Typhoon Aid and Development: The Effects of Typhoon-Resistant Schools and Instructional Resources on Educational Attainment in the Philippines

AVA GAIL CAS*

This paper examines the effects on educational attainment of assistance programs that provided typhoon-resistant secondary schools and instructional resources in the Philippines. Using the variation in the availability of assistance programs and differences in exposure across age cohorts induced by the timing of the allocation of program packages, I find positive and statistically significant impacts on education outcomes for both boys and girls. For boys, the presence of typhoon-resistant schools equipped with instructional resources led to an average increase of 0.26–0.31 years of education, while the presence of instructional resources alone led to an average increase of 0.23–0.26 years of education. For girls, the availability of both components led to an average increase of 0.23–0.32 years of education, while the availability of either component alone did not seem to have an effect.

Keywords: aid, instructional resources, school building, schooling, typhoons
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I. Introduction

The question of whether access to schools and instructional resources enhances human capital outcomes is of interest to economists. A number of economists have examined the effects of an expansion in the number of schools and classrooms on educational attainment, wages, fertility, and child health (Breierova and Duflo 2004, Chou et al. 2010, Duflo 2001, Osili and Long 2008). In the United States (US), economists have looked at the effect of a comprehensive school construction program on test scores, enrollment, and housing prices (Neilson and Zimmerman 2014). Meanwhile, a growing number of studies have investigated

*Ava Gail Cas: Assistant Professor of Economics, School of Business and Economics, The Catholic University of America. E-mail: cas@cua.edu. This is a revised version of the third chapter of my doctoral dissertation (Cas 2012). I would like to thank the managing editor and two anonymous referees for helpful comments and suggestions. I am also grateful to Amar Hamoudi, Elizabeth Frankenberg, Alessandro Tarozzi, and Duncan Thomas; and to seminar participants at the Catholic University of America. I am greatly indebted to the staff of the Department of Education of the Philippines and the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) for providing me the data used for this study.

the impact on student learning of technology-related instructional resources. For instance, Angrist and Lavy (2002) and Barrow, Markman, and Rouse (2009) investigate whether providing computers for pedagogical use in the classroom improves reading, mathematics, and algebra test scores in Israel and the US, while Beuermann et al. (2015) examine the impact of the One Laptop per Child program on children's cognitive test scores in Peru.

However, given the scarcity of resources in many developing economies, even access to basic instructional resources to assist student learning in the subjects of math and science is limited. In terms of school infrastructure, often the issue is not access to schools, but rather access to good quality schools (that are, for example, typhoon resistant), particularly in economies that are prone to natural disasters. Earlier research suggests that the destruction of school infrastructure can lead to a loss of human capital, especially with regard to permanent and unrepaired damages (Baez and Santos 2009).

In this paper, I evaluate the long-term impact of a bilateral program that constructed typhoon-resistant secondary schools and provided instructional materials for major high school subjects (e.g., biology, chemistry, home economics, mathematics, physics, and technology) in typhoon-affected parts of the Philippines. The importance of typhoon-resistant schools cannot be understated in disaster-prone economies such as the Philippines. Lying astride the "typhoon belt" in the Pacific Ocean, the Philippines is the most typhoon-affected country in the world with an average of 20 typhoons each year, of which an average of six are classified as extreme or destructive with maximum sustained winds of at least 150 kilometers per hour.[1] Municipalities that sustain direct hits from typhoons tend to sustain severe damage to their infrastructure. The loss of school infrastructure can disrupt schooling for an extended period of time, especially if buildings and facilities are permanently damaged or left unrepaired. In cases where regular classes are disrupted for several weeks during the reconstruction period, a loss of human capital is inevitable. When instruction time is lost, the quality of learning may also decline. Some students may find it difficult to catch up and eventually drop out of school. At the same time, the loss of instructional resources may also affect the quality of student learning.

I examine the impacts on educational attainment of typhoon-resistant school construction and instructional materials assistance program in the Philippines 10 years after their initial implementation. The results of my analysis suggest that for boys, the presence of typhoon-resistant secondary schools equipped with instructional resources led to an average increase of 0.26–0.30 years of education, while the presence of instructional resources alone led to an average increase of

[1]This is based on data from PAGASA. Tropical cyclones in the western Pacific Ocean are called typhoons, while tropical cyclones in the Atlantic Ocean and eastern Pacific Ocean are called hurricanes. Typhoons are generally very strong, because of the western Pacific's warm water, and occur more frequently than hurricanes.

0.23–0.26 years of education. For girls, the availability of both components led to an average increase of 0.23–0.32 years of education, while the availability of either component alone did not seem to have an effect. Estimates are robust for the inclusion of individual-level characteristics and when accounting for concurrent national government programs, restricting to municipalities in the Philippines typhoon-affected regions, and accounting for municipality-specific trends.

The paper contributes to the literature in a number of ways. First, to the best of my knowledge, it is the first study to assess the effects of disaster-resistant secondary schools and instructional resources for math and science at the population level. The paper qualifies the separate effects of typhoon-resistant schools and instructional resources in addition to examining the cumulative impacts when both components are present. Second, it adds to the growing literature that independently evaluates the longer-term impacts of grant assistance and loan programs using microlevel data, given that development assistance efforts are generally evaluated at the project level during implementation by the same aid agencies and institutions that are providing funding. One exception is the evaluation of a World Bank-financed rural development program 10 years after its implementation by Chen, Mu, and Ravallion (2009), who found only small and statistically insignificant gains on mean consumption in the long-term. Third, this paper evaluates an innovative policy solution for mitigating the risks of natural disasters. As global warming proceeds, many economies will continue to experience extreme weather conditions that can affect human capital accumulation. The destruction of secondary schools due to natural disasters is of particular importance since children at this age are more likely than affected primary school children to transition from schooling to work and family formation, especially if they have also lost one or both parents due to natural disaster (Cas et al. 2014). Thus, it is important to continually develop and evaluate innovative solutions to protect secondary school children from disruptions to their education.

