University of Heidelberg

Department of Economics

Discussion Paper Series | No. 685

Unraveling the Effects of Tropical Cyclones on Economic Sectors Worldwide: Direct and Indirect Impacts

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May 2020

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Abstract

This paper examines the current, lagged, and indirect effects of tropical cyclones on annual sectoral growth worldwide. The main explanatory variable is a new damage measure for local tropical cyclone intensity based on meteorological data weighted for individual sectoral exposure, which is included in a panel analysis for a maximum of 205 countries over the 1970-2015 period. I find a significantly negative influence of tropical cyclones on two sector aggregates including agriculture, as well as trade and tourism. In subsequent years, tropical cyclones negatively affect the majority of all sectors. However, the Input-Output analysis shows that production processes are sticky and indirect economic effects are limited.

Keywords: Natural Disasters, Environmental Economics, Spatial Econometrics, Tropical Cyclones, Input-Output Analysis.

JEL Codes: Q54, Q56, O44, 011

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1 Introduction

Tropical cyclones can have devastating economic consequences. Globally they are among the most destructive natural hazards. From 1980-2018 they were responsible for nearly half of all the natural disaster losses worldwide, with damages amounting to an aggregate of 2,111 billion U.S. dollars (Munich Re, 2018). Driven by climate change, at least in some ocean basins (Elsner et al., 2008; Mendelsohn et al., 2012) and the higher exposure of people in large urban agglomerations near oceans (World Bank, 2010), the overall damage and the number of people affected by tropical cyclones have been increasing since the 1970s (EM-DAT, 2015). Thus, tropical cyclones are and will continue to be a serious threat to the life and assets of a large number of people worldwide.

In order to design effective mitigation and adaptation disaster policies to this threat, it is important to understand the economic impact of natural disasters. Economic sectors most vulnerable to direct capital destruction of tropical cyclones need to be identified. However, also time-delayed effects must be taken into account since some damages such as supply-chain interruptions or demand-sided impacts will only be visible after a certain time lag (Kousky, 2014; Botzen et al., 2019). Perhaps the most challenging task is to identify critical sectors that may be responsible for widespread spillover effects leading to substantial modifications in other sectors' production input schemes. This study aims to better understand the sectoral impacts of tropical cyclones by looking at the direct and indirect effects in a large dataset covering 205 countries from 1970-2015. Additionally, a new damage measure is developed which considers the varying levels of exposure of different sectors.

From a theoretical perspective, a natural disaster can have both positive and negative effects. Direct negative impacts can result from the destruction of productive capital, infrastructure, or buildings, and thereby generate a negative income shock for the whole economy (Kousky, 2014). Positive effects include for instance, as a consequence of the destruction of capital, that the marginal productivity of capital increases, making it more attractive to invest in capital in the affected area (Klomp & Valckx, 2014). Furthermore, a shortage in the labor force can lead to a wage increase which can serve as an incentive for workers from other regions to migrate to the affected region, also leading to a positive effect (Hallegatte & Przyluski, 2010). Given the different theoretical possibilities, it is not surprising that the empirically identified effects are rather ambiguous. They can best be summarized by three possible hypotheses: *recovery to trend*, *build-back-better*, and *no recovery* (Chhibber & Laajaj, 2008).

The *recovery to trend* hypothesis characterizes a pattern where after a negative effect in the short run, the economy recovers after some time to the previous growth path. Possible mechanisms for this situation are, for example, additional capital flows such as remittances from relatives living abroad (Yang, 2008), international aid (De Mel et al., 2012), insurance payments (Nguyen & Noy, 2019), or government spending (Ouattara & Strobl, 2013) which help the economy reach its pre-disaster income level. Other studies identify negative effects which are only significant in the short run, but insignificant in the long run (Bertinelli & Strobl, 2013; Strobl, 2012; Elliott et al., 2015). The *build-back-better* hypothesis describes a situation where natural disasters first trigger a downturn of the economy, which is then followed by a positive stimulus, leading to a higher growth path than in the pre-disaster period. This hypothesis is supported by empirical findings for a positive GDP growth effect for Latin American countries (Albala-Bertrand, 1993), for high-income countries (Cuaresma et al., 2008), and for a cross-section of 153 countries (Toya & Skidmore, 2007). In contrast to this, the *no recovery* hypothesis states that natural disasters lead to a permanent decrease of the income level without the prospect of reaching the pre-disaster growth path again. This could result from a situation where recovery measures are not effectively implemented, or various negative income effects accumulate over time (Hsiang & Jina, 2014). Additionally, low and middle income countries suffer the greatest losses from natural disasters (Felbermayr & Gröschl, 2014).

This paper contributes to two strands of the literature. First, I add to the research area on the macroeconomic effects of disasters. Older empirical studies suffer to a large extent from endogeneity problems in their econometric analysis because their damage data are based on reports and insurance data such as the EM-DAT database. Such data are positively correlated with GDP (Felbermayr & Gröschl, 2014) and prone to measurement errors (Kousky, 2014). More recent studies have started to use physical data such as observed wind speeds to generate a more objective damage function for the impacts of tropical cyclones (Strobl, 2011). To address the varying economic exposure of affected areas, studies have used population (Strobl, 2012), nightlight intensity (Heinen et al., 2018) or exposed area (Hsiang & Jina, 2014) to weight the respective physical intensities of tropical cyclones. Yet, an area weight has the disadvantage of including largely unpopulated areas such as deserts, which are economically meaningless. In contrast, for the agricultural sector it would be misleading to take a nighttime light or a population weight, since these areas have rather a low population density. Therefore I propose a new damage measure that explicitly considers these different exposures. For the agricultural sector, I use the fraction of exposed agricultural land, while for the remaining sectors, I use the gridded population. Further, only a minority of studies explicitly investigate the disasters' influences on sectoral economic development. While Loayza et al. (2012) solely differentiate between three sectors and uses rather outdated report based data, Hsiang (2010) focuses on 26 Caribbean countries, which are highly exposed but only account for 11% of global GDP (in 2015) (United Nations Statistical Division, 2015c). In total, I extend this research area in three ways: I include all (exposed) countries, which allows me to get more generalizable results. Next, I conduct a thorough assessment of long term sectoral influences of tropical cyclones. Finally, I introduce a new objective damage measure which allows for sector specific exposure of tropical cyclones.

Second and most importantly, I contribute to the literature on Input-Output analysis of natural disasters. While there exists a lot of theoretical work on the importance of cross-sectional linkages in consequences of a shock (see e.g.: Acemoglu et al., 2012; Dupor, 1999; Horvath, 2000), recent empirical studies focus on the shock propagation in production networks within the United States of America (Barrot & Sauvagnat, 2016) or after single natural disasters like the 2011 earthquake in Japan (Boehm et al., 2018; Cole et al., 2019). These empirical studies all share that they use firm-level data to draw conclusions on upstream and downstream production disruptions. However, little is known about the empirical Input-Output effects across broader sectors after a natural disaster shock. In a single country study on floods in Germany Sieg et al. (2019) show that indirect impacts are nearly as high as direct impacts. For tropical cyclones no empirical cross-country study on indirect effects exists so far. With this paper I close this research gap by using an Input-Output panel dataset to analyze potential sector interactions after the occurrence of a tropical cyclone. This allows me to analyze whether any key sectors exist that, if damaged, result in direct damages of other sectors.

The main causal identification stems from the exogenous nature of tropical cyclones, whose intensity and position are difficult to predict even 24 hours before they strike (NHC, 2016). Based on a fine-gridded wind field model, I generate a new sector-specific damage measure weighted by either agricultural land use or population data. This exogenous measure allows me to identify an immediate negative growth effect of tropical cyclones for two out of seven sectoral aggregates including *agriculture, hunting, forestry, and fishing*, and *wholesale, retail trade, restaurants, and hotels*. The largest negative impacts can be attributed to the annual growth in the *agriculture, hunting, forestry, and fishing* sector aggregate, where a standard deviation increase in tropical cyclone damages is associated with a decrease of 262 percentage points of the annual sectoral growth rate. This corresponds to a mean annual global loss of 16.7 billion U.S. Dollars (measured in constant 2005 U.S. Dollars) for the sample average. The years following a tropical cyclone the majority of sectors experience negative growth effects. Within the *agriculture, hunting, forestry, and fishing* sectors the negative effects become less pronounced with a zero effect being present after four years, while the *wholesale, retail trade, restaurants, and hotels* sectoral aggregate experiences a persistent negative growth even after 20 years.

Based on the Input-Output analysis, there are only a small number of significant sectoral shifts. This suggests that the production chains of the economy are only slightly disrupted by tropical storms and, thus, indirect impacts are negligible. Still, we can learn from this analysis the important role of the not directly affected *manufacturing* sectors. They are responsible for a demand shock in the *mining and quarrying* sectoral aggregate, leading to delayed negative growth effects being persistent over ten years. At the same time, other sectors demand more from the *manufacturing* sectors, resulting in a zero aggregate negative effect for them. Moreover, for the vast majority of sectors, the indirect effects do not last longer than one year.

The remainder of this paper is structured as follows: section 2 contains a description of the data source, the construction of the tropical cyclone damage measure, and presents descriptive statistics. In section 3, the empirical approach is described. Section 4 presents the main results as well as robustness checks. Section 5 concludes with a discussion of the results and highlights policy implications.

2 Data

2.1 Tropical Cyclone Data

Tropical cyclones are large cyclonically rotating wind systems that form over tropical or sub-tropical oceans and are mostly concentrated on months in summer or early autumn in both hemispheres (Korty, 2013). Their destructiveness has three sources: damaging winds, storm surges, and heavy rainfalls. The damaging winds are responsible for serious destruction of buildings and vegetation. In coastal areas, storm surges can lead to flooding, destruction of infrastructures and buildings, erosion of shorelines and the salinization of the vegetation (Le Cozannet et al., 2013; Terry, 2007). Torrential rainfall can cause serious in-land flooding, thereby augmenting the risk coming from storm surges (Terry, 2007). Typically, the destructiveness of tropical cyclones is measured in terms of wind speed, since storm surges and heavy rainfalls are closely related to it (Jiang et al., 2008).

Since the commonly used report-based EM-DAT dataset (Lazzaroni & van Bergeijk, 2014) has been criticized for measurement errors (Kousky, 2014), endogeneity, and reverse causality problems (Felbermayr & Gröschl, 2014), I use meteorological data on wind speeds to generate a proxy for the destructive power of tropical cyclones. Consequently, I take advantage of the International Best Track Archive for Climate Stewardship (IBTrACS) provided by the National Oceanic and Atmospheric Administration (Knapp et al., 2010). It is a unification of all best track data on tropical cyclones collected by weather agencies worldwide. Best track data are a postseason reanalysis from different available data sources, including satellites, ships, aviation, and surface measurements to describe the position and intensity of tropical cyclones (Kruk et al., 2010).[1]

To calculate a new aggregate and meaningful measure of tropical cyclone damages separated by economic sectors on a country-year level, I make use of the climada model developed by Aznar-Siguan & Bresch (2019) at a resolution of $0.1°$.[2] It employs the well-established Holland (1980) analytical wind field model to calculate spatially varying wind speed intensities around each raw data observation track. Consequently, for each track point a wind speed S is calculated, depending

[1]Further details on the data on tropical cyclones can be found in Appendix A.1.
[2]$0.1°$ correspond to approximately 10 kilometers at the equator.

on the forward speed (T), the distance (D) from the storm center, and radius of the maximum wind (R):

$$S = \begin{cases} \max(0, ((M - abs(T)) * \frac{R}{D}^{\frac{3}{2}} * e^{1-\frac{R}{D}^{\frac{3}{2}}}) + T), & \text{if } D < 10 * R \text{ from center to outer core} \\ 0, & \text{if } D > 10 * R \text{ out of radius} \end{cases} \quad (1)$$

As a result, I generate hourly wind fields for each of the 7814 tropical cyclones in my sample period (1970-2015).[3] Figure 1 illustrates the resulting modeled wind fields for Hurricane Ike in 2008 on its way to the US coast. The individual colors represent different wind speed intensities. The wind speed drops with distance to the center of the hurricane and as soon as it makes landfall.

One major effort of this paper is to generate a new meaningful sectoral damage variable on a country year level. In total, I use two different aggregations methods. First, I account for the economic exposure by weighting the maximum occurred wind speed per grid cell and year by the number of exposed people living in that grid cell relative to the total population of the country. This is a well established method (Strobl, 2012; Heinen et al., 2018; Elliott et al., 2019). However, since agricultural areas are seldom highly populated using a population-weighted damage function for

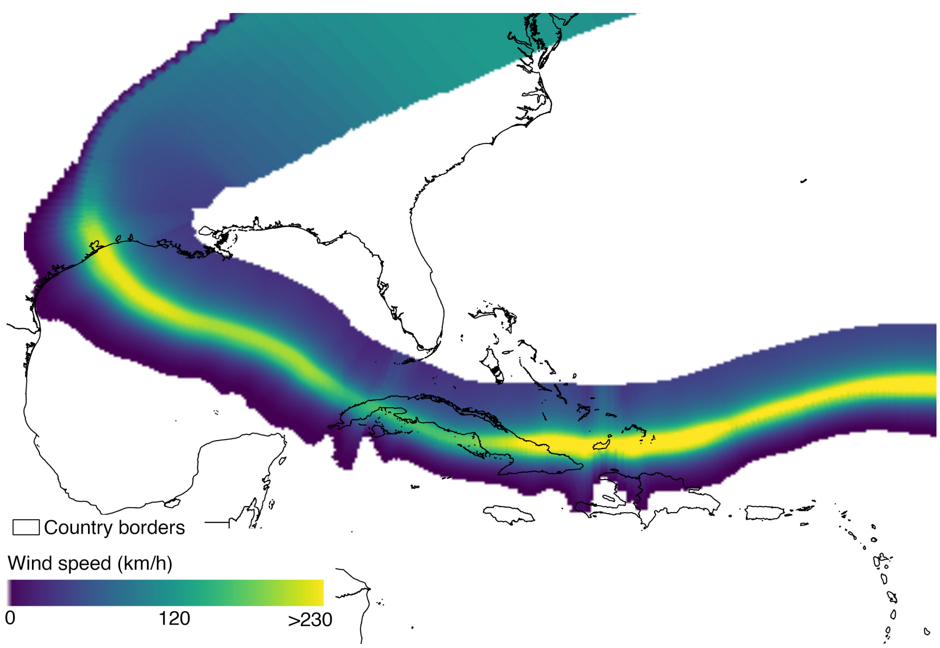

Figure 1: Wind field model for Hurricane Ike, 2008.

[3]Since the tropical cyclone data are available at global coverage since 1950, I will extend my database later for further specifications.

all sectors would be biased. Therefore I propose for the agricultural sector a new spatial exposure weight, agricultural land, consisting of the sum of land used for grazing and crops in km^2 per grid cell. All weights are available in the HYDE 3.2 dataset (Klein Goldewijk, 2017) at a spatial resolution of around 10x10 kilometer.[4] To avoid potential endogeneity concerns I lag the respective weights by one period.

Figure 2 shows why it is important to differentiate between exposed agricultural and population. Panel (a) displays the percentage of agricultural land, whereas (b) shows the distribution of population in Australia in 2008. A damage function which only takes into account the exposed population would underestimate the damage caused to the agricultural sector, given the large unpopulated but agriculturally used areas in the north and west of Australia.

It has been shown that the damages of tropical cyclones increase non-linearly with wind speed and occur only above a certain threshold. I follow Emanuel (2011) by including the cube of wind speed above a cut-off wind speed of 92 km/h. Taken all considerations together, I calculate for each country i and year t its tropical cyclone damage:

$$Damage_{i,t} = \frac{\sum_{g \in i} w_{g,t-1}}{W_{i,t-1}} * \sum_{g \in i} S(max)^3_{g,t} \mathbb{1}_{S(max)>92}, \tag{2}$$

where $w_{g,t-1}$ are the exposure weights, agricultural land or population, in grid g in period $t-1$.

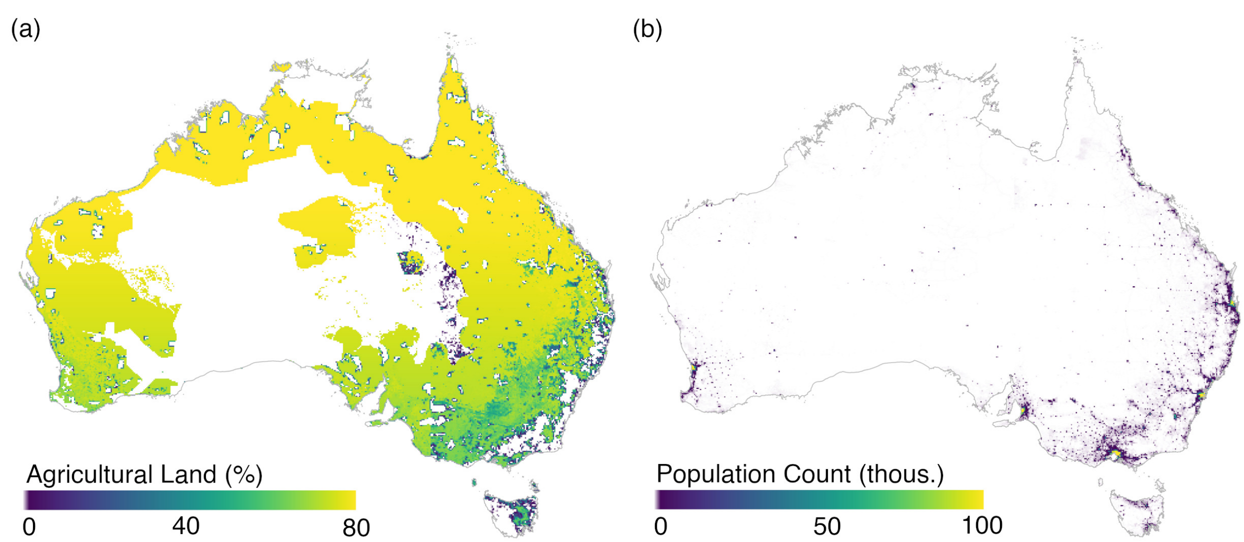

Figure 2: Land used for agriculture (in %) and population count (in 1000) in Australia in 2008.

[4]Before 2000 only decadal data are available. Hence, I interpolate the data to generate yearly observations.

They are divided by the total sum of the weight $W_{i,t-1}$ in country i in period $t-1$. This index is then multiplied with the cubed maximum wind speed $S(max)^3_{g,t}$ in grid g and year t as calculated by equation 1, but only for values above 92 km/h.

There are two important points to note about this tropical cyclone damage variable. First, I use the maximum wind speed, leaving out potential rainfall and storm surge damages. For potential rainfall damages, there exists a strong relationship between the maximum wind speed of a tropical cyclone and the total amount of precipitation (Cerveny & Newman, 2000). Storm surge damages are hard to model and no global data set exists so far. But it is a common simplification to assume that wind speed is a good proxy for rainfall and storm surge damages. Second, only the maximum wind speed per grid cell and year is used for the calculation of the tropical cyclone damages. This means that if a grid cell of a country was exposed to two storms in one year, only the physically more intense storm is considered. In the used sample, 70% of all grid-points are hit once by a tropical cyclone per year, whereas 20% are hit twice, and 10% more than twice.

2.2 Sectoral GDP Data

The sectoral GDP data originates from the United Nations Statistical Division (UNSD) (United Nations Statistical Division, 2015b). Sectoral GDP is defined as gross value added per sector aggregate and is collected for different economic activities following the International Standard Industrial Classification (ISIC) revision number 3.1. Gross value added is defined by the UNSD as "the value of output less the value of intermediate consumption" (United Nations Statistical Division, 2015a). The variables are measured in constant 2005 U.S. dollars. The different economic activities are classified as follows with the respective ISIC codes given in parentheses: *agriculture, hunting, forestry, and fishing (A&B); mining, and utilities (C&E); manufacturing (D); construction (F); wholesale, retail trade, restaurants, and hotels (G-H); transport, storage, and communication (I); other activities (J-P)*, which includes inter alia the financial and government sector. Appendix A.2 provides a more detailed description of the composition of the individual ISIC categories. The data are collected every year for as many countries and regions as possible.[5] The sample used in my analysis covers the 1970-2015 period and includes a maximum of 205 countries.[6]

2.3 Input-Output Data

To analyze potential sectoral shifts within the economy after a tropical cyclone, I take advantage of the Input-Output data of EORA26 (Lenzen et al., 2012, 2013). It provides data on 26 homogeneous sectors for 189 countries from 1990 until 2015 and is the only Input-Output panel dataset with (nearly) global coverage available. However, one disadvantage of the EORA26 data set is that parts of the data are estimated and not measured. On the other hand, EORA26 works continuously on quality check reports and compares its result to other IO databases such as GTAP or WIOD.[7]

To be consistent with the remaining analysis, I aggregate the given 26 sectors to the previously used seven sectoral aggregates.[8] For my analysis, I calculate the Input-Output coefficients by dividing the specific input of each sector by the total input of each sector, given in the transaction matrix of the data:

$$IO_t^{j,k} = \frac{Input_t^{j,k}}{TotalInput_t^j} \tag{3}$$

The resulting Input-Output coefficients $IO^{j,k}$ range between 0 and 1 in year t. It indicates how much input from sector k is needed to produce one unit of output of sector j. Consequently, they give an idea of the structural interactions of sectors within an economy and hence help to disentangle the indirect effects of tropical cyclone damages.[9]

[5]If the official data of the countries or regions are not available, the UNSD consults additional data sources. The procedure is hierarchical and reaches from other official governmental publications over publications from other international organizations to the usage of data from commercial providers (United Nations Statistical Division, 2015b).

[6]The sample is larger than the maximum size of recognized sovereign states as it also includes quasi-autonomous countries such as the Marshall Islands, if data are provided for them by the UNSD. Further, one can argue that only countries exposed to tropical cyclones are relevant for this analysis, therefore Table 36 provides a regression of the main result for exposed countries only.

[7]I decide not use the WIOD database, because its country sample is not very exposed to tropical cyclones. Additionally, the GTAP database is not freely available and only covers a few years.

[8]Later, I also look at the effects on the 26 individual sectors.

[9]I decide to only look at changes in the Input-Output coefficients and not at indirect costs because it almost needs no assumptions. Input-Output models which analyze indirect costs such as the Inoperability Input-Ouptut model (Haimes & Jiang, 2001) or the Gosh model (Ghosh, 1958) require many assumptions which tend to be problematic (Oosterhaven, 2017).

2.4 Further Control Data

As tropical cyclones are highly correlated with higher temperature and precipitation (Auffhammer et al., 2013), I will control for the mean temperature and precipitation of a country in further specifications. For both variables, I use the year-by-year variation calculated from the Climatic Research Unit (CRU) version 4.01, which is available at a resolution of approximately 5 kilometers since 1901 (University of East Anglia Climatic Research Unit et al., 2017). Together with further control variables, Table 2 in Appendix A.3 lists the exact definition of all variables used.

2.5 Descriptive Statistics

Figure 3 shows the country-year observations of the tropical cyclone damage variable for (a) exposed agricultural land and (b) exposed population. Country-year observations above two standard deviations are labeled with the respective ISO3 code. While the distribution reveals that on average, geographically smaller countries such as Hong Kong, Dominica or Jamaica have higher damages, there exists a difference between both damage measures, even for the highly exposed countries.

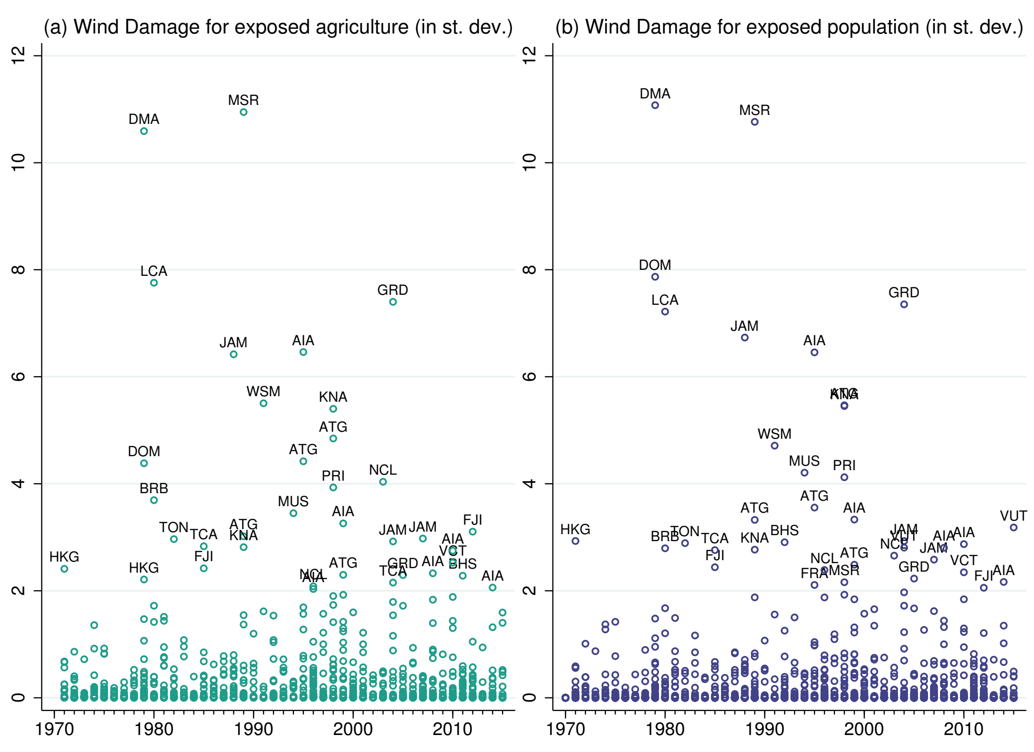

Figure 3: Distribution of the tropical cyclone damage variable (in standard deviations) for exposed agricultural areas (a) and exposed population (b), 1970-2015.

Further, extreme damaging tropical cyclones are relatively rare. A one standard deviation strong event has a probability of 8.9% among events above zero for agricultural damages and 8% for population damages.[10]

To demonstrate the average intersectoral connections within my sample, Figure 4 displays the average Input-Output coefficients for all countries for all available years (1990-2015). The different colors stand for different average coefficients, ranging from 0 (light purple) to 0.24 (dark purple). On average, the sector aggregates *agriculture, hunting, forestry, and fishing (A&B)* and *mining, and utilities (C&E)* are only little dependent on other sectors, while there is a stronger dependence for the remaining sectoral aggregates. The cross sectoral dependence is most pronounced for the *manufacturing (D)* and *other activities (J-P)*, which is not surprising since the *manufacturing (D)* sector needs at lot of input materials from other sectors (Sieg et al., 2019) and the sector *other activities (J-P)* comprises among others the financial sector. Tables 3 and 4 in Appendix A.4 show the main descriptive statistics for all variables used in this study.

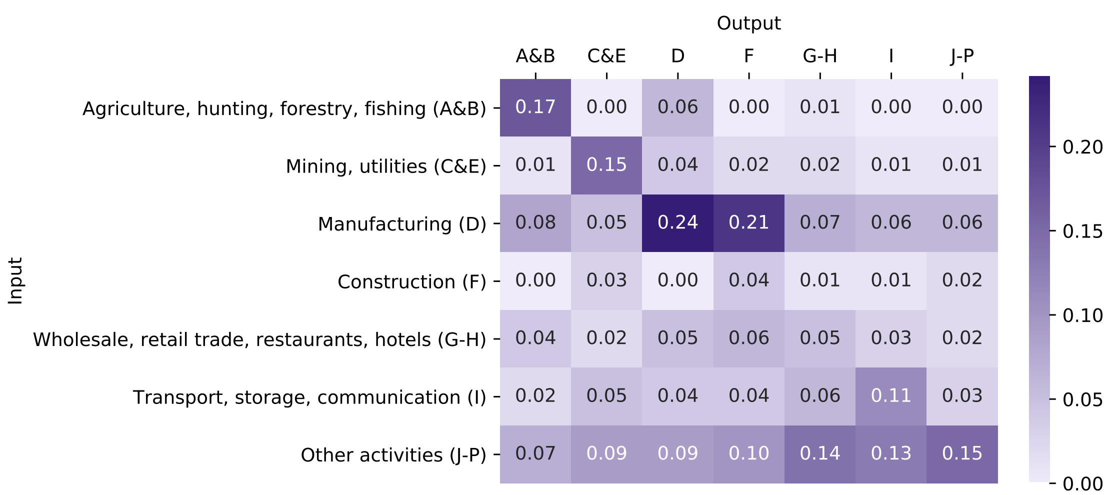

Figure 4: Heatmap of Input-Output coefficient averages, 1990-2015. Input-Output coefficients show how much input one sectors needs to produce one unit of output. They range between zero and one.

[10]The underlying calculations for these numbers are: agricultural damages: $91/1027 = 0.0886$, population damages: $82/1035 = 0.0801$.

3 Empirical Approach

3.1 Direct Effects

In order to examine tropical cyclones as exogenous weather shocks, I pursue a panel data approach in a simple growth equation framework (Dell et al., 2014; Strobl, 2012). The analysis is conducted on a country-year level. To identify the causal effects of tropical cyclone intensity on sectoral per capita growth, I use the following set of regression equations, which constitutes my main specifications:

$$Growth^j_{i,t-1->t} = \alpha^j + \beta^j * Damage_{i,t} + \gamma^j * \mathbf{Z}_{i,t-1} + \delta^j_t + \theta^j_i + \mu^j_i * t + \epsilon^j_{i,t}, \tag{4}$$

where the dependent variable $Growth^j_{i,t-1->t}$ is the annual value added per capita growth rate of sector j in country i. The main specification is estimated for each of the $j(= 1, ..., 7)$ sector aggregates separately. $Damage_{i,t}$ is the derived damage function for country i at year t from equation 2. Consequently, β^j is the coefficient of main interest in this specification. By calculating the annual sectoral GDP per capita growth rate, I lose the first year of observation of the panel. Hence, the sample period reduces to 1971-2015. In further specifications, I include additional control variables $\mathbf{Z}_{i,t-1}$ to account for potential socioeconomic or climatic influences. Besides, I include time fixed effects δ_t to account for time trends and other events common to all countries in the sample. The country fixed effects θ_i control for unobservable time-invariant country-specific effects such as culture, institutional background, and geographic location. Additionally, I allow for country-specific linear trends $\mu_i * t$. This assumption will be relaxed in further specifications by allowing more flexible country-specific trends (e.g. squared). The error term $\epsilon_{i,t}$ is clustered at the country level.

The growth literature predicts that some potential positive or negative impacts of natural disasters only emerge after a few years, it is therefore important to look at the effect over time (Felbermayr & Gröschl, 2014). To analyze the effect of tropical cyclones in the longer run, I introduce lags of the tropical cyclone damage variable to the main specification 4. Since the tropical cyclone data has a global coverage since 1950, I am able to introduce lags up to 20 years without losing observations of my dependent variable which ranges from 1971-2015. This allows me to identify which of the competing hypotheses – *build-back-better*, *recovery to trend*, or *no recovery*

– is appropriate for which sector. In detail, this model can be described by the following set of regression equations:

$$Growth^{j}_{i,t-1->t} = \alpha^{j} + \sum_{L=0}^{20}(\beta^{j}_{t-L} * Damage_{i,t-L}) + \gamma^{j} * \mathbf{Z}_{i,t-1} + \delta^{j}_{t} + \theta^{j}_{i} + \mu^{j}_{i} * t + \epsilon^{j}_{i,t}, \quad (5)$$

where all variables are defined as in equation 4. I show point coefficient estimates as well as accumulated effects and error statistics calculated via a linear combination of the lagged β_{t-L} coefficients.

3.2 Indirect Effects

To analyze potential indirect effects which could emerge because of changes in the Input-Output composition of the individual sectors, I test the following set of equations for the different Input (j)-Output (k) combinations:

$$IO^{j,k}_{i,t} = \alpha^{j,k} + \beta^{j,k} * Damage_{i,t} + \lambda^{j,k} * IO^{j,k}_{i,t-1} + \gamma^{j,k} * \mathbf{Z}_{i,t-1} + \delta^{j,k}_{t} + \theta^{j,k}_{i} + \mu^{j,k}_{i} * t + \epsilon^{j,k}_{i,t}, \quad (6)$$

where $IO^{j,k}_{i,t}$ indicates the Input-Output coefficient of sectors j and k in year t and country i. Depending on the level of aggregation, I run 49 (7*7) or 676 (26*26) different regressions. In contrast to equation 4, I introduce a lagged dependent variable, since I suspect a strong path dependence of the Input-Output coefficient, e.g., most sectors plan their inputs at least one period ahead. Additionally, it controls for a sluggish adjustment to shocks of the individual sector input composition. The remaining variables are defined as in equation 4. In general, this analysis reveals production scheme transformations which can result from both supply and demand changes of the sectors due to tropical cyclones.

3.3 Identification Strategy

The main causal identification stems from the occurrence of tropical cyclones which are unpredictable in time and location (NHC, 2016) and vary randomly within geographic regions (Dell et al., 2014). As demonstrated in section (2.5), their intensity and frequency spread sufficiently between years and countries. Additionally, tropical cyclone intensity is measured by remote sensing methods and other meteorological measurements. To underpin the causal identification, I conduct a falsification test, where I introduce leads instead of lags of the *Damage* variable, as well as a Fisher randomization test. Furthermore, one could also argue that the estimation results are biased by the fact that certain regions have a higher exposure to tropical cyclones than others. However, the country fixed effects will partly control for this concern. Additionally, I will cluster the standard errors at broader regional levels as a further robustness test.

As tropical cyclones are exogenous to sectoral economic growth, the greatest threat to causal identification could arise by leaving out important climatic variables which are correlated with tropical cyclones (Auffhammer et al., 2013). Therefore I include the mean level of temperature and precipitation as additional climate controls in a further specification. Both variables are associated with the occurrence of tropical cyclones, since they only form when water temperatures exceed 26 °C and torrential rainfalls are usually a part of them.

