Export competition between China and Latin America and the Caribbean in the United States Market

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Abstract

This paper investigates export competition between China and Latin America and the Caribbean (LAC) in the United States market between 2002 and 2022. Using a sample of 33 exporters and 10-digit Harmonized Tariff Schedule (HS) level trade data, we estimate a structural gravity model using an instrumental variable constructed from Chinese exports to eight other industrialized nations. We use a first-order Taylor-series expansion à la Baier and Bergstrand (2009a) to approximate the multilateral price terms pointed out by Anderson and Van Wincoop (2003). The results show that the impact of Chinese exports on United States imports from LAC is negative and statistically significant across several model specifications, levels of aggregation, and sectors. A percentage increase in imports from China decreased imports from LAC by ca. 0.75 percent. The displacement effect is ca. 0.32 for manufacturing products, 1.01 for resource-based products, 1.33 when estimated only for South America, 0.25 for the Caribbean, and not significant for Central America.

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1. Introduction

China's products have been accessing the global market for over two decades. Its success has been initially aided by unilateral tariff reductions of its own and low tariffs abroad, then by its membership in the World Trade Organization, and, more recently, by its increasing competitiveness in a range of manufacturing exports. In the United States (US) market, China's manufacturing exports exploded between 1972 and 2001 (Schott, 2006). During this period, the product penetration and market shares of Chinese exports grew faster than those of those of Latin America and the Caribbean (LAC). In the two subsequent decades, China's overall market share in the United States first outgrew that of LAC, increasing from 11% in 2002 to 22% in 2018, before dropping to 17% in 2022. While LAC's overall market share remained relatively stable, increasing from 17% in 2022 to 18% in 2022, two thirds of Latin American countries lost market share during this period. Mexico, who made up more than 75 percent of the US$553 billion LAC exports to the United States in 2022, is a notable exception, increasing its market share from 11% in 2002 to 14% in 2022.

Nevertheless, the United States continues to be the leading trade partner for the region. While China strives for greater technological sophistication in its export-driven growth model, its natural resources and comparative advantage in labor-intensive production continues to be a potential threat to LAC countries with similar comparative advantages. This overlap in the comparative advantages may result in direct competition between Chinese and LAC exporters in the United States market.

The potential displacement of LAC exports is relevant from both a development and a geoeconomic perspective. First, failure to differentiate exports from Chinese competitors may jeopardize LAC's progress towards increasing the volume and the diversity of its exports. Second, the escalating trade conflict between the United States and China, the disruptive impact of the COVID-19 pandemic, and Russia's invasion of Ukraine have prompted developed countries to question the existing configuration of global value chains. The increased focus on geoeconomic factors has spurred efforts to mitigate risks through near- and friendshoring strategies, which necessitate a sound understanding of import-share dynamics.

To determine the level of competition between China and LAC, we examine the impact of Chinese exports on LAC exports to the United States between 2002 and 2022 using an augmented gravity trade model. The analysis relies on a sample of 32 exporters and trade data disaggregated to the 10-digit Harmonized Tariff Schedule (HS) level. Gravity trade models have been used extensively to estimate the degree of export competition between China and Asian, and between African and European countries in third markets; however, few studies have leveraged the most disaggregated product data or focused on the entire LAC. In addition, much of the literature falls short in adequately addressing important estimation issues: accurately accounting for the endogeneity of Chinese exports while controlling for the significance of structural zero trade flows and multilateral resistance terms (MRTs). We address these issues by estimating a non-linear formulation of an augmented structural gravity model with a product level instrumental variable.

To estimate the degree of export displacement, we augment a gravity trade model by Chinese exports. To address endogeneity issues arising from unobservable variables like consumer sentiments, we construct a new instrumental variable from Chinese export shares in third industrialized nations. The MRTs pointed out by Anderson and Van Wincoop (2003), which represent the impact of relative trade costs with all trading partners on bilateral trade flows, are commonly addressed by including importer and export fixed effects. However, because product-level fixed effects would absorb the Chinese export variable of interest, we instead follow Baier and Bergstrand (2009a) in using a first-order Taylor series expansion to construct linear approximation of the resistance terms. At the level of disaggregation of our data, numerous tariff lines present a trade flow value of zero, which are omitted in linear estimation procedures. Because zero trade flows may have structural causes, like the extensive margin of export competition, we instead estimate a non-linear Poisson regression model using generalized method of moments (GMM).

We find the impact of Chinese exports on United States imports from LAC to be negative and statistically significant across various model specifications and levels of aggregation in the trade data. The estimations show an important displacement of LAC exports by China's exports in the period under analysis: a percentage increase in imports from

China decreased imports from LAC by ca. 0.75 percent for the entire sample. For manufacturing products, the displacement effect is ca. 0.32, for resource-based products ca. 1.01. The effect is not significant when estimating the model only on Central American exports (both including and excluding Mexico), but large and significant for South America, where, a percentage increase in Chinese exports to the United States decreases South American exports by 1.33 percent. For the Caribbean, the effect is 0.25.

The remainder of this paper is structured as follows: Section 2 reviews previous studies of export competition between China and LAC; Section 3 explores the similarity of the LAC and Chinese export structures; Section 4 introduces the theoretical background of gravity estimation; Section 5 reviews the gravity model literature on Chinese export competition; Section 6 lays down our estimation approach; while Section 7 summarizes the data used in the analysis; Section 8 presents the empirical results; Section 9 concludes the analysis.

2. Export Competition between China and Latin America, and the Caribbean

The expanding presence of China in the world market since the start of the century has prompted the study of its potential consequences for LAC countries. These studies have traditionally relied on comparing factor endowments and the evolution of export compositions and market shares to investigate export competition in the markets. For the United States market, however, there is no consensus about the extent of export competition between China and LAC.

Several studies have concluded that, except for Mexico, China presents little threat to LAC countries in the United States market. The argument favoring complementarity rather than competition with China builds on the notion of endowment-driven comparative advantages. Devlin, Estevadeordal, and Rodríguez-Clare (2006) stress that the land abundance in LAC favors resource-based production, while Asia's labor abundance provides a comparative advantage for manufacturing. Analyzing the shares and product penetration of the United States market by China and LAC, the authors find that while the Chinese export share grew more quickly than that of LAC between the 1970s and the 2000s, it was concentrated in manufacturing products, particularly in manufactured materials and miscellaneous manufactures. Lately, China has also increased its export of more sophisticated technologies like consumer electronics. China's focus on manufacturing and the increasing sophistication of its export basket is therefore seen as a sign of complementarity rather than competition with mostly resource-based exports from LAC (Devlin, Estevadeordal, and Rodríguez, 2006). Blázquez-Lidoy, Rodríguez, and Santiso (2006) study the export structure of the regions and come to the same conclusion: as net exporters of commodities, most LAC countries face no competition from manufacturing exporting China. However, they acknowledge the risk that the expansion into various export sectors by China poses for Mexico and partially Brazil. Similarly, Olarreaga, Lederman, and Perry (2007) find that any evidence of substitutability is limited to a few countries Mexico and, to a minor extent, Central America, within a few manufacturing sectors.

For other authors, however, the degree of overlap suggested by the indices of export similarity and the relative labor abundance of China do not warrant an optimistic view of export competition between LAC and China. For example, Schott (2006) compares relative endowments, market shares, product penetration, and indices for product and price similarity of Chinese and LAC exports to the United States and finds that although China's urban centers boast an enormous labor force, explaining its comparative advantage in the export of manufacturing products, resource-rich regions and growing penetration of high-tech product segments make China a competitor in many industries. This diversity and its enormous size make it a threat to a broader range of countries.

Similarly, Jenkins, Peters, and Moreira (2008) stress Mexican, Central American, and Caribbean exports compete with China in third markets. Because indices traditionally relied upon in the analysis of export competition substantially underestimate the degree of competition smaller countries face when comparing them with a large and diversified economy like China, previous studies may have understated the threat from China.