The rest of the paper is organized as follows. Section II provides background on the secondary education reform program, which was launched in 1988 with Japanese grant assistance and comprised a typhoon-resistant school building program and an instructional materials distribution program. Section III presents the data and results for the determinants of program placement. Section IV provides an identification strategy. Section V presents the results and section VI concludes and discusses policy implications.

II. Secondary Education Reform and the Typhoon-Resistant School Building and Instructional Equipment Programs

In 1988, the Philippines implemented a free public secondary education policy to complement its historically free and compulsory public elementary education policy.[2] Under the new policy, tuition and matriculation fees, laboratory and library fees, medical and dental fees, and athletic fees were all waived for secondary education. Thus, the policy led to a rapid increase in secondary school enrollment and a shortfall in classrooms and school buildings. Part of the reason for the shortage of classrooms was that school infrastructure in some provinces had been severely damaged by two super-typhoons in 1987. Given these capacity constraints, Department of Education officials prioritized the enrollment in secondary schools of graduates of public elementary schools in the same municipality, as well as returning students in the second, third, and fourth years of secondary school.[3]

In that same year, the government explored the possibility of tapping Japanese bilateral grant assistance to supplement its initiatives to address the shortage of classrooms and other school facilities. This resulted in the launching of a school building project in 1989—the Typhoon-Resistant School Building Program (TRSBP)—that used Japanese technology for constructing typhoon-resistant, prefabricated structures. The idea behind TRSBP was to not just build more schools to increase classroom capacity, but to build better infrastructure so that schooling would not be interrupted by damage caused by the typhoons that regularly affect the Philippines. TRSBP was an unusual assistance program as the Government of Japan provided an in-kind grant for its implementation. Thus, Japanese firms constructed all of the school infrastructure using prefabricated materials that were transported to the Philippines from Japan. A total of 252 public secondary schools, including 902 classrooms and 153 science rooms and workshops, were constructed under TRSBP, mainly in those regions most affected by typhoons.[4] On average, each school construction project represented an investment worth P7.4 million–P11.1 million.[5]

The major consideration for the selection of provinces participating in TRSBP was that a province must have been heavily affected by past typhoons, particularly one of the two super-typhoons in 1987. The guidelines used for selecting the recipient municipalities and schools were as follows: (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 should not be a recipient or prospective recipient of financial aid for disaster relief or disaster mitigation from any other foreign aid agency, or from the Philippine government's existing school-building program or calamity fund; and (iv) the school should not have received more than P300,000 from the government

[2]The Philippines has a long history of free and compulsory elementary education that dates back to 1898 when a new constitution was established after the expulsion of the Spanish regime from the Philippines.

[3]The Philippines has a 6–4–4 education system, with six years of elementary education, 4 years of secondary education, and 4 years of tertiary education.

[4]The program also constructed schools at the elementary level, although the secondary level was prioritized. Overall, a total of 360 elementary and secondary schools were constructed, including 1,289 classrooms and 219 science rooms.

[5]In 1990, one US dollar was equivalent to P47.08. Thus, the average investment per school under TRSBP was equivalent to about $157,000–$236,000. About 5.4% of the total project cost was appropriated to consultancy fees.

in addition to its regular budget. The design criteria for building the schools include an emphasis on typhoon resistance, flood resistance, flexibility for multiple uses, adaptation to tropical climate conditions, meeting the requirements of handicapped students, ease of maintenance, and a systematized construction process in order to complete each project in 1 year and with uniform quality. TRSBP also considered the availability of water, power, and sewerage to ensure properly functioning classrooms, laboratories, and sanitation facilities within the schools. If basic facilities such as power and electrical lines, and water and sewerage systems were insufficient, new basic facilities could be installed in some cases.

In addition to TRSBP, the Philippine government also requested from the Japanese government grant assistance for the provision of instructional materials and equipment, which became known as the Secondary Education Instructional Equipment Program (SEIEP).[6] With the goal of increasing access to quality education and developing students' curiosity in natural science and technology, the Department of Education aimed to address the shortage of experimental and training equipment to improve the teaching of science and technology, as well as home economics. One of the basic criteria used in the SEIEP selection process was that a recipient school should also be enrolled in TRSBP, although not all TRSBP recipient schools would benefit from SEIEP. Furthermore, SEIEP would end up providing instructional equipment to some non-TRSBP recipient schools.[7] The other criteria used in the SEIEP selection process were as follows: (i) the school should not receive any facilities or equipment assistance from any other local or foreign sources, and (ii) the school should have an enrollment of more than 200 students.

Therefore, the bilateral grant assistance from the Government of Japan led to three types of program packages for recipient schools, each of which will be evaluated in this paper: (i) TRSBP only, (ii) SEIEP only, and (iii) TRSBP and SEIEP.

A. Concurrent Programs

Besides tapping Japanese grant assistance, the Philippine government also obtained loans from the Asian Development Bank (ADB) and assistance from the United States Agency for International Development (USAID) to construct approximately 2,145 classrooms at 675 schools in other parts of the country. These schools also received instructional equipment packages to meet the Philippine government's goal of raising the quality of education and developing student interest

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[6] To ensure the proper use and maintenance of the equipment, a 3- to 5-day teacher training was conducted at each recipient school by a project team comprising representatives from the Philippine and Japanese governments.