To be in line with the related growth literature, I estimate a further specification where I add a set of socioeconomic control variables (Islam, 1995; Strobl, 2012; Felbermayr & Gröschl, 2014). It comprises the logged per capita value added of the respective sector j to simulate a dynamic panel model, the population growth rate, a variable for openness (imports plus exports divided by GDP), and the growth rate of gross capital formation.[11] Including these socioeconomic control variables introduce some threats to causal inference. First, as shown by Nickell (1981), there is a systematic bias of panel regressions with a lagged dependent variable and fixed effects. However, it has been demonstrated that this bias can be neglected if the panel is longer than 15 time periods (Dell et al., 2014). As my panel has a length of 25-45 years, depending on the chosen model, I assume this bias will not influence my analysis.[12] Second, all control variables are measured in *t-1* to reduce potential endogeneity problems stemming from the fact that control variables in t can also be influenced by tropical cyclone intensities in t (Dell et al., 2014). Admittedly, it will not

[11] The logged per capita value added is not included for the robustness tests of the indirect effects of model 6, because it already compromises a lagged dependent variable.

[12] For the dynamic analysis the panel length is 65 years and for the Input-Output regression it comprises still 20 years.

fully solve potential endogeneity problems, and concerns about bad controls (Angrist & Pischke, 2009) and "over-controlling" (Dell et al., 2014) remain.

Finally, the standard errors $\epsilon_{i,t}$ could be biased by the autocorrelation of unobservable omitted variables (Hsiang, 2016). To deal with this problem I will re-estimate my regression models with Newey-West (Newey & West, 1987) as well as spatial HAC standard errors (Hsiang, 2010; Fetzer, 2020), which allow for a temporal correlation of 10 years and a spatial correlation of 1000 kilometer radius.[13]

Generally speaking, the models proposed offer a simple but strong way for causal interpretation of the impact of tropical cyclones on sectoral growth. The weighted tropical cyclone damage variables are orthogonal to economic growth as well as the Input-Output coefficients and the panel approach allows me to identify the causal effect.

4 Results

4.1 Direct Effects

Table 1 presents the results of the main specification for each of the seven annual sectoral GDP per capita growth rates. The coefficients show the increase of the respective damage variable by a standard deviation. Previous empirical studies on the relationship between economic development and tropical cyclone damages found a negative influence on GDP growth (e.g. Bertinelli & Strobl, 2013; Strobl, 2011; Gröger & Zylberberg, 2016). My results show that this negative aggregate effect can be attributed to two sectoral aggregates, including *agriculture, hunting, forestry, and fishing; manufacturing* and *wholesale, retail trade, restaurants, and hotels.* Tropical cyclones have the largest negative effect on the *agriculture, hunting, forestry, and fishing* aggregate compared to other sectoral aggregates. The absolute size of this effect is approximately more than 2.5 times the size of the coefficient in the *wholesale, retail trade, restaurants, and hotels* sector aggregate. In general, a standard deviation increase in tropical cyclone damages is associated with a decrease

[13] I tested my data extensively for outliers having a high influence on my results. In particular, I calculated the leverage and dfbeta of the *damage* coefficient. Observations were excluded if they were above the $(2k+2)/n$ threshold for leverage and above the $2/sqrt(n)$ threshold for dfbeta. In total, I excluded five country-year observations from my analysis: Dominican Republic 1979, Grenada 2004, Montserrat 1989, Myanmar 1977, Saint Lucia 1980. However, I show as an additional robustness test also a regression where I include these outliers and the results remain unchanged.

Table 1. The effect of a standard deviation increase in wind speed damages on sectoral growth rates

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Agriculture, hunting, forestry, fishing	Mining, utilities	Manu-facturing	Construc-tion	Wholesale, retail trade, restaurants, hotels	Transport, storage, communi-cation	Other activities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	-2.6219***	-0.7682	-0.7242	0.7306	-1.1552**	-0.4861	-0.1886
	(0.4582)	(0.8424)	(0.5211)	(0.6645)	(0.5129)	(0.3649)	(0.2642)
	[0.0000]	[0.3629]	[0.1661]	[0.2729]	[0.0254]	[0.1843]	[0.4762]
N	8,500	8,500	8,500	8,500	8,500	8,500	8,500
Clusters	205	205	205	205	205	205	205
P-value	0.0000	0.3629	0.1661	0.2729	0.0254	0.1843	0.4762
Mean DV	0.8800	3.7458	2.6095	3.2388	2.5256	3.7030	2.5519
SD Damage	1,706,646	1,740,224	1,740,224	1,740,224	1,740,224	1,740,224	1,740,224

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects as well as country-specific linear trends.

of the annual growth rate in the sector aggregate *agriculture, hunting, forestry, and fishing* of 2.62 percentage points. For the sample average (0.88) of the regression of column (1) this effect can be translated into a decrease of 298 percent, as displayed in Figure 5. In terms of total losses, this decrease results in a mean yearly loss of 16.7 billion U.S. Dollars (measured in constant 2005 U.S. Dollars) for the sample average (5.63 billion U.S. Dollars). This large negative effect is not surprising. The agricultural sector heavily relies on environmental conditions as most of its production facilities lie outside of buildings, and hence are more vulnerable to the destructiveness of tropical cyclones. In addition to damaging wind speed, salty sea spread and storm surge can cause salinization of the soil, leaving it useless for cultivation.

For the sector aggregate *wholesale, retail trade, restaurants, and hotels*, a standard deviation increase in tropical cyclone damages cause a decrease of 46 percent in comparison to the sample average (2.53). The reasons for this downturn can stem from different sources. First, affected people could shift their spending from general products to products related to the construction sector. Second, if the landscape is devastated after a tropical cyclone, the restaurant and hotel industry will suffer heavily, as people prefer regions with an intact landscape.

How long past tropical cyclones will influence present economic growth rates is empirically not clear. While some studies provide evidence of only a short-term economic impact of tropical

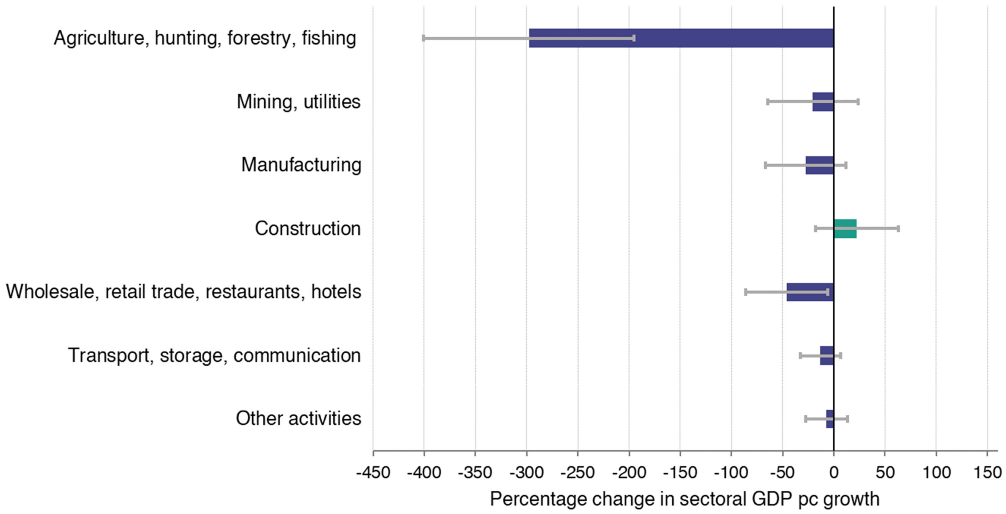

Figure 5: Effect of a standard deviation increase in tropical cyclone damage on the per capita sectoral GDP growth rate compared to the sample average (in %). The error bars depict the 95% confidence intervals.

cyclones (Bertinelli & Strobl, 2013; Elliott et al., 2019), Felbermayr & Gröschl (2014) show that storms from the previous five years can also have a negative growth effect. In addition, in a recent working paper Hsiang & Jina (2014) even demonstrate a long-term negative impact of tropical cyclones of up to 20 years.

Figure 6 illustrates the cumulative point estimates of the past influence of tropical cyclone damages on the different sectoral growth variables.[14] The x-axis represents the lags of the damage variable, whereas the y-axis indicates the size of the cumulative coefficient β (in standard deviations). The grey shaded area specifies the respective 95% confidence bands and the red line depicts the connected estimates. Appendix A.4 presents further statistics: Figures 13-15 show the cumulative results for different lag lengths (5, 10, 15) and Tables 12-13 the underlying estimations. The individual point estimates are shown in Figures 9-12, while Tables 5-11 show the regression results.

Figure 6 demonstrates that three out of seven sectoral aggregates suffer from delayed negative impacts of tropical cyclones. The *agriculture, hunting, forestry, and fishing* sector aggregate first depicts negative growth rates, but then quickly recovers after four years. Despite having the largest negative shock, destroyed capital is relatively quickly replaced. The situation is completely different in the *wholesale, retail trade, restaurants, and hotels* sector aggregate, where a negative influence can be observed over almost the entire 20 years period. This finding undermines the evidence

[14]The cumulative effects are calculated by F-Tests of the respective lag lengths, e.g., the coefficient and confidence intervals after two years are calculated by the F-Test: Damage+L1.Damage+L2.Damage. The tests are conducted with the STATA command parmest (Newson, 1998).

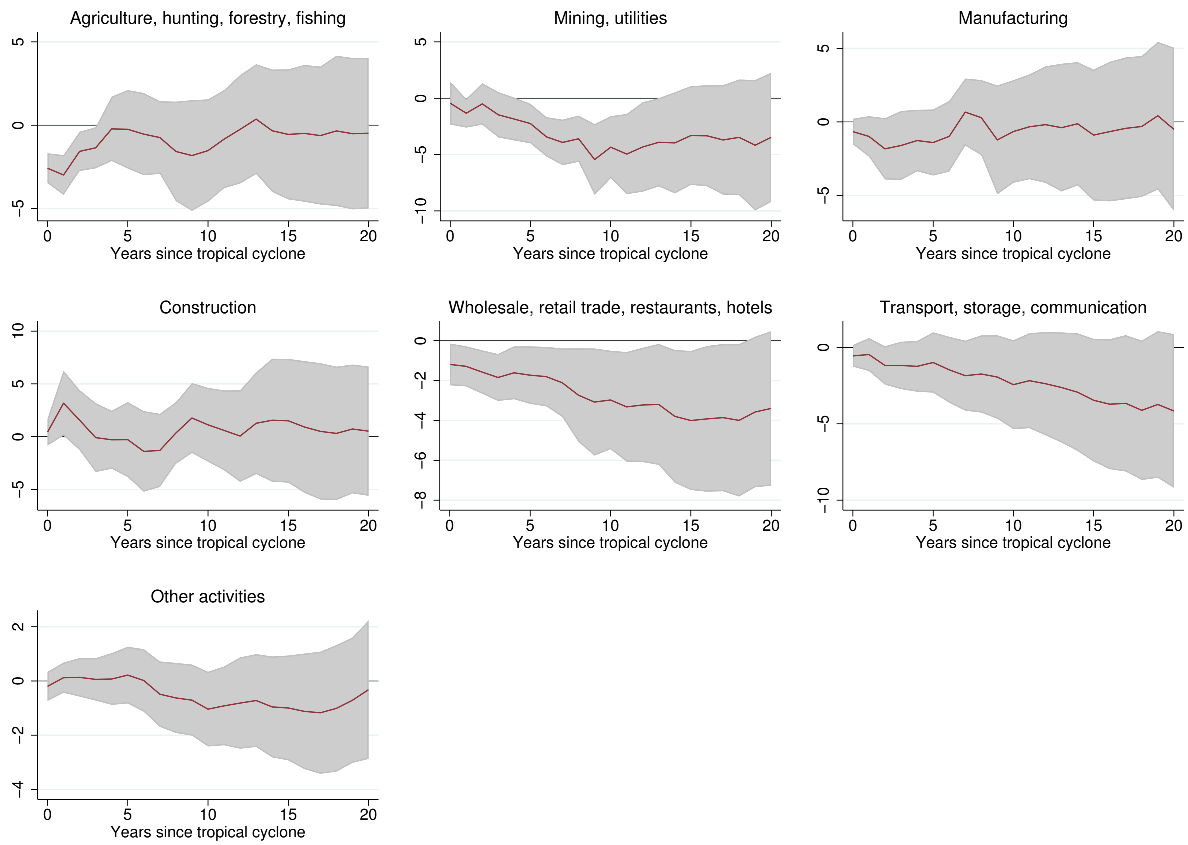

Figure 6: Cumulative point estimates of the past influence of tropical cyclone damages up to 20 years on the respective per capita growth rates. The y-axis displays the cumulative coefficient of tropical cyclone damages and the x-axis shows the years since the tropical cyclone passed. The grey areas represent the respective 95% confidence interval and the red line to respective cumulative point estimates. The underlying estimations can be found in Tables 12-13 in Appendix A.4.

presented in the main specification: People shift their consumption away from this sector aggregate and avoid restaurants and hotels in devastated areas, even several years after the occurrence of a tropical cyclone. Surprisingly, the sector aggregate *mining and utilities* turns negative three years after the tropical cyclone has hit the country. As section 4.2 shows, this effect may be driven by less demand from the *manufacturing* sectors. If we look at the underlying estimates in Tables 12-13 in Appendix A.4, we can see that the *transport, storage, communication* sectoral aggregate also turns negative, at least at the 90% confidence interval.[15]

In total, the majority of all sectoral aggregates experience lagged negative growth effects due to tropical cyclones. This finding clearly opposes the *build-back-better* hypothesis as well as the

[15] After one year we can also detect a positive effect in the construction sector, which is not surprising given the higher number of orders due to reconstruction efforts.

recovery to trend hypothesis. It rather points to the presence of (delayed) negative effects of tropical cyclones, from which the sectors cannot recover. The result offers a better understanding of the finding of Hsiang & Jina (2014), who show that tropical cyclones have long lasting negative impacts on GDP growth, by demonstrating which sectors are responsible for the long-lasting GDP downturn that they identify. Additionally, this finding undermines the urgency to analyze past influences beyond one or two years when looking at the economic impacts of natural disasters.

4.2 Indirect Effects

The analysis of the past influences of tropical cyclones damages demonstrates that the sectoral growth response following a tropical cyclone is a complex undertaking. It remains unclear if there exists some key sector, which, if damaged, results in a negative shock for the other sectors. Additionally, it is unexplained how the sectors are interconnected and if their structural dependence changes. Therefore, in this section, I investigate by means of the Input-Output analysis, how the sectors change their interaction after a tropical cyclone has hit a country. This will give further insights into whether production processes are seriously distorted by tropical cyclones. To my best knowledge, this is the first paper that analyzes globally sectoral interactions after the occurrence of a tropical cyclone.

Since the sample period is reduced to 1990-2015 due to data availability, I have re-estimated the regression model of the main specification 2 for the reduced sample of model 6. Table 21 in Appendix A.4 reveals that even with the smaller sample, all previously found effects can be identified again. Hence, we can be sure that the reduced sample size does not drive the new results.

Figure 7 illustrates the connections of significant changes of the Input-Output coefficient together with the relative effect size (in %) resulting from model 6. The coefficients are the effects of a standard deviation increase in tropical cyclone damages on the average Input-Output coefficient of the respective sector aggregates relative to their sample averages (in %).[16] For example, due to a standard deviation increase of tropical cyclone damages, the *manufacturing* sectors use 0.66% less input from the construction sector aggregate relative to the average Input-Output coefficient (0.0045) to produce one unit of output. The red and green arrow colors represent significant negative and positive effects, whereas the color intensities stand for different p-values. Circle sizes

[16]The underlying estimations can be found in Tables 14-20 in Appendix A.4.

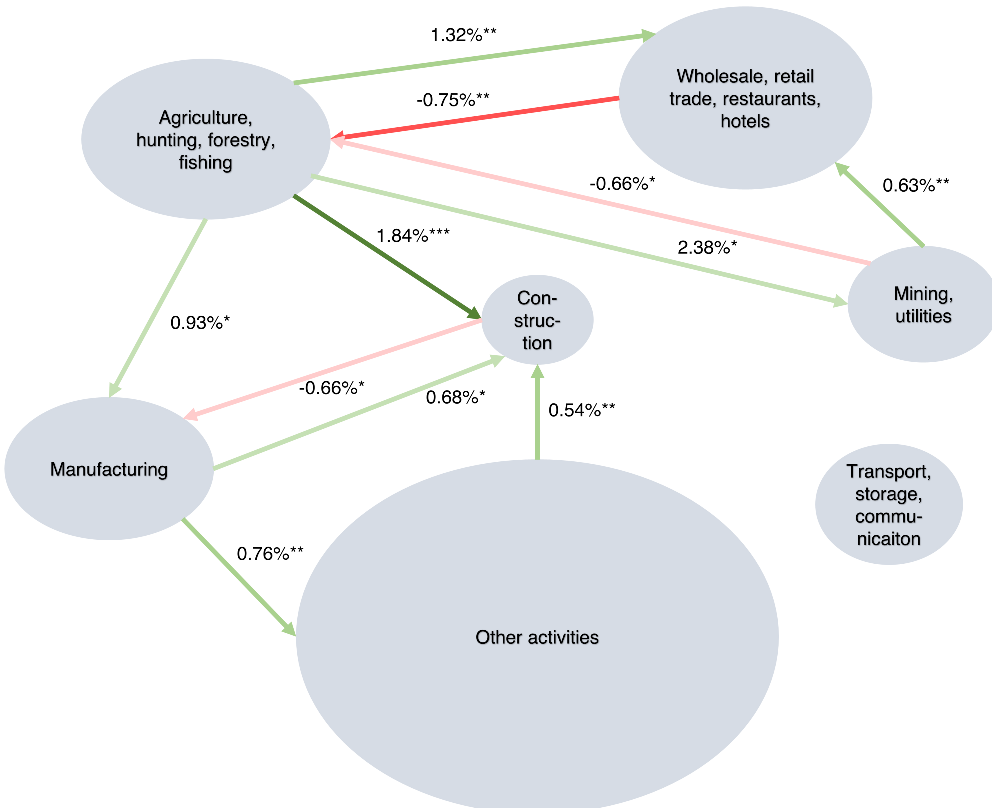

Figure 7: Significant effects of a standard deviation increase in tropical cyclone damage on the Input-Output coefficient compared to their respective sample average (in %). Circle size is proportional to the average sectoral share on total GDP. The arrows depict all significant coefficients between the sectoral aggregates, with negative coefficients in red and positive in green. The start of the arrow shows the input and the end of the respective output. Asterisks and color intensities indicate p-values according to: *** p<0.01, ** p<0.05, * p<0.1.

represent the average proportional share on total GDP ranging from 32% (*other activities*), over 12% (*manufacturing*) to 6% (*construction*).[17]

Tropical cyclones only lead to a small number of production process changes with coefficients being relatively small. Out of 49 parameter estimates, only 12 are significantly different from zero.[18] As expected, the heavily damaged *agriculture, hunting, forestry, and fishing* sector aggregate experiences the most changes. It asks less input from the *wholesale, retail trade, restaurants, hotels* and *mining and utilities* sector aggregate, which results from a supply shock in the agricultural sector. At the same time, the *construction* sector demands significantly more input (1.84%) from it. This change can be regarded as reconstruction efforts, reflected also in the relatively rapid

[17]The other proportional shares on total GDP are: *Wholesale, retail trade, restaurants, hotels* (15%); *agriculture, hunting, forestry, fishing* (14%); *mining and utilities* (10%); *transport, storage, communication* (8%).
[18]The manufacturing sectors use significantly less input from itself, which is not shown in Figure 7.

recovery of the agricultural sector aggregate in Figure 6. The second most indirectly affected sector is the *construction* sector. It demands more input from three other sector aggregates, while the *manufacturing* sectors use less input from it. Given these positive demand effects, one may ask why one cannot see a significant contemporaneous positive direct effect for the *construction* sector. One reason could be that the destruction of productive capital outweighs the higher number of orders. However, one year later, as shown in Figure 6, these positive demand shocks lead to a positive growth impulse in the *construction* sector. I also tested for lagged cumulative effects. The results can be found in Figure 16 in Appendix A.4. It shows that there are nearly no lagged responses present.[19]

Since the EORA26 database also offers the data decomposed for 26 sectors, this section shows the results of model 6 in more detail. Since it would be tedious to show 26x26 regression models, Figure 8 reduces the complexity of the analysis by showing only the sign of the significant coefficients together with color intensities representing different p-values.

Figure 8 reveals some patterns which are not visible on the aggregate level. The most interesting

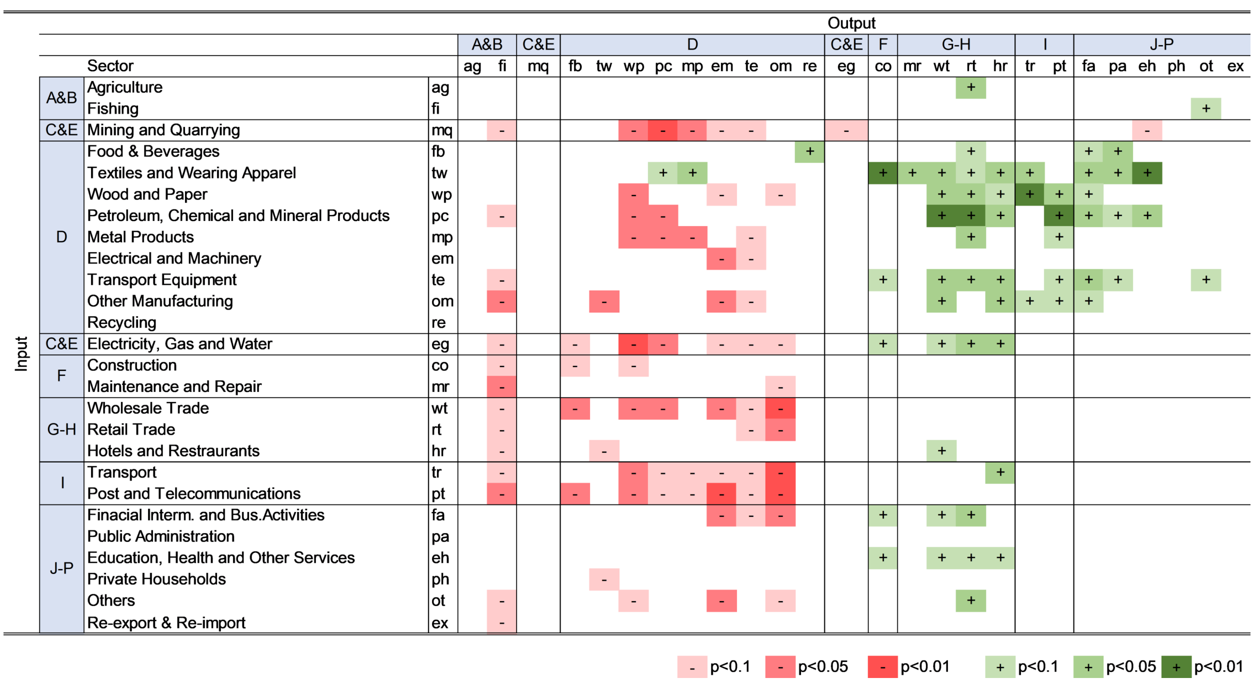

Figure 8: Significant effects of an increase in tropical cyclone damage on the Input-Output coefficient. The colored areas depict all significant coefficients between the sectors, with negative coefficients in red and positive in green. Asterisks and color intensities indicate p-values according to: p<0.01, p<0.05, p<0.1.

[19] I also checked for different lag length, but could hardly find any effect above a lag length of five years.

changes can be observed within the single sectors of the *manufacturing (D)* aggregate. They ask significantly less input from other sector aggregates, while at the same time, sectors from other aggregates ask more input from the *manufacturing* sectors. These opposing production changes may be one of the reasons why we can see no aggregate direct cost effects. Nevertheless, it unveils the importance of the *manufacturing* sectors as already demonstrated by their strong intersectoral connection in Figure 4. The sectors least affected by indirect changes are the *agriculture (ag), recycling (re), private households (ph)*, and *export (ex)* sectors. Figure 8 also offers an explanation for the downturn of the *mining and utilities (C&E)* sector aggregate after some years as shown in Figure 6: The *manufacturing* sectors ask significantly less input from it. Additionally, it seems that the *fishing* sector is responsible for the negative supply shock in the *agriculture, hunting, forestry, and fishing* sector aggregate.

We can learn from this analysis that many potential production changes cancel out because of counteracting indirect effects. This may be the reason why on the aggregate level for indirect influences (see Figure 7), we can only see significant changes in one quarter of all Input-Output connections, while in model 4 for the direct costs only two sector aggregates are negatively affected. Further, albeit the *manufacturing* sector shows no direct monetary damages, it is responsible for several changes in the production schemes of other sectors, leading to a monetary downturn in the *mining and utilities (C&E)* sectoral aggregate.

4.3 Sensitivity Analysis

To underline the credibility of my regression analyses, I test the sensitivity of my results in various ways. First, I run two randomization tests: a Placebo test by using leads instead of the contemporaneous measure of the *damage* variable and a Fisher randomization test where I randomly permute over years.[20] Second, to rule out potential omitted variable biases, I include additional climatological variables (precipitation and temperature) and a set of socioeconomic variables (population growth rate, economic openness, the growth rate of the gross capital formation, logged per capita

[20]For the Placebo test I have to forward the *damage* variable by two periods, since the *damage* in t index consists of the affected agricultural land/exposed population in *t-1*. To implement the Fisher randomization test, I use the code generated by Heß (2017) and randomly permute between years of the tropical cyclone damage variable for 2000 repetitions. By doing so I test the null-hypothesis of no effect of the damage variable.

value added of the respective sector).[21] Third, I test different trend specifications: region-specific, nonlinear, and no trends at all. Fourth, to take care of concerns of biased uncertainty measures (Hsiang, 2016), I calculate different standard errors: Newey-West standard errors with a lag length of 10 years, and Conley-HAC standard errors, allowing for a spatial and temporal dependence within a radius of 1000 kilometers and within a time span of 10 years. Furthermore, I cluster the standard errors at broader regional levels to account for the event that tropical cyclones can also affect neighboring countries within one region.[22] Finally, I test two sub-samples, one with all potential outliers and one where I include only countries exposed to tropical cyclones.[23]

Appendix A.5 shows the resulting robustness tests for the direct and indirect sectoral effects.[24] For the direct sectoral effects, the significant results remain robust in all different specifications underlining their credibility for the empirical model used. While the placebo test yield no significant coefficients, the coefficients and p-value remain relatively stable in all remaining robustness tests, as summarized in Figure 18. Further, the results of the randomization test show that the H_0 of no effect of tropical cyclone damages can be rejected at the 1% and 5% level of confidence for the *agriculture, hunting, forestry, and fishing* and *wholesale, retail trade, restaurants, and hotels* sectors respectively. The results of the Input-Output analysis, summarized in Appendix A.5.2, are a little less robust. However, on average, the previously found effects can be replicated for ten out of the 12 robustness tests.[25] Given the reduced quality of the data and a shorter time span (20 years), the Input-Output analysis still offers solid results.

5 Conclusion

This study gives an explanation of which sectors contribute to an overall negative GDP-effect identified by previous studies (Strobl, 2012; Elliott et al., 2015; Noy, 2009). To quantify the destructiveness of tropical cyclones, I construct a new damage measure based on meteorological data

[21] Since climatological impacts are most likely nonlinear, I also include squared precipitation and temperature in a further robustness test.

[22] These regions include East Asia & Pacific, Europe & Central Asia, Latin America & Caribbean, Middle East & North Africa, North America, South Asia, and Sub-Saharan Africa.

[23] Exposed countries are defined as having at least one positive *damage* observation over the sample period.

[24] Appendix A.5 first shows the results of the randomization tests, followed by coefficient plots that summarize the remaining specifications. The underlying tables are only included for the direct sectoral effects, while the robustness tables for the Input-Output analysis are available upon request.

[25] The robustness tests which frequently fail are the one with Conley-HAC and Newey-West standard errors.

weighted by different exposure of the sectors. I show that tropical cyclones have a significantly negative impact on the annual growth rate of two sectoral aggregates: *agriculture, hunting, forestry, and fishing*, and *wholesale, retail trade, restaurants, and hotels.* The dynamic analysis reveals that past tropical cyclones have a negative influence on the majority of sectors providing evidence for the *no recovery* hypothesis discussed in the literature. The Input-Output analysis shows that production processes are only slightly disturbed by tropical cyclones. However, we still can learn from this analysis of how certain direct effects evolve.

The outcomes of this study can serve as a guide for local governments as well as international organizations to revise and refine their adaptation and mitigation strategies. The findings can help them to identify the sectors for which they need to reduce disaster risk. The results indicate that the policies should focus on the direct costs of tropical cyclones. Immediately after the disaster, the policy should concentrate on *agriculture, hunting, forestry, and fishing*, and the *wholesale, retail trade, restaurants, and hotels* sector aggregates, as they are most vulnerable, and/or recovery measures were not conducted efficiently in these sectors. Likewise, the contemporaneous non-significant effect for the remaining sectors can be a result of lower vulnerability, and/or efficient recovery measures, which attenuate the potentially negative effect of tropical cyclones. In the years following the tropical cyclone, the efforts should be broadened to support the *mining, and utilities*, as well as the *transport, storage, and communication* sectors. Most worryingly, the majority of all sectors experience delayed negative effects underpinning how far away the international community still is from a “build-back better” or “recovery to trend” situation for tropical cyclone-affected economies. As the *manufacturing* sectors are responsible for much of counterbalancing indirect effects, they should not be forgotten by the policymakers, even though they show no direct negative effects.

Better post-disaster assistance is not the only required improvement; policymakers should also find ways to better prepare the affected sectors of their economy to possible effects of tropical cyclones before they strike. However, the presented results are generalized for at most 205 countries, and every specific country should make an analysis of their specific vulnerability and individual exposure. Nonetheless, the results can provide general guidance for international disaster relief organizations, which are active in various countries on how to direct their long-run disaster relief programs. The results are particularly pressing, as tropical cyclones will intensify due to global warming and simultaneously more people will be exposed to tropical cyclones. In this respect, the results can also be used to calculate the future costs of climate change.

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A Appendices

A.1 Tropical Cyclone Data

The unified data of the IBTrACS dataset identifies each storm uniquely by assigning an identification number, its geospatial position and its intensity given by maximum sustained wind speed and minimum sea level pressure. The data are reported at six-hour intervals. Data from IBTrACS are available from 1842 until today, but global coverage of the measurement has only been guaranteed since the start of satellite remote sensing in the late 1970s (Schreck et al., 2014). However, this restriction is for the most part only a concern for non-land-falling tropical cyclones as land-falling tropical cyclones were already covered by the other measurement methods (Knapp, 2016). For my analysis, I use the latest published version, the "IBTrACS-All data" version v03r09, for the 1950-2015 period.

One pitfall of the IBTrACS data is that the data of the maximum sustained wind speed of the different weather agencies are aggregated according to different rules. Weather agencies in the North Atlantic basin use the maximum sustained wind speed average over a one-minute period, agencies from China and Hong Kong use two-minute periods, agencies from India use three-minute periods, and the remaining agencies use ten-minute periods, which is the norm of the World Meteorological Organization (Kruk et al., 2010). As the conversion factor to consistent ten-minute averages is contested, the IBTrACS dataset stopped converging it since version 03 (Kruk et al., 2010). This inconsistent measurement introduces a measurement error in the data, where maximum sustained wind speed over a one-minute period is approximately 13% higher than over a ten-minute period (National Weather Service, 2015). However, this bias can partly be attenuated by country fixed effects.

