

## Responses to the reviewer's comments on the manuscript

### "The asymmetric impact of natural disasters on China's bilateral trade"

The authors would like to thank the reviewer for your efforts on this manuscript and providing us with insightful comments and suggestions to improve the quality of this manuscript. The following responses have been prepared to address reviewers' comments in a point-to-point fashion. And the sentences in red are the corresponding revised parts in our manuscript.

Comment: 1) Only a few studies have conducted a similar analysis using gravity models. In addition to Gassebner et al. (2006) and Oh and Reuveny (2010) that are quoted in the paper I can only suggest adding da Silva and Cernat (2012).

Response: Thanks for the reviewer's suggestion. We added the suggested reference on Page 2005, Line 27 in the revised manuscript "Da Silva and Cernat (2012) focused on the impact of natural disasters on developing countries' trade flows. Their results suggested that natural disasters impact negatively on the exports of small developing countries."

Comment: 2) Still the authors may elaborate more on the experience and insights learned from the model application in other areas (e.g. Gassebner et al., 2006) and using different model specification (e.g. Gómez-Herrera, 2013).

Response: Thanks for the reviewer's suggestion. In our study, most model variables are chosen based on the experience learned from existing research (Gassebner et al., 2006; Oh and Reuveny, 2010). We also take China's national situation into consideration. It is true that we should try different model specifications as in Gomez-Herrera (2013) to make the results more reliable.

In the revised manuscript, the Poisson Pseudo-Maximum Likelihood (PPML) technique is employed after several statistical analyses. Two paragraphs are added at the beginning of section 3 "Results and analysis" (Page 2012, Line 8).

"In the estimation, pooled panel analysis is employed rather than fixed effect and random effect models due to a couple of reasons. First, we estimate the random effects and perform the Hausman test. The chi-square statistic value is 76.04 and the probability of accepting the null hypothesis is almost 0. Therefore, it is inappropriate to consider random effects in the model. Then we estimate the fixed effects, but the results are far from acceptable. When country-fixed effects are added, the variables like Distance, Border are omitted because of collinearity. Similar phenomenon happens to variables like China's GDP, China's Disaster when period-fixed effects are added. Since all the above omitted variables are essential or even indispensable to this study, we exclude the fixed effects in our model. Thus, the pooled panel analysis is employed."

"Ordinary Least Squares (OLS) is the widely used method to estimate the gravity model. But Silva and Tenreyro (2006) point out that the parameters of log-linearized models estimated by OLS lead to biased estimates of the true elasticities under heteroskedasticity. Thus, Poisson Pseudo-Maximum Likelihood (PPML) technique is used in this study to tackle the heteroscedasticity issue (Silva and Tenreyro (2006))."

Comment: 3) Putting the applied model's results in the context of other gravity model applications would help to qualify and interpret the results in the sections 3 and 4.

Response: Thanks for the suggestion. It will be helpful to put the model's results in the context of other gravity model. On Page 2012, Line 22, we added the following sentence in the revised version: “The result regarding to land area is in line with the findings of Da Silva and Gassebner (Da Silva and Cernat, 2012;Gassebner et al., 2006), who conclude that the smaller a country is , the more are its exports reduced in case it is affected by a disaster”.

However, limitations do exist as well. As pointed in comment 7, the comparison to Gassebner et al. (2006) is inappropriate because only ‘great natural catastrophes’ were considered in that work. Similar issues exist in the comparisons to other existing relevant research (Da Silva and Cernat, 2012;Oh and Reuveny, 2010) since their results were all obtained under different conditions. Da Silva and Cernat focused on the impact of natural disasters in developing countries. While Oh and Reuveny focused on the climatic natural disasters.

Comment: 4) The paper is well written, except for Section 1 and the second half of the Section 4 that would benefit from a though revision.

Response: Thanks for the reviewer's suggestion. The corresponding revisions are listed in the responses to comments 12-16.

Comment: 5) In equation 1 on page 2008 the coefficients (exponents of GDPs and D) should be added and the term C (constant) explained. The term D may be more generally explained as ‘trade costs’ of which distance is an approximation.

Response: Thanks for your comment. The coefficients are added and the explanations of term C and D are also revised.

One Page 2008, Line 20

$$Trade_{ij} = C \times \frac{GDP_i GDP_j}{D_{ij}} \quad (1)$$

is revised as:

$$Trade_{ij} = C \times \frac{\alpha_1 GDP_i \times \alpha_2 GDP_j}{\alpha_3 D_{ij}} \quad (1)$$

On Page 2008, Line 21, “That is, bilateral trade flow ( $Trade_{ij}$ ) is in proportion to gross domestic product ( $GDP_i, GDP_j$ ) of two countries ( $i, j$ ) and in inverse proportion to the distance ( $D_{ij}$ ) between them” is revised as “That is, bilateral trade flow ( $Trade_{ij}$ ) is in proportion to gross domestic product ( $GDP_i, GDP_j$ ) of two countries ( $i, j$ ) and in inverse proportion to the trade costs ( $D_{ij}$ ) between them. C is the constant term and  $\alpha_1 \sim \alpha_3$  are the corresponding coefficients.”

