Trade in Electronic Products: Has China Displaced its Competitors on the Intensive and the Extensive Margins?

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Abstract Using product-level data of exports in electronics to 50 top importers for the 1992-2011 period this paper finds robust evidence that China’s exports adversely affect both the intensive export margin and the extensive export margin of its competitors in South East Asia, East Asia, South America and India. Specifically, a 10% increase in China’s bilateral exports of a product on average caused a 7.6% reduction in the bilateral exports of the product by China’s competitors. An increase of China’s exports of a product by approximately US$ 4.7 million causes the probability of having positive exports of the product to a foreign market to decrease by 7.9%. The displacement effects of China’s exports on the intensive margin are much more robust and significantly larger in magnitude than the displacement effects found in studies using more aggregate trade data. Importantly, it is for the group of intermediate and capital electronic goods having high Chinese domestic content that the displacement effects of China’s electronics exports on both margins are substantial and largest.

Keywords China, gravity equation, intensive margin and extensive margin, trade in electronics

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I. Introduction

China has become the world’s largest exporter and the world’s second largest importer in merchandise in 2014. The projection is that China will soon take over the US as the world top importer. The exponential growth of China’s economy and trade for more than three decades certainly has raised a relevant question among researchers and policy makers on the implications it may have for the world trade patterns.

This study empirically investigates the question of whether or not China displaced other exporters in electronic products on both the intensive margin and the extensive margin. The case of electronic trade is chosen because of a number of reasons. First, no studies have investigated the effects of China’s exports on its competitors in electronics. Today electronic exports represent more than 10% of money earned from world trade in goods. Second, it is in electronics that China exhibits an exceptional performance which parallels its performance in aggregate trade in general. In 1992 China was far behind world top exporters in electronics such as Japan, South Korea and Singapore with a total volume of electronic exports of less than US$ 5 billion. In 2010 its exports topped the world at more than US$ 400 billion. Note that in 2010 Japan’s electronic exports were valued at US$ 130 billion, which was only one third of China’s exports in electronics only. Third, since electronics are considered to be technology intensive products not only developed countries but emerging and especially developing countries always consider the expansion of their electronic exports as a major component of their trade and economic policy aimed at promote their long run economic growth. Coates, Horton and McNamee (2012) documented a shift of Chinese exports towards sophisticated

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1 In 2014 according to the World Factbook the estimated volumes of imports by the U.S. and China, the two top importers are US$ 2,334 billion and US$ 1,949 billion, respectively. The estimated volumes of exports by China and the U.S are US$ 2,252 billion and US$ 2,173 billion, respectively. More details on the list of world top exporters and importers are available from the following link of the World Bank and the World Factbook: http://wits.worldbank.org/CountryProfile/Country/WLD/Year/2012/TradeFlow/Import; https://www.cia.gov/library/publications/the-world-factbook/rankorder/2087rank.html.

2 For a comprehensive literature review of the empirical studies on the displacement effects of China’s exports see Pham et al. (2018).

3 The share of electronic trade in world trade and the volumes of China’s exports in electronics in 1992 and in 2010 are computed by the authors using data available from the UN COMTRADE database. Also see Coates, Horton and McNamee (2012) for a detailed analysis of the evolution of the patterns of Chinese exports.
products in heavy manufacturing and electronic sectors and the strong relationship between this shift and China’s economic growth. Consequently the research question of whether or not China’s success in electronic trade comes at the cost of other major electronics exporters has important policy implications for a wide range of countries now and in years to come.\(^4\)

In contrast to previous studies like Eichengreen et al. (2004) and Greenaway et al. (2010) which used data at aggregate level we use a comprehensive data of exports at disaggregate 6-digit product level. It is our point that the use of aggregate country-level and industry-level trade data in the existing related literature make it very difficult to accurately identify the displacement effect of China’s exports. All the exported products that make up the aggregate country-level exports can be very different. Many studies such as Schott (2004), Khandelwal (2010) show that even within the same product category at disaggregate level exported products may substantially differ in their quality/unit values. In other words, the degree of disaggregation of the data is of critical importance to identify the existence of the competition or substitution effects. If China’s exports displace the exports of other “competing” exporters this is because China exports products/goods that are substitutes for products/goods exported by its competitors. If China’s competitors however specialize in products of quality that is different from that of China’s electrical products and if the love for variety characterizes the utility function of consumers of importing countries then the competition effects of China’s exports are likely to be absent.\(^5\) If this is the case the increase in China’s exports are rather accompanied by an increase in exports by other countries. In brief, it is our point that the identification of the displacement effects of China’s exports must empirically be done using product-level data.

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\(^4\) A number of recent important studies look into the effects of China’s import competition on labour markets of the importing country. They find that exposure to competition from China adversely impacts employment and average earnings (Autor et al. (2013), Autor et al. (2014)).

\(^5\) Theoretically, even if China and other exporting countries export different products China’s exports still adversely influence exports of other countries via the condition of the budget constraint. Yet, we assume that this general equilibrium effect is likely to be small.
Third, we empirically look into the extent to which China affects not only the intensive margin but also the extensive margin of electronic exports of its competitors. It is the study of China’s displacement effect on the extensive margin that is absent in the literature despite the fact that the presence of zero flows in aggregate exports and in electronic exports is very frequent.\(^6\) Note that a study on the displacement effects of China’s exports on the extensive margin at disaggregate 6-digit product level involves much more data work than studies on China’s displacement effects on the intensive margin using aggregate data.\(^7\)

We found strong evidence that China’s exports significantly displaced its South East Asian, East Asian, South American competitors and India on both margins. Specifically, a 1\% increase in China’s bilateral exports of a product to a foreign market caused a 7.6 \% reduction in the bilateral exports of the product by China’s competitors to that market. This negative effect was equivalent to the negative effect of a 0.62 \% increase in the bilateral distance by 42 km between China’s competitors and foreign markets for their exports. Evidence of a strong displacement effect of China’s exports on the intensive margin holds after we control for potential Hecman sample selection bias, bias due censoring of the dependent variable à la Tobit or bias à la Helpman, Melitz and Rubinstein (2008).

Similarly, China’s exports were found to significantly reduce the probability of China’s competitors to sell their products in foreign markets. An increase of China’s exports of a product by approximately US$ 4.7 million causes the probability of exporting the product to a foreign market to decrease by 7.9 \%. While the displacement effects on the intensive margin and the extensive margin are robust across groups of exporters and groups of importers China was found to displace more exports of its competitors to OCED markets than to non-OECD markets. Importantly, compared to other studies that used more aggregate level of export data,

\(^6\) Note that studies such as Baldwin and Harrigan (2011) and Martin and Pham (2015) documented substantial presence of zero trade flows especially at the product level.

\(^7\) Specifically, a study on the extensive margin of exports requires the creation of a dataset that also includes country pairs having zero bilateral exports. As you will see, the sample used for our analysis of the extensive margin is 2.5 times larger for the sample used for our analysis of the intensive margin.
the displacement effects of China’s exports in electronics on the intensive margin at the
disaggregate level of data are much stronger and more robust, which suggests that aggregation
bias might have been the reason for the finding of relatively modest displacement effects in
those previous studies. Last but not least, we find that the displacement effects on both margins
are present for products used as intermediate and capital goods but not for consumption goods.
Since intermediate and capital electronic products have relatively high China’s domestic
content this finding suggests that the displacement effects in electronic trade are more of a real
issue for China’s competitors than studies on the domestic content of Chinese exports would
suggest.

Our paper is organized as follows. We discuss the data in Section II. Section III provides
a descriptive analysis of the intensive and extensive margins of China’s and its competitors’
exports in electronics. Section IV explains the econometrics and analyses the results. Section
V concludes.

II. Data

The trade data are from the UN Comtrade database. We use trade data at 6-digit HS
classifications under following category: Electrical, Electronic Equipment, which corresponds
to 2-digit HS classification 85 of the 1992 version. There are in total 103 electrical products at
6-digit HS classification. Appendix Table 1 lists all the 103 6-digit products belonging to the
2-digit HS classification 85. The data are from 1992 to 2011. These are the years for which
data on China’s exports in this category are available. Note that we refer to China’s exports in
electronics as the exports by the People’s Republic of China and its two special administrative
regions, Hong Kong and Macau. Later we also use the electronic exports of the PRC as our
main explanatory variable of interest in one of our robustness checks.

