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Trade and Natural Disasters: The Role of Institutional Quality on APEC's Exports

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Abstract: *This paper examines how natural disasters affect exports of the Asia Pacific Economic Cooperation (APEC) economies including how institutional quality (government effectiveness) plays a role in the export flows after natural disasters hit the economies. While various literatures have identified these issues separately, this research would like to fill this gap by exploring the linkages between exports, natural disasters, and institutional quality. The analysis in this paper is based on the gravity model theory which used exports, natural disasters, and the government effectiveness index data from 2003-2022. Overall, the results show that natural disasters have a negative association with the export flows from APEC both at the time when natural disasters hit and in the following year. Having the government effectiveness index above the APEC's average has positively counteracted the negative effect caused by natural disasters, particularly when devastating catastrophes hit the economies. The findings in this paper are relevant for APEC economies that are prone to experience natural disasters, but they need economic growth, particularly from exports. Some policy implications can be drawn from these results such as in the area of export strategies, improving government effectiveness, and disaster preparedness. The key message here is to encourage the APEC economies which are vulnerable to face natural disasters, to keep maintaining a positive export performance through improving the government effectiveness.*

Keywords: Exports; Natural Disasters; Institutional Quality; Government Effectivenes

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INTRODUCTION

The issue of trade and natural disasters has become more prominent in policy discussions nowadays. Its critical conjecture lies in the frequency, severity, and economic impacts caused by natural disasters (Roberts & Mohammed, 2017). According to the data from the World Meteorological Organization (2021) and Our World Data (2023), the total count of disasters has grown to be approximately five to seven times larger over the past fifty years, which mainly come from climate-change related disasters and extreme weather. In terms of economic losses, the amount of damages and losses amounted to USD 202 million on average per day during the same period. In this sense, natural disasters pose great challenges for trade, particularly for exports and imports between economies.

Due to the immediate impacts of natural disasters, a key element that influences an economy's ability to respond effectively is institutional quality. In this context, an interesting question that should be raised is how institutional quality affects or maintains trade performance in times of catastrophic events. While various literature has examined the impact of natural disasters and institutional quality on international trade separately, there is scant

literature that has addressed both issues in the international trade context. Therefore, this brings the core of this research essay to examine the role of institutional quality on APEC economies' exports in times of natural disasters.

In the context of the Asia-Pacific Economic Cooperation (APEC), this regional organization comprising 21 Pacific Rim economies, the interplay between trade and natural disasters takes on particular significance. Geographically, the Asia Pacific region has great diversity which makes it prone to face natural disasters by six times compared to other regions (Srivastava et al., 2023). This region is highly susceptible to a wide array of natural disasters due to its location situated along the Pacific Ring of Fire and typhoon-prone Western Pacific. Economically, APEC represents 60 percent of the world GDP and 48 percent of global trade in 2018 (APEC, 2023). In addition, APEC also consists of developed and developing economies which can show how institutional quality may differ from one to another. This condition has become an important aspect of measuring the relevance of institutional quality in dealing with natural disasters. Therefore, identifying the role of institutional quality on exports in the natural disaster context is crucial not only for academic purposes but also for policy implications. Knowledge of this research is expected can be used by policymakers to focus on which institutional quality, trade strategies, and disaster preparedness efforts should be improved to mitigate negative effects on export performance caused by natural disasters.

In this paper, I argue that institutional quality plays a significant role in maintaining export performance in APEC economies after natural disasters occur within a country, particularly devastating ones. Institutional quality in this research refers to the role of government effectiveness in providing public services and delivering sound policies. It is expected that an effective government can coordinate with each other and maintain stability from the supply side so it can absorb the negative impacts caused by natural disasters for exports. This quality even plays a greater role when devastating disasters hit countries. In the absence of natural disasters, government effectiveness itself is believed to be associated with higher exports. Therefore, government effectiveness is expected to be a significant aspect of boosting exports when natural disasters occur.

The research questions of this paper address the impact of natural disasters on exports in APEC economies and examine how the quality of institutions influences exports in APEC economies after natural disasters occur. Therefore, the purpose of this research is to examine the impact of natural disasters on the APEC's export performance and to assess the role of institutional quality (government effectiveness) in APEC economies' exports after natural disasters hit the economies.

In the previous literature, Osberghaus (2019) finds that natural disasters decrease trade for exporting and importing countries. The finding is that the higher level of political freedom in a country contributes to better handling in times of natural disasters. This condition leads to resiliency in times of disaster. Liu et al. (2023) examine the impact of natural disasters related to climate shocks on international trade in developed and developing countries. They find that the occurrence of climate disasters has a stronger negative effect on exports from developing countries than from developed countries. The exports are about to decrease by 0.65% after the disasters hit developing countries. This is due to the risk mitigation mechanism and disaster preparedness in place in developed countries. Hadri et al. (2018) study the impact of natural disasters by focusing on developing countries, particularly their exports of agricultural products. Their finding indicates that small developing countries with a population of less than twenty million experience a significant negative effect on their agricultural exports, especially when natural disasters occur in rural areas during the growing season. On the other hand, Conevska (2021) finds that deep Preferential Trade Agreements (PTAs) work to increase countries' exports during medium-sized natural disasters but still decrease for other sizes of natural disasters.

From the institutional quality point of view, it is found that institutional quality plays a crucial role in international trade flow. Some studies have shown that the better institutions, the higher international and bilateral trade flows can occur. According to Álvarez et al. (2018), if the trading partners have better institutional quality, it makes the institutional distance between exporter and importer small. This can lead to increased bilateral trade between them. They also find that institutional quality in the form of regulatory quality and government effectiveness matters the most for trade in agriculture. Yu et al. (2015) show that institutional quality in the form of formal and informal facilitates trade in European countries. The formal institutional quality in their paper refers to the rule of law while the informal ones refers to trust among trading partners. Formal institutions here are substitutable with informal institutions, meaning if formal institutions are not in place, informal institutions can play a greater role in increasing trade.