[7] Similar to TRSBP, the program considered the availability of electrical and water utilities. In cases where these basic facilities were insufficient, the Government of the Philippines could provide the necessary electrical system and water supply assistance packages.

in the natural sciences and technology. However, unlike the TRSBP schools, these schools were constructed using materials that were similar to that used by the government under its regular school-building program. The rest of the municipalities that did not receive assistance under either TRSBP or ADB- or USAID-funded programs were covered under the government's regular school-building program.[8]

A separate program, the National Secondary Education Curriculum, was implemented beginning in 1993 and was phased in across various municipalities. As part of the government's secondary education reform policy, it may have potentially been correlated in some municipalities with the allocation of typhoon-resistant schools and/or instructional equipment packages. Unfortunately, I do not have data on the recipient municipalities of National Secondary Education Curriculum assistance. Thus, to estimate the impact of the Japanese grant assistance programs, I will restrict my analysis to program packages allocated before 1992.

At around the same time, the government launched a water supply, sanitation, and sewerage master plan for the period 1988–2000. The goal of this plan was to provide basic water supply facilities (e.g., wells) in 37 of the Philippines' 83 provinces and sanitation facilities (e.g., household latrines, public toilets, sullage removal units, disinfections) in 75 provinces. The specifications of this paper will also account for the presence of assistance programs under the water supply, sanitation, and basic water supply facilities master plan since they operated concurrently with TRSBP and SEIEP.

III. Data and Determinants of Typhoon-Resistant School Building Program Recipient Municipalities

The main data source for this paper is the 10% Integrated Public Use Microdata Series (IPUMS) of the Philippines decennial censuses. The 2000 IPUMS is the main data used in regression estimates, while the 1990 IPUMS is used to construct variables predicting the determinants of program availability. Data on the recipients of TRSBP and SEIEP assistance were obtained from 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 two programs and their corresponding allocations by municipality. The Manual on Secondary Education Development, published by the Department of Education, also provides a list of recipient schools and municipalities under ADB- and USAID-funded school-building projects. Data on the water and sanitation programs are at the provincial level and were obtained

[8]Since these schools could potentially be damaged or destroyed by a typhoon, part of the funding under the regular school-building program was used to repair school buildings and classrooms that had been severely damaged by typhoons.

Table 1. **Summary Statistics at the Municipality Level**

	Type of Assistance				**P-values**		
Variables	**TRSBP (1)**	**SEIEP (2)**	**Both (3)**	**None (4)**	**Diff. (1)–(4)**	**Diff. (2)–(4)**	**Diff. (3)–(4)**
% impacted by super-typhoon	0.52	0.77	0.68	0.19	0.00	0.00	0.00
in 1987	(0.50)	(0.43)	(0.47)	(0.39)			
Nonenrollment rate in 1989	0.40	0.46	0.44	0.40	0.80	0.00	0.01
(13–16-year olds)	(0.10)	(0.11)	(0.09)	(0.11)			
Average years of education	7.97	7.16	7.45	7.62	0.09	0.05	0.44
(25–40-year olds)	(1.26)	(1.13)	(0.88)	(1.55)			
Average % of individuals who	0.26	0.34	0.33	0.29	0.19	0.00	0.05
work in agriculture sector	(0.13)	(0.12)	(0.10)	(0.15)			
% with electricity	0.55	0.30	0.40	0.46	0.02	0.00	0.13
	(0.26)	(0.20)	(0.13)	(0.27)			
% with piped water	0.33	0.38	0.35	0.29	0.27	0.00	0.10
	(0.24)	(0.21)	(0.19)	(0.22)			
% land owners	0.55	0.48	0.47	0.54	0.61	0.00	0.00
	(0.17)	(0.13)	(0.12)	(0.16)			
% own dwelling	0.88	0.88	0.89	0.88	0.99	0.49	0.41
	(0.08)	(0.05)	(0.05)	(0.09)			
% with television	0.31	0.09	0.12	0.25	0.09	0.00	0.00
	(0.25)	(0.11)	(0.09)	(0.23)			
% with radio	0.69	0.59	0.62	0.68	0.68	0.00	0.00
	(0.11)	(0.11)	(0.07)	(0.10)			
% with toilet	0.57	0.42	0.51	0.51	0.07	0.15	0.85
	(0.22)	(0.19)	(0.17)	(0.25)			
% roof made of metal	0.56	0.25	0.26	0.48	0.02	0.00	0.00
	(0.27)	(0.11)	(0.09)	(0.26)			
% walls made of wood	0.62	0.76	0.73	0.68	0.02	0.01	0.15
	(0.20)	(0.11)	(0.10)	(0.22)			
Observations	60	46	50	916			

Notes: Variable mean displayed to the right of variable name. Standard deviations displayed in parentheses below the mean.

Sources: Minnesota Population Center. 2015. *1990 Integrated Public Use Microdata Series, International: Version 6.4*. Minneapolis: University of Minnesota; Government of the Philippines, Department of Education. 1995. *Project Completion Report: Typhoon-Resistant School Building Program*. Manila; Government of the Philippines, Department of Education. 1995. *Project Completion Report: Secondary Education Instructional Equipment Program*. Manila.

from project completion reports under the Rural Water and Sanitation Services Program funded by ADB and the World Bank. I 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.

