Shocks, Resilience and Long-term Human Capital Outcomes: Evidence from Natural Disasters in the Philippines

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Abstract

Natural disasters can jeopardize human capital investments, especially in developing countries. Few empirical studies have analyzed interventions that build resilience to negative shocks and protect youth human capital. Using super-typhoons geographic variation combined with age-cohort exposure and the spatial variation of a secondary school infrastructure program in the Philippines, we estimate a triple difference model to analyze whether children who were exposed to typhoons and were fully exposed to the infrastructure program have better long-term human capital outcomes. Using census data, more than ten years after the natural disaster and program, we find that children affected by the super-typhoons and later benefited from the program, accumulated more years of schooling and were more likely to complete high school. We also find that these protective effects of the infrastructure program to the natural disaster are differentiated by gender. For men, these gains in education are associated with a higher likelihood of high-skilled employment and migrating overseas while for women these benefits are associated with a lower likelihood of being married.

Key Words: Resilience, Human Capital, Youth, Natural Disasters

JEL codes: J13, I25 O15

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Introduction

Adverse early life events can have long-term economic consequences (Cuhna andHeckman, 2007; Currie and Vogl, 2013). In particular, an extensive empirical evidence in developing countries has documented that natural disasters during early life and childhood can have detrimental and persistent effects on human capital (Baez and Santos, 2007; Maccini and Yang, 2009; Cas et al., 2014; Frankenberg et al. 2011 among others). Nevertheless, few studies have analyzed whether these negative effects in childhood can be mitigated by positive investments and to what extent it is possible to remediate in the long-term the affected children's human capital outcomes. Empirical challenges of analyzing resilience to adverse shocks arise from the fact that while natural disasters are arguably random, the responses to these shocks might be endogenous. Parents and government's responses to negative shocks to protect their children can be correlated with unobserved heterogeneity that also affects the children's future outcomes (Gunnsteinsson et al., 2016; Adhvaryu et al. 2016; Almond and Manzumder, 2013).

We examine whether positive investments in a secondary-school infrastructure program can mitigate the adverse effects of natural disasters during childhood on long-term human capital outcomes in the Philippines. To empirically address this question, we need that the same cohort of children is affected by extreme weather shocks and later on by a positive investment as well as plausible exogenous variation in the negative shock and positive investment. Thus, we use three sources of variation. First, we use the geographic variation of the 1987 super-typhoons which randomly affected some areas of the Philippines. Second, we leverage the cohort exposure and the spatial variation of the 1989 Typhoon-Resistant Secondary School Building and Instructional Equipment Program (TRSBP) that the Philippines government implemented with the help of the Japanese government. Due to certain administrative and locational requirements, the program was

not only allocated in areas directly affected by the 1987 super-typhoons but also in other unaffected areas. Our empirical strategy, therefore, takes advantage of this spatial variation in the super typhoons as well as the geographic variation in the TRSBP program together with temporal variation in cohort exposure to investigate resilience to negative shocks.

We estimate a triple-difference model by examining the difference across areas treated and not treated by the 1989 TRSBP, among younger (9-12 years old in 1989) and older cohorts (17-21 years old in 1989). We then take the third difference across the areas affected and not affected by the 1987 super-typhoons. We use the 2000 Census data in the Philippines which allows us to examine the effects of this triple interaction on human capital outcomes after ten years of these positive and negative shocks. We analyze the resilience effect of the negative shock on educational attainment, skills, the probability of being employed in a high skilled occupation, the likelihood of migrating overseas, and the likelihood of being ever married.

Our results indicate that the younger cohort of children affected by super-typhoons in 1987 and who later benefited from the TRSBP program is more likely to complete high school, speak English and accumulate more years of schooling. Among men, these long-term education gains are associated with a higher likelihood of working in high-skilled occupations and of migrating overseas, while for women they are associated with a lower likelihood of being ever married. These results point out that public investments in adolescence such as supply-side programs to improve school infrastructure have the potential to mitigate the adverse effects of natural disasters that occur during childhood.

Our paper contributes to the emerging literature that investigates whether negative effects on human capital due to natural disasters or extreme weather shocks can be mitigated by positive investments such as conditional cash transfers (Gunnsteinsson et al. 2014; Adhvaryu et al. 2014;

Duque et al., 2016). Departing from these studies, we focus on negative shocks occurring at a primary school age when children are starting formal education, as opposed to shocks *in utero.* Also, our analysis is different from the aforementioned studies in that we analyze a supply-side school infrastructure program rather than a demand-side incentive for schooling such as conditional cash transfers.

Our results echo the evidence that documents the persistent and adverse effects of natural disasters on education and cognitive skills in developing countries (Baez and Santos, 2007; Rosales, 2014; Maccini and Yan 2009; Alderman et. al, 2006; Goppo and Kraehnert, 2016 Deuchert and Felfe (2015), by testing if these adverse effects persist to young adulthood. Furthermore, we contribute to the empirical evidence that has analyzed the long-term effects of massive school construction programs on education and related outcomes such as wages, fertility and child health in developing countries (Breierova and Duflo 2004, Duflo 2001, Osili and Long 2008) by providing evidence on whether such programs can help mitigate the negative effects on human capital in developing countries that are prone to natural disasters.

The rest of the paper is organized as follows. Section 2 provides the context and background of the 1987 Super-Typhoons and the 1989 Typhoon-Resistant School Building and Instructional Equipment Project as well as the data sources. Section 3 lays out the empirical strategy and Section 4 discusses the results as well as robustness checks. Finally, Section 5 presents concluding remarks and policy implications.

