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Floods and Exports: An Empirical Study on Natural Disaster Shocks in Southeast Asia

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Abstract

This study analyzes the effects of climate-related disasters on international trade in Southeast Asia. We use monthly trade data to examine the relationship between disaster shocks and exports. The empirical analysis shows that natural disasters have a significant negative effect on exports. The estimation results suggest that flooding causes immediate export losses of USD 305–557 million. In addition, we find that the effect persists in the post-disaster period, with floods causing annual export losses of USD 2.54 billion in total. We further investigate the impact of disasters by product group and show that disasters are negatively associated with the exports of agricultural and manufacturing products. The findings suggest that extreme weather events have severe repercussions on Southeast Asia, where exports play an important role in economic development.

Keywords: Climate change; Exports; Extreme weather; Flood; Natural disaster; Southeast Asia; Storm

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1 Introduction

Natural disasters can cause severe destruction and devastation, leading to significant economic and human damage. According to the Emergency Events Database (EM-DAT), a total of 6,457 weather-related disasters have occurred worldwide between 1995 and 2015 (CRED and UNISDR 2015). These disasters have caused economic damages of USD 1,891 billion and, on average, affected 205 million people every year. Among such disasters, floods are the most frequent disaster type, accounting for 43% of the natural disasters. In the past two decades, 2.3 million people have been affected by floods, causing economic losses of USD 662 billion. The Intergovernmental Panel on Climate Change (IPCC) reports growing economic losses as a result of flooding since the 1970s (IPCC 2014). This trend is likely to continue with flood events projected to increase in certain parts of the world, especially developing nations where economic losses relative to GDP are the most significant.

Researchers have examined the effects of natural disasters on socioeconomic activities at the aggregate and disaggregate levels (Anttila-Hughes and Hsiang 2013; El Hadri et al. 2017; Gassebner et al. 2010; Hsiang 2010; Hsiang and Narita 2012; Leiter et al. 2009; Loayza et al. 2012; Mendelsohn et al. 2011). For example, Hsiang and Narita (2012) use global cross-sectional data for 1950 to 2008 to examine the marginal damages of tropical cyclones. The authors find that an increase in cyclone exposure is associated with greater economic damages and human losses. Loayza et al. (2012) investigate four types of natural hazards using cross-country panel data. They find that storms negatively affect agricultural growth in developing countries. However, their study shows mixed results for flood impacts.

While moderate flooding positively affects economic growth, severe floods have a negative growth effect. By using firm-level data, Leiter et al. (2009) also find a positive effect of floods on the firms' capital accumulation and employment growth while demonstrating a negative flood impact on productivity. The effects of natural disasters may not be limited to one country but involve multiple countries through international trade. Oh and Reuveny (2010) examine the effect of climatic disasters and political risk on trade. Their analysis includes bilateral trade data and various types of weather-related disasters, showing that these climatic events reduce imports. Gassebner et al. (2010) also use bilateral trade data to investigate the impact of large-scale natural and technological disasters. El Hadri et al. (2017) focus on four types of natural disasters to examine their impacts on export values. These studies draw attention to the economic costs of climate change through trade channel, considering the growing importance of international trade to the world economy. However, studies analyzing the relationship between climate-related disasters and trade remain limited.

The objective of this study is to examine the effects of climate-related disasters on international trade. We focus on two types of extreme weather events, that is, floods and storms, to explore the relationship between natural hazards and exports in Southeast Asian countries. Southeast Asia provides a good opportunity to analyze the topic for two reasons. First, floods and storms in Southeast Asia are the two most frequent and damaging natural hazards. Between 2006 and 2015, the average annual costs incurred as a result of floods and storms were USD 5.8 billion and USD 2.7 billion, respectively (Guha-Sapir et al. 2016). Economic losses in lower-income countries are smaller in absolute value, compared to those in high-income countries; however, these losses are relatively large as a share of GDP. In this sense, natural disasters can lead to severe consequences in Southeast Asia. Second, Southeast Asia's exports are a key factor for economic development. In ASEAN countries, for example, the total traded goods amounted to USD 2,270 billion in 2015, accounting for 93% of the region's GDP (ASEAN 2016). Since more than 70% of the goods are exported to the outside of ASEAN countries, Southeast Asia's export losses caused by natural disasters may also affect other countries' economy through the global supply chain.

Our study is also related to the literature that examines climate impacts on various socioeconomic activities (see Dell et al. 2014; Heal and Park 2016). While researchers have analyzed and found links between climate and aggregate economic outcomes, recent works emphasize broader dimensions of socioeconomic activities and explore them as channels through which climate affects macroeconomy. Such channels include agriculture, labor productivity, energy production, migration, health and mortality, and conflicts (Anttila-Hughes and Hsiang 2013; Barrios et al. 2006; Cachon et al. 2012; Chen et al. 2016; Di Falco et al. 2012; Marchiori et al. 2012; McDermott and Nilsen 2014; Miguel et al. 2004). Among these channels, agriculture has been the primary focus of climate studies because of the sector's critical dependence on weather conditions. Nevertheless, there is a growing body of literature that investigates climate impacts associated with non-agricultural outputs. Using international trade data, Jones and Olken (2010) examine the effects of weather shocks on exports and find that a 1°C increase in temperature reduces export growth by 2.0–5.7 percentage points in poor countries. They further analyze climate impacts on exports by product and show that temperature shocks in poor countries negatively affect the exports of agricultural and light manufacturing products. Dell et al. (2012) show that temperature shocks affect both agricultural and industrial value-added in poor countries. Hsiang (2010) examines the impact of temperature and cyclones and find that production losses from non-agricultural outputs outweigh those from agricultural ones. The existing literature suggests that economic impacts of extreme weather are not limited to the agricultural sector but also observed in broader aspects of the economy.

This paper makes the following contributions to the literature on climate impacts. First, we focus on two types of weather shocks, that is, floods and storms, to investigate the extent to which natural disasters affect exports. While Jones and Olken (2010) estimate the impact of temperature on trade, they do not consider weather-related disasters, which may be greatly affected by climate change in terms of intensity and frequency. Second, our analysis adopts export data classified by the Harmonized System (HS) code. The breakdown of export data in our study allows us to compare product groups and identify industries affected by disaster shocks. In addition, monthly data can capture the effect of climate disasters more precisely than annual data used in most studies (Gassebner et al. 2010; Oh and Reuveny 2010). Third, this study uses alternative measures for disaster variables, one of which represents the duration of disaster events. Flooding exhibits greater variability in duration depending on its type: while flash floods occur for a shorter duration, riverine and costal floods may last for longer periods, thereby leading to greater impacts on economic outputs. An advantage of using alternative variables is their ability to capture such severity of disasters.

The results of the regression analysis show that floods and storms are negatively associated with export values, suggesting that the disasters reduce exports from Southeast Asia. The findings suggest that the occurrence of floods has an immediate effect on export values, as well as a persistent impact that sustains in the post-disaster period. To explore this possibility, we include lagged disaster variables in the estimation. We find that these variables are negatively correlated with exports, showing that flood effects persist for several months. In addition, we find that the exports of both agricultural and manufacturing products are affected by disasters. While many studies on climatic impact focus on agriculture, this study identifies the effect of weather shocks on non-agricultural products. Our findings support recent research findings that the negative effects of weather shocks tend to prevail in various economic outcomes, including non-agricultural outputs (e.g., Hsiang 2010; Jones and Olken 2010).

The remainder of this paper is organized as follows. Section 2 provides an overview of flood and storm events in Southeast Asia. Section 3 presents the regression model and describes the data employed in the analyses. Section 4 discusses the empirical results. Finally, Section 5 concludes.

2 Floods and Storms in Southeast Asia

Southeast Asia, as part of the Asia-Pacific region, is one of the most disaster-prone areas in the world. Figure 1 illustrates the annual number of flood events in four Southeast Asian countries: Indonesia, Malaysia, the Philippines, and Thailand. As shown in the figure, the number of floods has been steadily increasing over the years. Floods, which were less frequent in the 1990s, have increased to about 10–25 times per year and intensified over the past decade. Figure 1 also depicts the extent of damages caused by floods; the circle-shaped markers indicate damages in areas proportional to the number of people affected. The larger circles observed in recent years denote the greater number of people affected by the flooding. Similarly,

Figure 2 presents the annual number of storm events in Southeast Asia. While the figure suggests only a modest increase in the number of storm events, storm damages are likely to become larger in the subsequent years. The larger circles in the figure indicate the severe impact of recent storms on countries in terms of human damages.

Table 1 presents the five most extreme disasters that have occurred in Southeast Asia between 1990 and 2016. These individual events caused the most costly damages during this period. Flood and storm events are presented by country, along with year of occurrence, economic damage, death toll, and number of people affected. As the table shows, most of the severe disasters have taken place after 2010. The most extensive flood occurred in Thailand, followed by Indonesia and the Philippines. On the other hand, the five most damaging storms reported during this period occurred in the Philippines.