As expected, the municipalities that received assistance under TRSBP, SEIEP, or both programs were heavily impacted by one or both of the super-typhoons in 1987 (Table 1). Of the municipalities that received TRSBP assistance, 52% were typhoon affected; of those that received SEIEP assistance, 77% were typhoon affected; and of those that received assistance under both programs, 68% were typhoon affected.

This is consistent with the primary requirement of the Japanese grant assistance program which was to channel aid to the most typhoon-affected areas.

In general, the municipalities that received SEIEP assistance packages tended to have the highest nonenrollment rates among 13–16-year olds, the lowest percentage of educated adults among 25–40-year olds, and the highest share of the population engaged in agriculture. They also tended to be the poorest municipalities based on various indicators such as percentages with electricity, television, radio, toilet, roof made of metal, or walls made of wood. This pattern was also observed among municipalities that received both SEIEP and TRSBP assistance packages, with these municipalities ranking second to SEIEP-only municipalities in terms of nonenrollment rates, education level of adults, share of the population engaged in agriculture, and socioeconomic status. Meanwhile, the municipalities that received only TRSBP assistance had the lowest nonenrollment rates among 13–16-year olds, which were similar to municipalities receiving no assistance; highest share of educated adults; lowest share of the population engaged in agriculture; and the highest socioeconomic status.

IV. Identification Strategy

To investigate the impact of these unique grant assistance programs on education, I use a difference-in-difference framework comparing the evolution of schooling outcomes by age cohorts. Specifically, the two age cohorts comprise students that were fully exposed to these program packages in 1989 (9–12-year olds) versus those that had little or no exposure to the program in 1989 (17–20-year olds) in municipalities with and without access to the three types of program packages: (i) TRSBP only, (ii) SEIEP only, and (iii) both programs.[9]

This suggests estimating an equation of the following general form:

$$Y_{impt} = \alpha_1 TRSBP_m T + \alpha_2 SEIEP_m T + \alpha_3 Both_m T + \alpha_4 X_{impt} + \alpha_4 Z_m T + \delta_m + \gamma_t + \epsilon_{imt} \quad (1)$$

where Y_{impt} is the years of schooling of person i residing in municipality m in 1990 and age t in 1989; $TRSBP_m$ is a dummy variable indicating whether the municipality received TRSBP assistance only and 0 otherwise; $SEIEP_m$ is a dummy variable indicating whether the municipality received SEIEP assistance only and 0 otherwise; $Both_m$ is a dummy variable indicating whether the municipality received both packages and 0 otherwise; T is a dummy variable indicating whether the individual was 9–12 years old or 17–20 years old in 1989; X_{imt} refers to individual-level characteristics such as religion and ethnicity; Z_m is the vector of variables such as

[9] In 2000, educational attainment was assessed for 20–23-year olds and 28–31-year olds.

the availability of ADB and USAID school assistance packages and water supplies and sanitation facilities; δ_m refers to the 1990 municipality of residence fixed effect; and γ_t refers to the age-cohort dummies. In this specification, the parameters of interest are α_1, α_2, and α_3, which correspond to the interaction between the age-group dummy T and each of the three possible program packages being reviewed. This paper also provides separate analysis for boys and girls.

In the Philippines, children typically enter secondary school at age 13 and finish by age 16. Based on administrative data from the Department of Education, less than 5% of the population of 17–24-year olds were enrolled in secondary school during the 1988/89 school year. Hence, the effects of the aid programs should be relatively close to 0 for these individuals. On the other hand, children who were 12 years old or younger in 1988/89 would soon be entering secondary school and therefore had the potential to be fully exposed to the programs.

Could it be that a student's advanced learning abilities or determined parents led in some cases to a student being enrolled in a secondary school other than one in his or her own municipality? Could the families of some students have simply migrated to those municipalities that were receiving aid? As mentioned in section II, the government mandates 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, which are the subject of analysis of this paper.

To deal with the migration issue, I use the municipality of residence of the individual in 1990, which is available in the 2000 IPUMS. To further examine the migration patterns of individuals in the sample prior to 1990 (aged 9–12 years and 17–20 years in 1989), I use the 1990 IPUMS question asking for the number of years a person has resided in their current municipality. In general, less than 3% of individuals in the sample had been living in a municipality for less than 1 year in 1990, which may have represented people who migrated to another municipality in 1989 when the program started, while less than 5% had been living in their municipality for less than 3 years in 1990, which may have represented people who migrated to another municipality in the aftermath of the super-typhoons in 1987. These statistics suggest that migration is not likely to have driven the results.

V. Results and Discussion

A. Main Results

Table 2 presents the average educational attainment in years by program package, age group, and gender. Following the pattern observed in Table 1, regardless

Table 2. **Average Educational Attainment in Years by Program and Age Cohort**

Boys					**Difference**		
Age in 1989	**TRSBP**	**SEIEP**	**Both**	**None**	**TRSBP–None**	**SEIEP–None**	**Both–None**
9–12 years	9.38	8.62	8.7	9.24	0.14	−0.61	−0.53
	[0.03]	[0.04]	[0.04]	[0.01]	[0.03]	[0.04]	[0.04]
17–20 years	9.06	7.97	7.99	8.91	0.15	−0.93	−0.91
	[0.03]	[0.05]	[0.04]	[0.01]	[0.04]	[0.05]	[0.05]
Difference	0.32	0.65	0.71	0.33	−0.01	0.32***	0.38***
	[0.04]	[0.07]	[0.06]	[0.01]	[0.05]	[0.07]	[0.06]
Obs.	22,188	11,597	14,333	333,167			