II. Data Description and Context

A. The Secondary Education Reform and the 1989 Typhoon-Resistant School Building and Instructional Equipment Project

In 1988, the Philippines implemented a free public secondary education policy to complement its historically free and compulsory public elementary education policy.[1] Under this policy, the tuition and matriculation fees, laboratory and library fees, medical and dental fees and athletic fees were made free. Thus the policy led to rapid increase in secondary school enrollment and a shortfall in classrooms and school buildings. Due to capacity constraints, as a general implementation rule, the Department of Education officials prioritized the enrollment for the first year high school of the graduates of public elementary schools in the same municipality as well as students in the second, third and fourth years of the same school.[2]

In that same year, the government explored the possibility of tapping Japanese bilateral assistance in the form of grants to supplement the initiatives to address the shortage of classrooms and school facilities. This resulted in a school building project that started in 1989 (became known as Typhoon-Resistant School Building Program (TRSBP)) which uses the Japanese technology for constructing typhoon-resistant pre-fabrication structures. The idea behind this program is not just to build schools or classrooms but to build better schools by making them typhoon-resistant so that access to school is not interrupted by school infrastructure loss due to typhoons that regularly visit the country. This is an unusual assistance program as the Government of Japan provided an "in-kind" grant. Thus, the Japanese handled the school building construction, using pre-fabricated construction materials transported to the Philippines from Japan. At the end of this

[1]The Philippines has a long history of free and compulsory elementary education which dates back in 1898, when a new constitution was established after the Spanish regime.
[2] The Philippines has a 6-4-4 education system, with six years of elementary education, 4 years of secondary education and another 4 years of tertiary education.

program, a total of 252 public secondary schools with 902 classrooms and 153 science rooms and workshops were constructed mainly in the regions which are most frequently visited by the typhoons. In addition, to address the shortage of experimental and training equipment in the fields of Science and Technology as well as Home Management, the Department of Education also provided instructional materials and equipment.

A major consideration for the selection of recipient provinces (or states) under this program is that a province should have been heavily affected by the past typhoons, particularly those that were directly hit by the two super typhoons in 1987. Furthermore, the municipalities and schools needed to meet the following criteria: i) the school should have sufficient space to build on; (ii) the school should be located in or near large population centers; (iii) the municipality and school should not be a recipient or prospective recipient of financial aid for disaster relief. Due to the different implementation of these criteria, we observe municipalities that received the TRSBP program and were not affected by the 1987 super-typhoons as well as municipalities that were affected by the super-typhoons and did not receive the TRSBP program.

B. 1987 Super Typhoons

Lying on the so-called "typhoon belt" in the Pacific Ocean, the Philippines is the most *typhoon* visited country in the world with an average of 20 typhoons each year. It is not unusual for the country to be hit by extreme or destructive typhoons with maximum sustained winds of 90 mph and above causing a havoc on provinces that tend to be hit directly by the passing typhoons.[3] In 1987, two super typhoons (known as *Sisang* and *Herming*) hit the Bicol region, the capital region

[3] Tropical cyclones in the West Pacific Ocean are called "typhoons" while tropical cyclones in the Atlantic and East Pacific Ocean are called "hurricanes". Typhoons are generally very strong because of the Pacific's warm water, and are also more frequent than hurricanes.

as well as provinces in the Southern Luzon region. Super typhoons are storms with wind speed of at least 150 miles per hour for a minimum of one minute and fall under category 5 of *the Saffir–Simpson* hurricane scale. Typhoon *Sisang* was considered as the most intense typhoon since 1981 with a maximum sustained winds of 165 mph, and it brought widespread damage to much of the northern Philippines. According to the National Disaster Coordinating Council (NDCC) of the Philippines, about 310,968 families lost their homes and the total damage in infrastructure and agricultural damages amounts to over 1.1 billion pesos. Another powerful and destructive super typhoon Herming came in later that year with maximum sustained winds of 160 mph. It brought widespread flooding, which resulted in severe destruction across the country leading to 61,758 homes destroyed and over 2 billion pesos worth of infrastructure and agricultural damages. The destructions caused by these two super typhoons led to significant damages in the school building, besides damages in other public infrastructures, agriculture, and personal properties. This is part of the reason why there was a shortage in classrooms when the free secondary education policy was implemented in 1988.

C. Data Sources

The main data sources in this paper are the 10% Integrated Public Use Microdata Series (IPUMS) of the 2000 Philippines decennial censuses as well as the 1990 Philippines Census obtained from the Philippine Statistics Authority of the Philippines. We obtained the data on the availability of Typhoon-Resistant School Building Project and Instructional Resources (TRSBP) in the municipalities from the project completion reports made available by the Educational Development Projects Implementing Task Force of the Philippines' Department of Education. These reports provide a complete list of schools receiving assistance under the program and their

corresponding allocations by municipality.

We also obtained data on typhoons and tropical storms affecting the Philippines in 1980–2000 from the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA). The data include areas affected as well as the corresponding strength of each typhoon and tropical storm affecting the Philippines during this period. The PAGASA data includes a list of provinces affected by the typhoons.

III. Empirical Strategy

To identify whether negative shocks caused by extreme weather events can be mitigated by positive investments, in our case a supply-side intervention in education infrastructure, we require at least two conditions. First, the same cohort of children affected by the super–typhoon is subsequently exposed to the educational program. Second, the possibility to exploit plausibly exogenous variation in the negative shock and in the positive investment to address the potential endogeneity that arises from the fact that child conditions and parental and/or government responses can be jointly determined with future outcomes by unobserved factors (Almond and Mazumder, 2013).

Therefore, we use three sources of variation to identify the TRSBP program effect in mitigating the negative impact of super-typhoon on human capital outcomes. We combine the geographic variation in 1987 super-typhoon exposure with temporal variation in cohort exposure as well as the spatial variation in the allocation of the 1989 TRSBP program. We exploit that in 1989 the cohort of students 9–12 years old were fully exposed to the educational program while the cohort 17-20 years old in that year had little or no exposure to the program in municipalities with and without access to the program. Thus, we estimate a triple difference model across these

three sources of variation. That is, by examining the effect of exposure to 1989 program and non-exposure to 1989 program among younger and older cohorts. We then take a third difference across the areas that were randomly affected by the 1987 super-typhoon. Figure 1 shows the sources of variation across the municipalities in the 2000 census.

<< Insert Figure 1 here>>

Since we are analyzing individual outcomes in 2000, more than ten years after the positive and negative shocks, it is important to note that we traced individuals to the municipality and provinces where they were living in 1990, the year when the TRSBP program was about to start operating. We do so by using the municipality of residence in 1990 which available in the 2000 census data.

To investigate whether the cohorts involved in the study may have migrated to another municipality in the aftermath of the 1987 super typhoon, we refer to the 1990 census question that asks for the number of years a person has resided in their current municipality. We find that less than 5% had been living in their municipality for less than 3 years in 1990, suggesting that migration is not really an issue. In addition, we find that less than 3% have been living in their municipality for less than a year which suggests that families may not have migrated in response to the availability of typhoon-resistant school program. The latter is further supported by the fact that the government mandated that secondary schools prioritize the enrollment of graduates of public elementary schools in the same municipality as well as returning students in the second, third, and fourth years of the same secondary school. Thus, it would have been difficult at that time for a student to be enrolled in a secondary school in another municipality, particularly for the first few years of the program.