Comment: 6) Using the number of recorded disaster from the EMDAT for the specification of the model is somehow limiting. Besides, the database is susceptible to reporting biases over time and from some geographic regions.

Response: We agree with the reviewer. It is better to consider disasters in magnitude than in numbers. But due to the limitation of available global disaster database, using the number of recorded disaster from the EMDAT is the best available choice. There is no magnitude information in the existing database, even a number of events have no loss record. In the research of Gassebner et al., (2006) and Oh and Reuveny (2010), they used the same data source. The number of

recorded disaster from the EM DAT is not the perfect option but still a reasonably good available data source.

*Comment: 7)* Importantly, the comparison to Gassebner et al. (2006) is wrong because in that paper a threshold was applied and only ‘great natural catastrophes’ considered.

*Response:* We agree with the reviewer that it is improper to compare two research results when they are obtained under different conditions. Based on this consideration, the sentence “The above results are not completely consistent with those from Gassebner and Oh (Oh and Reuveny, 2010;Gassebner et al., 2006), indicating that the impact of disasters on China is significantly different from that on the entire world.” on Page 2013, Line 23, is revised as “**The above results indicate that the impacts of disasters on China’s bilateral trade are asymmetric.**”

*Comment: 8)* A high R squared of the models (page 2011) does not necessarily indicate a good fit of the model, if the residuals are not random.

*Response:* Thanks for the reviewer’s comment. The randomness of residuals is a great concern in time series analysis. We examined the residuals of our model and the residuals follow a normal distribution. The pooled panel analysis, without random effect or fixed effect, are employed in this study. In this case, R squared can be used to measure the goodness of fit.

*Comment: 9)* On page 2013 (the first line) I assume the ‘amplified’ should rather mean ‘attenuate’.

*Response:* According to Figure 3.b, the value of the marginal effect is getting smaller when the area is increasing, which means the negative impact of disaster will be amplified with the increment of the importer land area.

On Page 2013, Line 1, we revised the manuscript as following: “**Thus, the negative impact of natural disasters will amplify with the increment of importer land area.**”

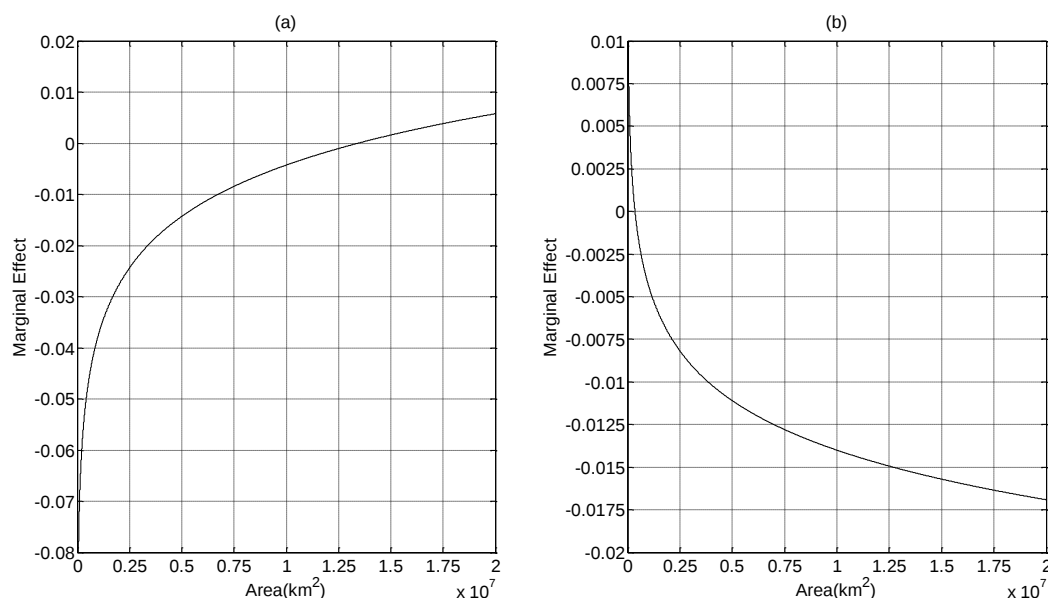


Figure 1 Figure 1 Marginal effect of natural disasters in partner countries on China’s bilateral trade as a function of land area. (a) is for China’s imports; (b) is for its exports.

