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FOOTPRINT OF EXPORT-RELATED GHG EMISSIONS

FROM LATIN AMERICA AND THE CARIBBEAN

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ABSTRACT

To quantify the growth in GHG emissions related to international trade, we build an extensive database for export-related production and transportation GHG emissions covering 189 countries and 10 sectors from 1990 to 2014. We employ this database to quantify the contribution of production and international transportation to total export-related GHG emissions from Latin America and the Caribbean (LAC) and decompose growth in these to contributions of the increase in the region's trade flows, shifts in the composition of trade partners, changes in the traded product basket, and technological progress. Some of the facts about LAC's export-related GHG emissions are summarized below:

- LAC's total export-related GHG emissions was 708 Mt CO_2eq in 2014 and production emissions accounted for 76%. The share of transportation emissions increased from 12% in 1990 to 24% in 2014.
- In 2014, LAC's export-related production GHG emissions were 535 Mt CO_2eq and only accounted for 4% of the global total. Manufacturing sector exports accounted for 72%, agricultural exports for 10%, and mining exports for 18%.

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- LAC's export-related production GHG emissions increased by 375% between 1990 and 2014. The scale effect was the main driver of emissions increases during this period.
- In 2018, LAC's export-related transportation CO_2 was 234 Mt and accounted for 17% of world total. Sea transportation accounted for 53%, air transportation for 23%, road freight for 23%, and rail for just 1%. The agriculture sector accounted for 12%, mining for 32%, and manufacture for 55%.
- Between 1990 and 2018, LAC's export-related transportation CO_2 emissions increased by 188 Mt. LAC's exports to Asian developing countries accounted for 32% of this increase, and North America for 26%. The scale effect accounted for 60% of the increase.

JEL Codes: Q56; F18

Keywords: Export-related GHG emissions, emission intensity, international trade by transportation mode.

1. Introduction

To quantify the growth in GHG emissions related to international trade, we build an extensive database for export-related production and transportation GHG emissions covering 189 countries and 10 sectors from 1990 to 2014. We employ this database to quantify the contribution of production and international transportation to Latin American and the Caribbean (LAC)'s total export-related GHG emissions and decompose growth in these to contributions of the increase in the region's trade flows, shifts in the composition of trade partners, changes in the traded product basket, and technological progress. In section 2 we present the methodology and data used to build the database. In section 3 we analyze the trend and the decomposition of growth in LAC's export-related GHG emissions using the generated database.

2. Methodology and Data

Total export-related emissions can be divided into emissions from production and emissions from international transportation, which are determined by the scale of trade flows and emission intensity (the emissions per dollar associated with a certain good). The above relationship can be represented by

$$E_g^{od} = EY_g^{od} + ET_g^{od} = EIY_g^o \cdot exp_g^{od} + EIT_g^{od} \cdot exp_g^{od}, \text{(1)}$$

where E_g^{od} stands for emissions related to exports of good *g* from origin *o* to destination *d*, EY_g^{od} is export-related emissions from production, ET_g^{od} is from transportation, exp_g^{od} stands for the value of exports, and EIY_g^o and EIT_g^{od} are the emission intensities for production and transportation, respectively. Throughout this paper, superscripts denote region indices, while subscripts are for sector indices.

Emission Intensity from Production

To estimate emissions from production, we use an environmentally extended input-output analysis. We use an enumeration of the supply chain to allocate emissions from producing to consuming sectors, and hence estimate the emissions required to produce exported goods. In each region *r*, products are produced for intermediate (industry) consumption and final consumption. Intermediate consumption is represented by an input-output table (IOT), denoted as Z_{ij}^r, which represents the domestic and imported purchases of sector *i* by sector *j* in region *r*. Final consumption, denoted as y_i^r, represents the domestic and imported purchases of sector *i* by final consumers in *r,* covering households, government, and capital investments. Exports from region *r* to *s* are treated as a separate final consumption, e_i^{rs}. Adding together intermediate and final consumption gives the total output in each region,

$$\mathbf{x}^r = \mathbf{Z}^r + \mathbf{y}^r + \sum_s \mathbf{e}^{rs} - \sum_s \mathbf{e}^{sr}, (2)$$

where the letters in bold represent the matrix, and the terms on the right-hand side are, respectively: intermediate consumption of domestic and imported products, final consumption of domestic and imported products, exports, and imports. In many forms of analysis, imports are removed from $\mathbf{Z}^r$ and $\mathbf{y}^r$ to focus on domestic production only,

$$\mathbf{x}^r = \mathbf{Z}^{rr} + \mathbf{y}^{rr} + \sum_s \mathbf{e}^{rs}, (3)$$

where imports to region *r* are expressed as

$$\mathbf{m}^r = \sum_s \mathbf{e}^{sr} = \sum_s \mathbf{Z}^{sr} + \sum_s \mathbf{y}^{sr}. (4)$$

Assuming fixed production ratios, the matrix of coefficients of inputs per unit of output can be calculated as

$$A_{ij}^{rs} = {Z_{ij}^{rs}}\Big/{x_j^s}, (5)$$

where A_{ij}^{rs} represents the industry purchase of sector *i* in region *r* by sector *j* in region *s* to produce one unit of sector *j* in region *s*. P_i^r is the total carbon emissions in each economic sector *i* and region *r*, and thus the direct emission intensity in sector *i* and region *r* is obtained by

$$F_i^r = {P_i^r}\Big/{x_i^r}. (6)$$

The matrix of emission intensity for production—that is, the total direct and indirect *domestic* emissions to produce a unit of final consumption—is

$$\mathbf{EIY}^r = \mathbf{F}^{r\prime}(\mathbf{I} - \mathbf{A}^{rr})^{-1}, (7)$$

where the prime represents a matrix transpose and $\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1}$ represents the supply chain. We can calculate EIY_g^o, the production emission intensity of sector *g* in origin country *o*, using (7).