We estimate a triple difference model in equation (1) of the following form:

$$Y_{impt} = \alpha + \boldsymbol{\beta_1} Sup87_p * Coh_{it} * TRSBP_{mp} + \beta_2 Sup87p * TRSBP_{mp} + \beta 3\, Sup87_p Cohit +$$

$$\beta 4 Cohit * TRSBP_{mp} + \beta_6 TRSBP_{mp} + \beta_5 X_{it} + \mu_m + \gamma_t + \varepsilon_{impt}$$

Where Y_{impt} is the 2000 outcome of analysis for individual *i* of the age *t* in 1989 living in municipality *m* and province *p* at the start of the program (1990). We examine a range of education, labor market and marriage outcomes including: i) a dummy variable to enter high school, ii) a dummy variable for whether the individual completed high school, iii) years of education, iv) a dummy variable for whether the individual speaks English, v) a dummy variable for whether the person is working or not; vi) dummy variable for whether the individual is employed in a high skill job [4], vi) a dummy variable for whether the individual has migrated overseas and vii) a dummy for whether the individual has been ever married.

The interaction of the variables $\boldsymbol{Coh_{it}}$, a dummy variable whether individual *i* is in the age cohort 9-12 in 1989; $\boldsymbol{Sup87_p}$, a dummy variable whether individual *i* living in province *p* was affected by the 1987 super-typhoons, and $\boldsymbol{TRSBP_{mp}}$, a dummy variable if individual *i* living in province *p* and municipality *m* in 1990 received the TRSBP program, measures the triple difference of TRSBP educational program among the 9-12 years old individuals who were affected by the typhoon. Thus, our coefficient of interest is $\boldsymbol{\beta_1}$. Intuitively, our tipple-difference model creates a treatment group of individuals who: i) were affected by the super-typhoons in 1987; ii) were in the young cohort in 1989; and iii) were exposed to the 1989 TRSBP program. Individuals

[4]According to the 2000 Census occupational categories, we define high-skill job if the person reports working in the following categories: legislators, seniors officials and managers, professionals, technicians and associate professionals, and clerks.

who satisfy none or some these conditions (i.e.; young cohort individual who are affected by the typhoon but did not receive the TRSBP program) are part of our control group.

We control in our models by a vector of individual-level socioeconomic characteristics, X_{itp} , which includes gender, ethnicity, and religion. Also, we include municipality level (μ_m) and age (γ_t) fixed effects. We are interested in exploring heterogeneous effects by gender, therefore, we estimate separate models for women and men. The heteroskedasticity-robust standard errors are clustered at the municipality level in all our specifications.[5] We estimate our triple difference models using OLS regressions. Table 1 presents the summary statistics of the variables used in the regression.

<< Insert Table 1 here>>

Prior to the discussion of our results on resilience, we document the results of double differences models wherein we estimate separate regressions examining the effects of a negative shock (i.e. super typhoon) and a positive shock (educational program). Using the same 2000 census, we examine first the long-term negative effects of the 1987 Super-Typhoon on the outcomes of interest for the young cohort of individuals 9-12 years old, compared to the older cohort, 17-20 years old. We estimate the following model:

$$Y_{impt} = \alpha + \beta_1 Sup87_p * Coh_{it} + \beta 3\, Sup87_p + \beta_5 X_{it} + \mu_p + \gamma_t + \varepsilon_{impt}$$

Where Y_{impt} is the 2000 outcome of analysis for individual *i* of the age *t* in 1989 living in municipality m and province *p* at the start of the program (1990) and the rest of the variables are

[5] Our results are robust to the model specifications that include province fixed effects and cluster the standard errors at the province level. Results are upon request.

the same as earlier described.[6] Second, to document the effects of the TRSBP program on the outcomes of interest, we use the temporal and geographic variation of the program as explained earlier and presented in Cas (2016). For the purpose of this paper, we do not examine the separately the effects of the different components of the TRSBP program. [7]

IV. Results

A. Education Outcomes

Figure 2 shows the results of difference-in-difference (DD) strategy comparing the younger cohort (9-12 years old) vis-à-vis, the older cohort (17-20 years old) living in provinces that were hit by 1987 super typhoons and those outside the path of these super-typhoons. It is worth noting that in 2000, these cohorts already completed their formal education allowing us to observe long-term effects of this natural disaster. As Figure 2 shows, the young cohort living in areas hit by the typhoon had lower educational attainment in 2000, more than ten years later than the 1987 super typhoons. These children exhibited 0.2 years of schooling less than their older counterparts; consistently, they were less likely to enter and complete high school and speak English. These results are statistically significant at the 1 percent level. For a complete report of these results, please see Table A.1 Appendix. Figure 2 also shows the negative effects by gender; however; we do not observe statistically significant differences between these two groups, with the exception that women are less likely to enter high school. Overall, these results indicate that children who were affected by the super typhoon at an age when they were in primary school, and thus starting

[6] Our estimates of the difference in difference model of the super typhoon on the outcomes of interest are robust to a specification that controls for province fixed effects.

[7] Cas (2016) analyses each component of the TRSBP program, school buildings and instructional resources separately. We define the presence of the program in each municipality if any or both of the components was present.

the formal education, were more affected than children exposed at an age when they were completing secondary school.

<< Insert Figure 2 here >>

These findings are consistent with the empirical evidence that has documented the adverse effects in the short-term and medium-term of natural disasters on educational attainment and test scores in developing countries (Baez and Santos, 2007; Rosales, 2016; Maccini and Yan 2009; Alderman et 2006; Goppo and Kraehnert, 2016). In particular, our results are in line with Deuchert and Felfe (2015) who, using longitudinal household data, analyze the effect of idiosyncratic household shocks due to the 1990 Mitch typhoon on long-term education and health outcomes in Cebu (a southern island in the Philippines). The authors find that by age 22 children who were hit by the typhoon at the age of 6-7 have 0.6 years of schooling less than those who were not affected. Additionally, they find negative results due to these shocks in IQ and test scores. Although we lack information to establish the mechanisms of how the 1987 super-typhoon affected the younger cohort's education, Baez and Santos (2007) suggest that natural disasters can negatively affect school infrastructure, and thus, the provision of education. On the other hand, Deuchert and Felfe (2015) indicate that parental investments away from their children's education towards investments made to cope with the economic consequences of the typhoon damages can consequently led children missing school more often and spend more time helping at home in non-remunerated work.

