ECONOMICS WORKING PAPER

How Do Natural Disasters Change Consumption Behaviour?
Estimates and Policy Responses from Thailand and the Philippines

Kensuke Tanaka

OECD, Paris, France

Prasiwi Ibrahim

OECD, Paris, France

Oudom Hean

North Dakota State University, USA

Abstract

This study examines the effects of natural disasters on consumption in Thailand and the Philippines, using three large natural disasters for each country. A decline in consumption is observed after natural disaster in Thailand. This decline stems from a reduction in expenditures of the service sector including recreation, restaurants, and hotels, though the decline is partially offset by increased spending on non-durable goods. For the Philippines, declines in overall consumer spending are observed in response to natural disasters with no specific sectoral responses in sample. The policy implications of natural disasters are then discussed in the final part of the paper.

How Do Natural Disasters Change Consumption Behaviour?
Estimates and Policy Responses from Thailand and the Philippines

Kensuke Tanaka, Prasiwi Ibrahim and Oudom Hean[1]

1. Introduction

Emerging Asia is one of the most disaster-prone regions in the world. Natural disasters - such as floods, tropical cyclones, and earthquakes - frequently affect countries across the region, causing devastating damage (OECD, 2018, 2019). Depending on their intensity and duration, these disasters can affect consumer behaviour. This study examines the effects of natural disasters on consumption behaviour in Thailand and the Philippines, looking at three large natural disasters for each country. For Thailand, the study adopts as case studies the tsunami in 2004 that resulted from an earthquake in the Indian Ocean, the floods of 2011, and the further flooding of late 2016 and early 2017. For the Philippines, the study examines Typhoon Bopha in 2012, Typhoon Haiyan in 2013, and Typhoon Meranti in 2016.

Overall, the study observed a decline in total consumption in Thailand after these disasters. This decline stemmed from a fall in spending in the service sector, which includes recreation, restaurants, and hotels. At the same time, the study generally observed an increase after these disasters in household spending on non-durable goods, such as food, alcoholic and non-alcoholic beverages, tobacco products, and clothing. For the Philippines, however, relatively small changes in consumer spending were observed. In the aftermath of natural disasters, swift and appropriate government reactions and policy responses are necessary in order to cope with the damage that they cause.

The study begins with a literature review, followed by descriptive and empirical analyses. The policy implications of natural disasters are then discussed in the final part of the study.

---

2. Literature Review: Consumer Behaviour When Disaster Strikes

This study draws on an existing body of academic literature that analyses consumer behaviour in the wake of natural disasters. Despite the inherent unpredictability of these calamitous situations, several authors have argued that consumption growth following a disaster is significantly influenced by past information, namely consumer confidence, consumption growth, and lagged income (Flavin, 1981; Campbell and Mankiw, 1989). As a result, estimates typically factor in a lag in consumption growth, testing the permanent income hypothesis posited by Friedman (1957) that individuals base their consumption on a longer-term view of income, consuming a fraction of this permanent income in each period, such that the average propensity to consume is equal to the marginal propensity to consume. In turn, the marginal propensity to consume is shaped by a number of factors, including unemployment, household resources, and broader perceptions of uncertainty.

Several studies have investigated whether large external shocks such as natural disasters or extremely disruptive civil conflicts have an effect on consumption. In particular, Miguel and Roland (2011) explore the long-term impact of the war in Viet Nam on local economic conditions. The authors find that the conflict had a moderate negative effect on consumption levels through to 1992-93, but that it also contributed to faster consumption growth between 1992-93 and 2002 (Miguel and Roland, 2011). In a similar vein, Gignoux and Menendez (2016) study the short- and long-term effects on individual economic outcomes of a set of earthquakes that occurred in rural Indonesia as of 1985. The empirical estimates show that an earthquake reduces household consumption per capita in the short-run, but that this negative effect then fades away, with the effect eventually turning out to be positive and statistically significant in the long-term (Gignoux and Menendez, 2016). These results suggest that any negative short-term impact from the large external shock on consumption dissipated over time, consistent with the permanent income hypothesis.

Moreover, the impact of a natural disaster depends largely upon its intensity and duration. The negative impact on economic outcomes is stronger for more intense disasters (Lee et al., 2018). Similarly, Baez et al. (2015) investigate the causal consequences of Tropical Storm Agatha, in 2010, on household welfare in Guatemala. The authors find that households reduced their food consumption by 10% on average, with a larger impact among urban households, for which average consumption per capita dropped by 12.6%. This greater impact is attributed to the strength of the shock itself, with much stronger excessive precipitation in urban areas (Baez et

al., 2015). More generally, Benson and Clay (1998) show that countries that suffer frequently from disasters tend to experience lower growth rates than countries with fewer disasters.

The change in consumption behaviour in times of crisis is asymmetric across different categories of goods. It is well documented that purchases of non-essential goods can easily be postponed. When the reason for postponement wanes, however, some portion of the missing demand tends to recover (Hai et al., 2013). Forbes (2017) studied the short-term consumption patterns in the aftermath of the 2011 earthquake in Christchurch, New Zealand. The study showed that immediately after the event – namely, within the first week – consumers mostly purchased essential items, such as water, non-perishable food, products providing access to communication services, and cleaning products (Forbes, 2017).

Elsewhere, Anttila-Hughes and Hsiang (2013) assess the economic effects of typhoons in the Philippines. They conclude that income losses induced by the typhoons translated into a 7.1% drop in household spending, with the sharpest adjustments hitting the kinds of spending most akin to investments in human capital, such as medicine, education, and high-nutrient food. By contrast, spending tends to fall much less when it comes to pure consumption goods, namely recreation, alcohol and tobacco (Anttila-Hughes and Hsiang, 2013). Similarly, Aladangady et al. (2016) show that in the immediate aftermath of Hurricane Matthew in the United States in October 2016, consumer discretionary spending decreased, falling by 4.1% at restaurants, and 6.8% at clothing stores.

3. Data and Descriptive Analysis: Natural Disaster Case Studies in Thailand and the Philippines

This section briefly introduces the large natural disasters in Thailand and the Philippines used in this analysis, and examines consumption data before and after these disasters to evaluate the effects of these events, particularly on consumption.

3.1. Thailand

Thailand is vulnerable to natural disasters such as floods and landslides (OECD, 2018; Center for Excellence in Disaster Management and Humanitarian Assistance, 2019). The present study focuses in on three natural disasters in Thailand: the tsunami in 2004, the floods of 2011, and another flooding disaster in late 2016 and early 2017. These are among the biggest disasters to affect Thailand in terms of human casualties or damage to property.

The 2004 Indian Ocean earthquake and tsunami, and its effect on Thailand

The 2004 Indian Ocean tsunami occurred on December 26. An earthquake measuring 9.1 on the Richter scale struck west of Sumatra causing massive tsunami waves from Indonesia to the east coast of Africa. The Tsunami displaced 1.7 million people in 14 different countries, killing nearly 230 000 people with the total damage estimated at USD 9.9 billion. More than half of the total deaths and damage occurred in Indonesia (Telford et al., 2006). According to the Center for Research on the Epidemiology of Disasters (2020), the total number of people affected in Thailand was about 67 000, and the total damage was estimated at USD 1 billion. It is estimated that more than 8 200 were killed and approximately 8 400 were injured by the tsunami in Thailand alone. Although the tsunami was most severe in the coastal areas favoured by tourists, only roughly a quarter each of those killed and injured were foreigners. The most affected sectors in Thailand were tourism, fishing and agriculture (Schwartz et al., 2006; TDRI, 2005).

Thailand's riverine floods of 2011-12

A series of riverine floods took place from August 2011 to January 2012, starting in the Mekong and Chao Phraya rivers in northern Thailand and Lao PDR, and eventually extending to parts of Thailand's capital, Bangkok. Thailand is prone to flash floods during the monsoon season due to its tropical climate. The 2011 riverine floods can be considered as the worst floods in modern Thai history, affecting around 13 million people, inundating 9.1% of the land mass, causing at least 680 casualties, and causing roughly USD 45.7 billion in damage (Centre for Research on the Epidemiology of Disasters, 2020). Approximately 90% of the damage occurred to the private sector, of which 70% to the manufacturing sector (Poapongsakorn et al. 2012, World Bank 2011).

The flood disaster in southern Thailand in 2016-17

The floods of 2016-17 in southern Thailand affected nearly two million people, causing 95 casualties, and property damage of about USD 1.15 billion (Centre for Research on the Epidemiology of Disasters, 2020) [i]. The rains that caused the flooding were the heaviest in the region over the previous 11 years. The gum and palm oil industries, which are based on farming in the inundated regions, were especially affected by the floods. Furthermore, the heavy rains also destroyed much infrastructure, such as roads, bridges and railways (Tebakari et al., 2018).

Effects of natural disasters on the overall economy in Thailand

Overall, the greatest changes to economic demand among the natural disasters examined in this study can be seen, among others, in the effects of the 2004 tsunami on the tourism industry in southern Thailand. While tourist arrivals overall declined slightly in 2005 compared with 2004, the most significant shift was seen in the locations where tourists tended to take holidays. The significant decline in tourism in the tsunami-afflicted regions, which was especially severe in Phuket, caused concomitant increased demand for tourism to seaside areas elsewhere in Thailand. For example, hotel occupancy in Pattaya, which is in eastern Thailand, grew by 28% in 2005. An additional result of this increase in tourism to these other regions was that property values also increased substantially there. By March 2006, land prices had increased to nearly seven times their pre-tsunami values in Koh Samui, which was not affected by the tsunami (Nidhiprabha, 2007). While the supply-side effects of the 2011 flooding have been discussed widely in terms of its major impact on certain industries—particularly in manufacturing—the specific effects on consumption are less clear. The 2016-17 flooding had a particularly acute impact on Thailand's rubber production, as production is concentrated in the south. Indeed, it was estimated that the floods would cause a 7.6% decrease in Thailand's rubber output in 2017.

Analysing natural disasters in Thailand: Household consumption data and descriptive statistics

In order to study the effects of these natural disasters, data on quarterly household consumption for 2003-18 from Thailand's Office of the National Economic and Social Development Council were examined. These data are seasonally-adjusted and inflation-corrected using chained volume measures (with 2002 as the reference year).

