RESPONSE TO THE REFEREE

First of all, we would like to thank the editor and the second referee for their diligent review, excellent comments and very valuable suggestions. We have tried to follow their suggestions as closely as possible and have changed the paper accordingly. Below, we answer each question separately.

The effect of technological innovation on international trade: A non-linear approach.

By Laura Márquez-Ramos and Inmaculada Martínez-Zarzoso

Referee General comment:

This empirical paper covers an interesting and important topic i.e. the effects of technological innovation on trade. The results show a positive relation going from technological innovation to exports. Unfortunately, I found the paper too descriptive, somewhat confusing and to some extent unconvincing. The paper should greatly benefit from more economic intuition about the empirical exercise performed and the importance and limitations of the results. In revising the paper, the following points might be of help to the authors:

Referee comment 1:

1. The contribution of the paper to the existing literature needs to be spelled out clearly. Is it the first paper that takes into account sector and country heterogeneity? In particular, a) the regression is a cross section (p.7), to what extent can DP (=1 when trading partners are richer than the sample average and 0 otherwise) account for country-heterogeneity (p.13) b) how does DP relate to Y_i and Y_j? c) There is no discussion of problems with unobserved country heterogeneity.

Answer:

This is not the first paper that takes into account sector and country heterogeneity. Previously, Loungani, Mody and Razin (2002) considered country heterogeneity, whereas Fink, Mattoo and Neagu (2005) took into account sector heterogeneity in their analysis (page 3). The contribution of the paper is now in the last paragraph of page 3: "The main aim of this paper is to investigate whether the effect of technological innovation on sectoral

trade is non-linear, which would indicate that the effect of improved technological innovation on trade could vary according to the technological achievement in countries. This effect is also analysed separately for developed and developing countries, as well as for different sectors."

a) We completely agree with the referee: the extent to which DP accounts for country heterogeneity is limited (See c) below).

b) In relation to how DP relates to income variables, two groups of countries are considered. The DP dummy takes the value of one when the trading partners are richer than the average in the sample, and zero otherwise. According to this criterion, we have obtained the classification which follows:[1]

Developed countries: ***Antigua and Barbuda, Argentina, Australia, Austria, Bahamas, Bahrain, Barbados, Belgium, Canada, Chile, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Equatorial Guinea, Estonia, Finland, France, French Polynesia, Germany, Greece, Hong Kong, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Rep., Kuwait, Luxembourg, Macao, Malaysia, Malta, Mauritius, Mexico, Netherlands, New Caledonia, New Zealand, Norway, Oman, Poland, Portugal, Puerto Rico, Saudi Arabia, Singapore, Slovak Republic, Slovenia, South Africa, Spain, St. Kitts and Nevis, Sweden, Switzerland, Trinidad and Tobago, United Kingdom, United States.***

Developing countries: ***Albania, Algeria, Angola, Armenia, Azerbaijan, Bangladesh, Belarus, Belize, Benin, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African Republic, Chad, China, Colombia, Comoros, Congo, Dem. Rep., Congo, Rep., Côte d'Ivoire, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, Arab Rep., El Salvador, Eritrea, Ethiopia, Fiji, Gabon, Gambia, Georgia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, India, Indonesia, Iran, Jamaica, Jordan, Kazakhstan, Kenya, Kyrgyz Republic, Lao PDR, Latvia, Lebanon, Lesotho, Lithuania, Macedonia, FYR., Madagascar, Malawi, Mali, Mauritania, Moldova, Mongolia, Morocco, Mozambique, Namibia, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Romania, Russian Federation, Rwanda, Samoa, Senegal, Sierra Leone, Solomon Islands, Sri Lanka, St. Lucia, St. Vincent and the Grenadines, Sudan, Swaziland, Syrian Arab Republic, Tajikistan, Tanzania, Thailand, Togo, Tonga, Tunisia, Turkey, Turkmenistan, Uganda, Ukraine, Uruguay, Uzbekistan, Vanuatu, Venezuela, Vietnam, Yemen, Rep., Zambia, Zimbabwe.***

c) We could have dealt with problems of unobserved country heterogeneity if we had panel data, but we only used data for a single year. With a panel dataset, we could also study the dynamics of the relationship between trade and technological innovation. These

[1] There are missing income data for a number of countries in the year 2000. Due to data limitations to construct the TAI, the final sample includes 13 exporters and 77 importers.

limitations are highlighted in the conclusions and are a matter for further research (page 22).

Referee comment 2:

2. I find the main results very descriptive and it would help if the estimated results are interpreted in the light of economic theory and also (6) below.

Answer:

We agree with the referee's comment. In the revised version of the paper, we have added the following in Section 2: -Theoretical framework and main hypothesis- an outline of the main related theories; we have also tried to link these with our empirical application. In addition, we have stated a number of hypotheses to be tested. The abstract, the empirical analysis and the conclusions have all been changed accordingly.