Given exports of good *g* from origin *o* to destination *d*, exp_g^{od}, the total direct and indirect domestic emissions in region *o* to produce goods *g* which are exported to region *d* are

$$EY_g^{od} = EIY_g^o \cdot exp_g^{od}. (8)$$

This method considers the total exports from a country (as per bilateral trade data), including all intermediate and final products, and therefore enumerates the complete domestic supply chain, but not the supply chain of other regions. This method is suitable for addressing the question of what *domestic emissions* country *o* generates to make the products it exports.

A variety of data sources are used to construct export-related emissions, EY_g^{od}. Export flows, exp_g^{od}, are taken from UN Comtrade[1]. We use the mirror of the import data to obtain export flows. The information required to build emission intensities for production, EIY_g^o (direct emissions F_i^r, total output x_j^s, intermediate input consumption Z_{ij}^{rs}), is taken from the Eora database[2]. We consider six greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6), which are governed by the Kyoto Protocol.

We calculate production emission intensities for 189 countries and 10 tradable sectors. Table A1 lists the 10 sectors. The years of data available in the Eora database limit our period of study to 1990 to 2014.

Emission Intensity from International Transportation

To estimate emissions from international transportation, we follow Cristea et al. (2013) and calculate the emissions intensity for this area as

$$EIT_g^{od} = wv_g^o * (CO2T^{Sea} * qshSea_g^{od} * distShip^{od} + CO2T^{Air} * qshAir_g^{od} * dist^{od} + CO2T^{Road} * qshRoad_g^{od} * dist^{od} + CO2T^{Rail} * qshRail_g^{od} * dist^{od}), \quad (9)$$

where wv is the weight-value ratio and $CO2T$ stands for CO_2 emissions per kg-km using different modes of transportation. The weight-value ratio (kg/dollar) is specific to each origin and sector. The values of CO_2 emissions per kg-km are obtained from Cristea et al. (2013). For sea transportation, $CO2T$ is differentiated by ship type (bulk, container, oil tanker, LNG, LPG, and chemical). qsh is the quantity share of trade for each mode of transportation. In the case of sea transportation, bilateral distance, $distShip$, is obtained from the Ship Analysis database[3]. Whenever information on a specific maritime route was unavailable in this database, the mirror distance was used as a proxy, under a symmetry assumption. In the case of air,

[1] UN Comtrade is a repository of official international trade statistics and relevant analytical tables. See https://comtrade.un.org/ for detailed information.
[2] The Eora global supply chain database consists of a multi-region input-output model that provides a time series of high-resolution IO tables with matching environmental and social satellite accounts for 190 countries. See https://www.worldmrio.com/ for detailed information.
[3] The Ship Analysis database is an internal database of shipping distance developed by IDB Integration and Trade sector.

rail, and road transportation, $dist$ is the distance between the most populous cities in the origin and destination countries, which is calculated using the great circle formula and obtained from CEPII[4].

The data needed for the above calculation is bilateral trade in dollars and kgs by transportation mode (sea, air, road, and rail). There are three sources for this data: US Census data on imports and exports (2003–2018), European Union (EU) data on extra-regional imports and exports (2001–2018) and intraregional ones (2010–2018), Latin America Integration Association (LAIA) data for 11 Latin American countries' imports (1990, 1995, 2000, 2005, 2006, 2010, 2015, 2018) and exports (2006, 2010, 2015, 2018). When there are multiple observations for one exporter-importer-sector-year, we follow appendix 2 in Cristea et al. (2013) to decide which to use. For the remaining years, we extrapolate trade in dollars and kgs using the value of the closest year. We then calculate the mode share and the weight-value ratio. The mode value and quantity shares are calculated at exporter-import-sector-year level, while the weight-value ratio is at exporter-sector-year level. There are some exporter-importers that are not covered by the data sources listed above, thus the mode share data cannot be obtained using these sources. Cristea et al. (2013) estimate these mode shares for 2004 using the matrix of modal trade flows mentioned above. We take the mode shares the authors estimated for 2004 and impute them to every year. Due to data availability issues, we only consider CO_2 emissions from international transportation. Both EIY_g^o and EIT_g^{od} are calculated in constant 2000 dollars using export and import price indices from the US Bureau of Labor Statistics and the Fundação de Comercio Exterior (FUNCEX), Brazil.

We calculate transportation emission intensities for 47 regions and 10 tradable sectors from 1990 to 2018. We aggregate the 189 countries that are included in the Eora database into 47 regions, which are listed in table A2. Some regions are single countries and others are aggregations of countries.