Table 1 provides descriptive statistics for the data used for this study. On average, household spending on food and non-alcoholic drinks is the highest, while expenditure on education is the lowest. Generally, Thai households spend around a third of their budget on non-durable goods including food, beverages, and tobacco products. Spending in restaurants, hotels, and on recreation – all categories particularly susceptible to natural disasters – accounts for about 18% of total consumption.

Table 1. Thailand's total consumption before and after natural disasters (billion Thai baht [THB])

Variable	Obser vation	Mean	Standard Deviation	Minimum	Maximum
Total consumption	64	1211.07	203.84	869.83	1605.42
Food and non-alcoholic beverages	64	222.08	13.63	187.88	249.59
Alcoholic beverages and tobacco	64	52.11	3.07	46.42	59.52
Clothing	64	71.87	4.4	60.5	76.97
Utility expenses	64	133.77	22.97	99.02	178.85
Furniture	64	63.57	12.31	41.09	82.77
Healthcare	64	65.77	15.65	41.08	93.4
Transport	64	168.37	29.4	123.42	224.6
Communication	64	45.36	11.91	23.98	66.55
Recreation	64	79.52	21.82	46.56	124.46
Restaurants and hotels	64	174	54.99	94.52	281.5
Education	64	20.61	3.19	14.65	26.5
Miscellaneous	64	128.07	34.68	81.83	196.68

Source: Office of the National Economic and Social Development Council (2020)

Figure 1 shows Thailand's total consumption before and after these disasters. The statistics show that consumption generally declined in the immediate aftermath of a natural disaster, but rebounded quickly. Indeed, it usually took less than a year for consumption to return to the pre-disaster expenditure trend. Distinguishing between the three disasters, the present study observes that total household consumption declined the most during the 2011 floods (represented by the brackets in Figure 1). Total household consumption also fell immediately, albeit to a relatively smaller degree, after the tsunami of 2004 and the flooding in 2016-17.

Figure 1. Total consumption in Thailand before and after natural disasters (billion THB)

A. Tsunami of 2004

B. Floods of 2011

C. Floods of 2016-17
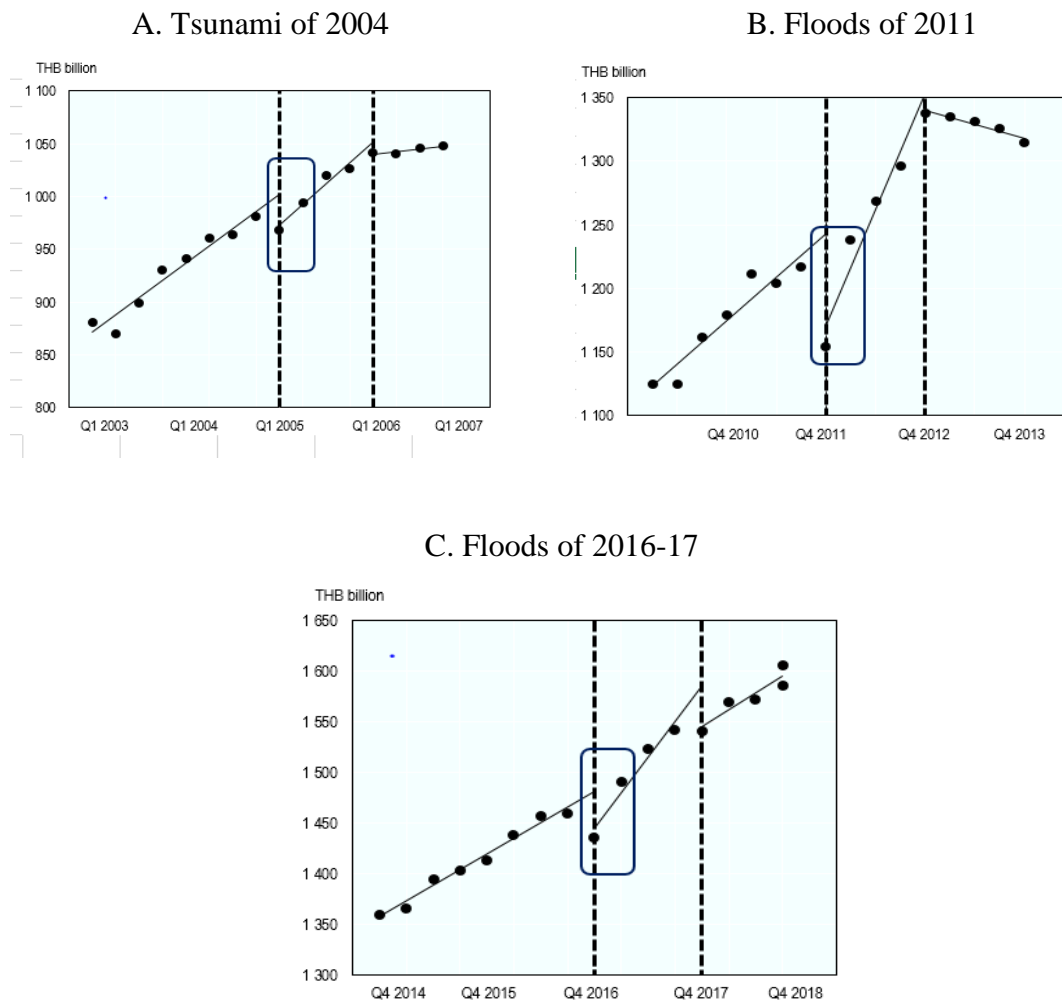
Source: Office of the National Economic and Social Development Council (2020). The data represent quarterly household consumption.

In all three cases, total household consumption bounced back to its normal long-run consumption trend within a year. Moreover, while the biggest fall in total consumption among the three disasters was after the 2011 floods, consumption then recovered at the fastest pace of all three of the case studies. This is shown in Figure 1, section B, in which the fast recovery speed is represented by the trend line between the first quarter of 2012 and the last quarter of 2012.

3.2.   The Philippines

The Philippines ranked third in the world in terms of disaster risks, according to the World Risk Report 2018 (World Economic Forum, 2018). Indeed, the Philippines is affected by

typhoons regularly and severely (Centre for Research on the Epidemiology of Disasters, 2020). Typhoons alone cost on average 2% of GDP, with a further 2% of GDP then being spent every year on rebuilding (UNDRR, 2019). This study looks in turn at three so-called super typhoons that have hit the country in recent years: Typhoon Bopha in 2012, Typhoon Haiyan in 2013, and Typhoon Meranti in 2016.

December 2012: Typhoon Bopha hits the Southern Philippines

Early in December 2012, Typhoon Bopha (known locally in the Philippines as Typhoon Pablo) blew in to hit the southern part of the country. The Centre for Research on the Epidemiology of Disasters (2020) estimates that Typhoon Bopha affected about 6.2 million people. Moreover, damage was estimated at over USD 1 billion, and the disaster caused more than 1 900 casualties (Weather Philippines, 2015). Most of the damage was to public infrastructure such as roads, power plants and bridges, as well as to agricultural lands used for banana and coconut farming. The damage to agricultural land significantly affected livelihoods, since 80% of the region's population works in the agricultural sector (UNOCHA, 2013).

November 2013: Typhoon Haiyan wreaks historic havoc

Less than a year after Typhoon Bopha, came Typhoon Haiyan (known locally as Typhoon Yolanda), hitting the Philippines in November 2013. It affected around 16.1 million people, leaving approximately 4 million of them homeless. There were 6 300 casualties, and the damage cost more than 10 billion U.S. dollars (Centre for Research on the Epidemiology of Disasters, 2020; Weather Philippines, 2015). Indeed, Typhoon Haiyan is the worst typhoon in modern Philippine history, at the time of writing. It hit the region's agricultural sector hard, and felled about 33 million coconut trees, a major source of livelihoods. Typhoon Haiyan also destroyed schools, hospitals and roads in an already poor region. The destruction of roads proved to be a particularly grave problem when early emergency help arrived, and continued to prove especially problematic when the recovery and rebuilding started (UNDP, 2014).

September 2016: Typhoon Meranti vies in power with Typhoon Haiyan

Typhoon Meranti (known locally as Typhoon Ferdie) hit the northern part of the Philippines in September 2016. It affected about 17 000 people in the country, causing approximately USD 5 million U.S. dollars in damage. In addition to destroying more than 2 000 houses, either totally or partially, the damage was mostly to communications network infrastructure.

Nonetheless, Typhoon Meranti is tied with Haiyan for being the second most powerful tropical cyclone in history. Most of the typhoon's damage occurred in mainland China (Centre for Research on the Epidemiology of Disasters, 2020; NDRRMC, 2016).

Damages of natural disasters to overall economy in the Philippines

Evidence from the Philippines suggests large-scale natural disasters can exacerbate economic disparities as typhoons have hit poor households and their consumption most severely. After a typhoon, households tend to spend only on necessities, and this may continue for a significant period, depending on the losses in terms of capital that a region has suffered (Jha et al., 2018). A study of the 2006 Milenyo Typhoon examines consumer behaviour in a rural Philippine village. The poor did not benefit from a sharp decrease of fish prices as much as the rich did, because their total level of consumption was not as high, and they did not consume fish as much in the first place. The richer households also had more possibilities to cope after the crisis, and to reallocate their resources and consumption. The main coping mechanism of those who bore the brunt of the disaster was to reduce their overall consumption, and even their consumption of food, while households living from agriculture shifted to consuming their own products rather than selling those (Sakai et al. 2017). Evidence from other natural disasters shows that, immediately after a large-scale disaster, consumers buy products that are necessary for survival. These include, for example, water and canned food. The purchase of hedonic products, such as alcohol or tobacco, also increases after a disaster has lasted for a couple of weeks (Forbes, 2017).