In the context of institutional quality and natural disasters, one of the recent studies which has been conducted by Tennant & Gilmore (2020) identifies that effective government institutions have successfully reduced mortality risks associated with tropical cyclone disasters. Government effectiveness is captured by the quality of public policy and public service delivery in times of disaster. Persson & Povitkina (2017) find that the level of democracy of a country is not enough to protect its citizens from the severity of natural disasters. Democracy only works to reduce the number of individuals impacted by natural disasters, only if institutional quality is high. However, there is scant literature that has addressed this issue concerning trade performance. Therefore, it is interesting to examine whether the positive impact of institutional quality also works well in times of natural disasters, particularly for trade performance in APEC's economies.

To analyze how institutional quality affects the export performance of APEC's economies after natural disasters, the gravity model is applied in this paper due to its broad and successful application in analyzing trade (Baier et al., 2017; Yotov, 2022). The basis of this model is based on Newton's Law of Universal Gravitation which says

that the masses between two objects and the distance between them will determine gravitational force. The basic concept of this law also applies in the context of trade analysis in economics. In trade, the economic force of trade will be determined by the Gross Domestic Product (GDP) of countries, representing the economic mass and also by the distance between them.

The same concept is applied in the gravity model for trade analysis. The economic force of trade is captured by the flow of exports or trade from one country to its trading partner. This force depends on the economic mass of the countries, which is the Gross Domestic Product (GDP) of countries, and negatively on the trade costs between two countries, such as distance and policy factors (Baier et al., 2017).

Gravity Trade Model, as follows;

X_{ij}: Exports or trade from country i to country j
C: Constant
Y: Economic mass such as GDP
t: Trade costs between two countries such as distance, policy factors, etc.

According to Yotov et al. (2016), some advantages of using a gravity model in economic analysis are very intuitive in explanation, realistic to capture a general equilibrium environment, flexible in structure, and predictive to fit in trade in goods and services data. However, the drawback of this gravity model is it does not have any theoretical foundation as a basis for analysis but only an intuitive explanation. Recently, gravity models have been linked to some theoretical foundations including the micro-foundations (Yotov, 2022). Therefore, the model can use real data to assess the sensitivity of trade flows due to variables that we are interested in.

In addition, Herman (2023) suggests addressing multilateral trade resistance in the gravity model by including country-pair fixed effects. First, creating the country-pair fixed effects is expected to handle the endogeneity issue of trade policies (Spornberger, 2021). Second, the country-pair fixed effect also can capture the effect of all unchanging bilateral trade costs since it brings systemic information about trade costs beyond what conventional gravity variables can capture (Yotov et al., 2016).

The dataset constructed in this paper is obtained from several sources. First, trade data which consists of export data of APEC's economies are from Trademap (www.trademap.org). The data is measured in USD thousand at the aggregate exports and imports of Harmonized System (HS) 2 digits for the period 2003-2022. By having recorded trade data from each of the 21 APEC economies, the panel data covers a total of 8,400 observations.

Second, the data on natural disasters is taken from the Emergency Events Database (EM-DAT) 2023. According to EM-DAT (2023), disasters can be defined as events or situations that affect local capacity, and require external assistance both at national and international levels. They classify an event to be called a disaster if one of the following criteria are fulfilled: 1) 10 fatalities or reported dead or missing, 2) 100 affected people, 3) the government seeks external assistance, and 4) declaration of state emergency. The natural disasters covered in this dataset such as droughts, earthquakes, extreme temperatures, famines, floods, slides, volcanic activities, waves and surges, wildfires, wind storms, epidemics, and insect infestations.

In more detail, natural disaster data capture not only the number of natural disasters that occurred or their occurrence but also the total deaths and total damage. Total death is a continuous variable that contains information on the number of dead people due to natural disasters per occurrence. Total damage is also a continuous variable that captures the total value of damage due to natural disasters. The value is in thousands of dollars. Therefore, there are 3 (three) channels as proxies to indicate natural disasters in this paper.

Third, institutional quality data is obtained from the World Bank's World Governance Indicators (WGI). According to Kaufmann and Kraay (2023), governance is defined as "the traditions and institutions by which authority in a country is exercised". In the WGI dataset, there are 6 (six) indicators to capture institutional quality such as 1) control of corruption, 2) government effectiveness, 3) political stability and absence of violence, 4) rule of law, 5) regulatory quality, and 6) voice and accountability. In this paper, the author decided to focus on institutional quality through the lens of government effectiveness. This indicator can be perceived as a measure of how the public perceives the quality of public services, bureaucracy, infrastructure, and the credibility of governments. This can also be classified as a channel to measure how governments deliver effective and efficient policies (Álvarez et al., 2018; Kaufmann and Kraay 2023). WGI is an index, ranging from around -2.5 to 2.5, which means the greater the value, the better the performance of the indicators selected, working in the economies.

Data for APEC's GDP are from the World Bank and International Monetary Fund, measured in current million USD for the period 2003-2022. The information on the Free Trade Agreement (FTA) is taken from the World Trade Organization (WTO) Regional Trade Database (https://rtais.wto.org/).

