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The Chinese Export Displacement Effect Revisited: The Case of the East African Community

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Abstract

China's increasing exports have prompted research to examine whether Chinese exports displace those that originate from elsewhere. In this paper we focus on the growth of China's exports to the East African Community (EAC) countries and show how they have affected exports from the European Union (EU). Our methodological contribution to the literature is a set of total and relative displacement estimates based on different specifications of the gravity model where we control for country–year fixed effects so as to avoid the error of not accounting for time-varying "multilateral resistance." Our empirical findings do not support the hypothesis that Chinese exports have displaced exports from other countries including those from the EU. These results suggest that competition in the EAC market has not been a zero-sum game among different exporting countries.

Keywords: East African Community, European Union, export displacement, gravity equation, trade

JEL codes: F13, F14, F15

I. Introduction

China's exports and export share have increased dramatically in recent decades, globally and in many regional and national markets, including destinations where traditional exporters have encountered great difficulties in expanding their exports, such as the African markets. For instance, while the European Union (EU) has managed to retain its status as one of the most important providers of exports to the African markets, its importance has diminished, despite its many efforts to strengthen its long-standing trade

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ties with Africa. These efforts include the EU's push for the completion of negotiations on the region-to-region Economic Partnership Agreements (EPA) with various groups of African countries, a core element of the EU's "comprehensive strategy with Africa" (European Commission, 2020).[1] The EPAs are intended to replace the various existing one-way trade preferences granted by the EU with the WTO-compatible free trade areas between the EU and its African partners (European Parliament, 2012; Jensen and Yu, 2012). In contrast, the two-way trade linkages between China and Africa have been strengthened greatly during the same period. While China has increased imports of resources and mineral products from Africa in recent decades (Besada et al., 2008; Information Office of the State Council, 2013), exports from China to Africa have also been rising steadily during a relatively short period, leading to a sizable and increasing share for China in the African import markets.

As a case in point, we take the East African Community (EAC), consisting of Burundi, Kenya, Rwanda, Tanzania, and Uganda as the focus of our paper. According to our calculations based on the reconciled import statistics of Base pour l'Analyse du Commerce International (BACI) (Gaulier and Zignago, 2010), China's import share rose from a mere 3 percent in 1995–1997 to 22 percent in 2016–2018, with import values growing by 42 percent. During the same period, the EU's import share dropped from 35 percent to 11 percent. In broadly defined sectors, China appears to have enjoyed particular success in expanding exports in the manufacturing and machinery sectors where the EU has held a dominant position traditionally. China is now the single most important source of imports for the EAC countries.

This quite dramatic change in import sourcing in the EAC (and in other parts of Africa) raises a number of interesting questions. For instance, from the perspective of the EAC countries, the obvious question to ask is how increased imports from China and the relative decline of imports from the EU affected the EAC consumers and producers. From a trade policy perspective, an interesting question is whether the EU–EAC EPA will lead to a larger EU import share in the EAC. The EPA between the EAC and the EU was concluded in October 2014 and all the EU member states have since signed the agreement, but on the EAC side so far only Kenya and Rwanda have signed it, meaning that the EU–EAC EPA is still not implemented.

In this paper, we do not go into the welfare effects of the changing EAC import shares. Nor do we analyze the effects of trade agreements in general or EU–Africa EPAs in particular. Instead, we focus on characterizing the relative rise (and fall) of exports

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[1] For recent developments in the EPA negotiations, see https://trade.ec.europa.eu/doclib/docs/2009/september/tradoc_144912.pdf [online; cited May 2022].

from China (and the EU) in third markets with an emphasis on the EAC. Specifically we use recent bilateral trade statistics spanning the period of 1995–2019 and connecting 216 countries to determine whether Chinese exports have displaced or "crowded out" EU exports to the EAC. This detailed data set contains more than 197 million observations. In this way, this paper makes a meaningful contribution to the recent literature on the "displacement" effects of Chinese exports, as Africa has so far not being featured in that literature as the destination market. To realize these objectives, we follow the relevant empirical literature and estimate a gravity model on bilateral trade data to investigate whether China's exports to the EAC have displaced those sourced from other countries, particularly those originating in the EU.

The paper also contributes to the literature on the displacement effect of Chinese exports by estimating the total displacement effect in a standard gravity model of trade with country–year, industry–year, and country-pair fixed effects, in addition to the relative displacement effect. None of the existing studies, for reasons discussed below, report the total as well as the relative displacement effects of Chinese exports based on a model with country–year fixed effects (Kong and Kneller, 2016). We also provide estimates on the displacement effect in six broadly defined sectors in a model with the fixed effects mentioned above using disaggregated trade data.

Our main findings do not support the claim that Chinese exports to the EAC countries and elsewhere have displaced exports from other sources in general and from the EU in particular. Instead, what we find is that Chinese exports have been positively associated with exports from other countries, including those from the EU. This finding is at odds with the early studies that did not account for country–year fixed effects. Some of the more recent studies that do account for these fixed effects do not estimate the total displacement effect, but only the displacement effect of certain countries relative to that of a control group. Unfortunately, the sign of this relative effect does not tell us anything about the sign of the total effect. For example, if the trade flow between exporter i belonging to group g and importer j involves a product that is a substitute for a similar product from China, then a negative relative effect implies that exporters from group g are more adversely affected by Chinese exports than other exporters. Conversely, if the product is a complement to Chinese goods, then a negative relative effect implies that exporters from g are less positively affected than those from other countries and they might even be negatively affected. However, as we do not know *a priori* whether a product is a substitute for or a complement to a similar Chinese good, we cannot infer from the relative effect alone whether the total displacement effect is negative or positive. By estimating both relative and total displacement effects, we show in this paper that the total displacement effect is in fact positive, i.e., Chinese exports do not displace or crowd out exports, in general, from other countries or the EU in particular. This is also the case for each of the broad sectors that we consider, including the manufacturing sector.

The rest of the paper is organized as follows. In Section II we introduce the gravity equation model and the data used in the estimations. We also briefly review the related literature on the displacement effects of Chinese exports. Section III contains an analysis of the estimation results and Section IV concludes the paper with discussions.

II. Model specification, data, and related literature

1. The gravity model of trade

The gravity model of trade is a very useful tool for describing global trade flows and for quantifying the determinants of trade, including WTO membership (Rose, 2004; Subramanian and Wei, 2007; Grant and Boys, 2011; Dutt et al., 2013), free trade agreements (Egger et al., 2011; Baier et al., 2014; Dai et al., 2014), currency unions (Rose and Honohan, 2001; Rose and van Wincoop, 2001; Barro and Tenreyro, 2007), colonial links (Head et al., 2010; Berthou and Ehrhart, 2017), and non-tariff barriers (Disdier et al., 2015), etc. There are also quite a few studies that use the gravity equation to estimate the displacement effect of Chinese exports on other countries' exports. The first application of the gravity equation in economics is attributed to Tinbergen (1962) who realized that large economies that are located close to each other tend to trade more than small economies that are far apart. Early studies used importer and exporter GDPs as well as geographical distance between capitals to explain trade flows and this specification fitted the trade data remarkably well (Anderson, 2011; Head and Mayer, 2014).

The empirical success of the gravity equation has been followed by studies that justify the model's theoretical foundations. Anderson (1979), derived the gravity equation from a setup with differentiated products and a constant elasticity of substitution utility function. Other authors have derived similar gravity equations from different setups but the now standard derivation is due to Anderson and van Wincoop (2003). As these authors pointed out, trade flows are not simply determined by bilateral trade costs but also by so-called multilateral resistance, which, essentially, accounts for the general equilibrium nature of trade (i.e., bilateral trade flows are also affected by trade costs with third countries). Whereas Anderson and van Wincoop (2003) themselves estimated these multilateral resistance terms from the data, more recent studies instead control for multilateral resistance by including sets of "fixed effects" in the model, as recommended by Feenstra (2002). We comment more on the estimation of gravity models in Section II.8.