Typhoon Haiyan revealed the vulnerabilities in the natural disaster management system in the Philippines. These included a lack of capacity to implement existing procedures, a lack of communication, and problems with co-operation between national and international operatives. Deficiencies of implementation stemmed from a scarcity of different key skills, and a lack of co-ordination between the local and provincial levels of government. The issues with communication and co-operation consisted of various problems, including a lack of formal partnerships between the collaborators, a lack of trust, and a lack of coordination. After Typhoon Haiyan, therefore, the government sought to improve co-ordination before, during and after a disaster (Dy et al., 2016). Certain financial arrangements such as the government's quick-response fund, its fund for national disaster risk-reduction and management, and its

calamity funds, also revealed major vulnerabilities. Indeed, lengthy administrative processes impede the timely delivery of funding (Bowen, 2015).

Analysing natural disasters in the Philippines: Household consumption data and descriptive statistics

This study used quarterly household consumption data from the Philippine Statistics Authority to estimate the effects of these typhoons. The data are inflation-corrected by chained volume measures (with 2002 as the reference year). The data are not seasonally adjusted, however. The data set used in this study spans from the first quarter of 2011 to the second quarter of 2018. Table 2 provides descriptive statistics for the data set. On average, Philippine households spend more than a third of their total consumption on non-durable goods. Spending on restaurants, hotels, and recreation is, on average, less than 10% of total consumption.

Table 2. Total consumption before and after typhoons (billion Philippine pesos [PHP])

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
Total consumption	32	1295.136	209.129	967.038	1789.083
Food and non-alcoholic beverages	32	536.29	92.56	385.365	761.383
Alcoholic beverages and tobacco products	32	17.347	3.138	12.261	24.074
Clothing	32	19.099	1.969	16.29	23.238
Utility expenses	32	142.214	20.849	107.11	187.126
Furniture	32	67.189	7.391	52.126	84.884
Healthcare	32	31.741	6.547	21.642	45.904
Transport	32	112.892	20.95	79.347	149.097
Communication	32	67.368	10.988	45.53	92.076
Recreation	32	29.859	6.243	20.178	43.783
Restaurants and hotels	32	56.331	11.007	38.8	281.5
Education	32	40.722	7.311	30.911	26.5
Miscellaneous	32	174.083	37.973	118.134	275.416

Source: Philippine Statistics Authority (2020)

Figure 2 shows Philippine inflation-corrected and seasonal-adjusted total consumption before and after the typhoons.[2] In each panel, the brackets represent the time these disasters occurred. Compared to the disasters in Thailand, declines in consumption after the Philippine typhoons were usually smaller, and the consumption expenditures rebounded quickly. It took less than a year for consumption to return to the long-term consumption trend.

From the graphs, we observe that total household consumption declined after both Typhoons Bopha and Haiyan (represented by the brackets in Figure 2). However, we do not see significant decline in total consumption after Typhoon Meranti (represented by the blue brackets in Figure 2b). In all cases, the total household consumption returned to the normal long-run consumption trend within one year. We also see consumption trend between the last quarter of 2012 (Typhoon Bopha) and the last quarter of 2013 (Typhoon Haiyan) is the steepest; this consumption trend indicates how consumption recovered quickly after Typhoon Bopha before dropping significantly after Typhoon Haiyan.

Figure 2. Total Consumption Before and After the Natural Disasters (Billion Pesos)

A. Typhoon Bopha and Haiyan   B. Typhoon Meranti
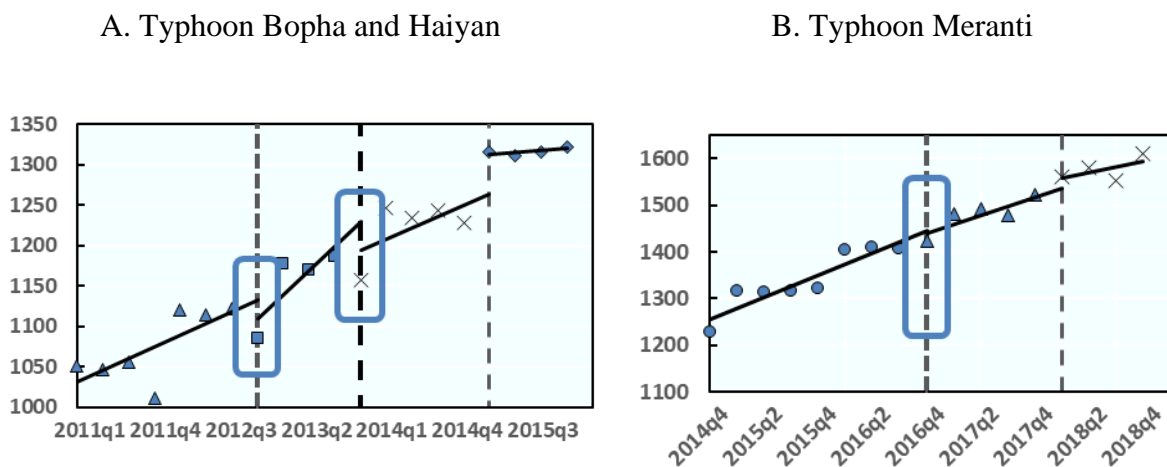
Notes: Each observation point represents the quarterly household consumption. The Philippine Statistics Authority (2020) provides inflation-adjusted quarterly consumption data. To adjust the data for seasonality, we use a seasonal dummy model where we regress total consumption on a series of quarter dummies. See footnote (1) for more details on our seasonal adjustment process.

---

[2] To adjust the data for seasonality, we use a seasonal dummy model where regress total consumption on a series of quarter dummies. We then predict residual terms, that contain no seasonal factors. We add the mean of original data on total consumption to these residual terms; therefore, our seasonal-adjusted consumption expenditure will have the same mean as the original data.

4. The Effects of Natural Disasters on Consumption in Thailand: Understanding Heterogeneity

4.1. The empirical model for studying the effects of natural disasters on consumption in Thailand

To examine the effects of a natural disaster on total consumption, this study uses an interrupted time-series analysis by estimating the following specification:

$$Consumption_{it} = \beta_0 + \beta_1 T_{it} + \beta_2 Disaster_{it} + \beta_3(Disaster_{it} * T_{it}) + \epsilon_{it} \,. \qquad (1)$$

$Consumption_{it}$ is seasonally-adjusted and inflation-corrected quarterly consumption in country i (i.e., Thailand) at date t. This model analyses both total consumption and its components in order to understand the heterogeneity of consumer spending. In other words, studying these components provides information on how consumers manage their budgets during a period of economic crisis. In this case, $Consumption_t$ is a consumption component expressed as a percentage of total consumption expenditure at date t.

T_t is the time since the beginning of the study. $Disaster_t$ is an indicator variable representing the periods of disasters (pre-disaster periods are zeros). In this paper, the pre-disaster period spans around two years, while the post-intervention period covers one year.

The estimated trend before a disaster is β_1, while β_2 captures the immediate effects of the disaster in question. Furthermore, β_3 captures treatment effects over time relative to the pre-disaster trend. Therefore, the linear combination of $\beta_1 + \beta_3$ captures the quarterly rate of change in consumption in the post-intervention period. The statistical significance of β_3 implies that there is a statistically significant difference between the consumption trends before and after a disaster. The study focuses on β_2 and the linear combination of $\beta_1 + \beta_3$, because they capture the immediate and short- to medium-term effects of disasters.

Specifically, the interrupted time-series analysis is a special form of regression discontinuity design with time as a running variable and a treatment (i.e., a disaster) beginning at a particular threshold in time (Kontopantelis, Doran, Springate, Buchan, & Reeves, 2015).[3] As mentioned

---

[3] See Linden (2005) for how to conduct interrupted time-series analysis.

in Lee and Lemieux (2010), the regression discontinuity requires milder assumptions compared to those required by other quasi-experimental approaches; therefore, estimates are potentially more credible.

It is important to note that our analysis could not compare the effects on consumption from a natural disaster that was followed by interventions from governments and other actors, with disasters that did not elicit such interventions. Therefore, our estimates are at the lower bound for the effects of a natural disaster. That is to say, the effects of a natural disaster on consumption without policy interventions to mitigate its impact are likely to be greater than our estimates.

4.2.   Empirical results: evidence of a decline in total consumption in the wake of natural disasters

The empirical study examined the three natural disasters selected for Thailand: the 2004 tsunami and the floods of 2011 and 2016-17. Overall, the study observed a decline in total consumption in the wake of natural disasters. This decline stems from a reduction in expenditure affecting the service sector, including recreation, restaurants, and hotels. Nevertheless, it was also generally observed that households increased their spending on non-durable goods including food and non-alcoholic drinks, alcoholic beverages and tobacco products, and clothing.

The effects of the 2004 tsunami on consumption spending in Thailand
Tables 3a and 3b present the estimated results for the effects of the 2004 tsunami on Thailand's total consumption expenditure, as well as its individual components. The coefficient of T_{it} represents the estimated consumption trend before the disaster, while the coefficient of the variable $Disaster_{it} * T_{it}$ captures the difference in the consumption trend before and after the disaster. The estimated coefficient of the variable $Disaster_{it}$ captures the immediate change in consumption expenditure after the disaster. Column (1) shows the estimates of the effects of the disaster on total consumption measured in billions of Thai baht, while the rest of the columns indicate the consumption components as percentages of total consumption.

After the disaster, total consumption immediately dropped by THB 29.08 billion, a fall of approximately 3% relative to total household consumption spending in the final quarter of

2004.[ii] However, the disaster did not statistically change the consumption trend over the short to medium term.

By examining the individual components of overall consumption, it can be seen that the 2004 tsunami in Thailand had a heavy negative impact on recreation, restaurants, and hotels. The expenditure that went on recreation, as a percentage of total household spending, fell immediately by 0.28%, while the percentage spent on hotels and restaurants dropped immediately by 0.66%. This decline in spending on recreation represented roughly 11% of the pre-disaster average spending in this category, and it reached roughly 5% of the pre-disaster average spending for hotels and restaurants.[iii] Furthermore, although consumption in these industries did bounce back, it subsequently grew at a slower or similar pace to the pre-disaster trends.