Girls					**Difference**		
Age in 1989	**TRSBP**	**SEIEP**	**Both**	**None**	**TRSBP–None**	**SEIEP–None**	**Both–None**
9–12 years	10.15	9.34	9.69	9.96	0.19	−0.61	−0.26
	[0.03]	[0.04]	[0.04]	[0.01]	[0.03]	[0.04]	[0.04]
17–20 years	9.45	8.61	8.66	9.29	0.16	−0.68	−0.63
	[0.03]	[0.05]	[0.04]	[0.01]	[0.04]	[0.05]	[0.05]
Difference	0.70	0.73	1.03	0.67	0.03	0.06	0.36***
	[0.04]	[0.07]	[0.06]	[0.01]	[0.05]	[0.07]	[0.060]
Obs.	20,971	10,508	12,877	316,920			

SEIEP = Secondary Education Instructional Equipment Program, TRSBP = Typhoon-Resistant School Building Program.

Notes: The sample includes individuals aged 9–12 years and 17–20 years in 1989. Standard errors in brackets. *** = 10% level of statistical significance, ** = 5% level of statistical significance, * = 1% level of statistical significance.

Source: Minnesota Population Center. 2015. *2000 Integrated Public Use Microdata Series, International: Version 6.4*. Minneapolis: University of Minnesota.

of the age cohort in 1989 (9–12 years or 17–20 years), boys and girls from municipalities that received only the SEIEP assistance package had the lowest average level of educational attainment. This was followed in ascending order by those from municipalities that received both assistance packages, neither assistance package, and the TRSBP package only. The results may reflect differences in economic status of the municipalities. On the other hand, over time, the average educational attainment seems to have increased more in municipalities that received either the SEIEP package only or both packages when compared to municipalities that received either the TRSBP package or none at all. Examining the differences among age cohorts for each of the municipalities that received assistance from TRSBP only, SEIEP only, or both programs relative to those receiving no assistance provides the simple difference-in-differences estimates. For boys living in municipalities that received either instructional resources only (SEIEP) or both typhoon-resistant schools and instructional resources (Both), educational attainment increased by 0.32 years and 0.38 years, respectively. For girls living in municipalities that received both packages (Both), educational attainment increased by 0.36 years. The availability of either program alone did not have an impact on the educational attainment of girls.

Table 3. **Impacts of TRSBP and SEIEP on Educational Attainment**

	Males		
	(1)	**(2)**	**(3)**
TRSBP × Age (9–12 years) in 1989	−0.02	−0.02	−0.03
	[0.044]	[0.044]	[0.044]
SEIEP × Age (9–12 years) in 1989	0.23***	0.26***	0.25***
	[0.060]	[0.060]	[0.060]
Both × Age (9–12 years) in 1989	0.29***	0.31***	0.26***
	[0.054]	[0.054]	[0.055]
Water and sanitation × Age (9–12 years) in 1989			0.05**
			[0.021]
ADB–USAID × Age (9–12 years) in 1989			−0.17***
			[0.023]
Individual-level characteristics	No	Yes	Yes
Age dummies and municipality fixed effect	Yes	Yes	Yes
Constant	9.06***	8.45***	8.45***
	[0.017]	[0.048]	[0.048]
	Females		
	(1)	**(2)**	**(3)**
TRSBP × Age (9–12 years) in 1989	0.01	0.01	−0.02
	[0.044]	[0.044]	[0.044]
SEIEP × Age (9–12 years) in 1989	0.03	0.03	0
	[0.061]	[0.061]	[0.062]
Both × Age (9–12 years) in 1989	0.30***	0.32***	0.23***
	[0.056]	[0.056]	[0.056]
Water and sanitation × Age (9–12 years) in 1989			0.14***
			[0.021]
ADB–USAID × Age (9–12 years) in 1989			−0.20***
			[0.022]
Individual-level characteristics	No	Yes	Yes
Age dummies and municipality fixed effect	Yes	Yes	Yes
Constant	9.20***	7.52***	7.52***
	[0.016]	[0.033]	[0.033]

ADB = Asian Development Bank, SEIEP = Secondary Education Instructional Equipment Program, TRSBP = Typhoon-Resistant School Building Program, USAID = United States Agency for International Development.

Notes: Standard errors (in brackets) account for clustering in the municipality of residence in 1990. The base sample consists of children aged either 9–12 years or 17–20 years in 1989. These children were assessed again in 2000 when aged 20–23 years or 28–31 years. Each column estimates the interaction of TRSBP availability and the age dummy (9–12 years), the interaction of SEIEP availability and the age dummy (9–12 years), and the interaction of the indicator of both programs' availability and the age dummy (9–12 years). All specifications include single age dummies and the 1990 municipality of residence fixed effect. Individual-level characteristics include religion and ethnicity indicators. The sample includes individuals aged 9–12 years and 17–20 years in 1989. *** = 10% level of statistical significance, ** = 5% level of statistical significance, * = 1% level of statistical significance.

Source: Minnesota Population Center. 2015. *2000 Integrated Public Use Microdata Series, International: Version 6.4*. Minneapolis: University of Minnesota.

Table 3 formally reports the estimates of the effects of access to typhoon-resistant schools, instructional equipment, or both components on the years of schooling of boys and girls (columns 1–3). Column (1) shows the most parsimonious specification, including only age-cohort fixed effects and municipality fixed effects. Among boys, the availability of the instructional equipment program package in a municipality led to an average increase of 0.23 years of schooling, while the availability of both typhoon-resistant schools and instructional resources led to an average increase of 0.29 years of schooling. Among girls, the availability of both packages increased their educational attainment by an average of 0.30 years. Relative to the average educational attainment of boys and girls in the Philippines, which are relatively high compared with other Asian economies, these effects are equivalent to about a 3% increase in years of education for both boys and girls.