The 2011 flooding in Thailand resulted in more than 800 deaths and affected 9.5 million people across the country, causing economic damages of USD 40 billion. The flood also reportedly destroyed 19,000 houses and damaged about 18,000 km^2 of farmland (World Bank 2012). The record-breaking precipitation levels and multiple typhoons from May to September are largely responsible for the widespread and prolonged flooding. The flood initiated in the northern region of Thailand, inundating 66 of the 77 provinces in the country and reaching the Bangkok metropolitan region by November. The primary reason for the devastating economic damage is that the flood affected the central part of the country, where foreign manufacturing firms are accumulated in industrial parks (Oizumi 2012).[1] Manufacturing

[1]These areas are covered by the Chao Phraya River Basin that drains through the central region to Bangkok and eventually, into the Gulf of Thailand.

firms were forced to halt production because of the floodwaters that engulfed these industrial areas. According to the World Bank, the manufacturing sector suffered the highest losses of approximately USD 32 billion from flood damages, followed by the finance and banking, tourism, and housing sectors (World Bank 2012). Thailand's GDP growth rate in 2011 was 0.84% compared to 7.51% in the previous year. Industrial outputs are a key component of Thailand's GDP; thus, such flood damages are likely to hinder the country's economic growth.

The Philippines is subject to a variety of natural hazards including floods and storms, making it the world's third highest country with the disaster risk (Kirch et al. 2017). In 2013, the Philippines was hit by Typhoon Haiyan, locally known as Yolanda, one of the strongest typhoons ever recorded in the country's history. The estimated damages by this category five typhoon were approximately USD 10,000 million and over 7,000 people were dead or missing. A total of 16 million people, that is, 16% of the country's population, were also affected. Typhoon Haiyan significantly affected the country's agriculture, with more than USD 700 million in damages (FAO 2015). Crop production in the disaster-affected areas was severely damaged; for instance, the typhoon destroyed 161,400 ha of coconut farms, affecting about one million farmers (Bowen 2015). Furthermore, the destruction of crop production, such as coconut, could cause widespread damage as the Philippines is the world's second largest coconut producer. In addition to farmers, traders, wage earners, processors, and other stakeholders in the industry were also affected by the typhoon (FAO 2015). Moreover, the typhoon caused severe damages to infrastructure, including electricity, roads, and seaports (World Bank 2013). Such losses of critical infrastructure could disrupt local and global supply chains, preventing the economy from recovering in the post-disaster period. The reconstruction of infrastructure, therefore, was highly emphasized in the rehabilitation process after Haiyan. The Philippines was also struck by other storms that brought serious damages. As Table 1 shows, subsequent typhoons have caused severe losses to the country in recent years.[2]

3 Empirical analysis

3.1 Empirical specification

Our empirical analysis aims to explore the effects of disasters on international trade. We collect data on disasters and exports to develop panel datasets for four Southeast Asian countries: Indonesia, Malaysia, the Philippines, and Thailand.[3] The dataset comprises unbalanced monthly panel data for the period from 2004 to 2016. The following specification is used to run the regressions:

$$Export_{it} = \alpha + \sum_{j=0}^{L} \beta_j Disaster_{it-j} + \gamma_i + \delta_t + \phi_{im} + \varepsilon_{it}, \tag{1}$$

where $Export_{it}$ is the export values in country i during time period t, and $Disaster_{it-j}$ denotes either floods or storms. Country-specific fixed effects are captured by γ_i, controlling for unobserved heterogeneity across countries. δ_t captures month-by-year time fixed-effects. These time-variant variables control for any external event common to all countries in each time period. We also include country-by-month fixed effects denoted by ϕ_{im}, which accounts for country-specific seasonal trends

[2] In addition, Myanmar was severely hit by Typhoon Nargis in 2008. More than 2.4 million people were affected and the number of fatalities exceeded 138,000 people. The typhoon caused the second highest economic damages of USD 4,000 million; however, we do not include Myanmar in our analysis owning to data availability.

[3] The analysis includes these four countries because data on either disasters or exports are unavailable for other Southeast Asian countries.

affecting production, such as national holidays and cultural events. ε_{it} is a disturbance term.

As shown in Equation 1, the disaster variable is subject to lags indexed by j. We allow up to a 12-month lag for the disaster variable in the models with lag structures. It is possible that the effects of disasters persist for more than one period when the production of export goods is affected by damages to factories and farmlands. Natural disasters also cause the disruption of supply chains, leading to a slowdown in production. Furthermore, severely damaged infrastructure, such as roads, bridges, railways, and seaports, could create difficulties and delays in both domestic and international shipping. The destruction of infrastructure may also prevent workers from commuting to their workplaces. All of these factors can reduce exports in the post-disaster period.

3.2 Data description

Table 2 presents the summary statistics of the variables used in the empirical analysis. We have three categories of export values as dependent variables. To examine the impact on these export values, this study focuses on floods and storms as representative of extreme weather events. For each disaster type, we introduce alternative variables to evaluate its impact. These alternative variables can capture the severity of the disasters.

Data on disasters are taken from the EM-DAT by the Centre for Research on the Epidemiology of Disasters (CRED) (CRED and Guha-Sapir 2017). The EM-DAT includes more than 22,000 natural and technological disasters worldwide. The data are provided at the country level and based on information from multiple sources including international organizations, NGOs, national governments, and insurance companies. Each disaster in the EM-DAT meets one of the following criteria: 10 or more people were reportedly killed, 100 or more people were reportedly affected, a state of emergency was declared, or international assistance was called for. This database has been often utilized in previous studies exploring the effects of natural disasters on socioeconomic activities (Anttila-Hughes and Hsiang 2013; El Hadri et al. 2017; Hsiang and Narita 2012; Leiter et al. 2009; Loayza et al. 2012; Oh and Reuveny 2010). For the purpose of the present research, we extract data on floods and storms from the EM-DAT to examine their effects on exports.

We first use a variable *disaster event* that represents the occurrence of disasters. This dummy variable takes the value of one if a disaster has occurred at least once during a month in a country. The summary statistics in Table 2 show that floods are more frequent than storms in Southeast Asia during the sample period. On average, the occurrence of floods is 0.3 per month, while that of storms is 0.1 per month. This tendency is in line with the long-term trends in Southeast Asia, where floods are the most frequent disaster type followed by storms (Guha-Sapir et al. 2016).

The dummy variable for disaster occurrence does not reflect the size and scale of each disaster event. Therefore, we also introduce variables associated with a disaster event in terms of duration, human losses and damages, and economic damages. Given that longer duration and greater damage indicate larger-scale disasters, we use these variables to capture the severity of disasters. We construct variable *disaster duration* considering the total number of disaster days in each month. The duration of a disaster is calculated on the basis of its start and end dates recorded in the EM-DAT.[4] Similar to the occurrence of disasters, the duration of floods tends to be longer than that of storms; the mean duration is 3.3 days per month for floods and 0.6 days per month for storms (see Table 2). Floods could persist for days or weeks, thus lasting longer than storms, which typically do not occur for more than a few days.

We also use human damages to measure the severity of disasters. Human damages are denoted by *death toll*, defined as the number of deaths and missing people, and *people affected*, which is the number of the injured, affected, and left homeless as a result of a disaster. Contrary to the occurrence and duration of disasters mentioned above, storms tend to cause greater consequences in terms of damages related to mortality and injury. On average, storms lead to higher number of deaths and people affected than floods.

Moreover, we use two variables that measure economic damages from floods and storms: *economic damages* and *insured losses*. The former is the total value of all damages and economic losses related to the disaster and the latter denotes damages covered by insurance companies. Unlike human damages, these two indicators exhibit larger impacts from floods than storms.

Trade data are based on monthly export values in each country. The data are obtained from the International Trade Centre (ITC), a joint agency by the World Trade Organization and United Nations.[5] The ITC database provides detailed trade data that classify products into groups using the HS classification code, thereby enabling us to investigate the effects of disasters on exports by sector. We

[4] In the case of disasters simultaneously occurring in different regions of a country, we include the durations for all such events in the calculation. This explains certain observations exhibiting disaster duration that exceeds the number of total days in a given month.

[5] Available at http://www.intracen.org/.

collect export values for all products and disaggregate export values at the two-digit HS code level. The latter is then aggregated to two major sectors: agriculture and manufacturing. In this study, agricultural goods include products with HS codes 1 to 15, whereas manufacturing goods mean products with HS codes 16 to 97.

4 Results

4.1 Main results

We run regressions to estimate the effects of floods and storms on export values using the fixed-effects model. The regression models include up to a 12-month lag in disaster variables. The models with lag structures allow us to investigate whether a disaster effect appears and persists in the post-disaster periods.

The regression results are presented in Table 3. Columns 1–4 show the results for flood events and columns 5–8 show the results for storm events. For each disaster type, the models include variables with no lag, 3 lags, 6 lags, or 12 lags. In addition, the bottom row of each column presents the total effect of disasters, calculated using the estimated coefficients of the disaster variable and its lagged variables.

According to the results in columns 1–4 in Table 3, the occurrence of floods is negatively related to the export values for all products. In the first column, the coefficients of disaster event, that is, the immediate effect of floods, are negative and statistically significant: the occurrence of floods reduces export values by USD 557 million in a month. This implies that, on average, export losses from floods are approximately 4% of the total export values per month.[6] The result of the model with no lag shows that exports are immediately affected by floods. The effect of floods is also observed in models with lags. In columns 2–4, the immediate impact of floods remains significant, with export losses ranging from USD 305 million to USD 405 million. The lagged variables are also negatively correlated with export values. These results are mostly consistent in magnitude and statistical significance, suggesting that the impact of floods appears two to three months after the floods. When we add 12 lags, the effect of floods is observed six months after the disaster. In these lag models, the coefficients of the cumulative effect at the bottom row are all negative and statistically significant. For instance, the model with 12 lags indicates that the annual export loss from floods that occurred in a given month is USD 2.54 billion. This shows the total export losses from floods more than four times as large as those of USD 557 million estimated without lags in the first column. These results suggest that ignoring lagged effects may underestimate flood damages that persist for over a period of time.