A.2 Detailed Description ISIC Sector Classification

A) Agriculture, hunting and forestry

1) Agriculture, hunting and related service activities
2) Forestry, logging and related service activities

B) Fishing

3) Fishing, aquaculture and service activities incidental to fishing

C) Mining and quarrying

4) Mining of coal and lignite; extraction of peat
5) Extraction of crude petroleum and natural gas; service activities in-cidental to oil and gas extraction, excluding surveying
6) Mining of uranium and thorium ores
7) Mining of metal ores
8) Other mining and quarrying

D) Manufacturing

9) Manufacture of food products and beverages
10) Manufacture of tobacco products
11) Manufacture of textiles
12) Manufacture of wearing apparel; dressing and dyeing of fur
13) Tanning and dressing of leather; manufacture of luggage, hand-bags, saddlery, harness and footwear
14) Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
15) Manufacture of paper and paper products
16) Publishing, printing and reproduction of recorded media
17) Manufacture of coke, refined petroleum products and nuclear fuel
18) Manufacture of chemicals and chemical products
19) Manufacture of rubber and plastics products
20) Manufacture of other non-metallic mineral products
21) Manufacture of basic metals
22) Manufacture of fabricated metal products, except machinery and equipment
23) Manufacture of machinery and equipment n.e.c.
24) Manufacture of office, accounting and computing machinery
25) Manufacture of electrical machinery and apparatus n.e.c.
26) Manufacture of radio, television and communication equipment and apparatus
27) Manufacture of medical, precision and optical instruments, watch-es and clocks
28) Manufacture of motor vehicles, trailers and semi-trailers
29) Manufacture of other transport equipment
30) Manufacture of furniture; manufacturing n.e.c.
31) Recycling

E) Electricity, gas and water supply

32) Electricity, gas, steam and hot water supply
33) Collection, purification and distribution of water

F) Construction

34) Construction

G) Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods

35) Sale, maintenance and repair of motor vehicles and motorcycles; re-tail sale of automotive fuel
36) Wholesale trade and commission trade, except of motor vehicles and motorcycles
37) Retail trade, except of motor vehicles and motorcycles; repair of per-sonal and household goods

H) Hotels and restaurants

38) Hotels and restaurants

I) Transport, storage and communication

39) Land transport; transport via pipelines
40) Water transport
41) Air transport
42) Supporting and auxiliary transport activities; activities of travel agencies
43) Post and telecommunications

J) Financial intermediation

44) Financial intermediation, except insurance and pension funding
45) Insurance and pension funding, except compulsory social security
46) Activities auxiliary to financial intermediation

K) Real estate, renting and business activities

47) Real estate activities
48) Renting of machinery and equipment without operator and of per-sonal and household goods
49) Computer and related activities
50) Research and development
51) Other business activities

L) Public administration and defence; compulsory social security

52) Public administration and defence; compulsory social security

M) Education

53) Education

N) Health and social work

54) Health and social work

O) Other community, social and personal service activities

55) Sewage and refuse disposal, sanitation and similar activities
56) Activities of membership organizations n.e.c.
57) Recreational, cultural and sporting activities
58) Other service activities

P) Activities of private households as employers and undifferentiated production activities of private households

59) Activities of private households as employers of domestic staff
60) Undifferentiated goods-producing activities of private households for own use
61) Undifferentiated service-producing activities of private households for own use

Q) Extraterritorial organizations and bodies

62) Extraterritorial organizations and bodies

A.3 Definitions and Sources of Variables

Table 2: Definitions and sources of variables

Variable	Definition	Units	Source
Growth rate pc sector A&B	Annual per capita growth rate of the ISIC sector A&B: agriculture, hunting, forestry, and fishing	2005 const. $, %	United Nations Statistical Division (2015c)
Growth rate pc sector C&E	Annual per capita growth rate of the ISIC sector C&E: mining, manufacturing, and utilities	2005 const. $, %	United Nations Statistical Division (2015c)
Growth rate pc sector D	Annual per capita growth rate of the ISIC sector D: manufacturing	2005 const. $, %	United Nations Statistical Division (2015c)
Growth rate pc sector F	Annual per capita growth rate of the ISIC sector F: construction	2005 const. $, %	United Nations Statistical Division (2015c)
Growth rate pc sector G-H	Annual per capita growth rate of the ISIC sector G-H: wholesale, retail trade, restaurants, hotels	2005 const. $, %	United Nations Statistical Division (2015c)
Growth rate pc sector I	Annual per capita growth rate of the ISIC sector I: transport, storage, communication	2005 const. $, %	United Nations Statistical Division (2015c)
Growth rate pc sector J-P	Annual per capita growth rate of the ISIC sector J-P: other activities	2005 const. $, %	United Nations Statistical Division (2015c)
Input-Output coefficients	Input-Output coefficients: Specific input divided by total input		Lenzen et al. (2012, 2013)
Damage	Weighted cubic wind speed by exposed population or agricultural land	km^3/h^3	Own modeling after Knapp et al. (2010)
Population Count	Population counts	Inhabitants/gridcell	Klein Goldewijk et al. (2011)
Cropland	Total cropland area	km^2/gridcell	Klein Goldewijk et al. (2011)
Grazing Land	Total land used for grazing	km^2/gridcell	Klein Goldewijk et al. (2011)
Temperature	Yearly mean air temperature	Degree Celsius	University of East Anglia Climatic Research Unit et al. (2017)
Precipitation	Yearly precipitation	mm	University of East Anglia Climatic Research Unit et al. (2017)
Log pc value added	Logarithm of the per capita value added of the respective ISIC sector	2005 const. $	United Nations Statistical Division (2015c)
Trade openness	Imports plus exports divided by GDP	2005 const. $, %	United Nations Statistical Division (2015c)
Population growth	Annual population growth rate	%	United Nations Statistical Division (2015c)
Capital growth	Annual growth rate of the gross capital formation	2005 const. $, %	United Nations Statistical Division (2015c)

A.4 Additional Statistics and Results

Table 3: Summary statistics

Variable	Obs.	Mean	St. dev.	Min	Max	Mean if storm	St. dev. if storm
Damage (agriculture)	8,750	74,433.30	600,971.10	0.00	23700000.00	174,749.50	911,327.40
Damage (population)	8,750	74,753.80	613,559.80	0.00	25100000.00	175,501.90	930,734.80
Growth rate pc sector A&B	8,500	0.88	10.63	-80.28	167.28	1.04	9.08
Growth rate pc sector C&E	8,500	3.75	30.44	-99.75	995.48	4.07	23.27
Growth rate pc sector D	8,500	2.61	26.63	-95.24	1,745.50	2.29	9.88
Growth rate pc sector F	8,500	3.24	25.78	-96.31	1,453.02	2.67	14.62
Growth rate pc sector G-H	8,500	2.53	12.74	-80.57	459.62	2.33	7.26
Growth rate pc sector I	8,500	3.70	15.50	-91.94	659.28	3.51	7.36
Growth rate pc sector J-P	8,500	2.55	10.45	-77.67	375.99	2.55	5.34
Temperature	8,229	19.77	8.25	-17.30	29.60	20.14	8.66
Precipitation	8,229	1,247.85	867.93	9.80	6,699.00	1,543.78	888.15
Log pc value added A&B	8,683	5.40	0.79	2.34	8.23	5.47	0.76
Log pc value added C&E	8,676	4.97	2.23	-4.13	11.26	5.09	2.04
Log pc value added D	8,683	5.66	1.82	-3.06	10.52	5.97	1.77
Log pc value added F	8,685	5.06	1.85	-1.97	9.31	5.42	1.79
Log pc value added G-H	8,684	6.04	1.67	0.49	10.30	6.41	1.59
Log pc value added I	8,683	5.36	1.76	-0.84	9.23	5.68	1.66
Log pc value added J-P	8,685	6.78	1.92	0.43	11.03	7.14	1.87
Trade openness	8,428	195.47	834.45	0.07	18,015.42	1,116.75	0.10
Population growth	8,500	1.73	1.94	-54.70	19.27	1.39	-16.55
Capital growth	8,293	6.27	30.73	-376.22	1,263.33	4.89	19.50

Table 4: Summary statistics Input-Output coefficients

	Obs.	Mean	St. dev.	Min	Max
$IO^{A\&B,A\&B}$	4647	.1662722	.1709245	1.00e-06	.974811
$IO^{A\&B,C\&E}$	4647	.0121479	.0124637	4.56e-06	.1369842
$IO^{A\&B,D}$	4647	.0846725	.0552218	.000056	.299829
$IO^{A\&B,F}$	4647	.0037546	.0043553	0	.131224
$IO^{A\&B,G\text{-}H}$	4647	.0356446	.0355103	4.56e-08	.4175104
$IO^{A\&B,I}$	4647	.0219238	.0179971	9.25e-06	.1859521
$IO^{A\&B,J\text{-}P}$	4647	.070706	.0536481	.000173	.4691
$IO^{C\&E,A\&B}$	4647	.0008422	.0016779	3.97e-08	.0258813
$IO^{C\&E,C\&E}$	4647	.1514745	.1176578	.0000802	.9996359
$IO^{C\&E,D}$	4647	.0537984	.0564091	.000087	.884369
$IO^{C\&E,F}$	4647	.0277999	.0226761	2.06e-08	.1834678
$IO^{C\&E,G\text{-}H}$	4647	.0192595	.0145801	1.29e-06	.1063142
$IO^{C\&E,I}$	4647	.0486505	.0301493	.000016	.398454
$IO^{C\&E,J\text{-}P}$	4647	.0881599	.0518342	.0000348	.4748183
$IO^{D,A\&B}$	4647	.0563642	.0542414	1.42e-07	.5359839
$IO^{D,C\&E}$	4647	.0393183	.0466088	.000141	.60063
$IO^{D,D}$	4647	.2399205	.1103603	.000605	.998675
$IO^{D,F}$	4647	.0045227	.002871	7.39e-08	.0316864
$IO^{D,G\text{-}H}$	4647	.0536236	.0230651	4.00e-06	.214414
$IO^{D,I}$	4647	.0359096	.0153304	.0000742	.1480716
$IO^{D,J\text{-}P}$	4647	.0855877	.040535	.0000556	.3476429
$IO^{F,A\&B}$	4647	.0033265	.0053454	0	.080139
$IO^{F,C\&E}$	4647	.0161254	.0139202	2.74e-07	.1273087
$IO^{F,D}$	4647	.2098782	.0715656	8.39e-07	.4854064
$IO^{F,F}$	4647	.0395914	.0822892	0	.996022
$IO^{F,G\text{-}H}$	4647	.0645109	.0290355	1.10e-06	.2101925
$IO^{F,I}$	4647	.0395516	.0194235	4.22e-06	.1451188
$IO^{F,J\text{-}P}$	4647	.098781	.0484502	.000022	.376105
$IO^{G\text{-}H,A\&B}$	4647	.0084109	.010755	1.65e-06	.1156533
$IO^{G\text{-}H,C\&E}$	4647	.0158055	.0088905	9.37e-06	.0968774
$IO^{G\text{-}H,D}$	4647	.0711979	.0433933	4.00e-06	.624181
$IO^{G\text{-}H,F}$	4647	.0061702	.0042947	5.93e-09	.0553494
$IO^{G\text{-}H,G\text{-}H}$	4647	.053871	.0695904	.0000693	.9245332
$IO^{G\text{-}H,I}$	4647	.061231	.0328779	.000019	.473436
$IO^{G\text{-}H,J\text{-}P}$	4647	.1391351	.0555886	.0003702	.5434914
$IO^{I,A\&B}$	4647	.0004068	.0012979	2.22e-08	.015707
$IO^{I,C\&E}$	4647	.0099685	.0087259	.00002	.099051
$IO^{I,D}$	4647	.0620294	.0393132	.0000266	.3060028
$IO^{I,F}$	4647	.0087888	.0061438	2.04e-08	.0458489
$IO^{I,G\text{-}H}$	4647	.0276095	.0295263	3.00e-06	.252107
$IO^{I,I}$	4647	.1094513	.0749535	.0000306	.9978023
$IO^{I,J\text{-}P}$	4647	.1300935	.0564797	.0001369	.313433
$IO^{J\text{-}P,A\&B}$	4647	.0026576	.0092353	6.00e-06	.257432
$IO^{J\text{-}P,C\&E}$	4647	.0122318	.0075814	.000102	.0716968
$IO^{J\text{-}P,D}$	4647	.0565184	.029694	.0000751	.2703193
$IO^{J\text{-}P,F}$	4647	.0173059	.0090651	0	.076051
$IO^{J\text{-}P,G\text{-}H}$	4647	.0231643	.0119405	.0000253	.1070365
$IO^{J\text{-}P,I}$	4647	.0318075	.0144938	.0000448	.1364643
$IO^{J\text{-}P,J\text{-}P}$	4647	.1450746	.0787744	.000394	.740301

Table 5. The past influence of wind speed damages on sectoral growth rates

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Agriculture, hunting, forestry, fishing	Agriculture, hunting, forestry, fishing	Agriculture, hunting, forestry, fishing	Agriculture, hunting, forestry, fishing
	(1)	(2)	(3)	(4)
$Damage_{t}$	-2.6275***	-2.6406***	-2.5945***	-2.5847***
	(0.4531)	(0.4556)	(0.4503)	(0.4556)
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
$Damage_{t-1}$	-0.4314	-0.4681	-0.4076	-0.4047
	(0.4467)	(0.4532)	(0.4500)	(0.4497)
	[0.3353]	[0.3029]	[0.3662]	[0.3691]
$Damage_{t-2}$	1.4378***	1.4368***	1.4179***	1.4161***
	(0.3995)	(0.4028)	(0.4083)	(0.4022)
	[0.0004]	[0.0005]	[0.0006]	[0.0005]
$Damage_{t-3}$	0.2373	0.2169	0.2185	0.2152
	(0.3331)	(0.3256)	(0.3279)	(0.3305)
	[0.4771]	[0.5060]	[0.5059]	[0.5156]
$Damage_{t-4}$	1.1155*	1.1231*	1.1233*	1.1374*
	(0.5863)	(0.5828)	(0.5793)	(0.5818)
	[0.0585]	[0.0553]	[0.0539]	[0.0519]
$Damage_{t-5}$	-0.0860	-0.0638	-0.0172	-0.0268
	(0.3097)	(0.3083)	(0.3104)	(0.3077)
	[0.7815]	[0.8363]	[0.9559]	[0.9306]
$Damage_{t-6}$		-0.3046	-0.3012	-0.2889
		(0.4460)	(0.4259)	(0.4235)
		[0.4953]	[0.4802]	[0.4958]
$Damage_{t-7}$		-0.1822	-0.1972	-0.2056
		(0.5307)	(0.5404)	(0.5513)
		[0.7317]	[0.7156]	[0.7095]
$Damage_{t-8}$		-0.8401	-0.8437	-0.8357
		(1.2063)	(1.1881)	(1.1967)
		[0.4870]	[0.4784]	[0.4858]
$Damage_{t-9}$		-0.2056	-0.2377	-0.2458
		(0.4608)	(0.4477)	(0.4542)
		[0.6559]	[0.5960]	[0.5890]
$Damage_{t-10}$		0.2774	0.2851	0.2979
		(0.4825)	(0.4631)	(0.4773)
		[0.5659]	[0.5387]	[0.5332]
$Damage_{t-11}$			0.6831	0.6864
			(0.7825)	(0.7740)
			[0.3837]	[0.3762]
$Damage_{t-12}$			0.5987	0.5896
			(0.4491)	(0.4456)
			[0.1841]	[0.1873]
$Damage_{t-13}$			0.5975**	0.6132**
			(0.3017)	(0.3059)
			[0.0490]	[0.0463]
$Damage_{t-14}$			-0.6914*	-0.6979*
			(0.4100)	(0.4051)
			[0.0932]	[0.0865]
$Damage_{t-15}$			-0.2214	-0.2189
			(0.4041)	(0.4006)
			[0.5844]	[0.5854]
$Damage_{t-16}$				0.0631
				(0.2907)
				[0.8283]
$Damage_{t-17}$				-0.1343
				(0.3827)
				[0.7261]
$Damage_{t-18}$				0.2813
				(0.3274)
				[0.3912]
$Damage_{t-19}$				-0.1659
				(0.5556)
				[0.7655]
$Damage_{t-20}$				0.0244
				(0.1876)
				[0.8966]
N	8,500	8,500	8,500	8,500
Clusters	205	205	205	205
P-value	0.0000	0.0000	0.0000	0.0000
Mean DV	0.8800	0.8800	0.8800	0.8800
SD Damage	1,706,646	1,706,646	1,706,646	1,706,646

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects as well as country-specific linear trends.

Table 6. The past influence of wind speed damages on sectoral growth rates

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Mining, utilities	Mining, utilities	Mining, utilities	Mining, utilities
	(1)	(2)	(3)	(4)
$Damage_t$	-0.6876	-0.5101	-0.4927	-0.4347
	(0.8734)	(0.9150)	(0.8834)	(0.9616)
	[0.4321]	[0.5778]	[0.5776]	[0.6517]
$Damage_{t-1}$	-0.7455	-0.8769	-0.8343	-0.8934
	(0.7873)	(0.8026)	(0.7857)	(0.8479)
	[0.3448]	[0.2759]	[0.2896]	[0.2933]
$Damage_{t-2}$	0.7484	0.7583	0.8130	0.8259
	(0.6098)	(0.6138)	(0.6176)	(0.6286)
	[0.2212]	[0.2181]	[0.1895]	[0.1904]
$Damage_{t-3}$	-0.9537**	-0.9694**	-0.9714**	-0.9672**
	(0.4539)	(0.4599)	(0.4579)	(0.4729)
	[0.0368]	[0.0363]	[0.0351]	[0.0421]
$Damage_{t-4}$	-0.3247	-0.3908	-0.3862	-0.3796
	(0.3517)	(0.3638)	(0.3695)	(0.3960)
	[0.3569]	[0.2840]	[0.2972]	[0.3389]
$Damage_{t-5}$	-0.4838*	-0.4029*	-0.3679	-0.3992
	(0.2583)	(0.2437)	(0.2536)	(0.2476)
	[0.0625]	[0.0998]	[0.1484]	[0.1085]
$Damage_{t-6}$		-1.1859**	-1.2196**	-1.1819**
		(0.4730)	(0.5131)	(0.4967)
		[0.0129]	[0.0184]	[0.0183]
$Damage_{t-7}$		-0.5146	-0.4506	-0.4911
		(0.3822)	(0.3920)	(0.4168)
		[0.1797]	[0.2517]	[0.2400]
$Damage_{t-8}$		0.2670	0.2856	0.3268
		(0.3256)	(0.3305)	(0.3144)
		[0.4131]	[0.3885]	[0.2998]
$Damage_{t-9}$		-1.8192*	-1.8233*	-1.8472*
		(1.0021)	(1.0098)	(1.0186)
		[0.0709]	[0.0725]	[0.0712]
$Damage_{t-10}$		0.9977	1.0499	1.1008
		(0.6531)	(0.6605)	(0.6855)
		[0.1281]	[0.1135]	[0.1098]
$Damage_{t-11}$			-0.5780	-0.6148
			(0.5170)	(0.5562)
			[0.2648]	[0.2703]
$Damage_{t-12}$			0.6477	0.6350
			(0.4428)	(0.4434)
			[0.1451]	[0.1536]
$Damage_{t-13}$			0.3826	0.4128
			(0.5633)	(0.5500)
			[0.4977]	[0.4537]
$Damage_{t-14}$			-0.0418	-0.0526
			(0.6378)	(0.6398)
			[0.9478]	[0.9345]
$Damage_{t-15}$			0.6175	0.6515
			(0.7947)	(0.8284)
			[0.4381]	[0.4325]
$Damage_{t-16}$				-0.0241
				(0.8067)
				[0.9762]
$Damage_{t-17}$				-0.3680
				(0.5713)
				[0.5202]
$Damage_{t-18}$				0.2299
				(0.5707)
				[0.6874]
$Damage_{t-19}$				-0.6999
				(0.5209)
				[0.1805]
$Damage_{t-20}$				0.7053
				(0.8842)
				[0.4260]
N	8,500	8,500	8,500	8,500
Clusters	205	205	205	205
P-value	0.0000	0.0000	0.0000	0.0000
Mean DV	3.7458	3.7458	3.7458	3.7458
SD Damage	1,740,224	1,740,224	1,740,224	1,740,224

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects as well as country-specific linear trends.

Table 7. The past influence of wind speed damages on sectoral growth rates

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Manufacturing	Manufacturing	Manufacturing	Manufacturing
	(1)	(2)	(3)	(4)
$Damage_t$	-0.7744	-0.6328	-0.5932	-0.6580
	(0.5118)	(0.4759)	(0.4708)	(0.4413)
	[0.1318]	[0.1852]	[0.2091]	[0.1375]
$Damage_{t-1}$	-0.3449	-0.3864	-0.4121	-0.3278
	(0.5540)	(0.5974)	(0.5993)	(0.6004)
	[0.5343]	[0.5184]	[0.4925]	[0.5857]
$Damage_{t-2}$	-0.8700	-0.8277	-0.8301	-0.8441
	(0.5939)	(0.5821)	(0.5779)	(0.5906)
	[0.1445]	[0.1566]	[0.1524]	[0.1545]
$Damage_{t-3}$	0.3528	0.2814	0.2392	0.2274
	(0.4764)	(0.4708)	(0.4590)	(0.4481)
	[0.4598]	[0.5508]	[0.6028]	[0.6123]
$Damage_{t-4}$	0.3191	0.3004	0.3181	0.3357
	(0.4506)	(0.4650)	(0.4647)	(0.4519)
	[0.4797]	[0.5190]	[0.4944]	[0.4585]
$Damage_{t-5}$	-0.2016	-0.1280	-0.1582	-0.1330
	(0.4904)	(0.4855)	(0.5077)	(0.5085)
	[0.6814]	[0.7923]	[0.7556]	[0.7939]
$Damage_{t-6}$		0.4072	0.4422	0.4179
		(0.4026)	(0.4073)	(0.4064)
		[0.3131]	[0.2788]	[0.3049]
$Damage_{t-7}$		1.6369**	1.6176**	1.6485**
		(0.7152)	(0.7124)	(0.7055)
		[0.0231]	[0.0242]	[0.0204]
$Damage_{t-8}$		-0.3192	-0.3443	-0.3760
		(0.5348)	(0.5369)	(0.5329)
		[0.5512]	[0.5221]	[0.4813]
$Damage_{t-9}$		-1.5212	-1.5311	-1.5149
		(0.9531)	(0.9427)	(0.9532)
		[0.1120]	[0.1059]	[0.1135]
$Damage_{t-10}$		0.6595	0.6194	0.5703
		(0.4769)	(0.4789)	(0.4961)
		[0.1682]	[0.1973]	[0.2517]
$Damage_{t-11}$			0.2667	0.3225
			(0.2858)	(0.3103)
			[0.3518]	[0.2999]
$Damage_{t-12}$			0.1428	0.1468
			(0.4045)	(0.4030)
			[0.7244]	[0.7161]
$Damage_{t-13}$			-0.1894	-0.2056
			(0.3984)	(0.4187)
			[0.6350]	[0.6238]
$Damage_{t-14}$			0.2558	0.2630
			(0.3295)	(0.3233)
			[0.4385]	[0.4168]
$Damage_{t-15}$			-0.7252*	-0.7666*
			(0.3965)	(0.4048)
			[0.0689]	[0.0597]
$Damage_{t-16}$				0.2342
				(0.3046)
				[0.4428]
$Damage_{t-17}$				0.2235
				(0.2860)
				[0.4354]
$Damage_{t-18}$				0.1259
				(0.2085)
				[0.5464]
$Damage_{t-19}$				0.7305*
				(0.3708)
				[0.0502]
$Damage_{t-20}$				-0.9221
				(0.6077)
				[0.1307]
N	8,500	8,500	8,500	8,500
Clusters	205	205	205	205
P-value	0.2321	0.1081	0.0087	0.0000
Mean DV	2.6095	2.6095	2.6095	2.6095
SD Damage	1,740,224	1,740,224	1,740,224	1,740,224

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects as well as country-specific linear trends.

Table 8. The past influence of wind speed damages on sectoral growth rates

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Construction	Construction	Construction	Construction
	(1)	(2)	(3)	(4)
$Damage_t$	0.6080	0.5245	0.4851	0.4199
	(0.6260)	(0.6393)	(0.6323)	(0.6430)
	[0.3325]	[0.4129]	[0.4439]	[0.5144]
$Damage_{t-1}$	2.6311**	2.6978**	2.7381**	2.7534**
	(1.1531)	(1.1470)	(1.1793)	(1.1488)
	[0.0235]	[0.0196]	[0.0212]	[0.0174]
$Damage_{t-2}$	-1.6493*	-1.6037*	-1.5749*	-1.6063*
	(0.8377)	(0.8226)	(0.8130)	(0.8257)
	[0.0503]	[0.0526]	[0.0541]	[0.0531]
$Damage_{t-3}$	-1.7602***	-1.6796***	-1.6273***	-1.6556***
	(0.4487)	(0.4626)	(0.4648)	(0.4489)
	[0.0001]	[0.0004]	[0.0006]	[0.0003]
$Damage_{t-4}$	-0.0905	-0.1140	-0.1654	-0.2049
	(0.6021)	(0.5750)	(0.5996)	(0.6076)
	[0.8806]	[0.8430]	[0.7829]	[0.7363]
$Damage_{t-5}$	0.0690	0.0223	0.0271	0.0113
	(0.7443)	(0.7373)	(0.7371)	(0.7475)
	[0.9262]	[0.9759]	[0.9707]	[0.9879]
$Damage_{t-6}$		-1.0995**	-1.0783**	-1.1177**
		(0.4633)	(0.4671)	(0.4647)
		[0.0186]	[0.0220]	[0.0171]
$Damage_{t-7}$		0.0687	0.0857	0.0964
		(0.4763)	(0.4669)	(0.4873)
		[0.8855]	[0.8545]	[0.8433]
$Damage_{t-8}$		1.6210*	1.6803*	1.6541*
		(0.9750)	(0.9757)	(0.9884)
		[0.0980]	[0.0866]	[0.0958]
$Damage_{t-9}$		1.4358**	1.4250**	1.4181**
		(0.6005)	(0.5921)	(0.5756)
		[0.0177]	[0.0170]	[0.0146]
$Damage_{t-10}$		-0.6059**	-0.5987**	-0.6467**
		(0.2685)	(0.2791)	(0.2885)
		[0.0251]	[0.0331]	[0.0261]
$Damage_{t-11}$			-0.5109	-0.5271
			(0.5518)	(0.5639)
			[0.3555]	[0.3510]
$Damage_{t-12}$			-0.5298	-0.5381
			(0.6212)	(0.6260)
			[0.3947]	[0.3910]
$Damage_{t-13}$			1.2311	1.2136
			(1.1028)	(1.0968)
			[0.2656]	[0.2698]
$Damage_{t-14}$			0.2925	0.2873
			(0.9485)	(0.9502)
			[0.7581]	[0.7627]
$Damage_{t-15}$			-0.0251	-0.0529
			(0.3925)	(0.3886)
			[0.9491]	[0.8919]
$Damage_{t-16}$				-0.5861*
				(0.3420)
				[0.0880]
$Damage_{t-17}$				-0.4172
				(0.6622)
				[0.5294]
$Damage_{t-18}$				-0.1922
				(0.3900)
				[0.6226]
$Damage_{t-19}$				0.4175
				(0.4051)
				[0.3039]
$Damage_{t-20}$				-0.2049
				(0.2578)
				[0.4276]
N	8,500	8,500	8,500	8,500
Clusters	205	205	205	205
P-value	0.0000	0.0000	0.0000	0.0000
Mean DV	3.2388	3.2388	3.2388	3.2388
SD Damage	1,740,224	1,740,224	1,740,224	1,740,224

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects as well as country-specific linear trends.

Table 9. The past influence of wind speed damages on sectoral growth rates

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Wholesale, retail trade, restaurants, hotels	Wholesale, retail trade, restaurants, hotels	Wholesale, retail trade, restaurants, hotels	Wholesale, retail trade, restaurants, hotels
	(1)	(2)	(3)	(4)
$Damage_t$	-1.1769**	-1.1636**	-1.1665**	-1.1895**
	(0.5216)	(0.5343)	(0.5317)	(0.5317)
	[0.0251]	[0.0306]	[0.0294]	[0.0263]
$Damage_{t-1}$	-0.0479	-0.0801	-0.1049	-0.0936
	(0.5161)	(0.5332)	(0.5395)	(0.5403)
	[0.9261]	[0.8807]	[0.8461]	[0.8626]
$Damage_{t-2}$	-0.2738	-0.2956	-0.3109	-0.2848
	(0.2400)	(0.2435)	(0.2374)	(0.2390)
	[0.2554]	[0.2262]	[0.1917]	[0.2347]
$Damage_{t-3}$	-0.2410	-0.2624	-0.2908	-0.2768
	(0.2378)	(0.2306)	(0.2278)	(0.2258)
	[0.3120]	[0.2564]	[0.2032]	[0.2216]
$Damage_{t-4}$	0.2640	0.2649	0.2323	0.2346
	(0.2349)	(0.2428)	(0.2496)	(0.2561)
	[0.2625]	[0.2765]	[0.3531]	[0.3607]
$Damage_{t-5}$	-0.1599	-0.1490	-0.1426	-0.1183
	(0.2364)	(0.2377)	(0.2484)	(0.2544)
	[0.4996]	[0.5315]	[0.5665]	[0.6424]
$Damage_{t-6}$		-0.0454	-0.0794	-0.0722
		(0.2788)	(0.2764)	(0.2760)
		[0.8708]	[0.7741]	[0.7940]
$Damage_{t-7}$		-0.3164	-0.3272	-0.3076
		(0.3797)	(0.3849)	(0.3855)
		[0.4056]	[0.3963]	[0.4258]
$Damage_{t-8}$		-0.6149	-0.6285	-0.6202
		(0.5242)	(0.5272)	(0.5252)
		[0.2422]	[0.2345]	[0.2390]
$Damage_{t-9}$		-0.3311	-0.3650	-0.3482
		(0.2344)	(0.2388)	(0.2340)
		[0.1594]	[0.1278]	[0.1383]
$Damage_{t-10}$		0.1107	0.1148	0.1026
		(0.3226)	(0.3186)	(0.3101)
		[0.7319]	[0.7190]	[0.7411]
$Damage_{t-11}$			-0.3550	-0.3461
			(0.2501)	(0.2556)
			[0.1574]	[0.1772]
$Damage_{t-12}$			0.0860	0.0966
			(0.1860)	(0.1853)
			[0.6444]	[0.6027]
$Damage_{t-13}$			0.0246	0.0273
			(0.2290)	(0.2291)
			[0.9146]	[0.9053]
$Damage_{t-14}$			-0.6195	-0.5974
			(0.4335)	(0.4253)
			[0.1545]	[0.1617]
$Damage_{t-15}$			-0.2120	-0.2104
			(0.1901)	(0.1802)
			[0.2662]	[0.2443]
$Damage_{t-16}$				0.0808
				(0.1772)
				[0.6490]
$Damage_{t-17}$				0.0653
				(0.1978)
				[0.7418]
$Damage_{t-18}$				-0.1388
				(0.2015)
				[0.4918]
$Damage_{t-19}$				0.4196**
				(0.1768)
				[0.0185]
$Damage_{t-20}$				0.1802
				(0.3450)
				[0.6019]
N	8,500	8,500	8,500	8,500
Clusters	205	205	205	205
P-value	0.0000	0.0003	0.0000	0.0000
Mean DV	2.5256	2.5256	2.5256	2.5256
SD Damage	1,740,224	1,740,224	1,740,224	1,740,224

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects as well as country-specific linear trends.

Table 10. The past influence of wind speed damages on sectoral growth rates

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Transport, storage, communication	Transport, storage, communication	Transport, storage, communication	Transport, storage, communication
	(1)	(2)	(3)	(4)
$Damage_t$	-0.5071	-0.4901	-0.4922	-0.5464
	(0.3708)	(0.3755)	(0.3607)	(0.3582)
	[0.1729]	[0.1933]	[0.1738]	[0.1287]
$Damage_{t-1}$	0.1078	0.1025	0.0706	0.0890
	(0.3787)	(0.3723)	(0.3672)	(0.3592)
	[0.7761]	[0.7834]	[0.8477]	[0.8046]
$Damage_{t-2}$	-0.6321**	-0.6508**	-0.6910**	-0.7171***
	(0.2768)	(0.2757)	(0.2697)	(0.2694)
	[0.0234]	[0.0192]	[0.0111]	[0.0084]
$Damage_{t-3}$	0.0341	0.0355	0.0165	0.0016
	(0.2741)	(0.2647)	(0.2700)	(0.2691)
	[0.9010]	[0.8935]	[0.9513]	[0.9952]
$Damage_{t-4}$	0.0163	-0.0151	-0.0287	-0.0614
	(0.3971)	(0.3990)	(0.3957)	(0.3952)
	[0.9673]	[0.9698]	[0.9422]	[0.8768]
$Damage_{t-5}$	0.2730	0.2602	0.2475	0.2535
	(0.2892)	(0.2842)	(0.2921)	(0.2955)
	[0.3462]	[0.3609]	[0.3978]	[0.3920]
$Damage_{t-6}$		-0.4360	-0.4293	-0.4769*
		(0.2875)	(0.2779)	(0.2798)
		[0.1309]	[0.1240]	[0.0899]
$Damage_{t-7}$		-0.3668	-0.4075	-0.3878
		(0.3245)	(0.3420)	(0.3499)
		[0.2596]	[0.2348]	[0.2690]
$Damage_{t-8}$		0.1728	0.1510	0.1112
		(0.5338)	(0.5449)	(0.5508)
		[0.7465]	[0.7819]	[0.8402]
$Damage_{t-9}$		-0.1954	-0.2129	-0.1991
		(0.2675)	(0.2621)	(0.2635)
		[0.4661]	[0.4176]	[0.4508]
$Damage_{t-10}$		-0.4255**	-0.4540**	-0.4994**
		(0.1894)	(0.1972)	(0.1996)
		[0.0257]	[0.0223]	[0.0131]
$Damage_{t-11}$			0.2563	0.2603
			(0.4631)	(0.4645)
			[0.5805]	[0.5758]
$Damage_{t-12}$			-0.1970	-0.1973
			(0.2412)	(0.2407)
			[0.4150]	[0.4134]
$Damage_{t-13}$			-0.2124	-0.2478
			(0.2475)	(0.2563)
			[0.3917]	[0.3348]
$Damage_{t-14}$			-0.3103	-0.3094
			(0.3806)	(0.3797)
			[0.4159]	[0.4161]
$Damage_{t-15}$			-0.4994***	-0.5263***
			(0.1736)	(0.1711)
			[0.0044]	[0.0024]
$Damage_{t-16}$				-0.2597
				(0.2497)
				[0.2994]
$Damage_{t-17}$				0.0558
				(0.2539)
				[0.8264]
$Damage_{t-18}$				-0.4558**
				(0.1959)
				[0.0209]
$Damage_{t-19}$				0.3820
				(0.2513)
				[0.1300]
$Damage_{t-20}$				-0.4261*
				(0.2430)
				[0.0811]
N	8,500	8,500	8,500	8,500
Clusters	205	205	205	205
P-value	0.0024	0.0002	0.0007	0.0000
Mean DV	3.7030	3.7030	3.7030	3.7030
SD Damage	1,740,224	1,740,224	1,740,224	1,740,224

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects as well as country-specific linear trends.