Decomposition

As illustrated in (1), total export-related emissions can be attributed to production and transportation. Both transportation and production emissions can in turn be thought of as a combination of scale, composition, and technological factors. For example, production emissions can be re-expressed as

$$EY_t^o = \sum_g exp_t^o \cdot \frac{exp_{g,t}^o}{exp_t^o} \cdot EIY_{g,t}^o \quad (10)$$

[4] CEPII GeoDist provides several geographical variables, in particular bilateral distances measured using city-level data to account for the geographic distribution of population inside each nation. Different measures of bilateral distance are available for 225 countries. See http://www.cepii.fr/cepii/en/bdd_modele/presentation.asp?id=6 for detailed information.

where the first term represents the production in origin *o* (*scale*), the second term represents the share of good *g* in total production in *o* (*composition of goods*), and the last term stands for the emissions per dollar of *g* produced in *o* (*technology*). Similarly, for the case of emissions associated with transportation, the total can be decomposed into factors representing scale, the composition of destinations, the composition of goods, and technology:

$$ET_t^o = \sum_{dg} exp_t^o \cdot \frac{exp_t^{od}}{exp_t^o} \cdot \frac{exp_{g,t}^{od}}{exp_t^{od}} \cdot EIT_{g,t}^{od} \quad (11)$$

The literature on carbon emissions has sought to explain changes in total emissions through time as a result of changes in these determining factors. To decompose the change in total emissions, generally either structural decomposition analysis (SDA) or index decomposition analysis (IDA) is used. Given the data available and the scope of our question, we will focus on IDA. The additive form of IDA applied to our case as presented in (10) states that changes in production emissions can be attributed to a term related to changes in scale, one related to changes in the goods composition of exports, and another related to emission intensity:

$$\Delta EY^o = EY_{t+1}^o - EY_t^o = \Delta exp + \Delta share_g + \Delta emission\ intensity\ in\ production \quad (12)$$

We characterize this decomposition as suggested in Ang (2005) and others, using the logarithmic mean Divisia index approach (LMDI), as follows:

$$\Delta exp = \sum_g \frac{EY_{g,t+1}^o - EY_{g,t}^o}{\ln\left(EY_{g,t+1}^o\right) - \ln\left(EY_{g,t+1}^o\right)} \cdot \ln\left(\frac{exp_{t+1}^o}{exp_t^o}\right)$$

$$\Delta share_g = \sum_g \frac{EY_{g,t+1}^o - EY_{g,t}^o}{\ln\left(EY_{g,t+1}^o\right) - \ln\left(EY_{g,t}^o\right)} \cdot \ln\left(\frac{share_{g,t+1}^o}{share_{g,t}^o}\right)$$

$$\Delta emission\ intensity\ in\ production = \sum_g \frac{EY_{g,t+1}^o - EY_{g,t}^o}{\ln\left(EY_{g,t+1}^o\right) - \ln\left(EY_{g,t}^o\right)} \cdot \ln\left(\frac{EIY_{g,t+1}^o}{EIY_{g,t}^o}\right)$$

Similarly, changes to (11) can be characterized through an additive IDA:

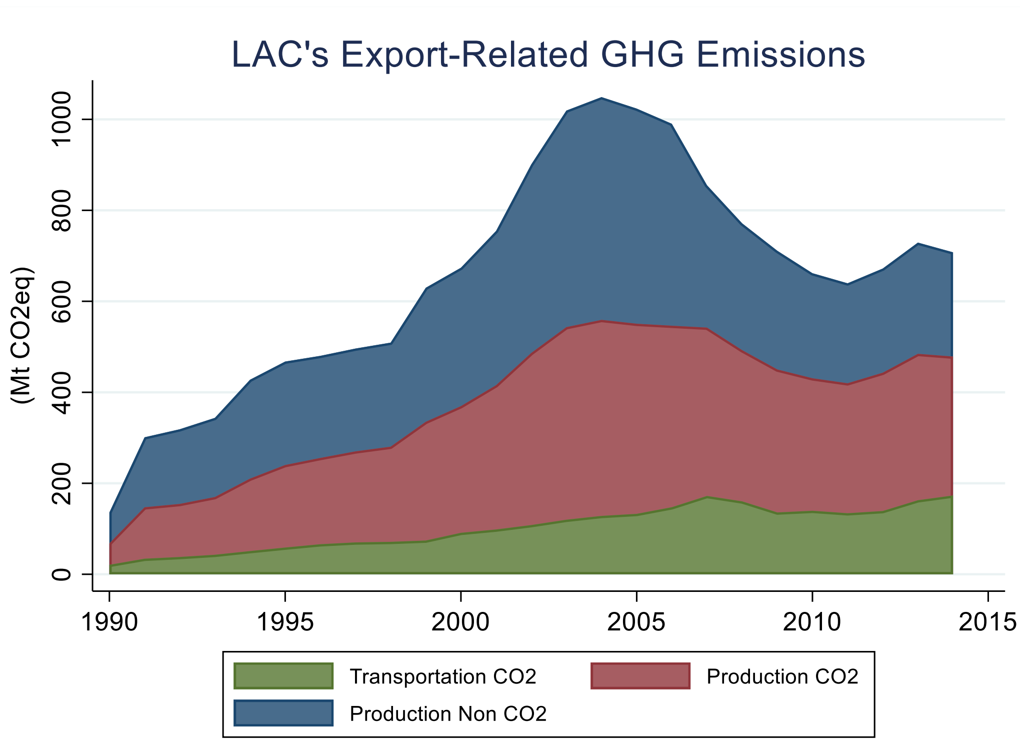
$$\Delta ET_t^o = ET_{t+1}^o - ET_t^o = \Delta exp + \Delta share^d + \Delta share_g^d + \Delta emission\ intensity\ in\ transport \quad (13)$$

The definitions of these change terms are similar to those discussed for production emissions, and the LMDI approach is also used.