Figure 3, on the other hand, presents the results of difference-in-difference strategy comparing the younger cohort (fully exposed) vs., the older cohort (not exposed) living in municipalities with and without access to the TRSBP program. These findings show that this

supply side intervention in secondary school infrastructure has positive returns in educational attainment, consistent with Cas (2016) findings. We find that that the younger cohort who was fully exposed to the program attain 0.12 years more of education than their older counterpart who did not have access to the program. Furthermore, the younger cohort is more likely to enter and complete high school as well as speak English. These results are statistically significant at the 1 percent level. We do not find gender statistically differences except for the case that women are more likely to speak English than men. For the complete report of these results, see Table A.2 in the Appendix.

<< Insert Figure 3 here >>

Table 2 shows the results of the triple differences strategy for the education outcomes. Panel A shows the results for all the sample while the Panel B and C display the results by gender. The triple interaction coefficients suggest that the TRSBP program may have had a significant protective effect that helped mitigate the negative impact of the super-typhoons in educational attainment and related educational outcomes. In particular, the younger cohort who were living in provinces that were hit by the 1987 super typhoons and later got allocated the TRSBP program before entering secondary school were more likely to enter high school, complete high school, speak English and achieve 0.19 more years of schooling. These results are statistically significant at the 1 percent level. These findings suggest that this infrastructure program has a positive marginal effect on the children of the young cohort who were disadvantaged due to the exposure to the typhoon. Furthermore, these resilience results are consistent with Adhvaryu et al. (2016) who show that Progresa, a conditional cash transfer in Mexico, help children affected by early life

rainfall shocks to catch up with their grade progression and their likelihood of completing high school.

<< Insert Table 2 here>>

Examining these effects by gender, we find that women, in particular, tend to benefit from the protective effects of the TRSBP program. They were significantly more likely to enter high school, to complete high school, to attain more years of schooling and to speak English. Although we did not find a gender differentiated effect in the negative shocks, this finding might suggest that secondary school-aged girls and boys may be affected in different ways by inadequate schooling infrastructure due to natural disasters. According to Adams et al. (2009), girls are likely to be more affected than boys by the lack of physical infrastructure. For instance, parents would be less likely to send their daughters to school when there is a lack of adequate, private, and secure sanitation facilities.

B. Effects on Employment, Migration and Marriage

We also analyze whether the TRSBP program mitigated the effects of the super-typhoon on labor market outcomes and marriage. We start by showing in Figure 4 the long-term impact of the 1987 super-typhoons on employment, type of work, migration overseas and marriage. More than ten years after the super typhoon, we observe that individuals who were living in affected areas are more likely to be employed; this effect is statistically significant at the one percent level, and it is statistically different for men and women. We find that the super-typhoons decreased the likelihood of being employed in a high-skilled job at the one percent level. This effect is statistically larger for men than women. Although we do not find any effect on the probability of

migrating overseas for the full sample, super typhoons decreased the likelihood of migrating for men while it increases for women. Additionally, we find that the women and men affected by the typhoon are more likely to be married. For complete results see Table A.1 of the Appendix.

<< Insert Figure 4 here>>

Figure 4 shows the effects of the TRSBP program on labor market outcomes and marriage which were not included in Cas (2016) analysis. The young cohort, who was fully exposed to the program, is more likely to be working; however, we do not observe statistically significant effects on the likelihood of being employed in high-skilled positions. Nevertheless, there is a statistically significant effect on the probability of migrating overseas; plausible due to the gains in education. Furthermore, we observe that beneficiaries of the TRSBP program are less likely to be married, and interestingly, this effect is not different by gender. For complete results see Table A.2 of the Appendix.

<< Insert Figure 5 here>>

Table 3 shows the results for the triple difference models. These results show that young individuals, who were affected by the super typhoons and later on were benefited by the program, are more likely to have a high-skilled job, and this effect is larger and statistically significant for men. Nevertheless, we do not find any statistically significant effects in the triple interaction coefficient on the probability of being employed. Although, we show earlier that there is no long-term effect of the TRSBP program on high-skilled employment; it seems that there is a marginal benefit for the young cohort of individuals who were affected by the disasters and who set back their education outcomes.

<< Insert Table 3 here>>

Related to the labor market outcomes, we observe that the young cohort affected by the typhoon and beneficiary of the program is more likely to migrate overseas; this effect is only statistically significant for men. Unfortunately, we lack information on the type of occupation that these individuals have in foreign countries; however, as we described earlier there was a positive effect of the school infrastructure program on the likelihood of migrating overseas that might offset the negative shock of the typhoon. Interestingly, we find that the coefficient on marriage is negative and statistically significant at the one percent level, and this effect is only significant for women. In other words, women in the young cohort, compared to their older counterparts, who were living in areas affected the natural disaster and later benefit from the TRSBP program are less likely to marry.

Overall, these findings indicate the young cohort (9-12 years old) affected by super-typhoons in 1987 and who benefited from the TRSBP program is more likely to complete high school, speak English and accumulate more years of schooling more than a decade later after the negative and positive shocks. For men, these long-term education gains are associated with a higher likelihood of working in high-skilled occupations and of migrating overseas; while for women these gains are associated with a lower likelihood of being married. These findings point out that public investments in adolescence such as supply-side programs to improve schooling infrastructure have the potential to mitigate the adverse effects of natural disasters occurred during childhood.

C. Robustness Checks (In Progress)

To support our identification strategy, we estimate the effects of the triple difference model restricted to the municipalities that are located in the Philippines' typhoon belt since this area is geographically more prone to be affected by destructive typhoons and the municipalities located in this region are more similar in terms of socioeconomic characteristics. Table 4 shows that our results are qualitative similar to those estimated in Table 2 and Table 3.

<< Insert Table 4 here>>

We also conduct a placebo test where we estimate the same specification of triple difference models but instead of using the young and old cohorts, as defined in the empirical strategy, we estimate this model for a sample of all post-secondary school age individuals, 17 to 24 years old for whom the TRSBP program should have not mitigated the negative effect of the 1987 super-typhoon since these individuals were not exposed to the program. We show in table 6 that the coefficient of the triple interaction on the outcomes of interest is smaller than those reported in Table 3 and 4 and they are not statistically significant with the exception of marriage and employment.

<< Insert Table 5 here>>

Future work will analyze further robustness checks and placebo tests in the main empirical specification to rule out potential threats to identification.