Exporting countries used in our sample are the two major developed exporters in
electronics: Japan and South Korea; two major South American (SA) exporters: Brazil and
Mexico and five South East Asian (SEA) exporters in electronics: Indonesia, Malaysia, Philippines, Singapore, Vietnam and Thailand. These countries are selected because either they are major exporters of electrical products or some of them are comparable to China in terms of their level of technology and labour cost. For example, Brazil, Mexico, and SEA exporters with the exception of Singapore are comparable to China and are believed to be the most likely to be affected by China’s performance. While the data are available from 1992 to 2011 for all countries Philippines’ and Vietnam’s exports are available only from 1996 and 2000, respectively. The sample includes the top 54 importers in electronics. 8

Data on standard gravity variables are available from CEPII’s gravity dataset. 9 Data on whether the pair of trading partners has a common currency or a common free trade agreement are from De Sousa’s database. 10

### III. Trade in Electronics: A Preliminary Analysis

*The intensive margin of electronic trade*

In this section we examine the evolution of the intensive margin and the extensive margin of electronic exports and imports of countries included in our sample. Figure 1 and Figure 2 show the evolution of the value of exports by the top 4 exporters and other exporters of the sample. With the exception of the period of the Asian financial crisis China’s exports in electronics have been increasing steadily over time at an increasing growth rate. Figure 1 also shows that China has largely surpassed other top exporters such as Japan, South Korea and Singapore in electrical products since 2004. In 2011 China’s exports of electrical products are 450 billion US$ and equal to the sum of exports by Japan, Singapore and South Korea.

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8 See Appendix Table 2 for more details on the list of top 54 importers in electronics.
10 The link to de Sousa’s gravity data on common currency and free trade agreements is the following: [http://jdesousa.univ.free.fr/data.htm](http://jdesousa.univ.free.fr/data.htm).
Both Figure 1 and Figure 2 show that not only China outperformed top exporters in electronics it outperformed other emerging exporters of electrical products even to a larger extent. For example in 2011 Mexico, the most important exporter of this group exported only less than one sixth of the volume of Chinese exports in electronics. In terms of the growth rate, China is also the best performer by a large margin. Both Figures 1 and 2 show that all exporting countries were negatively and substantially influenced by the 2007-08 global financial crisis. The export

**Figure 1: Value of Exports in Electronics (1992-2011) - Top 4 Exporters**

*(Billions of 2005 U.S. dollars)*

**Figure 2: Value of Exports in Electronics – Other Exporters**

*(Billions of 2005 U.S. dollars)*

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11 All the graphs are constructed based on the authors’ computation using data from the UN Comtrade Database.
volume decreased substantially in 2007-08 for all the countries. Yet, it is important to note that China exhibited the fastest recovery following the crisis.

**Figure 3: Value of Imports in Electronics - Top 4 Importers**

*(Billions of 2005 U.S. dollars)*

So far the analysis is carried out with respect to the export supply of electronics. Figure 3 presents the demands for imported electronics by top four importers: the United States, China, Japan and Germany. Figure 4 presents the demands for imported electronics by other major importers. Both figures show that the demands exhibit a substantial reduction following the
global crisis. Countries that exhibit the most significant reductions in demands are the U.S.,
and other European developed economies such as France, Spain and UK. Importantly,
comparing Figure 1 and Figure 3 shows that China’s exports to the world and imports from the
world follow a very similar upward trend over time. Given China’s status as the world top
exporter and the world second largest destination in electronics China’s exports and imports
are considered to be two major components of the third-country effects on the foreign sales of
any exporter in electronics and will need to be taken into account in our econometric gravity
specification.

**Figure 4: Value of Imports in Electronics – Other Importers**

*(Billions of 2005 U.S. dollars)*

*The extensive margin of electronic trade*

As already emphasized in the Introduction an important aspect of the question of whether
China’s exports are an impediment to its competitors relates to the extensive margin of trade,
i.e. the extent to which China’s exports affects whether or not a country exports to a destination.
This subsection is aimed at providing a preliminary analysis of the extensive margin of trade.
As already mentioned in Section III, the analysis applies to a sample of 54 largest importers only.

Figure 5 shows the evolution of the shares of nonzero flows of electronic exports by top 5 exporters. They are computed as the ratio of the total number of nonzero export flows a country has to the total of all possible nonzero flows of exports in 103 HS 6-digit products to 56 largest importers.\textsuperscript{12} Note that China is the best performer in terms of extensive margin since 1999. In 2011 China has positive exports in more than 80\% of all possible nonzero export flows. From 1992 to 2011 China also shows a steadily increase in the number of products-destinations for which it has positive electronic exports. It also exhibits the highest growth rate in this respect. Korea and India are also found to exhibit an improvement in their extensive margin of electronic exports over time of the sample. In contrast with China, Japan exhibits a steadily decline in the number of products-destinations for which it has nonzero electronic exports.

Figure 6 shows the evolution of the same statistic for other exporters of the sample. The ranking of these exporters in terms of their performance with respect to the extensive margin of electronic exports is in line with their economic size and level of technology. The best performers of this group are Thailand and Brazil while the worst performers are Vietnam and Philippines.

For all countries of the two groups the 2007-08 global financial crisis adversely affects them. Yet, the negative impact of the global crisis varies from one exporter to another. Countries that are the most negatively influenced are Philippines, Brazil and Japan. Following the crisis the extensive margin of electronic exports by the three countries substantially deteriorated. Figures 6 and 7 also show that countries that are the most resilient to the global crisis are China, Korea, India and Vietnam.

\textsuperscript{12} For each year the number of all possible nonzero flows of exports that a country may have is 5562 (i.e. 103*54).
We also compare the average number of destinations for an exported product and the average number of products exported to a destination by China and its competitors. We find that China also outperforms its competitors in these two respects. China not only on average exports a product to more destinations than other exporters but also exports on average more products to a destination than its competitors.\textsuperscript{13}

In sum, the descriptive analysis of this section show that China performs exceptionally well with regard to the intensive margin and the extensive margin. It remains however unclear at this stage if China’s performance comes at the cost of other exporters in the sample. It is this question that the next section is aimed at answering.

**Figure 5: Shares of Nonzero Flows of Electronics Exports – Top 5 Exporters**

![Figure 5: Shares of Nonzero Flows of Electronics Exports – Top 5 Exporters](image)

**Figure 6: Shares of Nonzero Flows of Electronic Exports – Other Exporters**

\textsuperscript{13} The graphs depicting the average numbers of products to a destination and the average number of destinations for an exported product are not presented to save space. But they are available upon request from the authors.
IV. Regression Results

The Econometric Methodology of the Gravity Model

In order to investigate the displacement effects of Chinese exports in electronics we use the gravity model. The gravity model has been found to be an empirical success in numerous studies to explain the volume of bilateral trade or exports. The original cross-sectional log-linearized gravity equation used by Tinbergen (1962) can be written as follows:

$$\log(Exp_{ij}) = \alpha_0 + \alpha_1 \log(Gdp_i) + \alpha_2 \log(Gdp_j) + \alpha_3 \log(TradeCost_{ij}) + \varepsilon_{1ij} \quad (1)$$

where $Gdp_i$ and $Gdp_j$ are measures of economic sizes of the exporter and the importer, respectively while $TradeCost_{ij}$ represent their bilateral trade costs.

For a few decades following its first empirical application the gravity equation has been criticized by the lack of solid theoretical foundations. The seminal paper by Anderson and van Wincoop (2003) made a major contribution to the literature and provided important micro-foundations to the gravity model. As Head and Meyer (2014) correctly pointed out, the model set up by Anderson and van Wincoop (2003) derives the gravity equation without assuming imperfect competition and increasing returns, which justifies the application of the gravity model to a more general set of countries and industries. Importantly, the paper emphasized the need to control for the third-country effects or the multilateral resistance terms in order to avoid
getting biased estimates of the border effects.\textsuperscript{14} Note that the multilateral resistance terms measures the barriers that the exporter and the importer face in their trade not only with each other but also with the rest of the world.