Table 11. The past influence of wind speed damages on sectoral growth rates

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Other activities	Other activities	Other activities	Other activities
	(1)	(2)	(3)	(4)
$Damage_{t}$	-0.1957	-0.1992	-0.1983	-0.1986
	(0.2653)	(0.2701)	(0.2741)	(0.2726)
	[0.4616]	[0.4616]	[0.4701]	[0.4672]
$Damage_{t-1}$	0.3164*	0.3095*	0.3163*	0.3207*
	(0.1764)	(0.1782)	(0.1716)	(0.1743)
	[0.0743]	[0.0840]	[0.0667]	[0.0672]
$Damage_{t-2}$	0.0273	-0.0005	-0.0147	0.0115
	(0.2312)	(0.2195)	(0.2134)	(0.2190)
	[0.9060]	[0.9983]	[0.9451]	[0.9582]
$Damage_{t-3}$	-0.0826	-0.0844	-0.0872	-0.0737
	(0.1412)	(0.1356)	(0.1354)	(0.1317)
	[0.5593]	[0.5342]	[0.5203]	[0.5762]
$Damage_{t-4}$	0.0314	0.0175	0.0105	0.0145
	(0.2182)	(0.2183)	(0.2235)	(0.2171)
	[0.8856]	[0.9364]	[0.9625]	[0.9470]
$Damage_{t-5}$	0.1313	0.1167	0.1297	0.1435
	(0.1549)	(0.1588)	(0.1625)	(0.1602)
	[0.3976]	[0.4630]	[0.4256]	[0.3714]
$Damage_{t-6}$		-0.2200	-0.2209	-0.1996
		(0.1667)	(0.1638)	(0.1623)
		[0.1884]	[0.1788]	[0.2200]
$Damage_{t-7}$		-0.5182	-0.5235	-0.5060
		(0.3682)	(0.3664)	(0.3610)
		[0.1609]	[0.1546]	[0.1625]
$Damage_{t-8}$		-0.1524	-0.1565	-0.1374
		(0.1293)	(0.1302)	(0.1258)
		[0.2396]	[0.2305]	[0.2761]
$Damage_{t-9}$		-0.0685	-0.0803	-0.0805
		(0.1915)	(0.1868)	(0.1871)
		[0.7207]	[0.6677]	[0.6673]
$Damage_{t-10}$		-0.3355**	-0.3338**	-0.3326**
		(0.1636)	(0.1630)	(0.1598)
		[0.0416]	[0.0419]	[0.0387]
$Damage_{t-11}$			0.1267	0.1200
			(0.2717)	(0.2727)
			[0.6414]	[0.6605]
$Damage_{t-12}$			0.0901	0.1043
			(0.2600)	(0.2621)
			[0.7294]	[0.6911]
$Damage_{t-13}$			0.0736	0.0931
			(0.1716)	(0.1895)
			[0.6685]	[0.6239]
$Damage_{t-14}$			-0.2511	-0.2361
			(0.2044)	(0.1998)
			[0.2206]	[0.2388]
$Damage_{t-15}$			-0.0480	-0.0384
			(0.1275)	(0.1208)
			[0.7066]	[0.7510]
$Damage_{t-16}$				-0.1259
				(0.1884)
				[0.5050]
$Damage_{t-17}$				-0.0509
				(0.1613)
				[0.7526]
$Damage_{t-18}$				0.1624
				(0.1738)
				[0.3512]
$Damage_{t-19}$				0.2999***
				(0.1126)
				[0.0084]
$Damage_{t-20}$				0.3898
				(0.4822)
				[0.4199]
N	8,500	8,500	8,500	8,500
Clusters	205	205	205	205
P-value	0.3635	0.0001	0.0000	0.0000
Mean DV	2.5519	2.5519	2.5519	2.5519
SD Damage	1,740,224	1,740,224	1,740,224	1,740,224

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects as well as country-specific linear trends.

Table 12. The past cumulative effect of wind speed damages on sectoral growth rates

Dependent Variables: *Per capita growth rate (%) in sector aggregates*

Accumulated damage effects after:	0 years	1 years	2 years	3 years	4 years	5 years	6 years	7 years	8 years	9 years
Agriculture, hunting,	-2.5847***	-2.9894***	-1.5733***	-1.3581**	-0.2207	-0.2475	-0.5364	-0.7421	-1.5777	-1.8236
forestry, fishing	(0.4556)	(0.6064)	(0.5989)	(0.6257)	(0.9810)	(1.1938)	(1.2518)	(1.1060)	(1.5156)	(1.6854)
	[0.0000]	[0.0000]	[0.0093]	[0.0311]	[0.8222]	[0.8360]	[0.6687]	[0.5030]	[0.2991]	[0.2805]
Mining, utilities	-0.4347	-1.3281**	-0.5021	-1.4693	-1.8489*	-2.2481**	-3.4300***	-3.9211***	-3.5943***	-5.4415***
	(0.9616)	(0.6495)	(0.9336)	(1.0208)	(0.9635)	(0.8910)	(0.8866)	(1.0249)	(1.0404)	(1.5957)
	[0.6517]	[0.0422]	[0.5913]	[0.1516]	[0.0564]	[0.0124]	[0.0001]	[0.0002]	[0.0007]	[0.0008]
Manufacturing	-0.6580	-0.9857	-1.8298*	-1.6024	-1.2667	-1.3997	-0.9818	0.6667	0.2908	-1.2242
	(0.4413)	(0.6982)	(1.0553)	(1.1886)	(1.0598)	(1.1366)	(1.2176)	(1.1558)	(1.2954)	(1.8766)
	[0.1375]	[0.1595]	[0.0844]	[0.1791]	[0.2334]	[0.2196]	[0.4210]	[0.5647]	[0.8226]	[0.5149]
Construction	0.4199	3.1734**	1.5671	-0.0886	-0.2935	-0.2822	-1.3998	-1.3034	0.3507	1.7688
	(0.6430)	(1.5599)	(1.4459)	(1.6583)	(1.3940)	(1.8048)	(1.9385)	(1.7578)	(1.4824)	(1.6819)
	[0.5144]	[0.0432]	[0.2797]	[0.9575]	[0.8334]	[0.8759]	[0.4710]	[0.4592]	[0.8132]	[0.2942]
Wholesale, retail	-1.1895**	-1.2831**	-1.5680***	-1.8448***	-1.6101**	-1.7285**	-1.8006**	-2.1082**	-2.7285**	-3.0767**
trade, restaurants,	(0.5317)	(0.5111)	(0.5520)	(0.5966)	(0.6731)	(0.7312)	(0.7562)	(0.8723)	(1.1894)	(1.3632)
hotels	[0.0263]	[0.0128]	[0.0050]	[0.0023]	[0.0177]	[0.0190]	[0.0182]	[0.0165]	[0.0228]	[0.0251]
Transport, storage,	-0.5464	-0.4574	-1.1745*	-1.1729	-1.2342	-0.9808	-1.4577	-1.8455	-1.7342	-1.9333
communication	(0.3582)	(0.5481)	(0.6388)	(0.7866)	(0.8444)	(1.0020)	(1.0969)	(1.1639)	(1.2830)	(1.3875)
	[0.1287]	[0.4049]	[0.0674]	[0.1375]	[0.1454]	[0.3288]	[0.1854]	[0.1144]	[0.1780]	[0.1650]
Other activities	-0.1986	0.1221	0.1337	0.0599	0.0744	0.2179	0.0183	-0.4877	-0.6251	-0.7056
	(0.2726)	(0.2826)	(0.3602)	(0.3968)	(0.4851)	(0.5311)	(0.5864)	(0.6128)	(0.6558)	(0.6657)
	[0.4672]	[0.6661]	[0.7110]	[0.8801]	[0.8783]	[0.6820]	[0.9751]	[0.4270]	[0.3416]	[0.2904]
N	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. F-tests of panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages accumulated over different years. The independent variable is Damage_t, which is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects as well as country-specific linear trends.

Table 13. The past cumulative effect of wind speed damages on sectoral growth rates

Dependent Variables: *Per capita growth rate (%) in sector aggregates*

Accumulated damage effects after:	10 years	11 years	12 years	13 years	14 years	15 years	16 years	17 years	18 years	19 years	20 years
Agriculture, hunting, forestry, fishing	-1.5257	-0.8392	-0.2497	0.3636	-0.3343	-0.5532	-0.4901	-0.6243	-0.3430	-0.5089	-0.4845
	(1.5593)	(1.4932)	(1.6496)	(1.6716)	(1.8635)	(1.9798)	(2.0824)	(2.0996)	(2.2881)	(2.3054)	(2.2923)
	[0.3290]	[0.5747]	[0.8799]	[0.8280]	[0.8578]	[0.7802]	[0.8142]	[0.7665]	[0.8810]	[0.8255]	[0.8328]
Mining, utilities	-4.3407***	-4.9555***	-4.3205**	-3.9076*	-3.9602*	-3.3087	-3.3328	-3.7008	-3.4709	-4.1708	-3.4655
	(1.3957)	(1.8049)	(2.0143)	(1.9848)	(2.2766)	(2.2232)	(2.2751)	(2.4650)	(2.6024)	(2.9363)	(2.9092)
	[0.0021]	[0.0066]	[0.0331]	[0.0503]	[0.0834]	[0.1382]	[0.1445]	[0.1348]	[0.1838]	[0.1570]	[0.2350]
Manufacturing	-0.6539	-0.3314	-0.1846	-0.3903	-0.1272	-0.8938	-0.6595	-0.4360	-0.3100	0.4204	-0.5016
	(1.7681)	(1.8058)	(2.0077)	(2.2014)	(2.1249)	(2.2555)	(2.4040)	(2.4435)	(2.4294)	(2.5437)	(2.8126)
	[0.7119]	[0.8546]	[0.9268]	[0.8595]	[0.9523]	[0.6923]	[0.7841]	[0.8586]	[0.8986]	[0.8689]	[0.8586]
Construction	1.1221	0.5950	0.0569	1.2705	1.5579	1.5050	0.9188	0.5016	0.3094	0.7269	0.5220
	(1.7752)	(1.9211)	(2.2023)	(2.4460)	(2.9568)	(2.9755)	(3.1644)	(3.2770)	(3.2086)	(3.0947)	(3.1083)
	[0.5280]	[0.7571]	[0.9794]	[0.6040]	[0.5988]	[0.6136]	[0.7718]	[0.8785]	[0.9233]	[0.8145]	[0.8668]
Wholesale, retail trade, restaurants, hotels	-2.9741**	-3.3202**	-3.2236**	-3.1963**	-3.7937**	-4.0041**	-3.9233**	-3.8580**	-3.9968**	-3.5772*	-3.3970*
	(1.2533)	(1.3953)	(1.4542)	(1.5393)	(1.6894)	(1.7692)	(1.8532)	(1.8745)	(1.9393)	(1.9157)	(1.9666)
	[0.0186]	[0.0183]	[0.0277]	[0.0391]	[0.0258]	[0.0247]	[0.0355]	[0.0408]	[0.0406]	[0.0633]	[0.0856]
Transport, storage, communication	-2.4327	-2.1724	-2.3697	-2.6174	-2.9269	-3.4532*	-3.7129*	-3.6571	-4.1130*	-3.7310	-4.1570
	(1.4760)	(1.5800)	(1.7156)	(1.8306)	(1.9560)	(2.0391)	(2.1587)	(2.2660)	(2.3168)	(2.4371)	(2.5539)
	[0.1009]	[0.1707]	[0.1687]	[0.1543]	[0.1361]	[0.0919]	[0.0870]	[0.1081]	[0.0773]	[0.1273]	[0.1051]
Other activities	-1.0382	-0.9182	-0.8139	-0.7209	-0.9570	-0.9954	-1.1212	-1.1721	-1.0097	-0.7098	-0.3201
	(0.6989)	(0.7375)	(0.8542)	(0.8682)	(0.9444)	(0.9810)	(1.0815)	(1.1432)	(1.1841)	(1.1733)	(1.2970)
	[0.1389]	[0.2145]	[0.3418]	[0.4074]	[0.3121]	[0.3115]	[0.3011]	[0.3064]	[0.3948]	[0.5459]	[0.8053]
N	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500	8,500

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. F-tests of panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages accumulated over different years. The independent variable is Damage_t, which is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects as well as country-specific linear trends.

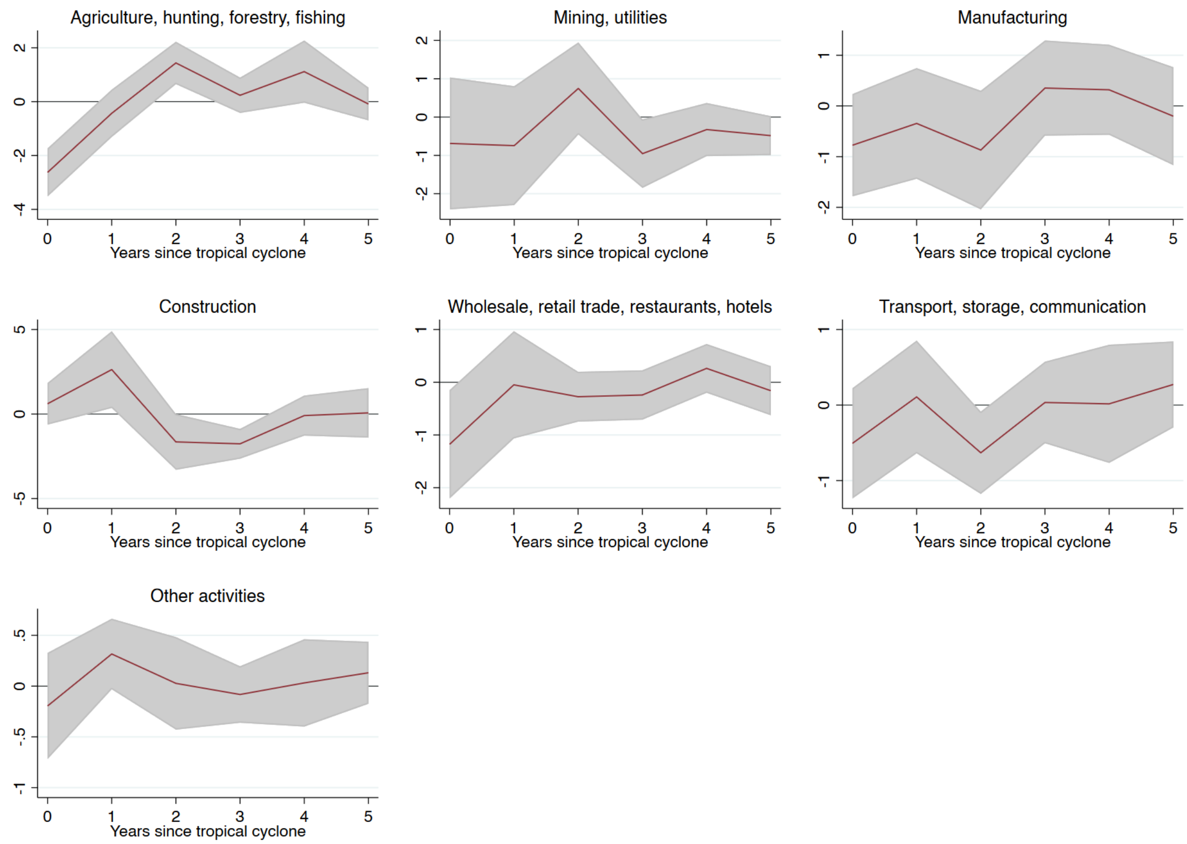

Figure 9: Point estimates of the past influence of tropical cyclone damages up to 5 years on the respective per capita growth rates. The y-axis displays the coefficient of tropical cyclone damages and the x-axis shows the years since the tropical cyclone passed. The grey areas represent the respective 95% confidence interval and the red line the respective (connected) point estimates. The underlying estimations can be found in Tables 5-11 in Appendix A.4.

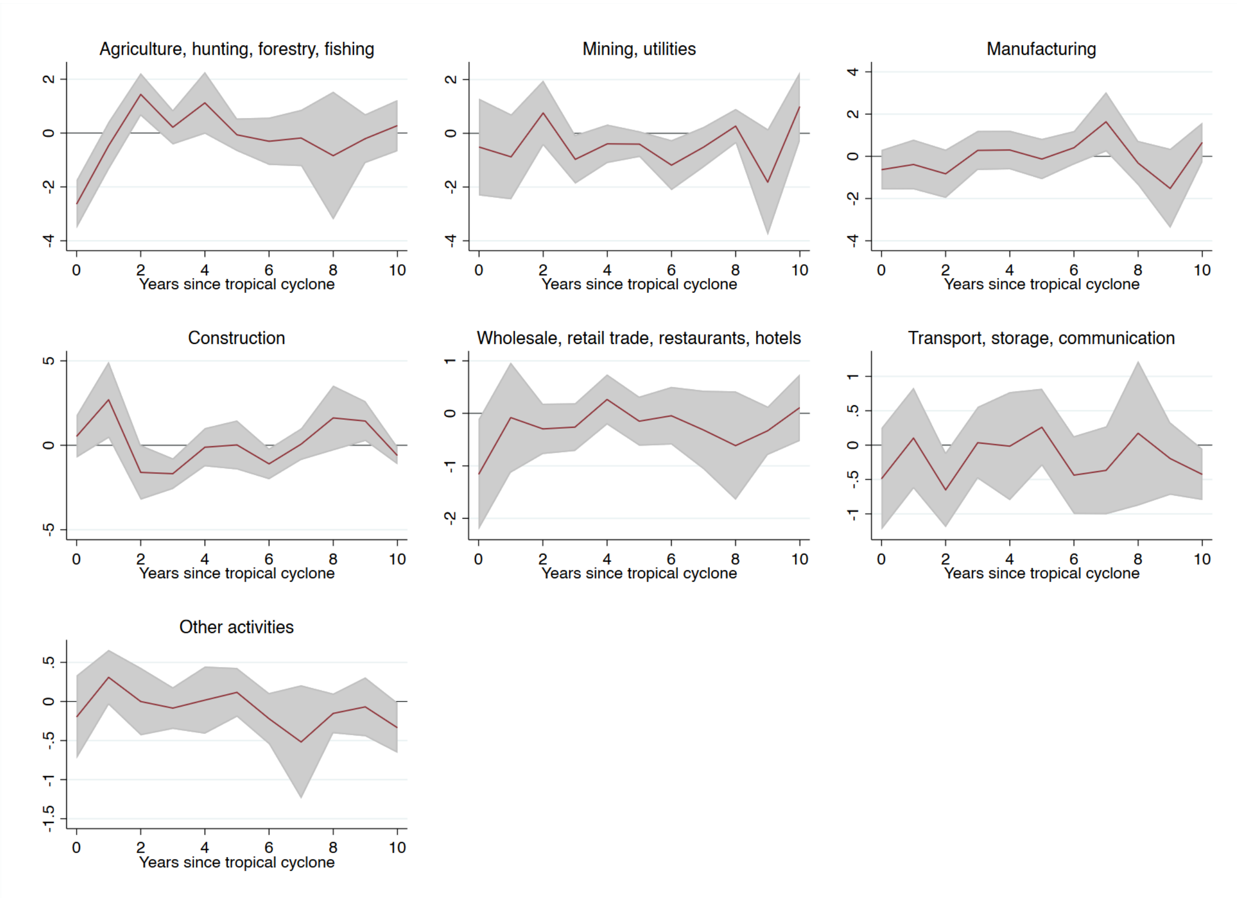

Figure 10: Point estimates of the past influence of tropical cyclone damages up to 10 years on the respective per capita growth rates. The y-axis displays the coefficient of tropical cyclone damages and the x-axis shows the years since the tropical cyclone passed. The grey areas represent the respective 95% confidence interval and the red line the respective (connected) point estimates. The underlying estimations can be found in Tables 5-11 in Appendix A.4.

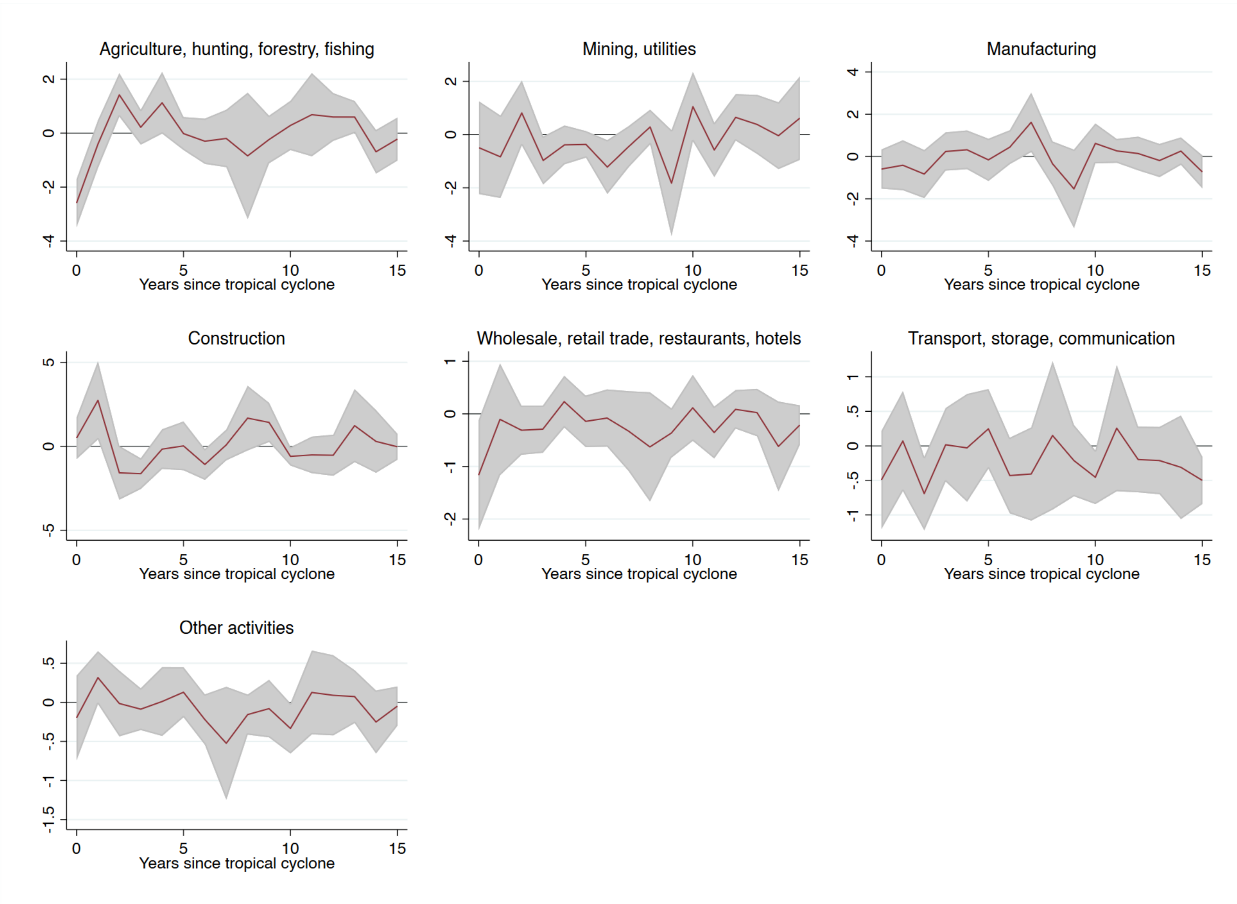

Figure 11: Point estimates of the past influence of tropical cyclone damages up to 15 years on the respective per capita growth rates. The y-axis displays the coefficient of tropical cyclone damages and the x-axis shows the years since the tropical cyclone passed. The grey areas represent the respective 95% confidence interval and the red line the respective (connected) point estimates. The underlying estimations can be found in Tables 5-11 in Appendix A.4.

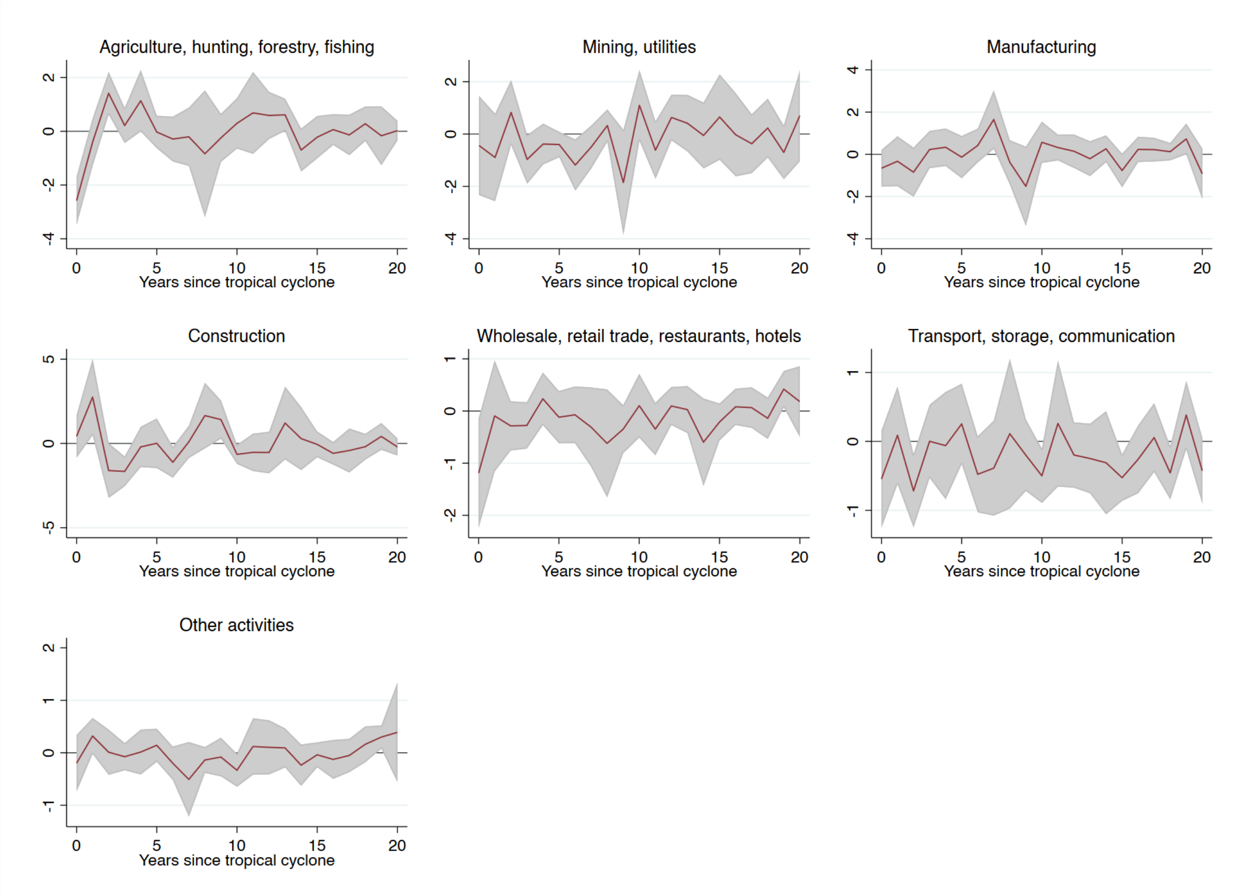

Figure 12: Point estimates of the past influence of tropical cyclone damages up to 20 years on the respective per capita growth rates. The y-axis displays the coefficient of tropical cyclone damages and the x-axis shows the years since the tropical cyclone passed. The grey areas represent the respective 95% confidence interval and the red line the respective (connected) point estimates. The underlying estimations can be found in Tables 5-11 in Appendix A.4.

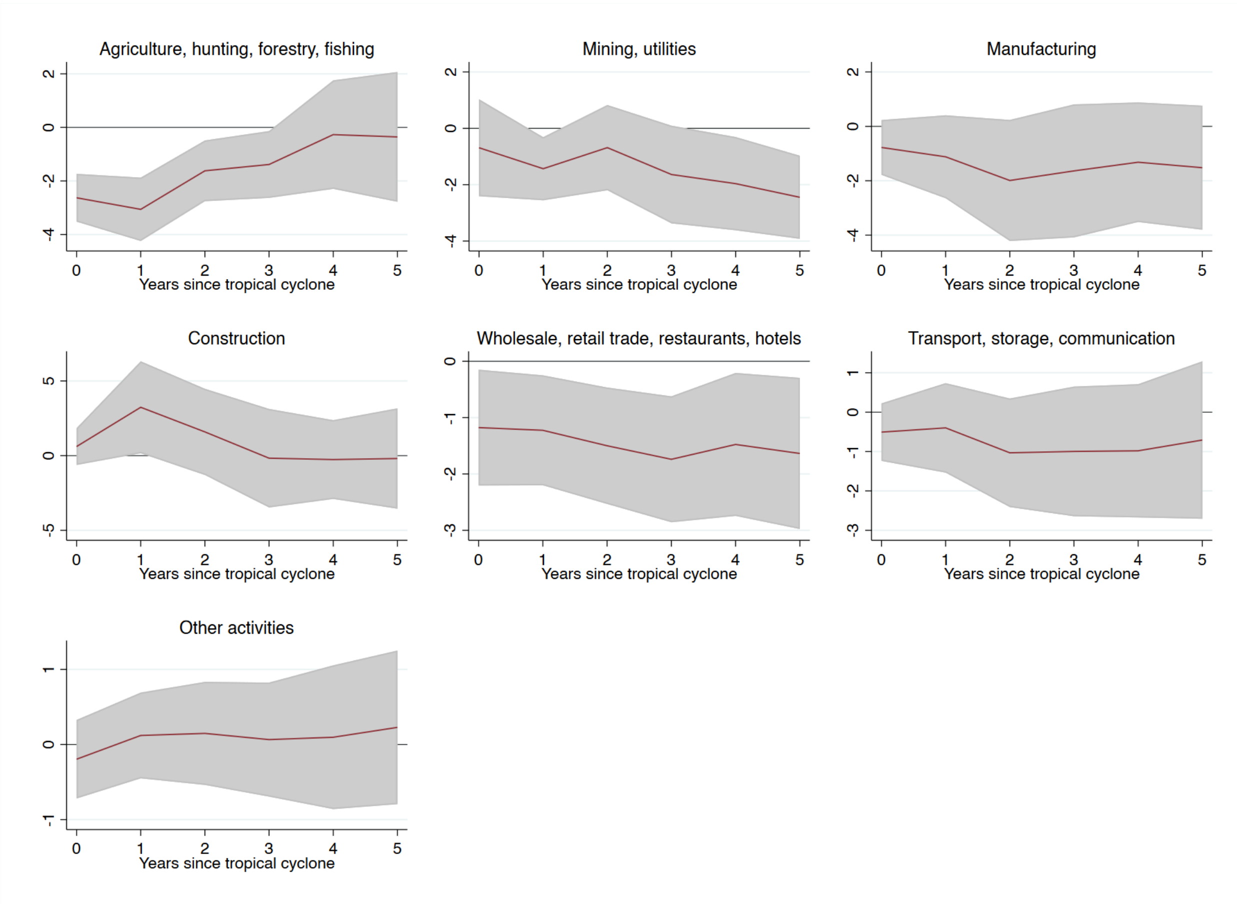

Figure 13: Cumulative point estimates of the past influence of tropical cyclone damages up to 5 years on the respective per capita growth rates. The y-axis displays the cumulative coefficient of tropical cyclone damages and the x-axis shows the years since the tropical cyclone passed. The grey areas represent the respective 95% confidence interval and the red line the respective cumulative (connected) point estimates. The underlying estimations can be found in Tables 12-13 in Appendix A.4.

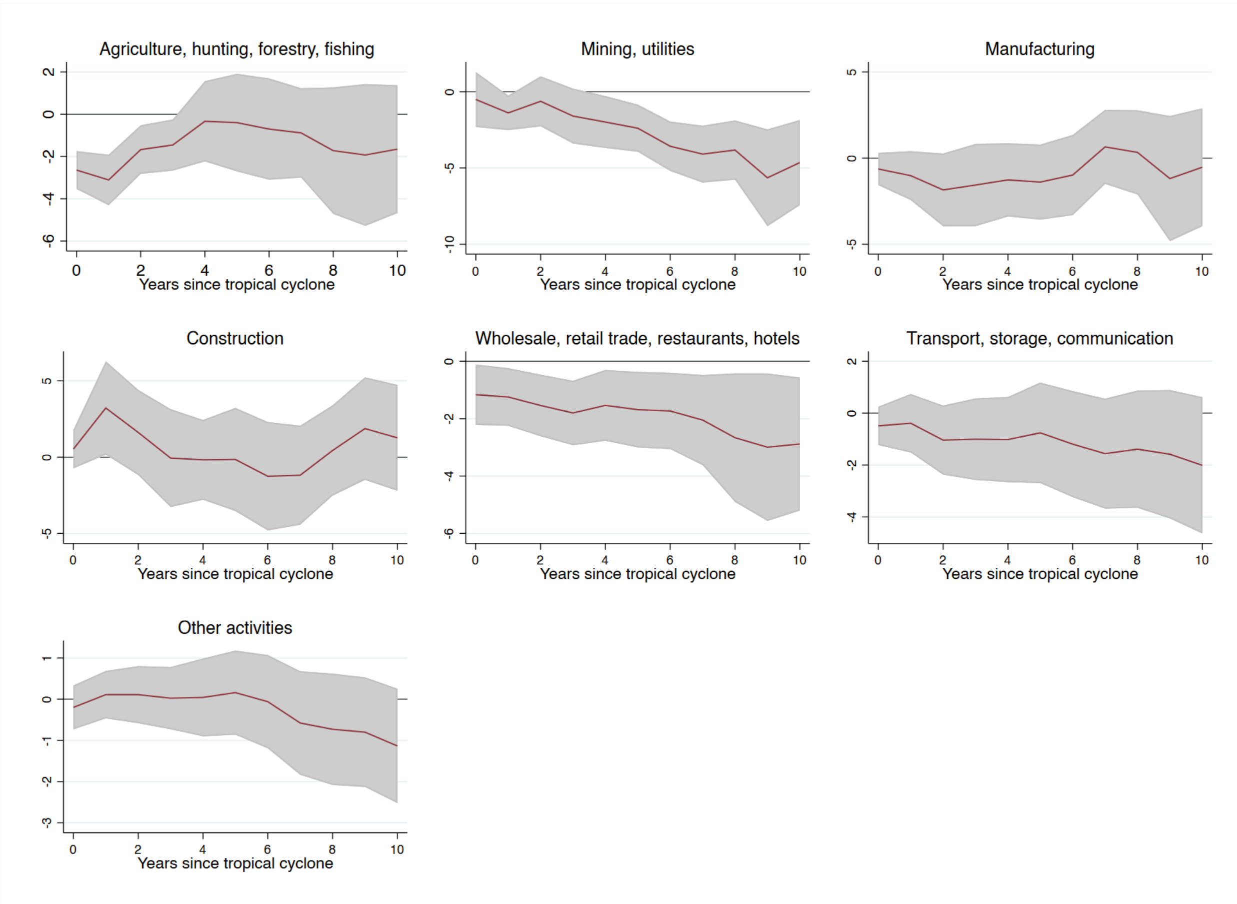

Figure 14: Cumulative point estimates of the past influence of tropical cyclone damages up to 10 years on the respective per capita growth rates. The y-axis displays the cumulative coefficient of tropical cyclone damages and the x-axis shows the years since the tropical cyclone passed. The grey areas represent the respective 95% confidence interval and the red line the respective cumulative (connected) point estimates. The underlying estimations can be found in Tables 12-13 in Appendix A.4.