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TABLES AND FIGURES

Table 1: Descriptive statistics of Education and Labor Market Outcomes

	Mean	Std. Deviation	N
Dependent Variables			
Enter High School	0.741	0.438	742566
Complete High School	0.607	0.488	742566
Years of Schooling	9.328	3.402	742566
Speaking English	0.778	0.416	746941
Employed	0.652	0.476	767936
High Skilled Occupation	0.122	0.327	500389
Overseas	0.025	0.157	767936
Married	0.514	0.500	763127
Key Regressors			
Received TRSBP	0.124	0.330	767936
Impacted by Super-typhoon in 1987	0.340	0.474	767936
Young Cohort (Age 9-12 years in 1989)	0.540	0.498	767936
Young Cohort * TRSBP * Super-typhoon in 1987	0.047	0.211	767936
Young Cohort * TRSBP	0.068	0.251	767936
Young Cohort * Super-typhoon in 1987	0.181	0.385	767936
TRSBP * Super-typhoon in 1987	0.085	0.279	767936
Control Variables			
Age in 1989	14.134	4.181	767936
Male	0.513	0.500	767936
Ethnicity Tagalog	0.312	0.463	762888
Ethnicity Bicol	0.059	0.235	762888
Ethnicity Cebuano	0.129	0.336	762888
Ethnicity Ilocano	0.095	0.293	762888
Christian Religion	0.940	0.238	766341

Source: 2000 IPUMS Census

Table 2: Triple Difference Models on Educational Outcomes

Panel A : Full Sample	(1)	(2)	(3)	(4)
	Enter High School	Completed High School	Years of Schooling	Speak English
$\boldsymbol{\beta 1}$(Sup87*Coh*TRSBP)	0.0355**	0.0376***	0.197**	0.0238**
	(0.0142)	(0.0128)	(0.0987)	(0.0105)
Outcome mean	0.741	0.607	9.329	0.778
N	736742	736742	736742	741356
Panel B : Male Sample				
	Enter High School	Completed High School	Years of Schooling	Speak English
$\boldsymbol{\beta 1}$(Sup87*Coh*TRSBP)	0.0337**	0.0352**	0.183*	0.0189*
	(0.0146)	(0.0141)	(0.102)	(0.0109)
Outcome Mean	0.712	0.571	9.045	0.759
N	378293	378293	378293	380609
Panel C: Female Sample				
	Enter High School	Completed High School	Years of Schooling	Speak English
$\boldsymbol{\beta 1}$(Sup87*Coh*TRSBP)	0.0365**	0.0393**	0.203*	0.0284**
	(0.0171)	(0.0153)	(0.120)	(0.0130)
Outcome mean	0.771	0.644	9.628	0.797
N	358449	358449	358449	360747

Notes:* p<0.10; ** p<0.05; *** p<0.01. Robust standard errors clustered at municipality level. All specifications control for gender, religion, ethnicity, age and municipalities fixed effects.

Table 3: Triple Difference Models on Employment, Migration and Marriage

Panel A: Full Sample				
	(1)	(2)	(3)	(4)
	Employed	High Skilled Occupation	Migrated Overseas	Ever Married
$\boldsymbol{\beta 1}$ (Sup87*Coh*TRSBP)	-0.00422	0.0181*	0.00736**	-0.0271***
	(0.0169)	(0.0106)	(0.00312)	(0.00915)
Outcome Mean	0.651	0.122	0.0254	0.514
N	761676	495981	761676	757131
Panel B: Male sample				
	Employed	High Skilled Occupation	Migrated Overseas	Ever Married
$\boldsymbol{\beta 1}$ (Sup87*Coh*TRSBP)	-0.0297	0.0278***	0.0147***	-0.0200*
	(0.0195)	(0.00951)	(0.00386)	(0.0107)
Outcome Mean	0.813	0.0814	0.0228	0.451
N	390747	317587	390747	388348
Panel C: Female Sample				
	Employed	High Skilled Occupation	Migrated Overseas	Ever Married
$\boldsymbol{\beta 1}$ (Sup87*Coh*TRSBP)	0.0237	-0.00942	-0.000610	-0.0353***
	(0.0170)	(0.0201)	(0.00401)	(0.0124)
Outcome Mean	0.481	0.195	0.0281	0.582
N	370929	178394	370929	368783

Notes:* p<0.10; ** p<0.05; *** p<0.01. Robust standard errors clustered at municipality level. All specifications control for gender, religion, ethnicity, age and municipalities fixed effects.

Table 4: Triple Difference Models for the Typhoon Belt Region-Full Sample

Education Outcomes

	(1)	(2)	(3)	(4)
	Enter High School	Completed High School	Years of Schooling	Speak English
$\boldsymbol{\beta 1}$(Sup87*Coh*TRSBP)	0.0330**	0.0367***	0.166	0.0155
	(0.0148)	(0.0132)	(0.102)	(0.0108)
Outcome Mean	0.766	0.641	9.589	0.811
N	575056	575056	575056	578003

Labor Market and other outcomes

	(5)	(6)	(7)	(8)
	Employed	High Skilled Occupation	Migrated Overseas	Ever Married
$\boldsymbol{\beta 1}$(Sup87*Coh*TRSBP)	-0.00902	0.0205*	0.00306	-0.0234**
	(0.0180)	(0.0106)	(0.00327)	(0.00952)
Outcome Mean	0.651	0.134	0.0274	0.510
N	593101	385896	593101	589740

Notes:* p<0.10; ** p<0.05; *** p<0.01. Robust standard errors clustered at municipality level. All specifications control for gender, religion, ethnicity, age and municipalities fixed effects.

Table 5: Falsification test Triple Difference Models -Full Sample

Education Outcomes

	(1)	(2)	(3)	(4)
	Enter High School	Completed High School	Years of Schooling	Speak English
$\boldsymbol{\beta 1}$ (Sup87*Coh*TRSBP)	0.00828	0.00485	0.0520	-0.00140
	(0.00899)	(0.00946)	(0.0647)	(0.00845)
Outcome Mean	0.688	0.566	8.993	0.751
N	640871	640871	640871	648650

Labor Market and other outcomes

	(5)	(6)	(7)	(8)
	Employed	High Skilled Occupation	Migrated Overseas	Ever Married
$\boldsymbol{\beta 1}$ (Sup87*Coh*TRSBP)	-0.0105*	-0.00172	0.000854	-0.0187**
	(0.00628)	(0.00563)	(0.00281)	(0.00792)
Outcome Mean	0.715	0.147	0.0314	0.805
N	664524	475321	664524	662399

Notes:* p<0.10; ** p<0.05; *** p<0.01. Robust standard errors clustered at municipality level. All specifications control for gender, religion, ethnicity, age and municipalities fixed effects.