2. Literature review

Starting with Eichengreen et al. (2007), a number of studies have investigated whether or not Chinese exports have displaced exports from other Asian countries (Greenaway et al., 2008; Amann et al., 2009; Athukorala, 2009; Kong and Kneller, 2016). The models used in these papers are variants of the general model on the empirical form

$$\ln EXP_{ijt} = \alpha_o + \alpha_1 \ln ChEXP_{jt} + \alpha_2 \boldsymbol{X}_{ijt} + \epsilon_{ijt}, \tag{1}$$

where variable $\ln EXP_{ijt}$ denotes the natural log of exports from source country i to destination j in year t and $\ln ChEXP_{jt}$ denotes the natural log of exports from China to country j in year t. $\boldsymbol{X}_{ijt}$ is a vector of additional gravity controls including importer and exporter GDP, distance between i and j, etc. Finally, ϵ_{ijt} is the error term. Due to the logarithmic formulation of the model, the coefficient α_1 can be interpreted as the elasticity of exports from country i with respect to exports from China into country j. A significant negative α_1 suggests that Chinese exports are displacing exports from other countries. For reasons that will become clear below, we shall refer to α_1 in Equation (1) as the “level effect.”

One could think of the $\ln ChEXP_{jt}$ term as an additional variable representing trade frictions. Specifically, if $\alpha_1 < 0$, it means that a larger export from China to country j implies fewer exports from other countries to j. This effect is similar to including j’s Most Favored Nation tariff level or other importer-specific friction affecting trade. Alternatively, one can think of the term as representing market size similar to the importer’s GDP. A negative α_1, in this case, would signify that more trade with China, for a given total market size as represented by the importer GDP, means a lower market share for other exporting countries (market displacement).

As Kong and Kneller (2016) noted, results from the early studies are inconclusive. The preferred estimator in Eichengreen et al. (2007) led to a statistically insignificant overall displacement effect. However, when they split up the trade data into capital goods, intermediate goods, and consumer goods, the effect became significant. For consumer goods $\hat{\alpha}_1 < 0$, whereas $\hat{\alpha}_1 > 0$ for capital goods and intermediates.[2] That is, exporters of capital goods and intermediates seem to benefit trade-wise from increasing Chinese exports whereas exporters of consumer goods suffer. This implies that China’s export growth has benefitted high- and middle-income Asian countries that are large exporters of capital goods and intermediates, whereas low-income Asian countries, which are more dependent on consumer goods, are negatively affected. Greenaway et al. (2008) estimated a model that is similar to that of Eichengreen et al. (2007) but they arrived at a different set of conclusions. According to their results, there is

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[2] We represent estimated parameters with “hats” (^) above them (e.g., $\hat{\alpha}_1$ is the estimated value of α_1).

a displacement effect on other Asian countries $(\hat{\alpha}_1 < 0)$. When they split up their dataset according to the income level of Asian countries, they found that China's export expansion had affected high income Asian exporters adversely whereas low-income Asian exporters were not affected. They did not, however, consider trade in different types of goods but only aggregate trade flows. Athukorala (2009) analyzed trade in machinery and transport equipment and manufactures. He found that $\hat{\alpha}_1 < 0$ and this was highly significant across all estimations (based on different subsets of the data). He could not find much evidence that East Asian countries were more adversely affected by Chinese exports than other countries but there were some differences in terms of the size of the export response, among the individual Asian countries and across sectors, to increasing Chinese exports.

The studies reviewed so far did not include country–year fixed effects in their models. As Kong and Kneller (2016) noted, this omission was the "gold medal mistake" of not controlling for (time varying) multilateral resistance terms (Baldwin and Taglioni, 2006). The main model considered by Kong and Kneller (2016) is given by Equation (2):

$$\ln EXP_{ijt} = \beta_0 + \beta_1 \ln ChEXP_{jt} \times endow_i + \gamma_{it} + \gamma_{jt} + \gamma_{ij} + \epsilon_{ijt}, \tag{2}$$

where $endow_i$ is a measure of the factor endowment of country i relative to the factor endowment of China and where γ_{it}, γ_{jt}, and γ_{ij} are sets of exporter–year, importer–year, and country-pair fixed effects, respectively. Kong and Kneller (2016) are not able to estimate β_1 without interacting the *ChEXP* variable with a variable that varies across the exporter dimension i, due to the country–year fixed effects γ_{it} and γ_{jt} included in the model. That is, Kong and Kneller (2016) can only estimate the displacement effect conditional on a specific endowment level of the exporter. In Section II.3 below, we denote the coefficients to such an interaction term as the "relative effect" as opposed to the "level effect" such as α_1 in Equation (1), which does not depend on other variables. This terminology is best suited, though, for models that include both terms.

Kong and Kneller (2016) found that endowments played an important role in explaining the extent to which a country was affected by Chinese exports. Specifically, countries with higher capital–labor ratios and human capital levels relative to China experienced more export growth or less export displacement in connection with increasing Chinese exports ($\hat{\beta}_1 > 0$). The problem with this model is that the relative effect is not very informative without the level effect. In fact, the total effect (level + relative effect) could either be positive or negative depending on the signs and sizes of the two effects. Kong and Kneller (2016) recognized this so they inferred the sign of the level effect from economic theory. In particular they argued that the level effect should be negative for final goods and positive for parts and components. According to this reasoning, the sign of the total effect is ambiguous for final goods.

A group of related studies has also estimated the effect of Chinese exports in a gravity model but without a focus on other Asian countries. Giovannetti et al. (2013) estimated the effects of increasing Chinese exports on EU exports to OECD markets. What they found was that the sign and significance of the level effect varied according to the two-digit Standard International Trade Classification (SITC) sectors and exporting countries considered. They therefore did not find evidence of a general displacement effect of Chinese exports. In a recent paper, Pham et al. (2017) investigated the effects of China's high-tech exports on other exporters of high-tech products. The authors concluded that Chinese exports had displaced the exports of its developing competitors in South America and South East Asia in most high-tech products. They also found that Chinese exports were associated with additional high-tech exports from developed exporters like South Korea and Japan. This suggested that Chinese high-tech exports were substitutes for other developing countries' exports of high-tech goods whereas they were complements to those of developed countries.

We have identified four studies based on the gravity model that focused on trading relationships between African countries and China. Giovannetti and Sanfilippo (2009) and Geda and Meskel (2008) each considered the manufacturing sector and analyzed whether Chinese exports had displaced exports from African countries. Both studies found evidence that Chinese exports were crowding out African exports in third-country markets. Montinari and Prodi (2011) studied China's impact on intra-African trade and concluded that exports from the Sub-Saharan African (SSA) countries to China increased intra-African trade for small exporters and reduced it for large exporters. Chinese imports to SSA, on the other hand, did not have a statistically significant effect on intra-African trade. He (2013) estimated the impact of imports from the US, France, and China on SSA countries' manufactured exports. He found a positive relationship between SSA imports from these three countries and SSA exports for each of the manufacturing sectors considered. Moreover, China's impact was the strongest among these three countries.

None of the studies focusing on Africa reviewed above account for time varying multilateral resistance in their estimations, so they all made the "gold medal mistake" of gravity analysis. Edwards and Jenkins (2014), on the other hand, included country–year–product fixed effects in their model, which is given by:

$$\ln EXP_{ijkt} = \beta_0 + \beta_1 \ln ChEXP_{jkt} \times SA_i + \gamma_{ikt} + \gamma_{jkt} + \gamma_{ijk} + \epsilon_{ijkt}, \qquad (3)$$

where the k subscript refers to a Harmonized System (HS) four-level sector and SA_i is a dummy indicating whether or not the exporter is South Africa. Equation (3) is an interesting case. Similar to Kong and Kneller (2016), Edwards and Jenkins (2014) did not actually estimate the level effect, which in this case would represent the displacement effect of Chinese exports on exports from non-South African countries. Instead they focused exclusively on the displacement effect conditionally on the exporter being South African. As discussed above and in Section II.3, if the model would include a "level" term ($\ln ChEXP_{jkt}$ is not interacted with the SA_i dummy in this case), then β_1 would be interpreted as the displacement effect on South African exports relative to other exporters. This is not possible, however, because of the importer–product–year fixed effect γ_{jkt}. Edwards and Jenkins (2014) found that exports from China had a negative relative effect on exports from South Africa to other African countries for all product groups considered.