The original gravity equation that embeds the multilateral resistance terms a la Anderson and van Wincoop becomes:

\[
\log(\text{Exp}_{ij}) = \alpha_0 + \alpha_1 \log(Gdp_i) + \alpha_2 \log(Gdp_j) + \alpha_3 \log(\text{Distance}_{ij}) + \alpha_4 \text{MR}_i + \alpha_5 \text{MR}_j + \delta \times \text{Dummies}_{ij} + \varepsilon_{2ij}
\]

where $\log(\text{Distance}_{ij})$ is the bilateral distance and $\text{Dummies}_{ij}$ are a vector of standard gravity dummy variables on common language, common colonial relationship, common border and common membership to the a free trade agreement or a common currency. Since both $\log(\text{Distance}_{ij})$ and $\text{Dummies}_{ij}$ account for the bilateral trade cost between the exporter and the importer $\text{MR}_i$ and $\text{MR}_j$ represent the two components of the multilateral resistances that control for the trade costs the exporter and the importer face with the rest of the world or with all trading partners other than the exporter and the importer, respectively.

Gravity specification (2) later has been used extensively to explore questions related to the determinants of the bilateral trade using aggregate country-level or sector-level of data. Yet, it still leaves unanswered a number of questions that only later another important study by Helpman et al. (2008) can satisfactorily address. An important contribution of Helpman et al. (2008) is to set up a model of firm heterogeneity from which a gravity equation is derived. As such it reconciles the gravity equation with the new trade theory literature in a major way. Their model allows to explain the determinants not only of the intensive margin (i.e. the volume of bilateral trade) but also the extensive margin (i.e. the probability that countries trade with each other). Note that the presence of zero trade flows is not exclusive to disaggregate export flows but is also a major feature of aggregate country-level exports. In Helpman et al. (2008) a country does not trade with a trading partner if even its most productive firm finds unprofitable

\textsuperscript{14} See Head and Mayer (2014) for a detailed and updated literature review on the gravity equation.
exporting to the foreign destination. Importantly, Helpman et al. (2008) shows that factors that determine the intensive margin are also those that determine the extensive margin and that with equality of income and expenditure a gravity equation a la Anderson and van Wincoop can also be derived from their model.

For our purpose we use a modified version of the gravity equation to take into account the characteristics of the product-level export data. Specifically, we use the two following version of the gravity equation:

\[
\log(\text{Exp}_{ijpt}) = \alpha_0 + \alpha_t + \alpha_p + \alpha_i + \alpha_1 \log(\text{Gdp}_i \times \text{Gdp}_j) + \alpha_2 \log(\text{Dist}_{ij}) + \alpha_3 \log(\text{Exp}_{\text{China,jpt}}) + \delta \times \text{Dummies}_{ijt} + \epsilon_{ijpt}
\]  

(3)

where \(\log(\text{Exp}_{\text{China,jpt}})\) our explanatory variable of interest, is the volume of exports of product \(p\) by China to importer \(j\) in year \(t\).\(^{15}\) The inclusion of \(\log(\text{Exp}_{\text{China,jpt}})\) as an explanatory variable in gravity equation (3) is straightforward. It controls for a major component of the multilateral resistance term associated with importer \(j\) because China is a major exporter of electronics. A country’s exports to an importer depend not only on the bilateral trade cost between them but also the trade costs other exporters including China face in their trade with the very importer.\(^{16}\) Gravity specification (3) also includes the year dummies \(\alpha_t\), the product dummies \(\alpha_p\) and the exporter dummies \(\alpha_i\). These dummies control for time-specific, the time-invariant product-specific and time-invariant exporter-specific determinants of the dependent variable (i.e.

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\(^{15}\) In our gravity specification (3) we implicitly assume that the effects of GDPs or economic sizes of exporters and importers on the exports of electronic products are exactly the same. This assumption is supported by robust empirical evidence that the coefficient estimates of \(\log(\text{Gdp}_i)\) and \(\log(\text{Gdp}_j)\) are very similar to each in magnitude. Importantly, we have checked our regression results to make sure that this assumption has not changed our results in any significant way at all. When we include GDPs separately the results on the displacement effect remain essentially the same and the coefficient of GDPs of exporters and importers are very similar in magnitude. These regression results obtained when GDPs of exporters and importers are included separately are available upon request from the authors.

\(^{16}\) It is important to note that the data we use are the export data at the product level. Consequently, we need to control for the multilateral resistance associated with importer \(j\) at the product level. Since the bilateral tariff and especially non-tariff barriers are not available at the six-digit HS classifications China’s exports to importer \(j\), \(\log(\text{Exp}_{\text{China,jpt}})\) is the best available proxy for the multilateral resistance associated with importer \(j\).
Log(Exp_{ijpt}), respectively. Note that in the literature of the gravity equation the inclusion of $\alpha_i$ controls for the time-invariant multilateral resistance associated with exporter $i$. \(^{17}\)

In order to differentiate the impact of Chinese exports by geographical group of exporters we also run the following gravity regression:

$$\begin{align*}
\text{Log}(\text{Exp}_{ijpt}) &= a_0 + a_t + a_p + a_i + a_1 \text{Log}(\text{Gdp}_{it} \times \text{Gdp}_{jt}) + a_2 \text{Log}(\text{Dist}_{ij}) + \\
&+ a_3 \text{Log}(\text{Exp}_{\text{China,}\text{Developed}}_{ijpt}) + a_3 \text{Log}(\text{Exp}_{\text{China,}\text{Emerging}}_{ijpt}) + \delta \times \text{Dummies}_{ijt} + \epsilon \times \text{ijpt}
\end{align*}$$

(3*)

where \(\text{Log}(\text{Exp}_{\text{China,}\text{Developed}}_{ijpt})\) and \(\text{Log}(\text{Exp}_{\text{China,}\text{Emerging}}_{ijpt})\) are created as the interactions between \(\text{Log}(\text{Exp}_{\text{China,}\text{ijpt}})\) and dummies on whether the exporter is a developed economy of East Asia such as Japan and South Korea or the exporter is an emerging economy from South East Asia, South American or India, respectively.

The evident problem with the OLS estimation of gravity equations (3) and (3*) is that \(\text{Log}(\text{Exp}_{\text{China,}\text{ijpt}})\) may correlate with the error term $\epsilon_{3ijpt}$ and $\epsilon^*_{3ijpt}$. Eichengreen et al. (2004) and Greenaway et al. (2012) mentioned some specific examples in which China’s exports to foreign destinations may correlate with the unobservable factors of the gravity equation. A favourable change in sentiment worldwide in favour of electronics will result in a positive correlation between exports in electronics of China and the exports in electronics of its competitors to the same destination and consequently in an upward bias of the OLS gravity coefficient estimates vis-à-vis the IV gravity coefficient estimates. Similarly, a negative shock in the global oil market will have similar upward bias of the OLS estimates on China’s displacement effect because it will result in a reduction of exports in electronics of China and its competitors. It is important to note that the inclusion of $a_t$, $a_p$ and $a_i$ in gravity equations (3) and (3*) already help us to remove a number of potential sources of endogeneity corresponding to the two examples above. If a global demand shock or/and a global supply shock affect both China’s

\(^{17}\) Alternatively, we can also use \(\text{Log}(\text{Exp}_{\text{China,ijpt}-1})\), the lagged Chinese exports of product $h$ to importer $j$ as our explanatory variable to allow for the fact that the impact of Chinese exports on the exports of other exporters to the same destination may occur with some delay. We later use this variable in our robustness checks.
exports and its competitors’ exports and if this effect varies from one year to another but is the same for all foreign destinations and for all the categories of electronic products the resulting correlation between \( \log(\text{Exp}_{\text{China,jpt}}) \) and the dependent variable \( \log(\text{Exp}_{ijpt}) \) is purely time/year specific. If this is the case the inclusion of \( \alpha_t \) in gravity equation (3) and (3*) allows us to remove this source of endogeneity. Similarly, if a global demand shock or a global supply shock affect both China’s exports and its competitors’ exports and if this effect varies from one product to another but is the same for all foreign destinations and all the years the resulting correlation between \( \log(\text{Exp}_{\text{China,jpt}}) \) and the dependent variable \( \log(\text{Exp}_{ijpt}) \) is purely product specific. In this case, the inclusion of \( \alpha_p \) in gravity equation (3) and (3*) allows us to remove this source of endogeneity.