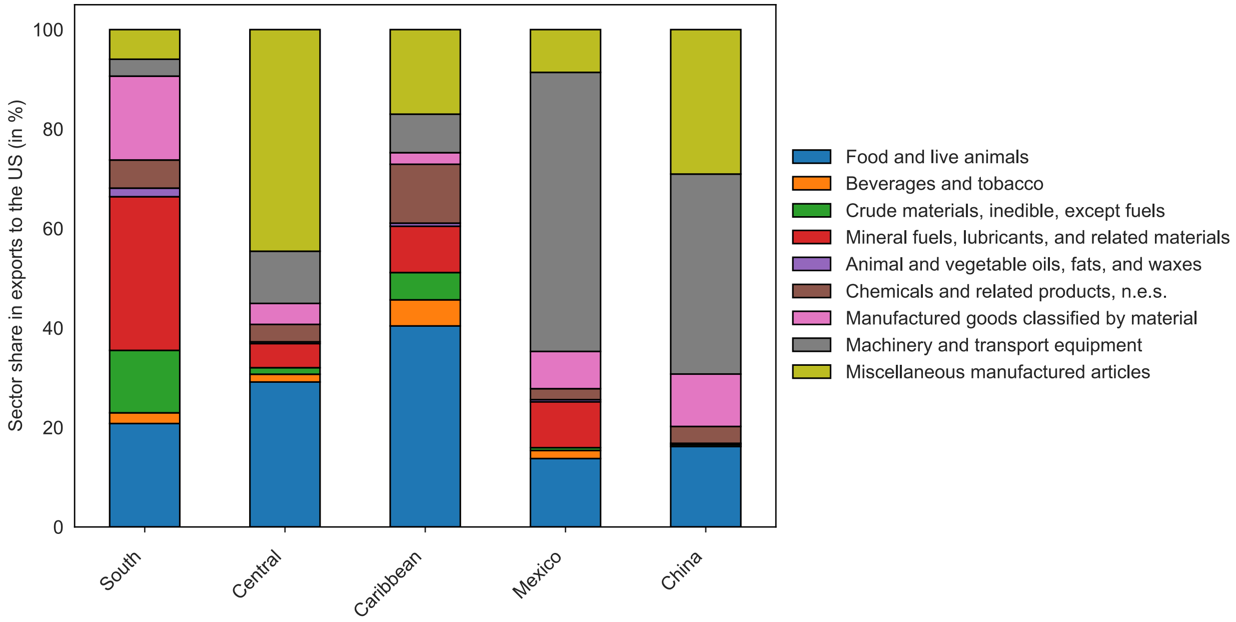
Other studies have focused on sectoral threats. For example, using export similarity indices and estimates of the elasticity of substitution of exports to the US, López-Córdova, Micco, and Molina (2008) argue that the manufacturing industries of Mexico, Central America, and the Caribbean, as well as low-wage industries of other countries, are at risk. Lall and Weiss (2007) classify the development and correlation of United States import market shares between 1990 and 2002 held by China and LAC into levels of competitive threat. According to their analysis, although China affects a larger share of exports from East Asian economies, it threatens 40 percent of exports from a range of LAC countries to the US.

Moreover, some studies have found that China's competitive threat applies to a broad range of products: the increasing diversification of China, stressed by Schott (2006), has affected more capital-intensive industries such as iron, steel, and aluminum (Lall & Weiss, 2007). Other studies highlight that China competes with Mexico in textiles, garments, electronics, and auto parts (Dussel Peters, 2016; Jenkins, Peters, and Moreira, 2008). Likewise, while affected negatively primarily in low-tech industries, Brazil also faces threats in the high-tech sector (Jenkins, 2014). China's comparative and competitive advantages thus go well beyond cheap labor and have expanded since the early 2000s (Dussel Peters, 2016).

3. Similarity of Latin American and Chinese Export Structures

The export structures of LAC and China reveal their relative similarity at a sectoral level. Manufactured articles dominate exports from Mexico, Central America, and China, and make up much of Caribbean exports. For its part, South America exported mostly resource-based products from 2002 to 2022 (see details in Figure 1).

Figure 1. *Export Structures of Latin America and the Caribbean and China by SITC Sections (2002-2022)*



Source: Author's calculations based on United States Census Bureau data (United States Census Bureau, 2024).

However, decompositions of export flows based on sectors offer only a partial picture. Two countries with similar sector competition could specialize in different products within a sector and complement each other's exports. To determine how similar the export structures of China and LAC are on a product-level basis, we calculate the Export Similarity Index (ESI) for all countries, sectors, and years in the sample based on HS 10-digit United States import data. The index, first developed by Finger and Klein (1979), represents the similarity of two countries' exports in a common third market based on the relative product share among their respective total exports. For any two United States trading partners, the ESI is defined as

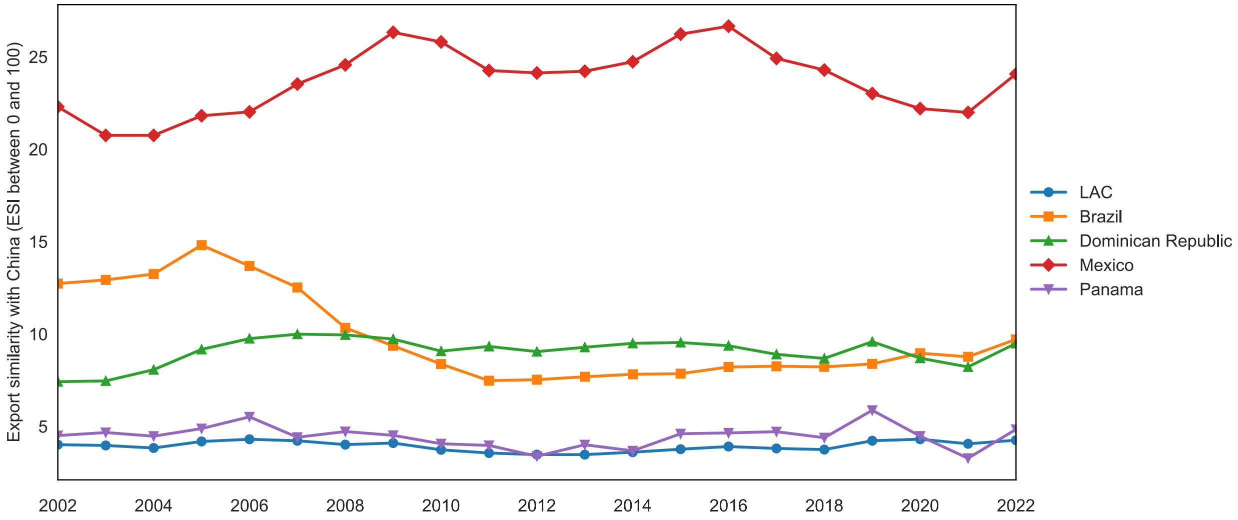
$$ESI_{ijt} = \sum_{p} \min(s_{ipt}, s_{jpt})$$

Where s_{ipt} and s_{jpt} are the shares of product p among total exports from countries i and j respectively in a given year t. Here, the ESI is normalized to a scale between zero, indicating no similarity, and one hundred, indicating complete similarity. Product shares for exporter i are given by

$$s_{ipt} = \frac{\text{Country } i \text{ exports of product } p \text{ to the third market}}{\text{Total country } i \text{ exports to the third market}} * 100$$

Product shares for exporter j are calculated analogously. *Figure* 2 shows the evolution of export similarity between LAC and China in the United States market over the sample period from 2002 to 2022. The average ESI of the region remained relatively stable, around an average value of 3.3. Mexico, Brazil, and the Dominican Republic had the highest average ESI over the sample period. The Mexican ESI degree is higher than other major United States trade partners (such as Canada, the United Kingdom, Japan, and Germany). At a world-level comparison, the average ESI of LAC in 2022 was 3.3, below the global average of 5.5.

Figure 2. *Evolution of Export Similarity between Latin America and China in the United States Market*



Source: Author's calculations based on United States Census Bureau data (United States Census Bureau, 2024).

While the calculation of the ESI reveals the potential for competition, it does not deliver conclusive insights. Firstly, the ESI and the simple comparison of sectoral compositions in Figure 1 are relative measures: because of the large absolute magnitude of Chinese exports to the United States market, exports that make up only a tiny share of Chinese exports can still present a significant threat to LAC countries without this threat being captured by the index. Secondly, the index does not reveal causal relationships between export shares: exports of products within the same HS 10-digit code may complement each other if they inhabit different quality segments (i.e., expensive, high-quality garments may not compete in the same market as low-price, low-quality garments). Thirdly, the ESI is limited by its static nature. We use a structural gravity model that considers time and sector-specific trends to address these shortcomings.

4. Trade Gravity Models

Gravity equations of trade have been the workhorse for analyzing determinants of bilateral trade for more than half a century. Tinbergen (1962) was the first to use a gravity equation to describe bilateral trade flows. Analogous to the Newtonian theory of gravitation, in which gravitational force is proportionate to the mass and distance of two bodies, he described how bilateral trade flow is proportional to any two countries' GDP and bilateral distance. In most general terms, gravity models of trade, like their Newtonian counterparts, can be expressed in the multiplicative form:

$$X_{ij} = GS_iM_j\phi_{ij}.$$

Here, X_{ij} stands for the value of exports from country i to country j, G is a gravitational constant that describes characteristics like the level of trade liberalization worldwide, S_i denotes exporter-specific factors and represents total supply by the exporter, M_j comprises importer-specific factors and represents the demand of the importer, and ϕ_{ij} represents the market access for exporter i to the market of country j. Expressing market access as the inverse of trade costs and denoting supply and demand as the GDP of the respective countries, the equation could be log-linearized and estimated as the following linear regression:

$$lnX_{ij} = \beta_0 + \beta_1 lnY_i + \beta_2 lnY_j + \beta_3 lnD_{ij} + \varepsilon_{ij},$$

Here, the gravitational constant is captured by the constant β_0, S_i and M_j are estimated by the GDP Y of countries i and j, respectively. Since trade costs are not directly observable, they have been traditionally proxied by geographical distance D_{ij}, as well as additional geographical and cultural binary variables like border and colonial history dummies. The error term is denoted by ε_{ij}. Although purely agnostic, this relationship was long viewed as so statistically robust that Krugman (1997) referred to it as an example of *"social physics"* and Frankel and Rose (2002) as one of the most robust findings in econometrics. Gravity models have since been adopted widely to describe global trade flows and quantify the determinants of trade, including among others: WTO membership (Dutt et al., 2013; Grant & Boys, 2012; Rose, 2004; Subramanian & Wei, 2007), free trade agreements (Baier et al., 2014; Baier & Bergstrand, 2007, 2009b; Dai et al., 2014; Egger et al., 2011), currency unions (Barro & Tenreyro, 2007a; Rose & Honohan, 2001; Rose & Van Wincoop, 2001), colonial links (Berthou & Ehrhart, 2017; Head et al., 2010), and non-tariff barriers (Disdier et al., 2015; Disdier & Head, 2008).