FIGURES

Figure1: Sources of Variation across municipalities in 2000 census

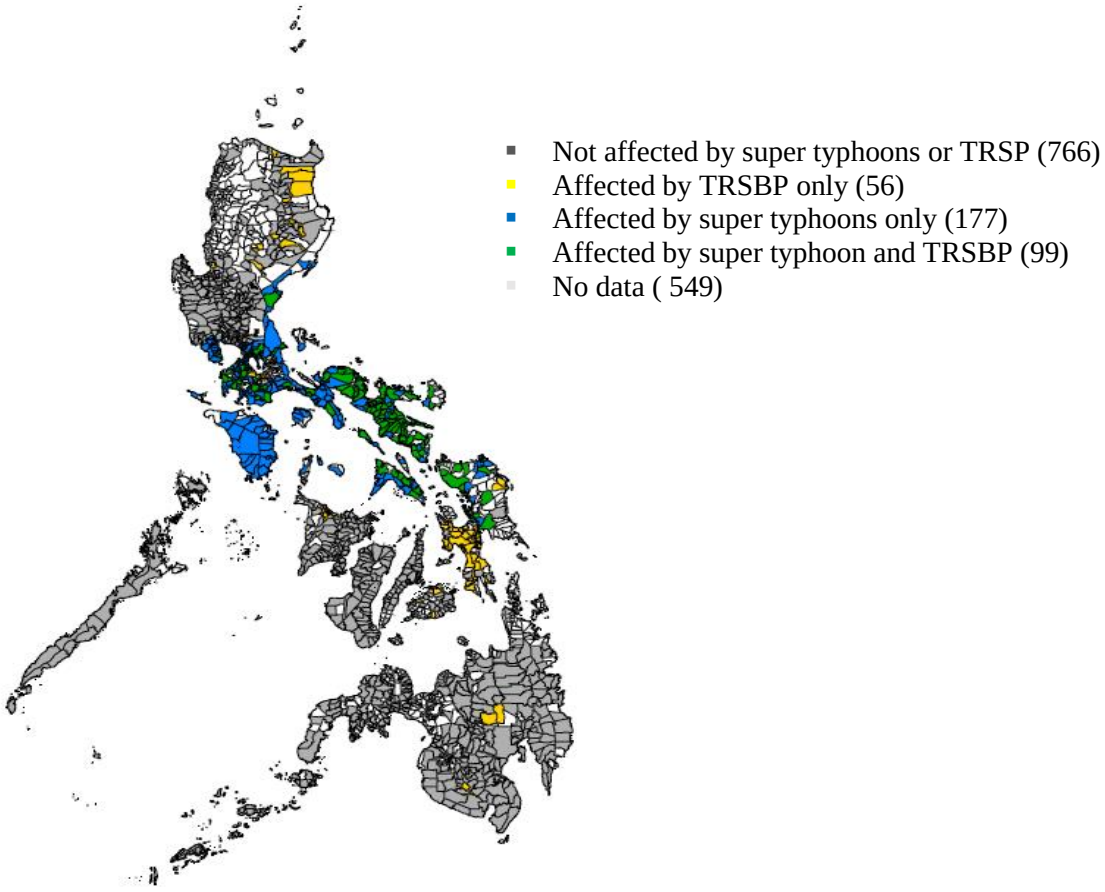


Figure 2: Difference-in-Difference Model of Negative Shocks on Education Outcomes