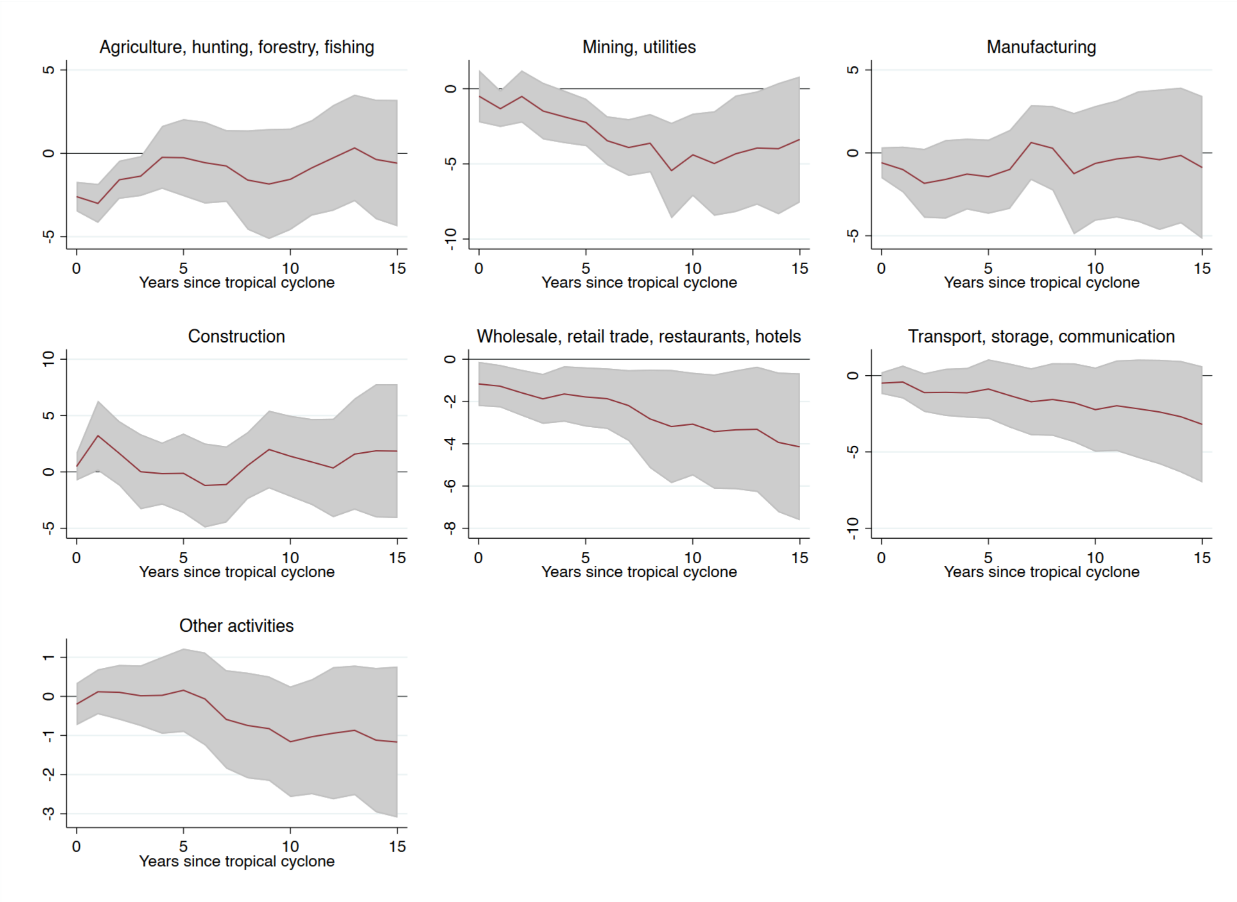

Figure 15: Cumulative point estimates of the past influence of tropical cyclone damages up to 15 years on the respective per capita growth rates. The y-axis displays the cumulative coefficient of tropical cyclone damages and the x-axis shows the years since the tropical cyclone passed. The grey areas represent the respective 95% confidence interval and the red line the respective cumulative (connected) point estimates. The underlying estimations can be found in Tables 12-13 in Appendix A.4.

Table 14. Regression results of the Input-Output factors for the agriculture, hunting, forestry and fishing sector (A&B)

Dependent Variables: *Input-Output coefficient (IO)*

	$IO^{A\&B,A\&B}$	$IO^{A\&B,C\&E}$	$IO^{A\&B,D}$	$IO^{A\&B,F}$	$IO^{A\&B,G\text{-}H}$	$IO^{A\&B,I}$	$IO^{A\&B,J\text{-}P}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	-0.00004	-0.00008*	-0.00034	-0.00004	-0.00027**	-0.00016	-0.00038
	(0.00075)	(0.00005)	(0.00041)	(0.00003)	(0.00012)	(0.00014)	(0.00027)
	[0.95825]	[0.08510]	[0.40568]	[0.19239]	[0.01954]	[0.24485]	[0.15445]
$IO_{t-1}^{A\&B,A\&B}$	0.81383***						
	(0.04690)						
	[0.00000]						
$IO_{t-1}^{A\&B,C\&E}$		0.93027***					
		(0.05625)					
		[0.00000]					
$IO_{t-1}^{A\&B,D}$			0.85587***				
			(0.01276)				
			[0.00000]				
$IO_{t-1}^{A\&B,F}$				1.24487***			
				(0.15348)			
				[0.00000]			
$IO_{t-1}^{A\&B,G\text{-}H}$					0.84204***		
					(0.02799)		
					[0.00000]		
$IO_{t-1}^{A\&B,I}$						0.85337***	
						(0.02055)	
						[0.00000]	
$IO_{t-1}^{A\&B,J\text{-}P}$							0.90448***
							(0.01996)
							[0.00000]
N	4,490	4,490	4,490	4,490	4,490	4,490	4,490
Clusters	182	182	182	182	182	182	182
P-value	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Mean DV	0.16618	0.01220	0.08494	0.00377	0.03579	0.02204	0.07102
SD Damage	1,337,310	1,337,310	1,337,310	1,337,310	1,337,310	1,337,310	1,337,310

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. The dependent variables are Input-Output coefficients (IO) and can range between 0-1. For example the coefficient $IO_t^{A\&B,D}$ displays how much input the sector aggregate A&B needs from sector aggregate D to produce one unit of output. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P). All regressions include country and year fixed effects as well as country-specific linear trends.

Table 15. Regression results of the Input-Output factors for the mining and utilities sector (C&E)

Dependent Variables: *Input-Output coefficient (IO)*

	$IO^{C\&E,A\&B}$	$IO^{C\&E,C\&E}$	$IO^{C\&E,D}$	$IO^{C\&E,F}$	$IO^{C\&E,G\text{-}H}$	$IO^{C\&E,I}$	$IO^{C\&E,J\text{-}P}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	0.00002*	0.00106	-0.00025	-0.00014	-0.00015	-0.00020	-0.00010
	(0.00001)	(0.00154)	(0.00025)	(0.00012)	(0.00017)	(0.00021)	(0.00045)
	[0.09364]	[0.49122]	[0.31567]	[0.25528]	[0.36630]	[0.34866]	[0.82336]
$IO_{t-1}^{C\&E,A\&B}$	0.74893***						
	(0.06455)						
	[0.00000]						
$IO_{t-1}^{C\&E,C\&E}$		0.84491***					
		(0.05335)					
		[0.00000]					
$IO_{t-1}^{C\&E,D}$			0.89889***				
			(0.01903)				
			[0.00000]				
$IO_{t-1}^{C\&E,F}$				0.89490***			
				(0.02000)			
				[0.00000]			
$IO_{t-1}^{C\&E,G\text{-}H}$					0.81616***		
					(0.05525)		
					[0.00000]		
$IO_{t-1}^{C\&E,I}$						0.81922***	
						(0.05698)	
						[0.00000]	
$IO_{t-1}^{C\&E,J\text{-}P}$							0.89500***
							(0.02070)
							[0.00000]
N	4,490	4,490	4,490	4,490	4,490	4,490	4,490
Clusters	182	182	182	182	182	182	182
P-value	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Mean DV	0.00084	0.15156	0.05376	0.02778	0.01925	0.04862	0.08812
SD Damage	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. The dependent variables are Input-Output coefficients (IO) and can range between 0-1. For example the coefficient $IO_t^{C\&E,D}$ displays how much input the sector aggregate C&E needs from sector aggregate D to produce one unit of output. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P). All regressions include country and year fixed effects as well as country-specific linear trends.

Table 16. Regression results of the Input-Output factors for the manufacturing sector (D)
Dependent Variables: *Input-Output coefficient (IO)*

	$IO^{D,A\&B}$	$IO^{D,C\&E}$	$IO^{D,D}$	$IO^{D,F}$	$IO^{D,G\text{-}H}$	$IO^{D,I}$	$IO^{D,J\text{-}P}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	0.00052*	-0.00031	-0.00152*	-0.00003*	-0.00033	-0.00029	-0.00036
	(0.00029)	(0.00028)	(0.00085)	(0.00002)	(0.00022)	(0.00022)	(0.00022)
	[0.0770]	[0.2632]	[0.0768]	[0.0811]	[0.1348]	[0.1899]	[0.1064]
$IO^{D,A\&B}_{t-1}$	0.85952***						
	(0.03335)						
	[0.0000]						
$IO^{D,C\&E}_{t-1}$		0.77462***					
		(0.04997)					
		[0.0000]					
$IO^{D,D}_{t-1}$			0.80588***				
			(0.04449)				
			[0.0000]				
$IO^{D,F}_{t-1}$				0.96723***			
				(0.06204)			
				[0.0000]			
$IO^{D,G\text{-}H}_{t-1}$					0.84009***		
					(0.03605)		
					[0.0000]		
$IO^{D,I}_{t-1}$						0.90409***	
						(0.06205)	
						[0.0000]	
$IO^{D,J\text{-}P}_{t-1}$							0.87878***
							(0.01853)
							[0.0000]
N	4,490	4,490	4,490	4,490	4,490	4,490	4,490
Clusters	182	182	182	182	182	182	182
P-value	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Mean DV	0.05578	0.03927	0.23938	0.00452	0.05355	0.03589	0.08555
SD Damage	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. The dependent variables are Input-Output coefficients (IO) and can range between 0-1. For example the coefficient $IO^{D,F}_t$ displays how much input the sector aggregate D needs from sector aggregate F to produce one unit of output. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P). All regressions include country and year fixed effects as well as country-specific linear trends.

Table 17. Regression results of the Input-Output factors for the construction sector (F)

Dependent Variables: *Input-Output coefficient (IO)*

	$IO^{F,A\&B}$	$IO^{F,C\&E}$	$IO^{F,D}$	$IO^{F,F}$	$IO^{F,G\text{-}H}$	$IO^{F,I}$	$IO^{F,J\text{-}P}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	0.00006***	-0.00006	0.00142*	-0.00073	0.00019	-0.00009	0.00053**
	(0.00002)	(0.00011)	(0.00078)	(0.00082)	(0.00023)	(0.00021)	(0.00023)
	[0.00111]	[0.57363]	[0.07080]	[0.37456]	[0.40417]	[0.67856]	[0.02526]
$IO^{F,A\&B}_{t-1}$	0.85276***						
	(0.02954)						
	[0.00000]						
$IO^{F,C\&E}_{t-1}$		0.81229***					
		(0.03102)					
		[0.00000]					
$IO^{F,D}_{t-1}$			0.77678***				
			(0.08966)				
			[0.00000]				
$IO^{F,F}_{t-1}$				0.85699***			
				(0.07010)			
				[0.00000]			
$IO^{F,G\text{-}H}_{t-1}$					0.83059***		
					(0.01923)		
					[0.00000]		
$IO^{F,I}_{t-1}$						0.79211***	
						(0.05507)	
						[0.00000]	
$IO^{F,J\text{-}P}_{t-1}$							0.86569***
							(0.01474)
							[0.00000]
N	4,490	4,490	4,490	4,490	4,490	4,490	4,490
Clusters	182	182	182	182	182	182	182
P-value	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Mean DV	0.00326	0.01606	0.20939	0.03962	0.06433	0.03951	0.09867
SD Damage	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. The dependent variables are Input-Output coefficients (IO) and can range between 0-1. For example the coefficient $IO^{F,G\text{-}H}_t$ displays how much input the sector aggregate F needs from sector aggregate G-H to produce one unit of output. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P). All regressions include country and year fixed effects as well as country-specific linear trends.

Table 18. Regression results of the Input-Output factors for the wholesale, retail trade, restaurants and hotels sector (G-H)

Dependent Variables: *Input-Output coefficient (IO)*

	$IO^{G\text{-}H,A\&B}$	$IO^{G\text{-}H,C\&E}$	$IO^{G\text{-}H,D}$	$IO^{G\text{-}H,F}$	$IO^{G\text{-}H,G\text{-}H}$	$IO^{G\text{-}H,I}$	$IO^{G\text{-}H,J\text{-}P}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	0.00011**	0.00010**	0.00058	0.00002	0.00158	-0.00001	0.00049
	(0.00005)	(0.00004)	(0.00045)	(0.00002)	(0.00119)	(0.00019)	(0.00063)
	[0.04378]	[0.01794]	[0.20337]	[0.32710]	[0.18587]	[0.96554]	[0.44368]
$IO_{t-1}^{G\&H,A\&B}$	0.86464***						
	(0.03825)						
	[0.00000]						
$IO_{t-1}^{G\&H,C\&E}$		0.82509***					
		(0.02879)					
		[0.00000]					
$IO_{t-1}^{G\&H,D}$			0.86836***				
			(0.03732)				
			[0.00000]				
$IO_{t-1}^{G\&H,F}$				0.79217***			
				(0.02664)			
				[0.00000]			
$IO_{t-1}^{G\&H,G\text{-}H}$					0.84379***		
					(0.07443)		
					[0.00000]		
$IO_{t-1}^{G\&H,I}$						0.87736***	
						(0.02081)	
						[0.00000]	
$IO_{t-1}^{G\&H,J\text{-}P}$							0.91386***
							(0.02899)
							[0.00000]
N	4,490	4,490	4,490	4,490	4,490	4,490	4,490
Clusters	182	182	182	182	182	182	182
P-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mean DV	0.00831	0.01580	0.07093	0.00617	0.05380	0.06116	0.13920
SD Damage	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. The dependent variables are Input-Output coefficients (IO) and can range between 0-1. For example the coefficient $IO_t^{GH,F}$ displays how much input the sector aggregate G-H needs from sector aggregate F to produce one unit of output. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P). All regressions include country and year fixed effects as well as country-specific linear trends.

Table 19. Regression results of the Input-Output factors for the transport, communication and infrastructure sector (I)

Dependent Variables: *Input-Output coefficient (IO)*

	$IO^{I,A\&B}$	$IO^{I,C\&E}$	$IO^{I,D}$	$IO^{I,F}$	$IO^{I,G\text{-}H}$	$IO^{I,I}$	$IO^{I,J\text{-}P}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	0.00001	-0.00002	0.00039	0.00002	0.00001	0.00061	0.00014
	(0.00001)	(0.00004)	(0.00042)	(0.00003)	(0.00016)	(0.00055)	(0.00072)
	[0.37763]	[0.59378]	[0.35267]	[0.48078]	[0.96794]	[0.27302]	[0.84708]
$IO^{I,A\&B}_{t-1}$	0.75844***						
	(0.06742)						
	[0.00000]						
$IO^{I,C\&E}_{t-1}$		0.83975***					
		(0.03543)					
		[0.00000]					
$IO^{I,D}_{t-1}$			0.79606***				
			(0.03055)				
			[0.00000]				
$IO^{I,F}_{t-1}$				0.84223***			
				(0.02507)			
				[0.00000]			
$IO^{I,G\text{-}H}_{t-1}$					0.81081***		
					(0.07214)		
					[0.00000]		
$IO^{I,I}_{t-1}$						0.75830***	
						(0.09322)	
						[0.00000]	
$IO^{I,J\text{-}P}_{t-1}$							0.85232***
							(0.02148)
							[0.00000]
N	4,490	4,490	4,490	4,490	4,490	4,490	4,490
Clusters	182	182	182	182	182	182	182
P-value	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Mean DV	0.00041	0.00996	0.06178	0.00877	0.02755	0.10965	0.12995
SD Damage	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. The dependent variables are Input-Output coefficients (IO) and can range between 0-1. For example the coefficient $IO^{I,F}_t$ displays how much input the sector aggregate I needs from sector aggregate F to produce one unit of output. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P). All regressions include country and year fixed effects as well as country-specific linear trends.

Table 20. Regression results of the Input-Output factors for the other activities sector (J-P)

Dependent Variables: *Input-Output coefficient (IO)*

	$IO^{J\text{-}P,A\&B}$	$IO^{J\text{-}P,C\&E}$	$IO^{J\text{-}P,D}$	$IO^{J\text{-}P,F}$	$IO^{J\text{-}P,G\text{-}H}$	$IO^{J\text{-}P,I}$	$IO^{J\text{-}P,J\text{-}P}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	0.00004	0.00000	0.00043*	0.00003	0.00004	-0.00003	-0.00012
	(0.00003)	(0.00005)	(0.00023)	(0.00008)	(0.00009)	(0.00016)	(0.00039)
	[0.24367]	[0.93791]	[0.05994]	[0.73487]	[0.70197]	[0.85695]	[0.75992]
$IO_{t-1}^{J\text{-}P,A\&B}$	0.71852***						
	(0.27363)						
	[0.00938]						
$IO_{t-1}^{J\text{-}P,C\&E}$		0.87298***					
		(0.03855)					
		[0.00000]					
$IO_{t-1}^{J\text{-}P,D}$			0.77269***				
			(0.08736)				
			[0.00000]				
$IO_{t-1}^{J\text{-}P,F}$				0.80920***			
				(0.03406)			
				[0.00000]			
$IO_{t-1}^{J\text{-}P,G\text{-}H}$					0.79393***		
					(0.05463)		
					[0.00000]		
$IO_{t-1}^{J\text{-}P,I}$						0.88210***	
						(0.04426)	
						[0.00000]	
$IO_{t-1}^{J\text{-}P,J\text{-}P}$							0.76232***
							(0.07446)
							[0.00000]
N	4,490	4,490	4,490	4,490	4,490	4,490	4,490
Clusters	182	182	182	182	182	182	182
P-value	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Mean DV	0.00266	0.01221	0.05630	0.01723	0.02307	0.03172	0.14495
SD Damage	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. The dependent variables are Input-Output coefficients (IO) and can range between 0-1. For example the coefficient $IO_t^{J\text{-}P,F}$ displays how much input the sector aggregate JP needs from sector aggregate F to produce one unit of output. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P). All regressions include country and year fixed effects as well as country-specific linear trends.

Table 21. The effect of a standard deviation increase in wind speed damages on sectoral growth rates - Input-Output sample

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Agriculture, hunting, forestry, fishing	Mining, utilities	Manu-facturing	Construc-tion	Wholesale, retail trade, restaurants, hotels	Transport, storage, communi-cation	Other activities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	-2.6738***	-0.7476	0.0793	-1.2425	-1.1227***	-0.0780	-0.0272
	(0.6167)	(0.5568)	(0.6927)	(1.2898)	(0.3678)	(0.4348)	(0.3057)
	[0.0000]	[0.1810]	[0.9090]	[0.3367]	[0.0026]	[0.8578]	[0.9293]
N	4,490	4,490	4,490	4,490	4,490	4,490	4,490
Clusters	182	182	182	182	182	182	182
P-value	0.0000	0.1810	0.9090	0.3367	0.0026	0.8578	0.9293
Mean DV	0.8402	3.3496	2.5646	3.8989	2.7094	4.1525	2.4175
SD Damage	1,337,310	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599	1,342,599

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1990 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects as well as country-specific linear trends.

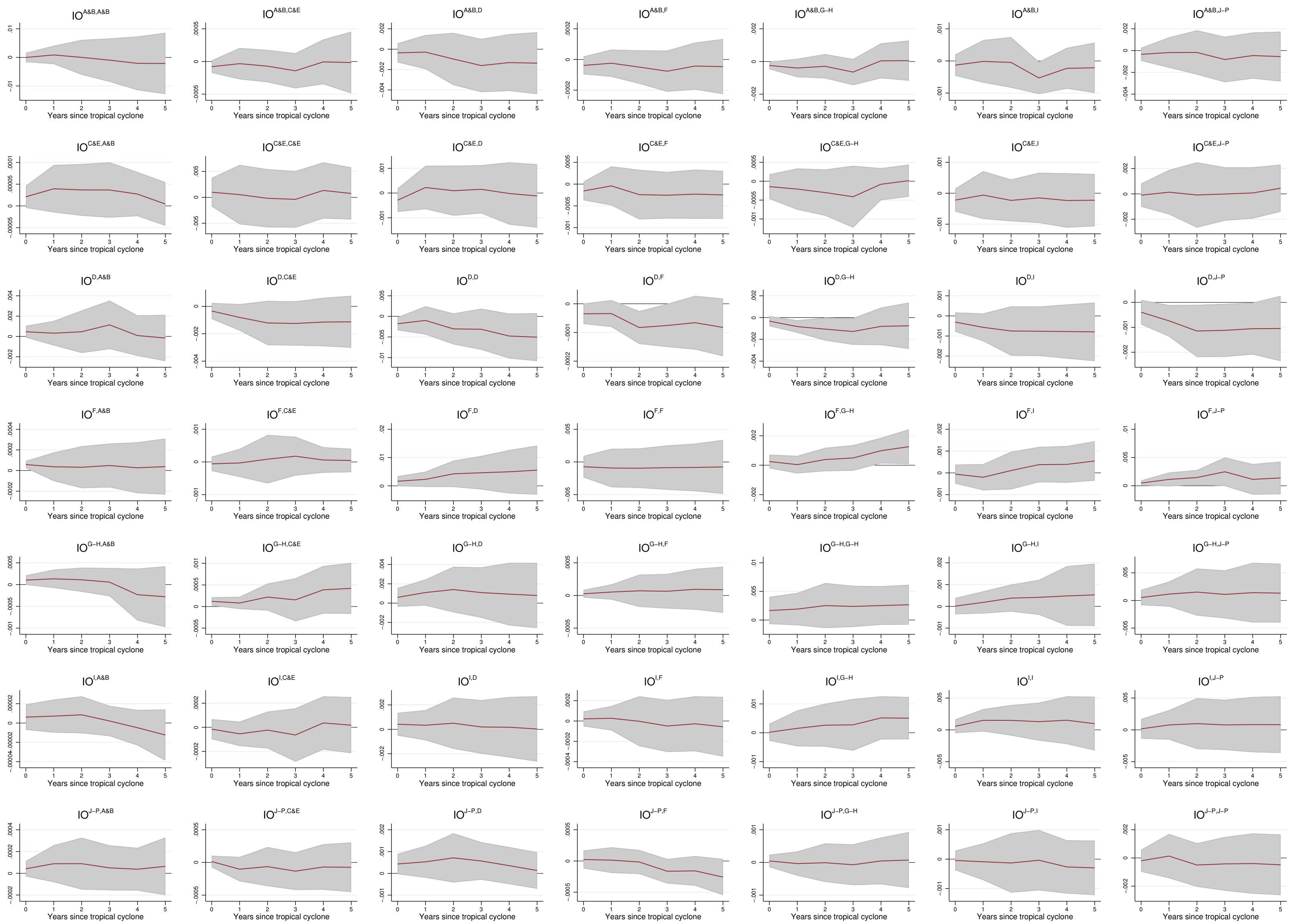

Figure 16: Cumulative point estimates of the past influence of tropical cyclone damages (5 years) on the respective Input-Output coefficients. The y-axis displays the cumulative coefficient of tropical cyclone damages and the x-axis shows the years since the tropical cyclone passed. The grey areas represent the respective 95% confidence interval and the red line the respective cumulative (connected) point estimates.

A.5 Robustness Statistics

A.5.1 Direct effects

Table 22. The effect of a standard deviation increase in wind speed damages on sectoral growth rates (Placebo Test)

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Agriculture, hunting, forestry, fishing	Mining, utilities	Manu-facturing	Construc-tion	Wholesale, retail trade, restaurants, hotels	Transport, storage, communi-cation	Other activities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Damage_{t+2}	0.2800	0.1413	-0.1306	0.3074	-0.0170	0.2501	-0.0656
	(0.2114)	(0.3928)	(0.3284)	(0.5417)	(0.2709)	(0.2010)	(0.1130)
	[0.1868]	[0.7195]	[0.6912]	[0.5710]	[0.9499]	[0.2147]	[0.5623]
N	8,092	8,092	8,092	8,092	8,092	8,092	8,092
Clusters	205	205	205	205	205	205	205
P-value	0.1868	0.7195	0.6912	0.5710	0.9499	0.2147	0.5623
Mean DV	0.8735	3.9027	2.6874	3.2847	2.5517	3.7559	2.5872
SD Damage	1,730,623	1,754,144	1,754,144	1,754,144	1,754,144	1,754,144	1,754,144

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. Damage_{t+2} is the weighted damage measure for tropical cyclone intensity in year t+2. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t+1, whereas for the remaining sector aggregates it is weighted by exposed population in t+1. All regressions include country and year fixed effects as well as country-specific linear trends.

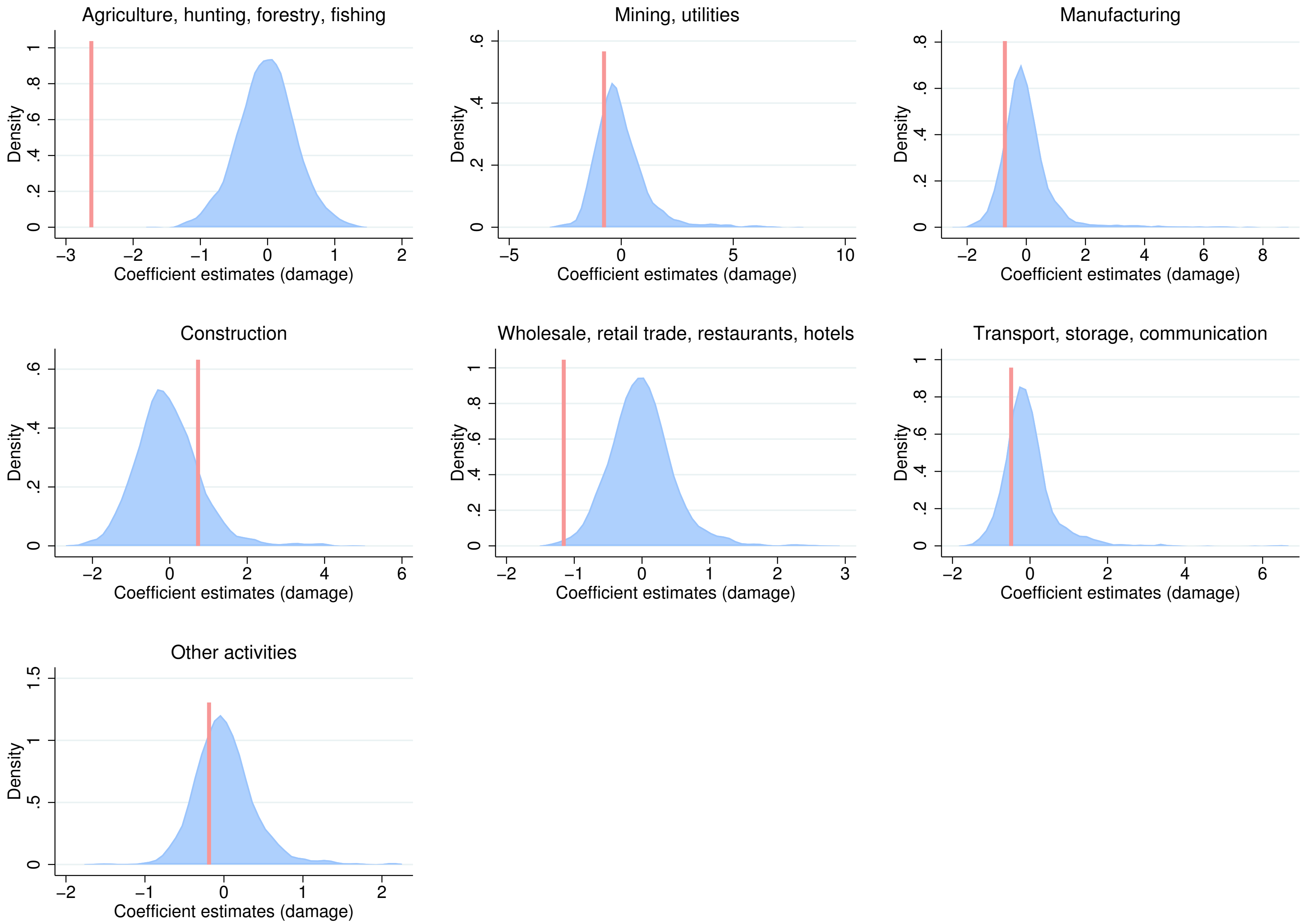

Figure 17: Randomization tests. This figure shows the Fisher randomization test results for the damage_t variable where the years are permuted for 2000 repetitions. It displays the kernel density plots (blue) of the randomization coefficient estimates together the results of model 4 (red bar).

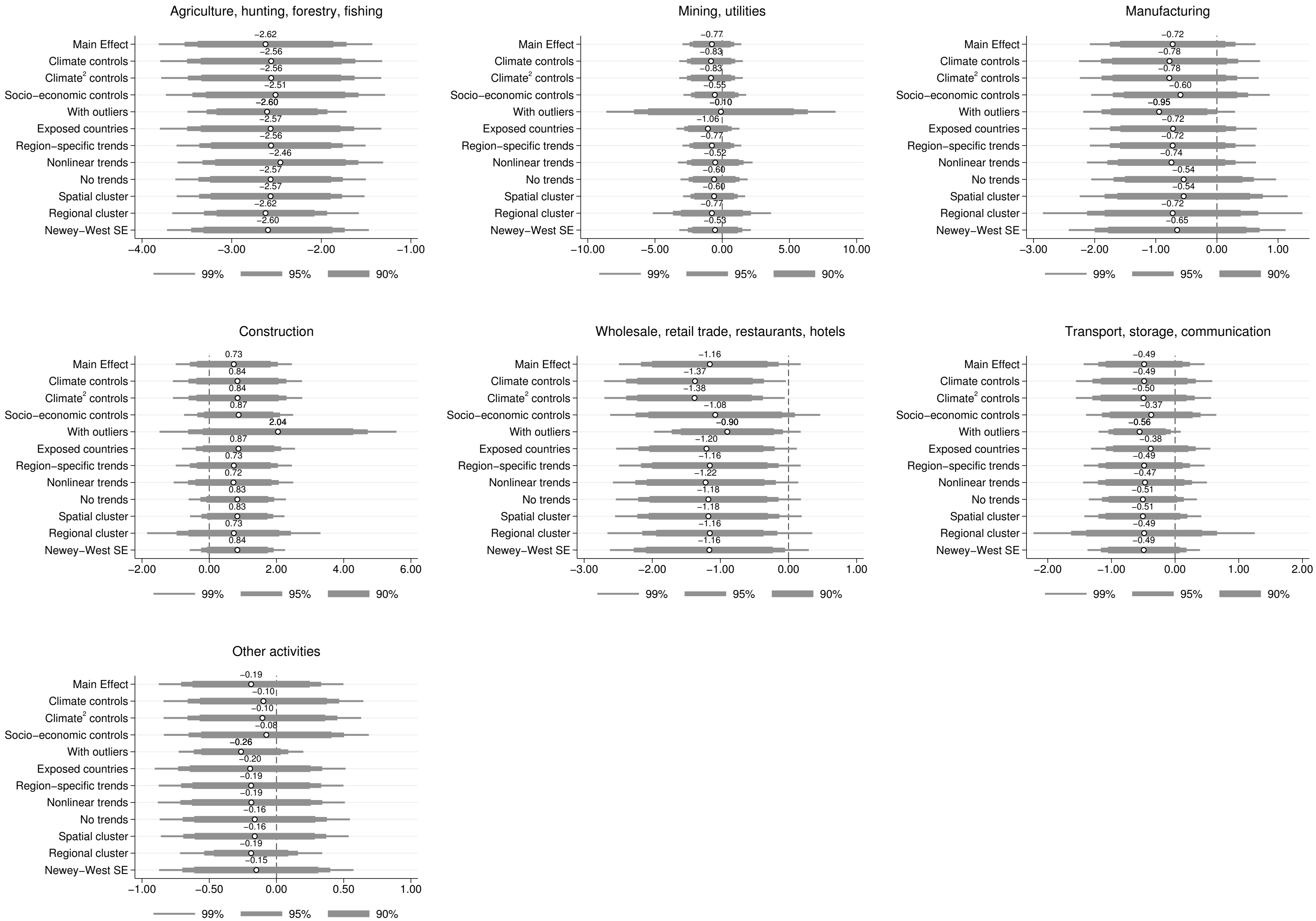

Figure 18: Coefficient plots for different robustness tests for direct effects of tropical cyclone damages of model 4. The underlying regressions are shown in Tables 23-42.