3. Results

LAC's total export-related GHG emissions increased steadily from 136 Mt CO_2eq in 1990 to 1,049 Mt CO_2eq in 2004, before decreasing gradually to 640 Mt CO_2eq in 2011, then increasing again to 708 Mt CO_2eq in 2014, as shown in figure 1. The share of transportation CO_2 emissions increased from 12% in 1990 to 24% in 2014.[5] As shown in table 1, transportation plays a more important role in export-related GHG emissions in LAC than in the rest of the world. For example, the share of transportation CO_2 emissions was 24% for LAC in 2014, compared with 7% for the whole world. In 2014, LAC's export-related production CO_2 emissions account for 43% and non-CO_2 emissions account for 32% of the total export-related GHG emissions.

Figure 1



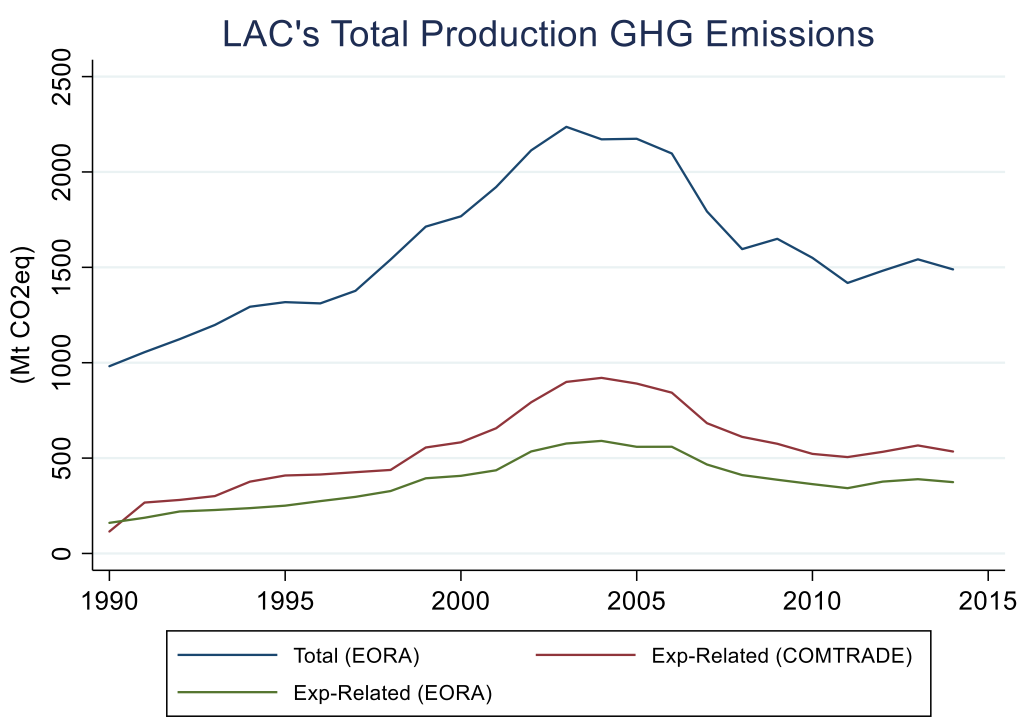
[5] Even though the transportation emissions used in these calculations are available for 1990 through 2018, the available period for production emissions data is 1990 to 2014. Except when analyzing transportation emissions by themselves, we focus on 1990 to 2014.

Table 1. Composition of Total Export-Related GHG Emissions, 2014

Exporter Region	Production CO_2	Production Non-CO_2	Transportation CO_2
Developed countries in East and Southeast Asia	88%	7%	5%
Developing countries in East and Southeast Asia	77%	20%	2%
EU27	70%	17%	13%
LAC	43%	32%	24%
North America	72%	16%	12%
ROW	69%	25%	6%
World	72%	21%	7%

Using Eora export data, LAC's export-related production GHG emissions accounted for 25% of its total production GHG emissions in 2014. We need to point out that export-related GHG emissions using UN Comtrade exports data, on which the analysis in this paper is based, are higher than those calculated using Eora data, as shown in figure 2.

Figure 2



Export-Related GHG Emissions: Production

LAC's export-related production GHG emissions are lower than those of other regions. In 2014, LAC's export-related production GHG emissions were 535 Mt CO_2eq and only accounted for 4% of the global total (14,342 Mt CO_2eq). As shown in figure 3, developing countries in East and Southeast Asia contribute the most to the total global export-related production GHG emissions, followed by EU27 and North America. However, LAC's low export-related production GHG emissions are more due to low export levels than low GHG emission intensity. LAC's production GHG emission intensity is only lower than developing countries in East and Southeast Asia and is greater than all the developed countries (see figure A1).