Columns 5–8 in Table 3 present the estimation results for storm events. In contrast to the results for floods, we find no statistically significant effect of storms on exports. While the effect of floods is statistically significant both with and without lags, we find little evidence of storm impacts on export values from the variable representing the disaster occurrence. One reason for the insignificance might be the fact that the dummy variable of disaster occurrence does not fully capture the difference in the scale of storm events. In Section 4.3, we conduct the analysis by incorporating alternative variables that reflect the size of climate-

[6] According to the summary statistics in Table 2, the mean export values for all products in the sample are USD 12.68 billion.

related disasters.

4.2 Agricultural and manufacturing products

We estimate the effect of floods and storms on the total export values in Section 4.1. The results suggest that extreme weather events contribute to reductions in exports. This leads us to further analysis on the relationship between disasters and exports. This section investigates the effect of floods and storms on exports, with focus on specific components of exporting products. The export data are classified into two industrial sectors using the two-digit HS code: agriculture and manufacturing.

Table 4 presents the effect of floods on exports by two product groups. Agricultural products are examined in columns 1–4 and manufacturing products are in columns 5–8. In the first column, the coefficients of disaster event are negative and statistically related to the export values of agricultural products. This immediate effect is also correlated with export values when the models include lagged variables, as shown in columns 2–4. The magnitude of these coefficients is slightly smaller than the model without lags, although the negative signs and statistical significance remain consistent. The total effect of flood variables suggests that the export losses of agricultural products from floods occurred in a given month are USD 133 million in the model with no lag and USD 595 million in the model with 12 lags. Comparing these losses with the mean export values of agricultural products in the sample (see Table 2), we find that the export losses from floods per month are about 4–12% of the export values of agricultural products.

Similarly, we find that floods are associated with reductions in the export values of manufacturing products. The model in the fifth column shows that the immediate impact of flood events is statistically related to export values of manufacturing products. The coefficients of disaster event in columns 6–8 are also statistically significant. Moreover, the effect of floods is significant two to three months after the disasters. The cumulative effect at the bottom row of Table 4 indicates that, in the model without lags, floods that occurred in a given month reduce the export values of manufacturing products by USD 398 million. In the model with 12 lags, floods are associated with export losses of USD 1.90 billion. Applying the same calculation as that for agricultural products, we find that monthly export losses from floods are 1–3% of the mean export values for manufacturing products.

The estimation results by product group suggest that both agricultural and manufacturing sectors suffer export losses caused by floods. Related research by Jones and Olken (2010) also investigates weather shocks on export values. Using the two-digit SITC data, their study finds that higher temperature negatively affects agricultural and light manufacturing products in poor countries. In the study on the relationship between temperature and economic growth, Dell et al. (2012) find the impact of temperature on agricultural and industrial value-added as potential channels for aggregate outputs. In line with these studies, our results indicate that extreme weather events negatively affect both sectors.

Table 5 presents the results for the impact of storms on the exports of agricultural and manufacturing products. Contrary to floods, we find no clear evidence of storms affecting exports. The coefficients of storm variables are negative and statistically significant in the first and second columns. These models suggest that storms are correlated with the export values of agricultural products. However, the impact of storms does not remain when lags are added. As for manufacturing products, we find no significant impact of storm variables, although the coefficients of these variables mostly show negative signs, as expected.

4.3 Alternative measures for disaster variables

We conduct additional analyses using alternative measures for disaster variables. The five variables examined in this section depict the extent of effect floods and storms have on exports in terms of duration, human losses and damages, and economic damages. As described in Section 3.2, floods and storms have different characteristics in terms of disaster severity. Therefore, these variables may better represent disaster impacts. We apply the same estimation strategy as used for the main results and examine the effect of disasters using alternative measures.

We begin with a variable representing the duration of disasters. Table 6 shows the results using the total days of flood and storm events during a month. Columns 1–4 show the negative impact of floods on export values for all products. In the second column, the coefficients of the immediate flood impact indicate that an additional day of flooding increases export losses by USD 17 million. The coefficients of the immediate impact in other models also show negative signs, but statistically insignificant. In the lag models, the flood effect also appears two months after the disaster. The coefficients of these variables are all negative and statistically significant. Columns 5–8 present the results using the total days of storm events during a month. In these models, certain storm variables have a positive effect on exports, which is contrary to our hypothesis. However, a positive effect becomes statistically insignificant when we estimate the model by product group (see Appendix Table A2).

Table 7 shows the effect of floods and storms measured by human losses; that is, the number of deaths and missing people by disasters. In columns 2–4, we find that exports are affected by floods in the post-disaster periods. For instance, the coefficients of the two-month lagged variable in the second column indicate that export losses per death in a given month amount to USD 3 million. These flood impacts are consistent in the remaining lag models. In the case of storms, we find a persistent effect of the disasters, as shown in columns 5–8. The coefficients of both immediate and lagged variables are negative and statistically significant, suggesting that the impact of storms lasts for five months. The cumulative effect of storms shows that export losses are between USD 0.4 million (no lag) and USD 3 million (12 lags) per death. Interestingly, the magnitude of the coefficients of storm variables is smaller than that of flood variables, whereas we find the effect of storms to be more persistent than that of floods. These findings suggest that floods and storms may affect exports differently. When measured in terms of human losses, floods are associated with larger and temporary export losses, while storms with the same levels of severity lead to smaller and persistent export losses.

When the disaster variable is measured by the number of people affected, the estimation results show similar patterns to those for the number of deaths. Table 8 presents the regression results with the number of people affected by disasters. In the lag models in columns 2–4, the coefficients of the two-month lagged variable are correlated with export values, indicating that export losses from floods are USD 0.2–0.3 million per 1,000 people affected. In columns 5–8, we find a negative and statistically significant effect of storms that persists up to four months after the disaster. In the fifth column, for example, the coefficients suggest that economic losses from storms are USD 0.1 million per 1,000 people affected. These results show coefficient patterns similar to those for the death toll variable. That is, the coefficients of each storm variable are smaller but the post-disaster effect persists for a longer period. We again find that the effect of floods tends to be larger and temporary, while the effect of storms tends to be smaller and persistent. Together with the death toll variable, these findings show that the indicators for human losses and damages predict reductions in export values.

Furthermore, we estimate the effect of floods and storms on the basis of economic damages, presented in Table 9. The effect of floods appears in lagged variables, as shown in columns 2–4. The coefficients of the two- and three-month lagged variables are negative and significantly related to export values. On the other hand, we find a positive effect of floods in the four-month lagged variable, as shown in columns 3–4. For the storm variables, the impact on exports appears immediately and persistently in all models. The coefficients of these storm variables are negative and a significant effect persists for four months. In the model with no lag, economic damages of USD one million by storms are associated with a reduction in export values of USD 0.2 million.[7] In the models with lags, the total effect of storms in the bottom row of Table 9 shows that the estimated export losses are approximately USD 0.8–1.3 million.

We also estimate the models with the disaster variable measured by damages covered by insurance. Table 10 presents the results using insured losses as a proxy for disaster impacts. In columns 2–4, the flood variables with two- and three-month lags are negatively correlated with export values. We also find a positive sign for the four-month lagged variable in the models with more than six lags. Columns 5–8 show the immediate and persistent impact of storms on export values. These

[7] A response from the CRED to our inquiry suggests that economic damages and insured losses recorded in the EM-DAT do not include losses in export values.

models suggest that the immediate storm effect causes export values to decrease by approximately USD 3 million. When lagged variables are included, the cumulative effect of storms indicates export losses of USD 11–19 million.

In addition, we separately examine the effect on the export values of agricultural and manufacturing products using alternative disaster variables discussed in this section. The results by product category show that both agriculture and manufacturing are affected by floods and storms. This supports our findings in the previous sections that both agricultural and manufacturing sectors account for export losses from disasters. Furthermore, we find a significant effect of lagged variables, suggesting that the effect of floods and storms persists in the post-disaster periods. These results are presented in Appendix Tables A1 to A10.

5 Conclusions

This paper examines the effect of natural disaster shocks on exports in Southeast Asia. We focus on the two most frequent weather-related disasters: floods and storms. The panel dataset comprises monthly export data for four Southeast Asian countries for the past two decades. In the empirical analysis, disasters are measured by occurrence and severity to examine the extent to which floods and storms affect exports.

The regression results show a significant effect of natural disasters on exports, suggesting that flood and storm events reduce export values. In the case of floods, we find that the occurrence of flooding is significantly correlated with total export values. The findings suggest that the immediate effect of floods leads to a reduction in exports by USD 305–557 million. This study also analyzes models with lag structures and finds flood impacts in the post-disaster periods. When considering 12-month lags, we find that the total effect of floods occurred in a given month decreases export values by USD 2.54 billion. The effect of storms is also found in the case of alternative disaster variables. For instance, we use human losses as a disaster variable and find a negative and significant impact of storms. Moreover, the results show that storm effects appear immediately and persistently in the post-disaster periods. With 12-month lags, we find that storm impacts are associated with export losses of USD 3 million per death.

When disasters are measured by human losses and damages, we find that floods and storms affect differently in terms of size and length. The results show that floods are associated with larger export losses that appear in a relatively short period of time. On the other hand, estimated export losses incurred by storms are smaller but more persistent than those by floods. These findings suggest that floods and storms have different implications on trade in Southeast Asia. In addition, this may also suggest that each disaster type should be examined individually when evaluating their impacts.