In order to address the problem of endogeneity we instrument China’s exports to a destination by using the time-invariant bilateral distance between China and the importer (i.e. \( \log(\text{Dist}_{\text{China,j}}) \)). This instrument is relevant because there is an established strong negative correlation between China’s exports to foreign markets and their bilateral distances. Moreover, it is our argument that China’s bilateral distance with foreign destinations for their exports are likely to meet the requirement of exogeneity because they affect other countries’ exports to these destinations only via their effects on China’s exports, \( \log(\text{Exp}_{\text{China,jpt}}) \). Later in our

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18 The roles that \( \alpha_t \) and \( \alpha_p \) play in addressing the endogeneity of \( \log(\text{Exp}_{\text{China,jpt}}) \) can be illustrated as follows. Let define the following baseline gravity equation: \( \log(E_{ijpt}) = \alpha_0 + \alpha_t \log(\text{Exp}_{\text{China,jpt}}) + \alpha_p \log(\text{Exp}_{\text{Other,jpt}}) + \delta \times \text{Dummies} + \epsilon_{ijpt} \) where Controls is a vector of control variables in equation (3) such as GDPs and the standard gravity dummies and \( \epsilon_{ijpt} = (\alpha_t + \alpha_p) + \epsilon_{ijpt} \). Thus, the inclusion of \( \alpha_t \) and \( \alpha_p \) clearly controls for all sources of endogenous year-specific and product-specific variation in \( \epsilon_{ijpt} \) that may correlate with \( \log(\text{Exp}_{\text{China,jpt}}) \).

19 Greenaway et al. (2008) use both the bilateral distances between China and its trading partners and China’s GDP as instruments for China’s bilateral exports in electronics. As a robustness check we also use these two instruments in our IV estimation of a gravity equation that excludes the year dummies. See the sub-section on robustness checks below for a short discussion of the regression results.

20 Feenstra (2002) proposed to include the exporter and importer fixed effects (FE) as a way to control for the multilateral resistances and consequently to eliminate the potential omitted variable bias due to the correlation between the explanatory variable of interest and unobservable exporter specific or unobservable importer specific factors. Note that we use as the instrument for China’s exports to foreign destinations the bilateral distance between China and these destinations. This instrument is time-invariant and specific to destinations. Consequently, our gravity specification can only include the exporter FE but not the importer FE.
analysis we will put more restrictions in our gravity specification to control for year-product specific unobservable factors which may correlate with our instrument. 21

In order to empirically explore the effects of China’s exports on the extensive margin of its competitors in electronics we apply the following probit regression:

\[
\rho_{ijt} = \Pr(T_{ijpt} = 1| Observed\ variables) = \Phi(a_0 + \alpha_t + \alpha_p + \alpha_i + \alpha_1 \log(Gdp_{it} \times Gdp_{jt}) + \alpha_2 \log(Dist_{ij}) + \alpha_3 \log(Exp_{China,ijpt}) + \delta \times Dummies_{ijt} + \epsilon_{4ijpt})
\]

where \(\rho_{ijt}\) is the probability that exporter \(i\) exports to importer \(j\) in year \(t\), conditional on the observed variables. \(T_{ijpt}\) is the indicator variable equal to 1 when country \(i\) exports in product \(p\) to country \(j\) in year \(t\) and 0 otherwise. It is important to note that we follow Baldwin and Harrigan (2011) and use a sample that only includes zero export flows which could have occurred but could not. In other words, zero export flows are defined only for products that an exporter could export to at least one destination but not all in year \(t\). To address the endogeneity problem of \(\log(Exp_{China,ijpt})\) we estimate the probit regression (5) using as instruments the bilateral distance between China and the importer \(j\).

*China’s exports and the intensive export margin of its competitors*

Table 2 presents the OLS and the IV regression results of both gravity equation (3). Column 1, which present the OLS regression results shows that the gravity equation generally performs well. Standard gravity variables such as the product of GDPs of the exporter and the importer, their bilateral distances and the dummies on sharing common border and common language have a statistically significant effect on the bilateral exports with expected sign and magnitude.

Our main explanatory variable of interest, China’s exports, have a positive and statistically

\[21\text{ To our knowledge we are not aware of any major global demand shock or global supply that has occurred during the time span of our sample and that correlated with China’s bilateral distance with foreign markets in a major way. A potential concern in this respect is that the 2007-2008 global financial crisis negatively affected Asian economies which are closer to China than the rest of the world. In one of our robustness checks we later carry out these years are excluded from our sample and the results remain essentially the same. See the subsection analysing the results for more details.}\]
significant effect at 1% on the exports of its competitors. As already emphasized due to the endogeneity problem associated with $\log(\text{Exp}_{\text{China,jpt}})$ the OLS regression is likely to yield biased coefficient estimates of China’s displacement effects.

Contrary to the OLS regression results, the 2SLS IV and GMM regression results, which are presented in columns 3 to 4, provide strong evidence that China’s electronic exports have a statistically significant displacement effects at 1%. Note that the results of the first stage regression presented in columns 2 confirm that China’s bilateral distance is an important determinant of China’s bilateral exports to a foreign market. The variable has a statistically significant negative effect at 1% on China’s exports. Importantly, the first-stage F-statistic value, which are reported in columns 3, is 26.73 and consequently is above 10, the threshold frequently used to qualify a good instrument.

The 2SLS and regression results of our gravity specification (3) in column 3 show that a 1% increase in China’s bilateral exports on average causes approximately a 0.76 % reduction (or a reduction by 7287 US$) in the bilateral exports in a product by its competitors to third markets. Note that this displacement effect of a 1% increase in China’s bilateral exports is equivalent to the displacement effect of a 0.62 % increase in the bilateral distance between China and foreign markets. Put it differently, the negative effect of a 1% increase in China’s exports to foreign markets is equal to a negative effect of an increase of 42 km in the bilateral distance.

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22 Note that Eichengreen et al (2007) who used aggregate bilateral trade for the period 1990-2003 and the bilateral distances between China and foreign destinations of its exports as an instruments of Chinese exports to those markets (i.e. $\log(\text{Exp}_{\text{China,jpt}})$) also found a positive and statistically significant coefficient estimates of $\log(\text{Exp}_{\text{China,jpt}})$ from the OLS estimator and a negative and statistically significant coefficient estimate of $\log(\text{Exp}_{\text{China,jpt}})$ from their 2SLS IV estimator. The magnitude of the displacement effect at the aggregate level of data found by Eichengreen was -0.06, which is much smaller than the displacement effect we found using disaggregate product-level export data (see Table 1a in their paper). Econometrically, the opposite sign of the IV estimate vis-a-vis the OLS estimate is straightforward. Let assume we have the following regression: $y=\beta_0+\beta_1x+e$, where the endogeneity occurs if we have $\text{Cov}(x,e)\neq0$. If $z_i$ is a valid instrument then the IV estimate of $\beta_1$ is: $\hat{\beta}_{1,\text{IV}}=\beta_1+\text{Cov}(z_i,e)\sigma_z/\text{Cov}(z_i,x)\sigma_x$, while the OLS estimate of $\beta_1$ is: $\hat{\beta}_{1,\text{OLS}}=\beta_1+\text{Cov}(x,e)\sigma_z/\sigma_x$. It is clear that $\text{Cov}(z_i,e)\sigma_z/\text{Cov}(z_i,x)$ and $\text{Cov}(x,e)\sigma_z/\sigma_x$ can have opposite signs, resulting in the OLS estimate of $\beta_1$ and the IV estimate of $\beta_1$ having opposite signs.