METHODOLOGY

In terms of the econometric model, this research paper adopts an augmented gravity model to estimate the effects of natural disasters and institutional quality on APEC's economies' exports. This approach has been used in previous literature such as in Oh (2017), Conevska (2021), and Permani & Xu (2022) which address natural disaster issues in their research. The models in this paper are developed, as follows.

$$lnExports_{ijt} = \alpha + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(GDP_{jt}) + \beta_3 (NaturalDisaster_{it}) + \beta_4 (Institutions_{it-1}) + \beta_5 (FTA_{ijt}) + \gamma_{ij} + v_{ij} + \varepsilon_{ijt} \quad (1)$$

$$lnExports_{ijt} = \alpha + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(GDP_{jt}) + \beta_3 (NaturalDisaster_{it-1}) + \beta_4 (Institutions_{it-1}) + \beta_5 (FTA_{ijt-1}) + \gamma_{ij} + v_{ij} + \varepsilon_{ijt} \quad (2)$$

$$lnExports_{ijt} = \alpha + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(GDP_{jt}) + \beta_3 (Institutions_{it-1}) + \beta_4 (NaturalDisaster_{it-1}) + \beta_5 (Institutions_{it-1} * NaturalDisaster_{it-1}) + \gamma_{ij} + v_{ij} + \varepsilon_{ijt} \quad (3)$$

In Equation (1), $lnExports_{ijt}$, as a dependent variable, denotes the total value of bilateral exports from country i to country j at time t, in natural logarithm form. The independent variables which are also variables of interest in this model are $(NaturalDisaster_{it})$, and $(Institutions_{it-1})$. Variable $(NaturalDisaster_{it})$ is a dummy variable that indicates "1" if there is a natural disaster occurring in the country i at time t. This paper then uses other channels to capture variable natural disasters in a more specific way through total deaths (number of people killed) and total damage (total value of economic damage in USD) due to the natural disaster event. This strategy is used as well to check the effect of natural disasters through total death and total damage on export performance. The expected sign of natural disasters, total deaths, and total damage is negative (-), meaning that if a natural disaster occurred, it would be associated with a decrease in exports to the partner country, all else equal.

For the $(Institutions_{it-1})$, it is a dummy variable, indicating "1" if the government effectiveness index of country i is above the average of the APEC's economies index and "0" otherwise. Here, I'll use the lag 1 year of institutional quality instead of at time t because literature has shown that institutional variables have a lagged effect on trade. This also aims to address simultaneity and endogeneity problems (Abreo et al., 2021; Álvarez et al., 2018; Yu et al., 2015). The expected sign of this variable is (+) positive which indicates a positive association with export performance.

While the control variables are $\ln(GDP_{it})$, $\ln(GDP_{jt})$, and (FTA_{ijt}). $\ln(GDP_{it})$ and $\ln(GDP_{jt})$, denotes the GDP of country i and country j at time t, respectively. (FTA_{ijt}) and (FTA_{ijt-1}) is a dummy variable that indicates "1" if country i and country j have trade agreements enforced at time t and $t-1$, respectively. The expected sign of GDP variables is positive (+), as the trade gravity theory notion. For the FTA variable, the sign is expected to be positive (+).

In Equation (2), the dependent variable is still the same as in model (1). The differences are in the independent variables such as $(NaturalDisaster_{it-1})$ and (FTA_{ijt-1}) for model (2), which is in lagged 1 year. This design aims to compare the sign of the coefficients and the magnitude of the natural disasters at time t and the next period. Therefore, variables at $t-1$ are used in the model. The expected sign of the coefficients of the $(NaturalDisaster_{it-1})$ is negative (-).

While Equation (3) is the core and the knowledge gap that this research would like to fill. In this equation, there is an interaction between $(Institutions_{it-1})$ and $(NaturalDisaster_{it-1})$. The purpose of this interaction is to examine the impact of institutional quality on handling negative impacts caused by natural disasters. If the estimated coefficient of this interaction is (-) negative, it means that the institutional quality itself is not enough to 'absorb' the negative effects of natural disasters on export performance.

Conversely, if the estimated coefficient of this interaction variable is (+) positive, it can be translated that institutional quality can counteract the negative impacts of natural disasters on export performance. The expected sign of the interaction variables is (+) positive in this case. Therefore, Equations (1) and (2) above are used to answer Research Question No. 1 by analyzing how natural disasters affect exports in APEC economies. Equation (3) is used to answer Research Question No.2 by checking how institutional quality through government effectiveness can handle the negative effects of natural disasters on APEC's exports.

In terms of estimation strategy, Osberghaus (2019) sums up that there is no universal estimation strategy agreed to examine the linkages between natural disasters and trade. The selection of estimation strategies is diverse and depends on the dependent variables as well as the observation. Nevertheless, most of the studies use fixed-effect models with multiple sources of fixed-effects such as by time, country-pair, sector, country-by-time, sector-by-time, or others (Osberghaus, 2019; Permani & Xu, 2022). The rationale for using fixed effects is to manage differences across observations over time and ensure that the estimated coefficients in the model remain unbiased in omitted time-invariant characteristics. To handle heteroskedasticity issues, the model also includes robust standard error clustered per country pair.

In line with this and referring to Conevska (2021) and Permani & Xu (2022), the estimation strategy used in this analysis is fixed effect with year and country-pair fixed effect. The use of the fixed effect is to control for factors that differ across observations but are constant over time, while the country-pair fixed effect aims to absorb the endogeneity of trade policies and other constant trade costs. Lastly, the robustness of the model is then evaluated by using other channels to capture natural disasters such as total deaths, the total damage caused by natural disasters, and the size of natural disasters, including through using high-dimensional fixed-effects as used in Conevska (2021).

Lastly, this paper also examines how institutional quality or government effectiveness affects exports when devastating natural disasters occur. According to Gassebner et al. (2006), a devastating catastrophe can be

defined as a natural disaster that caused more than 500 deaths and USD 500 million in total damages. Therefore, the model later also shows how the size of natural disasters affects the export performance of APEC economies and how institutional quality plays its role. The expected sign of the interaction between the size of natural disasters and institutional quality is positive. If this is the case, institutional quality contributes to maintaining export performance after natural disasters.

