in the treated group. We calculate $P(Z)$ using Probit model specifications, where Z consists of characteristics of individuals, household and their primary school setting (see the Appendix). Upon estimation of the propensity score, we then make sure that the Common Support Assumption is satisfied (see the Appendix for distribution of observed variables between the treated and the non-treated group). Table 10 shows Balancing Tests of the matched sample from the data.

Subsequently, we estimate the PTSD shock effect using various matching specifications, namely Nearest-Neighbour Matching (Rosenbaum and Rubin, 1983; Dehejia and Wahba, 2002), Caliper Matching (Cochran and Rubin, 1973), Kernel-Based Matching (Heckman, Ichimura and Todd, 1998) and Local Linear Regression Matching (Heckman, Ichimura, Smith and Todd, 1998). Table 11 reports the results from the estimations, with bootstrapped standard errors. In all specifications, the sample is restricted to only the data within the common support. The estimations of average treatment effect on the treated look robust to various matching specifications. Overall, we do not detect statistically

significant effect of the PTSD shock on the treated group in the full sample analysis. However, when the sample is further restricted to within 3 different age cohorts, we find a negative effect of PTSD shock on schooling of the 10-12 years old. Similar to other specifications previously conducted, the average treatment effect of PTSD shock on the affected is approximately 2 fewer years of schooling than the non-affected group.

8. Discussions and Conclusions

The study provides evidence showing that mental health condition at childhood can have an important and adverse effect on adult outcomes, in particular the schooling outcomes. By focusing on the mental health that is induced from a typhoon event, it also identifies another important channel in which natural disasters can cause damage on individuals. Our findings suggest that the persistence of the trauma on PTSD mental health condition leads to a negative outcome in schooling achievement. The effect is found to be exacerbated among individuals whose age at the time was at a borderline between free compulsory school and fee-paying middle school age cohorts. We can only speculate that this is an indicator of a situation when other shocks, for example potential price and income shock, become intensified simultaneously.

To substantiate the negative impact of the PTSD shock in real term, we consider the labour market condition in Thailand. Given the rate of an additional year of schooling in Asian developing countries on average is 10 percent (Psacharopoulos and Patrinos, 2004) with an approximate of 6-7 percent for wage-earners in Thailand (Yamauchi, 2005), a loss of two years of education can be substantively disadvantageous. A subsequent national policy on the additional three years of free school to younger cohorts (implemented in 2003) means that the average level of education of the labour market will be raised, making it more competitive for people with lower education.

Lastly, we believe the major limitation of this paper is that it lacks contemporary datasets to support the findings. But we hope that the paper at least demonstrates a plausible channel in which health capital and cognitive capital are related and also stimulates thinking about the significance of mental health condition along these lines.

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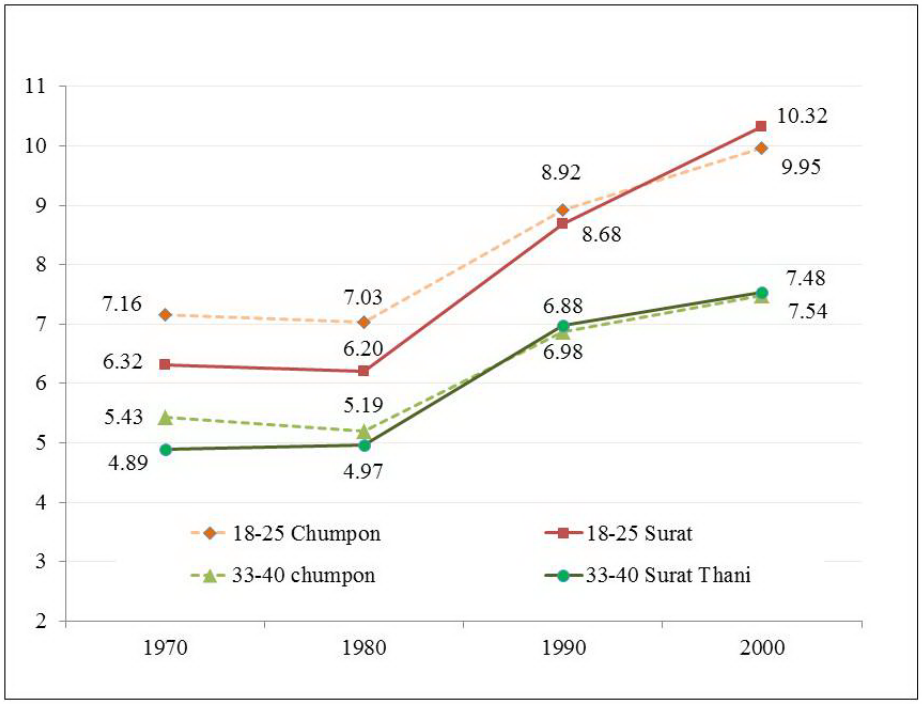
Figures