Furthermore, our study suggests that floods and storms have a significant impact on exports across industrial sectors. We find that extreme weather events negatively affect agricultural and manufacturing products. Climatic impacts on agriculture is in line with the findings presented in the existing literature (for example, Dell et al. 2012; Jones and Olken 2010). In addition, we also find extreme weather effects on manufacturing, which have not been largely emphasized in previous studies. This result also offers support to the findings of studies examining the effect of weather shocks on firm-level labor productivity (Cachon et al. 2012; Li et al. 2016).

The results of our study suggest international trade as a channel through which climate may affect aggregate economic outputs. A better understanding of the channels and mechanisms of the relationship between climate and economy is important to achieve economic development while facing the risks of climate change. For developing countries, particularly those where exports play a crucial role in boosting economic growth, disaster shocks can be a great concern that needs immediate policy responses. Such issues are also related to developed countries, whose firms are located in disaster-prone regions and who trade various products through a global supply chain. Therefore, this study highlights the need for business entities and policymakers to pay more attention to the risks associated with extreme weather events in the context of international trade.

References

Anttila-Hughes JK, Hsiang SM (2013) Destruction, disinvestment, and death: Economic and human losses following environmental disaster

ASEAN (2016) ASEAN Economic Community Chartbook 2016. The Association of Southeast Asian Nations (ASEAN) Secretariat, Jakarta

Barrios S, Bertinelli L, Strobl E (2006) Climatic change and rural–urban migration: The case of sub-Saharan Africa. Journal of Urban Economics 60(3):357–371

Bowen T (2015) Social protection and disaster risk management in the Philippines : The case of Typhoon Yolanda (Haiyan). Policy Research Working Paper; No 7482, world Bank, Washington, DC, https://openknowledge.worldbank.org/handle/10986/23448 License: CC BY 3.0 IGO

Cachon GP, Gallino S, Olivares M (2012) Severe weather and automobile assembly productivity. Columbia Business School Research Paper No 12/37, available at SSRN: https://ssrn.com/abstract=2099798 or http://dx.doi.org/10.2139/ssrn.2099798

Chen S, Chen X, Xu J (2016) Impacts of climate change on agriculture: Evidence from China. Journal of Environmental Economics and Management 76:105–124

CRED, Guha-Sapir D (2017) EM-DAT: The Emergency Events Database, université catholique de Louvain (UCL), www.emdat.be, Brussels, Belgium

CRED, UNISDR (2015) The human cost of weather-related disasters 1995-2015, Centre for Research on the Epidemiology of Disasters (CRED) and The United Nations Office for Disaster Risk Reduction (UNISDR)

Dell M, Jones BF, Olken BA (2012) Temperature shocks and economic growth: Evidence from the last half century. American Economic Journal: Macroeconomics 4(3):66–95

Dell M, Jones BF, Olken BA (2014) What do we learn from the weather? The new climate–economy literature. Journal of Economic Literature 52(3):740–798

Di Falco S, Yesuf M, Kohlin G, Ringler C (2012) Estimating the impact of climate change on agriculture in low-income countries: Household level evidence from the Nile Basin, Ethiopia. Environmental and Resource Economics 52(4):457–478

El Hadri H, Mirza D, Rabaud I (2017) Natural disasters and countries' exports: New insights from a new (and an old) database. LEO Working Papers / DR LEO 2503, Orleans Economics Laboratory / Laboratoire d'Economie d'Orleans (LEO), University of Orleans

FAO (2015) Typhoon Haiyan - Portraits of resilience, Food and Agriculture Organization of the United Nations (FAO)

Gassebner M, Keck A, Teh R (2010) Shaken, not stirred: The impact of disasters on international trade. Review of International Economics 18(2):351–368

Guha-Sapir D, Hoyois P, Wallemacq P, Below R (2016) Annual disaster statistical review 2016: The numbers and trends, brussels, CRED

Heal G, Park J (2016) Temperature stress and the direct impact of climate change: A review of an emerging literature. Review of Environmental Economics and Policy 10(2):347–362

Hsiang SM (2010) Temperatures and cyclones strongly associated with economic production in the caribbean and central america. Proceedings of the National Academy of Sciences 107(35):15367–15372

Hsiang SM, Narita D (2012) Adaptation to cyclone risk: Evidence from the global cross-section. Climate Change Economics 03(02):1250011

IPCC (2014) Climate change 2014: Impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects. In: Field C, Barros V, Dokken D, Mach K, Mastrandrea M, Bilir T, Chatterjee M, Ebi K, Estrada Y, Genova R, Girma B, Kissel E, Levy A, MacCracken S, Mastrandrea P, White L (eds) Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA

Jones BF, Olken BA (2010) Climate shocks and exports. The American Economic Review 100(2):454–459

Kirch L, Luther S, Mucke P, Prütz R, Radtke K, Schrader C (2017) World Risk Report 2017. Bündnis Entwicklung Hilft, Berlin

Leiter AM, Oberhofer H, Raschky PA (2009) Creative disasters? Flooding effects on capital, labour and productivity within European firms. Environmental and Resource Economics 43(3):333–350

Li C, Cong J, Gu H, Xiang X (2016) Extreme heat and exports: Evidence from chinese exporters, available at SSRN: https://ssrn.com/abstract=2864893

Loayza NV, Olaberría E, Rigolini J, Christiaensen L (2012) Natural disasters and growth: Going beyond the averages. World Development 40(7):1317–1336

Marchiori L, Maystadt JF, Schumacher I (2012) The impact of weather anomalies on migration in sub-Saharan Africa. Journal of Environmental Economics and Management 63(3):355–374

McDermott GR, Nilsen ØA (2014) Electricity prices, river temperatures, and cooling water scarcity. Land Economics 90(1):131–148

Mendelsohn R, Emanuel K, Chonabayashi S (2011) The impact of climate change on hurricane damages in the United States. World Bank Policy Research working paper; no WPS 5561, license: CC BY 3.0 IGO

Miguel E, Satyanath S, Sergenti E (2004) Economic shocks and civil conflict: An instrumental variables approach. Journal of Political Economy 112(4):725–753

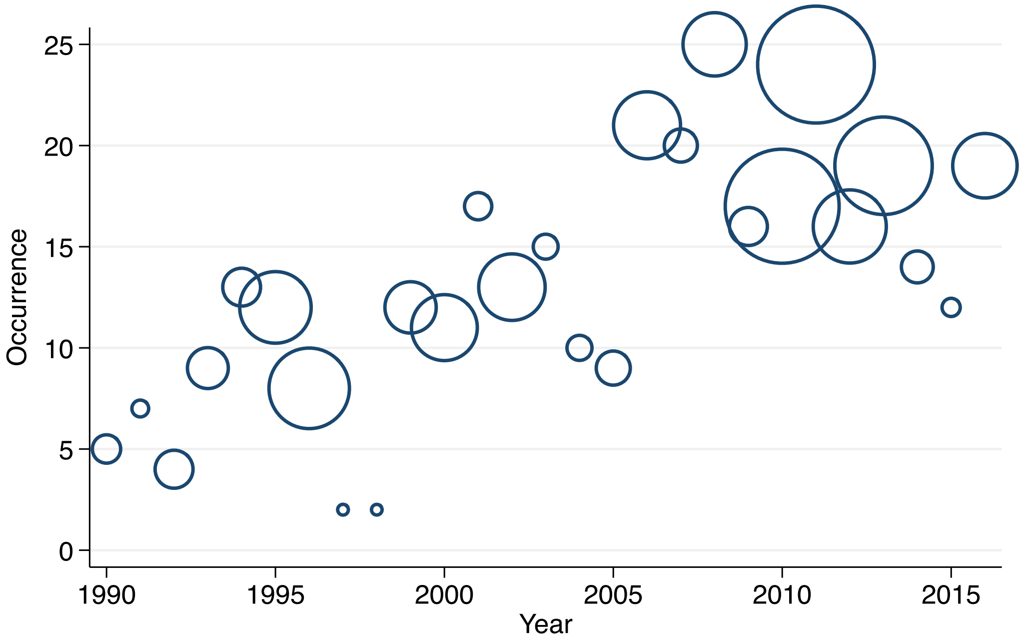
Oh CH, Reuveny R (2010) Climatic natural disasters, political risk, and international trade. Global Environmental Change 20(2):243–254

Oizumi K (2012) Thai no kozui wo dou toraeruka–sapuraichen no shizen-saigairisuku wo ikani keigen suruka (How do we understand the flood in Thailand–How do we reduce the natural disaster risk in the supply chain). Research for International Management 12(44):24–48

World Bank (2012) Thai flood 2011: rapid assessment for resilient recovery and reconstruction planning: Overview (English). World Bank, Washington, DC, http://documents.worldbank.org/curated/en/677841468335414861/Overview