RESULTS

APEC is recognized as one of the most vibrant regions in the world both for political and economic relations. Established in 1989, this organization has recorded many tremendous achievements such as a significant reduction of tariffs from 17 percent to 5.3 percent in 2018 on average (Quitzon and Benson, 2023). The exports among APEC economies have grown from USD 2.4 trillion in 2003 to USD 8.59 trillion in 2022.

From Figure 1, the highest export growth peaked at 30.27 percent growth in 2010, while the deepest contraction occurred in 2009 when the export growth fell by 18.82%. Overall, the intra-APEC export growth has reached around 7.5% on average from 2003-2022. The share of intra-APEC exports to their total exports to the world is also quite large, accounting for 71.62% of their total exports to the world on average during 2003-2022 (See Appendix Figure 3). Despite its growth in exports, one of the inevitable challenges that APEC economies face is the tendency to experience natural disasters. According to APEC (2017), APEC economies generally face 70 percent of all disasters globally and suffer around USD 100 billion in related losses every year.

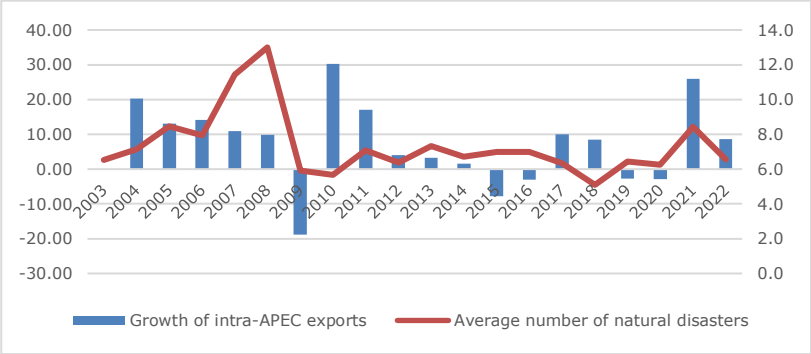

Figure 1. Growth of intra-APEC exports and the average number of natural disasters in APEC, 2003-2022
Source: Trademap and EMDAT, processed by author's calculation (2023)

In terms of natural disaster occurrence, the EMDAT database has recorded that APEC economies suffered around 3,081 natural disasters of various types from 2003 to 2022. From Figure 2, it can be seen that China was a country that experienced natural disasters the most during 2003-2022, with 823 natural disasters in total. This position was followed by the United States (475), Indonesia (323), the Philippines (312) and Vietnam (150). Some of the greatest disasters such as the 2004 Tsunami in the Indian Ocean which hit several countries like Indonesia, Thailand, Malaysia, and Thailand at the same time, the 2008 earthquake in Sichuan Province China, the 2010 earthquake in Chile and the 2011 earthquake in New Zealand and Japan. On average, each of APEC economies experienced around 7 (seven) times of natural disasters with the average total deaths reaching 1,000 people and total economic damage approaching USD 5.87 billion annually.

As has been depicted in Figure 2, most of the countries that suffered the most from the occurrence of natural disasters are at the same time the countries which have larger areas compared to others. For example, China and the US have a total area of more than 9 (nine) million km2 (CIA 2023). This is in contrast to Hong Kong, Singapore, and Brunei Darussalam which each of their land-area is less than 10,000 km2. According to Kahn (2005), countries that have larger areas are prone to experience natural disasters more frequently than others. Therefore, the size of a country matters for the frequency of natural disasters experienced by countries. Since the size of the country is unchangeable over time, another aspect should be examined to minimize the severe impacts of natural disasters.

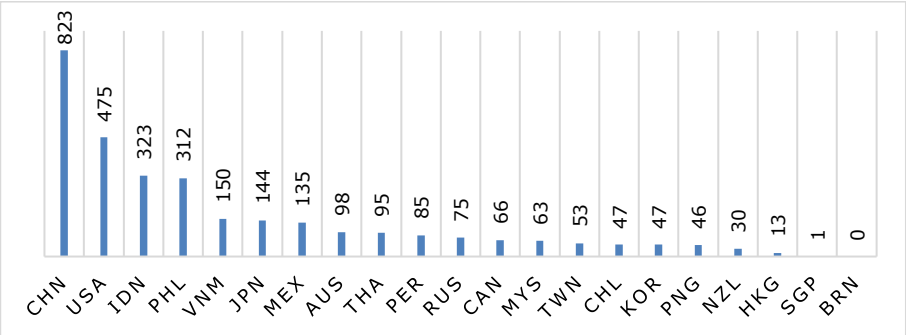

Figure 2. Total number of natural disasters per economy in APEC, 2003-2022
Source: Trademap and EMDAT (2023)

From the previous section, it is found that the physical size of the economies affects their vulnerability to natural disasters. However, the physical size of an economy also can affect the level of severity when disasters hit that economy. Gassebner et al. (2006) find that countries that have smaller areas are riskier to experience negative impacts caused by natural disasters. Acknowledging this condition, some studies have identified which aspect of the country can accommodate or at least minimize the severity caused by natural disasters. Those studies mention the role of income inequality in reducing total deaths, democracy level on import flows, and preferential trade agreements on exports within natural disasters context (Conevska, 2021; Gassebner et al., 2006; Kahn, 2005). In this paper, I examine the role of institutional quality in the form of government effectiveness as a potential factor in maintaining export performance after natural disasters hit.