Table 3a. Statistical breakdown of the impact of the 2004 tsunami on consumption in Thailand

	Total	Food & non-alcoholic beverages	Alcohol & tobacco products	Clothing	Utility expenses	Furniture	Healthcare
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
T_{it}	16.29***	-0.13**	-0.05***	-0.07***	-0.08***	0.02*	0.05***
	(1.46)	(0.04)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
$Disaster_{it}$	-29.08***	0.43	0.49***	0.32***	0.49***	0.04	-0.07
	(6.38)	(0.24)	(0.07)	(0.08)	(0.06)	(0.05)	(0.08)
$Disaster_{it} * T_{it}$	3.44	0.10	-0.01	0.08**	-0.11***	-0.03	-0.08***
	(2.77)	(0.11)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)

Notes: Newey-West standard errors are in parentheses. One lag is set as the maximum lag order of auto-correlation. *, **, *** denote statistical significance at the respective levels of 10%, 5%, and 1%. Each component of consumption is expressed as a percentage of total consumption expenditure. The coefficient of T_{it} represents the estimated consumption trend before the disaster, while the coefficient of the variable $Disaster_{it} * T_{it}$ captures the difference in the consumption trend before and after the disaster. The estimated coefficient of the variable $Disaster_{it}$ captures the immediate change in consumption expenditure after the disaster. Column (1) shows the estimates of the effects of the disaster on total consumption measured in billions of Thai baht, while the rest of the columns indicate the consumption components as percentages of total consumption. See Section 4.1 for more details on the regressions and interpretation of the estimated coefficients.

Table 3b. The effects of the 2004 tsunami on consumption spending in Thailand (continued)

	Transport	Communication	Recreation	Restaurants and hotels	Education	Miscellaneous
	(8)	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**
T_{it}	-0.01	0.04**	0.13***	0.02	-0.00	0.07**
	(0.02)	(0.01)	(0.01)	(0.08)	(0.01)	(0.03)
$Disaster_{it}$	-0.17	0.11	-0.28***	-0.66**	0.04	-0.43*
	(0.15)	(0.09)	(0.07)	(0.28)	(0.04)	(0.22)
$Disaster_{it} * T_{it}$	-0.04	-0.02	-0.05***	0.17	-0.01	-0.05
	(0.04)	(0.03)	(0.01)	(0.13)	(0.02)	(0.06)

Notes: Newey-West standard errors are in parentheses. One lag is set as the maximum lag order of auto-correlation. *, **, *** denote statistical significance at the respective levels of 10%, 5%, and 1%. Each component of consumption is expressed as a percentage of total consumption expenditure. The coefficient of T_{it} represents the estimated consumption trend before the disaster, while the coefficient of the variable $Disaster_{it} * T_{it}$ captures the difference in the consumption trend before and after the disaster. The estimated coefficient of the variable $Disaster_{it}$ captures the immediate change in consumption expenditure after the disaster. Please note that Column (1) shows the estimates of the effects of the disaster on total consumption measured in billions of Thai baht, while the rest of the columns indicate the consumption components as percentages of total consumption. See Section 4.1 for more details on the regressions and interpretation of the estimated coefficients.

Still, the study also demonstrated immediate positive impacts on non-durable goods including alcohol, tobacco and clothes because of the disasters. It also showed an increase in immediate spending on household utility expenses. This might not be entirely surprising if consumers ended up spending more time on home-based activities immediately after the disasters.

The effects of the 2011 floods on consumption spending in Thailand

As demonstrated in Tables 4a and 4b, the 2011 floods had a huge effect on Thailand's levels of consumption. The coefficient of T_{it} represents the estimated consumption trend before the disaster, while the coefficient of the variable $Disaster_{it} * T_{it}$ captures the difference in the consumption trend before and after the disaster. The estimated coefficient of the variable $Disaster_{it}$ captures the immediate change in consumption expenditure after the disaster. Column (1) shows the estimates of the effects of the disaster on total consumption measured in billions of Thai baht, while the rest of the columns indicate the consumption components as percentages of total consumption.

Table 4a. Statistical breakdown of the impact of the 2011 floods on consumption

	Total	Food & non-alcoholic beverages	Alcoholic beverages & tobacco products	Clothing	Utility expenses	Furniture	Healthcare
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
T_{it}	17.25***	-0.23***	-0.06***	-0.04***	-0.10**	0.04	0.10***
	(2.02)	(0.02)	(0.01)	(0.01)	(0.03)	(0.02)	(0.02)
$Disaster_{it}$	-69.60***	0.89***	0.24***	0.32***	1.00***	0.19	0.05
	(14.53)	(0.26)	(0.06)	(0.04)	(0.15)	(0.14)	(0.14)
$Disaster_{it} * T_{it}$	25.27***	-0.34***	-0.07***	-0.20***	-0.11**	-0.13*	-0.19***
	(5.56)	(0.08)	(0.02)	(0.01)	(0.04)	(0.06)	(0.04)

Notes: Newey-West standard errors are in parentheses. One lag is set as the maximum lag order of auto-correlation. *, **, *** denote statistical significance at the respective levels of 10%, 5%, and 1%. Each component of consumption is expressed as a percentage of total consumption expenditure. The coefficient of T_{it} represents the estimated consumption trend before the disaster, while the coefficient of the variable $Disaster_{it} * T_{it}$ captures the difference in the consumption trend before and after the disaster. The estimated coefficient of the variable $Disaster_{it}$ captures the immediate change in consumption expenditure after the disaster. Column (1) shows the estimates of the effects of the disaster on total consumption measured in billions of Thai baht, while the rest of the columns indicate the consumption components as percentages of total consumption. See Section 4.1 for more details on the regressions and interpretation of the estimated coefficients.

Table 4b. Statistical breakdown of the impact of the 2011 floods on consumption (continued)

	Transport	Communication	Recreation	Restaurants & hotel	Education	Miscellaneous
	(8)	(9)	(10)	(11)	(12)	(13)
T_{it}	0.04	0.01	0.10***	0.20**	-0.01**	0.06
	(0.02)	(0.03)	(0.01)	(0.06)	(0.01)	(0.04)
$Disaster_{it}$	-1.89***	0.15	-0.13	-0.71***	0.05	0.18
	(0.27)	(0.16)	(0.11)	(0.18)	(0.03)	(0.30)
$Disaster_{it} * T_{it}$	1.09***	-0.11**	-0.01	-0.07	-0.04***	-0.0008
	(0.09)	(0.04)	(0.04)	(0.07)	(0.01)	(0.08)

Notes: Newey-West standard errors are in parentheses. One lag is set as the maximum lag order of auto-correlation. *, **, *** denote statistical significance at the respective levels of 10%, 5%, and 1%. Each component of consumption is expressed as a percentage of total consumption expenditure. The coefficient of T_{it} represents the estimated consumption trend before the disaster, while the coefficient of the variable $Disaster_{it} * T_{it}$ captures the difference in the consumption trend before and after the disaster. The estimated coefficient of the variable $Disaster_{it}$ captures the immediate change in consumption expenditure after the disaster. Column (1) shows the estimates of the effects of the disaster on total consumption measured in billions of Thai baht, while the rest of the columns indicate the consumption components as percentages of total consumption. See Section 4.1 for more details on the regressions and interpretation of the estimated coefficients.

The immediate drop in total consumption due to the floods came to approximately THB 69.6 billion, which is a decline of approximately 6% relative to the third quarter of 2011.[iv] However, total consumption in the Thai economy then proceeded to bounce back at the rate of THB 45.53 billion per quarter.

As in the aftermath of the tsunami in 2004, it is apparent that households increased their immediate spending on non-durable goods after the 2011 floods. These goods encompassed food and non-alcoholic drinks, alcoholic beverages and tobacco products, and clothing. Increases in household spending on such goods ranged from 0.3% to around 1%. Households also increased their immediate spending on utility expenses. However, their expenditure on restaurants and hotels fell by 0.7%, while spending on transport fell by about 2%. It is also apparent that expenditure on these goods and services more or less returned to pre-disaster levels within a year.

The flood disaster of 2016-17 and its effects on consumer spending in Thailand

As shown in Tables 5a and 5b, households reduced their total immediate consumption by THB 26.36 billion during the 2016-17 floods - a drop of around 2% from the level of total consumption in the final quarter of 2015. Nevertheless, total consumption bounced back to the pre-disaster trend in less than a year.

As in the previous two natural disasters in Thailand analysed in this study, the findings show that households rapidly reduced their spending on restaurants and hotels by about 0.45%, or approximately 3% of the level of spending on this category prior to the disaster. Instead of cutting expenditure immediately, households immediately increased their spending by between 0.2% and 1% on non-durable goods such as food and clothing.

Table 5a. Statistical breakdown of the impact of the 2016-17 floods on consumption

	Total	Food & non-alcoholic beverages	Alcohol and tobacco products	Clothing	Utility expenses	Furniture	Healthcare
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
T_{it}	15.46***	-0.07***	-0.06***	-0.03***	0.01**	-0.04***	-0.01
	(0.73)	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)
$Disaster_{it}$	-26.36*	0.23*	0.003	0.10*	0.03	0.12	0.16
	(12.60)	(0.11)	(0.05)	(0.04)	(0.12)	(0.07)	(0.12)
$Disaster_{it} * T_{it}$	10.62*	-0.12**	0.01	-0.03	-0.06	-0.00	-0.05
	(5.76)	(0.04)	(0.02)	(0.02)	(0.05)	(0.03)	(0.04)

Notes: Newey-West standard errors are in parentheses. One lag is set as the maximum lag order of auto-correlation. *, **, *** denote statistical significance at the respective levels of 10%, 5%, and 1%. Each component of consumption is expressed as a percentage of total consumption expenditure. The coefficient of T_{it} represents the estimated consumption trend before the disaster, while the coefficient of the variable $Disaster_{it} * T_{it}$ captures the difference in the consumption trend before and after the disaster. The estimated coefficient of the variable $Disaster_{it}$ captures the immediate change in consumption expenditure after the disaster. Column (1) shows the estimates of the effects of the disaster on total consumption measured in billions of Thai baht, while the rest of the columns indicate the consumption components as percentages of total consumption. See Section 4.1 for more details on the regressions and interpretation of the estimated coefficients.