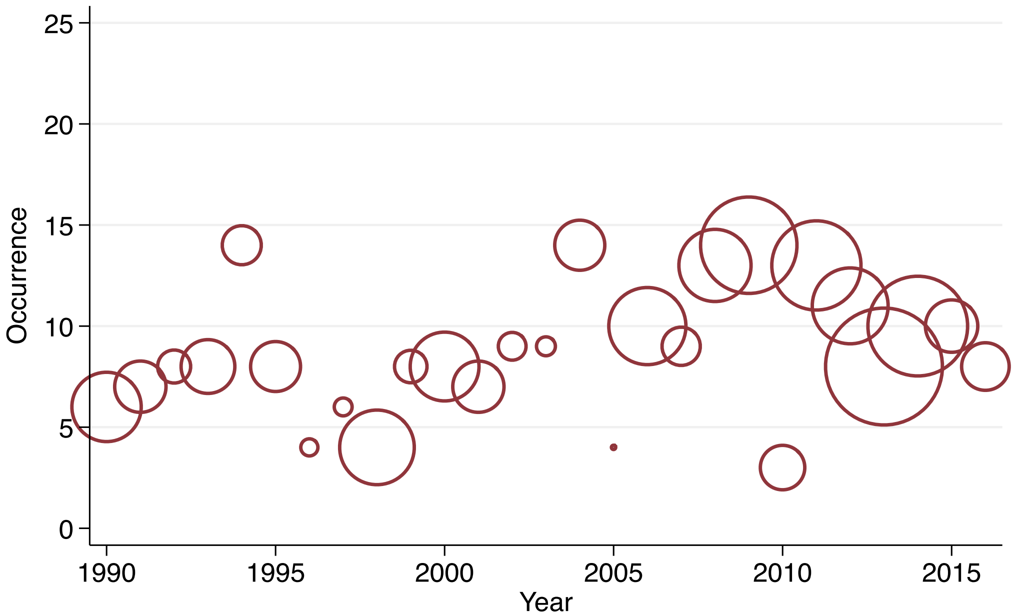
World Bank (2013) Philippine Economic Update, World Bank

Fig. 1 Number of flood events in Southeast Asia



Note: The areas of symbol are propotional to the number of poeple affected by floods.
The countries include Indonesia, Malaysia, the Philippines, and Thailand.
Source: CRED and Guha-Sapir (2017)

Fig. 2 Number of storm events in Southeast Asia



Note: The areas of symbol are propotional to the number of poeple affected by storms.
The countries include Indonesia, Malaysia, the Philippines, and Thailand.
Source: CRED and Guha-Sapir (2017)

Table 1 Severe disasters in Southeast Asia (1990–2016)

Flood

	Country	Year	Economic damage (million USD)	Death toll	People affected
1	Thailand	2011–2012	40000	813	9500000
2	Indonesia	2013	3000	34	248846
3	Philippines	2013	2190	31	3096422
4	Thailand	1993	1261	23	393809
5	Indonesia	2007	971	68	217087

Storm

	Country	Year	Economic damage (million USD)	Death toll	People affected
1	Philippines	2013	10000	7354	16106870
2	Philippines	2015	1500	5	14100
3	Philippines	2012	898	1901	6246664
4	Philippines	2014	821	111	4654966
5	Philippines	2009	585	512	4478491

Note: The countries include Indonesia, Malaysia, the Philippines, and Thailand.
Source: CRED and Guha-Sapir (2017)

Table 2 Summary statistics of variables

Variable	Unit	Mean	S.D.	Min	Max
Export values					
All products	million USD	12682.00	5421.28	2506	21777
Agriculture	million USD	1116.74	687.95	95	2922
Manufacturing	million USD	11470.72	5057.29	1756	20418
Flood variables					
Disaster event	dummy	0.34	0.47	0	1
Disaster duration	day	3.32	6.88	0	39
Death toll	people	8.48	28.69	0	329
People affected	1000 people	94.29	407.43	0	4452
Economic damages	million USD	96.30	725.55	0	6667
Insured losses	million USD	20.59	177.72	0	1667
Storm variables					
Disaster event	dummy	0.13	0.33	0	1
Disaster duration	day	0.57	2.16	0	17
Death toll	people	26.79	339.36	0	7354
People affected	1000 people	150.13	949.07	0	16107
Economic damages	million USD	31.00	444.31	0	10000
Insured losses	million USD	1.41	30.52	0	700

Table 3 Main regression results

	Export values All products							
	Flood				Storm			
	No lag (1)	3 lags (2)	6 lags (3)	12 lags (4)	No lag (5)	3 lags (6)	6 lags (7)	12 lags (8)
Disaster event	-557.457* (194.199)	-405.375*** (27.940)	-305.171*** (21.417)	-384.119** (79.775)	-305.084 (243.706)	-191.187 (221.550)	-40.815 (277.688)	63.646 (344.284)
L.Disaster event		-209.778 (100.135)	-115.623 (123.786)	-170.422 (129.548)		-265.623 (117.323)	-204.404 (134.623)	-153.459 (231.824)
L2.Disaster event		-329.010* (105.882)	-268.624** (56.488)	-227.486*** (34.020)		-289.756 (291.747)	-258.790 (284.033)	-53.459 (354.475)
L3.Disaster event		-510.313** (137.003)	-431.765** (73.970)	-309.799* (121.149)		-329.845 (165.792)	-314.262 (162.230)	-20.048 (301.362)
L4.Disaster event			-197.135 (106.083)	-79.057 (127.973)			31.311 (139.400)	234.526 (264.730)
L5.Disaster event			-247.066 (117.225)	-148.174 (96.431)			50.201 (67.953)	304.470 (152.548)
L6.Disaster event			-386.569 (200.050)	-345.671** (104.243)			273.503 (288.492)	451.650 (343.632)
Observation	528	516	504	480	528	516	504	480
Adjusted R^2	0.74	0.74	0.74	0.73	0.73	0.72	0.71	0.71
Month-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-by-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total effect of disaster	-557.457* (194.199)	-1454.476** (281.738)	-1951.953** (404.555)	-2538.317** (663.140)	-305.084 (243.706)	-1076.411 (723.620)	-463.254 (1111.963)	3033.941 (3255.272)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are clustered by country and reported in parentheses.

Table 4 The effect of floods on exports by product group

	Export values Agriculture				Manufacturing			
	No lag (1)	3 lags (2)	6 lags (3)	12 lags (4)	No lag (5)	3 lags (6)	6 lags (7)	12 lags (8)
Disaster event	-132.590*	-93.699*	-74.925*	-87.857*	-397.667*	-312.017***	-262.055**	-307.688**
	(45.669)	(29.942)	(29.219)	(34.868)	(158.497)	(37.146)	(46.122)	(80.658)
L.Disaster event		-66.396*	-57.900**	-68.578**		-127.110	-56.404	-111.895
		(22.346)	(15.497)	(20.817)		(86.775)	(115.037)	(123.605)
L2.Disaster event		-11.750	-1.451	3.601		-287.894**	-250.523***	-256.589**
		(52.666)	(53.462)	(63.862)		(70.245)	(36.251)	(55.246)
L3.Disaster event		-139.440**	-104.520*	-83.436		-345.285*	-320.366**	-274.561*
		(36.767)	(35.684)	(43.685)		(108.653)	(63.612)	(108.972)
L4.Disaster event			-73.243*	-83.037*			-102.097	-22.318
			(24.717)	(32.112)			(100.068)	(109.229)
L5.Disaster event			-52.903*	-44.988			-165.673	-112.246
			(19.844)	(20.210)			(95.148)	(83.206)
L6.Disaster event			-91.467***	-82.156**			-267.516	-272.337
			(6.090)	(14.460)			(189.520)	(126.402)
Observation	528	516	504	480	528	516	504	480
Adjusted R^2	0.58	0.59	0.60	0.58	0.75	0.74	0.73	0.71
Month-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-by-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total effect of flood	-132.590*	-311.285*	-456.408**	-594.562*	-397.667*	-1072.306**	-1424.634**	-1902.437*
	(45.669)	(103.543)	(124.503)	(209.736)	(158.497)	(244.549)	(408.957)	(724.798)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are clustered by country and reported in parentheses.

Table 5 The effect of storms on exports by product group

	Export values Agriculture				Manufacturing			
	No lag (1)	3 lags (2)	6 lags (3)	12 lags (4)	No lag (5)	3 lags (6)	6 lags (7)	12 lags (8)
Disaster event	-65.822**	-56.719**	-22.375	2.055	-245.341	-153.623	-83.752	25.030
	(11.685)	(10.905)	(14.997)	(14.503)	(231.567)	(223.914)	(265.555)	(323.562)
L.Disaster event		-60.193	-44.553	-17.956		-241.056	-221.483	-195.409
		(29.445)	(35.135)	(39.920)		(119.259)	(132.473)	(216.165)
L2.Disaster event		28.419	35.940	90.321		-349.256	-334.170	-220.404
		(99.055)	(99.217)	(113.357)		(199.712)	(195.151)	(251.423)
L3.Disaster event		-43.349*	-45.646	5.759		-318.764	-309.450	-132.371
		(17.300)	(19.505)	(23.485)		(148.680)	(143.256)	(261.776)
L4.Disaster event			-51.776	0.152			28.763	119.240
			(56.461)	(58.097)			(78.753)	(178.900)
L5.Disaster event			33.074	71.464			-15.785	114.679
			(39.573)	(44.057)			(63.942)	(119.415)
L6.Disaster event			112.282	138.476*			148.327	249.578
			(51.428)	(50.917)			(264.044)	(316.389)
Observation	528	516	504	480	528	516	504	480
Adjusted R^2	0.57	0.55	0.54	0.54	0.74	0.73	0.71	0.69
Month-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-by-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total effect of storm	-65.822**	-131.843	16.946	821.381	-245.341	-1062.699	-787.549	1601.853
	(11.685)	(108.268)	(155.716)	(371.173)	(231.567)	(619.940)	(971.417)	(2811.712)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are clustered by country and reported in parentheses.