In summary, the survey above is inconclusive as to whether Chinese exports have been displacing exports from other countries. Moreover, most of the studies that estimate a level displacement effect failed to account for time varying multilateral resistance. The studies that did account for time varying multilateral resistance were only able to estimate a displacement effect conditional on the exporter being a certain country or on the level of a variable characterizing the exporter.

Below we introduce the models that we use in this paper to estimate the total displacement effect of Chinese exports as well as the relative displacement effect on EU exports in general and EU exports to the EAC countries in particular. Our main contribution is a set of estimates of the total displacement effect of Chinese exports on exports from other sources based on models that includes country–year fixed effects. As will be clear, our solution to the problem of how to include country–year dummies in the model, in order to account for multilateral resistance and still be able to estimate the level effect, involves using trade data with sectoral variation rather than aggregate trade data. The source of the trade data and sectoral aggregation scheme is discussed in Section II.7.

3. Benchmark model estimated with sectoral trade data

Our baseline gravity model for estimating the displacement effect of Chinese exports is given by

$$\begin{aligned} \ln EXP_{ijst} = {} & \beta_0 + \beta_1 \ln ChEXP_{jst} + \beta_2 \ln ChEXP_{jst} \times EU15_i + \\ & \beta_3 \ln ChEXP_{jst} \times EAC_j + \beta_4 \ln ChEXP_{jst} \times EU15_i \times EAC_j + \\ & \gamma_{st} + \gamma_{it} + \gamma_{jt} + \gamma_{ij} + \epsilon_{ijst}, \end{aligned} \tag{4}$$

where subscripts i, j, s, and t denote exporting country, importing country, sector, and year, respectively. The variable $\ln EXP_{ijst}$ denotes the log of exports from i to j in year t of goods belonging to sector s, whereas $\ln ChEXP_{jst}$ denotes the log of exports from China to j. The variables $EU15_i$ and EAC_j are dummies indicating whether the exporter is one of the EU15 countries and whether the importer is one of the EAC countries, respectively. ϵ_{ijst} is the error term containing omitted influences on bilateral trade flows and the gammas are sets of dummies defined in Table 1.

Table 1. Definition of dummy variables

Dummy variables	Definition
γ_{st}	1 if trade flow concerns sector *s* and year *t*, 0 otherwise (sector–year fixed effect)
γ_{it}	1 if trade flow concerns exporter *i* and year *t*, 0 otherwise (exporter–year fixed effect)
γ_{jt}	1 if trade flow concerns importer *j* and year *t*, 0 otherwise (importer–year fixed effect)
γ_{ij}	1 if trade flow concerns exporter *i* and importer *j*, 0 otherwise (country-pair fixed effect)

It is instructive to consider the expression for the partial effect of interest, namely the elasticity of exports from countries other than China with respect to exports from China. For this purpose, we can denote the set of all explanatory variables $\boldsymbol{X}$ and ignore the subscripts i, j, and s. Then we take the conditional expectation on both sides of Equation (4) and differentiate with respect to ln*ChEXP*:

$$\frac{\mathrm{d}E[\ln EXP \mid X]}{\mathrm{d}\ln ChEXP} = \eta_{EXP,\,ChEXP} = \beta_1 + \beta_2 EU15 + \beta_3 EAC + \beta_4 EU15 \times EAC. \tag{5}$$

Obviously, the value of this elasticity depends on whether the exporting country is in the EU15 and whether the importing country is in the EAC. If both conditions hold, $\eta_{EXP,\,ChEXP} = \sum_{k=1}^{4} \beta_k$. If either of the conditions is violated, then one or more of the terms will be 0.

In line with the literature reviewed in Section II.2, we shall refer to this sum as the total displacement effect. We refer to the coefficients β_2, β_3, and β_4 in front of the interaction terms as relative displacement effects, whereas β_1 represents the level effect.

The level effect, β_1, represents the impact of Chinese exports on the reference group, which consists of exporting countries that do not belong to EU15 (i.e., $EU15_i = 0$) and importing countries that do not belong to the EAC (i.e., $EAC_j = 0$). The coefficients to the interaction terms, β_2, β_3, and β_4, represent partial effect differences relative to the reference group. For example,

$$\begin{aligned}\beta_2 &= \frac{\mathrm{d}E[\ln EXP \mid X, EU15 = 1, EAC = 0]}{\mathrm{d}\ln ChEXP} - \frac{\mathrm{d}E\left[\ln EXP \mid X, EU15 = 0, EAC = 0\right]}{\mathrm{d}\ln ChEXP} \\ &= \frac{\mathrm{d}E\left[\ln EXP \mid X, EU15 = 1, EAC = 0\right]}{\mathrm{d}\ln ChEXP} - \beta_1.\end{aligned} \tag{6}$$

Therefore, if $\beta_2 < 0$, for example, it does not necessarily imply that Chinese exports reduce exports from EU15 countries. In contrast, because β_1 represents the impact on the reference group, $\beta_1 < 0$ implies that Chinese exports are displacing exports from countries other than those in the EU15 to countries other than those in the EAC, on average.

If $\beta_1 + \beta_2 < 0$, it means that Chinese exports are displacing exports from the EU countries to countries other than those in the EAC. If $\beta_1 + \beta_3 < 0$, then it must be the case that Chinese exports displace exports from non-EU15 countries to the EAC countries. Finally, if $\sum_{k=1}^{4} \beta_k < 0$, then it must be the case that Chinese exports, on average, displace exports from the EU15 countries to the EAC countries.

If the level effect and one or more of the relative effects have different signs, then the total effect can either be positive or negative depending on the relative magnitudes of the two effects. For example, if $\beta_1 > 0, \beta_2 < 0$, and $\beta_1 + \beta_2 > 0$, then Chinese exports lead to additional exports from all other sources (EU as well as non-EU countries) on average, but less so when the exporter is an EU country. In the opposite case (i.e., $\beta_1 < 0$, $\beta_2 > 0$ and $\beta_1 + \beta_2 < 0$), Chinese exports displace exports from all other sources on average, but the effect on EU15 exporters is smaller (closer to zero) than for non-EU15 exporters. In each case, the sign of the total effect depends on the sign of the sum $\beta_1 + \beta_2$.

As mentioned in Section II.1, the issue of which fixed effects to control for is a somewhat contentious topic in the gravity literature in general and the literature on the Chinese export displacement in particular. In the gravity literature, a fixed effect refers to a set of dummies that, when included in the model, controls for unobserved multilateral resistance. To not control for multilateral resistance is the "gold medal mistake" of gravity analysis (Baldwin and Taglioni, 2006) because it causes omitted variable bias. With aggregate panel data, these dummies indicate unique importer–year and exporter–year combinations (referred to jointly as country–year dummies). Some studies also control for bilateral trade frictions by including a set of (time invariant) country-pair dummies in the model unless the variable of interest is a time-invariant bilateral (dyadic) variable. With disaggregated trade data, it is possible to include a set of country–year–product dummies to control for a country's time- and product-specific multilateral resistance. In our benchmark Equation (4), we do not do this. Instead, we control for country–year, country-pair and sector–year fixed effects. In effect we are assuming that the average trade costs faced by a country are the same across all sectors. This assumption is relaxed in Section II.6.

Another benefit of controlling for country–time fixed effects is that it takes care of some unobserved factors affecting Chinese exports such as country specific business cycles. Most of the studies in the literature on the displacement effect of Chinese exports do not, however, control for country–year fixed effects. Instead they use instrumental variable (IV) estimation to alleviate the omitted variable bias associated with the endogeneity of *ChExp*. One reason for this is that many of these studies use aggregate trade data and it is not possible to estimate the displacement effect in a model with country–year fixed effects, without sectoral variation in the data or, alternatively, without variation in the *ChExp* variable across the importer–exporter and time dimension. The latter approach is discussed below.