Column (2) suggests that these estimates are also generally robust to the inclusion of individual-level characteristics such as ethnicity and religion, as the estimates only slightly increased for both boys and girls. Column (3) accounts for the presence of other programs being implemented concurrently that also could have potentially impacted educational attainment. For boys, accounting for these concurrent programs led to an average increase of about 0.25 years and 0.26 years of education for those exposed to SEIEP only and to both programs, respectively. For girls, the availability of both programs leads to an average increase of 0.23 years of education, while the availability of either program alone does not seem to have had an effect.

Taken jointly, these results suggest that the presence of typhoon-resistant secondary schools alone is not enough to increase one's educational attainment. The availability of secure and adequate school facilities needs to be accompanied by appropriate instructional resources in order to significantly increase the educational attainment of both boys and girls. Although recent papers have focused on examining the effects of technology-related instructional resources (Angrist and Lavy 2002; Barrow, Markman, and Rouse 2009; and Beuermann et al. 2015), in general, the results of this study corroborate the importance of equipping classrooms with instructional resources to improve student outcomes. While there have been a limited number of studies that examine the importance of nontechnological instructional resources, Chingos and Whitehurst (2012) note that such instructional materials have a direct influence on both teacher effectiveness and student learning.

Now, what might explain the difference in patterns observed for boys and girls? The pattern of results for boys reflects the importance of instructional resources (or the quality of instruction), regardless of the presence of typhoon-resistant school infrastructure, in keeping teenage boys in secondary schools. On the other hand, the pattern observed for girls suggests the importance of school infrastructure, in addition to the instructional resources, in keeping teenage girls in secondary schools. The latter finding is consistent with studies that suggest the importance of the availability of an adequate water supply, sanitation facilities, and hygienic conditions on girls' education outcomes (Birdthistle et al. 2011, Burton 2013, Gius and Subramanian 2015, and Adams et al. 2009). Secondary school-aged girls and boys may be affected in different ways by inadequate schooling infrastructure,

Table 4. **Robustness Checks**

	Restrict to Localities in Typhoon Belt		With Municipality-Specific Linear Trend	
	Male (1)	**Female (2)**	**Male (3)**	**Female (4)**
TRSBP × Age (9–12 years) in 1989	0	0.01	−0.05	−0.05
	[0.04]	[0.04]	[0.04]	[0.04]
SEIEP × Age (9–12 years) in 1989	0.29***	0.04	0.23***	−0.03
	[0.06]	[0.06]	[0.06]	[0.06]
Both × Age (9–12 years) in 1989	0.30***	0.28***	0.24***	0.20***
	[0.05]	[0.05]	[0.05]	[0.06]
With controls	Yes	Yes	Yes	Yes
Constant	4.88***	5.02***	3.61***	3.44***
	[0.30]	[0.30]	[0.26]	[0.27]

ADB = Asian Development Bank, SEIEP = Secondary Education Instructional Equipment Program, TRSBP = Typhoon-Resistant School Building Program, USAID = United States Agency for International Development.

Note: Standard errors (in brackets) account for clustering in the municipality of residence in 1990. The dependent variable (education) is measured in years. Each column estimates the interaction of TRSBP availability and the age dummy (9–12 years), the interaction of SEIEP availability and the age dummy (9–12 years), and the interaction of the indicator of both programs' availability and the age dummy (9–12 years). All specifications include single age dummies, 1990 municipality of residence, religion, and ethnicity indicators, water and sanitation availability × Age (9–12 years), ADB–USAID × Age (9–12 years), and enrollment rate × Age. *** = 10% level of statistical significance, ** = 5% level of statistical significance, * = 1% level of statistical significance.

Source: Minnesota Population Center. 2015. *2000 Integrated Public Use Microdata Series, International: Version 6.4*. Minneapolis: University of Minnesota.

particularly by an inadequate water supply or a lack of toilets or sanitation facilities. According to Adams et al. (2009), girls are disproportionately more affected than boys by the lack of physical infrastructure. This may be because parents are less likely to send their daughters to school when there is a lack of adequate, private, and secure sanitation facilities. Furthermore, the lack of appropriate facilities for menstrual hygiene can lead teenage girls to miss school during their menstruation period and possibly to drop out altogether. Thus, while instructional resources are crucial for teenage girls' learning and motivation, having secure and adequate physical infrastructure is also essential in keeping them in school.

B. Robustness and Specification Checks

Table 4 includes robustness checks for the results obtained in Table 3. The first two columns restrict the analysis to regions within the Philippines' typhoon belt. By restricting the analysis to these regions, municipalities have more or less a similar probability of being affected by a destructive typhoon and are more homogeneous in terms of socioeconomic status. As shown in columns (1) and (2), this leads to slightly higher coefficients. For boys, the availability of SEIEP leads to an average increase of 0.29 years of education, while the availability of both programs leads to an average increase of 0.30 years of education. For girls, the availability of both programs leads to an average increase of 0.28 years of education. Columns (3) and (4) add a municipality-specific linear time trend to capture evolving, unobserved municipality characteristics that may have changed the level of schooling independent of the programs. In general, adding this only slightly decreases the coefficients while the patterns remain the same.