In tandem with the growth of empirical applications, theoretical work has succeeded in deriving gravity equations from various mainstream modeling frameworks. These include the Armington-CES model of Anderson (1979), which was popularized by Anderson and Van Wincoop (2003), as well as Heckscher-Ohlin (Bergstrand, 1985; Deardorff, 1998) and Ricardian models (Eaton & Kortum, 2002). Later contributions combined gravity models with those of firm heterogeneity (Chaney, 2008; Helpman et al., 2008), as well as sectoral Armington models (Anderson & Yotov, 2016), sectoral Ricardian models (Arkolakis et al., 2012; Caliendo & Parro, 2015; Chor, 2010), and dynamic models (Anderson et al., 2015; Eaton et al., 2016; Olivero & Yotov, 2012).

Although the abovementioned work has pointed out clear shortcomings of the agnostic approach, empirical applications have been guided by these theoretical advances to varying degrees. Some theoretical works have had a considerable impact on the estimation methods, first and foremost, Anderson and van Wincoop's formulation of a structural gravity equation with MRTs (2003). Following the work of Anderson (1979), the model context is given by the Armington assumption, according to which goods are differentiated by country of origin. Consumers then form constant-elasticity-of-substitution (CES) preferences over the pool of goods from all countries. Thus, all countries import at least some of every good from every country. Because national income equates to total demand for domestically produced goods in equilibrium, larger countries trade more. Trade costs, the second factor in the general gravity framework, function analogously to iceberg costs and grow proportionately with geographical distance. Besides country size and direct trade costs, however, Anderson and van Wincoop (2003) show that two additional factors impact trade volume: the multilateral resistance terms (MRTs), which describe the overall resistance that exports from country i and imports of country j are faced with respectively.

To derive the MRTs, consider, as in Anderson and van Wincoop (2003), a world in with *N* countries. Each country *i* produces a single good and consumers in each country *j* have CES preferences and maximize utility subject to a budget constraint. The resulting first-order conditions, assuming market clearing, can be solved for the nominal bilateral trade flow from country *i* to country *j* (X_{ij}):

$$X_{ij} = \left(\frac{Y_i Y_j}{Y^W}\right)\left(\frac{t_{ij}}{P_i P_j}\right)^{1-\sigma}$$

(1)

Here, Y_i and Y_j denote total expenditure of countries *i* and *j* =, and Y^W is total expenditure across all countries. Trade costs or bilateral resistance t_{ij} are assumed to be directionally equivalent, so that $t_{ij} = t_{ji}$. P_i and P_j are the CES consumer price indices and represent the MRTs for countries *i* and *j*, and are given by:

$$\mathrm{P}_i = \left[\sum_{j=1}^{N} \left(\theta_j / t_{ij}^{\sigma-1}\right) P_j^{\sigma-1}\right]^{1/(1-\sigma)}$$

$$P_j = \left[\sum_{i=1}^{N} \left(\theta_i / t_{ij}^{\sigma-1}\right) P_i^{\sigma-1}\right]^{1/(1-\sigma)}$$

(2)

Where σ is the elasticity of substitution between goods and θ_i and θ_j denote the share of each country's expenditure in total or world expenditure Y_i/Y^W and Y_j/Y^W. These resistance terms are multilateral in the sense that they are functions not just of trade costs between *i* and *j*, but between all *N* countries. Intuitively, if two countries face trade costs that are relatively lower than costs of trading with alternative trading partners, bilateral trade flow will be higher and vice versa. While country and total world expenditure can be proxied by GDP, bilateral trade resistance is proxied by variables like distance and geographical dummy variables, as in the abovementioned literature. Defining bilateral trade resistance t_{ij} as a function of a continuous distance variable and a vector of binary variables indicating whether countries share a border, or whether either of the trading partners is an island or landlocked (B_{ij}), we can write:

$$t_{ij} = D_{ij}^{\delta} e^{\alpha B_{ij}}$$

(3)

Taking logs, inserting (3) into the trade flow equation (1) and rewriting, we can derive the following linear gravity equation:

$$\ln(X_{ij}) = \beta_0 + \beta_1 \ln\left(Y_i Y_j\right) + \delta(1-\sigma)\ln(D_{ij}) + \alpha(1-\sigma)B_{ij} + \ln(\mathrm{P}_i)^{1-\sigma} + \ln\left(\mathrm{P}_j\right)^{1-\sigma} + \varepsilon_{ij}$$

(4)

Where the constant $\beta_0 = Y^W$ represents world GDP and ε_{ij} is the error term. Because the MRTs are by construction related to other explanatory variables, their omission in the estimation strategy is what Baldwin and Taglioni (2007) call the gold medal mistake in the gravity literature. Estimation strategies that account for MRTs are discussed below.

5. Augmented Gravity and Export Competition

Since China acceded to the WTO in 2001, the gravity framework has been employed increasingly to analyze the effects of Chinese exports on exports of other countries. Starting with Eichengreen et al. (2004), these studies rely on augmented versions of the gravity regression, including Chinese exports among its covariates. Work so far includes analyses of the effects of exports competition between China and Asia (Athukorala, 2009; Eichengreen, Rhee, and Tong, 2004, 2007; Greenaway, Mahabir, and Milner, 2010; Kong and Kneller, 2016), African (Edwards & Jenkins, 2014; Geda & Meskel, 2007; Giovannetti & Sanfilippo, 2009), and European countries (Giovannetti, Sanfilippo and Velucchi, 2012; Stanojevic, Bin and Jian, 2020; Elleby, Yu, and Yu, 2018), as well as sector-specific applications that include individual Latin American countries (Lederman et al., 2007; Módolo & Hiratuka, 2017; Pham et al., 2017; Zeidan, 2015).

Lederman, Olarreaga, and Perry (2007) examine the partial correlation between Chinese and Indian non-fuel exports and LAC trade with third markets between 2002 and 2004. Their estimates are small or insignificant except for Central America and Mexico, which show evidence of export complementarity. Notably, the model does not rely on instrumental variables to account for potential endogeneity. Other studies that decide against an instrumental variable approach have similarly found positive coefficients for Chinese exports (e.g., Elleby et al., 2018).

Zeidan (2015) looks at export competition between China and the 13 largest exporters of textiles in the United States market for apparel between 2002 and 2010. Because Chinese exports are found to be exogenous, a panel estimation without instrumental variables is performed. The study finds evidence of displacement for more than half of the countries in his sample, including both developing and developed countries. For the two LAC countries in the sample, a 1 percent increase in Chinese textile exports is found to decrease Mexican exports by 0.82 percent and exports from the Dominican Republic by 0.31 percent.

Módolo and Hiratuka (2017) find similar displacement effects for the manufacturing sector from 2000 to 2009 using 2SLS with bilateral distance as an instrumental variable. Annual product data is aggregated to technological intensities following Lall (2000). Mexico and Central America are among the regions with the highest degree of export competition. A percentage increase in Chinese exports was associated with a drop in exports by 0.37 percent. For South America, the drop is 0.22 percent and thus is similar to the world average of 0.22 percent. For medium-tech industries, Central American and Mexican exports drop by 0.52 percent and South American exports by 0.55. Likewise, Central American and Mexican low-tech industries are strongly affected, dropping by 0.42 percent. South American high-tech industries drop by 0.37 percent. These findings underline the variety of sectors potentially at risk of displacement by China.

Pham et al. (2017) examine high-tech industries between 1992 and 2014 using 2SLS, employing, bilateral distance and Chinese GDP as instruments. Their sample includes data on chemistry, computer–office machinery, electrical and non-electrical machinery, electronics–communications, pharmacy, and scientific instruments exports of 18 major high-tech exporters and 56 major high-tech importers. The authors find that Chinese high-tech exports increase those of East Asian economies such as Japan and South Korea as well as of OECD exporters while displacing those of developing competitors such as India, Brazil, Mexico, and Malaysia. For Brazil and Mexico, a 1 percent increase in Chinese exports was found to cause export drops between 0.1 and 0.16 percent.

To summarize, the gravity literature on export competition with China finds evidence of displacement across various sectors and geographical regions. The results suggest that developing countries are at greater risk of displacement and that crowding out mainly occurs in different manufacturing sector segments. However, many studies fail to adequately control for MRTs, an issue that is further discussed below. Second, studies that account for MRTs by including country-fixed effects either report only marginal displacement effects (see, e.g., Kong and Kneller, 2016) or do not rely on an instrumental variable approach (see, e.g., Elleby, Yu, and Yu, 2018; Lederman, Olarreaga and Soloaga, 2007), giving rise to a potentially strong bias. Importantly, none of the studies cover a broad range of sectors and countries in LAC or use more disaggregated product data to account for competition within specific product groups. The analysis presented here addresses these issues and closes the respective gap in the literature by estimating an augmented structural model for LAC using HS 10-digit level important data. The estimation approach is presented and discussed in the next section.