4. Benchmark model estimated with aggregate sectoral trade data

One potential issue with Equation (4) is that it leads to a loss of information and potentially sample selection bias, as it drops those observations in the dataset where there are exports from *i* to *j* but not from China to *j* in a specific sector and year. Therefore, if there are systematic differences between the Chinese export flows and the export flows of other countries, then the model may suffer from potential selection bias. Another issue with Equation (4) is that a country's multilateral resistance may vary significantly across sectors. As a robustness check on the results based on Equation (4), we consider an aggregated version, as follows:

$$\begin{aligned}\ln EXP_{ijt} &= \beta_0 + \beta_1 \ln ChEXP_{ijt} + \beta_2 \ln ChEXP_{ijt} \times EU15_i + \\ &\beta_3 \ln ChEXP_{ijt} \times EAC_j + \beta_4 \ln ChEXP_{ijt} \times EU15_i \times EAC_j + \\ &\gamma_{it} + \gamma_{jt} + \gamma_{ij} + \epsilon_{ijst}.\end{aligned} \tag{7}$$

The dependent variable in Equation (7) is defined as $EXP_{ijt} = \Sigma_s EXP_{ijst}$, i.e., total exports from *i* to *j*. However, the Chinese export variable in Equation (7) is given by

$$ChExp_{ijt} = \sum\nolimits_{s(ij)} ChEXP_{ijst}, \tag{8}$$

where the (*ij*) subscripts in the sum signify that we only sum over the sectors *s* where there are exports from *i* to *j*, rather than the sectors where there are exports from China to *j*. This aggregation scheme preserves the information contained in these Chinese export flows and, importantly, generates variations in Chinese exports across the exporter – in addition to the importer – and time dimensions, which is why we include an *i* subscript in $ChEXP_{ijt}$. This enables us to estimate β_1 while controlling for country–year and country-pair fixed effects, even with aggregate trade data.

5. A model without country–year fixed effects

As a second robustness check, we analyze the ramifications of not controlling for country–year fixed effects. Although it is generally accepted that it is necessary to control for these fixed effects, it is often not done in practice for two main reasons. The first is that it prevents us from estimating the effects of variables that only vary along the country–year dimensions. The second reason is that the standard estimators, including ordinary least squares (OLS), instrument variables (IV), and the within estimator, as programmed in standard statistical software packages, are not suitable for regressions involving a large number of dummies.

The model that we consider without country–year fixed effects is given by

$$\begin{aligned}\ln EXP_{ijst} = {} & \beta_0 + \beta_1 \ln ChEXP_{jst} + \beta_2 \ln ChEXP_{jst} \times EU15_i + \\ & \beta_3 \ln ChEXP_{jst} \times EAC_j + \beta_4 \ln ChEXP_{jst} \times EU15_i \times EAC_j + \\ & \beta_5 \ln GDP_{it} + \beta_6 \ln GDP_{jt} + \beta_7 \ln POP_{it} + \beta_8 \ln POP_{jt} + \\ & \beta_9 \ln RER_{ijt} + \gamma_s + \gamma_i + \gamma_j + \gamma_{ij} + \gamma_t + \epsilon_{ijst},\end{aligned} \tag{9}$$

where the additional explanatory variables are the GDPs and population sizes of the trading partners and their bilateral real exchange rate. The fixed effect dummies are defined in Table 2.

Table 2. Definition of fixed–effect dummies

Fixed–effect dummies	Definition
γ_s	1 if trade flow concerns sector *s*, 0 otherwise (sector fixed effect)
γ_i	1 if trade flow concerns exporter *i*, 0 otherwise (exporter fixed effect)
γ_j	1 if trade flow concerns importer *j*, 0 otherwise (importer fixed effect)
γ_t	1 if trade flow concerns year *t*, 0 otherwise (year fixed effect)

We follow Rose (2000) and Vandenbussche and Zanardi (2010) and include the bilateral real exchange rate, RER_{ijt} to control for time varying bilateral trade frictions. We do not include the traditional trade friction proxies; instead we control for country-pair fixed effects. For completeness we also estimate the aggregated model

$$\begin{aligned}\ln EXP_{ijt} = {} & \beta_0 + \beta_1 \ln ChEXP_{ijt} + \beta_2 \ln ChEXP_{ijt} \times EU15_i + \\ & \beta_3 \ln ChEXP_{ijt} \times EAC_j + \beta_4 \ln ChEXP_{ijt} \times EU15_i \times EAC_j + \\ & \beta_5 \ln GDP_{it} + \beta_6 \ln GDP_{jt} + \beta_7 \ln POP_{it} + \beta_8 \ln POP_{jt} + \\ & \beta_9 \ln RER_{ijt} + \gamma_i + \gamma_j + \gamma_{ij} + \gamma_t + \epsilon_{ijt},\end{aligned} \tag{10}$$

where the two export variables are the same as in Equation (7).

As mentioned above, a concern in the literature is that exports from China are likely to be correlated with those from other countries, due to some common unobserved factors exerting influences on exports from both China and other exporting countries. In this case, the error term in the model will be correlated with the *ChEXP* variable and the OLS estimator will be biased. The typical solution to this problem is to use IV estimation where the distance to China and the Chinese GDP are the two most commonly used instruments. There are, however, some issues with these instruments, which make them unsuitable. First, the distance to China varies only across the importer dimension and therefore it is redundant once a full set of importer or importer–year dummies is included. Second, Chinese GDP only varies across the time dimensions and therefore it is redundant once a full set of year or country–year dummies is included. Following Eichengreen et al. (2007), we instead use (the log of) time-varying "economic distances" between China and its export destinations as an instrument (denoted $\ln ChDist_{jt}$). These distances are weighted averages of the distance to j from Beijing, Guangdong, and Shanghai where the weights are the export shares of these origins in total Chinese exports sourced from the *China Statistical Yearbook*.[3]

It should, however, be immediately clear that including a full set of importer–year dummies controls for the same factors as does the economic distance instrument. This is exactly why we cannot use economic distance as an instrument in Equations (4) or (7), as we do not have data on Chinese sectoral exports at the provincial level.

6. Benchmark model estimated with product-level trade data

As a third and final robustness check, we run a set of regressions for each sector separately. We cannot estimate Equations (4) and (7) with trade data aggregated to the sectoral level. Instead we must base the sectoral regressions on Equation (9) or, alternatively, we can estimate Equation (4) with product-level trade data. That is, for each sector s we estimate the model:

$$\begin{aligned}\ln EXP_{g\in s,ijt} = \beta_0 + \beta_1 \ln ChEXP_{g\in s,jt} + \beta_2 \ln ChEXP_{g\in s,jt} \times EU15_i + \\ \beta_3 \ln ChEXP_{g\in s,jt} \times EAC_j + \beta_4 \ln ChEXP_{g\in s,jt} \times EU15_i \times EAC_j + \\ \gamma_{gt} + \gamma_{it} + \gamma_{jt} + \gamma_{ij} + \epsilon_{gijt},\end{aligned} \qquad (11)$$

where the $g \in s$ subscript refers to a specific good or product belonging to sector s. The country–year fixed effects in these sectoral regressions are not specific to the particular good in question because this would make it impossible to estimate the level effect β_1. However, they are specific to the sector s to which the good belongs. In effect we assume that average trade frictions are the same for each of the goods belonging to a given sector. Finally, to account for the many missing Chinese export flows at the goods level we also estimate the aggregated model:

$$\begin{aligned}\ln EXP_{ij(s)t} = \beta_0 + \beta_1 \ln ChEXP_{ij(s)t} + \beta_2 \ln ChEXP_{ij(s)t} \times EU15_i + \\ \beta_3 \ln ChEXP_{ij(s)t} \times EAC_j + \beta_4 \ln ChEXP_{ij(s)t} \times EU15_i \times EAC_j + \\ \gamma_{it} + \gamma_{jt} + \gamma_{ij} + \epsilon_{ij(s)t},\end{aligned} \qquad (12)$$

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[3] The *China Statistical Yearbook* is available from the website of the National Bureau of Statistics of China, see http://www.stats.gov.cn/english/Statisticaldata/AnnualData/ [online; cited May 2022].

with product level data, for each sector separately, where the aggregation is similar to the one in Equation (7) except that, for each s, we sum over $g \in s$ rather than s.