23 Note that the coefficient of $\log(\text{Distance}_{ij})$ is -1.21, which means that a 1% increase in $\log(\text{Distance}_{ij})$ will results in 1.21 % reduction in $\log(\text{Exp}_{ij})$. Or a 0.62 % increase in $\log(\text{Distance}_{ij})$ will results in 0.76 % reduction in $\log(\text{Exp}_{ij})$, which is equal to the effect of a 1% increase in $\log(\text{Exp}_{\text{China,jpt}})$.
distance between any pair of trading partners.\textsuperscript{24} Importantly, compared to studies such as Greenaway et al. (2008) which used more aggregate trade data, the magnitude of the displacement effect we find using product-level export data is much larger. Specifically, Greenaway et al. (2008) found that over the period 1990-2003, a 1% increase in China’s exports caused a 0.07% drop in Asian countries’ exports to third markets.

Table 2, which also reports in Column 4 the regression results of the GMM estimator, shows that the effect of China’s bilateral exports is qualitatively and quantitatively similar. China’s surge in exports is found to displace its competitors to third market, with 1% increase leading to a 0.76% drop in exports. As expected the GMM estimator is more efficient than the 2SLS IV estimator and generally yields smaller robust standard errors of the gravity coefficient estimates.

Next, we investigate the variation of the displacement effect across groups of exporters, across foreign markets and for the periods before and after the 2007-2008 Global Financial Crisis. Specifically, we make a distinction between developed exporters such as Japan and South Korea and emerging exporters such as SEA countries, SA and India. We divide importers into two groups: OECD importers and non-OECD importers.

Table 3 shows in its first column that the displacement effect applies to both groups of exporters and is statistically significant at 1%. The magnitude of the displacement effect is higher for emerging exporters than for developed exporters. Columns 2 and 3 reveal that China’s exports negatively impact the exports of its competitors in the period after the GFC more than in the period preceding it. Finally, it is for OECD importers that China’s exports adversely impact the exports of its competitors the most.

\textsuperscript{24} Note that the effects are evaluated at the means of the explanatory variables and the dependent variable. See Tables 1 for their descriptive statistics. If China’s bilateral exports, $Exp_{China,jpt}$, increase by 1% from its mean of 739559 US$ (i.e. $2.71828^{13.8181} \times 746948$ US$) to 746948 US$ (i.e. $2.71828^{13.8181} \times 1.01$) the bilateral exports of China’s competitors, $Exp_{ijpt}$, decrease by 0.76% from their mean of 96203.34 US$ (i.e. $2.71828^{11.4745} \times 96203.34$ US$) to 88916 US$ (i.e. $2.71828^{11.4745} \times (1-0.076)$). This effect of a 1% increase in China’s exports is equivalent to the effect of a 0.62% increase in bilateral distance between any pair of trading partners approximately by 41 km, from 6656 km (i.e. $2.71828^{8.03263} \times 6656$ km) to 6697 km (i.e. $2.71828^{8.03263} \times 1.0062$).
China’s exports and the extensive export margin of its competitors

In this section we closely look into the effects of Chinese exports on the extensive export margin of its competitors. Specifically, we look into the extent to which Chinese exports influence the likelihood of exports by other countries to the same destination by using probit regressions (4).

Table 4 presents the results of the standard probit regression, the 2SLS IV probit regression and the ML probit regression for the 1992-2011 sample. It is important to note that since our preferred specification is the IV probit regression Table 4 only reports the marginal probability effects of the IV probit. The standard probit regression generally yields estimates in line with our expectations. GDPs of the exporter and the importer, sharing a common language and belonging to the same FTA increase the probability of their bilateral exports while the bilateral distance reduce it. Yet, China’s exports have a positive effect on the probability of its competitors to have positive exports of a product to the same foreign market. This is not our preferred regression results because the standard Probit regression is subject to bias due to the endogeneity of China’s exports.

The results of the 2SLS IV probit in columns 2 first show that $\log(\text{Distance}_{\text{China},i})$ is important and statistically significant determinants of China’s exports to a foreign destination. The 2SLS IV Probit regression in the second stage in column 3 yields a strong negative effect (-0.21) of China’s exports on the probability of China’s competitors to have positive bilateral exports of a product to a foreign destination. This effect is statistically significant at 1%. The marginal effect of China’s exports showed in Column 3 is -0.07, which means that a one unit increase in $\log(\text{Exp}_{\text{China},ipt})$ or equivalently an increase of China’s exports of a product by approximately US$ 4.7 million causes the probability of exporting the product to a foreign market to decrease by 7.9%.

As expected the results of the ML IV probit regression in Table 4 only reports the marginal probability effects of the IV probit. The standard probit regression generally yields estimates in line with our expectations. GDPs of the exporter and the importer, sharing a common language and belonging to the same FTA increase the probability of their bilateral exports while the bilateral distance reduce it. Yet, China’s exports have a positive effect on the probability of its competitors to have positive exports of a product to the same foreign market. This is not our preferred regression results because the standard Probit regression is subject to bias due to the endogeneity of China’s exports.

The results of the 2SLS IV probit in columns 2 first show that $\log(\text{Distance}_{\text{China},i})$ is important and statistically significant determinants of China’s exports to a foreign destination. The 2SLS IV Probit regression in the second stage in column 3 yields a strong negative effect (-0.21) of China’s exports on the probability of China’s competitors to have positive bilateral exports of a product to a foreign destination. This effect is statistically significant at 1%. The marginal effect of China’s exports showed in Column 3 is -0.07, which means that a one unit increase in $\log(\text{Exp}_{\text{China},ipt})$ or equivalently an increase of China’s exports of a product by approximately US$ 4.7 million causes the probability of exporting the product to a foreign market to decrease by 7.9%. As expected the results of the ML IV probit regression in

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25 The effects are evaluated at the means of the explanatory variables. See Tables 1 for their descriptive statistics. An increase of 1 unit of $\log(\text{Exp}_{\text{China},ipt})$ at its mean (i.e. 13.51381) is equivalent to an increase of $\exp(\text{Exp}_{\text{China},ipt})$ from 739559 US$ (i.e. $\exp(13.51381)$) to 5464646 US$ (i.e. $\exp(14.51381)$). Thus the change in the value of China’s exports is approximately 4.7 (i.e. 5464646- 739559) million US$. 

19
column 5 confirm the finding of the negative effect of China’s exports. Note that the negative marginal effect of $\log(\text{Exp}_{\text{China,jpt}})$ is a quarter of the negative effect of the bilateral distance among the pair of trading partners, $\log(Distance_{ij})$. The effect of one unit increase in $\log(\text{Exp}_{\text{China,jpt}})$ on the extensive margin is equivalent to the effect of an increase of $\log(Distance_{ij})$ by 0.25 unit (i.e. 0.07/0.28), which corresponds to an increase of bilateral distance $Distance_{ij}$ by approximately 1900 km.\footnote{The coefficient estimates of $\log(\text{Exp}_{\text{China,jpt}})$ and $\log(Distance_{ij})$ are -0.07 and -0.28, respectively. It means that either an increase of $\log(\text{Exp}_{\text{China,jpt}})$ by 1 unit or an increase of $\log(Distance_{ij})$ by 0.25 unit will reduce the probability of China’s competitors to have positive exports to a foreign destination by 7 %. If $\log(Distance_{ij})$ increases by 0.25 unit from its mean $Distance_{ij}$ increases from 6656 (i.e. $e^{8.803263}$) km to 8546 (i.e. $e^{8.803263+0.25}$) km, that is an increase of $Distance_{ij}$ by 1900 (i.e. 8229-6656) km.}

We next closely examine the variation of the displacement effects of China’s exports across groups of exporters, groups of foreign markets and the two periods preceding and following the 2007-08 global financial crisis. The IV probit results are presented in Table 5. They show that regardless of the groups of exporters, the groups of importers and the period considered the displacement effect on the extensive margin is found to be economically and statistically significant at 1% level for most of the subsamples used. A one unit increase in $\log(\text{Exp}_{\text{China,jpt}})$ causes the probability of having positive exports to foreign markets to decrease by 7.6% to 8.5%. It is only for the period before the GFC and non-OECD importers that the displacement effect on the extensive margin is not found. China’s exports displaced its competitors’ exports to OECD importers much more than to non-OECD importers.