Figure 3

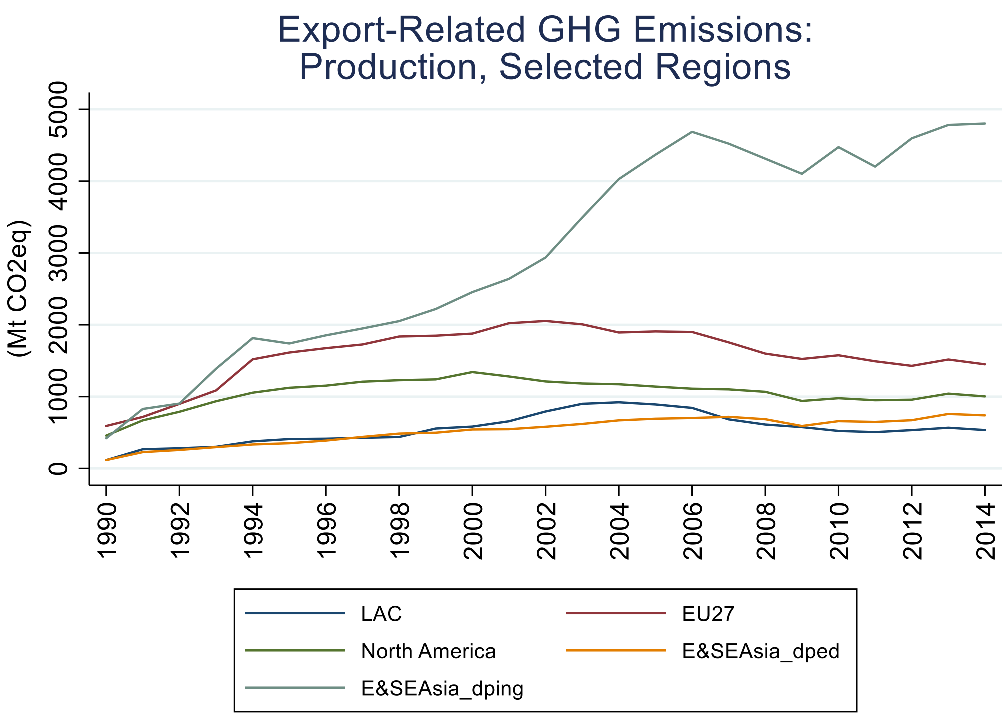
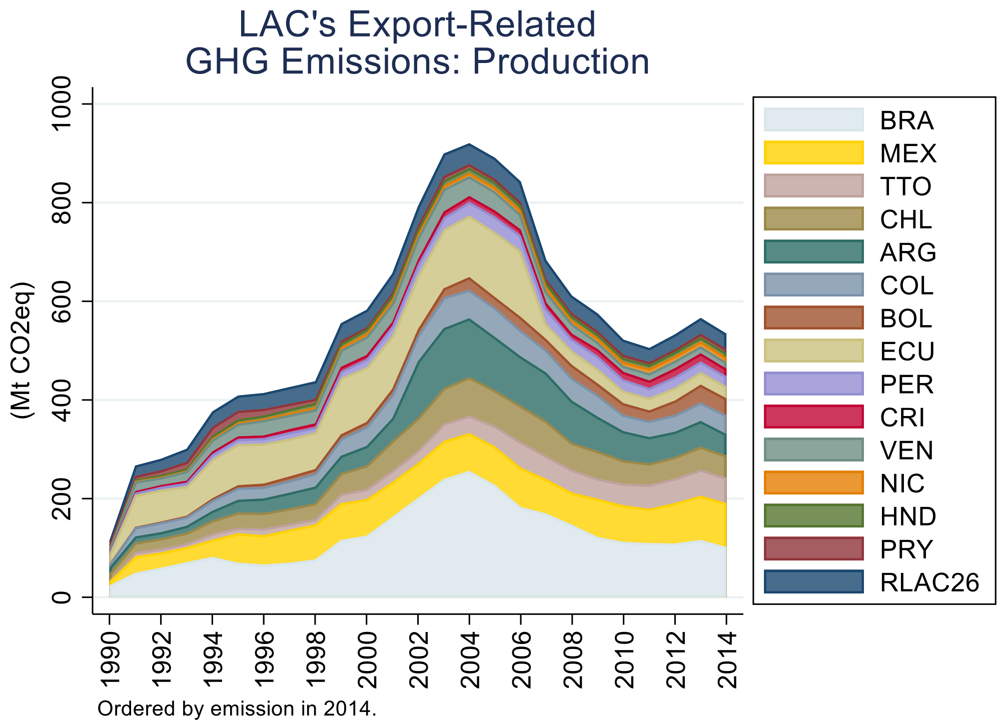


Figure 4



As shown in figure 4, the top ten contributors to LAC's export-related production GHG emissions are Brazil (19%), Mexico (17%), Trinidad and Tobago (10%), Chile (8%), Argentina (8%), Colombia (7%), Bolivia (6%), Ecuador (5%), Peru (4%), and Costa Rica (3%), using data for 2014. The high level of export-related production GHG emissions from Trinidad and Tobago is mainly due to petroleum exports, which account for 84% of its total. Not only does petroleum represent the majority of Trinidad and Tobago's exports, but the country's production emission intensity for petroleum is the second-highest in LAC. Indeed, Bolivia is the only country that has higher production emission intensity for petroleum than Trinidad and Tobago.