6. Estimation Approach

As mentioned in the introduction, several econometric issues must be addressed when estimating displacement effects with augmented gravity models. Unobserved macroeconomic factors (e.g., demand shocks that move imports from all trading partners in the same direction) could generate endogeneity issues, that is, the inability to disentangle the changes in LAC exports to the United States market that are the genuine result of changes in Chinese exports to the United States markets from those that are the result of other factors. The standard approach to address this issue is using instrumental variables that only correlate with Chinese exports but not with those of its competitors. The most common instruments are gravity covariates like bilateral distance and GDP, which have been popular since being suggested by Eichengreen et al. (2004) (Athukorala, 2009; Giovannetti and Sanfilippo, 2009; Greenaway, Mahabir, and Milner, 2010; Pham et al., 2017; Módolo and Hiratuka, 2017). Additionally, time-varying instruments include political risk (Eichengreen, Rhee, and Tong, 2004), a measure of time-varying economic distance calculated as weighted averages of distances to Chinese trade hubs (Eichengreen, Rhee, and Tong, 2007; Elleby, Yu, and Yu, 2018), a time-varying distance measure based on increasing reliance on air traffic (Kong & Kneller, 2016), or the number of Confucius Institutes in destination countries (Stanojevic et al., 2020).

This study employs as an instrumental variable the sum of Chinese exports to third industrialized nations normalized by respective total imports at the HS 6-digit level and Chinese GDP. This approach addresses a central issue with the instruments presented above: since traditional instruments model trade flows at the national level, they rely on variation in the importer dimension. Such approaches are not feasible in analyses with only a single importer and highly disaggregated data. If the instrument is not time-varying or includes time-fixed effects in the specification, the instrument takes identical values for all observations and is thus dropped due to collinearity. Therefore, following the approach of Autor, Dorn, and Hanson (2013), we rely instead on disaggregate trade data in other countries to model trade flows with China. The strategy rests on the premise that China's export growth is primarily driven by supply-side factors like the rising competitiveness of its manufacturing firms, industrial policy, and reductions in trade barriers. Autor et al. (2013) identify eight industrialized markets whose imports from China strongly correlate with United States imports of Chinese commodities.[1] The eight countries' geographical dispersion and global economic integration lower the chance of exclusive correlations with local United States or LAC shocks. Here, the same countries are used to compute the instrumental variable for Chinese imports (IV_{pt}^{CN}) for each year and product as follows:

$$IV_{pt}^{CN} = \sum_{i=1}^{N} \frac{Imports_{ipt}^{CN}}{Imports_{ipt}^{W}} \tag{5}$$

where $Imports_{ipt}^{CN}$ are the industrialized third nations' import values for product p by third country i from China in year t, and $Imports_{ipt}$ are total imports for the respective year and commodity. We calculate the instrument at the HS 2, 4, and 6-digit level.

Another challenge in estimating gravity models with highly disaggregated trade data is dealing with the prevalence of zero or missing trade flow data, i.e., records of goods that were not exported in a given year. This may not be an issue

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[1] The eight industrialized countries are Australia, Denmark, Finland, Germany, Japan, Spain, Switzerland, and New Zealand. Below, we additionally present robustness tests employing alternative country compositions and a moving average representation of the instrument.

of concern at the more aggregate level, where countries are likely to report a trade value different from zero. However, many countries report zero trade flows for specific products at the HS 10-digit level. The traditional estimation of a gravity model with Ordinary Least Squares (OLS) disregards all observations that take the value of zero; the gravity equation, which is stated in the multiplicative form, must be log-linearized to make it estimable with OLS. Zeros are thus dropped before estimation. While the resulting effect of parameter estimates is small for higher levels of aggregation, significant information may be lost when dealing with more disaggregated data like ours (Borchert et al., 2022).

This is especially problematic when measuring export competition, since zero trade flows can reflect the extensive margin of trade and thus of export competition.[2] Firms may choose to exit the United States market as a direct result of rising Chinese competition. Moreover, disregarding missing or zero flows risks introducing a sample selection bias: The dependent variable becomes contingent on a trading relationship existing for the product. To the extent that the probability of a trading relationship is correlated with other covariates like GDP or distance, the exclusion could therefore bias OLS estimates (Helpman et al., 2008).

The solution to this problem, which has become standard practice in the literature, was proposed by Silva and Tenreyro (2007b), who estimate the parameters of the gravity equation as a Poisson model using Poisson pseudo-maximum-likelihood (PPML). First and foremost, PPML provides unbiased estimates in the presence of heteroscedasticity which is commonly found in trade data (Barro & Tenreyro, 2007b). In addition, however, PPML assumes the sample distribution's first moment to take multiplicative form, and thus no longer requires taking the logarithm of the dependent variable. This allows zero or missing trade flows to remain part of the sample. The risk of overrepresentation of small countries, who naturally exhibit a higher share of zero trade flows, is mitigated by the country GDP acting as weight in the first order condition of the PPML estimator (Borchert et al., 2022; Hinz et al., 2020). By estimating our model on different exporter samples, we provide additional controls for small country biases.

We augment the gravity equation (4) from the last section with Chinese exports and rewrite it in exponential form. Because we will estimate the model using a panel of product level data, we add time (*t*) and product (*p*) subscripts that have so far been omitted. (Baldwin & Taglioni, 2007b) note that estimating on a panel data can introduce a bias in the parameter estimates, which can be addressed by introducing a vector of year dummies (γ_t). Because our panel features the United States as single importer, the logarithm of nominal importer GDP will be absorbed by the time dummies and has been dropped from the second term in the exponent. The resulting gravity equation can be written as

$$X_{ijpt} = e^{\left[\beta_0 + \beta_1 \ln(Y_{it}) + \beta_2 \ln\left(X_{jpt}^{CN}\right) + \delta(1-\sigma)\ln(D_{ij}) + \alpha(1-\sigma)B_{ij} + \ln\left(\mathrm{P}_{ipt}\right)^{1-\sigma} + \ln\left(\mathrm{P}_{jpt}\right)^{1-\sigma} + \gamma_t + \varepsilon_{ijpt}\right]} \tag{6}$$

Where X_{ijpt} is the trade flow of product p, from exporting country i, to importing country j, in year t. $\ln(X_{jpt}^{CN})$ is the logarithm of trade flow of product p from China, to importing country j, in the year t. Trade flows are measured as nominal United States dollar import values. $\ln(Y_{it})$ is the logarithm of nominal exporter GDP. Log distance $\ln(D_{ij})$ and geographical dummy variables B_{ij} remain unchanged. Log MRTs $\ln\left(\mathrm{P}_{ipt}\right)^{1-\sigma}$ and $\ln\left(\mathrm{P}_{jpt}\right)^{1-\sigma}$ are now also time and product specific.

Correctly accounting for the MRTs presents a further estimation issue. Approaches like the inclusion of simple remoteness indices, measuring the weighted distances between countries, or relying solely on geographical dummy variables lack theoretical consistency since they ignore economic determinants of multilateral resistance (Anderson & Van Wincoop, 2003; Bacchetta et al., 2012; Baier & Bergstrand, 2009a; Borchert et al., 2022; Head & Mayer, 2014). A structurally consistent and by far the most popular approach is the inclusion of exporter and importer fixed effects, first employed by Harrigan (1996) and adopted for panel data by Olivero and Yotov (2012). However, while fixed

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[2] Because we must take the logarithm of Chinese exports to the United States and the corresponding instrumental variable, we still loose several observations. Since we are interested in the effect of Chinese competition, however, conditioning the dataset on a trade flow with China existing is an acceptable limitation.

effects would absorb the MRTs in our model above, the appropriate country-product-time fixed effects would also absorb all other variables, including the variable of interest, Chinese exports. Additionally, the inclusion of high dimensional fixed effects can give rise to the incidental parameter problem (Lancaster, 2000). While Poisson models are a notable exception to this problem in a standard setting, they, too, become inconstant when accounting for an endogenous regressor using instrumental variables (Cameron & Trivedi, 2013).

Unsurprisingly given these issues, several studies do not properly account for MRTs when estimating augmented gravity models. Authors who circumvent this issue by interacting Chinese import values with other characteristics of export countries can only retrieve the relative impact of Chinese competition (Edwards & Jenkins, 2014; Kong & Kneller, 2016). To estimate the absolute impact, Elleby et al. (2018) choose to avoid instrumental variables altogether, trusting in fixed effects to account for all endogeneity.