Figure 3 displays the average of the Government Effectiveness Index of APEC economies during 2002-2021. Overall, the average of the index shows a value of 0.77, where the closer to 2.5 indicates a more effective government and the closer to -2.5 shows a less effective government. There were 12 out of 21 APEC economies that reached the index above the APEC's average.

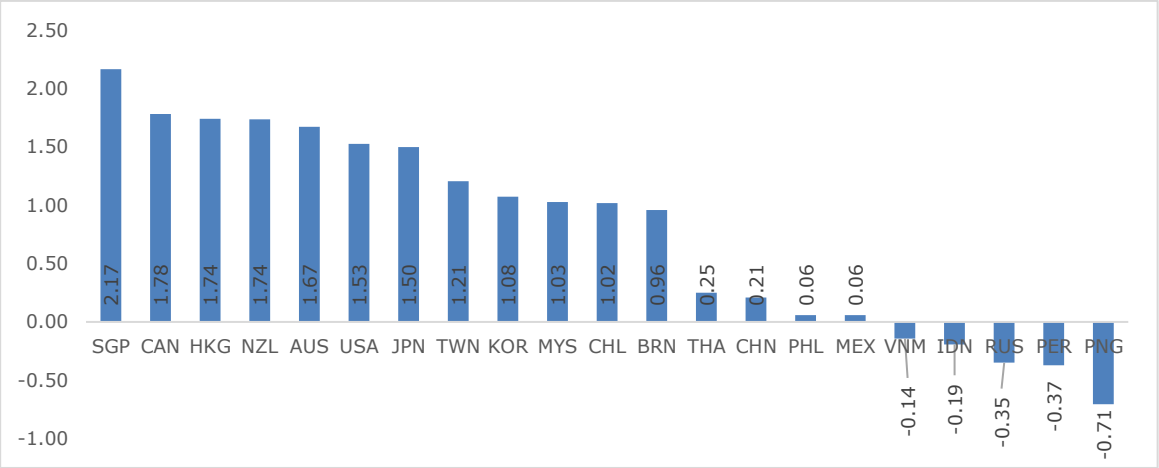

Figure 3. The average of the Government Effectiveness Index (Institutional Quality) of APEC, 2002-2021
Source: World Governance Indicators World Bank (2023)

First, it is important to assess how natural disasters affect export performance. Table 1 presents results from Eq (1) on how natural disasters affect APEC economies' exports at time t or when natural disasters occur. This model is estimated by using fixed-effects with year fixed-effect and country-pair fixed-effect. Overall, the model is quite represented, as the R-squared of all models is considerably moderate, ranging from 25% to 44%. The expected signs of coefficients are in line with the estimated signs coefficients, except for FTA. These results are generally consistent for the three columns, even though not all of them are significant.

The estimated results in Table 1 use 3 (three) different channels to capture natural disasters which are through 1) dummy variable of natural disasters, 2) total deaths, and 3) total damage. By comparing the three columns above, there is a negative correlation between total deaths and export performance while the effects cannot be captured through the dummy variable for natural disasters and variable for total damage at time t. The dummy variable itself may not be representative enough since it just indicates the existence of natural disasters but not their magnitude. Therefore, the interpretation focuses on Columns (2) and (3).

In Column (2), there is a positive coefficient for the GDP of country i, this shows that an increase in 10% of GDP of country i, can be associated with the increase in exports to country j by 0.3%, all other things are constant. This estimated coefficient is significant at a 1 percent level. This result is consistent with Column (3) which also shows a positive significance for the GDP of the country at 1 percent level as well. If there is an increase in the country's GDP by 1%, it is associated with an increase in exports to the partner country by 0.6%, all else equal. This finding is in line with the trade gravity theory and previous studies (Gassebner et al., 2006; Oh & Reuveny, 2010), the economic size of the exporter or country i is positively associated with the exports to the partner countries. However, the estimated sign of the country's GDP is positive but not significant.

The institutional quality aspect is captured through the dummy variable of government effectiveness. This variable still shows a consistent, positive, and significant coefficient at a one percent level in both Columns (2) and (3). The dummy variable indicates "1" when the government effectiveness of the country is above the APEC economies' average, which is 0.77, and "0" otherwise. In the case of Column (2), changing the government effectiveness from below the APEC economies' average to above the average is associated with the percentage change in exports by (100 ×(e^0.335-1))= 39.79%, all else equal. In the case of Column (3), switching the condition from "0" to "1" is associated with the percentage change in exports by (100 ×(e^0.178-1))= 19.48%, all else equal. This finding is in line with previous studies that examine the effect of institutional quality on the performance of trade (Abreo et al., 2021; Álvarez et al., 2018). They find that institutional quality in the form of government effectiveness has appeared to have a notable effect on trade performance between countries.

In Column (2), I capture the natural disasters aspect through the total deaths caused by the disasters. The

estimated coefficient of the regressor is negative and significant at a 1 percent level. This suggests, that if there is a ten percent increase in total deaths, it can be associated with a decrease in exports by 0.17%, no change on other things. However, the negative effects on exports from the channel of total damage cannot be captured in Column (3). For the dummy variable of FTA, the estimated coefficient is negatively insignificant in Column (2) but negatively significant at the 5 percent level in Column (3). This means if APEC economies have bilateral FTA enforced among them, it is associated with a reduction in exports to partner countries by 11.6%, all else equal. One of the possibilities that may cause this condition is the "noodle-bowl effect" due to the massive proliferation of trade agreements in Asia Pacific. According to Kawai & Wignaraja (2009), the "noodle-bowl" problem can distort bilateral trade since there are overlapping trade agreements which pose challenges in streamlining Rules of Origin (ROO) among countries. This can lead to an increase in administrative cost and transaction costs which leads to a decrease in exports. However, this notion should be deeply examined but this paper does not focus on this issue.