Table 23. The effect of a standard deviation increase in wind speed damages on sectoral growth rates with temperature control variables

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Agriculture, hunting, forestry, fishing	Mining, utilities	Manu- facturing	Construc- tion	Wholesale, retail trade, restaurants, hotels	Transport, storage, communi- cation	Other activities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	-2.5247***	-0.8171	-0.6918	0.8478	-1.3570***	-0.4830	-0.1038
	(0.4758)	(0.9290)	(0.5825)	(0.7365)	(0.5137)	(0.4061)	(0.2855)
	[0.0000]	[0.3802]	[0.2364]	[0.2511]	[0.0089]	[0.2358]	[0.7167]
$Temperature_t$	-0.4693	-0.2674	-0.0911	-0.2456	-0.2755	0.5192	0.2818
	(0.3236)	(0.9645)	(0.6324)	(0.5503)	(0.3549)	(0.4588)	(0.3586)
	[0.1486]	[0.7819]	[0.8856]	[0.6559]	[0.4385]	[0.2592]	[0.4330]
N	7,992	7,992	7,992	7,992	7,992	7,992	7,992
Clusters	193	193	193	193	193	193	193
P-value	0.0000	0.6779	0.4863	0.4668	0.0201	0.3020	0.6974
Mean DV	0.8441	3.7568	2.6349	3.2407	2.4850	3.7287	2.5230
SD Damage	1,652,118	1,691,535	1,691,535	1,691,535	1,691,535	1,691,535	1,691,535

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. Temperature is measured in degree Celsius. All regressions include country and year fixed effects as well as country-specific linear trends.

Table 24. The effect of a standard deviation increase in wind speed damages on sectoral growth rates with precipitation control variables

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Agriculture, hunting, forestry, fishing	Mining, utilities	Manu- facturing	Construc- tion	Wholesale, retail trade, restaurants, hotels	Transport, storage, communi- cation	Other activities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	-2.5641***	-0.8320	-0.7753	0.8379	-1.3739***	-0.4842	-0.0960
	(0.4760)	(0.9105)	(0.5694)	(0.7375)	(0.5127)	(0.4124)	(0.2849)
	[0.0000]	[0.3619]	[0.1749]	[0.2573]	[0.0080]	[0.2418]	[0.7366]
$Precipitation_t$	0.0008	0.0003	0.0019	0.0002	0.0004	0.0000	-0.0002
	(0.0005)	(0.0013)	(0.0016)	(0.0015)	(0.0004)	(0.0007)	(0.0003)
	[0.1204]	[0.7892]	[0.2435]	[0.8765]	[0.3310]	[0.9829]	[0.5946]
N	7,992	7,992	7,992	7,992	7,992	7,992	7,992
Clusters	193	193	193	193	193	193	193
P-value	0.0000	0.5776	0.2191	0.5078	0.0221	0.4908	0.8182
Mean DV	0.8441	3.7568	2.6349	3.2407	2.4850	3.7287	2.5230
SD Damage	1,652,118	1,691,535	1,691,535	1,691,535	1,691,535	1,691,535	1,691,535

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. Precipitation is measured in milimeters. All regressions include country and year fixed effects as well as country-specific linear trends.

Table 25. The effect of a standard deviation increase in wind speed damages on sectoral growth rates with precipitation and temperature control variables

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Agriculture, hunting, forestry, fishing	Mining, utilities	Manu- facturing	Construc- tion	Wholesale, retail trade, restaurants, hotels	Transport, storage, communi- cation	Other activities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	-2.5590***	-0.8312	-0.7752	0.8387	-1.3730***	-0.4860	-0.0969
	(0.4760)	(0.9102)	(0.5694)	(0.7388)	(0.5129)	(0.4113)	(0.2856)
	[0.0000]	[0.3623]	[0.1750]	[0.2577]	[0.0081]	[0.2388]	[0.7348]
$Precipitation_t$	0.0007	0.0003	0.0019	0.0002	0.0004	0.0001	-0.0002
	(0.0005)	(0.0013)	(0.0016)	(0.0015)	(0.0004)	(0.0007)	(0.0003)
	[0.1390]	[0.8013]	[0.2334]	[0.8887]	[0.3650]	[0.9198]	[0.6437]
$Temperature_t$	-0.4423	-0.2554	-0.0202	-0.2378	-0.2619	0.5217	0.2760
	(0.3204)	(0.9533)	(0.5958)	(0.5401)	(0.3556)	(0.4599)	(0.3556)
	[0.1690]	[0.7891]	[0.9730]	[0.6602]	[0.4623]	[0.2580]	[0.4386]
N	7,992	7,992	7,992	7,992	7,992	7,992	7,992
Clusters	193	193	193	193	193	193	193
P-value	0.0000	0.7682	0.2853	0.6748	0.0369	0.4925	0.8517
Mean DV	0.8441	3.7568	2.6349	3.2407	2.4850	3.7287	2.5230
SD Damage	1,652,118	1,691,535	1,691,535	1,691,535	1,691,535	1,691,535	1,691,535

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. Precipitation is measured in milimeters and temperature in degree Celsius. All regressions include country and year fixed effects as well as country-specific linear trends.

Table 26. The effect of a standard deviation increase in wind speed damages on sectoral growth rates with precipitation and temperature squared control variables

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Agriculture, hunting, forestry, fishing	Mining, utilities	Manu-facturing	Construc-tion	Wholesale, retail trade, restaurants, hotels	Transport, storage, communi-cation	Other activities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	-2.5586***	-0.8335	-0.7780	0.8432	-1.3795***	-0.4952	-0.1046
	(0.4716)	(0.9085)	(0.5621)	(0.7390)	(0.5088)	(0.4082)	(0.2825)
	[0.0000]	[0.3601]	[0.1679]	[0.2553]	[0.0073]	[0.2265]	[0.7117]
$Precipitation_t$	0.0074***	0.0000	0.0058***	-0.0008	0.0033***	0.0043***	0.0028***
	(0.0018)	(0.0045)	(0.0021)	(0.0026)	(0.0011)	(0.0015)	(0.0010)
	[0.0000]	[0.9949]	[0.0055]	[0.7661]	[0.0024]	[0.0040]	[0.0034]
$Precipitation_t^2$	-0.0000***	0.0000	-0.0000**	0.0000	-0.0000***	-0.0000***	-0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
	[0.0001]	[0.9333]	[0.0320]	[0.6513]	[0.0012]	[0.0003]	[0.0009]
$Temperature_t$	0.5378	-0.6870	0.8767	0.0846	-0.2075	0.6124	0.1631
	(0.3452)	(0.7100)	(0.7258)	(0.6794)	(0.5370)	(0.5837)	(0.5643)
	[0.1209]	[0.3345]	[0.2286]	[0.9010]	[0.6996]	[0.2955]	[0.7729]
$Precipitation_t^2$	-0.0343***	0.0168	-0.0328*	-0.0133	-0.0003	-0.0009	0.0063
	(0.0117)	(0.0409)	(0.0196)	(0.0210)	(0.0137)	(0.0165)	(0.0130)
	[0.0037]	[0.6821]	[0.0961]	[0.5284]	[0.9829]	[0.9554]	[0.6292]
N	7,992	7,992	7,992	7,992	7,992	7,992	7,992
Clusters	193	193	193	193	193	193	193
P-value	0.0000	0.8272	0.0047	0.8527	0.0062	0.0046	0.0175
Mean DV	0.8441	3.7568	2.6349	3.2407	2.4850	3.7287	2.5230
SD Damage	1,652,118	1,691,535	1,691,535	1,691,535	1,691,535	1,691,535	1,691,535

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. Precipitation is measured in milimeters and temperature in degree Celsius. All regressions include country and year fixed effects as well as country-specific linear trends.

Table 27. The effect of a standard deviation increase in wind speed damages on sectoral growth rates with socioeconomic control variables

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Agriculture, hunting, forestry, fishing	Mining, utilities	Manu-facturing	Construc-tion	Wholesale, retail trade, restaurants, hotels	Transport, storage, communi-cation	Other activities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	-2.5111***	-0.5517	-0.5968	0.8748	-1.0761*	-0.3748	-0.0754
	(0.4702)	(0.8971)	(0.5615)	(0.6245)	(0.5929)	(0.3934)	(0.2932)
	[0.0000]	[0.5392]	[0.2891]	[0.1628]	[0.0710]	[0.3419]	[0.7973]
Log pc value $added_{t-1}$	-8.6382***	-10.3300***	-14.7435*	-12.7315***	-7.6492***	-8.5118***	-7.2226***
	(1.0997)	(3.6141)	(7.9749)	(3.6421)	(1.1502)	(1.9726)	(1.2506)
	[0.0000]	[0.0047]	[0.0660]	[0.0006]	[0.0000]	[0.0000]	[0.0000]
Population $growth_{t-1}$	-0.2484	0.5531	0.7243	0.5887	0.0752	-0.1808	-0.0675
	(0.1671)	(0.6103)	(0.8187)	(0.5371)	(0.1833)	(0.4064)	(0.1861)
	[0.1388]	[0.3659]	[0.3774]	[0.2743]	[0.6822]	[0.6568]	[0.7173]
Capital $growth_{t-1}$	0.0009	0.0272	0.0040	0.0412*	0.0535**	0.0358*	0.0060
	(0.0058)	(0.0165)	(0.0270)	(0.0240)	(0.0254)	(0.0187)	(0.0088)
	[0.8712]	[0.1018]	[0.8828]	[0.0873]	[0.0365]	[0.0561]	[0.4967]
Trade $openness_{t-1}$	0.0008***	0.0026**	0.0027*	0.0019**	0.0008**	0.0006	0.0009**
	(0.0002)	(0.0013)	(0.0014)	(0.0008)	(0.0004)	(0.0003)	(0.0004)
	[0.0014]	[0.0434]	[0.0648]	[0.0216]	[0.0442]	[0.1119]	[0.0156]
N	8,249	8,249	8,249	8,249	8,249	8,249	8,249
Clusters	203	203	203	203	203	203	203
P-value	0.0000	0.0275	0.0000	0.0000	0.0000	0.0004	0.0000
Mean DV	0.8576	3.7800	2.6098	3.2809	2.5274	3.7516	2.5350
SD Damage	1,724,530	1,755,552	1,755,552	1,755,552	1,755,552	1,755,552	1,755,552

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects, country-specific linear trends, and the respective socioeconomic control variables, which are all measured in t-1: log per capita value added of the re-spective sector, population growth rate, openness, investment rate.

Table 28. The effect of a standard deviation increase in wind speed damages on sectoral growth rates with socioeconomic control variables

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Agriculture, hunting, forestry, fishing	Agriculture, hunting, forestry, fishing	Agriculture, hunting, forestry, fishing	Agriculture, hunting, forestry, fishing
	(1)	(2)	(3)	(4)
Damage_t	-2.5365***	-2.6476***	-2.6670***	-2.6664***
	(0.4652)	(0.4647)	(0.4607)	(0.4607)
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Log pc value $\text{added}_{t\text{-}1}$	-8.5243***			
	(1.0985)			
	[0.0000]			
Population $\text{growth}_{t\text{-}1}$		-0.2480		
		(0.1627)		
		[0.1291]		
Capital $\text{growth}_{t\text{-}1}$			-0.0005	
			(0.0059)	
			[0.9267]	
Trade $\text{openness}_{t\text{-}1}$				0.0002
				(0.0002)
				[0.3385]
N	8,249	8,249	8,249	8,249
Clusters	203	203	203	203
P-value	0.0000	0.0000	0.0000	0.0000
Mean DV	0.8576	0.8576	0.8576	0.8576
SD Damage	1,724,530	1,724,530	1,724,530	1,724,530

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. Damage_t is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects, country-specific linear trends, and the respective socioeconomic control variables, which are all measured in t-1: log per capita value added of the re-spective sector, population growth rate, openness, investment rate.

Table 29. The effect of a standard deviation increase in wind speed damages on sectoral growth rates with socioeconomic control variables

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Mining, utilities	Mining, utilities	Mining, utilities	Mining, utilities
	(1)	(2)	(3)	(4)
Damage_{t}	-0.5328	-0.8364	-0.8396	-0.8080
	(0.8298)	(0.7722)	(0.7741)	(0.7727)
	[0.5215]	[0.2800]	[0.2794]	[0.2969]
Log pc value $\text{added}_{t\text{-}1}$	-10.1346***			
	(3.5445)			
	[0.0047]			
Population $\text{growth}_{t\text{-}1}$		0.2839		
		(0.6254)		
		[0.6503]		
Capital $\text{growth}_{t\text{-}1}$			0.0327*	
			(0.0169)	
			[0.0550]	
Trade $\text{openness}_{t\text{-}1}$				0.0010
				(0.0010)
				[0.3256]
N	8,249	8,249	8,249	8,249
Clusters	203	203	203	203
P-value	0.0093	0.5181	0.1043	0.3530
Mean DV	3.7800	3.7800	3.7800	3.7800
SD Damage	1,724,530	1,724,530	1,724,530	1,724,530

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. Damage_{t} is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects, country-specific linear trends, and the respective socioeconomic control variables, which are all measured in t-1: log per capita value added of the re-spective sector, population growth rate, openness, investment rate.

Table 30. The effect of a standard deviation increase in wind speed damages on sectoral growth rates with socioeconomic control variables

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Manu-facturing	Manu-facturing	Manu-facturing	Manu-facturing
	(1)	(2)	(3)	(4)
$Damage_t$	-0.5286	-0.7829*	-0.7348	-0.7210
	(0.5327)	(0.4602)	(0.4668)	(0.4655)
	[0.3222]	[0.0904]	[0.1170]	[0.1230]
Log pc value $added_{t-1}$	-14.4572*			
	(7.8463)			
	[0.0669]			
Population $growth_{t-1}$		0.7290		
		(0.8938)		
		[0.4157]		
Capital $growth_{t-1}$			0.0128	
			(0.0213)	
			[0.5470]	
Trade $openness_{t-1}$				0.0006**
				(0.0003)
				[0.0436]
N	8,249	8,249	8,249	8,249
Clusters	203	203	203	203
P-value	0.0447	0.1760	0.2657	0.0469
Mean DV	2.6098	2.6098	2.6098	2.6098
SD Damage	1,724,530	1,724,530	1,724,530	1,724,530

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects, country-specific linear trends, and the respective socioeconomic control variables, which are all measured in t-1: log per capita value added of the re-spective sector, population growth rate, openness, investment rate.

Table 31. The effect of a standard deviation increase in wind speed damages on sectoral growth rates with socioeconomic control variables

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Construction	Construction	Construction	Construction
	(1)	(2)	(3)	(4)
$Damage_t$	0.8510	0.6745	0.6548	0.6910
	(0.5943)	(0.6648)	(0.6539)	(0.6606)
	[0.1537]	[0.3116]	[0.3179]	[0.2968]
Log pc value $added_{t-1}$	-12.4440***			
	(3.5391)			
	[0.0005]			
Population $growth_{t-1}$		0.1896		
		(0.4891)		
		[0.6987]		
Capital $growth_{t-1}$			0.0440**	
			(0.0216)	
			[0.0430]	
Trade $openness_{t-1}$				0.0002
				(0.0003)
				[0.4814]
N	8,249	8,249	8,249	8,249
Clusters	203	203	203	203
P-value	0.0012	0.5386	0.0705	0.4603
Mean DV	3.2809	3.2809	3.2809	3.2809
SD Damage	1,724,530	1,724,530	1,724,530	1,724,530

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects, country-specific linear trends, and the respective socioeconomic control variables, which are all measured in t-1: log per capita value added of the re-spective sector, population growth rate, openness, investment rate.

Table 32. The effect of a standard deviation increase in wind speed damages on sectoral growth rates with socioeconomic control variables

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Wholesale, retail trade, restaurants, hotels	Wholesale, retail trade, restaurants, hotels	Wholesale, retail trade, restaurants, hotels	Wholesale, retail trade, restaurants, hotels
	(1)	(2)	(3)	(4)
$Damage_t$	-0.9141	-1.0459*	-1.0937**	-1.0486*
	(0.6028)	(0.5453)	(0.5456)	(0.5460)
	[0.1310]	[0.0565]	[0.0464]	[0.0562]
Log pc value $added_{t-1}$	-7.6211***			
	(1.1515)			
	[0.0000]			
Population $growth_{t-1}$		-0.0566		
		(0.2039)		
		[0.7815]		
Capital $growth_{t-1}$			0.0548**	
			(0.0263)	
			[0.0385]	
Trade $openness_{t-1}$				0.0003
				(0.0002)
				[0.1595]
N	8,249	8,249	8,249	8,249
Clusters	203	203	203	203
P-value	0.0000	0.1531	0.0202	0.0610
Mean DV	2.5274	2.5274	2.5274	2.5274
SD Damage	1,724,530	1,724,530	1,724,530	1,724,530

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects, country-specific linear trends, and the respective socioeconomic control variables, which are all measured in t-1: log per capita value added of the re-spective sector, population growth rate, openness, investment rate.

Table 33. The effect of a standard deviation increase in wind speed damages on sectoral growth rates with socioeconomic control variables

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Transport, storage, communication	Transport, storage, communication	Transport, storage, communication	Transport, storage, communication
	(1)	(2)	(3)	(4)
$Damage_t$	-0.3690	-0.4633	-0.5150	-0.4829
	(0.4063)	(0.3740)	(0.3775)	(0.3823)
	[0.3648]	[0.2169]	[0.1740]	[0.2080]
Log pc value $added_{t-1}$	-8.5883***			
	(1.9869)			
	[0.0000]			
Population $growth_{t-1}$		-0.2716		
		(0.4565)		
		[0.5525]		
Capital $growth_{t-1}$			0.0380*	
			(0.0206)	
			[0.0663]	
Trade $openness_{t-1}$				0.0004
				(0.0002)
				[0.1348]
N	8,249	8,249	8,249	8,249
Clusters	203	203	203	203
P-value	0.0001	0.4088	0.0604	0.1841
Mean DV	3.7516	3.7516	3.7516	3.7516
SD Damage	1,724,530	1,724,530	1,724,530	1,724,530

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects, country-specific linear trends, and the respective socioeconomic control variables, which are all measured in t-1: log per capita value added of the re-spective sector, population growth rate, openness, investment rate.

Table 34. The effect of a standard deviation increase in wind speed damages on sectoral growth rates with socioeconomic control variables

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Other activities	Other activities	Other activities	Other activities
	(1)	(2)	(3)	(4)
$Damage_t$	-0.1455	-0.2366	-0.2530	-0.2431
	(0.2663)	(0.2463)	(0.2478)	(0.2477)
	[0.5855]	[0.3380]	[0.3085]	[0.3276]
Log pc value $added_{t-1}$	-7.1717***			
	(1.2283)			
	[0.0000]			
Population $growth_{t-1}$		-0.1124		
		(0.2103)		
		[0.5935]		
Capital $growth_{t-1}$			0.0094	
			(0.0086)	
			[0.2775]	
Trade $openness_{t-1}$				0.0004
				(0.0003)
				[0.1080]
N	8,249	8,249	8,249	8,249
Clusters	203	203	203	203
P-value	0.0000	0.5462	0.3059	0.1739
Mean DV	2.5350	2.5350	2.5350	2.5350
SD Damage	1,724,530	1,724,530	1,724,530	1,724,530

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects, country-specific linear trends, and the respective socioeconomic control variables, which are all measured in t-1: log per capita value added of the re-spective sector, population growth rate, openness, investment rate.

Table 35. The effect of a standard deviation increase in wind speed damages on sectoral growth rates with outliers

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Agriculture, hunting, forestry, fishing	Mining, utilities	Manu- facturing	Construc- tion	Wholesale, retail trade, restaurants, hotels	Transport, storage, communi- cation	Other activities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	-2.6049***	-0.0986	-0.9457**	2.0446	-0.8982**	-0.5571**	-0.2636
	(0.3414)	(3.2776)	(0.4771)	(1.3543)	(0.4137)	(0.2477)	(0.1782)
	[0.0000]	[0.9760]	[0.0488]	[0.1326]	[0.0311]	[0.0256]	[0.1406]
N	8,611	8,611	8,611	8,611	8,611	8,611	8,611
Clusters	210	210	210	210	210	210	210
P-value	0.0000	0.9760	0.0488	0.1326	0.0311	0.0256	0.1406
Mean DV	0.8767	24.2969	2.6107	3.2691	2.5209	3.6908	2.5528
SD Damage	2,033,934	2,105,019	2,105,019	2,105,019	2,105,019	2,105,019	2,105,019

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects as well as country-specific linear trends. These regressions explictly include the following identified outliers: Dominican Republic 1979, Grenada 2004, Montserrat 1989, Myanmar 1977, Saint Lucia 1980.

Table 36. The effect of a standard deviation increase in wind speed damages on sectoral growth rates only for exposed countries

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Agriculture, hunting, forestry, fishing	Mining, utilities	Manu- facturing	Construc- tion	Wholesale, retail trade, restaurants, hotels	Transport, storage, communi- cation	Other activities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	-2.5656***	-1.0617	-0.7166	0.8698	-1.2040**	-0.3823	-0.1959
	(0.4683)	(0.8886)	(0.5185)	(0.6384)	(0.5029)	(0.3552)	(0.2694)
	[0.0000]	[0.2356]	[0.1706]	[0.1767]	[0.0189]	[0.2850]	[0.4693]
N	3,622	3,622	3,622	3,622	3,622	3,622	3,622
Clusters	84	84	84	84	84	84	84
P-value	0.0000	0.2356	0.1706	0.1767	0.0189	0.2850	0.4693
Mean DV	1.0412	4.0654	2.2929	2.6719	2.3282	3.5110	2.5494
SD Damage	1,706,646	1,740,224	1,740,224	1,740,224	1,740,224	1,740,224	1,740,224

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects as well as country-specific linear trends.

Table 37. The effect of a standard deviation increase in wind speed damages on sectoral growth rates with region-specific linear trends

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Agriculture, hunting, forestry, fishing	Mining, utilities	Manu-facturing	Construc-tion	Wholesale, retail trade, restaurants, hotels	Transport, storage, communi-cation	Other activities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	-2.5604***	-0.5822	-0.5362	0.8452	-1.1757**	-0.5040	-0.1541
	(0.4057)	(0.9474)	(0.5813)	(0.5620)	(0.5189)	(0.3246)	(0.2740)
	[0.0000]	[0.5396]	[0.3574]	[0.1342]	[0.0245]	[0.1220]	[0.5744]
N	8,500	8,500	8,500	8,500	8,500	8,500	8,500
Clusters	205	205	205	205	205	205	205
P-value	0.0000	0.5396	0.3574	0.1342	0.0245	0.1220	0.5744
Mean DV	0.8800	3.7458	2.6095	3.2388	2.5256	3.7030	2.5519
SD Damage	1,706,646	1,740,224	1,740,224	1,740,224	1,740,224	1,740,224	1,740,224

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects as well as regional-specific linear trends. The regions are East Asian and Pacific, Europe and Central Asia, Latin America and the Caribbean, Middle East and North Africa, North America, South Asia, Sub-Saharan Africa.

Table 38. The effect of a standard deviation increase in wind speed damages on sectoral growth rates with country-specific nonlinear trends

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Agriculture, hunting, forestry, fishing	Mining, utilities	Manu-facturing	Construc-tion	Wholesale, retail trade, restaurants, hotels	Transport, storage, communi-cation	Other activities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	-2.4560***	-0.5203	-0.7438	0.7197	-1.2175**	-0.4722	-0.1869
	(0.4411)	(1.0678)	(0.5316)	(0.6839)	(0.5234)	(0.3745)	(0.2677)
	[0.0000]	[0.6266]	[0.1633]	[0.2939]	[0.0210]	[0.2088]	[0.4859]
N	8,500	8,500	8,500	8,500	8,500	8,500	8,500
Clusters	205	205	205	205	205	205	205
P-value	0.0000	0.6266	0.1633	0.2939	0.0210	0.2088	0.4859
Mean DV	0.8800	3.7458	2.6095	3.2388	2.5256	3.7030	2.5519
SD Damage	1,706,646	1,740,224	1,740,224	1,740,224	1,740,224	1,740,224	1,740,224

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects as well as country-specific nonlinear trends.

Table 39. The effect of a standard deviation increase in wind speed damages on sectoral growth rates without country-specific linear trends

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Agriculture, hunting, forestry, fishing	Mining, utilities	Manu-facturing	Construc-tion	Wholesale, retail trade, restaurants, hotels	Transport, storage, communi-cation	Other activities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	-2.5655***	-0.6040	-0.5440	0.8345	-1.1767**	-0.5056	-0.1614
	(0.4086)	(0.9613)	(0.5817)	(0.5570)	(0.5225)	(0.3264)	(0.2721)
	[0.0000]	[0.5305]	[0.3507]	[0.1356]	[0.0254]	[0.1229]	[0.5537]
N	8,500	8,500	8,500	8,500	8,500	8,500	8,500
Clusters	205	205	205	205	205	205	205
P-value	0.0000	0.5305	0.3507	0.1356	0.0254	0.1229	0.5537
Mean DV	0.8800	3.7458	2.6095	3.2388	2.5256	3.7030	2.5519
SD Damage	1,706,646	1,740,224	1,740,224	1,740,224	1,740,224	1,740,224	1,740,224

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects.

Table 40. The effect of a standard deviation increase in wind speed damages on sectoral growth rates with Conley HAC standard errors

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Agriculture, hunting, forestry, fishing	Mining, utilities	Manu-facturing	Construc-tion	Wholesale, retail trade, restaurants, hotels	Transport, storage, communi-cation	Other activities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	-2.5655***	-0.6040	-0.5440	0.8345	-1.1767**	-0.5056	-0.1614
	(0.4068)	(0.8961)	(0.6600)	(0.5451)	(0.5318)	(0.3565)	(0.2712)
	[0.0000]	[0.5003]	[0.4098]	[0.1258]	[0.0269]	[0.1561]	[0.5519]
N	8,500	8,500	8,500	8,500	8,500	8,500	8,500
SD Damage	1,706,696	1,740,317	1,740,317	1,740,317	1,740,317	1,740,317	1,740,317

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects as well as country-specific linear trends. For all regressions, Conley HAC standards with a maximum lag length of 10 and a spatial cutoff of 1000 km are calculated.

Table 41. The effect of a standard deviation increase in wind speed damages on sectoral growth rates with regional clusters

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Agriculture, hunting, forestry, fishing	Mining, utilities	Manu-facturing	Construc-tion	Wholesale, retail trade, restaurants, hotels	Transport, storage, communi-cation	Other activities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	-2.6219***	-0.7682	-0.7242	0.7306	-1.1552**	-0.4861	-0.1886
	(0.2809)	(1.1861)	(0.5725)	(0.6953)	(0.4053)	(0.4685)	(0.1426)
	[0.0001]	[0.5412]	[0.2527]	[0.3339]	[0.0292]	[0.3395]	[0.2341]
N	8,500	8,500	8,500	8,500	8,500	8,500	8,500
Clusters	7	7	7	7	7	7	7
P-value	0.0001	0.5412	0.2527	0.3339	0.0292	0.3395	0.2341
Mean DV	0.8800	3.7458	2.6095	3.2388	2.5256	3.7030	2.5519
SD Damage	1,706,646	1,740,224	1,740,224	1,740,224	1,740,224	1,740,224	1,740,224

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by regions in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. The regions are East Asian and Pacific, Europe and Central Asia, Latin America and the Caribbean, Middle East and North Africa, North America, South Asia, Sub-Saharan Africa. All regressions include country and year fixed effects as well as country-specific linear trends.

Table 42. The effect of a standard deviation increase in wind speed damages on sectoral growth rates with Newey-West standard errors

Dependent Variables: *Per capita growth rate (%) in sector aggregate*

	Agriculture, hunting, forestry, fishing	Mining, utilities	Manu-facturing	Construc-tion	Wholesale, retail trade, restaurants, hotels	Transport, storage, communi-cation	Other activities
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_t$	-2.5950***	-0.5325	-0.6506	0.8369	-1.1619**	-0.4921	-0.1500
	(0.4370)	(1.0325)	(0.6882)	(0.5510)	(0.5665)	(0.3429)	(0.2806)
	[0.0000]	[0.6060]	[0.3445]	[0.1288]	[0.0403]	[0.1513]	[0.5929]
N	8,500	8,500	8,500	8,500	8,500	8,500	8,500
P-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mean DV	0.8800	3.7458	2.6095	3.2388	2.5256	3.7030	2.5519
SD Damage	1,706,646	1,740,224	1,740,224	1,740,224	1,740,224	1,740,224	1,740,224

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. The sample covers the period 1971 through 2015. $Damage_t$ is the weighted damage measure for tropical cyclone intensity in year t. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t-1, whereas for the remaining sector aggregates it is weighted by exposed population in t-1. All regressions include country and year fixed effects as well as country-specific linear trends. For all regressions Newey-West standard errors with a maximum lag length of 10 years are calculated.

A.5.2 Indirect effects

Table 43. The effect of a standard deviation increase in wind speed damages on the Input-Output coefficients of the agriculture, hunting, forestry and fishing sector aggregate (A&B) (Placebo Test)

Dependent Variables: : *Input-Output coefficients (IO)*

	$IO_t^{A\&B,A\&B}$	$IO_t^{A\&B,C\&E}$	$IO_t^{A\&B,D}$	$IO_t^{A\&B,F}$	$IO_t^{A\&B,G-H}$	$IO_t^{A\&B,I}$	$IO_t^{A\&B,J-P}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_{t+2}$	-0.00134	-0.00002	-0.00001	-0.00001	-0.00015	0.00003	-0.00011
	(0.00133)	(0.00005)	(0.00037)	(0.00002)	(0.00014)	(0.00010)	(0.00041)
	[0.31705]	[0.70470]	[0.97559]	[0.66644]	[0.30366]	[0.79136]	[0.79816]
$IO_{t-1}^{A\&B,A\&B}$	0.80645***						
	(0.05008)						
	[0.00000]						
$IO_{t-1}^{A\&B,C\&E}$		0.85656***					
		(0.00966)					
		[0.00000]					
$IO_{t-1}^{A\&B,D}$			0.84284***				
			(0.01386)				
			[0.00000]				
$IO_{t-1}^{A\&B,F}$				0.78281***			
				(0.05125)			
				[0.00000]			
$IO_{t-1}^{A\&B,G-H}$					0.82225***		
					(0.03118)		
					[0.00000]		
$IO_{t-1}^{A\&B,I}$						0.84184***	
						(0.02293)	
						[0.00000]	
$IO_{t-1}^{A\&B,J-P}$							0.87825***
							(0.01491)
							[0.00000]
N	4,128	4,128	4,128	4,128	4,128	4,128	4,128
Clusters	182	182	182	182	182	182	182
P-value	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Mean DV	0.16742	0.01225	0.08573	0.00379	0.03616	0.02231	0.07167
SD Damage	1,362,359	1,362,359	1,362,359	1,362,359	1,362,359	1,362,359	1,362,359

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_{t+2}$ is the weighted damage measure for tropical cyclone intensity in year t+2. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t+1, whereas for the remaining sector aggregates it is weighted by exposed population in t+1. The dependent variables are Input-Output coefficients (IO) and can range between 0-1. For example the coefficient $IO_t^{A\&B,D}$ displays how much input the sector aggregate A&B needs from sector aggregate D to produce one unit of output. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P). All regressions include country and year fixed effects as well as country-specific linear trends.

Table 44. The effect of a standard deviation increase in wind speed damages on the Input-Output coefficients of the mining and utilities sector aggregate (C&E) (Placebo Test)

Dependent Variables: *Input-Output coefficients (IO)*

	$IO_t^{C\&E,A\&B}$	$IO_t^{C\&E,C\&E}$	$IO_t^{C\&E,D}$	$IO_t^{C\&E,F}$	$IO_t^{C\&E,G\text{-}H}$	$IO_t^{C\&E,I}$	$IO_t^{C\&E,J\text{-}P}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_{t+2}$	0.00001	0.00313	-0.00058	-0.00006	-0.00021	-0.00017	-0.00026
	(0.00001)	(0.00258)	(0.00039)	(0.00020)	(0.00018)	(0.00031)	(0.00063)
	[0.36703]	[0.22702]	[0.13804]	[0.74574]	[0.24310]	[0.58776]	[0.67726]
$IO_{t-1}^{C\&E,A\&B}$	0.73657***						
	(0.06345)						
	[0.00000]						
$IO_{t-1}^{C\&E,C\&E}$		0.83415***					
		(0.05844)					
		[0.00000]					
$IO_{t-1}^{C\&E,D}$			0.89133***				
			(0.02168)				
			[0.00000]				
$IO_{t-1}^{C\&E,F}$				0.88360***			
				(0.02112)			
				[0.00000]			
$IO_{t-1}^{C\&E,G\text{-}H}$					0.79680***		
					(0.06043)		
					[0.00000]		
$IO_{t-1}^{C\&E,I}$						0.79961***	
						(0.05834)	
						[0.00000]	
$IO_{t-1}^{C\&E,J\text{-}P}$							0.87720***
							(0.02265)
							[0.00000]
N	4,128	4,128	4,128	4,128	4,128	4,128	4,128
Clusters	182	182	182	182	182	182	182
P-value	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Mean DV	0.00084	0.15083	0.05438	0.02809	0.01938	0.04883	0.08881
SD Damage	1,343,134	1,343,134	1,343,134	1,343,134	1,343,134	1,343,134	1,343,134

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_{t+2}$ is the weighted damage measure for tropical cyclone intensity in year t+2. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t+1, whereas for the remaining sector aggregates it is weighted by exposed population in t+1. The dependent variables are Input-Output coefficients (IO) and can range between 0-1. For example the coefficient $IO_t^{C\&E,D}$ displays how much input the sector aggregate C&E needs from sector aggregate D to produce one unit of output. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P). All regressions include country and year fixed effects as well as country-specific linear trends.