Comment: 10) On the same page and referring to the Figure 3, there are only 5 trade partners of China whose area exceeds 7.35 mil sq.km. In these cases it is perhaps not the exact land size but rather the sheer weight of these economies that matters.

Response: The exact land areas listed in the manuscript are obtained from our model. Since there are only 5 trade partners of China whose area exceeds 7.35 mil sq.km due to the distribution of land area for all countries and regions in this study, this value (7.35) may not be meaningful. However, this result depicts the trend of the impact of area on disaster marginal effects. To avoid the confusion caused by this statement, we deleted the sentences ‘When that area exceeds 7.35million km<sup>2</sup>, the marginal effect of the disasters on those imports becomes positive’ and ‘If that area is smaller than 30 000 km<sup>2</sup>, the marginal effect of the disasters on those exports becomes positive’ on Page 2013.

Comment: 11) The fact that disasters are less important than other characteristics of the countries in shaping the international trade does not mean that the ‘bilateral trade’ of China is resilient (page 2014).

Response: Thank you. The sentence ‘This suggests that Chinese bilateral trade is relatively resilient to natural disasters, considering several variables’, on Page 2014, Line 1, has been deleted.

Comment: 12) In abstract and elsewhere in the text the authors may revise formulations like ‘... and faces the most frequent natural disasters.’, or ‘International trade is one of the major approaches linking the world’. The former only implies that China is prone to recurrent disasters, which is not surprising. If the text was to indicated that China was affected ‘most frequently’ based on the EMDAT-recorded disasters, one could still doubt whether the reporting bias. Section 1 is rife with unqualified statements, for example one could argue that large scale disasters (by meaning of the word) have always, and not only in recent years, been a challenge for society.

Response: Thanks for the reviewer’s comment. We revised the abstract and other parts of our manuscript to make the statements more appropriate.

On Page 2004, Line 3, “International trade is one of the major approaches linking the world” is changed to “**International trade is an important approach linking the world.**”

On Page 2004, Line 5, “China is the second largest trader in the world and faces the most frequent natural disasters” is changed to “**China is the second largest trader in the world and faces frequent natural disasters.**”

On Page 2004, Line 25, “Natural disasters, especially large-scale ones, are becoming severe challenges for human society and development” is changed to “**Natural disasters, especially large-scale ones, are severe challenges for human society and development.**”

On Page 2005, Line 2, “The effects of large-scale disasters (LSDs) are increasing on the global scale” is changed to “**The effects of large-scale disasters (LSDs) are significant on the global scale.**”

Comment: 13) The 2012 report of the WTO (WTO, 2012) on page 2005 have listed other very important factors in addition to Tohoku earthquake and floods in Thailand that resulted in ‘below average growth’ in trade in 2011.

Response: Thanks for the reviewer’s comment.

On Page 2005, Line 4, “the WTO(WTO, 2012) claimed that the 2011 Tohoku earthquake and tsunami in Japan and flooding in Thailand contributed to below average growth in international trade in 2011” is changed to “**the WTO(WTO, 2012) claimed that, in addition to financial uncertainty and civil conflict, the 2011 Tohoku earthquake and tsunami in Japan and flooding in Thailand contributed to below average growth in international trade in 2011**”.

Comment: 14) On the same page the categories of economic impact assessment methods is incomplete; the text can rather be used to highlight the wealth of different methods.

Response: Thanks for the reviewer’s suggestion.

The paragraph on Page 2005, Line 9~20, is re-organized as: “**Various modeling frameworks have been employed to estimate the economic impact of natural disasters. Some of them focus on direct/indirect loss of an actual disaster from the perspective of case studies, including before-and-after macroeconomic (Albalabertrand, 1993), input–output (IO) model (Okuyama and Santos, 2014;Akhtar and Santos, 2013;Rose and Wei, 2012;Lin et al., 2012;Haimes et al., 2005;Rose et al., 1997), and general equilibrium models(Xie et al., 2014;Rose et al., 2007). In addition to that, econometric statistical models are used from a macroscopic viewpoint to analyze the impact of per capita income (Kahn, 2005), education attainment, trade openness (Toya and Skidmore, 2007), investment climate (Raschky, 2008), and others on disaster effects. Also analyzed are the effects of disasters on regional economic development (Noy, 2009) and consumption (Auffret and Turk, 2003).**”

This paragraph is used to summarize the various research on economic impact of natural disaster, also serves as a foil to the rareness of research on regional trade impacts of natural disasters.

Comment: 15) Also the WTO database (stat.wto.org) indicates slightly different figures for the import value of China and USA for 2012.