We instead follow the approach originally proposed by Baier & Bergstrand (2006, 2009a) , who apply a first-order log-linear Taylor-series expansion to the system of price equations in (2), to derive a tractable gravity equation that can be estimated with standard techniques[3]. Centering their expansion around a state with symmetric trade frictions ($t_{ij} = t$) and equal GDP shares ($\theta_i = \theta_j = 1/N$), the price indices can be linearly approximated as:

$$\ln\left(P_{ipt}\right)^{1-\sigma} = (\sigma-1)\left[-\frac{1}{N}\left(\sum_{i=1}^{N} \ln t_{ijpt}\right) + \frac{1}{2}\frac{1}{\mathrm{N}^2}\left(\sum_{i=1}^{N}\sum_{j=1}^{N} \ln t_{ijpt}\right)\right]$$

$$\ln\left(P_{jpt}\right)^{1-\sigma} = (\sigma-1)\left[-\frac{1}{N}\left(\sum_{j=1}^{N} \ln t_{ijpt}\right) + \frac{1}{2}\frac{1}{\mathrm{N}^2}\left(\sum_{i=1}^{N}\sum_{j=1}^{N} \ln t_{ijpt}\right)\right] \tag{7}$$

Combining the linear approximation with the trade cost function (3) and the gravity equation (6), we can derive a version of the model in which each trade cost variable is defined to reflect its contribution to the bilateral and the multilateral trade resistance. Hence, the contributions of bilateral distance D_{ij} and the binary variables in the trade cost vector B_{ij} to respective trade flows each consist of three parts: A direct impact on bilateral trade, $(1-\sigma)\ln t_{ijpt}$, the effect operating via the multilateral resistance of country i and j, $(\sigma-1)\frac{1}{N}\sum_{i=1}^{N} \ln t_{ijpt}$ and $(\sigma-1)\frac{1}{N}\sum_{j=1}^{N} \ln t_{ijpt}$, and through an effect on world trade resistance, $\frac{1}{\mathrm{N}^2}\left(\sum_{i=1}^{N}\sum_{j=1}^{N} \ln t_{ijpt}\right)$. Collecting terms, we can rewrite our gravity equation as

$$X_{ijpt} = e^{\left[\beta_0 + \beta_1 \ln(Y_{it}) + \beta_2 \ln\left(X_{jpt}^{CN}\right) + \beta_3 D_{ij}^{MR} + \beta_4 C_{ij}^{MR} + \beta_5 I_{ij}^{MR} + \beta_6 L_{ij}^{MR} + \gamma_t + \varepsilon_{ijpt}\right]}$$

Where the trade costs variables with MR (multilateral resistance) superscript, log distance (D_{ij}^{MR}) and the dummies for contiguity (C_{ij}^{MR}), island (I_{ij}^{MR}), and landlockedness (L_{ij}^{MR}) comprise the respective three parts described above.[4]

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[3] For analytical details see (Baier & Bergstrand, 2006, 2009a).

[4] The four variables are defined as:
$D_{ij}^{MR} = \ln\left(D_{ij}\right) - \frac{1}{N}\sum_{i=1}^{N} \ln\left(D_{ij}\right) - \frac{1}{N}\sum_{j=1}^{N} \ln\left(D_{ij}\right) + \frac{1}{\mathrm{N}^2}\left(\sum_{i=1}^{N}\sum_{j=1}^{N} \ln D_{ij}\right)$,
$C_{ij}^{MR} = C_{ij} - \frac{1}{N}\sum_{i=1}^{N} C_{ij} - \frac{1}{N}\sum_{j=1}^{N} C_{ij} + \frac{1}{\mathrm{N}^2}\left(\sum_{i=1}^{N}\sum_{j=1}^{N} C_{ij}\right)$,
$I_{ij}^{MR} = I_{ij} - \frac{1}{N}\sum_{i=1}^{N} I_{ij} - \frac{1}{N}\sum_{j=1}^{N} I_{ij} + \frac{1}{\mathrm{N}^2}\left(\sum_{i=1}^{N}\sum_{j=1}^{N} I_{ij}\right)$,
$L_{ij}^{MR} = L_{ij} - \frac{1}{N}\sum_{i=1}^{N} L_{ij} - \frac{1}{N}\sum_{j=1}^{N} L_{ij} + \frac{1}{\mathrm{N}^2}\left(\sum_{i=1}^{N}\sum_{j=1}^{N} L_{ij}\right)$.

Because the relative trade costs of all countries, not just those in the LAC region affects multilateral resistance, we construct the multilateral resistance variables using bilateral geographical data for 188 countries.

The general model fit and the instrumental variables' robustness are determined with various specification tests. Full sample estimates of baseline PPML and OLS specifications are estimated to confirm the fit of the gravity model. The results of these baseline models are assessed to determine whether they lie within the standards suggested by the gravity model literature. The baseline model is then augmented using Chinese exports. We then estimate our augmented model specification for different regional and sectoral subsamples.

7. Data

The gravity model is estimated using United States import data at the product level retrieved from the United States International Trade Commission (USITC) trade and tariff data (United States Census Bureau, 2023). Including China, the sample comprises 33 exporters and the United States as single importer and spans the period from 2002 to 2022.[5] We exclude 2008 and 2020, two years with anomalous trade data due to the shocks of the great financial crisis and the COVID 19 pandemic. We estimate all models using 2, 4, 6, and 10-digit HS data. Import values for third industrialized markets used to construct the instrumental variable for Chinese import are retrieved from the UN Comtrade database at HS 2, 4, and 6-digit levels. Since most countries do not report data at the 10-digit level, we rely on the 6-digit level instrumental variable for estimations at both the 6 and the10-digit level. Nominal GDP data are taken from the International Monetary Fund's (2023) World Economic Outlook. Geographical variables are sourced from the CEPII Gravity Database (Conte et al., 2022). The distance measure is equal to the population-weighted distance between most populated cities.[6] Additional geographical data on island and landlocked countries are compiled by us.

8. Results

8.1 Baseline Gravity Model

We estimate a baseline gravity model that includes exporter GDP, distance, and dummy variables common borders or whether a trading partner is an island or landlocked nation. The model is estimated on samples of HS 2, 4, 6, and 10-digit level trade data, using OLS and PPML in two specifications. The first, baseline specification ignores MRTs, the second specification estimates the structural model à la Baier & Bergstrand (2009a), in which covariates have been transformed to comprise the effect of multilateral resistance (see Section 6). Standard errors are clustered by exporters' respective industries, as defined by HS sections.

Table 1 shows results at the 10-digit level. Here PPML estimates for the sample period are of the expected signs and magnitudes.[7] As expected, OLS and PPML produce different parameter estimates for respective specifications, with GDP and distance variables taking higher values in absolute terms using PPML. The small OLS estimates of the effect

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[5] The 33 countries are Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Chile, China, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, El Salvador, French Guiana, Grenada, Guatemala, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay, and Venezuela.

[6] Its calculation was originally proposed by Head and Mayer (2002) and can be stated as $d_{ij} = \left(\sum_{k\epsilon i}(pop_k/pop_i)\sum_{l\epsilon j}(pop_l/pop_j)d^{\theta}{}_{kl}\right)^{1/\theta}$, where pop_k and pop_l are the populations of agglomerations k and l in country i and j respectively. The parameter θ expresses the sensitivity of trade flows to bilateral distance d_{kl} bilateral and is equal to -1 in our case.

[7] The estimates sign and value are in line with the benchmark values recorded by Borchert et al. (2022).

of GDP and distance could be driven by the omission of zero-trade flows, a result of expressing trade value in logarithmic form. The discrepancies between parameter estimates of OLS and PPML at this high level of disaggregation clearly favour estimation using PPML. Differences between baseline and multilateral resistance specifications are expected and underline the importance of accounting for MRTs. Statistically insignificant results for some PPML covariates may be driven by the sample selection. However, because the magnitude of our estimates is correct and the chosen covariates well established, we assume our model to be well specified.

Table 1. *Baseline Gravity Model Estimates*

		OLS		PPML	
		(I)	(II)	(III)	(IV)
	Mathematical expression	BL	MR	BL	MR
Log GDP	$\ln(Y_{it})$	0.183**	0.195**	0.796***	0.782***
		(0.0892)	(0.0813)	(0.156)	(0.132)
Log distance (MR)	$D_{ij}^{MR} = \ln(D_{ij}) - \frac{1}{N}\sum_{i=1}^{N} \ln(D_{ij}) - \frac{1}{N}\sum_{j=1}^{N} \ln(D_{ij}) + \frac{1}{\mathrm{N}^2}\left(\sum_{i=1}^{N}\sum_{j=1}^{N} \ln D_{ij}\right)$	-0.214	-0.239	-1.307*	-1.241*
		(0.289)	(0.294)	(0.746)	(0.662)
Contiguity (MR)	$C_{ij}^{MR} = C_{ij} - \frac{1}{N}\sum_{i=1}^{N} C_{ij} - \frac{1}{N}\sum_{j=1}^{N} C_{ij} + \frac{1}{\mathrm{N}^2}\left(\sum_{i=1}^{N}\sum_{j=1}^{N} C_{ij}\right)$	1.470**	1.387**	0.728	0.692
		(0.609)	(0.596)	(1.189)	(1.117)
Island (MR)	$I_{ij}^{MR} = I_{ij} - \frac{1}{N}\sum_{i=1}^{N} I_{ij} - \frac{1}{N}\sum_{j=1}^{N} I_{ij} + \frac{1}{\mathrm{N}^2}\left(\sum_{i=1}^{N}\sum_{j=1}^{N} I_{ij}\right)$	-0.0430	-0.0844	-0.518	-1.407
		(0.182)	(0.692)	(0.525)	(1.915)
Landlocked (MR)	$L_{ij}^{MR} = L_{ij} - \frac{1}{N}\sum_{i=1}^{N} L_{ij} - \frac{1}{N}\sum_{j=1}^{N} L_{ij} + \frac{1}{\mathrm{N}^2}\left(\sum_{i=1}^{N}\sum_{j=1}^{N} L_{ij}\right)$	-0.419	-1.799	-1.012	-5.155*
		(0.463)	(2.009)	(0.672)	(2.749)
Constant		11.59***	9.435***	19.51***	7.086***
		(2.278)	(0.482)	(5.794)	(1.076)
Observations		707,629	707,629	18,392,608	18,392,608