Figure 1: Average Years of Schooling by Age Cohort for Chumpon and Surat-Thani



Notes: Datasets are from Thailand Population Census (IPUMS Sub-sample of 1970, 1980, 1990 and 2000). Age cohorts at each census year are divided into 2 groups: Those of age 18-25 years on at the census year, and those of 33-40 years old. Those of age 18-25 years old in the 2000 census as they would have been 7-14 years old in 1989, which is the age group of interest in this study. Those of the 33-40 years old would have been 22-29 years old in 1989 and already passed their schooling ages. Chumpon province is the location that experienced the typhoon in 1989 whilst the comparable Surat-Thani province was unaffected by the event.

Figure 2: A Geographical Map of Thailand, Chumpon Province and Typhoon Gay' s Path in 1989

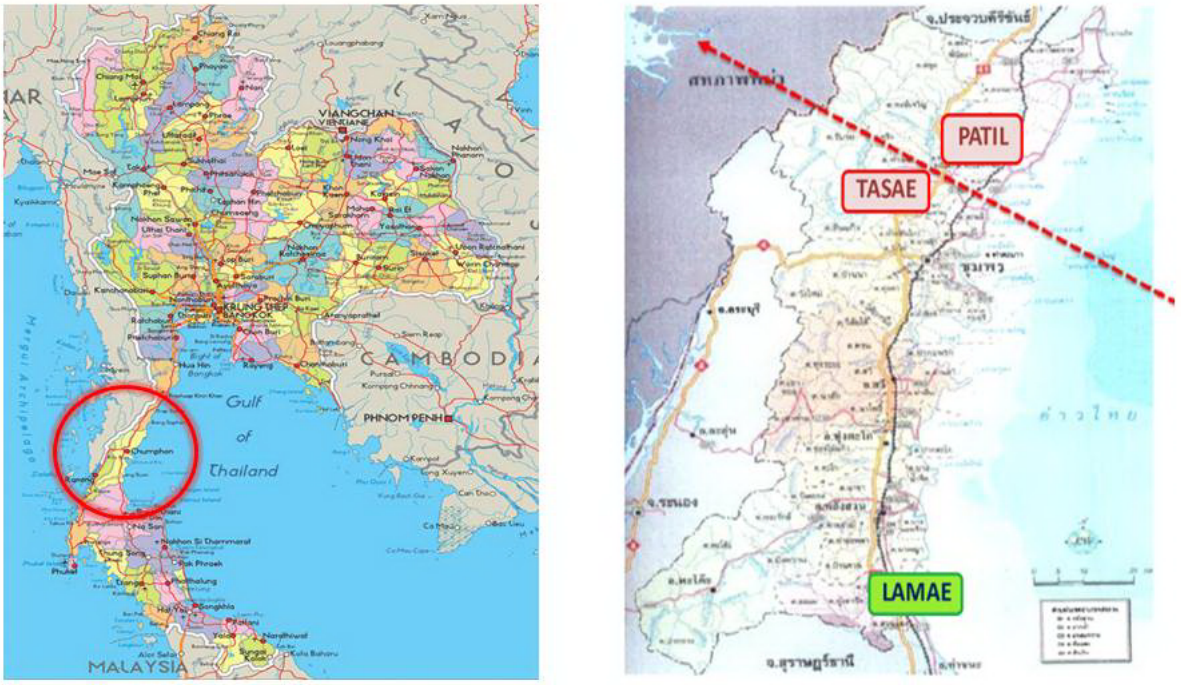
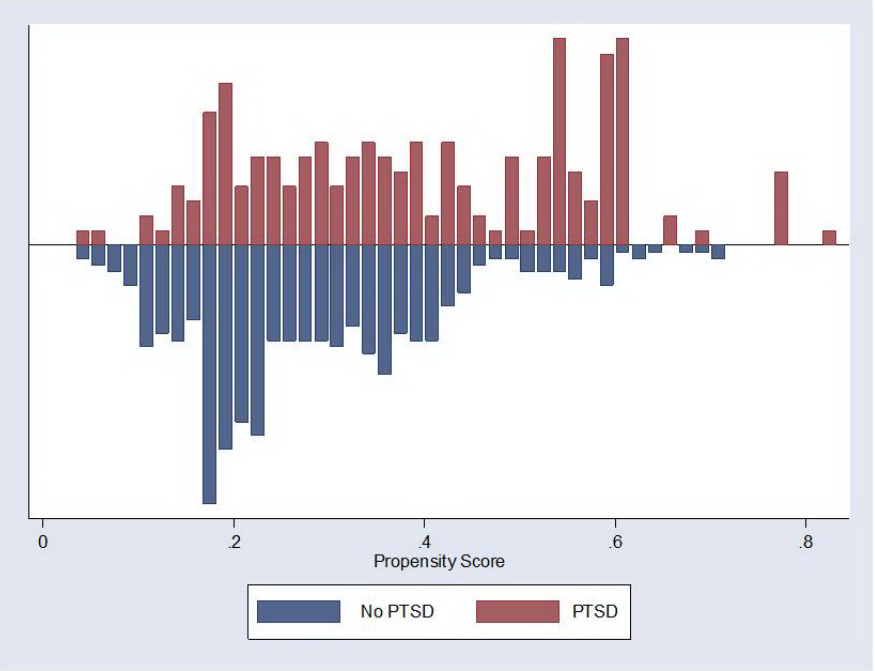