Table 6 The effect of disasters on exports, measured by duration

	Export values All products							
	Flood				Storm			
	No lag (1)	3 lags (2)	6 lags (3)	12 lags (4)	No lag (5)	3 lags (6)	6 lags (7)	12 lags (8)
Disaster duration	-22.264 (9.800)	-16.924* (6.530)	-12.926 (6.384)	-6.584 (10.618)	22.816 (18.138)	24.745 (12.761)	35.635* (14.937)	5.934 (21.778)
L.Disaster duration		-5.242 (9.547)	-3.945 (11.224)	-6.540 (7.912)		4.636 (15.771)	9.949 (16.275)	-35.758 (26.086)
L2.Disaster duration		-24.533*** (0.998)	-22.615*** (2.511)	-19.653* (7.334)		6.951 (23.362)	5.640 (22.308)	-7.685 (14.223)
L3.Disaster duration		-31.914 (18.008)	-26.902 (15.276)	-21.737 (14.286)		-38.977 (20.569)	-47.537 (21.262)	-46.026 (28.164)
L4.Disaster duration			-10.135 (12.507)	-7.772 (11.898)			23.965** (6.742)	17.896** (4.399)
L5.Disaster duration			-21.660 (10.440)	-18.438 (7.987)			23.412 (16.155)	41.181** (12.371)
L6.Disaster duration			-26.159 (16.925)	-19.167 (12.070)			16.241 (37.425)	19.832 (41.575)
Observation	528	516	504	480	528	516	504	480
Adjusted R^2	0.73	0.74	0.74	0.72	0.73	0.72	0.71	0.70
Month-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-by-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total effect of disaster	-22.264 (9.800)	-78.613* (31.627)	-124.344 (59.027)	-167.415 (105.264)	22.816 (18.138)	-2.646 (52.419)	67.305 (53.734)	59.592 (148.479)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are clustered by country and reported in parentheses.

Table 7 The effect of disasters on exports, measured by death toll

	Export values All products							
	Flood				Storm			
	No lag (1)	3 lags (2)	6 lags (3)	12 lags (4)	No lag (5)	3 lags (6)	6 lags (7)	12 lags (8)
Death toll	-5.852 (2.563)	-4.076 (2.800)	-3.623 (2.977)	-2.606 (3.118)	-0.380** (0.074)	-0.400** (0.081)	-0.401** (0.083)	-0.328** (0.082)
L.Death toll		-1.206 (1.375)	-0.857 (1.346)	-1.946 (1.834)		-0.363* (0.126)	-0.367* (0.128)	-0.330* (0.135)
L2.Death toll		-3.338** (0.582)	-3.264** (0.702)	-2.941 (1.294)		-0.393** (0.083)	-0.398** (0.085)	-0.391** (0.089)
L3.Death toll		-5.038 (2.733)	-4.121** (0.972)	-3.929** (1.219)		-0.350** (0.063)	-0.364** (0.065)	-0.358** (0.069)
L4.Death toll			0.345 (3.520)	0.375 (4.203)			-0.216*** (0.024)	-0.217*** (0.026)
L5.Death toll			-2.148 (2.010)	-1.653 (1.063)			-0.301* (0.096)	-0.304* (0.102)
L6.Death toll			-0.118 (3.445)	-0.062 (1.581)			-0.186 (0.110)	-0.196 (0.116)
Observation	528	516	504	480	528	516	504	480
Adjusted R^2	0.73	0.73	0.72	0.70	0.73	0.73	0.73	0.71
Month-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-by-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total effect of disaster	-5.852 (2.563)	-13.657 (5.899)	-13.786 (11.285)	-5.920 (15.553)	-0.380** (0.074)	-1.507** (0.338)	-2.233** (0.505)	-2.919** (0.785)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are clustered by country and reported in parentheses.

Table 8 The effect of disasters on exports, measured by people affected

	Export values All products							
	Flood				Storm			
	No lag (1)	3 lags (2)	6 lags (3)	12 lags (4)	No lag (5)	3 lags (6)	6 lags (7)	12 lags (8)
People affected	-0.434 (0.276)	-0.264 (0.181)	-0.261 (0.182)	-0.231 (0.169)	-0.141** (0.026)	-0.153** (0.029)	-0.152** (0.033)	-0.119** (0.037)
L.People affected		-0.228 (0.159)	-0.203 (0.149)	-0.160 (0.149)		-0.157* (0.055)	-0.161* (0.058)	-0.155* (0.057)
L2.People affected		-0.295* (0.110)	-0.290* (0.098)	-0.233* (0.094)		-0.138** (0.037)	-0.145** (0.041)	-0.129* (0.041)
L3.People affected		-0.432 (0.338)	-0.391 (0.212)	-0.368 (0.189)		-0.156** (0.031)	-0.162** (0.034)	-0.143** (0.043)
L4.People affected			0.049 (0.239)	0.070 (0.208)			-0.086*** (0.013)	-0.087*** (0.014)
L5.People affected			-0.202 (0.210)	-0.243 (0.173)			-0.095 (0.042)	-0.079 (0.049)
L6.People affected			-0.204 (0.390)	-0.163 (0.267)			-0.053 (0.052)	-0.039 (0.060)
Observation	528	516	504	480	528	516	504	480
Adjusted R^2	0.73	0.74	0.73	0.71	0.73	0.73	0.73	0.71
Month-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-by-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total effect of disaster	-0.434 (0.276)	-1.219 (0.690)	-1.501 (1.312)	-1.639 (2.013)	-0.141** (0.026)	-0.603** (0.151)	-0.856** (0.254)	-0.618 (0.338)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are clustered by country and reported in parentheses.

Table 9 The effect of disasters on exports, measured by economic damages

	Export values All products							
	Flood				Storm			
	No lag (1)	3 lags (2)	6 lags (3)	12 lags (4)	No lag (5)	3 lags (6)	6 lags (7)	12 lags (8)
Economic damages	-0.116 (0.223)	-0.017 (0.198)	0.034 (0.239)	0.072 (0.236)	-0.225*** (0.025)	-0.230*** (0.026)	-0.231*** (0.026)	-0.189*** (0.030)
L.Economic damages		0.077 (0.051)	0.073 (0.051)	0.040 (0.024)		-0.189* (0.075)	-0.193* (0.076)	-0.160 (0.075)
L2.Economic damages		-0.273** (0.049)	-0.284*** (0.043)	-0.295*** (0.037)		-0.214** (0.042)	-0.217** (0.044)	-0.202** (0.046)
L3.Economic damages		0.014 (0.106)	-0.187*** (0.028)	-0.180*** (0.024)		-0.190*** (0.029)	-0.193*** (0.030)	-0.180** (0.033)
L4.Economic damages			0.178*** (0.029)	0.196*** (0.032)			-0.087** (0.024)	-0.084** (0.025)
L5.Economic damages			-0.021 (0.047)	0.007 (0.058)			-0.169 (0.083)	-0.164 (0.089)
L6.Economic damages			0.130 (0.163)	0.161 (0.129)			-0.088 (0.076)	-0.089 (0.079)
Observation	528	516	504	480	528	516	504	480
Adjusted R^2	0.73	0.73	0.72	0.71	0.73	0.73	0.72	0.70
Month-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-by-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total effect of disaster	-0.116 (0.223)	-0.198 (0.273)	-0.077 (0.366)	0.092 (0.525)	-0.225*** (0.025)	-0.823** (0.159)	-1.180** (0.284)	-1.265* (0.505)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are clustered by country and reported in parentheses.

Table 10 The effect of disasters on exports, measured by insured losses

	Export values All products							
	Flood				Storm			
	No lag (1)	3 lags (2)	6 lags (3)	12 lags (4)	No lag (5)	3 lags (6)	6 lags (7)	12 lags (8)
Insured losses	-0.510 (0.976)	-0.088 (0.966)	0.146 (1.174)	0.333 (1.210)	-3.289** (0.566)	-3.289** (0.569)	-3.270** (0.579)	-3.085** (0.551)
L.Insured losses		0.307 (0.361)	0.261 (0.307)	0.131 (0.204)		-2.677* (1.017)	-2.685* (1.026)	-2.305 (1.024)
L2.Insured losses		-1.202*** (0.130)	-1.148*** (0.147)	-1.249*** (0.130)		-2.844** (0.712)	-2.844** (0.717)	-2.827** (0.743)
L3.Insured losses		0.208 (0.496)	-0.753** (0.185)	-0.710** (0.156)		-2.277** (0.587)	-2.277** (0.591)	-2.254** (0.615)
L4.Insured losses			0.817*** (0.064)	0.922** (0.169)			-1.218** (0.215)	-1.206** (0.232)
L5.Insured losses			-0.157 (0.310)	-0.158 (0.290)			-2.230 (1.217)	-2.221 (1.258)
L6.Insured losses			0.542 (0.836)	0.789 (0.931)			-1.071 (1.076)	-1.056 (1.102)
Observation	528	516	504	480	528	516	504	480
Adjusted R^2	0.73	0.72	0.72	0.70	0.73	0.73	0.72	0.70
Month-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-by-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total effect of disaster	-0.510 (0.976)	-0.775 (1.182)	-0.292 (1.623)	0.430 (2.299)	-3.289** (0.566)	-11.088** (2.646)	-15.595** (4.590)	-18.585* (7.828)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are clustered by country and reported in parentheses.