Figure 5

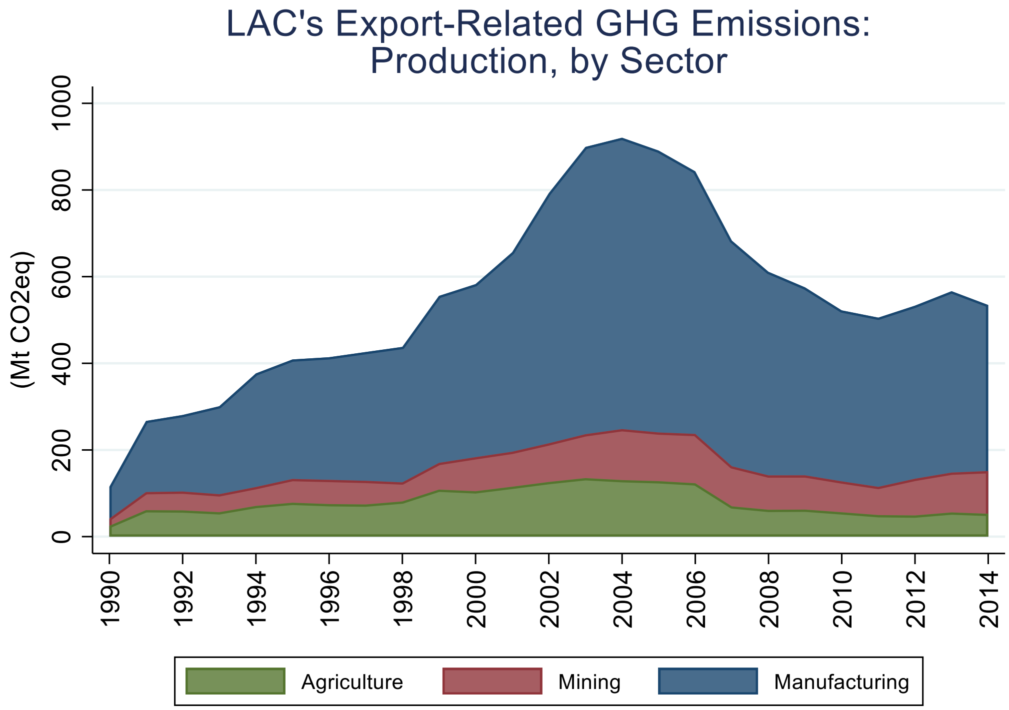
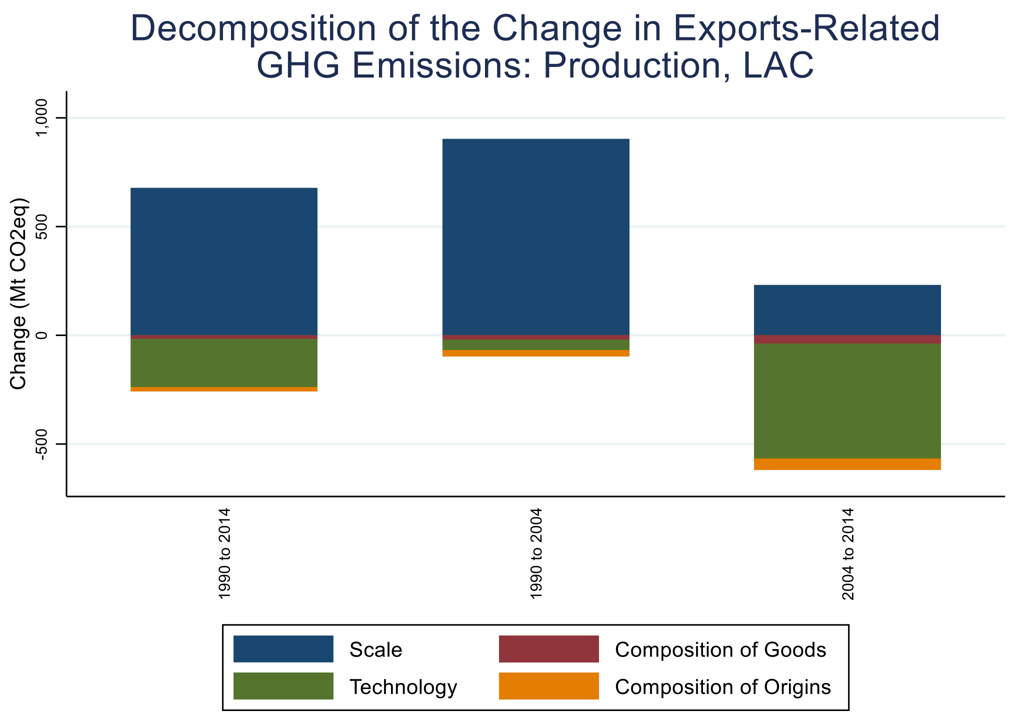


Figure 5 plots LAC's export-related production GHG emissions by sectors. Manufacturing sector exports accounted for 72% of 2014 LAC's total export-related production GHG emissions, while agricultural exports represented 10%, and mining exports 18%.