Table 1. Exports and Natural Disasters at Time t

Variable	**Natural Disaster (1)**	**Total Deaths (2)**	**Total Damage (3)**
GDP country *i* (ln)	0.0297***	0.0304***	0.623***
	(0.00616)	(0.00560)	(0.0867)
GDP country *j* (ln)	0.0109	0.0111	0.0180
	(0.00978)	(0.00918)	(0.0124)
Natural disasters	-0.0323		
	(0.0311)		
Government effectiveness	0.242	0.335***	0.178**
	(0.213)	(0.0722)	(0.0885)
FTA	-0.0499	-0.0273	-0.111**
	(0.0545)	(0.0530)	(0.0497)
Total deaths (ln)		-0.0163***	
		(0.00440)	
Total damage (ln)			-0.00499
			(0.00369)
Constant	18.92***	19.11***	3.258
	(0.334)	(0.298)	(2.394)
Observations	7,875	5,784	5,351
R-squared	0.252	0.345	0.441
Number of country pair	420	380	380

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

After examining the negative effects of natural disasters at time t, Table 2 presents results from Eq (2) to show how natural disasters affect APEC economies' exports in the next period by using variables at time t-1. This model is quite similar to Eq (1), the difference is only in using lagged variables for natural disasters variables and FTA. This aims to compare the effect of natural disasters on export performance between time t in Eq (1) and at the next period using time t-1 variables in Eq (2). Overall, the model has a quite representative R-squared ranging from 25% to 39%. The regressors' expected and estimated coefficients are also consistent and mostly significant. In general, the results from Eq (2) show quite similar results with Eq (1), the difference here is at the total damage variable. Below is the interpretation for each column except for Column (1), since the justification is the same as the previous one.

In Table 2, Columns (2) and (3), the estimated coefficients for the GDP of country i are positive and significant at a 1 percent level. This means if there is a 10% increase in the country i's GDP, it is associated with a rise in exports by around 0.32-0.33%, all other things are constant. In terms of the estimated coefficients for the GDP of country j are positive but insignificant in Columns (2) and (3). A similar case also happens for dummy variables of FTA which are found negative and insignificant in those columns.

From the variables of natural disasters, there are several important findings by using lagged variables in Columns (2) and (3). Firstly, the negative effects of natural disasters which are captured through total deaths are identified both at time t and at the next period. If we compare the estimated coefficients in Table 1 and Table 2, the magnitude is not much different at time t than at time t-1. If there is a 10 percent increase in people killed by natural disasters, it is associated with a reduction in exports to the partner country by 0.13% in the next period, compared to the reduction in the model at time t which is 0.16%, all else equal. Both coefficients are significant at a 1 percent level.

Secondly, the negative effect of natural disasters is captured through total damage in Table 2 but not in Table 1. This means that the impact of natural disasters through total damage comes into effect in the next period. From Table 2, the estimated coefficient of the Total Damage is significant at a 1 percent level. This finding suggests that an increase of 10 percent in total damage is associated with a decrease in exports by 0.09%, other things unchanged.

Thirdly, the estimated coefficients for government effectiveness are consistently positive and significant both at

time t and t-1. Therefore, the findings in this paper confirm previous literature that government effectiveness has a strong connection to the export performance of partner countries. The next question that should be elaborated on is how this institutional quality (government effectiveness) can work to keep increasing exports of APEC economies after natural disasters hit.

Table 2. Exports and Natural Disasters at Time t-1

Variables	**Natural Disasters (1)**	**Total Deaths (2)**	**Total Damage (3)**
GDP country *i* (ln)	0.0294***	0.0329***	0.0322***
	(0.00615)	(0.00590)	(0.00618)
GDP country *j* (ln)	0.0108	0.0120	0.0106
	(0.00980)	(0.0136)	(0.0122)
Natural disasters	-0.0373		
	(0.0240)		
Government effectiveness	0.248	0.409***	0.306***
	(0.213)	(0.0829)	(0.0733)
FTA	-0.0390	-0.0131	-0.0179
	(0.0550)	(0.0500)	(0.0542)
Total Deaths (ln)		-0.0130***	
		(0.00393)	
Total Damage (ln)			-0.00895***
			(0.00276)
Constant	18.93***	18.96***	19.27***
	(0.328)	(0.409)	(0.387)
Observations	7,875	5,803	5,348
R-squared	0.252	0.363	0.389
Number of country pair	420	380	380

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3 shows results from Eq (3), examining the impact of government effectiveness on exports after natural disasters hit the APEC economies. Overall, the model is quite represented by showing the R-squared of all models ranging from 25% to 39% for Columns (1) to (3) by using fixed-effect estimation. As a comparison and for robustness check purposes, Columns (4) to (6) show the estimation results by using high-dimensional fixed effects. The use of high-dimensional fixed effects here refers to Conevska (2021). The estimated coefficients of the regressors are found to be consistent and as expected for all columns. The main results of this paper are in Columns (2) and (3) which capture natural disaster variables through lagged total deaths and lagged total damage in natural logarithm, respectively.

In Columns (2) and (3), there are positive and significant coefficients for 〖ln(GDP〗_it) at a 1 percent level. This shows that an increase of 10% in a country i's GDP is associated with an increase in exports to partner countries by 0.3%, all else equal. However, there are positive and insignificant coefficients for 〖ln(GDP〗_jt) and the lagged FTA variable in both columns.