Appendix

Table A1 The effect of floods on exports, measured by duration: agricultural and manufacturing products

	Export values Agriculture				Manufacturing			
	No lag (1)	3 lags (2)	6 lags (3)	12 lags (4)	No lag (5)	3 lags (6)	6 lags (7)	12 lags (8)
Disaster duration	-5.228	-3.875	-2.931	-2.381	-11.991	-9.606	-7.725	-4.216
	(3.413)	(2.522)	(2.944)	(3.549)	(11.405)	(8.267)	(8.498)	(11.168)
L.Disaster duration		-1.976	-2.044	-2.006		-1.349	-0.257	-4.231
		(1.652)	(1.632)	(1.738)		(8.215)	(9.739)	(7.639)
L2.Disaster duration		-0.177	0.134	1.017		-20.998***	-19.879**	-21.074*
		(3.171)	(3.522)	(4.428)		(3.247)	(4.343)	(7.356)
L3.Disaster duration		-7.281**	-5.283*	-4.172*		-20.417	-18.885	-16.976
		(1.863)	(1.761)	(1.689)		(14.821)	(12.628)	(13.393)
L4.Disaster duration			-3.663	-3.752			-3.891	-2.563
			(1.584)	(1.977)			(10.990)	(11.522)
L5.Disaster duration			-4.379**	-4.364***			-14.259	-12.851
			(0.763)	(0.716)			(6.795)	(6.024)
L6.Disaster duration			-5.600	-3.187			-17.523	-14.554
			(3.320)	(4.017)			(13.032)	(9.497)
Observation	528	516	504	480	528	516	504	480
Adjusted R^2	0.57	0.57	0.57	0.55	0.74	0.74	0.72	0.70
Month-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-by-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total effect of flood	-5.228	-13.309	-23.767	-30.126	-11.991	-52.370	-82.419	-118.343
	(3.413)	(7.693)	(11.730)	(18.162)	(11.405)	(27.968)	(48.605)	(90.775)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are clustered by country and reported in parentheses.

Table A2 The effect of storms on exports, measured by duration: agricultural and manufacturing products

	Export values Agriculture				Manufacturing			
	No lag (1)	3 lags (2)	6 lags (3)	12 lags (4)	No lag (5)	3 lags (6)	6 lags (7)	12 lags (8)
Disaster duration	2.789	2.768	4.574	-0.520	5.568	10.599	14.781	-0.584
	(7.491)	(5.841)	(6.881)	(7.731)	(12.632)	(9.417)	(11.346)	(23.214)
L.Disaster duration		0.172	0.829	-0.329		-4.822	-2.035	-34.460
		(3.544)	(4.052)	(6.821)		(13.149)	(13.531)	(26.046)
L2.Disaster duration		4.593	4.358	4.918		-5.404	-6.745	-16.788
		(7.122)	(7.440)	(10.176)		(17.222)	(15.709)	(7.425)
L3.Disaster duration		-4.885**	-4.839**	-4.805*		-46.810*	-49.558*	-52.485
		(1.313)	(1.037)	(1.576)		(18.635)	(19.492)	(27.772)
L4.Disaster duration			0.804	3.980			9.883	0.039
			(3.129)	(7.517)			(9.382)	(11.109)
L5.Disaster duration			0.267	1.696			9.728	18.501
			(4.948)	(5.041)			(20.243)	(16.101)
L6.Disaster duration			1.949	3.682			-3.732	1.814
			(6.544)	(6.725)			(34.986)	(38.346)
Observation	528	516	504	480	528	516	504	480
Adjusted R^2	0.56	0.55	0.54	0.51	0.74	0.73	0.71	0.69
Month-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-by-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total effect of storm	2.789	2.648	7.942	31.097	5.568	-46.436	-27.678	-137.004
	(7.491)	(16.899)	(29.672)	(74.360)	(12.632)	(38.274)	(51.454)	(132.982)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are clustered by country and reported in parentheses.

Table A3 The effect of floods on exports, measured by death toll: agricultural and manufacturing products

	Export values Agriculture				Manufacturing			
	No lag (1)	3 lags (2)	6 lags (3)	12 lags (4)	No lag (5)	3 lags (6)	6 lags (7)	12 lags (8)
Death toll	-1.793**	-1.154	-0.741	-0.651	-3.485	-2.832	-3.003	-2.188
	(0.431)	(0.518)	(0.517)	(0.339)	(2.160)	(2.386)	(2.790)	(2.795)
L.Death toll		-0.288	-0.175	-0.325		-0.736	-0.543	-1.406
		(0.363)	(0.361)	(0.411)		(1.353)	(1.487)	(2.107)
L2.Death toll		-1.124*	-1.015*	-0.747		-1.953**	-2.111*	-2.186*
		(0.419)	(0.392)	(0.560)		(0.397)	(0.721)	(0.794)
L3.Death toll		-1.101**	-0.248	0.189		-3.371	-3.666***	-4.205**
		(0.298)	(0.456)	(0.415)		(1.896)	(0.425)	(0.901)
L4.Death toll			-1.112	-1.383			1.621	1.654
			(0.651)	(0.856)			(2.698)	(3.389)
L5.Death toll			-1.875**	-1.703***			-0.096	-0.077
			(0.485)	(0.147)			(1.278)	(0.926)
L6.Death toll			-0.456	0.513*			0.824	-0.574
			(0.302)	(0.185)			(2.727)	(1.302)
Observation	528	516	504	480	528	516	504	480
Adjusted R^2	0.58	0.58	0.59	0.57	0.75	0.73	0.71	0.69
Month-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-by-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total effect of flood	-1.793**	-3.667*	-5.622	-7.112	-3.485	-8.891	-6.973	2.313
	(0.431)	(1.449)	(2.724)	(3.785)	(2.160)	(4.133)	(7.474)	(10.746)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are clustered by country and reported in parentheses.

Table A4 The effect of storms on exports, measured by death toll: agricultural and manufacturing products

	Export values Agriculture				Manufacturing			
	No lag (1)	3 lags (2)	6 lags (3)	12 lags (4)	No lag (5)	3 lags (6)	6 lags (7)	12 lags (8)
Death toll	-0.036	-0.037	-0.035	-0.017	-0.305***	-0.323**	-0.326**	-0.301**
	(0.027)	(0.027)	(0.027)	(0.018)	(0.050)	(0.057)	(0.059)	(0.064)
L.Death toll		-0.012	-0.012	-0.015		-0.316*	-0.319*	-0.308
		(0.007)	(0.007)	(0.007)		(0.125)	(0.127)	(0.134)
L2.Death toll		-0.019**	-0.019**	-0.016**		-0.349**	-0.354**	-0.354**
		(0.005)	(0.005)	(0.005)		(0.078)	(0.080)	(0.084)
L3.Death toll		-0.027	-0.028	-0.026		-0.298**	-0.310**	-0.310**
		(0.032)	(0.034)	(0.034)		(0.056)	(0.058)	(0.065)
L4.Death toll			-0.021	-0.021			-0.167**	-0.171**
			(0.040)	(0.041)			(0.034)	(0.039)
L5.Death toll			0.018	0.019			-0.293**	-0.297**
			(0.013)	(0.013)			(0.086)	(0.092)
L6.Death toll			0.007	0.008			-0.162	-0.172
			(0.016)	(0.018)			(0.115)	(0.124)
Observation	528	516	504	480	528	516	504	480
Adjusted R^2	0.57	0.55	0.54	0.51	0.75	0.74	0.72	0.70
Month-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-by-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total effect of storm	-0.036	-0.094	-0.089	-0.090	-0.305***	-1.286**	-1.930**	-2.443*
	(0.027)	(0.054)	(0.099)	(0.193)	(0.050)	(0.296)	(0.466)	(0.855)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are clustered by country and reported in parentheses.

Table A5 The effect of floods on exports, measured by people affected: agricultural and manufacturing products

	Export values Agriculture				Manufacturing			
	No lag (1)	3 lags (2)	6 lags (3)	12 lags (4)	No lag (5)	3 lags (6)	6 lags (7)	12 lags (8)
People affected	-0.087	-0.056	-0.054	-0.041	-0.314	-0.194	-0.195	-0.186
	(0.055)	(0.036)	(0.034)	(0.029)	(0.248)	(0.176)	(0.177)	(0.173)
L.People affected		-0.043	-0.035	-0.028		-0.174	-0.155	-0.127
		(0.032)	(0.033)	(0.029)		(0.116)	(0.106)	(0.120)
L2.People affected		-0.032	-0.030	-0.033		-0.244	-0.243*	-0.197
		(0.042)	(0.044)	(0.041)		(0.112)	(0.098)	(0.095)
L3.People affected		-0.087	-0.071	-0.058		-0.320	-0.309	-0.308
		(0.053)	(0.049)	(0.045)		(0.260)	(0.148)	(0.141)
L4.People affected			0.001	-0.002			0.063	0.067
			(0.034)	(0.033)			(0.216)	(0.189)
L5.People affected			-0.065***	-0.068**			-0.139	-0.170
			(0.010)	(0.013)			(0.196)	(0.164)
L6.People affected			-0.064	-0.046			-0.129	-0.118
			(0.045)	(0.031)			(0.330)	(0.231)
Observation	528	516	504	480	528	516	504	480
Adjusted R^2	0.57	0.57	0.56	0.53	0.75	0.74	0.72	0.70
Month-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-by-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total effect of flood	-0.087	-0.217	-0.317	-0.379	-0.314	-0.932	-1.108	-1.194
	(0.055)	(0.104)	(0.149)	(0.231)	(0.248)	(0.579)	(1.118)	(1.784)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are clustered by country and reported in parentheses.