In Table 5, as a falsification test, I run the same specifications used in Table 3 with a sample of all postsecondary school-aged individuals (17–24-year olds) who would have had little or no exposure to the program packages. This table serves as a specification check as it aims to examine whether there are any preexisting trends in schooling outcomes in the same municipalities that later received the Japanese grant assistance. If educational attainment increased faster in municipalities that would later receive these program packages, even among young adults who would not have been exposed to these programs, then the estimates may be capturing the effects of other municipality trends that are correlated with the programs.

In general, for both boys and girls, the coefficients under TRSBP only and under both program packages are relatively small and not significant. On the other hand, the coefficients under SEIEP are relatively large and are particularly significant for girls. It may be that the estimate for SEIEP × Age (17–20 years) could be capturing some preexisting trends correlated with the allocation of the instructional resources program. However, since the effect of SEIEP for girls is small and not statistically significant when using the original sample, but becomes sizable and statistically significant when using the sample for the falsification test, it could be that there is also a timing issue. That is, teenage girls in relatively poorer municipalities may be more likely to fall behind in their schooling relative to peers in more affluent municipalities. It is also possible that these girls may have entered school at a later age.

To further examine the differing impacts on young boys and girls, Table 6 shows the interaction between the availability of each program package with age dummies ranging from 9–18 years. Those aged 19–20 years in 1989 are included in the control group. In general, the interactions of the availability of typhoon-resistant schools (TRSBP) with age dummies yield relatively small and insignificant coefficients, although some coefficients are larger than the others. These results are consistent with the patterns observed in Tables 3–5. The coefficients of the interaction of having both programs (Both) with each of the age dummies are also consistent with the results found earlier. For both boys and girls, coefficients are relatively large and statistically significant (ranging from 0.16 to 0.42) until about age 13–14 and then they fluctuate around 0 afterward. The interactions of the availability of instructional resources (SEIEP) with each of the age dummies also provide a clearer picture of the patterns observed earlier. For boys, coefficients are relatively large and statistically significant until about age 12 and then they become smaller and are not statistically significant. For girls, the coefficients are relatively

Table 5. **Impact of TRSBP and SEIEP on Educational Attainment: Falsification Test Sample**

	(1)	(2)	(3)
Males			
TRSBP × Age (17–20 years) in 1989	−0.03	−0.03	−0.04
	[0.05]	[0.05]	[0.05]
SEIEP × Age (17–20 years) in 1989	0.11*	0.1	0.09
	[0.07]	[0.07]	[0.07]
Both × Age (17–20 years) in 1989	−0.03	−0.03	−0.05
	[0.06]	[0.06]	[0.06]
Water and sanitation × Age (17–20 years) in 1989			0.04*
			[0.02]
ADB–USAID × Age (17–20 years) in 1989			−0.03
			[0.02]
Individual-level characteristics	No	Yes	Yes
Constant	8.66***	7.17***	7.18***
	[0.02]	[0.04]	[0.04]
Females			
	(1)	**(2)**	**(3)**
TRSBP × Age (17–20 years) in 1989	0.01	0	−0.01
	[0.05]	[0.05]	[0.05]
SEIEP × Age (17–20 years) in 1989	0.18***	0.19***	0.18***
	[0.07]	[0.07]	[0.07]
Both × Age (17–20 years) in 1989	−0.03	−0.03	−0.05
	[0.06]	[0.06]	[0.06]
Water and sanitation × Age (17–20 years) in 1989			0.06**
			[0.02]
ADB–USAID × Age (17–20 years) in 1989			−0.04
			[0.02]
Individual-level characteristics	No	Yes	Yes
Constant	8.93***	7.15***	7.15***
	[0.02]	[0.04]	[0.04]

ADB = Asian Development Bank, SEIEP = Secondary Education Instructional Equipment Program, TRSBP = Typhoon-Resistant School Building Program, USAID = United States Agency for International Development.

Notes: Standard errors (in brackets) account for clustering in the municipality of residence in 1990. The base sample consists of children aged either 17–20 years or 21–24 years in 1989. These children were assessed again in 2000 when aged 28–31 years or 22–35 years. The dependent variable (education) is measured in years. Each column estimates the interaction of TRSBP availability and the age dummy (17–20 years), the interaction of SEIEP availability and the age dummy (17–20 years), and the interaction of the indicator of both programs' availability and the age dummy (17–20 years). All specifications include single age dummy and the 1990 municipality of residence dummy. *** = 10% level of statistical significance, ** = 5% level of statistical significance, * = 1% level of statistical significance.

Source: Minnesota Population Center. 2015. *2000 Integrated Public Use Microdata Series, International: Version 6.4*. Minneapolis: University of Minnesota.

small and not significant except for some large and statistically significant effects at ages 14 and 17.

The large coefficient (0.34) for the interaction between the availability of instructional equipment (SEIEP) and age 17 may suggest three things. First, it is

Table 6. **Coefficients of the Interaction of Each Program Package with Age in 1989**