**Variation of the displacement effects of Chinese exports across categories of goods**

In this section we closely examine how the displacement effects of China’s exports on both margins vary across different categories of goods. Specifically, we investigate the displacement effects for three types of electronic goods: electronic goods used for consumption, electronic goods used as intermediates and electronic goods used as capital goods. It is important for us to explore the extent to which the displacement effects of China’s exports vary depending on
types of goods associated with different levels of Chinese domestic content. The reason is that despite the robust evidence of a strong displacement effects of China’s exports these effects will represent however less a real issue for China’s competitors and the world trade patterns if the domestic content of China’s exports is low. A number of important studies such as Kee and Tang (2012), Koopman et al. (2008), Koopman et al. (2012) and Ma et al. (2014) recently looked into the evolution and the determinants of the domestic content of Chinese exports. Kee and Tang (2012) find that the average domestic value added ratio (DVAR) in Chinese processing exports has risen from 35% in 2000 to 49% in 2006 and that this increase is mainly driven by firms substituting imported materials with domestic materials. Koopman et al. (2008) find that the share of domestic content in exports by PRC has increased from 50% before China’s WTO membership to 60% since then. They however point out that those sectors that are likely labelled as relatively sophisticated such as electronic devices have particularly low domestic content (about 30% or less).

For our purpose we consider three types of electronic goods defined by Broad Economic Categories (BEC) of the United Nations Statistics Division. Note that the domestic content of China’s exports is likely to be the least important for the consumption goods (iPads, iPhones for example) for which China’s participation in the global supply chain is only in the final assembling stage with low value added. If the effects of China’s exports in electronics we find early are mostly the result of China’s adversely affecting the exports of its competitors in the exports of electronics as consumption goods then the threat China’s exports pose to its competitors is not as serious as people think it is.

Table 6, which presents the results of the IV 2SLS regression and the IV probit regression for each of the three categories, shows that for both the intensive and the extensive margins the negative and statistically significant effects of China’s exports are confirmed for intermediate and capital electronic products but not for consumption electronic products. We actually documented the evidence that China’s exports increase its competitors’ exports in
consumption electronic products. Since the intermediate and capital electronic products are those for which China has a relatively high domestic content the findings above clearly suggest that the displacement effects of China’s exports represent a more serious problem for China’s competitors than the literature on the determinants of Chinese domestic content would suggest.

Additional qualifications of the results

In this section we are going to put more restrictions on our gravity specification in order to address the potential time-variant endogeneity of China’s exports. As already emphasized in subsection on the econometric methodology of the gravity equation the IV estimation of the displacement effects only generates unbiased estimates if and only if the instrument used, $\text{Log}(\text{Dist}_{\text{China},j})$, meets the condition of exogeneity.

As we already mentioned in Section III electronics trade is characterized by the fact that China is not only the world top exporter but also the world second largest importer of electronics. As a results China’s bilateral imports from a country certainly influence the exports of this country to the third markets. We now include China’s bilateral imports ($\text{Log(Exp}_{i,\text{China},pt}$)) as an explanatory variable in both specifications (3) and (4) in order to address the potential problem of omitted variable bias.

The new set of results, which is presented in columns 1 to 2 of Table 7, show that the evidence of a substantial displacement effect of China’s electronics exports holds for both margins. Specifically, the magnitude of the displacement effect on the intensive margin is similar to that we obtain earlier when our gravity equation does not control for China’s imports. Yet, the coefficient estimate of China’s bilateral exports in our instrumental variable probit regression, while remaining economically and statistically significant, is -0.10, which is half as large as the one we obtain without controlling for China’s bilateral imports.

So far we evaluate the displacement effects of China’s exports in electronics on the intensive margin and extensive margin separately. We next evaluate the displacement effects
of China’s exports using adapted Eaton-Tamura Tobit (i.e. ET-Tobit), Heckman sample selection and Helpman-Melitz-Rubinstein estimators with our main variable of interest, China’s bilateral electronic exports, is instrumented by China’s bilateral distances. The first two estimators allow us to estimate the displacement effects of China’s exports on the intensive margin of its competitors while addressing potential biases resulting from censoring or sample selection, respectively. The Helpman-Melitz-Rubinstein estimator not only addresses the sample selection bias but also bias resulting for not controlling for the fraction of exporting firms. The regression results for the three estimators are presented in columns 3 to 5 of Table 7. All the results show that China’s exports adversely and significantly impact the exports of its competitors. While the magnitude of the displacement effect is smaller in Eaton-Tamura Tobit, Heckman sample selection and Helpman-Melitz-Rubinstein models than in 2SLS IV regression it remains significant. In sum, our finding of significant adverse displacement effects of China’s exports remain significant and very robust to potential biases resulting from censoring, sample selection and the omitted fraction of exporting firms.

**Further Robustness Checks**

In this section we carry out a number of additional robustness checks to investigate the sensitivity of our results. First, we restrict our sample to observations of export flows of more than US$ 1000. The idea is that export flows of small values are more likely to be subject to measurement error. The displacement effects on the extensive margin and the intensive margin still hold for all groups of exporters and importers. We also found that the displacement effect was much larger for the period before the GFC than for the period after the GFC.

We also include the product of GDPs per capita of the trading partners as an explanatory variable in our regression. In the literature using gravity equation, GDP per capita is used to

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27 It is important to note that our sample of data is characterized by a large proportion of zero observations on bilateral electronic exports.
control for the level of development of the trading partners that may affect their bilateral trade. The effect of China’s exports still remain negative and statistically significant at 1% level and with a similar magnitude.

In order to account for the possibility that China’s exports displace the exports of its competitors with some delay we use $\log(Exp_{China,jp(t-1)})$ and $\log(Exp_{i,China,p(t-1)})$ as our explanatory variables. The displacement effects of China’s exports on both the extensive margin and the intensive margin remain still strong and statistically significant at 1% level. The lagged displacement effects are significant but slightly smaller than the displacement effects of China’s contemporary exports, which suggests that China’s exports have a long lasting displacement effect on the exports of its competitors. All the regression results taken together provide strong and robust evidence that China’s exports displaced those of its competitors on both intensive margin and the extensive margin.

V. Conclusion

Using a sample of disaggregate export data at 6-digit HS classifications for the 1992-2011 period this paper empirically looks into the effects of Chinese exports in electronics on the intensive export margin and extensive export margin of Asian exporters such as India, Japan, South Korea, Malaysia, Philippines, Singapore, Thailand and Vietnam and South American exporters such as Brazil and Mexico. For our econometric methodology, we estimate a gravity equation at the product level that includes year, product and exporter dummies and uses China’s bilateral distances with importers as the instrument for China’s bilateral exports.

We find strong and robust evidence of displacement effect of China’s exports. A 1% increase in China’s bilateral exports on average causes approximately a 0.76% reduction or a reduction by 7287 US$ in the bilateral exports in a product by its competitors to third markets. This the negative effect of a 1% increase in China’s bilateral exports to foreign markets is equal to a negative effect of an increase of China’s bilateral distance by 42 km. The displacement
effects on the intensive margin are also found to hold after controlling for Heckman sample selection bias, bias resulting from a censored dependent variable à la Tobit or bias à la Helpman Melitz and Rubinstein (2008). As for the extensive margin of export in electronics China is found to substantially reduce the probability of having positive exports by all of its competitors. An increase of China’s exports of a product by approximately US$ 4.7 million causes the probability of exporting the product to a foreign market to decrease by 7.9%. While the displacement effects on the intensive margin and the extensive margin are robust across groups of exporters and groups of importers China was found to displace more exports of its competitors to OCED markets than to non-OECD markets.

Last but not least, we find that the displacement effects on both margins are found for intermediate and capital goods but not for consumption goods. Since electronic intermediate and capital goods are these products that have high China’s value added this finding suggests that China’s exports in electronics represent more of an issue for its competitors than the recent literature on the domestic content of China’s exports would suggest.