Table 5b. Statistical breakdown of the impact of the 2016-17 floods on consumption (continued)

	Transport	Communication	Recreation	Restaurants & hotels	Education	Miscellaneous
	(8)	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**
T_{it}	0.03*	-0.02*	0.12**	0.06	-0.00	0.02
	(0.02)	(0.01)	(0.05)	(0.04)	(0.00)	(0.03)
$Disaster_{it}$	-0.19	0.18**	0.04	-0.45*	-0.02	0.15
	(0.21)	(0.06)	(0.20)	(0.22)	(0.02)	(0.17)
$Disaster_{it} * T_{it}$	0.12*	0.001	-0.12**	0.36***	-0.00	-0.08*
	(0.05)	(0.02)	(0.05)	(0.09)	(0.01)	(0.03)

Notes: Newey-West standard errors are in parentheses. One lag is set as the maximum lag order of auto-correlation. *, **, *** denote statistical significance at the respective levels of 10%, 5%, and 1%. Each component of consumption is expressed as a percentage of total consumption expenditure. The coefficient of T_{it} represents the estimated consumption trend before the disaster, while the coefficient of the variable $Disaster_{it} * T_{it}$ captures the difference in the consumption trend before and after the disaster. The estimated coefficient of the variable $Disaster_{it}$ captures the immediate change in consumption expenditure after the disaster. Column (1) shows the estimates of the effects of the disaster on total consumption measured in billions of Thai baht, while the rest of the columns indicate the consumption components as percentages of total consumption. See Section 4.1 for more details on the regressions and interpretation of the estimated coefficients.

To recap, the study observed an overall decline in immediate consumption after the aforementioned disasters in Thailand. The drop in total consumption came from a reduction in spending on the service sector including recreation, hotels, and restaurants. The study also found that households increased their expenditure on non-durable goods, including food and non-alcoholic drinks, alcoholic beverages and tobacco products, and clothing during the same period.

5. The Effects of Natural Disasters on Household Consumption: The Case of the Philippines

As noted previously, this study examined three super typhoons: Typhoon Bopha in 2012, Typhoon Haiyan in 2013, and Typhoon Meranti in 2016. In general, it observed small changes in consumer spending after these typhoons, both overall and by segment. This finding is consistent with Strobl (2019), who finds that typhoons have a small and short-term effect on economic activity. Finally, the study found that households changed their consumption spending more after Typhoon Haiyan than after the other typhoons.

5.1. The empirical model to analyse natural disasters' impact on consumption in the Philippines

Unlike the case studies for Thailand, the three natural disasters examined in the Philippines occurred in quick succession. It is, therefore, hard to disentangle their impacts on consumption using separate regressions. To recap, the three typhoons occurred in 2012, 2013, and 2016. To reiterate, the interrupted time-series analysis is a special form of regression discontinuity design with time as a running variable.[4] To study their effects, interrupted time series analysis with multiple treatments were used. Specifically, estimate the following regression specification was estimated:

$$Consumption_{it} = \alpha + \beta_0 T_{it} + \gamma_1 Disaster_{it}^{Bopha} + \beta_1 \left(Disaster_{it}^{Bopha} * T_{it} \right) +$$
$$\gamma_2 Disaster_{it}^{Haiyan} + \beta_2 \left(Disaster_{it}^{Haiyan} * T_{it} \right) +$$
$$\gamma_3 Disaster_{it}^{Meranti} + \beta_3 \left(Disaster_{it}^{Meranti} * T_{it} \right) +$$
$$quarter_t + \epsilon_{it} .$$

---

[4] See Linden (2005) for how to conduct interrupted time-series analysis.

$Consumption_t$ is the inflation-corrected quarterly consumption in country i at date t. Consumption data provided by the Philippine government are not seasonally adjusted. Therefore, quarterly fixed effects (i.e., $quarter_t$) are included in the regression specification (2), in order to control for seasonality. Both total consumption and its components are studied, in order to understand the heterogeneity in consumers' spending.

The symbol of α is a constant, while T_t is the the time since the beginning of the study. $Disaster_t^j$ is an indicator variable representing the periods of disaster j (pre-disaster periods are zeros).

The symbol γ^j captures the immediate effects of disaster j on consumption expenditures. Furthermore, β_0 is the estimated trend before Typhoon Bopha hit the Philippines, while $\beta_0 + \beta_1$ captures the quarterly rate of reduction or increase in consumption in the aftermath of Typhoon Bopha. Similarly, $\beta_0 + \beta_1 + \beta_2$ provides the estimates of expenditure trends after Typhoon Haiyan, while $\beta_0 + \beta_1 + \beta_2 + \beta_3$ amounts to the estimated trends after Typhoon Meranti.

As explained in the section above on the data for Thailand, it was not possible to distinguish between the effects on consumption of a natural disaster that is not followed by policy interventions, and a disaster for which there is not a subsequent response in the form of policy interventions. As with the data concerning Thailand, therefore, the results can be interpreted as the lower-bound estimates of the effects of a natural disaster. The effects of natural disasters on consumption without government economic stimulus are likely to be more significant than the estimates in this study. However, and as with the case of Thailand, the Philippines is a developing country, and its government's response capacity to disasters is still relatively limited.

5.2.   Empirical Results: Typhoons Tend to have a Small Effect on Consumption in the Philippines

As can be seen from Tables 6a and 6b, the effects of typhoons on consumption tend to be rather small. Among the three typhoons examined in the study, Typhoon Haiyan had the severest impact on consumer spending. The immediate drop in consumption after Typhoon Haiyan was

about PHP 40 billion, or 3.6% of total consumption in the third quarter of 2013. However, total consumption then rebounded at the rate of PHP 21 billion per quarter. Changes in consumer spending after Typhoon Bopha were less significant, and there were no significant changes to consumption after Typhoon Meranti.

Looking at the individual components of consumption in granular detail, the study did not detect any regular pattern of consumption spending among Philippine households. For example, it did not reveal any significant change in spending on food and non-alcoholic beverages immediately after Typhoon Bopha. Moreover, the study showed a decline in immediate spending on this component of consumption after Typhoon Haiyan, and yet an increase in it after Typhoon Meranti.

There are two notable findings. First, the study revealed a significant decline in spending on recreation immediately after Typhoon Haiyan and Typhoon Bopha. The estimated immediate fall in expenditure on recreation as a percentage of total consumption came to 0.15% after Typhoon Haiyan, and 0.2% after Typhoon Meranti.

Secondly, immediately after Typhoon Haiyan, the study showed that households immediately increased their spending on alcoholic drinks and tobacco. However, the study also showed that households increased their spending in restaurants and hotels after this typhoon. It could be partly explained, that households, especially those living in non-affected regions, increased their spending at restaurants and hotels as they participated in traditional New Year celebrations.

Table 6a. The effects of typhoons on consumption in the Philippines

	Total	Food & non-alcoholic beverages	Alcohol & tobacco products	Clothing	Utility expenses	Furniture	Healthcare
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
T_{it}	17.67***	0.02	-0.002	-0.01	-0.06	-0.04	0.02
	(1.85)	(0.06)	(0.004)	(0.01)	(0.05)	(0.04)	(0.02)
$Disaster_{it}^{Bopha}$	-29.25*	-0.33	-0.07*	-0.09	-0.02	-0.10	-0.003
	(15.20)	(0.25)	(0.04)	(0.07)	(0.21)	(0.18)	(0.09)
$Disaster_{it}^{Bopha} * T_{it}$	10.52**	0.06	-0.01	0.04	0.25**	0.02	-0.03
	(4.08)	(0.11)	(0.01)	(0.02)	(0.09)	(0.04)	(0.02)
$Disaster_{it}^{Haiyan}$	-40***	-0.56**	0.09**	-0.02	-0.45	0.07	0.08
	(13.23)	(0.24)	(0.04)	(0.06)	(0.33)	(0.10)	(0.06)
$Disaster_{it}^{Haiyan} * T_{it}$	-7.48*	-0.12	0.01	-0.05*	-0.21**	-0.02	0.02
	(4.20)	(0.10)	(0.01)	(0.03)	(0.08)	(0.03)	(0.02)
$Disaster_{it}^{Meranti}$	3.83	0.30**	0.00	0.04	-0.14	-0.08	0.04
	(7.06)	(0.12)	(0.02)	(0.07)	(0.14)	(0.10)	(0.03)
$Disaster_{it}^{Meranti} * T_{it}$	1.00	-0.05*	-0.03***	0.01	0.08**	0.06***	-0.01**
	(1.74)	(0.03)	(0.00)	(0.01)	(0.03)	(0.02)	(0.01)

Notes: Newey-West standard errors are in parentheses. One lag is set as the maximum lag order of auto-correlation. *, **, *** denote statistical significance at the respective levels of 10%, 5%, and 1%. Each component of consumption is expressed as a percentage of total consumption expenditure. See Section 5.1 for more details on the regressions and interpretation of the estimated coefficients.

Table 6b. The effects of typhoons on consumption in the Philippines (continued)

	Transport	Communication	Recreation	Restaurants & hotels	Education	Miscellaneous
	(8)	(9)	(10)	(11)	(12)	(13)
T_{it}	0.01	0.03*	0.04	0.01	-0.03***	0.03
	(0.04)	(0.02)	(0.02)	(0.02)	(0.01)	(0.04)
$Disaster_{it}^{Bopha}$	0.12	-0.01	-0.15	0.12	0.15*	0.40
	(0.27)	(0.12)	(0.10)	(0.09)	(0.08)	(0.24)
$Disaster_{it}^{Bopha}$ $* T_{it}$	-0.11	0.003	-0.003	-0.09***	-0.02	-0.12
	(0.12)	(0.05)	(0.03)	(0.03)	(0.03)	(0.08)
$Disaster_{it}^{Haiyan}$	0.52*	-0.20	-0.15**	0.24***	0.23**	0.16
	(0.26)	(0.15)	(0.07)	(0.05)	(0.09)	(0.28)
$Disaster_{it}^{Haiyan}$ $* T_{it}$	0.18*	-0.03	-0.01	0.10***	0.04	0.09
	(0.10)	(0.05)	(0.03)	(0.02)	(0.03)	(0.07)
$Disaster_{it}^{Merant}$	0.12	-0.18	-0.20***	0.004	-0.03	0.13
	(0.17)	(0.13)	(0.07)	(0.06)	(0.07)	(0.16)
$Disaster_{it}^{Merant}$ $* T_{it}$	-0.16***	-0.01	-0.03***	0.01	0.06***	0.08**
	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.03)

Notes: Newey-West standard errors are in parentheses. One lag is set as the maximum lag order of auto-correlation. *, **, *** denote statistical significance at the respective levels of 10%, 5%, and 1%. Each component of consumption is expressed as a percentage of total consumption expenditure. See Section 5.1 for more details on the regressions and interpretation of the estimated coefficients.