7. Data

The dependent variable $\ln EXP_{gijt}$ in Equation (11), defined as the log of bilateral exports of good g, produced in country i and sold in country j, is sourced from the BACI database (Gaulier and Zignago, 2010). The BACI database, which is based on the UN COMTRADE database, improves upon its source in several ways and has been used in place of the COMTRADE database by a number of studies (e.g., Fontagné et al., 2008; Bensidoun et al., 2009; Disdier et al., 2010). First, it reconciles import and export reports of the same trade flows; second, it harmonizes quantities for all trade flows to allow for consistent computing of unit values and, finally, it has a much wider country coverage, as data for missing reporters in the COMTRADE database can be inferred from data reported by missing reporters' trading partners. These improvements are particularly important when investigating bilateral trade flows concerning African countries, as data for these countries have been known for large discrepancies and inconsistencies.[4]

A good g is defined as a six-digit HS product code. In order to aggregate individual goods g into sectors s, we use a concordance between the HS classification and the SITC classification, to convert the BACI data classified in the sixth edition of HS nomenclature into the Standard International Trade Classification Rev 3 classification (SITC-3). Then we group the disaggregated trade flows into six main product groups: "Food," "Resource based products," "Manufacturing products," "Chemicals," "Machinery and transportation equipment," and "Other goods." The source of this aggregation scheme is the United Nations Statistics Division (UNSTAT).

Our disaggregated dataset contains 197,099,564 observations and covers bilateral trade between 216 countries over the 25-year period 1995–2019. When we aggregate the trade data into 6 sectors, the number of observations drops to a more manageable 2.3 million. We do not include zero-trade flows in our estimations for reasons laid out below.

8. Estimation

Given the large number of observations in the dataset and the many country–year dummies included in Equations (4), (7), and (11), it is computationally challenging to

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[4] These issues have long been recognized in the literature. For instance, an early study by Yeats (1990) suggested that statistics on trade between African countries are almost useless for empirical and policy studies, partly because of smuggling and false invoicing. Another study by Ng and Yeats (2001) pointed out that sub-Saharan African countries are among the most deficient in reporting timely and accurate trade data to the United Nations Statistical Office, which compiles the COMTRADE database.

estimate these models with standard estimators. We therefore used estimation approach developed by Gaure (2013b), which allowed us to project out multiple group effects prior to estimation.[5] In this way, we did not actually estimate the many dummies (fixed effects) in the model but, instead, we transformed the model variables to wipe out the fixed effects prior to estimation.

The Gaure (2013b) estimation approach is different from the estimation strategies typically used in the so-called structural approach to gravity analysis, where estimated trade costs and theory-consistent multilateral resistance terms often play an important role in the analysis. In this case, the trade costs can be obtained using constrained optimization techniques such as a mathematical program with equilibrium constraints approach employed in Balistreri and Hillberry (2007), Fally (2015), and Balistreri et al. (2011), or by including country–year dummies as recommended by Feenstra (2002). The latter is now standard in the structural gravity literature (e.g., Cheptea et al., 2021).

The generalized within-estimation method described above only works with linear models, which is why we did not include zero-trade flows in the dataset. The now standard estimator in the presence of zero-trade flows, the Poisson pseudo maximum likelihood (PPML) estimator promoted by Silva and Tenreyro (2006),[6] is based on a nonlinear model, so we cannot transform it in a way to get rid of the multilateral resistance terms prior to estimation. However, explicit inclusion of country–year dummies in the model makes estimation with the PPML estimator very computationally demanding unless we limit the number of observations to a small subset. We therefore leave this issue for future work. Standard errors are clustered by country-pairs, as is the tradition in gravity analysis.

III. Estimation results

In this section we first present the results obtained from the benchmark Equations (4) and (7). Next, we discuss the effects of disregarding country–year fixed effects based on Equations (9) and (10). Finally, we discuss whether the results are sensitive to the assumption that multilateral resistance is the same for all sectors by estimating the sector specific Equations (11) and (12) with disaggregated trade data. The variables used in these regressions are described in Table 3.

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[5] The method is implemented in the R package lfe, described in Gaure (2013a).

[6] The PPML estimator permits zero trade flows to enter into the estimation albeit with small weights and ensures that adding-up constraints are satisfied with fixed effects in most general gravity models. It also resolves an issue with heteroscedasticity related to the log transformation of the structural model.

Table 3. Description of variables used in the regressions

Variables	Equation	Description	Source
Dependent variables			
lnEXP_{sijt}	(4), (9)	Log of exports from country i to country j in year t of goods belonging to sector s (current US dollars)	BACI and authors' calculations
lnEXP_{ijt}	(7), (10)	Log of aggregate exports from country i to country j in year t (current US dollars)	BACI and authors' calculations
ln$EXP_{g\in s,ijt}$	(11)	Log of exports from country i to country j in year t of a HS6 tariff line belonging to sector s (current US dollars)	BACI
ln$EXP_{(s)ijt}$	(12)	Log of exports from country i to country j in year t of goods belonging to sector s (current US dollars). Separate regression for each sector s.	BACI and authors' calculations
China export regressors			
ln$ChEXP_{sjt}$	(4), (9)	Log of exports from China to importer j in year t of goods belonging to sector s (current US dollars)	BACI and authors' calculations
ln$ChEXP_{ijt}$	(7), (10)	Log of aggregate exports from China to country j in year t (current US dollars). Aggregation is over the sectors s where there is export from i to j in year t.	BACI and authors' calculations
ln$ChEXP_{g\in s,jt}$	(11)	Log of exports from China to country j in year t of a HS6 tariff line belonging to sector s (current US dollars)	BACI
ln$ChEXP_{(s)ijt}$	(12)	Log of exports from China to country j in year t of goods belonging to sector s (current US dollars). Separate regression for each sector s. Aggregation is over the goods g where there is export from i to j in year t.	BACI and authors' calculations
Country group indicator variables			
$EU15_i$	All	Dummy indicating whether the exporter is an EU15 country	Authors' construction
EAC_j	All	Dummy indicating whether the importer is an EAC country	Authors' construction
Traditional gravity control variables			
lnGDP_{it}	(9), (10)	Log of GDP of exporting country i in year t (current US dollars)	World Bank, World Development Indicators
lnGDP_{jt}	(9), (10)	Log of GDP of importing country j in year t (current US dollars)	World Bank, World Development Indicators
lnPOP_{it}	(9), (10)	Log of population of exporting country i in year t	World Bank, World Development Indicators
lnGDP_{jt}	(9), (10)	Log of population of importing country j in year t	World Bank, World Development Indicators
lnRER_{ijt}	(9), (10)	Log of real exchange rate between i and j in year t. It is defined as $\frac{E_{i,US,t}}{E_{j,US,t}}\frac{CPI_{i,t}}{CPI_{j,t}}$	World Bank, World Development Indicators, authors' calculations
ln$ChDist_{jt}$	(9), (10), First stage regression	Log of "economic distance" between China and importing country j in year t	China Statistical Yearbook, CEPII, authors' calculations

Notes: BACI, Base pour l'Analyse du Commerce International; CEPII, Internationales-Centre d'Etudes Prospectives d'Informations Internationales; CPI, Consumer Price Index; EAC, the East African Community; HS, the Harmonized System classification.

1. Results based on the benchmark model

Table 4 summarizes the results from our estimated benchmark model. The table is divided into two Panels, A and B, where Panel A contains results from Equation (1) based on data pooled over the broad sectors and Panel B contains results from the aggregated Equation (2). In the first column we report results based on data spanning the entire 25 year period

1995–2019. The second and third columns contain results based on the two subperiods 1995–2001 and 2002–2019, respectively. The motivation behind this is that China became a WTO member in late 2001, so trade frictions were presumably lower in the latter period.