Figure 6



LAC's export-related production GHG emissions increased by 375% (420 Mt CO_2eq) between 1990 and 2014. As figure 6 shows, the scale effect was the main driver of emissions increases during this period. In contrast, technology, the composition of goods, and the composition of origin countries diminished emissions. The negative technology effect and the composition of goods effect in LAC imply that the production of goods and export baskets became cleaner over this period. The negative effect of the composition of origin indicates that countries whose production and export baskets were cleaner increased their share in LAC's total exports. As shown in figure 1, LAC's total export-related GHG emissions peaked in 2004, driven by export-related emissions from production. Comparing the decomposition of growth before the peak and after the peak provides more insight into how export-related production emissions evolved. Between 1990 and 2004, the emissions increase due to the scale effect was even greater. Between 2004 and 2014, LAC's export-related production GHG emissions decreased as the scale effect lost momentum and cleaner production technology became more widespread.

Figure 7

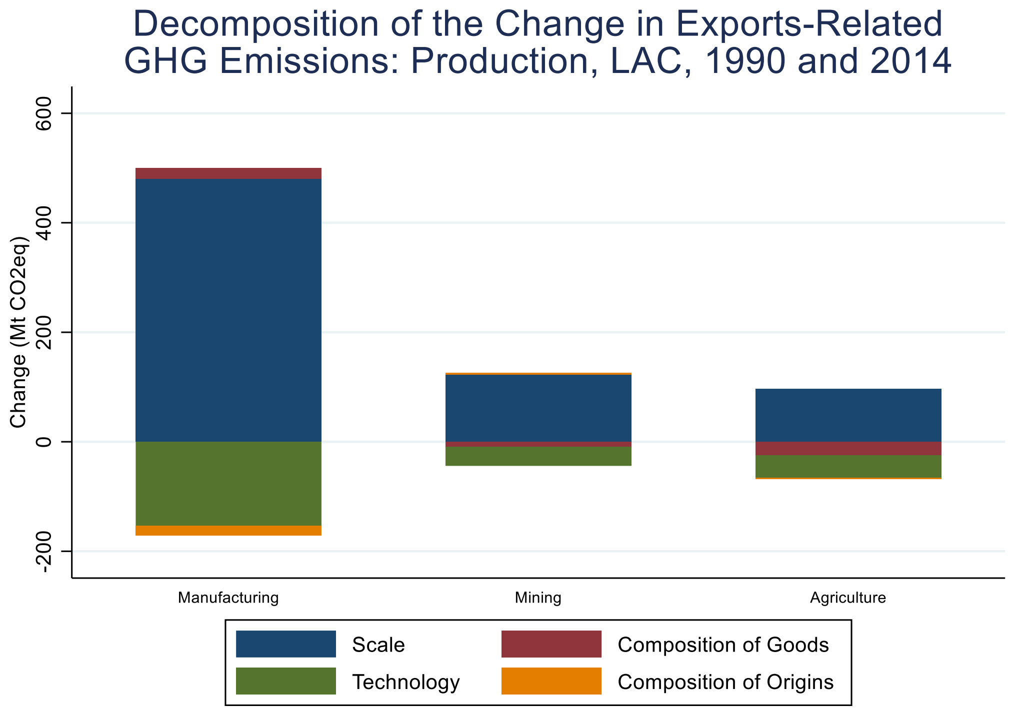


Figure 7 plots the decomposition of growth by sectors. In all three sectors, the positive scale effect dominates the negative technology effect in generating export-related production emissions. The composition of goods leads to an increase in emissions in the manufacturing sector and a reduction in these in the mining and agriculture sectors, which means that LAC's manufacturing export basket became dirtier and the mining and agricultural export basket cleaner between 1990 and 2014. The composition of origin countries led to a reduction in emissions in the manufacturing and agriculture sectors, but an increase in those of the mining sector. The cleaner countries in the manufacturing and agriculture sectors accounted for a larger share in exports, while the dirtier countries in the mining sector accounted for a larger share.