Note: Ordinary least squares (OLS) and Poisson pseudo-maximum-likelihood (PPML) estimates for baseline (BL) gravity model and Baier and Bergstrand's (2009) linear approximation for multilateral resistance (MR), using US import data for Latin America and the Caribbean at the HS 10-digit level. BL covariates are log nominal GDP, log population-weighted distance, and dummies for contiguity and island (the first term in the respective mathematical expression). MR distance and dummy variables additionally comprise MR contributions (the second, third, and fourth term in the respective expression. Both specifications feature year fixed effects. Robust standard errors clustered by exporter HS sections in parentheses. *** p<0.01, ** p<0.05, * p<0.1

8.2 Specification Tests

Several tests confirm the robustness of the model specifications. The Durbin-Wu-Hausman confirms the endogeneity of Chinese imports, rejecting the null of exogeneity, as expected. To account for the endogeneity, an augmented gravity model using as instrumental variable the log of Chinese exports to third industrialized nations, normalized by respective total imports at the 2, 4, and 6-digit levels, is employed. The instrument is calculated as laid out in Section 6. The instrumental variable is strongly correlated with Chinese exports (see Table 2). Using a Kleibergen-Paap rk LM test, the null hypothesis of under-identification is rejected. The augmented regression test for endogeneity rejects the null of exogeneity. Lastly, a RESET test is performed. Here, too, the null hypothesis that coefficients are zero when including non-linear combinations of the fitted values to help explain the response variable cannot be rejected. We therefore judge the non-linear model with endogenous regressor to be well specified. Specification test results for the HS 10-digit level are reported in Table 2.

Table 2. *IV and Specification Tests*

		(I) Chinese exports - IV correlation	(II) Kleibergen-Paaprk LM	(III) Durbin-Wu-Hausmann	(IV) Reset test
Chinese IV	IV_{pt}^{CN}	0.891***			
		(0.0362)			
Constant		18.54***			
		(0.114)			
Observations		7,719,456			
Test statistic			367.13	149.07	0.39
p-value			0	0	0.5308

Notes: Robust standard errors clustered by HS sections in parentheses. *** p<0.01, ** p<0.05, * p<0.1

8.3 Instrumental Variable Results

Table 3 reports the results of the Poisson model with endogenous regressor using HS 2, 4, 6, and 10-digit level United States import data and the instrumental variable discussed above. The model is estimated using a two-step GMM procedure and includes standard gravity covariates as well as Chinese exports. Logarithmic distance and the geographical dummies are again transformed to comprise the effect of multilateral resistance. The effect of Chinese exports is estimated using the instrumental variable introduced in Section 6. The main gravity covariates, GDP and distance, are significant across aggregation levels and take the expected signs. While the magnitude of the effect of GDP is relatively stable across levels of trade data aggregation, the magnitude of the effect of the MRT adjusted distance term increases in absolute terms at higher levels of disaggregation. Additional geographical dummies are not significant after controlling for Chinese exports, precluding a meaningful interpretation.

Table 3. *Instrumental Variable Poisson Estimates*

		(I)	(II)	(III)	(IV)
HS level		2	4	6	10
Log Chinese exports	$\ln\left(X_{jpt}^{CN}\right)$	-0.193	-0.326***	-0.413***	-0.760***
		(0.125)	(0.0955)	(0.122)	(0.145)
Log GDP	$\ln(Y_{it})$	1.093***	1.093***	1.088***	1.166***
		(0.112)	(0.107)	(0.120)	(0.103)
Log distance, MR	D_{ij}^{MR}	-1.924***	-2.785***	-3.225***	-4.030***
		(0.494)	(0.507)	(0.543)	(0.511)
Contiguity, MR	C_{ij}^{MR}	-0.391	-0.680	-1.059	-1.060
		(0.916)	(0.910)	(0.945)	(1.016)
Island, MR	I_{ij}^{MR}	-1.186	-1.735	-2.108	-2.669*
		(1.732)	(1.650)	(1.844)	(1.578)
Landlocked, MR	L_{ij}^{MR}	-3.764	-2.855	-2.063	-0.191
		(2.466)	(2.065)	(2.239)	(2.579)
Constant		15.31***	14.04***	13.64***	17.55***
		(2.564)	(1.705)	(2.105)	(2.711)
Observations		57,504	681,440	2,579,904	7,705,952

Notes: Poisson results for gravity models at different levels of HS aggregation, augmented with log US import value from China using instrumental variables normalized third nations' shares of imports from China and Chinese GDP. Distance variable and geographical dummies are transformed to account for multilateral resistance following Baier and Bergstrand's (2009). Robust standard errors clustered by country pair HS sections. *** p<0.01, ** p<0.05, * p<0.1

While the effect of Chinese imports is not significant at the HS 2-digit level, it is significant and negative across all other aggregation levels. Its absolute magnitude increases with levels of disaggregation: A percentage increase in the value of imports from China for a given commodity resulted in a decrease of imports from LAC of the respective commodity by about 0.33 percent when measured at the 4-digit level, 0.41 percent at the 6-digit level, and 0.76 percent at the 10-digit level. The change in the absolute magnitude of coefficient estimates at higher disaggregation levels could reflect the richness of information in the more detailed data.

To confirm the robustness of our instrumental variable, sample selection, and model specification, we repeat the estimation at the 10-digit level, using: (1) an alternative sample of industrialized third nations to construct the variable[8], (2) the original instrumental variable calculated as a three-year moving average, (3) a subsamples that excludes the Caribbean, given the small size of most of its economies, (3) a subsample that excludes zero trade flows, and (5) a specification that includes dummy variables for free trade agreements (FTA) with the United States. All gravity covariates and the displacement effect by China are robust to the alternative specifications. Like in the OLS case (see Table 1), estimates of gravity covariates are smaller in absolute terms when excluding zero trade flows. The displacement caused by Chinese exports, however, is slightly larger. The displacement effect is also larger when estimating the model on the sample excluding the Caribbean. Here a percentage increase in Chinese exports is associated with a drop in Latin American exports of 0.85 percent. Finally, the inclusion of FTA dummy variables also results in a slightly larger displacement effect. The estimated effect for the FTA dummy is significant and positive, indicating an increase in exports to the US by ca. 1.5 percent.

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[8] The alternative sample for the construction of the instrument includes Belgium, Norway, Spain, France, Korea, Israel, United Kingdom, and the Netherlands.

Table 4. *Robustness Checks*

Robustness Check		(I) Alternative IV composition	(II) IV as moving average	(III) Excl. Mexico	(IV) Excl. Caribbean	(V) Excl. zero flows	(VI) Incl. FTA dummy
Log Chinese exports	$\ln(X_{jpt}^{CN})$	-0.754***	-0.726***	-0.771***	-0.849***	-0.836***	-0.853***
		(0.180)	(0.144)	(0.147)	(0.151)	(0.157)	(0.164)
Log GDP	$\ln(Y_{it})$	1.154***	1.164***	1.169***	1.285***	0.479***	1.127***
		(0.105)	(0.104)	(0.104)	(0.108)	(0.116)	(0.111)
Log distance, MR	D_{ij}^{MR}	-4.060***	-4.011***	-4.030***	-4.727***	-2.488***	-2.848***
		(0.518)	(0.512)	(0.508)	(0.514)	(0.575)	(0.744)
Contiguity, MR	C_{ij}^{MR}	-1.049	-1.104	-0.180	1.483	0.309	-0.392
		(1.038)	(1.003)	(2.590)	(2.554)	(1.026)	(1.194)
Island, MR	I_{ij}^{MR}	-2.790*	-2.621*	-2.716*	-	-2.038	-0.438
		(1.572)	(1.575)	(1.581)	-	(1.406)	(1.619)
Landlocked, MR	L_{ij}^{MR}	-0.378	-0.213	0.144**	0.0933*	-0.408	0.446
		(2.556)	(2.546)	(0.0597)	(0.0527)	(2.786)	(2.711)
Free trade agreement		-	-	-	-	-	1.488***
		-	-	-	-	-	(0.459)
Constant		17.49***	16.95***	17.79***	18.44***	25.31***	20.29***
		(3.294)	(2.642)	(2.757)	(2.757)	(2.939)	(3.358)
Observations		7,430,400	7,743,520	7,465,141	4,816,220	610,800	7,705,952

Notes: Poisson results for gravity models with different instrumental variable and sample specifications, augmented with log US import value from China using instrumental variables normalized third nations' shares of imports from China and Chinese GDP. Distance variable and geographical dummies are transformed to account for multilateral resistance following Baier and Bergstrand's (2009). Robust standard errors clustered by country pair HS sections. *** p<0.01, ** p<0.05, * p<0.1

8.4 Industry and Regional Results

Dividing the sample by SITC sectors and regions, we estimate the Poisson model separately for manufacturing and resource-based products, as well as for Central America (both including and excluding Mexico), South America, and the Caribbean. Subsample results are reported results in Table 4. Gravity covariates are of the expected sign and magnitude across SITC sectors. The distance parameter estimate is higher in absolute terms and significant only for manufacturing products, many of which are imported from Mexico and Central America and thus in proximity to the US. GDP parameter estimates are much smaller for manufacturing than for resource-based products. This discrepancy may be driven by the significant role of Mexico in LAC manufacturing products trade with the United States and the resulting positive effect on trade absorbed by the multilateral contiguity variable. Indeed, the dummy takes a larger value than in the baseline case presented above for manufacturing products but enters with a negative sign for resource-based products, which are predominantly imported from South American countries.