REFERENCES


United Nations, Department of Economic and Social Affairs, Statistics Division. 2002.
“Classification by Broad Economic Categories”. *Statistical Papers Series M No. 53, Rev. 4.*
### Table 1: Descriptive Statistics

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<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
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<td>2.53492</td>
<td>6.907755</td>
<td>20.93987</td>
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<td>Log(Gdp_{it} * Gdp_{jt})</td>
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<td>1.982844</td>
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<td>Log(Exp_{China,jpt})</td>
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<td>2.648716</td>
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### Table 2: Effects of China’s Electronic Exports the Intensive Margin of Its Competitors

<table>
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<tr>
<th>Independent Variables</th>
<th>OLS</th>
<th>2SLS IV</th>
<th>GMM</th>
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<td>(0.012)</td>
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<td>0.83***</td>
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<td></td>
<td>(0.037)</td>
<td>(0.012)</td>
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<td>Log(Distance_{ij})</td>
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Notes: (1) Robust standard errors are in parentheses. The regression allows for the clustering of exporter pairs.
* *, ** and *** denote 10%, 5% and 1% level of significance, respectively.
Table 3: China’s Electronic Exports and the Intensive Margin of Its Competitors

Robustness Checks

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>2SLS</th>
<th>1992-2011 Sample</th>
<th>Before GFC Sample</th>
<th>After GFC Sample</th>
<th>Before GFC Sample for OECD importers</th>
<th>Before GFC Sample for non-OECD importers</th>
<th>After GFC Sample for OECD importers</th>
<th>After GFC Sample for non-OECD importers</th>
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<td>Log(Exp_China,jpt)_Developed</td>
<td>-0.54***</td>
<td>-0.45**</td>
<td>-0.61***</td>
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<td>(0.200)</td>
<td>(0.204)</td>
<td>(0.258)</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Number of observations</td>
<td>202197</td>
<td>131692</td>
<td>42345</td>
<td>71519</td>
<td>60173</td>
<td>20291</td>
<td>22054</td>
<td></td>
</tr>
</tbody>
</table>

Notes: (1) All the regressions include the same set of control variables as in Table 3. We choose not to report the coefficient estimates on those variables to save space. They are available upon request by the authors. (2) Robust standard errors adjusted for the clustering of the exporter-importer pairs are in parentheses. *, ** and *** denote 10%, 5% and 1% level of significance, respectively.
Table 4: Effects of China’s Electronic Exports on the Extensive Margin of Its Competitors

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Standard Probit</th>
<th>2SLS</th>
<th>IV Probit</th>
<th>ML</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log(Exp\textsubscript{China,jpt})</td>
<td>0.07***</td>
<td>(0.004)</td>
<td>-0.21**</td>
<td>-0.079***</td>
</tr>
<tr>
<td>Log(Gdp\textsubscript{it}×Gdp\textsubscript{jt})</td>
<td>0.31***</td>
<td>(0.014)</td>
<td>0.86***</td>
<td>0.56***</td>
</tr>
<tr>
<td>Log(Distance\textsubscript{ij})</td>
<td>-0.65***</td>
<td>(0.057)</td>
<td>-0.11</td>
<td>-0.81***</td>
</tr>
<tr>
<td>Language\textsubscript{ij}</td>
<td>0.60***</td>
<td>(0.125)</td>
<td>0.25***</td>
<td>0.63***</td>
</tr>
<tr>
<td>Colony\textsubscript{ij}</td>
<td>-0.05</td>
<td>(0.177)</td>
<td>-0.16</td>
<td>-0.10</td>
</tr>
<tr>
<td>Border\textsubscript{ij}</td>
<td>0.38</td>
<td>(0.329)</td>
<td>0.28</td>
<td>0.30</td>
</tr>
<tr>
<td>RTA\textsubscript{ijt}</td>
<td>0.44***</td>
<td>(0.091)</td>
<td>0.27</td>
<td>0.47***</td>
</tr>
<tr>
<td>Log(Distance\textsubscript{China,j})</td>
<td>-0.57***</td>
<td>(0.117)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Products dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Exporter dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>First stage F-statistic</td>
<td>23.62</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of observations</td>
<td>642,382</td>
<td>642,382</td>
<td>642,382</td>
<td>642,382</td>
</tr>
</tbody>
</table>

Notes: (1) Robust standard errors adjusted for the clustering of the exporter-importer pairs are in parentheses. *, ** and *** denote 10%, 5% and 1% level of significance, respectively.
Table 5: Effects of China’s Electronic Exports on the Extensive Margin of Its Competitors

Robustness Checks

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>1992-2011 Sample</th>
<th>Before GFC Sample</th>
<th>After GFC Sample</th>
<th>Before GFC Sample for OECD importers</th>
<th>Before GFC Sample for non-OECD importers</th>
<th>After GFC Sample for OECD importers</th>
<th>After GFC Sample for non-OECD importers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
</tr>
<tr>
<td>Log(Exp_{China,jpt} _Developed</td>
<td>-0.085***</td>
<td>-0.084**</td>
<td>-0.127***</td>
<td>-1.054***</td>
<td>-0.035</td>
<td>-0.620***</td>
<td>-0.093***</td>
</tr>
<tr>
<td></td>
<td>(0.036)</td>
<td>(0.042)</td>
<td>(0.040)</td>
<td>(0.298)</td>
<td>(0.049)</td>
<td>(0.140)</td>
<td>(0.041)</td>
</tr>
<tr>
<td>Log(Exp_{China,jpt} _Emerging</td>
<td>-0.076***</td>
<td>-0.066*</td>
<td>-0.137***</td>
<td>-1.030***</td>
<td>-0.045</td>
<td>-0.620***</td>
<td>-0.123***</td>
</tr>
<tr>
<td></td>
<td>(0.035)</td>
<td>(0.039)</td>
<td>(0.039)</td>
<td>(0.297)</td>
<td>(0.044)</td>
<td>(0.136)</td>
<td>(0.041)</td>
</tr>
<tr>
<td>Year dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Product dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Exporter dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of observations</td>
<td>642,832</td>
<td>419,465</td>
<td>132,526</td>
<td>194,666</td>
<td>224,799</td>
<td>56,676</td>
<td>75,566</td>
</tr>
</tbody>
</table>

Notes: (1) All the regressions include the same set of control variables as in Table 4. We choose not to report the coefficient estimates on those variable to save space. They are available upon request by the authors. (2) Robust standard errors adjusted for the clustering of the exporter-importer pairs are in parentheses. * ** and *** denote 10%, 5% and 1% level of significance, respectively.
Table 6: Effects of China’s Electronic Exports on the Intensive and the Extensive Margins of its Competitors
(By Category of Goods)

<table>
<thead>
<tr>
<th></th>
<th>GMM IV Regression</th>
<th>2SLS IV Probit Regression</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intermediate</td>
<td>Extensive</td>
</tr>
<tr>
<td></td>
<td>Electronic</td>
<td>Products</td>
</tr>
<tr>
<td>Intermediate Margin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronic Products</td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Log(Exp\text{China,ipt})</td>
<td>-1.08***</td>
<td>-0.36***</td>
</tr>
<tr>
<td></td>
<td>(0.053)</td>
<td>(0.026)</td>
</tr>
<tr>
<td>Year dummies</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Product dummies</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Exporter dummies</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of observations</td>
<td>77,185</td>
<td>90,957</td>
</tr>
</tbody>
</table>

Notes: (1) All the regressions include the same set of control variables as in Table 4. We choose not to report the coefficient estimates on those variable to save space. They are available upon request by the authors. (2) Robust standard errors adjusted for the clustering of the exporter-importer pairs are in parentheses. *, ** and *** denote 10%, 5% and 1% level of significance, respectively.