	Male	**Female**		**Male**	**Female**		**Male**	**Female**
TRSBP_9	−0.02	0.03	SEIEP_9	0.26***	0.15	BOTH_9	0.22**	0.42***
	[0.07]	[0.07]		[0.10]	[0.10]		[0.09]	[0.09]
TRSBP_10	−0.11	−0.03	SEIEP_10	0.27***	0.03	BOTH_10	0.35***	0.28***
	[0.08]	[0.07]		[0.10]	[0.10]		[0.09]	[0.09]
TRSBP_11	0.01	0.08	SEIEP_11	0.30***	−0.07	BOTH_11	0.19**	0.28***
	[0.08]	[0.08]		[0.10]	[0.11]		[0.09]	[0.10]
TRSBP_12	−0.01	−0.05	SEIEP_12	0.27**	0.00	BOTH_12	0.18*	0.16*
	[0.08]	[0.08]		[0.11]	[0.11]		[0.10]	[0.10]
TRSBP_13	−0.09	−0.09	SEIEP_13	0.10	0.01	BOTH_13	0.27***	0.21**
	[0.08]	[0.08]		[0.10]	[0.11]		[0.10]	[0.10]
TRSBP_14	−0.12	0.02	SEIEP_14	−0.03	0.26**	BOTH_14	0.18*	0.00
	[0.08]	[0.08]		[0.11]	[0.11]		[0.10]	[0.10]
TRSBP_15	−0.02	0.09	SEIEP_15	0.03	0.02	BOTH_15	−0.03	0.07
	[0.08]	[0.08]		[0.11]	[0.11]		[0.10]	[0.10]
TRSBP_16	−0.01	0.01	SEIEP_16	−0.03	0.03	BOTH_16	0.18*	0.00
	[0.08]	[0.08]		[0.11]	[0.11]		[0.10]	[0.10]
TRSBP_17	0.01	0.01	SEIEP_17	0.00	0.34***	BOTH_17	0.04	0.13
	[0.08]	[0.08]		[0.11]	[0.11]		[0.10]	[0.10]
TRSBP_18	−0.01	0.09	SEIEP_18	0.11	−0.17	BOTH_18	−0.17*	0.08
	[0.08]	[0.08]		[0.11]	[0.11]		[0.10]	[0.10]
						Constant	7.30***	7.47***
							[0.03]	[0.03]

SEIEP = Secondary Education Instructional Equipment Program, TRSBP = Typhoon-Resistant School Building Program.

Notes: The sample includes individuals aged 9–20 years. Standard errors (in brackets) account for clustering in the municipality of residence in 1990. The dependent variable (education) is measured in years. Each column estimates the interaction of TRSBP availability with each of the age dummies 9–18 years (age 19–20 as base group), the interaction of SEIEP availability with each of the age dummies 9–18 years (age 19–20 as base group), and the interaction of the indicator of both programs' availability with each of the age dummies 9–18 years (age 19–20 as base group). All specifications include single age dummies and 1990 municipality of residence. *** = 10% level of statistical significance, ** = 5% level of statistical significance, * = 1% level of statistical significance.

Source: Minnesota Population Center. 2015. *2000 Integrated Public Use Microdata Series, International: Version 6.4*. Minneapolis: University of Minnesota.

possible that even children of this age in 1989 may be benefiting from the program because in poorer municipalities, these children might still be in secondary school due to a delayed entrance into school. Second, school officials in these municipalities may have also prioritized the enrollment of these students considered to be at the margin of eligibility. Unfortunately, I have insufficient data to support either of these possible explanations. But to the extent that some of the girls in the control cohorts (aged 17–20 years in 1989) have benefited from SEIEP, then the results shown earlier may be an underestimation of the true effects of the program. A third possible explanation is that there could be other municipality trends that are correlated with the SEIEP program but not captured by the specification. However, such trends do not really correspond to the null results observed in the interaction of SEIEP with younger age dummies (aged 9–12 years in 1989) as shown in Table 3. To the extent that girls in the control cohorts (aged 17–20 years in 1989) have benefited from other programs that might be correlated with the allocation of SEIEP assistance packages, then this could also lead to the underestimation of the true effects of the program.

VI. Conclusion and Policy Implications

This study evaluates the effects on educational attainment of typhoon-resistant schools and instructional equipment at the municipal level in the Philippines. For boys, the presence of typhoon-resistant schools equipped with instructional equipment led to an average increase of about 0.26–0.31 years of education, while the presence of instructional resources alone led to an average increase of 0.23–0.26 years of education. For girls, the availability of both components led to an average increase of 0.23–0.32 years of education, while the availability of either component alone does not seem to have had an effect. The estimates are generally robust when including individual-level characteristics, accounting for other central government programs being implemented concurrently, restricting to municipalities in the Philippines' typhoon belt, and accounting for municipality-specific trends.

The findings suggest the importance of not only expanding access to secondary schooling through increased availability of schools and classrooms, but also of improving the quality of learning through the availability of school resources that aid in secondary school students' learning in developing economies. For disaster-prone countries such as the Philippines, innovative solutions such as typhoon-resistant schools may not suffice. It may also be necessary to equip these schools with the needed instructional materials for critical subjects such as mathematics and science to reduce the likelihood of dropping out among secondary school children. This suggests that for governments to increase human capital, they need to pay equal, if not more, attention to increasing the quality of educational tools as is paid to improving the quantity and quality of educational infrastructure.

Furthermore, the findings of this study suggest there is a need to account for the fact that teenage boys and girls may be affected differently by the challenges of inadequate physical infrastructure and instructional resources. In order to improve the educational attainment of boys, the findings point to the importance of improving access to quality instructional resources. On the other hand, in order to improve the educational attainment of girls, the results indicate the need to invest not only in basic instructional materials for teaching high school subjects, but also in secure, disaster-resistant physical infrastructure with adequate access to water, power, sanitation, and sewerage facilities.

This study has focused on investigating the impact of typhoon-resistant schools and instructional resources on educational attainment. It remains an open question whether the observed increases in educational attainment had a broader impact on other measures of human capital development and labor market outcomes. Investigating these effects will be the subject of future study.

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