Table 45. The effect of a standard deviation increase in wind speed damages on the Input-Output coefficients of the manufacturing sector aggregate (D) (Placebo Test)

Dependent Variables: *Input-Output coefficients (IO)*

	$IO_t^{D,A\&B}$	$IO_t^{D,C\&E}$	$IO_t^{D,D}$	$IO_t^{D,F}$	$IO_t^{D,G\text{-}H}$	$IO_t^{D,I}$	$IO_t^{D,J\text{-}P}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_{t+2}$	0.00020	-0.00020	0.00012	-0.00000	-0.00001	-0.00002	0.00017
	(0.00019)	(0.00016)	(0.00140)	(0.00002)	(0.00012)	(0.00009)	(0.00027)
	[0.2990]	[0.1977]	[0.9332]	[0.7865]	[0.9369]	[0.8179]	[0.5261]
$IO_{t-1}^{D,A\&B}$	0.83958***						
	(0.03525)						
	[0.0000]						
$IO_{t-1}^{D,C\&E}$		0.75357***					
		(0.05013)					
		[0.0000]					
$IO_{t-1}^{D,D}$			0.79306***				
			(0.04695)				
			[0.0000]				
$IO_{t-1}^{D,F}$				0.83620***			
				(0.01902)			
				[0.0000]			
$IO_{t-1}^{D,G\text{-}H}$					0.78251***		
					(0.03204)		
					[0.0000]		
$IO_{t-1}^{D,I}$						0.82467***	
						(0.02131)	
						[0.0000]	
$IO_{t-1}^{D,J\text{-}P}$							0.84057***
							(0.01983)
							[0.0000]
N	4,128	4,128	4,128	4,128	4,128	4,128	4,128
Clusters	182	182	182	182	182	182	182
P-value	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Mean DV	0.05549	0.03909	0.24042	0.00452	0.05353	0.03586	0.08546
SD Damage	1,343,134	1,343,134	1,343,134	1,343,134	1,343,134	1,343,134	1,343,134

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_{t+2}$ is the weighted damage measure for tropical cyclone intensity in year t+2. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t+1, whereas for the remaining sector aggregates it is weighted by exposed population in t+1. The dependent variables are Input-Output coefficients (IO) and can range between 0-1. For example the coefficient $IO_t^{D,F}$ displays how much input the sector aggregate D needs from sector aggregate F to produce one unit of output. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P). All regressions include country and year fixed effects as well as country-specific linear trends.

Table 46. The effect of a standard deviation increase in wind speed damages on the Input-Output coefficients of the construction sector aggregate (F) (Placebo Test)

Dependent Variables: *Input-Output coefficients (IO)*

	$IO_t^{F,A\&B}$	$IO_t^{F,C\&E}$	$IO_t^{F,D}$	$IO_t^{F,F}$	$IO_t^{F,G\text{-}H}$	$IO_t^{F,I}$	$IO_t^{F,J\text{-}P}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_{t+2}$	0.00004**	-0.00008	0.00058	0.00016	0.00021	0.00009	0.00079*
	(0.00002)	(0.00008)	(0.00049)	(0.00116)	(0.00020)	(0.00015)	(0.00041)
	[0.02802]	[0.35420]	[0.23891]	[0.88889]	[0.28878]	[0.55218]	[0.05359]
$IO_{t-1}^{F,A\&B}$	0.82738***						
	(0.02152)						
	[0.00000]						
$IO_{t-1}^{F,C\&E}$		0.80762***					
		(0.03261)					
		[0.00000]					
$IO_{t-1}^{F,D}$			0.75346***				
			(0.09827)				
			[0.00000]				
$IO_{t-1}^{F,F}$				0.85201***			
				(0.07531)			
				[0.00000]			
$IO_{t-1}^{F,G\text{-}H}$					0.80791***		
					(0.02005)		
					[0.00000]		
$IO_{t-1}^{F,I}$						0.77454***	
						(0.05936)	
						[0.00000]	
$IO_{t-1}^{F,J\text{-}P}$							0.85000***
							(0.01407)
							[0.00000]
N	4,128	4,128	4,128	4,128	4,128	4,128	4,128
Clusters	182	182	182	182	182	182	182
P-value	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Mean DV	0.00319	0.01603	0.21046	0.03908	0.06434	0.03950	0.09892
SD Damage	1,343,134	1,343,134	1,343,134	1,343,134	1,343,134	1,343,134	1,343,134

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_{t+2}$ is the weighted damage measure for tropical cyclone intensity in year t+2. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t+1, whereas for the remaining sector aggregates it is weighted by exposed population in t+1. The dependent variables are Input-Output coefficients (IO) and can range between 0-1. For example the coefficient $IO_t^{F,G\text{-}H}$ displays how much input the sector aggregate F needs from sector aggregate G-H to produce one unit of output. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P). All regressions include country and year fixed effects as well as country-specific linear trends.

Table 47. The effect of a standard deviation increase in wind speed damages on the Input-Output coefficients of the wholesale, retail trade, restaurants and hotels sector aggregate (G-H) (Placebo Test)

Dependent Variables: *Input-Output coefficients (IO)*

	$IO_t^{G\text{-}H,A\&B}$	$IO_t^{G\text{-}H,C\&E}$	$IO_t^{G\text{-}H,D}$	$IO_t^{G\text{-}H,F}$	$IO_t^{G\text{-}H,G\text{-}H}$	$IO_t^{G\text{-}H,I}$	$IO_t^{G\text{-}H,J\text{-}P}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_{t+2}$	0.00006	0.00001	0.00025	0.00001	0.00282	0.00017	0.00047
	(0.00006)	(0.00004)	(0.00031)	(0.00003)	(0.00192)	(0.00024)	(0.00093)
	[0.25606]	[0.84014]	[0.41821]	[0.83753]	[0.14446]	[0.45985]	[0.60896]
$IO_{t-1}^{G\text{-}H,A\&B}$	0.85308***						
	(0.03951)						
	[0.00000]						
$IO_{t-1}^{G\text{-}H,C\&E}$		0.82517***					
		(0.03417)					
		[0.00000]					
$IO_{t-1}^{G\text{-}H,D}$			0.86195***				
			(0.04354)				
			[0.00000]				
$IO_{t-1}^{G\text{-}H,F}$				0.78960***			
				(0.02916)			
				[0.00000]			
$IO_{t-1}^{G\text{-}H,G\text{-}H}$					0.83892***		
					(0.07918)		
					[0.00000]		
$IO_{t-1}^{G\text{-}H,I}$						0.85301***	
						(0.02086)	
						[0.00000]	
$IO_{t-1}^{G\text{-}H,J\text{-}P}$							0.90666***
							(0.03344)
							[0.00000]
N	4,128	4,128	4,128	4,128	4,128	4,128	4,128
Clusters	182	182	182	182	182	182	182
P-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mean DV	0.00826	0.01583	0.07150	0.00622	0.05366	0.06138	0.13970
SD Damage	1,343,134	1,343,134	1,343,134	1,343,134	1,343,134	1,343,134	1,343,134

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_{t+2}$ is the weighted damage measure for tropical cyclone intensity in year t+2. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t+1, whereas for the remaining sector aggregates it is weighted by exposed population in t+1. The dependent variables are Input-Output coefficients (IO) and can range between 0-1. For example the coefficient $IO_t^{G\text{-}H,F}$ displays how much input the sector aggregate G-H needs from sector aggregate F to produce one unit of output. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P). All regressions include country and year fixed effects as well as country-specific linear trends.

Table 48. The effect of a standard deviation increase in wind speed damages on the Input-Output coefficients of the transport, communication and infrastructure sector aggregate (I) (Placebo Test)

Dependent Variables: *Input-Output coefficients (IO)*

	$IO_t^{I,A\&B}$	$IO_t^{I,C\&E}$	$IO_t^{I,D}$	$IO_t^{I,F}$	$IO_t^{I,G\text{-}H}$	$IO_t^{I,I}$	$IO_t^{I,J\text{-}P}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_{t+2}$	0.00000	0.00000	-0.00008	0.00000	0.00003	0.00111	-0.00001
	(0.00000)	(0.00003)	(0.00020)	(0.00003)	(0.00007)	(0.00082)	(0.00056)
	[0.45717]	[0.88410]	[0.69209]	[0.99657]	[0.61316]	[0.17533]	[0.98117]
$IO_{t-1}^{I,A\&B}$	0.73506***						
	(0.06792)						
	[0.00000]						
$IO_{t-1}^{I,C\&E}$		0.81433***					
		(0.03431)					
		[0.00000]					
$IO_{t-1}^{I,D}$			0.78372***				
			(0.03216)				
			[0.00000]				
$IO_{t-1}^{I,F}$				0.84054***			
				(0.03044)			
				[0.00000]			
$IO_{t-1}^{I,G\text{-}H}$					0.78946***		
					(0.07373)		
					[0.00000]		
$IO_{t-1}^{I,I}$						0.74516***	
						(0.09716)	
						[0.00000]	
$IO_{t-1}^{I,J\text{-}P}$							0.83369***
							(0.01953)
							[0.00000]
N	4,128	4,128	4,128	4,128	4,128	4,128	4,128
Clusters	182	182	182	182	182	182	182
P-value	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Mean DV	0.00041	0.00998	0.06225	0.00886	0.02776	0.10992	0.13054
SD Damage	1,343,134	1,343,134	1,343,134	1,343,134	1,343,134	1,343,134	1,343,134

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_{t+2}$ is the weighted damage measure for tropical cyclone intensity in year t+2. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t+1, whereas for the remaining sector aggregates it is weighted by exposed population in t+1. The dependent variables are Input-Output coefficients (IO) and can range between 0-1. For example the coefficient $IO_t^{I,F}$ displays how much input the sector aggregate I needs from sector aggregate F to produce one unit of output. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P). All regressions include country and year fixed effects as well as country-specific linear trends.

Table 49. The effect of a standard deviation increase in wind speed damages on the Input-Output coefficients of the other activities sector aggregate (J-P) (Placebo Test)

Dependent Variables: *Input-Output coefficients (IO)*

	$IO_t^{J\text{-}P,A\&B}$	$IO_t^{J\text{-}P,C\&E}$	$IO_t^{J\text{-}P,D}$	$IO_t^{J\text{-}P,F}$	$IO_t^{J\text{-}P,G\text{-}H}$	$IO_t^{J\text{-}P,I}$	$IO_t^{J\text{-}P,J\text{-}P}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Damage_{t+2}$	0.00005	-0.00001	0.00027	0.00010	0.00007	0.00010	0.00077
	(0.00004)	(0.00006)	(0.00020)	(0.00007)	(0.00007)	(0.00015)	(0.00052)
	[0.19941]	[0.82050]	[0.17815]	[0.16892]	[0.34915]	[0.47840]	[0.13686]
$IO_{t-1}^{J\text{-}P,A\&B}$	0.47027***						
	(0.04664)						
	[0.00000]						
$IO_{t-1}^{J\text{-}P,C\&E}$		0.85946***					
		(0.03964)					
		[0.00000]					
$IO_{t-1}^{J\text{-}P,D}$			0.72580***				
			(0.08154)				
			[0.00000]				
$IO_{t-1}^{J\text{-}P,F}$				0.79041***			
				(0.03416)			
				[0.00000]			
$IO_{t-1}^{J\text{-}P,G\text{-}H}$					0.76205***		
					(0.05821)		
					[0.00000]		
$IO_{t-1}^{J\text{-}P,I}$						0.83273***	
						(0.01998)	
						[0.00000]	
$IO_{t-1}^{J\text{-}P,J\text{-}P}$							0.74783***
							(0.07843)
							[0.00000]
N	4,128	4,128	4,128	4,128	4,128	4,128	4,128
Clusters	182	182	182	182	182	182	182
P-value	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Mean DV	0.00256	0.01218	0.05638	0.01734	0.02314	0.03174	0.14534
SD Damage	1,343,134	1,343,134	1,343,134	1,343,134	1,343,134	1,343,134	1,343,134

Notes: $*p < 0.1, **p < 0.05, ***p < 0.01$. Panel OLS regression results with clustered standard errors by countries in parentheses (), and p-values in brackets []. The coefficient shows a standard deviation increase in tropical cyclones damages. $Damage_{t+2}$ is the weighted damage measure for tropical cyclone intensity in year t+2. For the sector aggregate agriculture, hunting, forestry and fishing it is weighted by exposed agricultural land in t+1, whereas for the remaining sector aggregates it is weighted by exposed population in t+1. The dependent variables are Input-Output coefficients (IO) and can range between 0-1. For example the coefficient $IO_t^{J\text{-}P,F}$ displays how much input the sector aggregate J-P needs from sector aggregate F to produce one unit of output. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P). All regressions include country and year fixed effects as well as country-specific linear trends.

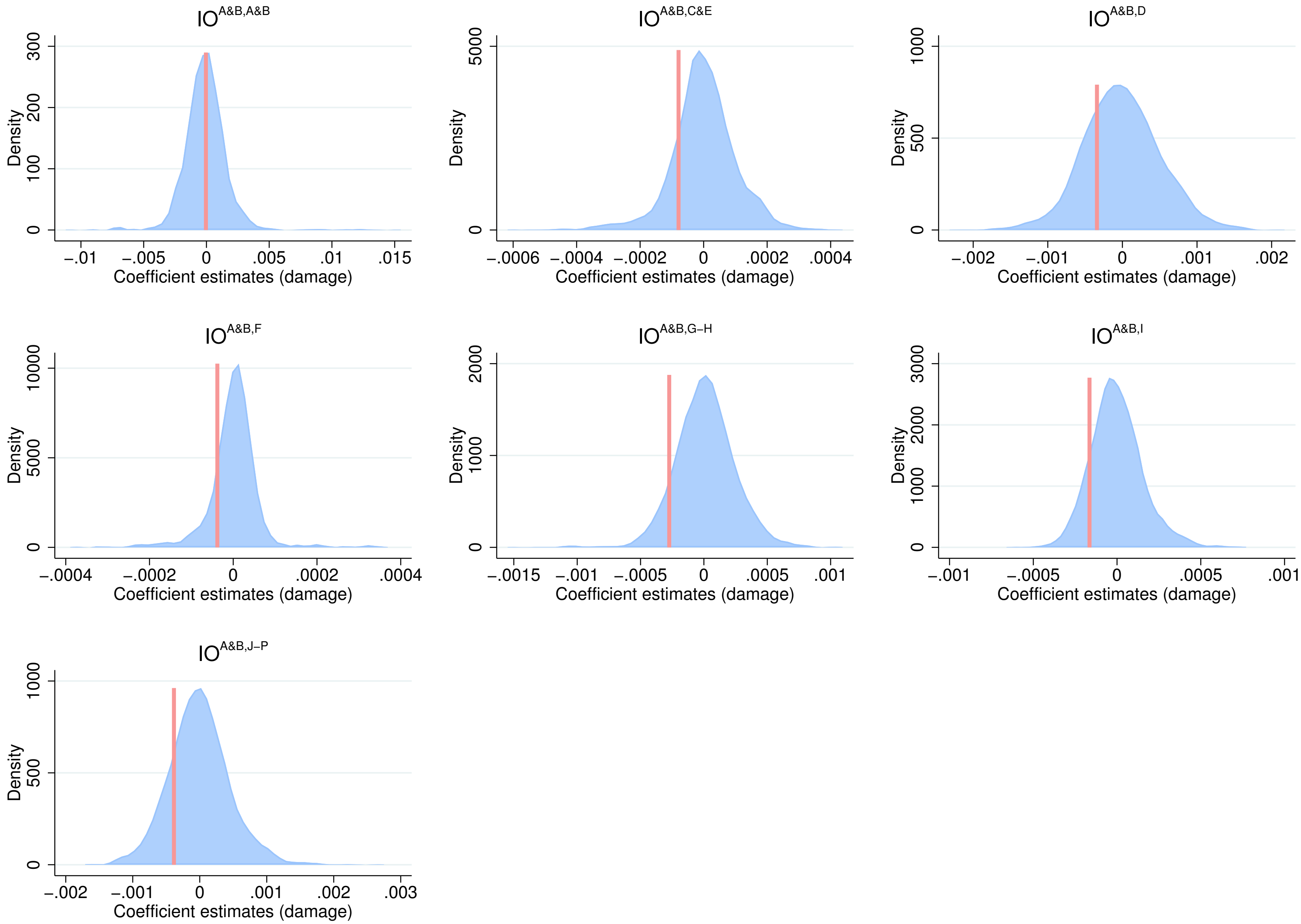

Figure 19: Randomization tests for Input-Output coefficients of sector aggregate A&B. This figure shows the Fisher randomization test results for the damage_t variable where the years are permuted for 2000 repetitions. It displays the kernel density plots (blue) of the randomization coefficient estimates together the results of model 6 (red bar). The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P).

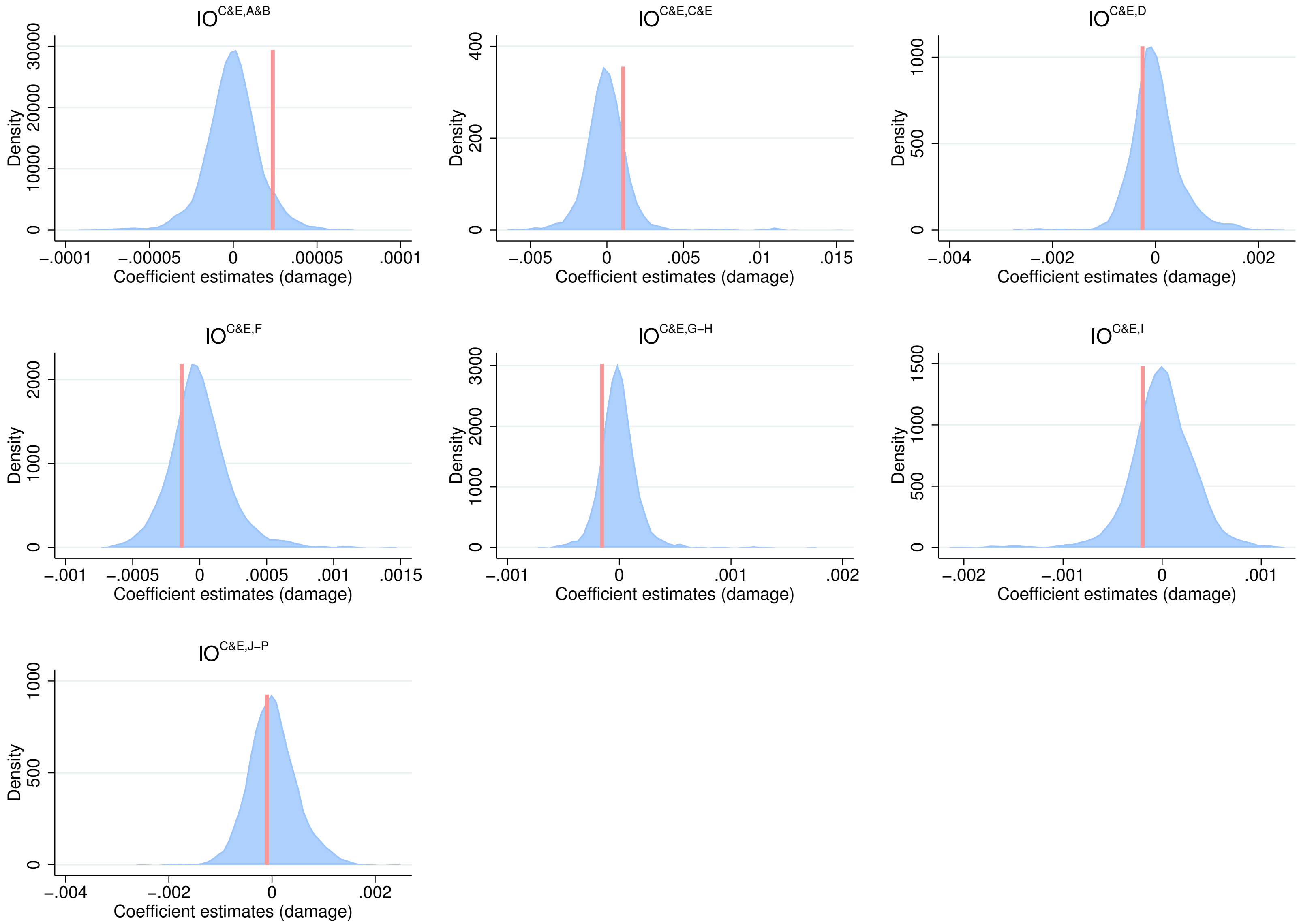

Figure 20: Randomization tests for Input-Output coefficients of sector aggregate C&E. This figure shows the Fisher randomization test results for the damage_t variable where the years are permuted for 2000 repetitions. It displays the kernel density plots (blue) of the randomization coefficient estimates together the results of model 6 (red bar). The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P).

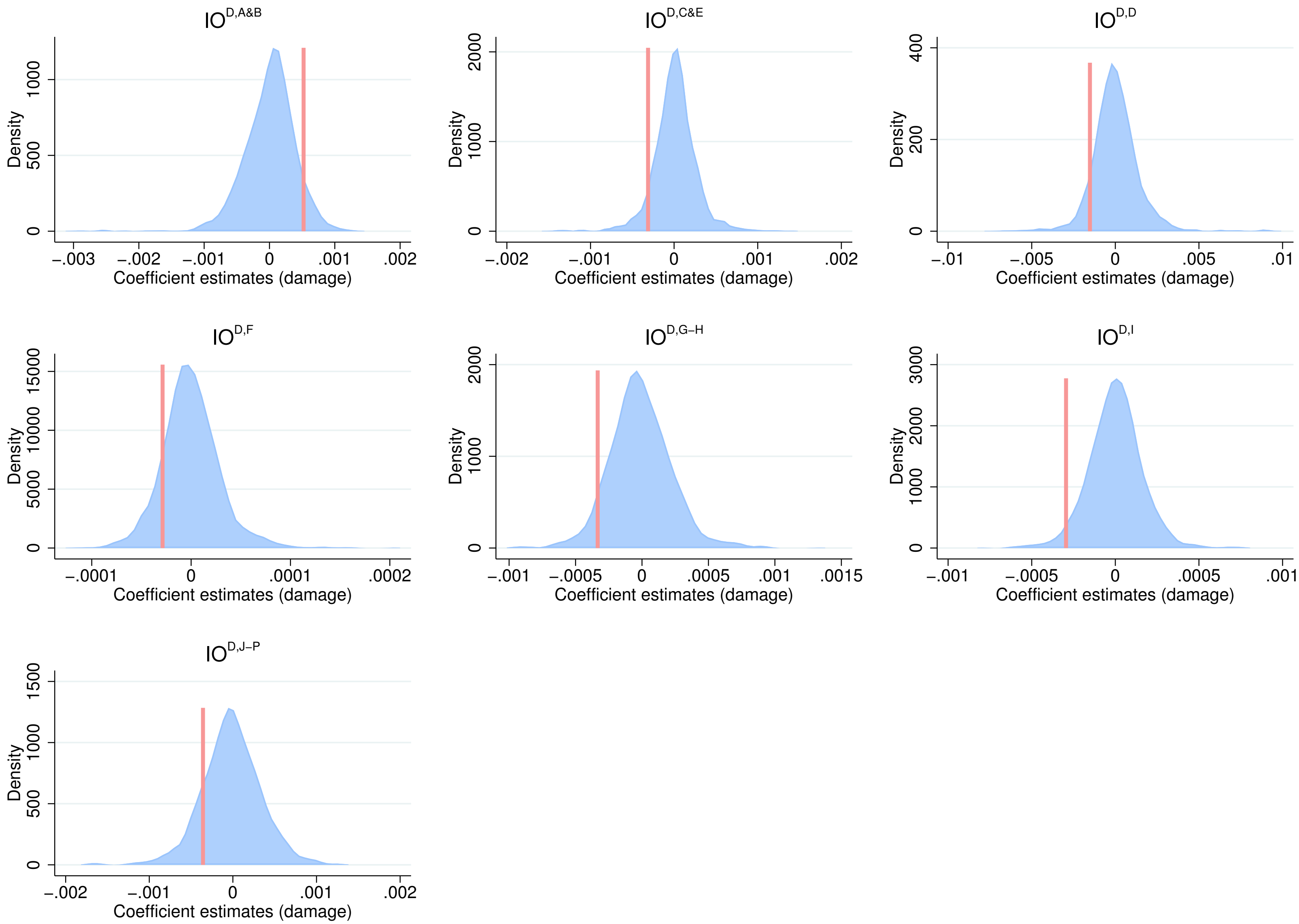

Figure 21: Randomization tests for Input-Output coefficients of sector aggregate D. This figure shows the Fisher randomization test results for the damage_t variable where the years are permuted for 2000 repetitions. It displays the kernel density plots (blue) of the randomization coefficient estimates together the results of model 6 (red bar). The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P).

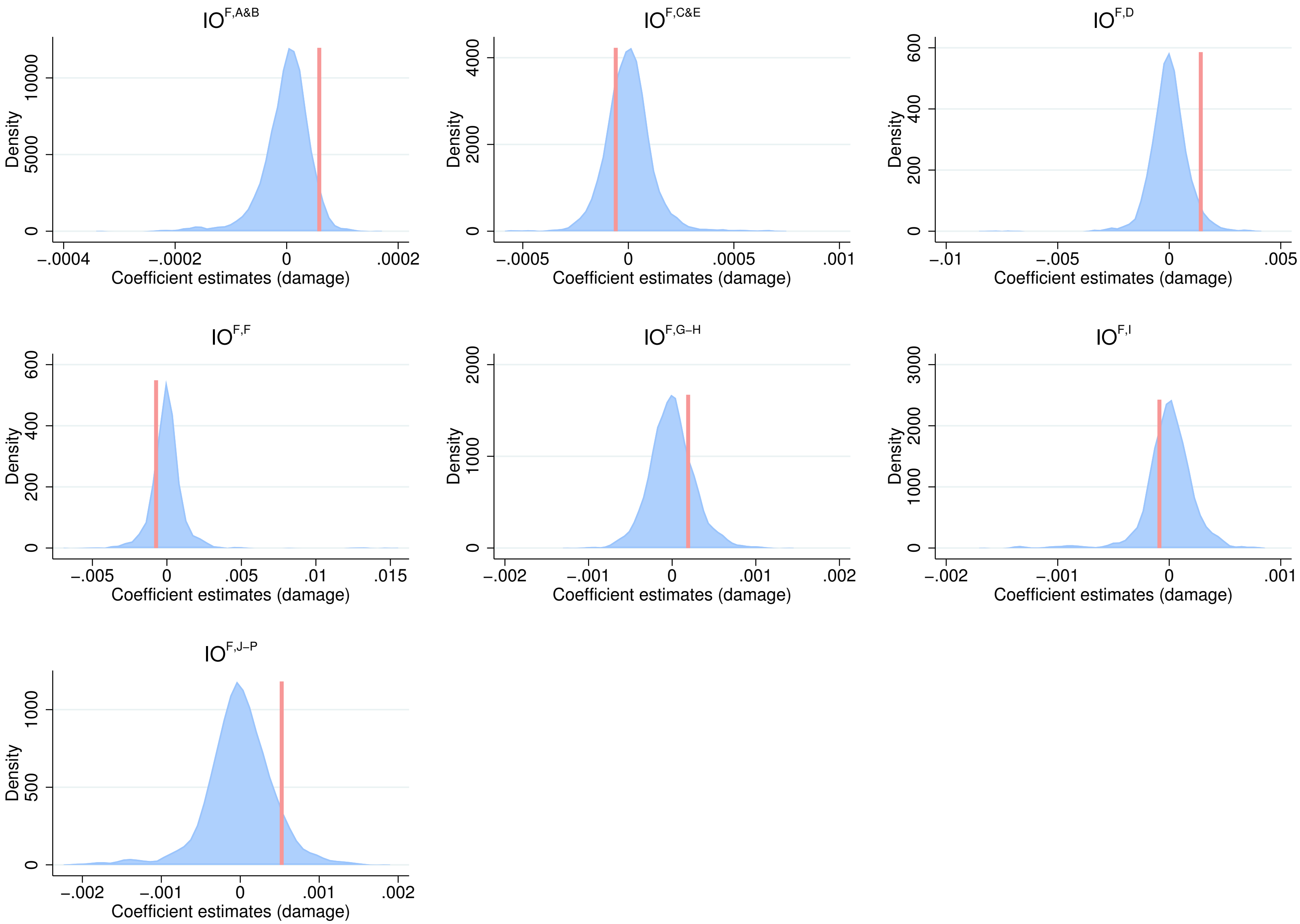

Figure 22: Randomization tests for Input-Output coefficients of sector aggregate F. This figure shows the Fisher randomization test results for the damage_t variable where the years are permuted for 2000 repetitions. It displays the kernel density plots (blue) of the randomization coefficient estimates together the results of model 6 (red bar). The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P).

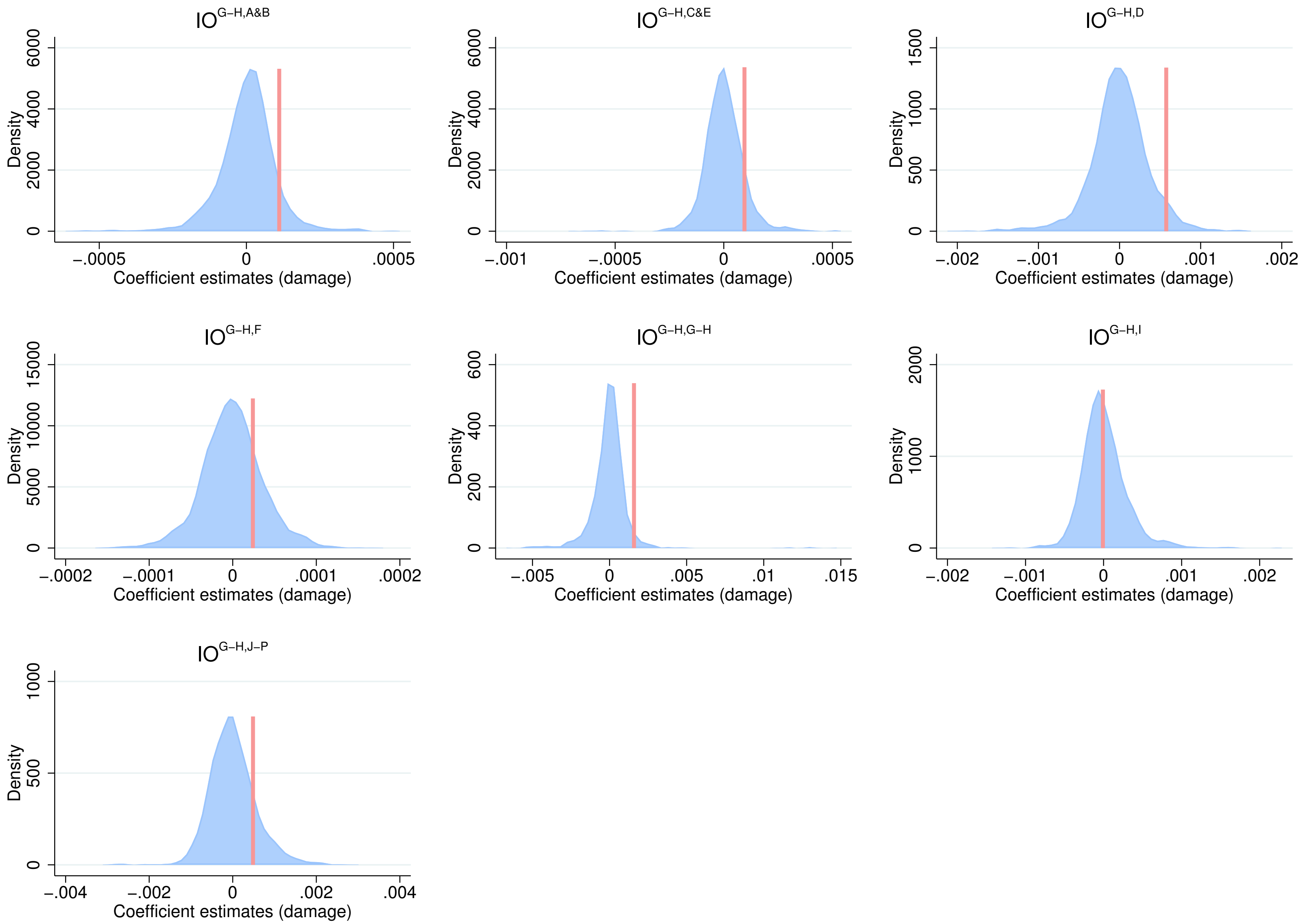

Figure 23: Randomization tests for Input-Output coefficients of sector aggregate G-H. This figure shows the Fisher randomization test results for the damage_t variable where the years are permuted for 2000 repetitions. It displays the kernel density plots (blue) of the randomization coefficient estimates together the results of model 6 (red bar). The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P).