Figure 3: The Distribution of the Common Support in the Matched Sample



Tables

Table 1: Survey Sample Size by Gender: Target and Actual Observations

	Exposed Area		**Unexposed Area**	
	Male	**Female**	**Male**	**Female**
Target	280	280	250	250
Actual	275	310	303	341

Notes: Exposed areas are 2 sub-districts in Patil and 2 other sub-districts in Tasae district in Chumpon. Unexposed areas are 4 sub-districts in Lamae district, also from Chumpon.

Table 2: Balancing tests for two alternative treatment assignments: means and p-values from the Chumpon Survey 2011 Survey

	Locations			Assessed PTSD Level		
	Unexposed Locations Obs: 315	Exposed Locations Obs: 719	Diff	No PTSD Obs: 737	Some PTSD Obs: 315	Diff
Gender	0.47	0.49	0.02	0.5	0.46	0.04
	[0.03]	[0.02]	[0.03]	[0.02]	[0.03]	[0.03]
Age in 1989	8.06	7.93	0.13	8.05	7.73	0.32
	[0.15]	[0.10]	[0.17]	[0.09]	[0.14]	[0.17]
Father's schooling	0.92	0.95	0.042	0.94	0.96	0.03
	[0.02]	[0.007]	[0.017]**	[0.01]	[0.01]	[0.02]
Mother's schooling	0.95	0.98	0.02	0.96	0.97	0.01
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
Same district	0.76	0.81	0.04	0.81	0.75	0.05
	[0.02]	[0.01]	[0.03]	[0.01]	[0.02]	[0.03]
Large school	0.01	0.04	0.03	0.03	0.05	0.02
	[0.004]	[0.01]	[0.01]**	[0.01]	[0.01]	[0.01]
Grew industrial crops	0.08	0.07	0.01	0.07	0.07	0.01
	[0.02]	[0.01]	[0.02]	[0.01]	[0.01]	[0.02]
Recall: date & place:	1.45	2.33	0.88	2.03	2.12	0.09
	[0.05]	[0.04]	[0.07]**	[0.04]	[0.05]	[0.07]
Recall: events:	3.94	4.32	0.37	4.21	4.19	0.02
	[0.14]	[0.07]	[0.14]**	[0.08]	[0.09]	[0.14]
Distance from Typhoon	117.8	69.78	48.01	80.55	87.3	6.75
path (km)	[0.31]	[1.86]	[3.09]**	[1.86]	[2.71]	[3.35]**
School Disruption Index	0.11	1.31	1.2	0.84	1.15	0.31
	[0.02]	[0.03]	[0.05]**	[0.03]	[0.05]	[0.06]**
Total Exposure Index	0.67	4.15	3.47	2.56	4.27	1.71
	[0.07]	[0.09]	[0.14]**	[0.09]	[0.16]	[0.17]**

Notes: ** p<0.05, * p<0.1. Standard errors are in square brackets. Parental schooling are measured as the probability of having a high school degree or higher. Same district variable equals to 1 if the individual was born and studied in the same district, zero otherwise. Grew industrial crops equals to 1 if the household already grew industrial crops before 1989 and zero otherwise. Large school equals to 1 if individuals at a large-size primary school in 1989. Recall scores are calculated from the recollection level from the Chumpon questionnaire. Distance is calculated by GIS distance of the house from the 1989 path, calculated from the meteorological information. Exposure indices are calculated from listed criteria in which individuals indicated to have experienced with the typhoon in 1989. Total exposure index is out of 16 and school disruption index is out of 2.