The results for the dummy variable of government effectiveness both in Column (2) and (3) show positive and significant at the 1 percent level. This is the evidence that there is a beneficial association of having a government effectiveness index more than the average of the APEC's economies. Having this condition can increase exports to the partner country by (100 ×(e^0.228-1))= 25.61% and (100 ×(e^0.337-1))= 40.07% at each model respectively, all else equal. These estimation results are reasonable since the variable of government effectiveness itself represents measures that cover the quality of bureaucracy, quality of road infrastructure, and public administration including the adaptability of government policy to changes.

In terms of the natural disasters variable, the estimated coefficient for the lagged Total Deaths is negative and significant at the 1 percent level. If there is a 10 percent increase in total deaths, it can be associated with a reduction in exports by 0.254% in the following year. For the lagged Total Damage variable, the estimated coefficient is negative and significant at the 5 percent level. Once there is a 10% increase in total damage, it will have a negative association with the exports by 0.08%, all other things are constant. Total damages represent the value of economic losses due to natural disasters which can come from the destruction of infrastructure and property.

The variable of interest in this paper is the interaction variable between government effectiveness and lagged Total Deaths. The estimated coefficient for this interaction variable is positive and significant at a 1 percent level. All else equal, a country with government effectiveness above the APEC's average can alleviate the negative effects of total deaths by increasing exports by 0.29%, even when there is a 10% increase in total deaths due to natural disasters. Therefore, having a government effectiveness above the APEC's average is empirically found to have a positive impact when natural disasters hit. However, the marginal impact is not that much.

Table 3. Exports, Natural Disasters and Institutional Quality

Variables	Fixed-Effect			High-dimensional Fixed-Effect		
	Natural Disasters (1)	Total Deaths (2)	Total Damage (3)	Natural Disasters (4)	Total Deaths (5)	Total Damage (6)
GDP country i (ln)	0.0293***	0.0338***	0.0322***			
	(0.00606)	(0.00595)	(0.00618)			
GDP country j (ln)	0.0108	0.0120	0.0106			
	(0.00982)	(0.0137)	(0.0122)			
FTA	-0.0379	-0.0141	-0.0182			
	(0.0552)	(0.0498)	(0.0542)			
Government effectiveness	0.222	0.228**	0.337**	0.217	0.258***	0.347**
	(0.250)	(0.0970)	(0.144)	(0.250)	(0.0964)	(0.145)
Natural disasters	-0.0801			-0.0900		
	(0.0801)			(0.0804)		
Government effectiveness	0.0610			0.0709		
× natural disasters	(0.103)			(0.103)		
Total deaths (ln)		-0.0254***			-0.0263***	
		(0.00580)			(0.00590)	
Government effectiveness		0.0292***			0.0263***	
× Total deaths (ln)		(0.00854)			(0.00838)	
Total damage (ln)			-0.00834**			-0.00800**
			(0.00387)			(0.00390)
Government effectiveness			-0.00144			-0.00150
× Total damage (ln)			(0.00564)			(0.00568)
Constant	18.96***	19.03***	19.26***	20.01***	20.24***	20.39***
	(0.339)	(0.410)	(0.391)	(0.159)	(0.0612)	(0.102)
Observations	7,875	5,803	5,348	7,875	5,803	5,346
R-squared	0.252	0.364	0.389	0.953	0.964	0.965
Number of country pair	420	380	380			

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

To capture the effect of government effectiveness in a more significant way, Table 4 represents results by inserting the interaction variable between government effectiveness and the lagged size of natural disasters. According to Gassebner et al. (2006), a devastating catastrophe causes more than 500 deaths and total damage reaches more than USD 500 million. The lagged size variable is a dummy variable, indicating "1" if the natural disaster is classified as a devastating catastrophe and "0" otherwise.

Table 4 shows if a devastating catastrophe occurs in a country, it is associated with a reduction in exports by (100 ×(e^(-0.129)-1))= -12.10%, all else equal. This result is significant at a 1 percent level. At the same time, institutional quality (read: government effectiveness) plays a greater role in counteracting the negative effects of natural disasters on exports in this case. By having government effectiveness that is above the APEC's average, it is associated with an increase in exports by (100 ×(e^0.134-1))= 14.34%, after devastating natural disasters hit the economies, other things unchanged. This magnitude is larger compared to the results in Table 3.

In terms of imports, the effect of natural disasters and government effectiveness cannot be detected in this model as displayed in Column 2. However, this is not the main interest of this paper, and further research is needed in the future. Despite the findings exposed in this paper, some caveats are acknowledged by the author such as in the scope of the research. It would be more meaningful if the research could be detailed on the specific exported products instead of the aggregate export data only.

Table 4. Exports, Imports, Size of Natural Disasters and Institutional Quality

Variables	Exports (1)	Imports (2)
GDP country i (ln)	0.0291***	0.0162*
	(0.00602)	(0.00919)
GDP country j (ln)	0.0108	0.0280***
	(0.00975)	(0.00685)
FTA	-0.0398	-0.00590
	(0.0549)	(0.0596)
Government effectiveness	0.219	0.0831
	(0.215)	(0.142)
Size	-0.129***	-0.0598
	(0.0290)	(0.0411)
Government effectiveness × Size	0.134***	0.0755
	(0.0493)	(0.0562)
Constant	18.93***	18.91***
	(0.325)	(0.324)
Observations	7,875	7,902
R-squared	0.253	0.227

Number of country pair	420	420

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

DISCUSSION

The estimation results presented in Tables 1 and 2 provide the foundation for analyzing how natural disasters affect exports in APEC economies. In principle, it is found that natural disasters negatively affect the performance of APEC economies' exports both at the time when natural disasters hit and in the following year. This effect is captured through 3 (three) channels: the occurrence of natural disasters, total damage, and total deaths caused by natural disasters.