Table A6 The effect of storms on exports, measured by people affected: agricultural and manufacturing products

	Export values Agriculture				Manufacturing			
	No lag (1)	3 lags (2)	6 lags (3)	12 lags (4)	No lag (5)	3 lags (6)	6 lags (7)	12 lags (8)
People affected	-0.020*	-0.020*	-0.019	-0.013	-0.101**	-0.112**	-0.114**	-0.104*
	(0.008)	(0.008)	(0.009)	(0.006)	(0.020)	(0.024)	(0.028)	(0.036)
L.People affected		-0.007	-0.006	-0.006		-0.134	-0.139	-0.150*
		(0.008)	(0.008)	(0.009)		(0.060)	(0.063)	(0.062)
L2.People affected		-0.011**	-0.011**	-0.006		-0.117*	-0.124*	-0.121*
		(0.002)	(0.002)	(0.005)		(0.037)	(0.041)	(0.041)
L3.People affected		-0.014	-0.014	-0.011		-0.132**	-0.138**	-0.128*
		(0.010)	(0.010)	(0.010)		(0.029)	(0.032)	(0.042)
L4.People affected			-0.008	-0.007			-0.070***	-0.073**
			(0.011)	(0.012)			(0.011)	(0.012)
L5.People affected			0.006	0.009			-0.092	-0.079
			(0.008)	(0.008)			(0.043)	(0.049)
L6.People affected			0.003	0.006			-0.043	-0.031
			(0.007)	(0.008)			(0.052)	(0.061)
Observation	528	516	504	480	528	516	504	480
Adjusted R^2	0.57	0.55	0.54	0.51	0.75	0.74	0.72	0.70
Month-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-by-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total effect of storm	-0.020*	-0.053**	-0.049	0.004	-0.101**	-0.495**	-0.720*	-0.429
	(0.008)	(0.009)	(0.021)	(0.065)	(0.020)	(0.145)	(0.247)	(0.377)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are clustered by country and reported in parentheses.

Table A7 The effect of floods on exports, measured by economic damages: agricultural and manufacturing products

	Export values Agriculture				Manufacturing			
	No lag	3 lags	6 lags	12 lags	No lag	3 lags	6 lags	12 lags
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Economic damages	-0.029	-0.020	-0.026	-0.021	-0.097	-0.006	0.049	0.085
	(0.035)	(0.035)	(0.041)	(0.044)	(0.192)	(0.172)	(0.207)	(0.209)
L.Economic damages		0.040	0.038	0.033		0.034	0.033	0.008
		(0.028)	(0.028)	(0.026)		(0.030)	(0.029)	(0.023)
L2.Economic damages		-0.033**	-0.033**	-0.035**		-0.238**	-0.250***	-0.261***
		(0.009)	(0.010)	(0.009)		(0.043)	(0.035)	(0.034)
L3.Economic damages		-0.038	-0.040	-0.038		0.051	-0.146***	-0.141**
		(0.029)	(0.048)	(0.042)		(0.073)	(0.023)	(0.026)
L4.Economic damages			0.030	0.031			0.147*	0.161**
			(0.022)	(0.018)			(0.049)	(0.049)
L5.Economic damages			-0.010	-0.018			-0.009	0.025
			(0.026)	(0.025)			(0.022)	(0.040)
L6.Economic damages			-0.021	0.001			0.144	0.157
			(0.028)	(0.024)			(0.126)	(0.110)
Observation	528	516	504	480	528	516	504	480
Adjusted R^2	0.57	0.56	0.55	0.52	0.74	0.73	0.72	0.69
Month-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-by-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total effect of flood	-0.029	-0.051	-0.061	-0.080	-0.097	-0.159	-0.031	0.156
	(0.035)	(0.040)	(0.052)	(0.072)	(0.192)	(0.228)	(0.308)	(0.443)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are clustered by country and reported in parentheses.

Table A8 The effect of storms on exports, measured by economic damages: agricultural and manufacturing products

	Export values							
	Agriculture				Manufacturing			
	No lag	3 lags	6 lags	12 lags	No lag	3 lags	6 lags	12 lags
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Economic damages	-0.026	-0.026	-0.026	-0.014	-0.163***	-0.167***	-0.168***	-0.157**
	(0.027)	(0.027)	(0.028)	(0.021)	(0.023)	(0.024)	(0.026)	(0.040)
L.Economic damages		0.002	0.002	0.004		-0.158	-0.162	-0.153
		(0.004)	(0.005)	(0.006)		(0.078)	(0.079)	(0.078)
L2.Economic damages		-0.008**	-0.008*	-0.005		-0.179**	-0.182**	-0.178**
		(0.002)	(0.003)	(0.002)		(0.044)	(0.047)	(0.048)
L3.Economic damages		-0.017	-0.017	-0.015		-0.149**	-0.151**	-0.146*
		(0.023)	(0.023)	(0.023)		(0.042)	(0.044)	(0.047)
L4.Economic damages			-0.010	-0.010			-0.050	-0.052
			(0.032)	(0.031)			(0.055)	(0.056)
L5.Economic damages			0.012	0.013			-0.157	-0.156
			(0.009)	(0.010)			(0.080)	(0.087)
L6.Economic damages			0.001	0.001			-0.065	-0.065
			(0.018)	(0.019)			(0.093)	(0.097)
Observation	528	516	504	480	528	516	504	480
Adjusted R^2	0.57	0.55	0.54	0.50	0.74	0.73	0.72	0.69
Month-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-by-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total effect of storm	-0.026	-0.049	-0.046	-0.030	-0.163***	-0.653**	-0.936*	-0.944
	(0.027)	(0.046)	(0.090)	(0.187)	(0.023)	(0.158)	(0.344)	(0.685)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are clustered by country and reported in parentheses.

Table A9 The effect of floods on exports, measured by insured losses: agricultural and manufacturing products

	Export values							
	Agriculture				Manufacturing			
	No lag	3 lags	6 lags	12 lags	No lag	3 lags	6 lags	12 lags
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Insured losses	-0.147	-0.144	-0.173	-0.156	-0.407	0.015	0.268	0.462
	(0.137)	(0.143)	(0.167)	(0.181)	(0.822)	(0.815)	(0.989)	(1.041)
L.Insured losses		0.218	0.208	0.198		0.071	0.052	-0.066
		(0.155)	(0.146)	(0.154)		(0.200)	(0.172)	(0.056)
L2.Insured losses		-0.141**	-0.145**	-0.165**		-1.053***	-1.003***	-1.085***
		(0.043)	(0.043)	(0.039)		(0.096)	(0.112)	(0.133)
L3.Insured losses		-0.161	-0.135	-0.113		0.368	-0.613***	-0.594**
		(0.154)	(0.227)	(0.192)		(0.315)	(0.088)	(0.112)
L4.Insured losses			0.098	0.072			0.707***	0.843**
			(0.103)	(0.080)			(0.119)	(0.167)
L5.Insured losses			-0.022	-0.037			-0.115	-0.122
			(0.140)	(0.112)			(0.170)	(0.202)
L6.Insured losses			-0.116	-0.042			0.628	0.818
			(0.161)	(0.146)			(0.621)	(0.773)
Observation	528	516	504	480	528	516	504	480
Adjusted R^2	0.57	0.56	0.55	0.52	0.74	0.73	0.72	0.69
Month-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-by-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total effect of flood	-0.147	-0.227	-0.286	-0.369	-0.407	-0.599	-0.077	0.730
	(0.137)	(0.171)	(0.221)	(0.312)	(0.822)	(0.971)	(1.341)	(1.919)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are clustered by country and reported in parentheses.

Table A10 The effect of storms on exports, measured by insured losses: agricultural and manufacturing products

	Export values Agriculture				Manufacturing			
	No lag (1)	3 lags (2)	6 lags (3)	12 lags (4)	No lag (5)	3 lags (6)	6 lags (7)	12 lags (8)
Insured losses	-0.370	-0.370	-0.363	-0.250	-2.658***	-2.658***	-2.657**	-2.718**
	(0.360)	(0.363)	(0.363)	(0.310)	(0.449)	(0.452)	(0.468)	(0.629)
L.Insured losses		0.035	0.035	0.055		-2.490	-2.496	-2.340
		(0.118)	(0.117)	(0.117)		(1.063)	(1.071)	(1.049)
L2.Insured losses		-0.071	-0.071	-0.064		-2.652**	-2.652**	-2.651**
		(0.047)	(0.047)	(0.050)		(0.696)	(0.701)	(0.727)
L3.Insured losses		-0.230	-0.230	-0.228		-1.922*	-1.922*	-1.910*
		(0.293)	(0.295)	(0.299)		(0.632)	(0.637)	(0.663)
L4.Insured losses			-0.170	-0.170			-0.883	-0.881
			(0.441)	(0.452)			(0.629)	(0.657)
L5.Insured losses			0.186	0.192			-2.276	-2.282
			(0.110)	(0.116)			(1.159)	(1.195)
L6.Insured losses			0.003	0.001			-0.890	-0.887
			(0.204)	(0.210)			(1.248)	(1.279)
Observation	528	516	504	480	528	516	504	480
Adjusted R^2	0.57	0.55	0.54	0.51	0.74	0.73	0.72	0.69
Month-by-year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-by-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total effect of storm	-0.370	-0.636	-0.611	-0.678	-2.658***	-9.723**	-13.777*	-15.606
	(0.360)	(0.489)	(1.024)	(2.138)	(0.449)	(2.567)	(4.983)	(9.461)

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors are clustered by country and reported in parentheses.