The estimated effect of Chinese imports is negative and significant for the manufacturing sector products as well as for resource-based products. For manufacturing goods, a percentage increase in import value from China decreased LAC exports by about 0.32 percent. For resource-based product, the negative effect from Chinese exports is significantly stronger, with a percentage increase associated with a fall in LAC exports by ca. 1.1 percent. This finding confirms the conclusions of aforementioned studies like Schott (2006), who see the competitive threat from China for LAC spanning multiple sectors.

Table 5. *Estimates by Sector and Region*

		(I)	(II)	(III)	(IV)	(V)	(VI)
Subsample		Manufacturing	Resource-based	Central incl. Mexico	Central excl. Mexico	South	Caribbean
Log Chinese exports	$\ln(X_{jpt}^{CN})$	-0.320**	-1.085***	0.108	0.143	-1.326***	-0.248*
		(0.125)	(0.101)	(0.0876)	(0.0936)	(0.138)	(0.149)
Log GDP	$\ln(Y_{it})$	1.085***	1.445***	1.047**	1.039**	1.298***	1.349***
		(0.122)	(0.0885)	(0.430)	(0.427)	(0.103)	(0.237)
Log distance, MR	D_{ij}^{MR}	-3.833***	-0.0734	-1.001	-1.023	-1.176	-0.599
		(0.533)	(0.489)	(3.879)	(3.881)	(0.888)	(1.192)
Contiguity, MR	C_{ij}^{MR}	0.801	-5.710***	-0.0115	-	1.231	-
		(2.653)	(1.973)	(2.798)	-	(2.662)	-
Island, MR	I_{ij}^{MR}	-1.961	-	-	-	-	-
		(1.746)	-	-	-	-	-
Landlocked, MR	L_{ij}^{MR}	0.139***	0.124	-0.0287	-0.0447	0.187***	-
		(0.0485)	(0.178)	(0.0369)	(0.0409)	(0.0722)	-
Constant		9.465***	26.11***	6.156	5.673	29.95***	11.23***
		(1.985)	(2.072)	(5.321)	(5.330)	(2.906)	(2.995)
Observations		6,830,368	839,232	1,926,488	1,685,677	2,889,732	2,889,732

Notes: Poisson results for gravity model with different sample specifications, augmented with log US import value from China using instrumental variables normalized third nations' shares of imports from China and Chinese GDP. Subsamples include SITC sections 5 to 8 for manufacturing products and 0 to 4 for resource-based products. Distance variable and geographical dummies are transformed to account for multilateral resistance following Baier and Bergstrand's (2009). Robust standard errors clustered by country pair HS sections.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

For regional subsamples, the estimated effect of GDP and distance are again of expected signs and magnitudes, with a somewhat lower estimate of the distance parameter for the Caribbean. Because since islands and landlocked countries are not present in all subsamples, geographical dummies had to be excluded because of collinearity in some cases. The effect of Chinese export competition is significant only for South America and the Caribbean, leading to a reduction in exports by 1.3 percent and 0.25 percent respectively. For Central America, both including and excluding Mexico, the estimated effect is insignificant. Together these findings suggest that while Chinese exports cause significant displacement of LAC exports across sectors, resource-based products and products exported by South America and the Caribbean are affected much more adversely than manufacturing exports.

9. Conclusion

We investigated the effect of United States imports from China on United States imports from LAC countries between 2002 and 2022. Using a sample of 33 exporters and product-level trade data disaggregated up to the 10-digit level, we estimated a structural gravity model that accounts for multilateral resistance, zero trade flows, heteroscedasticity, and the endogeneity of Chinese exports. Specifically, we employ a new instrumental variable from Chinese exports to eight other industrialized nations, adjust trade cost terms for multilateral resistance using the approach introduced by Baier & Bergstrand (2009a), and estimate a non-linear Poisson model using GMM.

Our results show that a percentage increase in imports from China decreased imports from LAC by ca. 0.75 percent for the entire sample. In addition, we estimate the effect on sectoral and regional subsamples. The effect of export competition is ca. 0.32 for manufacturing products and 1.01 for resource-based products. The effect is not significant when estimating the model only on Central American exports (both including and excluding Mexico), but large and significant for South America. Here, a percentage increase in Chinese exports to the United States decreases South American exports by 1.33 percent. For the Caribbean, the effect is 0.25. The findings highlight the significant degree of competition not only between China and industrializing nations with a relative focus on manufacturing exports, but also between China and developing, resource-focused exporters in the Americas.

Bibliography

Anderson, J. E. (1979). A theoretical foundation for the gravity equation. *The American Economic Review*, *69*(1), 106–116.

Anderson, J. E., Larch, M., & Yotov, Y. V. (2015). *Growth and trade with frictions: A structural estimation framework*. National Bureau of Economic Research.

Anderson, J. E., & Van Wincoop, E. (2003). Gravity with gravitas: A solution to the border puzzle. *American Economic Review*, *93*(1), Article 1.

Anderson, J. E., & Yotov, Y. V. (2016). Terms of trade and global efficiency effects of free trade agreements, 1990–2002. *Journal of International Economics*, *99*, 279–298.

Arkolakis, C., Costinot, A., & Rodríguez-Clare, A. (2012). New Trade Models, Same Old Gains? *The American Economic Review*, *102*(1), 94.

Athukorala, P. (2009). The rise of China and East Asian export performance: Is the crowding-out fear warranted? *World Economy*, *32*(2), Article 2.

Autor, David, Dorn, D., & Hanson, G. H. (2013). The China syndrome: Local labor market effects of import competition in the United States. *American Economic Review*, *103*(6), Article 6.

Bacchetta, M., Beverelli, C., Cadot, O., Fugazza, M., Grether, J.-M., Helble, M., Nicita, A., & Piermartini, R. (2012). *A practical guide to trade policy analysis*. Geneva, CH: World Trade Organization.

Baier, S. L., & Bergstrand, J. H. (2006). Bonus Vetus OLS: A Simple Approach for Addressing the Border Puzzle and other Gravity-Equation Issues. *Unpublished Manuscript*. https://www.nottingham.ac.uk/gep/documents/seminars/2006/jeff-bergstand.pdf

Baier, S. L., & Bergstrand, J. H. (2007). Do free trade agreements actually increase members' international trade? *Journal of International Economics*, *71*(1), 72–95.

Baier, S. L., & Bergstrand, J. H. (2009a). Bonus vetus OLS: A simple method for approximating international trade-cost effects using the gravity equation. *Journal of International Economics*, *77*(1), 77–85. https://doi.org/10.1016/j.jinteco.2008.10.004

Baier, S. L., & Bergstrand, J. H. (2009b). Estimating the effects of free trade agreements on international trade flows using matching econometrics. *Journal of International Economics*, *77*(1), 63–76.

Baier, S. L., Bergstrand, J. H., & Mariutto, R. (2014). Economic determinants of free trade agreements revisited: Distinguishing sources of interdependence. *Review of International Economics*, *22*(1), 31–58.

Baldwin, R., & Taglioni, D. (2007a). Trade effects of the euro: A comparison of estimators. *Journal of Economic Integration*, 780–818.

Baldwin, R., & Taglioni, D. (2007b). Trade effects of the euro: A comparison of estimators. *Journal of Economic Integration*, 780–818.

Barro, R., & Tenreyro, S. (2007a). Economic effects of currency unions. *Economic Inquiry*, *45*(1), 1–23.

Barro, R., & Tenreyro, S. (2007b). Economic effects of currency unions. *Economic Inquiry*, *45*(1), Article 1.

Bergstrand, J. H. (1985). The gravity equation in international trade: Some microeconomic foundations and empirical evidence. *The Review of Economics and Statistics*, 474–481.

Berthou, A., & Ehrhart, H. (2017). Trade networks and colonial trade spillovers. *Review of International Economics*, *25*(4), 891–923.

Blázquez-Lidoy, J., Rodríguez, J., & Santiso, J. (2006). Angel or Devil? China's Trade Impact on Latin American Emerging Markets. In *CEPAL Review* (Vol. 90). https://doi.org/10.1787/9789264028388-5-en

Borchert, I., Larch, M., Shikher, S., & Yotov, Y. V. (2022). Disaggregated gravity: Benchmark estimates and stylized facts from a new database. *Review of International Economics*, *30*(1), 113–136. https://doi.org/10.1111/roie.12555

Caliendo, L., & Parro, F. (2015). Estimates of the Trade and Welfare Effects of NAFTA. *The Review of Economic Studies*, *82*(1), 1–44.