Table 3: Estimates of the effect of exposures to the Typhoon on a PTSD symptom

	I	II	III	IV
Dependent variable: Probability of having a PTSD symptom				
Own injury	0.180***	0.217***	0.171***	0.174***
	[0.027]	[0.032]	[0.028]	[0.028]
HH jobs interrupt	0.023	0.027	0.025	0.023
	[0.023]	[0.026]	[0.023]	[0.023]
Displaced	0.027	-0.005	0.035	0.031
	[0.022]	[0.025]	[0.022]	[0.022]
School damage	0.014	-0.017	0.022	0.021
	[0.021]	[0.026]	[0.022]	[0.022]
Age (1989)	-0.013*	-0.022**	-0.012*	-0.012*
	[0.007]	[0.009]	[0.007]	[0.007]
Male	-0.059*	-0.075*	-0.060*	-0.058*
	[0.035]	[0.042]	[0.035]	[0.035]
Father's education	0.081	0.186**	0.084	0.078
	[0.091]	[0.079]	[0.091]	[0.091]
Mother's education	0.047	-0.006	0.043	0.048
	[0.128]	[0.181]	[0.130]	[0.128]
Same district	-0.022	-0.058	-0.009	-0.01
	[0.055]	[0.069]	[0.055]	[0.055]
Large school	-0.091	-0.09	-0.08	-0.084
	[0.087]	[0.106]	[0.090]	[0.088]
Agriculture HH	0.108**	0.133**	0.106**	0.103**
	[0.049]	[0.062]	[0.050]	[0.049]
Mental health assistance		0.104		
		[0.069]		
Places and dates			-0.032*	
			[0.020]	
Events			-0.006	
			[0.010]	
Total score				-0.013
				[0.008]
Observations	721	536	721	721
Pseudo R2	0.127	0.15	0.131	0.13

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors in bracket. Cluster is at sub-district level. The sample were aged between 5-12 years old with residence in the 3 districts in Chumpon in 1989. Damage indices are calculated from listed criteria in which individuals indicated to have experienced from the typhoon in 1989. Mental health assistance equals to 1 if received any government assistance post-Typhoon. Agri Household equals to 1 if agriculture was a main household activity before the typhoon. Others, see Table 2

Table 4: Effect of PTSD on adult's years of schooling

	Full sample	Male	Female
	I	II	III
Dependent variable: total years of schooling			
PTSD	-0.58	-1.393**	0.239
	[0.434]	[0.519]	[0.559]
Age (1989)	-0.022	0.004	-0.061
	[0.096]	[0.118]	[0.099]
Male	-1.041***		
	[0.200]		
Father's education	-3.256***	-4.073***	-2.844**
	[0.615]	[1.044]	[1.185]
Same district	-0.821	-0.609	-0.761
	[0.976]	[1.351]	[0.807]
Large school	3.746***	3.194***	4.401***
	[0.526]	[0.873]	[1.362]
No migration	-0.833	-0.899	-0.85
	[0.500]	[1.104]	[0.960]
Additional controls			
Activities in 1989	Yes	Yes	Yes
Activities in 2011	Yes	Yes	Yes
Observations	636	322	314
Adjusted R-squared	0.134	0.172	0.128

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors are in bracket. PTSD is a binary variable, and calculated from the PIECES-18 assessment in the questionnaire. It equals to 1 is an individual has a likelihood of PTSD development and zero if not. Years of schooling is converted from the highest qualification of individuals by 2011. Others, see Table 3