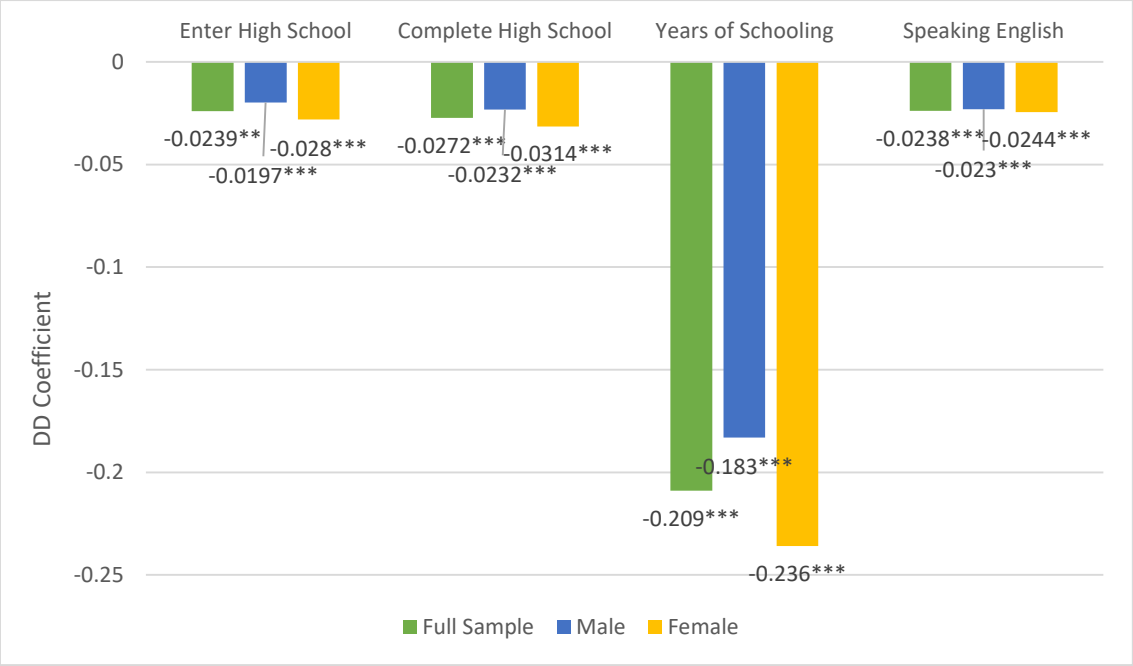


Figure 3: Difference-in-Difference of the TRSBP Program on Education Outcomes

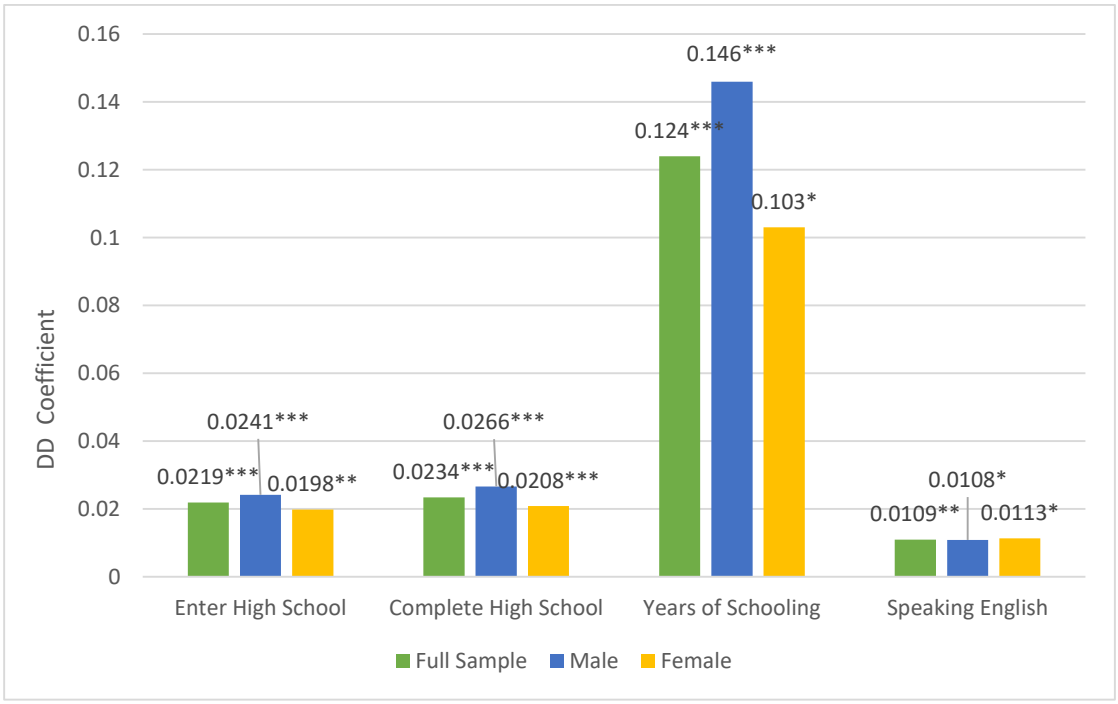


Figure 4: Difference-in-Difference Model of Negative Shocks on Employment, Migration and Marriage

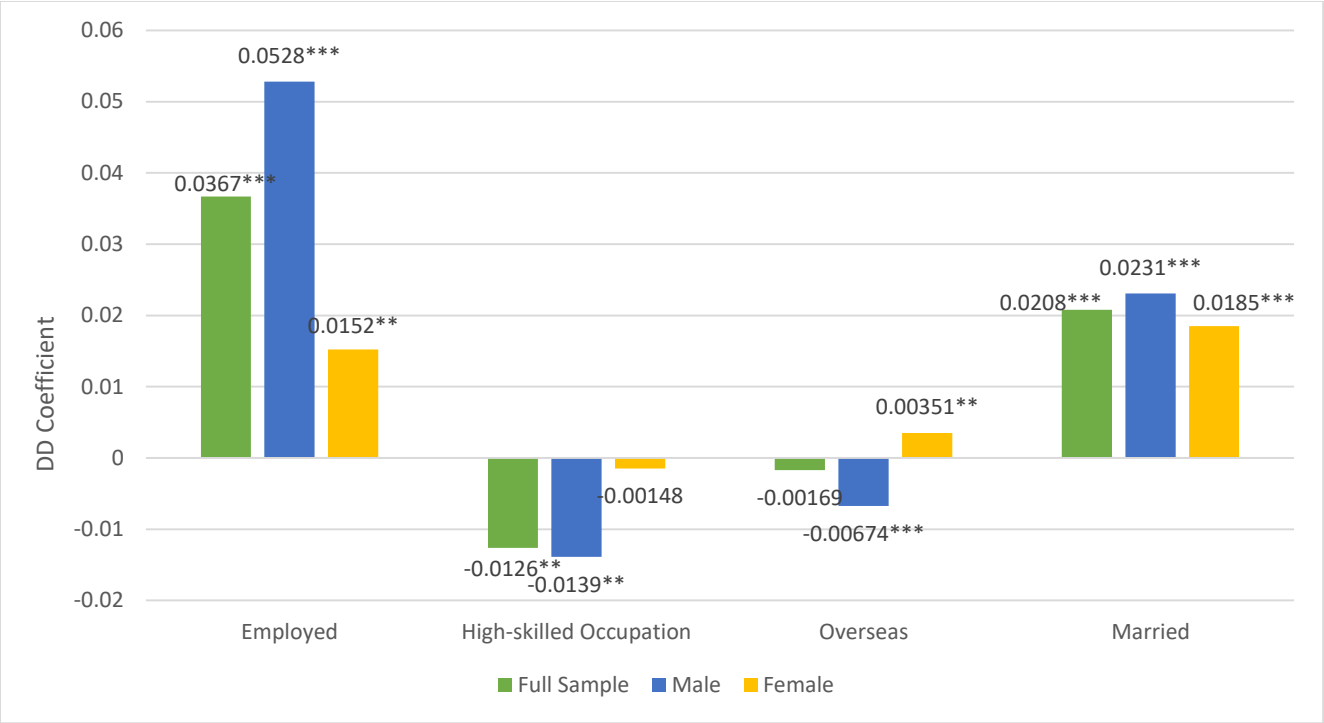
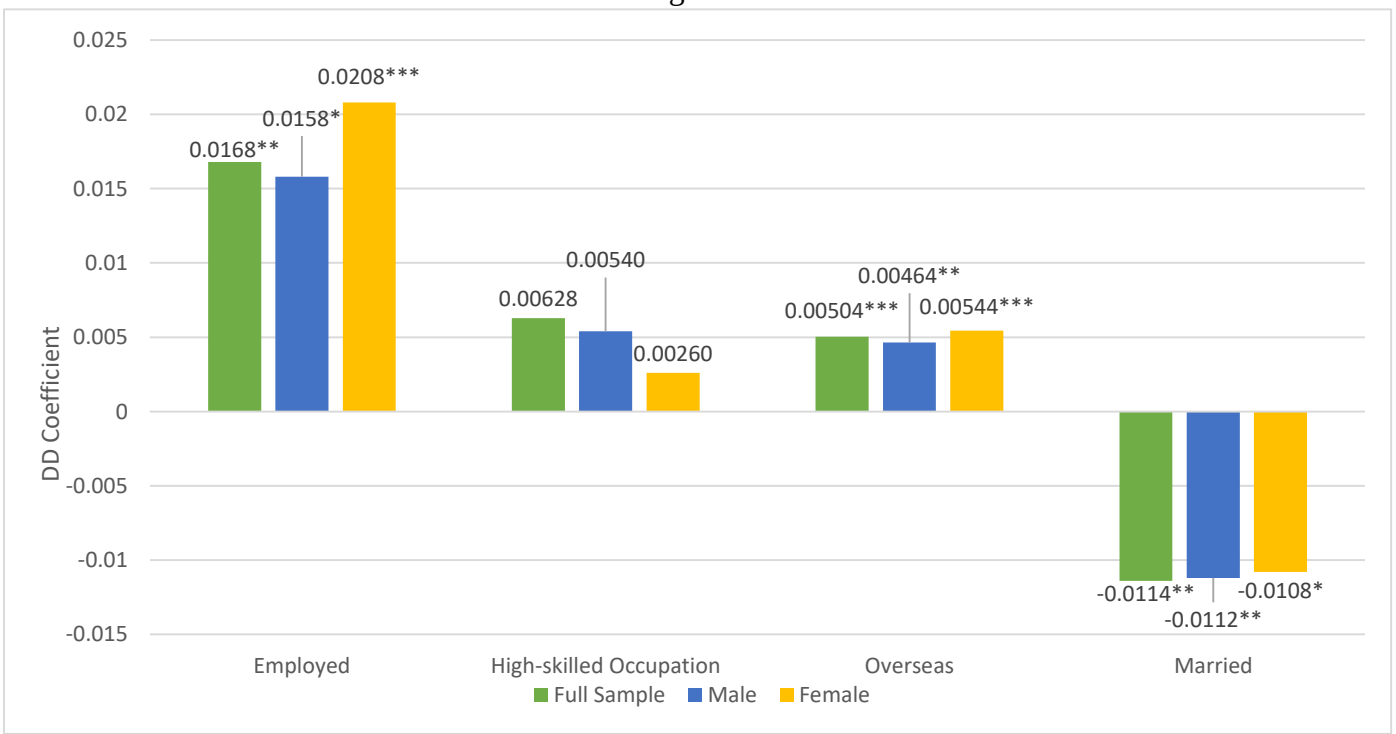