Cameron, A. C., & Trivedi, P. K. (2013). *Regression analysis of count data* (Vol. 53). Cambridge university press.

Chaney, T. (2008). Distorted gravity: The intensive and extensive margins of international trade. *American Economic Review*, *98*(4), 1707–1721.

Chor, D. (2010). Unpacking sources of comparative advantage: A quantitative approach. *Journal of International Economics*, *82*(2), 152–167.

Conte, M., Cotterlaz, P., & Mayer, T. (2022). The CEPII gravity database. *CEPII: Paris, France*. http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele_item.asp?id=8

Dai, M., Yotov, Y. V., & Zylkin, T. (2014). On the trade-diversion effects of free trade agreements. *Economics Letters*, *122*(2), 321–325.

Deardorff, A. V. (1998). Determinants of bilateral trade: Does gravity work in a neoclassical world? In *The regionalization of the world economy* (pp. 7–32). University of Chicago Press.

Devlin, R., Estevadeordal, A., & Rodríguez, A. (2006). *The Emergence of China: Opportunities and Challenges for Latin America and the Caribbean*. IDB.

Disdier, A.-C., Fontagné, L., & Cadot, O. (2015). North-South standards harmonization and international trade. *The World Bank Economic Review*, *29*(2), 327–352.

Disdier, A.-C., & Head, K. (2008). The puzzling persistence of the distance effect on bilateral trade. *The Review of Economics and Statistics*, *90*(1), 37–48.

Dussel Peters, E. (2016). *La nueva relación comercial entre América Latina y el Caribe-China:?` integración o desintegración regional?* UDUAL.

Dutt, P., Mihov, I., & Van Zandt, T. (2013). The effect of WTO on the extensive and the intensive margins of trade. *Journal of International Economics*, *91*(2), 204–219.

Eaton, J., & Kortum, S. (2002). Technology, geography, and trade. *Econometrica*, *70*(5), 1741–1779.

Eaton, J., Kortum, S., Neiman, B., & Romalis, J. (2016). Trade and the global recession. *American Economic Review*, *106*(11), 3401–3438.

Edwards, L., & Jenkins, R. (2014). The margins of export competition: A new approach to evaluating the impact of China on South African exports to Sub-Saharan Africa. *Journal of Policy Modeling*, *36*, S132–S150.

Egger, P., Larch, M., Staub, K. E., & Winkelmann, R. (2011). The trade effects of endogenous preferential trade agreements. *American Economic Journal: Economic Policy*, *3*(3), 113–143.

Eichengreen, B., Rhee, Y., & Tong, H. (2004). *The impact of China on the exports of other Asian countries*. National Bureau of Economic Research.

Eichengreen, B., Rhee, Y., & Tong, H. (2007). China and the exports of other Asian countries. *Review of World Economics*, *143*(2), Article 2.

Elleby, C., Yu, W., & Yu, Q. (2018). *The Chinese Export Displacement Effect Revisited*. IFRO Working Paper.

Finger, J. M., & Kreinin, M. E. (1979). A measure ofexport similarity'and its possible uses. *The Economic Journal*, *89*(356), 905–912.

Frankel, J., & Rose, A. (2002). An estimate of the effect of common currencies on trade and income. *The Quarterly Journal of Economics*, *117*(2), 437–466.

Geda, A., & Meskel, A. G. (2007). China and India: What is in it for Africa? The Case of Manufactured Exports. *Department of Economics, Addis Ababa University (Mimeo, Also at Www. Alemayeh. Com)*.

Giovannetti, G., & Sanfilippo, M. (2009). Do Chinese Exports Crowd-out African Goods? An Econometric Analysis by Country and Sector. *European Journal of Development Research*, *21*(4), Article 4.

Giovannetti, G., Sanfilippo, M., & Velucchi, M. (2012). The "China effect" on EU exports to OECD markets: A focus on Italy. In *The Chinese Economy* (pp. 163–180). Springer.

Grant, J. H., & Boys, K. A. (2012). Agricultural trade and the GATT/WTO: Does membership make a difference? *American Journal of Agricultural Economics*, *94*(1), 1–24.

Greenaway, D., Mahabir, A., & Milner, C. (2010). Has China displaced other Asian countries' exports? In *China and the World Economy* (pp. 60–90). Springer.

Harrigan, J. (1996). Openness to Trade in Manufactures in the OECD. *Journal of International Economics*, *40*(1–2), Article 1–2.

Head, K., & Mayer, T. (2014). Gravity equations: Workhorse, toolkit, and cookbook. In *Handbook of international economics* (Vol. 4, pp. 131–195). Elsevier.

Head, K., Mayer, T., & Ries, J. (2010). The erosion of colonial trade linkages after independence. *Journal of International Economics*, *81*(1), 1–14.

Helpman, E., Melitz, M., & Rubinstein, Y. (2008). Estimating trade flows: Trading partners and trading volumes. *The Quarterly Journal of Economics*, *123*(2), Article 2.

Hinz, J., Larch, M., Wanner, J., & Yotov, Y. V. (2020). *PPML vs. OLS: Implications for Modeling Trade Costs in Structural Gravity Estimations*. Manuscript.

International Monetary Fund. (2023). *World Economic Outlook, October 2023* [dataset]. https://www.imf.org/en/Publications/WEO/Issues/2023/10/10/world-economic-outlook-october-2023

Jenkins, R. (2014). Chinese competition and Brazilian exports of manufactures. *Oxford Development Studies*, *42*(3), 395–418.

Jenkins, R., Peters, E. D., & Moreira, M. M. (2008). The Impact of China on Latin America and the Caribbean. *World Development*, *36*(2), 235–253. https://doi.org/10.1016/j.worlddev.2007.06.012

Kong, Y. F., & Kneller, R. (2016). Measuring the Impact of China's Export Growth on its Asian Neighbours. *The World Economy*, *39*(2), Article 2.

Krugman, P. R. (1997). *Development, geography, and economic theory* (Vol. 6). MIT press.

Lall, S. (2000). The Technological structure and performance of developing country manufactured exports, 1985-98. *Oxford Development Studies*, *28*(3), Article 3.

Lall, S., & Weiss, J. (2007). *China and Latin America: Trade Competition, 1990-2002* (pp. 85–107). OECD. https://doi.org/10.1787/9789264028388-6-en

Lancaster, T. (2000). The incidental parameter problem since 1948. *Journal of Econometrics*, *95*(2), 391–413. https://doi.org/10.1016/S0304-4076(99)00044-5

Lederman, D., Olarreaga, M., & Soloaga, I. (2007). *The Growth of China and India in World Trade: Opportunity or Threat for Latin America and the Caribbean?* World Bank. https://doi.org/10.1596/1813-9450-4320

López-Córdova, E., Micco, A., Molina, D., López-Calva, L. F., & Schott, P. K. (2008). How Sensitive Are Latin American Exports to Chinese Competition in the U.S. Market? [With Comments]. *Economía*, *8*(2), 117–153.

Módolo, D. B., & Hiratuka, C. (2017). The impact of Chinese competition on third markets: An analysis by region and technological category. *Development Policy Review*, *35*(6), Article 6.

Olarreaga, M., Lederman, D., & Perry, G. (2007). Latin America´s response to China and India: Overview of research findings and policy implications - Observatorio de Política. *Revista de Economía y Estadística*, *XLV*, 149–193.

Olivero, M. P., & Yotov, Y. V. (2012). Dynamic gravity: Endogenous country size and asset accumulation. *Canadian Journal of Economics/Revue Canadienne d'économique*, *45*(1), 64–92.

Pham, C. S., Nguyen, X., Sgro, P., & Tang, X. (2017). Has China Displaced its Competitors in High-tech Trade? *The World Economy*, *40*(8), Article 8.

Rose, A. K. (2004). Do WTO members have more liberal trade policy? *Journal of International Economics*, *63*(2), 209–235.

Rose, A. K., & Honohan, P. (2001). Currency unions and trade: The effect is large. *Economic Policy*, 449–461.

Rose, A. K., & Van Wincoop, E. (2001). National money as a barrier to international trade: The real case for currency union. *American Economic Review*, *91*(2), 386–390.

Schott, P. K. (2006). *The relative revealed competitiveness of China's exports to the United States vis a vis other countries in Asia, the Caribbean, Latin America and the OECD*. IDB-INTAL.

Stanojevic, S., Bin, Q., & Jian, C. (2020). Sino-EU15 Export Competition in Central and Eastern Europe: Is China Crowding Out Exports from the EU15? *Eastern European Economics*, *58*(3), Article 3.

Subramanian, A., & Wei, S.-J. (2007). The WTO promotes trade, strongly but unevenly. *Journal of International Economics*, *72*(1), 151–175.

Tinbergen, J. (1962). *Shaping the world economy; suggestions for an international economic policy*.

United States Census Bureau. (2023). *USA Trade Online Database*. https://usatrade.census.gov/

Zeidan, R. (2015). The displacement effects of Chinese exports on the US clothing market. *Journal of Chinese Economic and Business Studies*, *13*(3), Article 3.