Table 5: Effect of PTSD on adult's years of schooling: by age cohorts in 1989

	Age 5-7	Age 8-9	Age 10-12		
			Full	Male	Female
	I	II	III	IV	V
Dependent variable: total years of schooling					
PTSD	-0.067	0.54	-1.918*	-2.269**	-2.021
	[0.453]	[0.735]	[0.877]	[0.723]	[1.214]
Age (1989)	-0.364	0.601	-0.474	-0.071	-1.159*
	[0.352]	[0.496]	[0.389]	[0.352]	[0.565]
Male	-2.078***	-0.308	-1.079*		
	[0.472]	[0.900]	[0.534]		
Father's education	-4.228***	-1.705***	-6.259***	-4.147	-5.876***
	[1.090]	[0.403]	[1.547]	[2.595]	[1.687]
Same district	-1.504	-2.024	1.079	2.846*	-0.878
	[1.134]	[1.527]	[1.376]	[1.451]	[1.572]
Large school	4.855*	4.828***	-1.154	-2.495**	-0.911
	[2.295]	[0.663]	[1.455]	[0.987]	[2.091]
No migration	0.542	0.858	-3.478***	-4.020***	-2.364*
	[1.044]	[1.218]	[0.645]	[1.123]	[1.077]
Additional controls					
Agricultural (1989)	Yes	Yes	Yes	Yes	Yes
Agricultural (2011)	Yes	Yes	Yes	Yes	Yes
Observations	215	140	214	109	105
Adjusted R-squared	0.233	0.231	0.218	0.261	0.297

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors are in bracket. See Table 4

Table 6: Effect of PTSD on high school attainment: by age cohorts in 1989

	Male	Female	Age 5-7	Age 8-9	Age 10-12	
					Male	Female
	I	II	III	IV	IV	VI
Dependent variable: having a high-school qualification						
PTSD	-0.164***	-0.011	-0.068	-0.067	-0.292***	-0.169
	[0.063]	[0.063]	[0.084]	[0.106]	[0.099]	[0.113]
Age (1989)	0.01	-0.009	-0.027	0.056	0.143**	-0.210***
	[0.012]	[0.011]	[0.045]	[0.093]	[0.062]	[0.071]
Male			-0.271***	0.057		
			[0.072]	[0.090]		
Same location	-0.014	-0.083	-0.034	-0.099	0.063	-0.105
	[0.110]	[0.108]	[0.137]	[0.155]	[0.213]	[0.216]
No Migration	-0.005	0.037	0.109	0.222*	-0.126	-0.237
	[0.110]	[0.099]	[0.117]	[0.130]	[0.211]	[0.201]
Additional controls						
Parent education	Yes	Yes	Yes	Yes	Yes	Yes
Agricultural (1989)	Yes	Yes	Yes	Yes	Yes	Yes
Agricultural (2011)	Yes	Yes	Yes	Yes	Yes	Yes
School size	Yes	Yes	Yes	Yes	Yes	Yes
Observations	337	327	220	138	112	107
Pseudo R2	0.126	0.0623	0.156	0.0989	0.205	0.149

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors are in bracket. High school equals to 1 if individuals have at least high-school attainment (both academic and vocational) by 2011 and zero otherwise. See Table 4.

Table 7: Effect of PTSD on high school attainment: by age cohorts in 1989

	All ages		Age 10-12		Only those with high recall	
	Male	Female	Male	Female	All ages	Age 10-12
	I	II	III	IV	V	VI
Dependent variable: total years of schooling						
PTSD	-1.354**	0.287	-2.159**	-1.788	-0.874*	-1.877*
	[0.525]	[0.680]	[0.649]	[1.304]	[0.420]	[0.947]
Recall scores:						
Places and dates	-0.257	0.406	0.273	-0.054		
	[0.184]	[0.388]	[0.295]	[0.574]		
Serie of events	0.226*	0.182*	0.259	0.21		
	[0.124]	[0.096]	[0.171]	[0.179]		
Age in 1989	0.01	-0.095	-0.051	-1.159*	-0.027	-0.404
	[0.139]	[0.109]	[0.328]	[0.548]	[0.122]	[0.417]
Male					-1.312***	-1.082
					[0.278]	[0.624]
Same location	-0.667	-0.804	2.941*	-0.903	-1.41	0.548
	[1.270]	[0.597]	[1.548]	[1.584]	[0.970]	[2.039]
No Migration	-0.869	-0.8	-3.973**	-2.489*	0.051	-2.617*
	[1.120]	[1.020]	[1.239]	[1.164]	[0.382]	[1.216]
Additional controls						
Parent education	Yes	Yes	Yes	Yes	Yes	Yes
Agricultural (1989)	Yes	Yes	Yes	Yes	Yes	Yes
Agricultural (2011)	Yes	Yes	Yes	Yes	Yes	Yes
Primary school size	Yes	Yes	Yes	Yes	Yes	Yes
Observations	329	320	112	108	495	181
R-squared	0.179	0.14	0.278	0.306	0.147	0.213

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors are in bracket. Recall scores are calculated from the recollection ability test from the questionnaire. Individuals are classified as high recall scorers when she answers at least 60% correctly. The assessment is divided into two subgroups: recollection of places and dates, and of the details of the events, in a closed-form question style. Others, see Table 4.