Referee comment 3:

3. One of the problems in the specification of the gravity model is how to account for economic distance (often approximated by geographical distance) between trading countries. How does this relate to the discussion regarding information and technological innovation (p.3), and also with the equation to be estimated?

Answer:

In Márquez-Ramos (2007), a different way to add technology in the trade equation has already been considered: the variable included was the technological distance between trading partners (Filippini and Molini, 2003). This is defined as the absolute difference between the technological indicators in the exporting and the importing countries. This variable indicates that two countries can be far away from each other not only geographically, but also from a technological perspective. Technological gaps can deter trade since similar countries trade more. Therefore, a negative correlation between this new variable and the export flows is expected. Technological distance was found to be significant in Márquez-Ramos (2007). The results in the present paper also support the view that countries tend to trade more when they are "closer" from a technological point

of view; however, the relationship between trade and technological distance is linear. These results are available upon request from the authors.

Referee comment 4:

4. Sections 2 and 3 both deal with sample selection and should be merged or linked. It is not clear what criteria (if any) have been used to choose the representative country (p.6). For example, among the homogenous medium income country group, why choose Brazil and not Argentina?

Answer:

We totally agree with the referee. So, Sections 2 and 3 have been merged and the title of Section 3 renamed as "Sample selection". We refer to an earlier research (Márquez-Ramos, 2007) for further details about the sample selection.

Referee comment 5:

5. The TAI measure plays a crucial role and it needs to be assessed critically and not only described. In particular, if the TAI measure can be substituted by its four dimensions (p.12), why has it been included in the regression estimation in addition to its dimensions? (p.18)

Answer:

All the columns in Table 2 of the paper show the results obtained when estimating the gravity model, which was augmented with each technological variable separately: creation of technology, diffusion of recent innovations, diffusion of old innovations, human skills, and the TAI. In the paper, we now point out: "Then, TAIi and TAIj are the technological variables measuring technological innovation in the exporting and importing countries. To analyse the individual effect of the different dimensions composing the TAI on international trade, four additional regressions were derived from Equation (3) where TAI can be substituted by each of its four dimensions. In order to analyse the existence of a non-linear relationship between technological innovation and international trade, two additional terms are included in the model, $(TAI_i)^2$ **and** $(TAI_j)^2$ **. Then, this index is**

decomposed into its four dimensions and the model is again estimated with the two additional terms in each dimension." (page 12).

Referee comment 6:

6. The authors should explain why they estimated the regression using four different techniques (p.13) and which is under their view, the most appropriate given their data (e.g. possibility of zero bilateral trade flows) and model specification. By the way, Harvey (1976) does not appear in the reference list, Harvey assumes multiplicative heteroscedasticity and the Notes in table 2 and 3 say that the estimations use White's heteroscedasticity-consistent error.

Answer:

We used different techniques to confirm the robustness of the results to different estimation methods. Since zero trade flows in our sample are not present and heteroscedasticity can be dealt with a "robust" variance-covariance matrix, we rely on the instrumental variables estimates with robust standard errors.

The main results hold independently of the estimation methodology. Nonetheless, Figures A.1-A.5 are based on the IV estimation results.

The notes in Tables 2 and 3 have been changed accordingly since White's heteroscedasticity-consistent errors have been used in the OLS and IV estimations.

Referee comment 7:

7. Endogeneity bias is a potential problem not only because of the presence of TAI but also the income variable. The latter is not discussed (or dealt with) in the paper. In addition, it would be desirable to test for endogeneity and "inverse causality" before applying IV. The Hausman test is used to test for validity of instruments. The authors should explain why it is better to examine the R squared than rely on the Hausman test.

Answer:

The endogeneity of the two explanatory variables, technological innovation and income, has been taken into account in Márquez-Ramos (2007) using the 65-country dataset. The results indicated that income could be treated as an exogenous variable. Additionally, and as the referee suggests, we have performed the Hausman test, as mentioned in the new

version of the paper. We found a significant difference between the OLS and the IV coefficients when using the 13-country sample (sectoral data), indicating that OLS is an inconsistent estimator in this equation. The reason for the inconsistent estimates is due to the endogeneity of technological innovation; so the IV results are preferable.

Referee comment 8:

8. There are some typos in p.16 (columns 1,2…?). In p.15, "Table 2 shows the main results for the technological variables considered. Results concerning the other explanatory variables in the model indicate …" why explain the "other explanatory variables" here? This is very distracting.

Answer:

The typos have been corrected. We totally agree with the referee, thus the explanations concerning the other variables in the model have been dropped from the paper. The results concerning the other explanatory variables are available upon request from the authors.

References

- Filippini, C. and Molini, V. (2003), "The determinants of East Asian trade flows: a gravity equation approach", *Journal of Asian Economics* 14(5), 695-711.
- Márquez Ramos, L. (2007), *New determinants of bilateral trade: An empirical analysis for developed and developing countries*. Doctoral Dissertation. Universitat Jaume I, Castellón. http://www.tesisenxarxa.net/TDX-0908108-140805/