6. Robustness

Our results could be sensitive to the pre-disaster periods. We conduct a sensitivity analysis by extending the pre-disaster period to 12 quarters. Tables 7a to 9b show the sensitivity analysis for Thailand's disasters, while Tables 10a and 10b show those results for the Philippine typhoons. As can be seen, the results are similar to those of the baseline.

In the case of Thailand, we generally find a decline in total consumption. This decline stems from a reduction in expenditures on the service sector including transportation, hotels, and restaurants. In contrast, we generally observe increased household spending on food and non-alcoholic drinks, alcoholic beverages and tobacco products, clothing, and utilities.

As seen from Table 7a, the total immediate expenditures declined by approximately 26 billion Thai baht after the Indian Ocean tsunami. Similar to our baseline results, we find housing-related expenses, including utilities and furniture, increased during this disaster. However, the estimates of the immediate expenditure declines in recreation, restaurants, and hotels are imprecise (Table 7b); yet we find the expenditure on transportation immediately dropped.

Table 8a shows total consumption expenditure immediately dropped by approximately 70 billion Thai baht due to the 2011 Thailand floods. The results presented in Tables 8a and 8b resemble those of the baseline. Specifically, we find households immediately increased spending on both durable and non-durable goods. On the other hand, we find consumers immediately reduced their spending on transportation, restaurants, and hotels.

Tables 9a and 9b show the results pertaining to the 2016-17 Thailand floods. We again find similar results to the baseline estimates. The total immediate consumption dropped approximately 31 billion Thai baht. Similar to aforementioned disasters in Thailand, households immediately increased spending on non-durable goods including food, beverages, tobacco, and clothing. Households also increased immediate spending on utilities. However, they reduced their spending on transportation, restaurants, and hotels.

For the Philippines, the effects of the typhoons on consumption are usually small. Among the three typhoons, we still find that Typhoon Haiyan had the largest immediate effects on consumption expenditures; the total household spending immediately declined by

approximately 40 billion pesos after Typhoon Haiyan. Although the magnitude of estimate shown in Table 10a is similar to that of the baseline, the estimate of total immediate household is imprecise. Similar to our bassline estimate, we do not find any significant changes in total consumption after Typhoon Meranti. Finally, we still do not find any regular patterns of change in consumption expenditures when we analyse components of consumption.

Table 7a. 2004 Indian Ocean Earthquake and Tsunami: Sensitivity Analysis

	Total	Food & non-alcoholic beverages	Alcohol and tobacco	Clothing	Utilities	Furniture	Health
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
T_{it}	15.43***	-0.09***	-0.01	-0.06***	-0.05***	0.02**	0.03***
	(0.38)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$Disaster_{it}$	-25.87***	0.26	0.34***	0.30***	0.38***	0.05	0.00
	(5.12)	(0.19)	(0.10)	(0.06)	(0.05)	(0.04)	(0.07)
$Disaster_{it} * T_{it}$	4.30*	0.06	-0.05	0.07***	-0.14***	-0.03	-0.06***
	(2.15)	(0.10)	(0.03)	(0.02)	(0.01)	(0.02)	(0.02)

Notes: Newey-West standard errors are in parentheses. We set one lag as the maximum lag order of autocorrelation. *, **, *** denote statistical significance at 10, 5, and 1 percent levels, respectively. Each consumption component is expressed as a percentage of total consumption expenditure.

Table 7b. 2004 Indian Ocean Earthquake and Tsunami (Continued)

	Transport	Communication	Recreation	Restaurants & hotels	Education	Miscellaneous
	(8)	(9)	(10)	(11)	(12)	(13)
T_{it}	0.08**	0.04***	0.07***	-0.09***	-0.01	0.06***
	(0.03)	(0.01)	(0.02)	(0.03)	(0.01)	(0.02)
$Disaster_{it}$	-0.51*	0.10	-0.07	-0.25	0.07*	-0.39**
	(0.25)	(0.08)	(0.12)	(0.31)	(0.03)	(0.17)
$Disaster_{it} * T_{it}$	-0.13**	-0.02	0.004	0.28**	-0.01	-0.05
	(0.05)	(0.02)	(0.02)	(0.09)	(0.02)	(0.06)

Notes: Newey-West standard errors are in parentheses. We set one lag as the maximum lag order of autocorrelation. *, **, *** denote statistical significance at 10, 5, and 1 percent levels, respectively. Each consumption component is expressed as a percentage of total consumption expenditure.

Table 8a. 2011 Floods: Sensitivity Analysis

	Total	Food & non-alcoholic beverages	Alcohol & tobacco	Clothing	Utilities	Furniture	Health
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
T_{it}	17.39***	-0.22***	-0.07***	-0.06***	-0.05***	0.06***	0.09***
	(0.92)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$Disaster_{it}$	-70.08***	0.89***	0.29***	0.39***	0.86***	0.12	0.09
	(13.37)	(0.23)	(0.08)	(0.05)	(0.11)	(0.13)	(0.14)
$Disaster_{it} * T_{it}$	25.13***	-0.34***	-0.06***	-0.18***	-0.16***	-0.15**	-0.18***
	(4.66)	(0.08)	(0.02)	(0.01)	(0.02)	(0.05)	(0.04)

Notes: Newey-West standard errors are in parentheses. We set one lag as the maximum lag order of autocorrelation. *, **, *** denote statistical significance at 10, 5, and 1 percent levels, respectively. Each consumption component is expressed as a percentage of total consumption expenditure.

Table 8b. 2011 Floods: Sensitivity Analysis (Continued)

	Transport	Communication	Recreation	Restaurants & hotels	Education	Miscellaneous
	(8)	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**
T_{it}	0.15***	0.00	0.09***	0.15***	-0.01***	-0.04
	(0.03)	(0.02)	(0.01)	(0.03)	(0.00)	(0.03)
$Disaster_{it}$	-2.25***	0.20*	-0.12	-0.58***	0.04	0.51**
	(0.28)	(0.11)	(0.10)	(0.17)	(0.02)	(0.23)
$Disaster_{it} * T_{it}$	0.98***	-0.10***	-0.01	-0.02	-0.04***	0.09
	(0.09)	(0.02)	(0.03)	(0.04)	(0.01)	(0.08)

Notes: Newey-West standard errors are in parentheses. We set one lag as the maximum lag order of autocorrelation. *, **, *** denote statistical significance at 10, 5, and 1 percent levels, respectively. Each consumption component is expressed as a percentage of total consumption expenditure.

Table 9a. Late 2016-Early 2017 Floods: Sensitivity Analysis

	Total	Food & non-alcoholic beverages	Alcohol & tobacco	Clothing	Utilities	Furniture	Health
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
T_{it}	16.72***	-0.11***	-0.04***	-0.04***	-0.00	-0.03***	-0.01
	(0.62)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
$Disaster_{it}$	-30.98**	0.36***	-0.05	0.14***	0.08	0.08	0.16
	(11.82)	(0.11)	(0.06)	(0.04)	(0.11)	(0.09)	(0.12)
$Disaster_{it} * T_{it}$	9.36	-0.08*	-0.00	-0.02	-0.04	-0.01	-0.05
	(5.49)	(0.04)	(0.02)	(0.02)	(0.05)	(0.03)	(0.04)

Notes: Newey-West standard errors are in parentheses. We set one lag as the maximum lag order of autocorrelation. *, **, *** denote statistical significance at 10, 5, and 1 percent levels, respectively. Each consumption component is expressed as a percentage of total consumption expenditure.

Table 9b. Late 2016-Early 2017 Floods: Sensitivity Analysis (Continued)

	Transport	Communication	Recreation	Restaurants & hotels	Education	Miscellaneous
	(8)	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**
T_{it}	0.03*	-0.02*	0.12**	0.06	-0.00	0.02
	(0.02)	(0.01)	(0.05)	(0.04)	(0.00)	(0.03)
$Disaster_{it}$	-0.19	0.18**	0.04	-0.45*	-0.02	0.15
	(0.21)	(0.06)	(0.20)	(0.22)	(0.02)	(0.17)
$Disaster_{it} * T_{it}$	0.12*	0.001	-0.12**	0.36***	-0.00	-0.08*
	(0.05)	(0.02)	(0.05)	(0.09)	(0.01)	(0.03)

Notes: Newey-West standard errors are in parentheses. We set one lag as the maximum lag order of autocorrelation. *, **, *** denote statistical significance at 10, 5, and 1 percent levels, respectively. Each consumption component is expressed as a percentage of total consumption expenditure.

Table 10a. Effects of Typhoons on the Philippines' Consumption: Sensitivity Analysis

	Total	Food & non-alcoholic beverages	Alcohol and tobacco	Clothing	Utilities	Furniture	Health
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
T_{it}	15.26***	0.05	-0.01*	-0.01	-0.07***	-0.01	0.02*
	(1.82)	(0.04)	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
$Disaster_{it}^{Bopha}$	-19.21	-0.59**	-0.02	-0.10*	0.05	-0.20	-0.00
	(15.07)	(0.26)	(0.04)	(0.06)	(0.18)	(0.12)	(0.07)
$Disaster_{it}^{Bopha} * T_{it}$	12.88**	0.09	-0.01	0.03	0.24**	0.00	-0.02
	(4.69)	(0.12)	(0.02)	(0.02)	(0.09)	(0.03)	(0.02)
$Disaster_{it}^{Haiyan}$	-39.76***	-0.71***	0.12**	-0.01	-0.41	0.06	0.07
	(13.40)	(0.26)	(0.05)	(0.05)	(0.30)	(0.09)	(0.06)
$Disaster_{it}^{Haiyan} * T_{it}$	-7.47*	-0.17	0.02	-0.05**	-0.19**	-0.03	0.02
	(4.21)	(0.11)	(0.02)	(0.02)	(0.09)	(0.03)	(0.02)
$Disaster_{it}^{Meranti}$	2.37	0.32**	-0.01	0.02	-0.07	-0.05	0.03
	(7.02)	(0.14)	(0.03)	(0.07)	(0.14)	(0.10)	(0.04)
$Disaster_{it}^{Meranti} * T_{it}$	1.37	-0.05*	-0.03***	0.02	0.06**	0.05***	-0.02**
	(1.29)	(0.03)	(0.00)	(0.01)	(0.03)	(0.02)	(0.01)

Notes: Newey-West standard errors are in parentheses. We set one lag as the maximum lag order of autocorrelation. *, **, *** denote statistical significance at 10, 5, and 1 percent levels, respectively. Each consumption component is expressed as a percentage of total consumption expenditure.