Table 4. Estimation results: Equations (4) and (7)

	1995–2019	1995–2001	2002–2019
Panel A: Dependent variable: lnEXP_{sijt}			
ln$ChEXP_{sjt}$	0.226*** (0.006)	0.152*** (0.007)	0.255*** (0.007)
ln$ChEXP_{sjt} \times EU15_i$	0.271*** (0.007)	0.240*** (0.008)	0.282*** (0.007)
ln$ChEXP_{sjt} \times EAC_j$	0.093*** (0.018)	0.023 (0.024)	0.107*** (0.020)
ln$ChEXP_{sjt} \times EU15_i \times EAC_j$	–0.022 (0.025)	0.025 (0.040)	0.004 (0.033)
Observations	2,185,013	511,274	1,673,739
R^2	0.681	0.708	0.686
Panel B: Dependent variable: lnEXP_{ijt}			
ln$ChEXP_{ijt}$	0.202*** (0.005)	0.194*** (0.008)	0.194*** (0.006)
ln$ChEXP_{ijt} \times EU15_i$	0.075*** (0.013)	0.052*** (0.019)	0.061*** (0.016)
ln$ChEXP_{ijt} \times EAC_j$	0.047 (0.030)	0.046 (0.041)	0.019 (0.038)
ln$ChEXP_{ijt} \times EU15_i \times EAC_j$	–0.006 (0.033)	–0.207*** (0.078)	0.016 (0.043)
Observations	611,585	149,784	461,801
R^2	0.873	0.923	0.883

Notes: *** represents significance at the 1 percent level. Standard errors clustered by country-pair in parentheses. Exporter–year fixed effects, importer–year fixed effects, industry–year fixed effects and country-pair fixed effects have also been controlled in Panel A regression. Exporter–year fixed effects, importer–year fixed effects and country-pair fixed effects have also been controlled in Panel B regression.

Because we control for country-pair fixed effects, it does not make sense to include any of the traditional bilateral (dyadic) variables related to trade friction in the model as these do not vary over time (common border/language, colonial history etc.). Nor do we include importer and exporter GDP, as the economic forces represented by these variables are accounted for by the country–year fixed effects. There are, however, two country dummies included in the model: $EU15_i$ and EAC_j. The former indicates whether or not the exporter is among the EU15 countries and the latter whether or not the importer is among the EAC countries. Each of these is interacted with the *ChEXP* variable individually as is their product. The coefficient to *ChEXP* represents the level effect of Chinese exports on exporting countries not in EU15 and importing countries not in the EAC. The coefficients to the interaction terms represent the effects of Chinese exports on EU exports and EAC imports relative to this reference group.

We can derive the following conclusions from the six regressions summarized in Table 4. Focusing on Panel A, the first thing we note is that the estimated level effects are positive and well below 1. The largest coefficient to $\ln ChEXP_{sjt}$ is 0.255 and it is from the regression based on the 2002–2019 period. It suggests that a 10 percent increase in Chinese exports led to a 2.6 percent increase in exports, on average, from countries that were not in EU15 to countries that were not in EAC. The estimated level effect is approximately half as large in the early period. Second, the EU15 relative effect is large and statistically significant. In fact, the total effect, based on estimates from the full sample, of a 10 percent increase in Chinese exports, is an increase of 5 percent in EU exports to non-EAC countries. This relative effect is similar for both sub-periods. Third, the EAC and EU15–EAC relative effects are smaller in comparison and in the latter case statistically insignificant. The coefficient to the $\ln ChEXP_{sjt} \times EAC_j$ term suggests that a 10 percent increase in Chinese exports led to a 3.2 percent in EAC imports on average over the whole period.

The estimates in Panel B are similar to those in Panel A but with three main differences: the EU15 relative effect is smaller in both sub-periods; the EAC relative effect is insignificant; and the EU15–EAC relative effect is large and statistically significant in the early period. In that period, according to the estimates in Panel B, an increase in Chinese exports increased EU exports to the EAC, but much less so than to other countries (total effect is $0.194 + 0.052 - 0.207 = 0.039$, disregarding the insignificant positive EAC relative effect). In summary, these regressions provide little evidence that Chinese exports displaced exports in general from other countries in the period considered. On the contrary, our results suggest that rather than displacing exports from other countries, exports from China were associated with additional exports from other countries on average, even after controlling for country–year specific factors that increase trade, such as economic growth. There is some evidence, though, that exports from the EU15 to the EAC were less positively associated with exports from China to EAC in the early period, although the negative relative EU15–EAC effect was not large enough to make the total effect negative.

2. Results based on the model without country–year fixed effects

In this section we assess the sensitivity of the results to changes in the model specification and the estimation technique. The model that we consider is similar to the one used by Eichengreen et al. (2007), Greenaway et al. (2008), and several other authors to quantify the displacement effect of Chinese exports (Section II.2). It is characterized by a lack of country–year fixed effects. This, however, means that we can include the traditional monadic gravity variables such as GDP and population size. We do not include any of the constant dyadic gravity variables such as distance or colonial history. Instead we include a set of country-pair fixed effects.

Table 5 reports the estimates from Equation (9) based on the sectoral trade data. Panel A contains results based on OLS whereas Panel B contain results based on IV estimation. What we see is that OLS leads to a level effect that is positive whereas IV estimation leads to a negative level effect. Note, however, that the IV level effect is only significant at the 10 percent level when based on the full sample. Apart from this, the results are similar to those in Table 4.

Table 5. Estimation results: Equation (9)

	Dependent variable: $\ln EXP_{sijt}$		
	1995–2019	1995–2001	2002–2019
Panel A: OLS estimation			
$\ln ChEXP_{sjt}$	0.249*** (0.007)	0.169*** (0.008)	0.304*** (0.008)
$\ln ChEXP_{sjt} \times EU15_i$	0.210*** (0.010)	0.224*** (0.011)	0.253*** (0.015)
$\ln ChEXP_{sjt} \times EAC_j$	0.029** (0.015)	–0.008 (0.026)	0.054*** (0.018)
$\ln ChEXP_{sjt} \times EU15_i \times EAC_j$	0.006 (0.045)	0.037 (0.043)	0.042 (0.068)
Observations	1,303,439	323,430	980,009
R^2	0.655	0.707	0.656
Panel B: IV estimation			
$\ln ChEXP_{ijt}$	–0.388* (0.223)	–0.224 (0.324)	–0.338 (0.391)
$\ln ChEXP_{ijt} \times EU15_i$	0.361*** (0.054)	0.369*** (0.120)	0.391*** (0.085)
$\ln ChEXP_{ijt} \times EAC_j$	0.185*** (0.056)	0.171 (0.150)	0.206** (0.094)
$\ln ChEXP_{ijt} \times EU15_i \times EAC_j$	–0.120* (0.063)	–0.105 (0.125)	–0.067 (0.094)
Observations	1,303,439	323,430	980,009
R^2	0.634	0.697	0.639

Notes: ***, **, and * represent significance at the 1, 5, and 10 percent levels, respectively. Standard errors clustered by country-pair in parentheses. Control variables includes $\ln GDP_{it}$, $\ln GDP_{jt}$, $\ln POP_{it}$, $\ln POP_{jt}$, and $\ln RER_{ijt}$. Exporter fixed effects, importer fixed effects, year fixed effects, industry fixed effects and country-pair fixed effects have also been controlled in OLS and IV estimation. IV, instrumental variable; OLS, ordinary least squares.

Table 6 reports regression results based on Equation (10) and the aggregated trade data. Interestingly, in the OLS case the EU15 and EAC relative effects now become negative in the latter period although the total effect remains positive. In the IV case in Panel B, none of the coefficients are significant on their own.