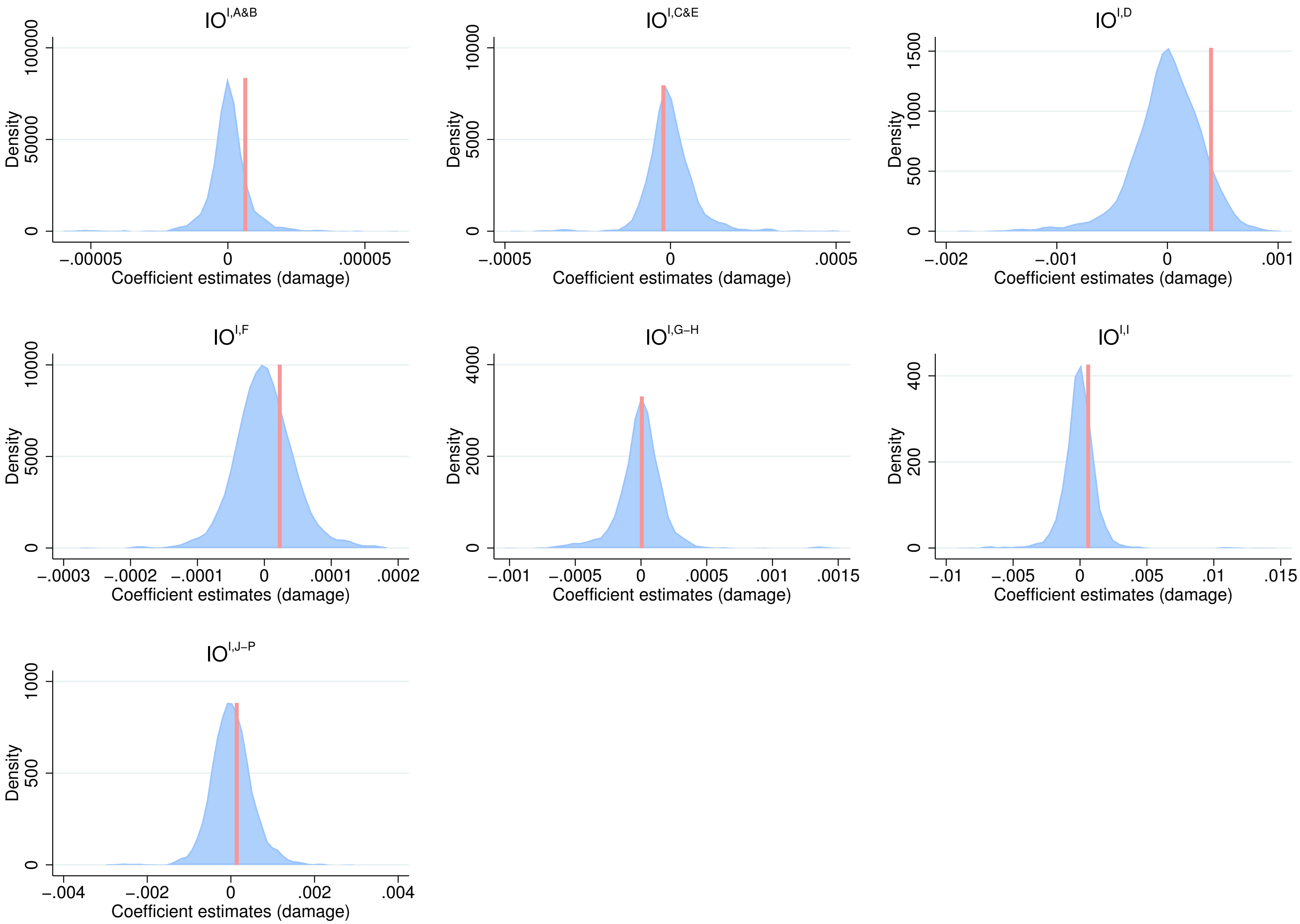

Figure 24: Randomization tests for Input-Output coefficients of sector aggregate I. This figure shows the Fisher randomization test results for the damage_t variable where the years are permuted for 2000 repetitions. It displays the kernel density plots (blue) of the randomization coefficient estimates together the results of model 6 (red bar). The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P).

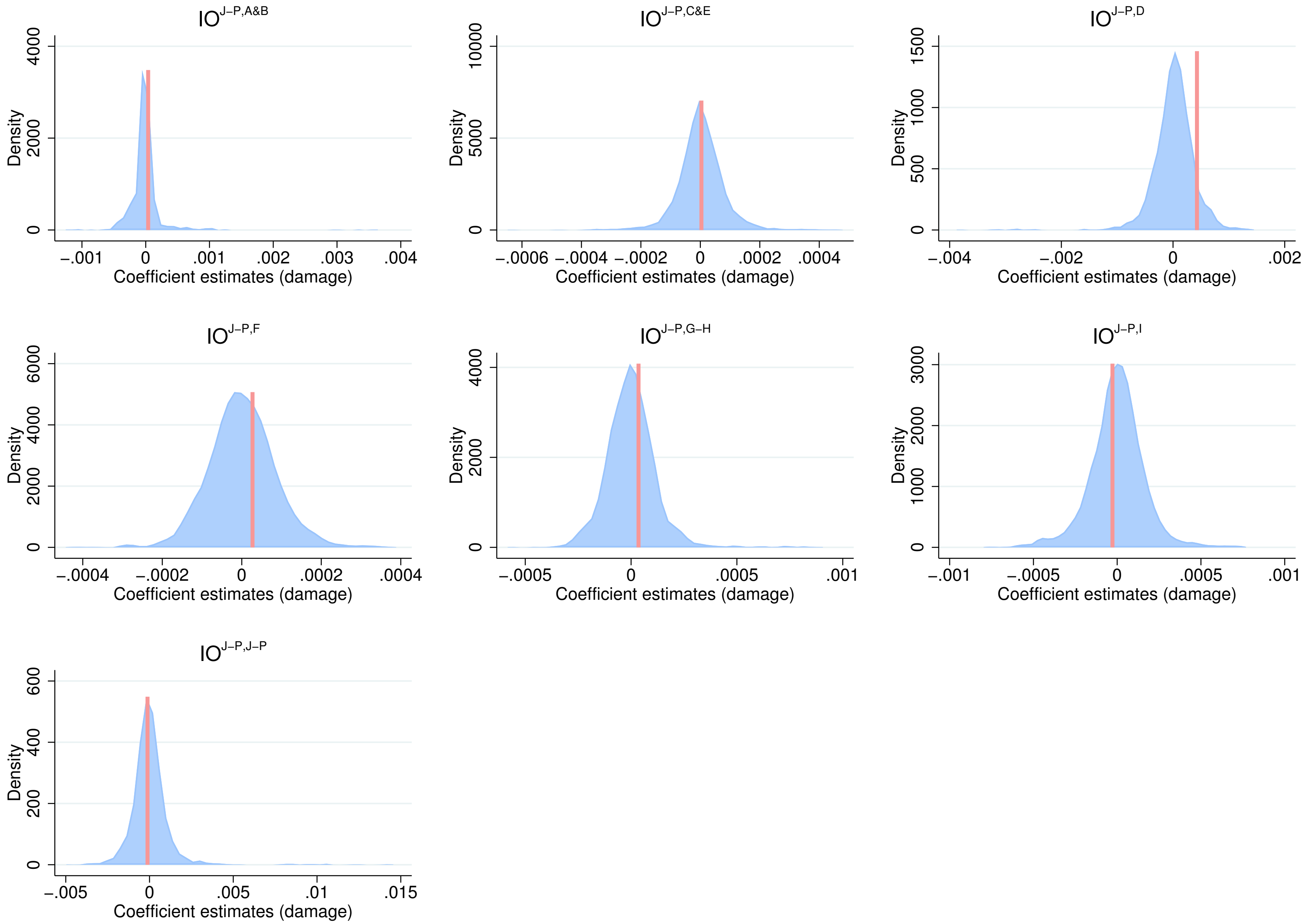

Figure 25: Randomization tests for Input-Output coefficients of sector aggregate J-P. This figure shows the Fisher randomization test results for the damage_t variable where the years are permuted for 2000 repetitions. It displays the kernel density plots (blue) of the randomization coefficient estimates together the results of model 6 (red bar). The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P).

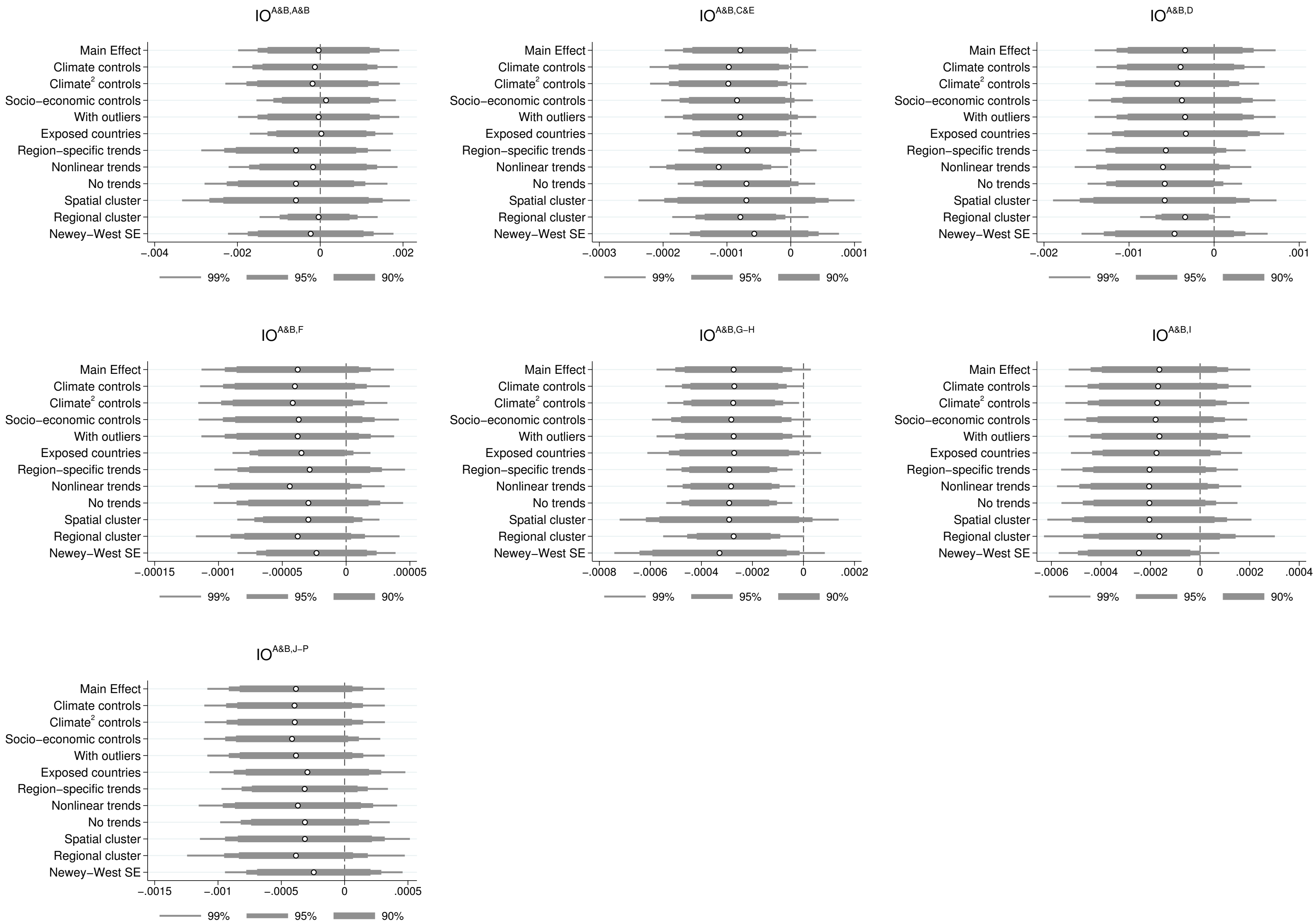

Figure 26: Coefficient plots for different robustness tests for indirect effects of tropical cyclone damages on Input-Output coefficients of sector aggregates A&B. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P).

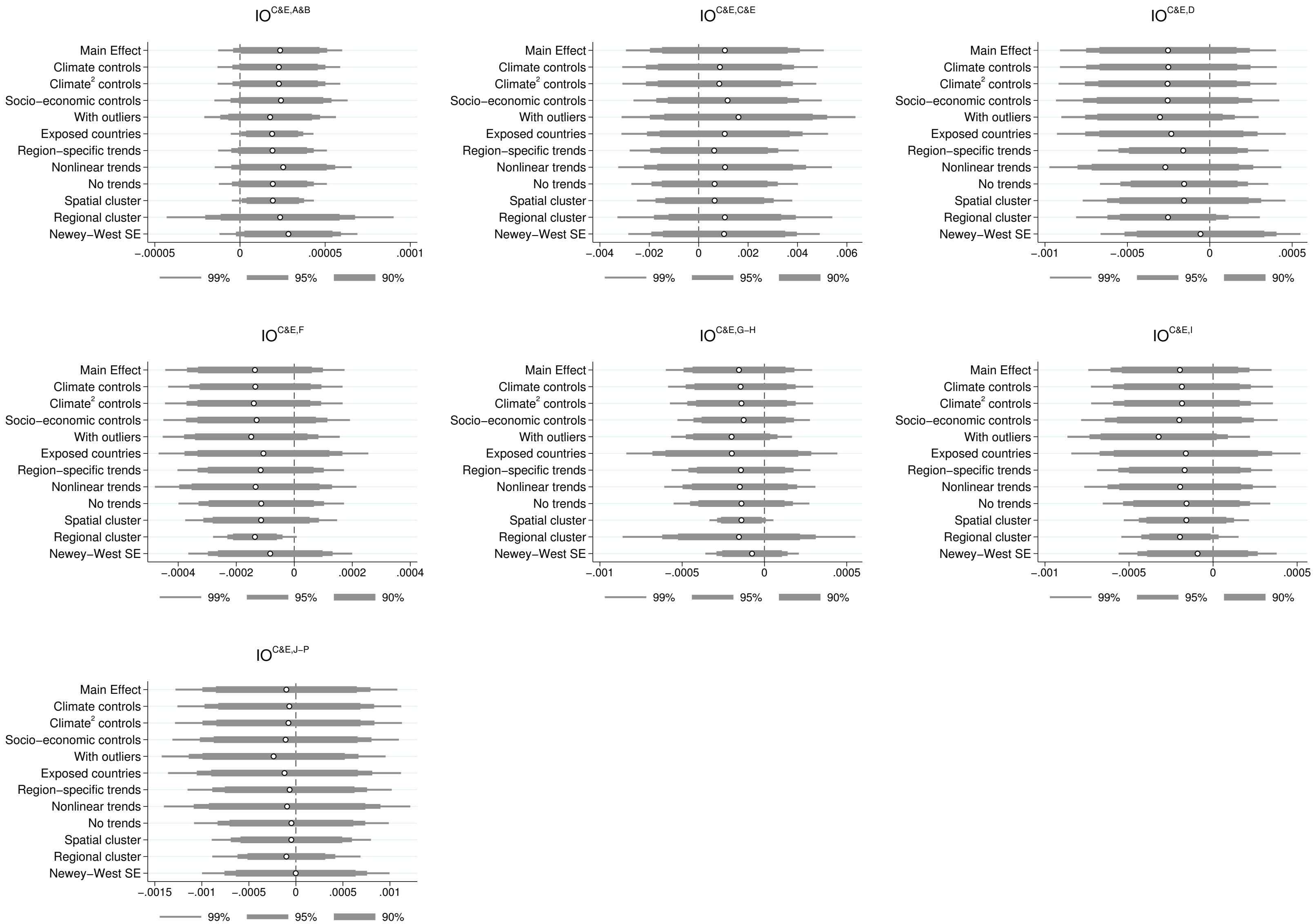

Figure 27: Coefficient plots for different robustness tests for indirect effects of tropical cyclone damages on Input-Output coefficients of sector aggregates C&E. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P).

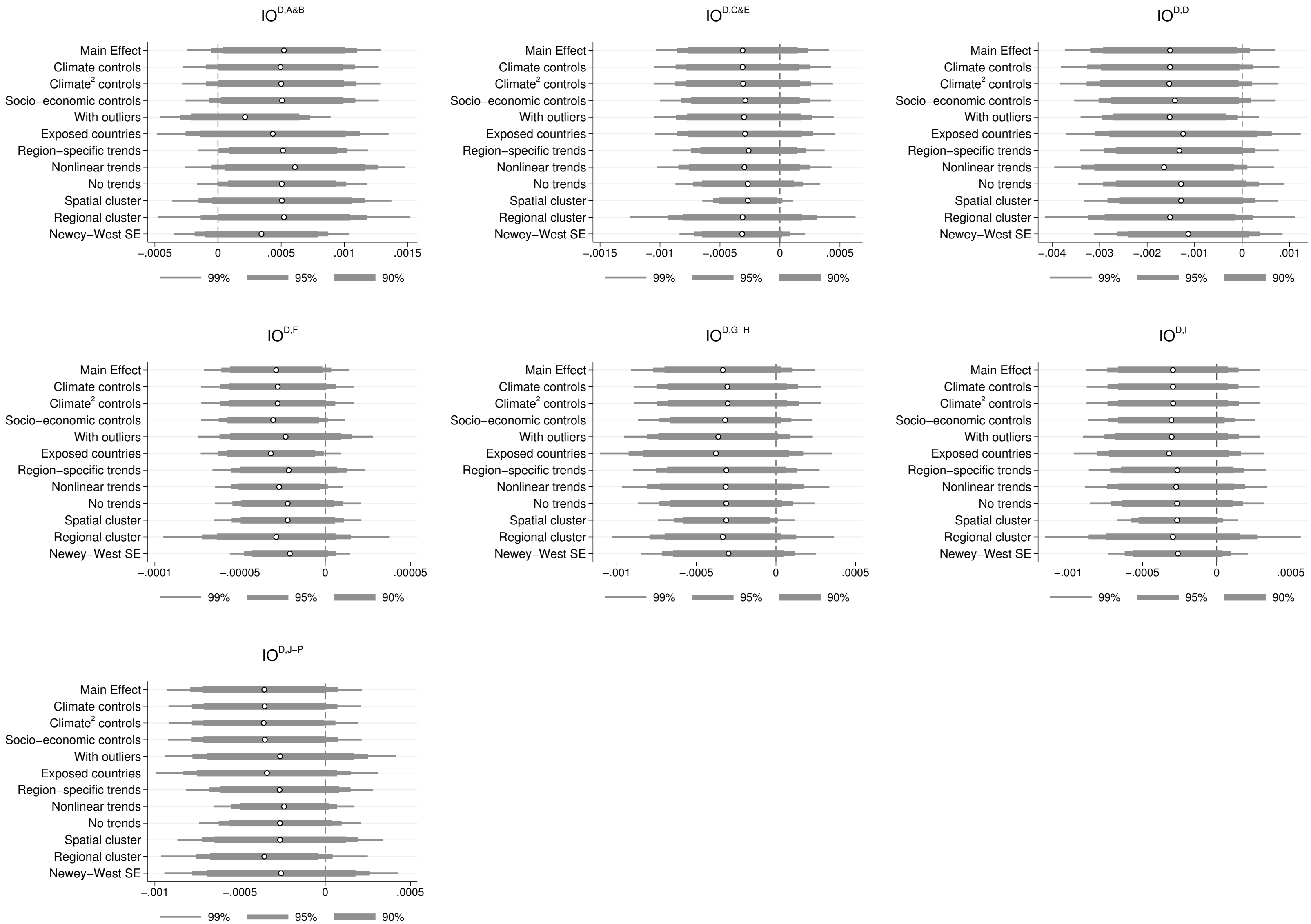

Figure 28: Coefficient plots for different robustness tests for indirect effects of tropical cyclone damages on Input-Output coefficients of sector aggregate D. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P).

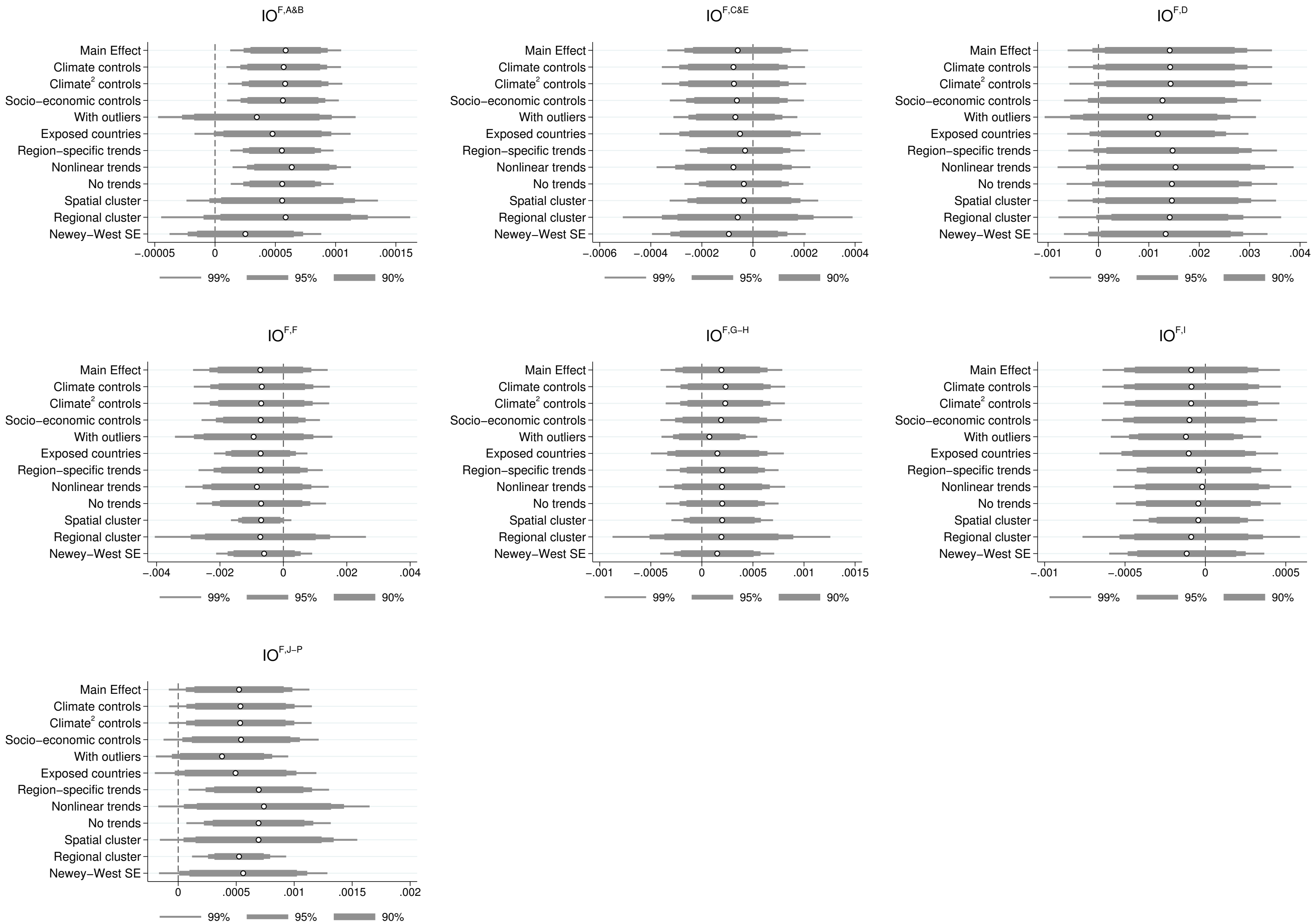

Figure 29: Coefficient plots for different robustness tests for indirect effects of tropical cyclone damages on Input-Output coefficients of sector aggregate F. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P).

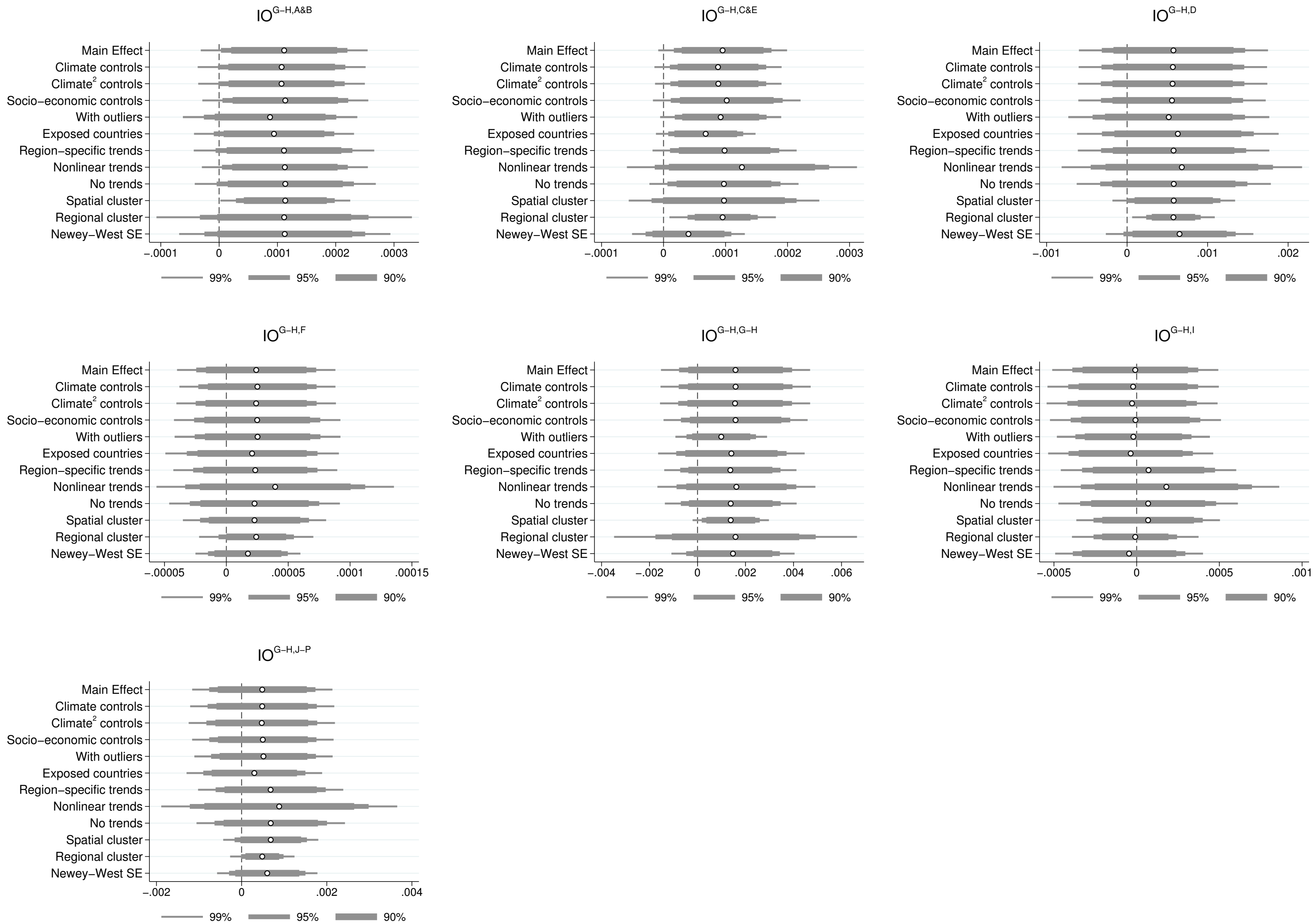

Figure 30: Coefficient plots for different robustness tests for indirect effects of tropical cyclone damages on Input-Output coefficients of sector aggregates G-H. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P).

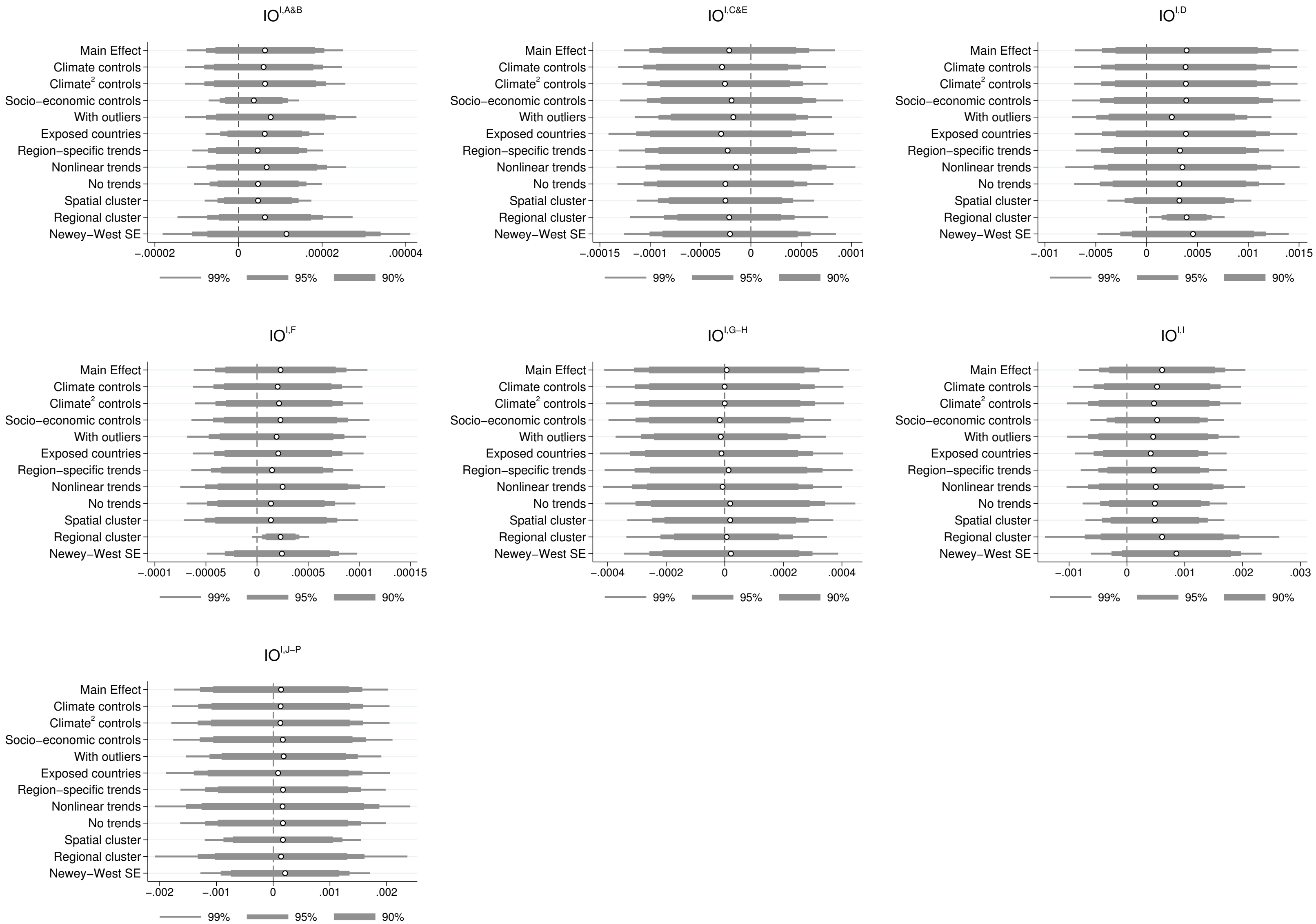

Figure 31: Coefficient plots for different robustness tests for indirect effects of tropical cyclone damages on Input-Output coefficients of sector aggregate I. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P).

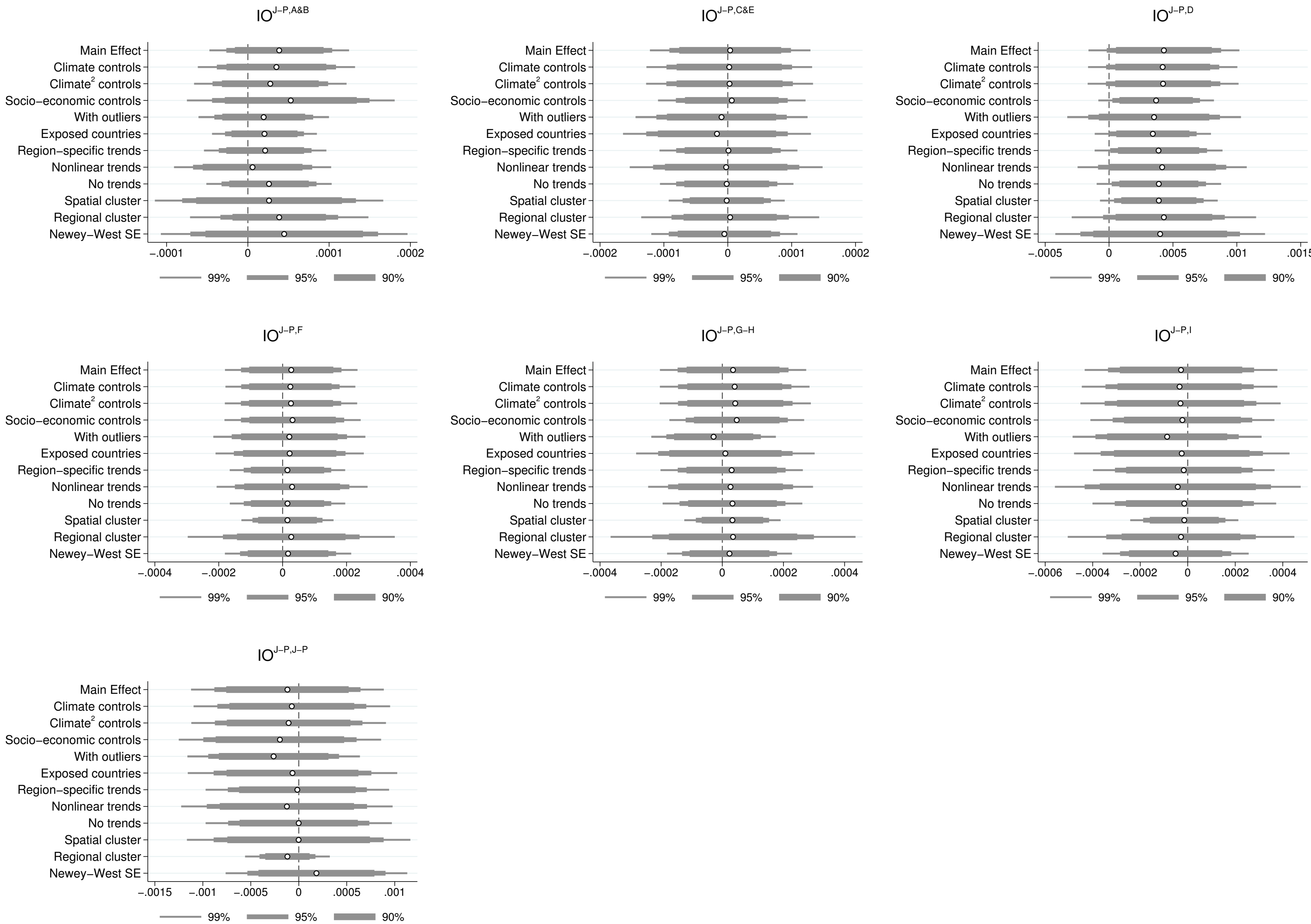

Figure 32: Coefficient plots for different robustness tests for indirect effects of tropical cyclone damages on Input-Output coefficients of sector aggregate J-P. The sector abbreviations represent the following sector aggregates: agriculture, hunting, forestry, and fishing (A&B), mining, and utilities (C&E), manufacturing (D), construction (F), wholesale, retail trade, restaurants, and hotels (G-H), transport, storage, and communication (I), other activities (J-P).