Table 10 b. Effects of Typhoons on the Philippines' Consumption: Sensitivity Analysis (Continued)

	Transport	Communication	Recreation	Restaurants & hotels	Education	Miscellaneous
	(8)	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**
T_{it}	-0.02	-0.01	0.01	0.01**	-0.02**	0.06
	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)	(0.04)
$Disaster_{it}^{Bopha}$	0.18	0.11	-0.04	0.09	0.09	0.42**
	(0.22)	(0.14)	(0.07)	(0.07)	(0.07)	(0.19)
$Disaster_{it}^{Bopha} * T_{it}$	-0.08	0.04	0.02	-0.08***	-0.04	-0.18*
	(0.10)	(0.05)	(0.03)	(0.01)	(0.03)	(0.09)
$Disaster_{it}^{Haiyan}$	0.53**	-0.20	-0.13*	0.20***	0.23***	0.24
	(0.24)	(0.14)	(0.07)	(0.05)	(0.07)	(0.29)
$Disaster_{it}^{Haiyan} * T_{it}$	0.18**	-0.03	-0.00	0.09***	0.04	0.12*
	(0.09)	(0.05)	(0.03)	(0.02)	(0.03)	(0.07)
$Disaster_{it}^{Meranti}$	0.05	-0.20*	-0.21***	0.02	0.00	0.09
	(0.16)	(0.12)	(0.06)	(0.06)	(0.05)	(0.16)
$Disaster_{it}^{Meranti} * T_{it}$	-0.14***	-0.00	-0.02***	-0.00	0.05***	0.09***
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)

Notes: Newey-West standard errors are in parentheses. We set one lag as the maximum lag order of autocorrelation. *, **, *** denote statistical significance at 10, 5, and 1 percent levels, respectively. Each consumption component is expressed as a percentage of total consumption expenditure.

7. Policy Responses: From Relief to Prevention

Natural disasters (especially large ones) often have a devastating impact on the life of the people who live in their paths. When disaster strikes, reactions from governments are crucial to providing immediate help to victims. These necessary government reactions take the form of emergency relief and assistance with early recovery, as well as helping with reconstruction, and working where possible to prevent or prepare for future disasters.

7.1. Immediate responses: Delivering emergency relief and necessary goods

Following a natural disaster, emergency relief is typically provided to help those affected by the disasters. This can include compensation schemes in the form of cash, as well as food, medicines, shelter, and provision for other primary necessities. Preparing for future natural disasters is key to keeping these schemes efficient.

In the case of the 2004 tsunami in Thailand, the country's interior ministry devised compensation schemes for survivors, distributing funds according to various criteria. For example, families that had lost members received funds, with additional support if the person in question was the main breadwinner. There was also compensation for those who suffered critical injuries or became disabled. The Thai authorities also provided help with funeral expenses, and with other costs. The labour ministry also provided compensation to those who had lost their jobs or businesses. Similarly, the Thai government mobilised various agencies and departments in response to the 2016-17 flood to provide relief to the people it had affected, including especially dedicated relief for people who had become homeless, and for farmers, manufacturers, and small and medium-sized enterprises (SMEs).

In the Philippines, the government's social welfare and development department (DSWD) implemented multiple social welfare and protection programmes in the aftermath of Typhoon Haiyan, in addition to other new policies. These programmes included initiatives focusing on relief, early recovery, general recovery, and reconstruction. The support that these programmes provided ranged from providing shelter, food and other essentials, to providing cash for employment and rebuilding projects (Bowen, 2015). Furthermore, the government enjoyed success with the Pantawid Pamiliya Pilipino Programme (known as the 4Ps), both at the stage of early recovery in the immediate aftermath of the disaster, and in the subsequent recovery phase. The 4Ps programme provided conditional cash grants to poor households (Bowen,

2015). Moreover, the existence of such a scheme makes it easier to identify households that need assistance. Another programme that proved useful in the Philippines was the Cash for Work (CfW) scheme. This programme was used to gather a workforce for the recovery phase. The government also rolled out an extension to CfW to promote long-term recovery, in the form of its Cash for Building Livelihoods Assets (CBLA) programme. The CBLA aims to promote the long-term restoration of livelihoods, and overall recovery.

When a disaster has been predicted, governments can also do a lot to prepare before it occurs, by both providing necessary goods in advance, and evacuating people who are at risk. In the case of Typhoon Bopha, the Philippine government's decision-making body, the National Disaster Risk Reduction and Management Council, advised cities in the typhoon's path to prepare for the storm. The preparation measures included pre-positioning of medicines and food, and measures for safe evacuation. Indeed, the Philippines has existing protocols to mitigate the effects of natural disasters (NDRRMC, 2012).

7.2.   Long-term policy actions: Laying the groundwork in order to cope better with future disasters

In addition to providing immediate support when disasters occur, governments also have the opportunity to take a longer-term perspective - particularly after large- scale disasters - to make sure that they are better protected if a similar event happens again in the future. This can include making improvements to early warning systems, revising regulatory frameworks, and even, in some cases, establishing new institutions to cope with natural disasters.

The 2004 Indian Ocean tsunami prompted the the Thai government to invest in disaster preparedness and early warning systems. The Thai government's disaster prevention and mitigation department worked to establish community-based early warning systems, and to improve public education. One of this department's main priorities was the establishment of the National Disaster Warning Centre (NDWC) to monitor for any potential disasters, and to provide warnings and information about any such events. This system includes 136 warning towers across various regions, as well as three tsunami-detection buoys in the Andaman Sea. The NDWC was authorised by the government to broadcast warning messages without needing to seek permission from television stations, and it has been officially designated as the only

agency responsible for tsunami alerts, in order to prevent the dissemination of incorrect information.

Repeated flooding in Thailand since 2011 has led the Thai government to update systems and create new institutions, tasking the institutions with various aspects of disaster response and prevention. In response to the flooding of 2011, the Thai government proposed five steps to work towards mitigating flood risks. The first of these was to issue clear regulations for land-use in flood-plain areas. The second step was to update the government's information management systems that monitor real-time water levels in rivers and canals. Thirdly, the Thai government set out to further develop the country's canal system and identify large areas that can temporarily hold water. The fourth step was about enforcing deforestation and pollution laws, in order to keep the drainage systems functional. Finally, the fifth step in the plan was to centralise authority in a bid to improve communication and co-operation. In response to the 2011 flooding, Thailand's government created a new task force, the Strategic Committee for Water Resource Management (SCWRM), to develop plans in order to prevent such devastation from happening again. Working together with the country's national board for economic and social development, the SCWRM drew up a master plan for water-resource management in 2012. This plan—worth THB 300 billion (approximately USD 9.4 billion)—focused on water management and flood prevention around the Chao Phraya River basin. Its scope included re-forestation and conservation, the construction of dikes and reservoirs, the conversion of farmland into floodwater containment areas, and the construction of floodways and flood diversion channels. It also included urban and land-use planning, and a modest amount (1% of the overall funding) for database and warning systems, and for the establishment of related organisations.

Following the 2016-17 floods, the Thai government's irrigation department made plans to implement new water-management projects, including the construction of dams in flood-prone areas. In terms of longer-term policy responses, the government established a dedicated office of national water resources, which it set up to take the lead in systematically regulating and managing the country's policies of integrated water-resource management, with a particular focus on flooding and drought in 2017. In order to help streamline co-ordination and decision-making, it was explicitly given a greater level of authority than other relevant bodies (Thailand has over 40 water agencies, spanning seven ministries). In conjunction with the establishment of the new institution, the government initiated the drafting of a 20-year master plan on water-

resource management (2018-37), to update and improve upon the country's existing strategy for water-resource management, which ran from 2015-26. The new master plan includes goals such as building over 541 000 small dams, restoring 5 600 square kilometres of watershed areas, and solving flooding problems and droughts in 66 areas, all by 2030. In addition, the government enacted a new law on water resources in 2018, and approved of a suite of measures in 2019 related to, among other things, the establishment of water-user organisations, the definition of these organisations' roles and responsibilities, and the implementation of rules and guidelines to manage compensation payments to people eligible for help from government initiatives to tackle floods and water shortages.

In the aftermath of Typhoon Haiyan, the Philippine government established a dedicated body - the Office of the Presidential Assistant for Rehabilitation and Recovery (OPARR) - to lead a comprehensive rehabilitation and recovery plan. The goal was to help affected areas to recover and rebuild. The recovery plan was made up of five national-level clusters, which were delegated to different government departments. The five programme clusters were infrastructure, resettlement, social services, livelihood, and support. The OPARR was later disbanded, and its projects transferred to the National Economic and Development Authority, which was already in charge of the support cluster (Jha et al., 2018). In addition, the Philippine government also aims for long-term programmes of poverty alleviation, as part of its disaster resilience goals. Indeed, resilience to natural disasters tends to correlate positively with wealth. Community-driven responses also play an important role. In this connection, the Philippine government launched a national community-driven development initiative, to allow communities to be closely involved in planning the rebuilding of their communities. Local people found this initiative empowering, as it allowed them to make their voices heard in the recovery process (Bowen, 2015).

With regard to early-warning systems, the Philippine government's science and technology department launched the improved version of NOAH project (Nationwide Operational Assessment of Hazards) in 2015, to provide early warning messages ahead of a potential disaster. Its activities include providing hazard maps, and it played a key role in establishing a law obligating mobile service providers to issue public service announcements via mobile phones free of charge (UNDRR, 2019).