Response: Thanks for the reviewer’s comment. The merchandise import value of China in 2012 should be 1.818 trillion USD. One thing needs to be stressed is that the trade value here is merchandise trade value and commercial services are exclusive.

One Page 2006, Line 8, “According to leading exporters and importers of merchandise trade in 2012 as listed by the WTO (WTO, 2013), the import value of China in 2012 was 1.814 trillion USD, which makes it the second largest importer after the United States. China is the largest exporter, with export value for 2012 of 2.049 trillion USD.” is changed to “**According to leading exporters and importers of merchandise trade in 2012 as listed by the WTO (WTO, 2013), the merchandise import value of China in 2012 was 1.818 trillion USD, which makes it the second largest importer of merchandise after the United States. China is the largest exporter of merchandise, with export value for 2012 of 2.049 trillion USD.**”

Comment: 16) The Pacific Rim on page 2006 is probably confused with ‘Pacific Ring of Fire’.

Response: Thanks for the reviewer’s comment. The “Pacific Rim” is changed to “**Pacific Ring of Fire**”.

Comment: 17) The dashed arrow in Figure 1 may be wrongly interpreted that the D influences the incidence of disasters.

Response: Thanks for the reviewer’s comment. By this dashed arrow, we mean that the

fulfilled/unfulfilled demand post disaster will attenuate or amplify the disruption caused by hazards while the disaster will increase/decrease the demand for merchandise. In this way, there exist a feedback loop between demand and disaster.

We added a legend to Figure 1 (see Figure 1) and the corresponding explanations on Page 2007, Line 25, is revised as:

“The dashed arrow in Fig. 1 between *Disasters* and  $D_A$  is a double arrow. This indicates that disasters will increase/decrease the demand and the fulfilled/unfulfilled demand post disaster will attenuate or amplify the disruption caused by disasters. If the post-disaster demand can be met by increase of  $I_A$ , reconstruction and lives of the people in a disaster area can benefit from the trade. In other words, regional trade makes the regional economic system resilient to disasters.”

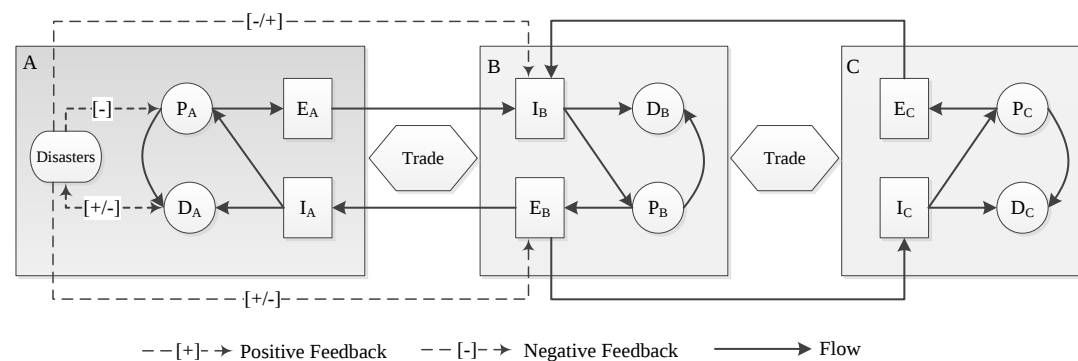


Figure 1 Figure 1 Interactions between disasters and trade system.  $P_i$  denotes production of region  $i$ ,  $D_i$  demand,  $I_i$  import value, and  $E_i$  export value. Solid arrows indicate flow between two components and dashed arrows indicate the impact.

## References:

- Da Silva, J., and Cernat, L.: Coping with loss: the impact of natural disasters on developing countries' trade flows, European Commission, 2012.
- Gassebner, M., Keck, A., and Teh, R.: The impact of disasters on international trade, WTO Staff Working Paper, 2006.
- Gomez-Herrera, E.: Comparing alternative methods to estimate gravity models of bilateral trade, *Empir Econ*, 44, 1087-1111, 10.1007/s00181-012-0576-2, 2013.
- Oh, C. H., and Reuveny, R.: Climatic natural disasters, political risk, and international trade, *Global Environmental Change-Human and Policy Dimensions*, 20, 243-254, DOI 10.1016/j.gloenvcha.2009.11.005, 2010.
- Silva, J. M. C. S., and Tenreyro, S.: The log of gravity, *Review of Economics and Statistics*, 88, 641-658, DOI 10.1162/rest.88.4.641, 2006.
- WTO: World Trade Report 2012, World Trade Organization, 2012.
- WTO: World Trade Report 2013, World Trade Organization, 2013.