Table 8: Childhood PTSD and adult physical health: Body Mass Index

	Male	Female	Age 5-7	Age 8-9	Age 10-12
	I	II	III	IV	V
PTSD	-0.188***	-0.03	-0.252***	-0.048	-0.026
	[0.055]	[0.054]	[0.064]	[0.062]	[0.056]
Age in 1989	-0.006	-0.002	0.043	-0.113	-0.050**
	[0.009]	[0.013]	[0.037]	[0.135]	[0.023]
Male			-0.052	0.145	-0.064
			[0.055]	[0.114]	[0.074]
Same location	-0.032	0.105	0.022	-0.05	0.059
	[0.051]	[0.088]	[0.110]	[0.112]	[0.089]
No Migration	0.044	-0.043	0.183**	-0.06	-0.129
	[0.064]	[0.070]	[0.081]	[0.106]	[0.081]
Observations	320	317	216	141	209
Pseudo R2	0.0427	0.0608	0.147	0.132	0.0291

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors are in bracket. The dependent variable is Body Mass Index. It equals to 1 if an individual has a healthy BMI range (18.5-25), and zero otherwise. All specifications control for the same set of covariates in previous tables. See Table 4.

Table 9: Childhood PTSD and fertility status: teenage parents and marital status

	Teen parenthood		Teen marriage	
	Male	Female	Male	Female
	I	II	III	IV
PTSD	-0.038***	-0.105***	-0.045**	-0.057
	[0.014]	[0.040]	[0.021]	[0.050]
Observations	287	283	310	309
Pseudo R2	0.133	0.0963	0.0655	0.0813

Notes: *** p<0.01, ** p<0.05, * p<0.1. Clustered standard errors are in bracket. In Column I and II, the dependent variable is teen parenthood. It equals to 1 if an individual had a child before aged 20, and zero otherwise. In Column III and IV, the dependent variable is teen marriage. It equals to 1 if an individual was married before aged 20, and zero otherwise. All specifications control for the same set of covariates in previous tables. See Table 4.

Table 10: Balancing Tests for the Matched-Propensity-Score Sample

	With Recall Scores		Without Recall Scores	
	Differences	Paired P-value	Differences	Paired P-value
Gender	0.04	0.34	0.04	0.32
Age in 1989	0.29	0.16	0.27	0.16
Father's schooling	0.02	0.26	0.02	0.22
Mother's schooling	0.004	0.73	0.006	0.63
Same location	0.02	0.29	0.03	0.29
School size	0.03	0.18	0.02	0.18
Industrial Crops (1989)	0.002	0.91	0.002	0.91
Recall Score: place & date	0.12	0.13	0.11	0.14
Recall Score: events	0.3	0.05	0.304	0.04
School Disruption Index	0.23	0	0.23	0.002
Total Exposure Index	1.66	0	1.67	0

Table 11: Childhood PTSD and Schooling attainment: Matching Sample

	Full sample				Age 10 -12			
	ATT	Bootstrapped Standard Errors			ATT	Bootstrapped Standard Errors		
		rep= 200	rep=300	rep=1000		rep= 200	rep=300	rep=1000
Nearest neighbour, n = 2								
no caliper	-0.210	0.528	0.547	0.554	-2.412	0.997	1.186	1.096
caliper(0.1)	-0.210	0.601	0.550	0.550	-2.412	1.052	1.067	1.115
Nearest neighbour, n = 5								
no caliper	-0.235	0.502	0.469	0.511	-2.298	0.888	0.967	0.949
caliper(0.1)	-0.235	0.465	0.495	0.499	-2.329	1.049	0.968	0.977
Kernel: Epanechnikov								
bwidth= 0.6	-0.217	0.442	0.409	0.423	-2.518	0.953	0.911	0.887
bwidth= 0.8	-0.604	0.358	0.356	0.348	-2.501	0.949	0.825	0.924
bwidth= 0.2	-0.427	0.348	0.372	0.381	-1.841	0.658	0.709	0.649
Kernel: Gaussian								
bwidth= 0.8	-0.612	0.353	0.360	0.366	-1.958	0.558	0.639	0.606
Kernel:Biweight								
bwidth= 0.6	-0.219	0.384	0.441	0.426	-2.502	0.925	0.925	0.940
Local linear regression								
	-0.223	0.402	0.431	0.421	-2.660	0.986	1.090	1.077