Further policy responses can include targeting industries that are particularly affected by a natural disaster, in order to provide support. This may include compensation schemes, tax relief, or soft loans for businesses. In response to the 2004 tsunami, the Thai government provided targeted local support to the industries that were especially devastated by the tsunami: tourism and fisheries. The government provided compensation to fishermen who had lost boats, including partial compensation to those whose boats had not been officially registered. The government also provided support to help revive the tourism industry in the affected areas. This included incentives to stimulate domestic tourism, as well as marketing and promotion efforts, and tax relief for businesses. Additionally, the Bank of Thailand helped entrepreneurs by providing soft loans through commercial banks. The central bank also created the Tsunami SME Fund and the Tsunami Recovery Fund. Furthermore, the labour ministry provided skills-training programmes for individuals who had lost their livelihoods. Finally, a number of different agencies and ministries were tasked with rebuilding houses for those whom the tsunami had rendered homeless. The Bank of Thailand also launched a THB 300 billion soft loan scheme to assist both SMEs and individuals who were affected by the 2021 floods. The government also established a national catastrophe insurance fund in 2012 to ensure that disaster insurance are broadly available for both individuals and businesses.

8. Conclusion

This study examined the effects of natural disasters on consumption in Thailand and the Philippines. In the case of Thailand, the study analysed the 2004 tsunami disaster, and the flood disasters of 2011 and 2016-17. The study observed a decline in Thailand's total consumption after these disasters. To recap, this decline stems from a reduction in spending in the service sector, which spans recreation, restaurants, and hotels. Households were generally seen to be increasing their spending on non-durable goods, including food and non-alcoholic drinks, alcoholic beverages and tobacco products, and clothing. In the cases of the Philippines, the study examined Typhoon Bopha of 2012, Typhoon Haiyan of 2013, and Typhoon Meranti of 2016. The study also observed changes in Philippine total consumer spending and its components after the typhoons, although these were relatively smaller than those that followed the disasters in Thailand. The study also found that households made changes to their spending on consumption, and that they did so most of all after Typhoon Haiyan.

The havoc that natural disasters wreak upon developing countries, and the manifest impact they have upon consumption and overall economic activity make the case for robust and efficient government action in the aftermath of such disasters, at least in the short term. However, governments must also develop longer-term policies focusing on disaster mitigation and resilience.

References

Aladangady, A., S. Aron-Dine, W. Dunn, L. Feiveson, P. Lengermann and C. Sahm (2016), "The Effect of Hurricane Matthew on Consumer Spending", FEDS Notes, Board of Governors of the Federal Reserve System.

Anttila-Hughes, J. K. and S. M. Hsiang (2013), "Destruction, Disinvestment, and Death: Economic and Human Losses Following Environmental Disaster", Goldman School of Public Policy Working Papers.

Baez, J. E., L. Lucchetti, M. E. Genoni, and M. Salazar (2015), "Gone with the Storm: Rainfall Shocks and Household Well-Being in Guatemala", Institute for the Study of Labour, Discussion Paper Series, No. 8792.

Benson, E. and E. Clay (1994), "The impact of drought on Sub-Saharan African economies: A preliminary examination", Overseas Development Institute Working Papers, No. 77.

Bowen, T., (2015), "Social Protection and Disaster Risk Management in the Philippines The Case of Typhoon Yolanda (Haiyan)", Policy Research Working Papers, No. 7482, World Bank Group, Washington D.C.

Campbell, J. Y. and G. Mankiw (1989), "Consumption, Income and Interest Rates: Reinterpreting the Time Series Evidence", NBER Macroeconomics Annual 1989, Volume 4.

Center for Excellence in Disaster Management and Humanitarian Assistance (2019), ASEAN Disaster Management Reference Handbook, Ford Island, Hawaii.

Center for Excellence in Disaster Management and Humanitarian Assistance. (2018), Thailand: Disaster Management Reference Handbook, Ford Island, Hawaii.

Centre for Research on the Epidemiology of Disasters. (2020), The International Disaster Database.

Dy, P., T. Stephens (2016). "The Typhoon Haiyan response: Strengthening Coordination Among Philippine Government, Civil Society, and International Actors", Program on Crisis Leadership PCL Discussion Paper Series, Harvard Kennedy School.

Flavin, M.A. (1981), "The Adjustment of Consumption to Changing Expectations About Future Income". The Journal of Political Economy, Vol. 89, No. 5 (Oct., 1981), pp. 974-1009.

Forbes, S. L. (2017), "Post-disaster consumption: analysis from the 2011 Christchurch earthquake", The International Review of Retail, Distribution and Consumer Research, Vol. 27, Issue 1, 2017, pp. 28-42.

Friedman, M. (1957), A Theory of the Consumption Function, Princeton University Press.

Gignoux, J. and M. Menendez (2016), "Benefit in the wake of disaster: Long-run effects of earthquakes on welfare in rural Indonesia", Journal of Development Economics, Vol. 118, pp. 26-44,

Hai, R., D. Krueger and A. Postlewaite (2013), "On the Welfare Cost of Consumption Fluctuations in the Presence of Memorable Goods", NBER Working Papers, No. 19386.

Jha, S., A. Martinez, P. Quising, Z. Ardaniel, & L. Wang. (2018). "Natural Disasters, Public Spending, and Creative Destruction: A Case Study of the Philippines", ADBI Working Papers, No. 817. Asian Development Bank Institute, Tokyo.

Kontopantelis, E., T. Doran, D.A. Springate, I. Buchan and D. Reeves (2015). "Regression based quasi-experimental approach when randomisation is not an option: interrupted time series analysis", BMJ, 350:h2750.

Lee, D. S & T. Lemieux (2010). "Regression discontinuity designs in economics", Journal of Economic Literature, 48, pp. 281–355.

Lee, D., H. Zhang and C. Nguyen (2018), "The Economic Impact of Natural Disasters in Pacific Island Countries: Adaptation and Preparedness", IMF Working Papers, WP/18/108.

Linden, A. (2015). Conducting interrupted time-series analysis for single- and multiple-group comparisons. Stata Journal, 15(2), pp.480-500.

Miguel, E. and G. Roland (2011), "The long-run impact of bombing Vietnam", Journal of Development Economics, Vol. 96, Issue 1, pp. 1-15.

NDRRMC (2012), NDRRM ADVISORY, National Disaster Risk Reduction and Management Center, Quezon City, Philippines.

NDRRMC (2016), NDRRM UPDATE, National Disaster Risk Reduction and Management Center, Quezon City, Philippines.

Nidhiprabha, Bhanupong (2007), "Adjustment and Recovery in Thailand Two Years after the Tsunami", ADB Institute Discussion Paper No.72, Asian Development Bank Institute, Tokyo.

OECD (2019), Economic Outlook for Southeast Asia, China and India 2020: Rethinking Education for the Digital Era, OECD Publishing, Paris. https://doi.org/10.1787/1ba6cde0-en

OECD (2018), Economic Outlook for Southeast Asia, China and India 2019: Towards Smart Urban Transportation, OECD Publishing, Paris, https://doi.org/10.1787/saeo-2019-en

Office of the National Economic and Social Development Council. (2020). Info/Statistics.

Philippine Statistics Authority. (2020, 10 15). Data series. Philippine Statistics Authority, Republic of the Philippines.

Poapongsakorn, N. and P. Meethom (2012), "Impact of the 2011 Floods, and Flood Management in Thailand", in Sawada, Y. and S. Oum (eds.). Economic and Welfare Impacts of Disasters in East Asia and Policy Responses. pp.247-310, Economic Research Institute for ASEAN and East Asia, Jakarta.

Sakai, Y., J. P. Estudillo, N. Fuwa, Y. Higuchi and Y. Sawada (2017), "Do Natural Disasters Affect the Poor Disproportionately? Price Change and Welfare Impact in the Aftermath of Typhoon Milenyo in the Rural Philippines", World Development, Vol. 94, pp. 16-26.

Schwartz, D., A. Goldberg, I. Ashkenasi, G. Nakash, R. Pelts, A. Leiba, Y. Levi and Y. Bar-Dayan (2006), "Prehospital Care of Tsunami Victims in Thailand: Description and Analysis". Prehospital and Disaster Medicine, No. 21(3), pp. 204-210.

Strobl, E. (2019), "The impacts of typhoons on economic activity in the Philippines: Evidence from nightlight intensity", ADB Economic Working Paper Series, No. 589, Asian Development Bank, Manila.

TDRI (2005), Economic Impact of Tsunami on Thailand, Thailand Development Research Institute.

Tebakari, T. & Y. Hayashi (2018). "Floods in Southern Thailand in December 2016 and January 2017", Journal of Disaster Research. No. 13, pp. 793-803

Telford, J, J. Cosgrave and R. Houghton (2006), "Joint Evaluation of the international response to the Indian Ocean tsunami: Synthesis Report". Tsunami Evaluation Coalition. London, United Kingdom.

UNDP (2014), TYPHOON HAIYAN (YOLANDA) STRATEGIC RESPONSE PLAN, United Nations Development Programme, Manila.

UNDRR (2019), Disaster Risk Reduction in the Philippines: Status Report 2019, United Nations Office for Disaster Risk Reduction, Bangkok.

UNOCHA (2013), TYPHOON BOPHA (PABLO) HUMANITARIAN HANDBOOK. United Nations Office for the Coordination of Humanitarian Affairs, Manila.

Weather Philippines (2015), WORST TYPHOONS OF THE PHILIPPINES (1947-2014), Weather Philippines Foundation, Inc., Manila.

World Economic Forum (2018), The Global Risks Report 2018: 3rd Edition, World Economic Forum, Geneva.

[i] CRED (2020) does not have an estimate for total damages caused by floods in the month of August 2016.

[ii] Total household consumption expenditure in the fourth quarter of 2004 was THB 980.9 billion.

[iii] The average spending on recreation from the first quarter of 2013 to the last quarter of 2014 was about 5.7% of total household spending; the average spending on hotels and restaurants in the same period was around 11.9%.

[iv] Total consumption expenditure in the third quarter of 2020 was THB 1.2 trillion.