Table 6. Estimation results: Equation (10)

	Dependent variable: lnEXP_{ijt}		
	1995–2019	1995–2001	2002–2019
Panel A: OLS estimation			
ln$ChEXP_{ijt}$	0.202***	0.191***	0.211***
	(0.006)	(0.010)	(0.007)
ln$ChEXP_{ijt} \times EU15_i$	–0.094***	–0.002	–0.130***
	(0.012)	(0.028)	(0.018)
ln$ChEXP_{ijt} \times EAC_j$	–0.048***	0.066	–0.063***
	(0.017)	(0.044)	(0.023)
ln$ChEXP_{ijt} \times EU15_i \times EAC_j$	0.026	–0.061	0.040
	(0.072)	(0.081)	(0.069)
Observations	359,481	90,331	269,150
R^2	0.860	0.925	0.868
Panel B: IV estimation			
ln$ChEXP_{ijt}$	–1.717	–1.075	–0.444
	(3.463)	(1.956)	(1.330)
ln$ChEXP_{ijt} \times EU15_i$	0.197	0.904	–0.007
	(0.526)	(1.400)	(0.250)
ln$ChEXP_{ijt} \times EAC_j$	0.582	1.234	0.229
	(1.137)	(1.807)	(0.594)
ln$ChEXP_{ijt} \times EU15_i \times EAC_j$	–0.660	–0.953	–0.294
	(1.244)	(1.382)	(0.682)
Observations	359,481	90,331	269,150
R^2	0.699	0.873	0.852

Notes: *** represents significance at the 1 percent level. Standard errors clustered by country-pair in parentheses. Control variables includes lnGDP_{it}, lnGDP_{jt}, lnPOP_{it}, lnPOP_{jt}, and lnRER_{ijt}. Exporter fixed effects, importer fixed effects, year fixed effects and country-pair fixed effects have also been controlled in OLS and IV estimation. IV, instrumental variable; OLS, ordinary least squares.

Results similar to those in panel B of Table 4, led Eichengreen et al. (2007), Greenaway et al. (2008), and other authors, to conclude that there was a displacement effect of Chinese exports. However, as pointed out by Kong and Kneller (2016), this conclusion is based on a mis-specified model. As discussed in Section II.5, the instrument variable economic distance to China does not vary across the sector dimension so the first-stage regression would suffer from perfect multicollinearity if we included a set of importer–year fixed effects. This clearly shows that the IV approach without country–year fixed effects controls for fewer omitted variables than does OLS with country–year fixed effects (or generalized within estimation). The former approach is therefore inferior to the latter and the negative (and generally insignificant) displacement effects reported in this section should not be taken at face value.

3. Results based on the disaggregated model

Tables 7 and 8 report results based on Equations (11) and (12). In both cases we estimate a separate regression for each of the six broad sectors. The difference between the two models is that the former is based on disaggregated (HS6 level) trade data whereas the latter is based on aggregated trade data so as to keep the observations where there is export from *i* to *j* but not from China to *j*.

In Table 7, the level effects are all positive and highly significant, albeit smaller in magnitude than those in Table 4. They are also remarkably stable across time and sectors. Compared with Table 8, there is also not a big difference between the results based on the two models except that the effects based on Equation (12) are generally larger.

One notable difference between the results in Table 4 and those in Tables 7 and 8 is that many of the relative effects are negative in regressions based on disaggregated trade data. For manufactures, for example, representing most of the trade flows, the EAC and EU15–EAC relative effects are both negative and highly significant in Table 7. The total effect is still positive although this is due primarily to the large positive level effect. For the "Other" sector, some of the relative effects are very large, but the underlying trade flows are very small, so this will not be discussed further here.

Table 7. Sectoral estimation results: Equation (11)

	Dependent variable: $\ln EXP_{gijt}$		
	1995–2019	1995–2001	2002–2019
Chemicals			
$\ln ChEXP_{gjt}$	0.137*** (0.003)	0.136*** (0.004)	0.136*** (0.003)
$\ln ChEXP_{gjt} \times EU15_i$	0.007 (0.004)	–0.056*** (0.006)	0.018*** (0.004)
$\ln ChEXP_{gjt} \times EAC_j$	0.006 (0.010)	0.054** (0.018)	0.001 (0.011)
$\ln ChEXP_{gjt} \times EU15_i \times EAC_j$	–0.055*** (0.013)	0.035 (0.027)	–0.060*** (0.014)
Observations	13,549,168	1,916,891	11,632,277
R^2	0.362	0.381	0.360
Food			
$\ln ChEXP_{gjt}$	0.128*** (0.002)	0.144*** (0.004)	0.125*** (0.002)
$\ln ChEXP_{gjt} \times EU15_i$	–0.035*** (0.003)	–0.059*** (0.005)	–0.030*** (0.003)
$\ln ChEXP_{gjt} \times EAC_j$	–0.019 (0.013)	0.026 (0.031)	–0.022 (0.014)
$\ln ChEXP_{gjt} \times EU15_i \times EAC_j$	0.014 (0.018)	0.019 (0.044)	0.013 (0.019)
Observations	7,478,015	1,034,681	6,443,334
R^2	0.337	0.362	0.336
Machinery			
$\ln ChEXP_{gjt}$	0.185*** (0.003)	0.153*** (0.004)	0.192*** (0.003)

(Continued on the next page)

(Table 7 continued)

	Dependent variable: $\ln EXP_{gijt}$		
	1995–2019	1995–2001	2002–2019
$\ln ChEXP_{gjt} \times EU15_i$	0.012**	–0.038***	0.021***
	(0.005)	(0.006)	(0.005)
$\ln ChEXP_{gjt} \times EAC_j$	–0.047***	–0.043***	–0.049***
	(0.012)	(0.012)	(0.013)
$\ln ChEXP_{gjt} \times EU15_i \times EAC_j$	–0.022	–0.023	–0.022
	(0.014)	(0.014)	(0.014)
Observations	35,987,163	5,432,832	30,554,331
R^2	0.472	0.484	0.471
Manufactures			
$\ln ChEXP_{gjt}$	0.178***	0.152***	0.184***
	(0.003)	(0.003)	(0.003)
$\ln ChEXP_{gjt} \times EU15_i$	0.034***	–0.030***	0.048***
	(0.005)	(0.005)	(0.005)
$\ln ChEXP_{gjt} \times EAC_j$	–0.036**	–0.031**	–0.038**
	(0.013)	(0.012)	(0.014)
$\ln ChEXP_{gjt} \times EU15_i \times EAC_j$	–0.095***	–0.036**	–0.102***
	(0.015)	(0.013)	(0.016)
Observations	84,461,372	13,630,672	70,830,700
R^2	0.411	0.419	0.407
Other			
$\ln ChEXP_{gjt}$	0.201***	0.095***	0.213***
	(0.013)	(0.028)	(0.014)
$\ln ChEXP_{gjt} \times EU15_i$	–0.083***	–0.034	–0.088***
	(0.021)	(0.037)	(0.023)
$\ln ChEXP_{gjt} \times EAC_j$	–2.749***		–2.761***
	(0.526)		(0.523)
$\ln ChEXP_{gjt} \times EU15_i \times EAC_j$	0.388		0.397
	(0.678)		(0.673)
Observations	54,410	6,709	47,701
R^2	0.653	0.708	0.659
Resources			
$\ln ChEXP_{gjt}$	0.136***	0.146***	0.134***
	(0.003)	(0.004)	(0.003)
$\ln ChEXP_{gjt} \times EU15_i$	–0.005	–0.055***	0.004
	(0.004)	(0.006)	(0.004)
$\ln ChEXP_{gjt} \times EAC_j$	0.064***	0.015	0.066***
	(0.018)	(0.037)	(0.019)
$\ln ChEXP_{gjt} \times EU15_i \times EAC_j$	0.057*	0.250***	0.046
	(0.024)	(0.060)	(0.025)
Observations	3,505,352	535,640	2,969,712
R^2	0.324	0.367	0.320

Notes: ***, **, and * represent significance at the 1, 5, and 10 percent levels, respectively. Standard errors clustered by country-pair in parentheses. Exporter–year fixed effects, importer–year fixed effects and country-pair fixed effects have also been controlled in the regression. Empty spaces signify that there are insufficient data to estimate the parameters.

These results thus support those reported in Table 4 based on the benchmark model. That is, the evidence clearly suggests that Chinese exports have not displaced exports from other countries in general. As to whether EU exports have increased less than exports from other countries, the evidence is a little more mixed depending on the sector and model considered. The same can be said for exports to the EAC in general and EU exports to the EAC in particular. However, the total estimated effect is always positive except for the resources sector based on Equation (12) and the full sample.