In more detail, the negative effect captured from total deaths is found to be the most significant factor behind the reduction in exports both at the time the disasters occurred and one year after. One plausible mechanism to explain this is that total deaths represent a reduction in human capital, which is crucial for production activities. This will lead to lower outputs contributing to decreased exports. Additionally, natural disasters can demotivate people from engaging in normal activities as they focus on the recovery process (Baffes, 2020). This can affect production and investment activities which can reduce exports as well.

However, the occurrence or frequency of natural disasters cannot represent a negative effect on the APEC's exports. The justification behind this lies in the inability of the frequency alone to capture the degree of severity caused by natural disasters. Meanwhile, the negative effects captured from total damage matter the most in the year following the disasters rather than when the disasters occur. Damage to infrastructure can increase trade costs, such as increasing distribution or insurance costs. Rising costs can raise the price of goods, which finally can decrease the total quantity demanded for exports.

Next, Tables 3 and 4 show the impact of institutional quality (government effectiveness) on APEC's export performance after natural disasters hit the economies. The results confirm that government effectiveness is an instrumental factor in maintaining APEC's export performance to be positive after natural disasters occur. However, the ability of the government effectiveness to counteract the negative effect of natural disasters on exports only exists when it has interacted with the total number of deaths. Thus, an economy that has government effectiveness above the APEC average (0.77) is better handle the negative impacts of casualties caused by natural disasters compared to those economies below the APEC average.

The existence of government effectiveness is even found to be even more impactful when the magnitude of the natural disasters is greater. Overall, the results in Table 4 show that APEC economies with better government effectiveness, particularly those above the average, are empirically more capable of handling the negative effects of devastating natural disasters on exports.

Government effectiveness is one among six indicators in the Worldwide Governance Indicators (WGI) from the World Bank. This index is developed by Kaufmann and Kraay (2023) to measure governance quality across countries. Among other indicators, this paper selects government effectiveness as the most relevant institutional quality in the natural disaster context. According to Kaufmann and Kraay (2023), government effectiveness as "perceptions of the quality of public services, the quality of civil services and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies".

Several reasons for selecting government effectiveness as one of the potential institutional qualities in absorbing natural disaster effects are as follows. First, government effectiveness can be used as a channel to capture institutional quality or 'behind-the-border' aspects that can hinder or facilitate trade. From the perspective of institutional economics, if institutions cannot work effectively, it can lead to a higher transaction cost (Constantine, 2017). Conversely, an effective government can reduce transaction costs which boosts the business climate to do exports (Sari and Prasetyani, 2021). Second, the government effectiveness variable represents around 45 measures which directly or indirectly can capture the state's capacity to handle shocks such as natural disasters, economic crises, or other types of crises. Two measures that are directly related to natural disasters are infrastructure disruption and state failure (Kaufmann and Kraay, 2023). These measures reflect the readiness of the government to provide infrastructure, supply basic goods, and ensure law during the crisis.

Therefore, Table 1-4 and supporting statistics in this study are relevant for the APEC economies that are prone to experience natural disasters than other regions in the world. This paper suggests that APEC should focus on improving government effectiveness within their economies to bolster their export performance in the aftermath of natural disasters. Government effectiveness here can be perceived as the quality of public services including the performance of the government officials to formulate, implement, and commit to the policies taken. Sustaining favorable export flows during such crises is essential for the robustness of macroeconomic indicators. This can contribute to a positive current account balance, serving as a valuable safeguard in times of uncertainties like natural disasters.

CONCLUSION

This research has explored the effect of natural disasters on export performance of APEC economies including

how institutional quality (government effectiveness) can counteract that effect. Many previous literatures have examined this issue separately while this paper would like to fill that gap by examining the linkages between exports, natural disasters, and institutional quality. The findings of this paper are based on the analysis of 21 APEC economies during 2003-2022. Summary of the key findings, as follows.

In terms of the effect of natural disasters on exports, this paper confirms the findings from the previous paper which overall indicates that natural disasters have been associated with the reduction in trade flows (Osberghaus, 2019; Conevska 2021). Specifically, this paper finds that natural disasters have a negative association with APEC's export performance, particularly if the natural disaster is measured through the channel of total deaths. After examining the effect of natural disasters by using variables both at time t and at time t-1, the negative effects of natural disasters on exports flow through the channel of total damage can be captured at the next period. To be more significant, this paper also points out that a more significant reduction in APEC's exports is associated with devastating natural disasters that occurred in the economies.

In terms of the effect of institutional quality (government effectiveness), it is found that government effectiveness plays a crucial role in keeping exports increasing after natural disasters hit and cause casualties in the economies. If the APEC economy has a government effectiveness index that is above the APEC's average, it is associated with an increase in exports, even when there is an increase in the percentage of total deaths, all else equal. Government effectiveness even plays a greater role in the context of devastating natural disasters. This can be seen through an alleviation of the negative effects of natural disasters on the APEC's exports in a more significant magnitude in this case.

This paper contributes to the economic literature by finding that institutional quality, particularly government effectiveness, matters to counteract the negative effects caused by natural disasters. Some policy implications can be drawn from these results such as in the area of export strategies, improving government effectiveness, and disaster preparedness. The key message here is to encourage the APEC economies which are vulnerable to face natural disasters, to keep maintaining a positive export performance through improving the government effectiveness. A positive export flow can be used as a source of national income which can be used to maintain the robustness of macroeconomic indicators in general, particularly to expedite recovery post natural disasters or unexpected shocks in the economy.

The findings from this paper suggest some recommendations for future research. Some caveats of the findings in this paper are only limited to the exports side and do not cover the import side. Another possible extension is also to specify a more detailed effect of natural disasters on the type of exported goods such as agricultural and manufacturing goods. A focus on the role of trade facilitation in the context of natural disasters also can be considered a promising and relevant issue for future study.

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