Table 7: Effects of China’s Electronic Exports on the Intensive and the Extensive Margins of its Competitors

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log(Exp\text{China,ipt})</td>
<td>-0.77***</td>
<td>-0.10***</td>
<td>-0.57***</td>
<td>-0.74***</td>
<td>-0.60**</td>
</tr>
<tr>
<td></td>
<td>(0.21)</td>
<td>(0.009)</td>
<td>(0.020)</td>
<td>(0.20)</td>
<td>(0.31)</td>
</tr>
<tr>
<td>Log(Exp\text{China,ipt})</td>
<td>0.29***</td>
<td>0.11***</td>
<td>0.43***</td>
<td>0.31***</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.09)</td>
<td>(0.31)</td>
</tr>
<tr>
<td>Year dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Product dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Exporter dummies</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of obs.</td>
<td>182,397</td>
<td>469,465</td>
<td>469,465</td>
<td>469,465</td>
<td>469,465</td>
</tr>
</tbody>
</table>

Notes: (1) All the regressions include the same set of control variables as in Table 4. We choose not to report the coefficient estimates on those variable to save space. They are available upon request by the authors. (2) Robust standard errors adjusted for the clustering of the exporter-importer pairs are in parentheses. (3) The product-year dummies are created based on 16 3-digit HS classifications. Thus, the gravity equation includes in total (16*20=319) product-year dummies. (4) For the Helpman-Melitz-Rubinstein estimator we address not only the sample selection bias using the Inverse Mills ratio but also the bias resulting from not controlling for the fraction of exporting firms. We use as our exclusion restriction variable for the probit selection equation the data on the cost to start a business from the World Bank’s Doing Business Database. Specifically, we construct an indicator for high fixed-cost trading country pairs. These pairs consist of both the importer and the exporter having the cost of starting a business above the cross-country means. For the Helpman-Melitz-Rubinstein estimator we follow Helpman et al. (2008) and control for the fraction of firms by including a polynomial in \( z_{ij} \) where \( z_{ij} \) is defined as follows: \( z_{ij} = \text{Inv}_{ij} + \Phi^{-1}(\hat{p}_{ij}) \) where \( \text{Inv}_{ij} \) is the inverse Mills ratio and \( \hat{p}_{ij} \) is the predicted probability of exports from exporter \( i \) to importer \( j \). See Helpman et al. (2008) for more details on how to construct \( z_{ij} \). *, ** and *** denote 10%, 5% and 1% level of significance, respectively.
### Appendix Table A1: List of Electronic Products at 6-Digit HS Classifications

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>850110</td>
<td>Electric motors of an output &lt; 37.5 watts; 850120: Universal AC/DC motors of an output &lt; 37.5 watts; 850131: DC motors, DC generators, of an output &lt; 750 watts; 850132: DC motors, DC generators, of an output 75-375 kW; 850134: DC motors, DC generators, of an output &gt; 375 kW; 850140: AC motors, single-phase, nes; 850151: AC motors, multi-phase, of an output &lt; 750 Watts; 850152: AC motors, multi-phase, of an output 75-75 kW; 850153: AC motors, multi-phase, of an output &gt; 75 kW; 850161: AC generators, of an output &lt; 75 kVA; 850162: AC generators, of an output &gt; 75 kVA; 850163: AC generators, of an output 75-750 kVA; 850164: AC generators, of an output &gt; 750 kVA; 850211: Generating sets, diesel, output &lt; 75 kVA; 850212: Generating sets, diesel, output 75-375 kVA; 850213: Generating sets, diesel, output &gt; 375 kVA; 850220: Generating sets, with spark ignition engines; 850230: Electric generating sets, nes; 850240: Electric rotary converters; 850300: Parts for electric motors and generators; 850410: Ballasts for discharge lamps or tubes; 850421: Liquid dielectric transformers &lt; 650 KVA; 850422: Liquid dielectric transformers 650-10,000 KVA; 850423: Liquid dielectric transformers &gt; 10,000 KVA; 850431: Transformers electric, power capacity &lt; 1 KVA, nes; 850432: Transformers electric, power capacity 1-16 KVA, nes; 850433: Transformers electric, power capacity 16-500 KVA; 850434: Transformers electric, power capacity &gt; 500 KVA, nes; 850440: Static converters, nes; 850450: Inductors, electric; 850490: Parts of electrical transformers and inductors; 850511: Metal permanent magnets, articles intended as magnets; 850519: Permanent magnets &amp; articles intended as magnets, nes; 850520: Electro-magnetic couplings, clutches and brakes; 850530: Electro-magnetic lifting heads; 850590: Electro-magnets nes and parts of magnetic devices; 850611: Manganese dioxide primary cell/battery volume &lt; 300 c; 850612: Mercuric oxide primary cell, battery, volume &lt; 300 cc; 850613: Silver oxide primary cells, batteries volume &lt; 300 cc; 850619: Primary cells, primary batteries nes, volume &lt; 300 cc; 850620: Primary cells, primary batteries nes, volume &gt; 300 cc; 850690: Parts of primary cells and primary batteries; 850710: Lead-acid electric accumulators (vehicle); 850720: Lead-acid electric accumulators except for vehicles; 850730: Nickel-cadmium electric accumulators; 850740: Nickel-iron electric accumulators; 850780: Electric accumulators, nes; 850790: Parts of electric accumulators, including separators; 850810: Drills, hand-held, with self-contained electric motor; 850820: Saws, hand-held, with self-contained electric motor; 850880: Tools, hand-held, with electric motor, not drills/saw; 850890: Parts, hand tools with self-contained electric motor; 850910: Domestic vacuum cleaners; 850920: Domestic floor polishers; 850930: Domestic kitchen waste disposers; 850940: Domestic food grinders, mixers, juice extractors; 850980: Domestic appliances, with electric motor, nes; 850990: Parts of domestic appliances with electric motor; 851010: Shavers, with self-contained electric motor; 851020: Hair clippers, with self-contained electric motor; 851090: Parts of shavers/hair clippers, electric; 851110: Spark plugs; 851120: Ignition magnetos, magneto-generators and flywheels; 851130: Distributors and ignition coils; 851140: Starter motors; 851150: Generators and alternators; 851180: Glow plugs &amp; other ignition or starting equipment nes; 851190: Parts of electrical ignition or starting equipment; 851210: Lighting/signalling equipment as used on bicycles; 851220: Lighting/visual signalling equipment nes; 851230: Sound signalling equipment; 851240: Windscreen wipers/defrosters/demisters; 851290: Parts of cycle &amp; vehicle light, signal, etc equipment; 851310: Portable battery and magneto-electric lamps; 851390: Parts for portable battery &amp; magneto electric lamps; 851410: Industrial electric resistance heated furnaces &amp; oven; 851420: Industrial electric induction, dielectric furnace/oven; 851430: Industrial/laboratory electric furnaces and ovens nes; 851440: Industrial induction/dielectric heating equipment nes; 851490: Parts of industrial/etal electric furnaces/ovens nes; 851511: Electric soldering irons and guns; 851519: Electric brazing, soldering machines and apparatus nes; 851521: Electric resistance welding equipment, automatic; 851529: Electric resistance welding equipment, non-automatic; 851531: Automatic electric plasma, other arc welding equipment; 851539:</td>
</tr>
</tbody>
</table>
Non-automatic electric plasma and other arc welders; 851580: Electric, laser and ultrasonic welding equipment nes; 851590: Parts of electric solder, weld or braze equipment; 851610: Electric instant, storage and immersion water heaters; 851621: Electric storage heating radiators; 851629: Electric space heating nes and soil heating apparatus; 851631: Electric hair dryers; 851632: Electro-thermic hairdressing apparatus, nes; 851633: Electro-thermic hand drying apparatus; 851640: Electric smoothing irons; 851650: Microwave ovens; 851660: Electric cooking, grilling & roasting equipment nes; 851671: Electric coffee or tea makers, domestic; 851672: Electric Toasters, domestic; 851679: Electro-thermic appliances, domestic, nes; 851680: Electric heating resistors; 851690: Parts of electro-thermic apparatus, domestic, etc.

Notes: (1) nes is short for not elsewhere classified.

Appendix Table A2: List of Top Importers in Electronics

Argentina, Australia, Austria, Bangladesh, Algeria, Belgium, Belgium-Luxembourg, Bolivia, Brazil, Bulgaria, Cameroon, Canada, Chile, Colombia, Cyprus, Czech Republic, Denmark, Egypt, Finland, France, Germany, Greece, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Mexico, Netherlands, New Zealand, Nigeria, Norway, Pakistan, Philippines, Poland, Portugal, Republic of Korea, Romania, Russian Federation, Slovakia, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, USA, Ukraine, United Kingdom, Uruguay, Venezuela, Viet Nam.