Table 8. Sectoral estimation results: Equation (12)

	Dependent variable: $\ln EXP_{ijt}$		
	1995–2019	1995–2001	2002–2019
Chemicals			
$\ln ChEXP_{ijt}$	0.254*** (0.004)	0.178*** (0.007)	0.254*** (0.005)
$\ln ChEXP_{ijt} \times EU15_i$	–0.031*** (0.009)	–0.050*** (0.013)	–0.028* (0.012)
$\ln ChEXP_{ijt} \times EAC_j$	0.077*** (0.022)	–0.008 (0.032)	0.097*** (0.025)
$\ln ChEXP_{ijt} \times EU15_i \times EAC_j$	–0.069* (0.031)	–0.058 (0.051)	–0.069 (0.039)
Observations	332,987	65,802	272,004
R^2	0.873	0.938	0.881
Food			
$\ln ChEXP_{ijt}$	0.171*** (0.003)	0.119*** (0.005)	0.165*** (0.003)
$\ln ChEXP_{ijt} \times EU15_i$	–0.072*** (0.006)	–0.057*** (0.009)	–0.074*** (0.007)
$\ln ChEXP_{ijt} \times EAC_j$	0.005 (0.016)	0.002 (0.032)	0.010 (0.019)
$\ln ChEXP_{ijt} \times EU15_i \times EAC_j$	0.006 (0.029)	0.022 (0.046)	0.008 (0.034)
Observations	340,632	66,922	278,458
R^2	0.878	0.940	0.888
Machinery			
$\ln ChEXP_{ijt}$	0.308*** (0.003)	0.228*** (0.006)	0.305*** (0.003)
$\ln ChEXP_{ijt} \times EU15_i$	–0.008 (0.008)	–0.067*** (0.014)	–0.015 (0.011)
$\ln ChEXP_{ijt} \times EAC_j$	0.022 (0.015)	0.023 (0.027)	0.027 (0.017)
$\ln ChEXP_{ijt} \times EU15_i \times EAC_j$	0.024 (0.025)	–0.069 (0.052)	0.052 (0.027)
Observations	458,445	93,367	370,030
R^2	0.875	0.931	0.882

(Continued on the next page)

(Table 8 continued)

	Dependent variable: $\ln EXP_{ijt}$		
	1995–2019	1995–2001	2002–2019
Manufactures			
$\ln ChEXP_{ijt}$	0.331***	0.253***	0.330***
	(0.003)	(0.005)	(0.003)
$\ln ChEXP_{ijt} \times EU15_i$	–0.045***	–0.094***	–0.047***
	(0.007)	(0.012)	(0.009)
$\ln ChEXP_{ijt} \times EAC_j$	0.042**	–0.004	0.054**
	(0.015)	(0.028)	(0.018)
$\ln ChEXP_{ijt} \times EU15_i \times EAC_j$	–0.008	–0.032	–0.010
	(0.019)	(0.042)	(0.030)
Observations	521,694	112,821	413,859
R^2	0.895	0.944	0.902
Other			
$\ln ChEXP_{ijt}$	0.313***	0.213***	0.334***
	(0.016)	(0.039)	(0.018)
$\ln ChEXP_{ijt} \times EU15_i$	–0.043*	–0.092	–0.010***
	(0.021)	(0.056)	(0.024)
$\ln ChEXP_{ijt} \times EAC_j$	–251.5***		7.082***
	(58.79)		(0.498)
$\ln ChEXP_{ijt} \times EU15_i \times EAC_j$	1.914***		0.394
	(0.151)		(0.453)
Observations	30,211	4,377	27,345
R^2	0.854	0.919	0.868
Resources			
$\ln ChEXP_{ijt}$	0.190***	0.144***	0.188***
	(0.003)	(0.006)	(0.004)
$\ln ChEXP_{ijt} \times EU15_i$	–0.060***	–0.095***	–0.053***
	(0.008)	(0.012)	(0.009)
$\ln ChEXP_{ijt} \times EAC_j$	–0.069***	–0.075	–0.067**
	(0.020)	(0.048)	(0.022)
$\ln ChEXP_{ijt} \times EU15_i \times EAC_j$	–0.092**	–0.076	–0.036
	(0.031)	(0.087)	(0.037)
Observations	306,881	59,115	252,397
R^2	0.834	0.921	0.844

Notes: ***, **, and * represent significance at the 1, 5, and 10 percent levels, respectively. Standard errors clustered by country-pair in parentheses. Exporter–year fixed effects, importer–year fixed effects and country-pair fixed effects have also been controlled in the regression. Empty spaces signify that there are insufficient data to estimate the parameters.

IV. Conclusion

In this paper we re-examined the question of whether Chinese exports have displaced exports from other countries in general and exports from the EU countries to the EAC countries in particular. The choice of the EAC countries as the destination market in focus was partly due to the observation that the African market has received little attention in the empirical literature on the displacement effect of Chinese exports. What sets this paper apart from other similar studies is that we estimated the total displacement effect (which includes the relative displacement effect) of Chinese exports in a model that includes (time varying) country–year fixed effects. Other studies that have estimated the total displacement effect only controlled for (time-invariant) country fixed effects. The few studies that do include country–year fixed effects, on the other hand, are only able to estimate the displacement effect relative to that of other countries, but not the level or total effect. It is important to include country–year fixed effects in a gravity model of trade because their omission leads to the error of not controlling for a country's general level of trade frictions, i.e., multilateral resistance (Anderson and van Wincoop, 2003; Baldwin and Taglioni, 2006; Kong and Kneller, 2016).

Guided by the above considerations, we used several different specifications of the gravity model to quantify the extent of Chinese export displacement. Our benchmark model is estimated with trade data aggregated into six broad sectors and includes country-pair and sector–year fixed effects, in addition to country–year fixed effects. An alternative version of the benchmark model usesd aggregated trade data where we only summed the Chinese export flows across sectors where there was trade between the exporter–importer pair (*i*, *j*). In this way we were able to keep the observations where there is an export from *i* to *j* but not from China to *j*, which would otherwise drop out of the regression. This aggregate specification also represents a robustness check on the assumption that multilateral resistance does not vary across sectors in the benchmark model estimated with sectoral data. Regression results from both model specifications suggest that, rather than displacing exports, the large increase in Chinese exports have led to additional exports from other countries in general and even more exports from the EU. On average, across the entire 1995–2019 period, a 1 percent increase in Chinese exports has led to around a 0.2 percent additional exports from non-EU countries and an additional 0.07–0.3 percent exports from the EU countries, depending on the model. The relative effect for the EAC countries varied from 0.03–0.1 percent.

To gauge the importance of including country–year fixed effects, we estimated a second set of models with (time-invariant) country fixed effects instead. Like other studies, we obtained a large negative (albeit insignificant) level effect when the regression was based on IV estimation. However, this specification did not properly control for multilateral resistance so the model suffered from omitted variable bias. Even if the results were significant, we should therefore not give much credence to them.

In a final set of regressions based on disaggregated trade data we analyzed differences across sectors in the displacement effect. In the underlying disaggregated model we assumed that multilateral resistance varied across sectors, countries and years but not across the individual six digit HS tariff lines included in each of the sectors. Results from these sectoral regressions are similar to the ones from the benchmark model, with a highly significant level effect of around 0.2 in most cases and relative effects that are smaller and whose sign and significance depend on the sector.

We conclude that there is strong evidence that the growth of Chinese exports has actually been associated with additional exports from other countries including those from the EU. Our results do not support the notion that the large increase in Chinese exports to the EAC countries has displaced EU exports to the EAC, although for some sectors the growth in EU exports to the EAC has been smaller than the one for other export destinations. The EAC imports from China as well as from the EU went up over the 1995–2019 period so it is not surprising that we did not find a displacement effect. Given that the gravity model explains the magnitude of trade flows between two markets rather than trade shares, the falling import share in the EAC by the EU is perfectly in line with a rising Chinese import share as well as a positive relationship between EU and Chinese exports in the estimated gravity model.

Some caveats regarding our methodological contributions remain. We have contributed to the literature by estimating the total displacement effect of Chinese exports with models that include (time varying) country–year fixed effects, but we are not at the same time able to account for zero-trade flows nor did we distinguish between the intensive and extensive margin of trade. These important issues we leave for future work.

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