Figure 5: Difference-in-Difference of the TRSBP Program on Employment, Migration and Marriage



APPENDIX

Table A.1: Difference in Difference of Super Typhoons on Education, Employment and Marriage outcomes

Full Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Enter High School	Completed High School	Years of Schooling	Speak English	Employed	High Skilled Occupation	Migrated Overseas	Ever Married
Super2*young	-0.0239***	-0.0272***	-0.209***	-0.0238***	0.0367***	-0.0126**	-0.00169	0.0208***
	(0.00614)	(0.00688)	(0.0491)	(0.00365)	(0.00578)	(0.00640)	(0.00125)	(0.00400)
Outcome Mean	0.741	0.607	9.329	0.778	0.651	0.122	0.0254	0.514
N	736742	736742	736742	741356	761676	495981	761676	757131

Male Sample

	Enter High School	Completed High School	Years of Schooling	Speak English	Employed	High Skilled Occupation	Migrated Overseas	Ever Married
Super2*young	-0.0197***	-0.0232***	-0.183***	-0.0230***	0.0528***	-0.0139**	-0.00674***	0.0231***
	(0.00569)	(0.00626)	(0.0431)	(0.00361)	(0.00680)	(0.00546)	(0.00160)	(0.00430)
Outcome Mean	0.712	0.571	9.045	0.759	0.813	0.0814	0.0228	0.451
N	378293	378293	378293	380609	390747	317587	390747	388348

Female Sample

	Enter High School	Completed High School	Years of Schooling	Speak English	Employed	High Skilled Occupation	Migrated Overseas	Ever Married
Super2*young	-0.0280***	-0.0314***	-0.236***	-0.0244***	0.0152**	-0.00148	0.00351**	0.0185***
	(0.00739)	(0.00860)	(0.0622)	(0.00480)	(0.00634)	(0.00859)	(0.00157)	(0.00489)
Outcome Mean	0.771	0.644	9.628	0.797	0.481	0.195	0.0281	0.582
N	358449	358449	358449	360747	370929	178394	370929	368783

Notes:* p<0.10; ** p<0.05; *** p<0.01. Robust standard errors clustered at municipality level. All specifications control for gender, religion, ethnicity, age and municipalities fixed effects.

Table A.2: Difference-in-Difference of the TRSBP Program on Education, Employment and Marriage Outcomes

Full Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Enter High School	Completed High School	Years of Schooling	Speak English	Employed	High Skilled Occupation	Migrated Overseas	Ever Married
TRSBP*young	0.0219***	0.0234***	0.124***	0.0109**	0.0168**	0.00628	0.00504***	-0.0114**
	(0.00700)	(0.00671)	(0.0469)	(0.00523)	(0.00743)	(0.00471)	(0.00146)	(0.00470)
Outcome Mean	0.741	0.607	9.329	0.778	0.651	0.122	0.0254	0.514
N	736742	736742	736742	741356	761676	495981	761676	757131

Male Sample

	Enter High School	Completed High School	Years of Schooling	Speak English	Employed	High Skilled Occupation	Migrated Overseas	Ever Married
TRSBP*young	0.0241***	0.0266***	0.146***	0.0108*	0.0158*	0.00540	0.00464**	-0.0112**
	(0.00695)	(0.00720)	(0.0497)	(0.00556)	(0.00940)	(0.00436)	(0.00186)	(0.00518)
Outcome Mean	0.712	0.571	9.045	0.759	0.813	0.0814	0.0228	0.451
N	378293	378293	378293	380609	390747	317587	390747	388348

Female Sample

	Enter High School	Completed High School	Years of Schooling	Speak English	Employed	High Skilled Occupation	Migrated Overseas	Ever Married
TRSBP*young	0.0198**	0.0208***	0.103*	0.0113*	0.0208***	0.00260	0.00544***	-0.0108*
	(0.00834)	(0.00770)	(0.0550)	(0.00630)	(0.00730)	(0.00902)	(0.00196)	(0.00639)
Outcome Mean	0.771	0.644	9.628	0.797	0.481	0.195	0.0281	0.582
N	358449	358449	358449	360747	370929	178394	370929	368783

Notes:* p<0.10; ** p<0.05; *** p<0.01. Robust standard errors clustered at municipality level. All specifications control for gender, religion, ethnicity, age and municipalities fixed effects.