Figure 8

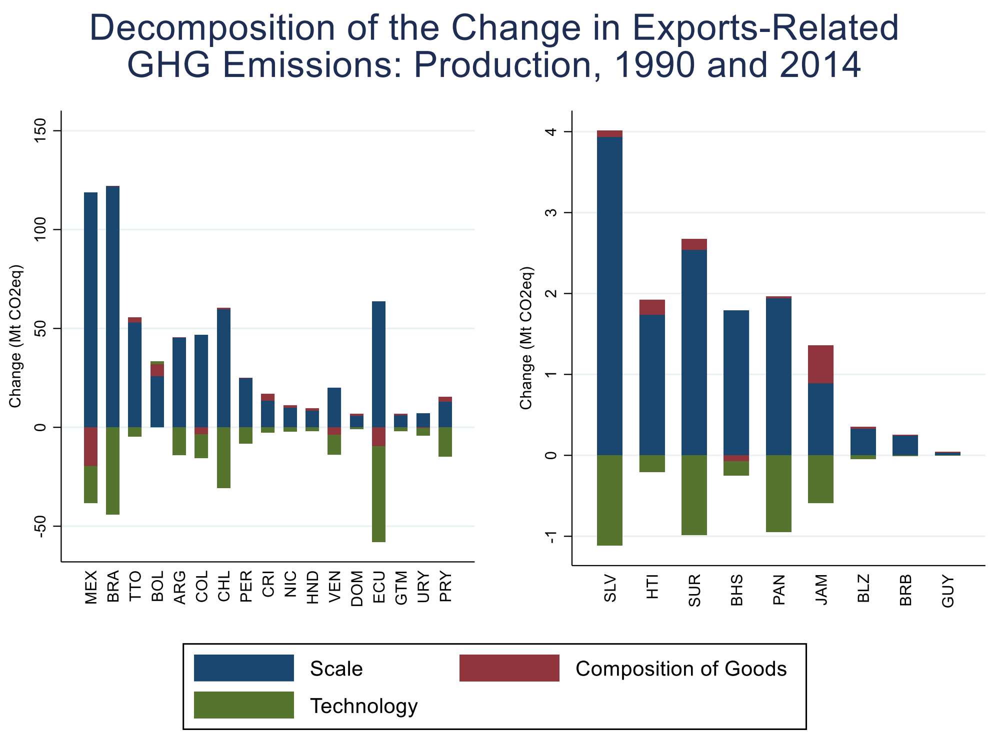


Figure 8 shows the decomposition of growth by LAC country. The largest changes were experienced by Mexico and Brazil, which was to be expected given that they export on a much larger scale than other countries in the region. For all countries, the scale effect increases emissions. The technology effect decreases emissions for all LAC countries except Bolivia. The composition of goods leads to a reduction in emissions in Mexico, Ecuador, Venezuela, Colombia, Uruguay, and the Bahamas, whose export baskets became cleaner over this period.

Export-Related GHG Emissions: International Transportation

LAC is one of the regions with the highest export-related transportation CO_2 emissions. Figure 9 plots the different regions' export-related transportation CO_2 emissions over time. For example, total world export-related transportation CO_2 emissions in 2018 were 1,374 Mt, of which EU27 accounts for 19%, LAC 17%, North America 15%, East and Southeast Asian developing countries 10%, and East and Southeast Asian developed countries 3%. Even though LAC's share is not particularly higher than any other region, its transportation CO_2 emissions per USD of exports are much higher than those of the rest of the world (see the plots of export-related transportation CO_2 emissions per USD of exports in figure A2).

Figure 9

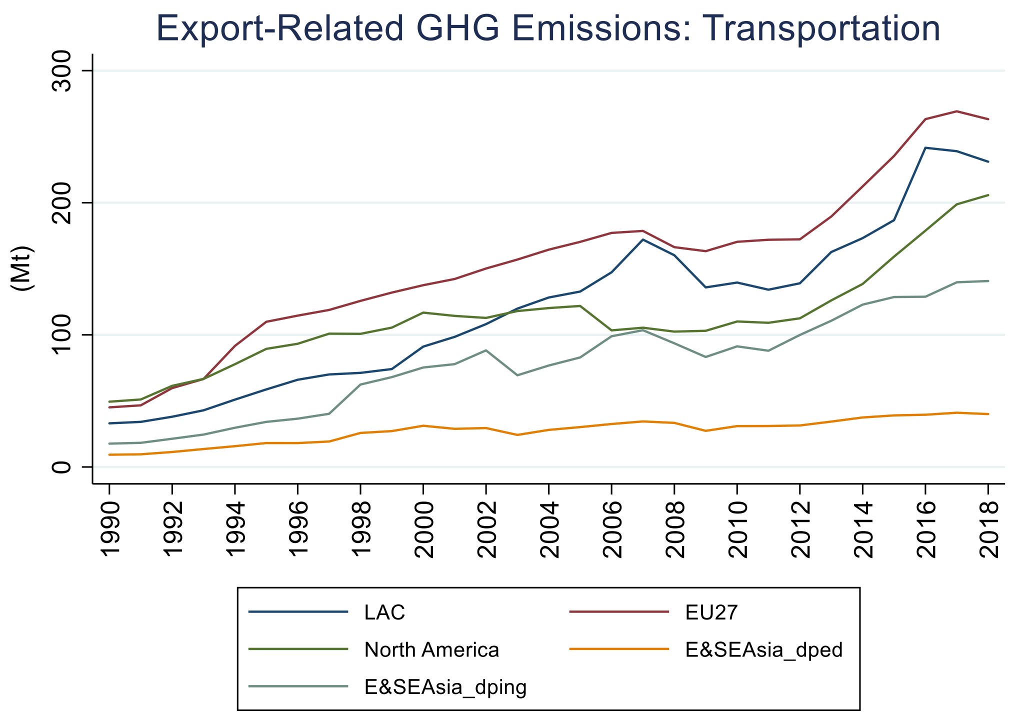
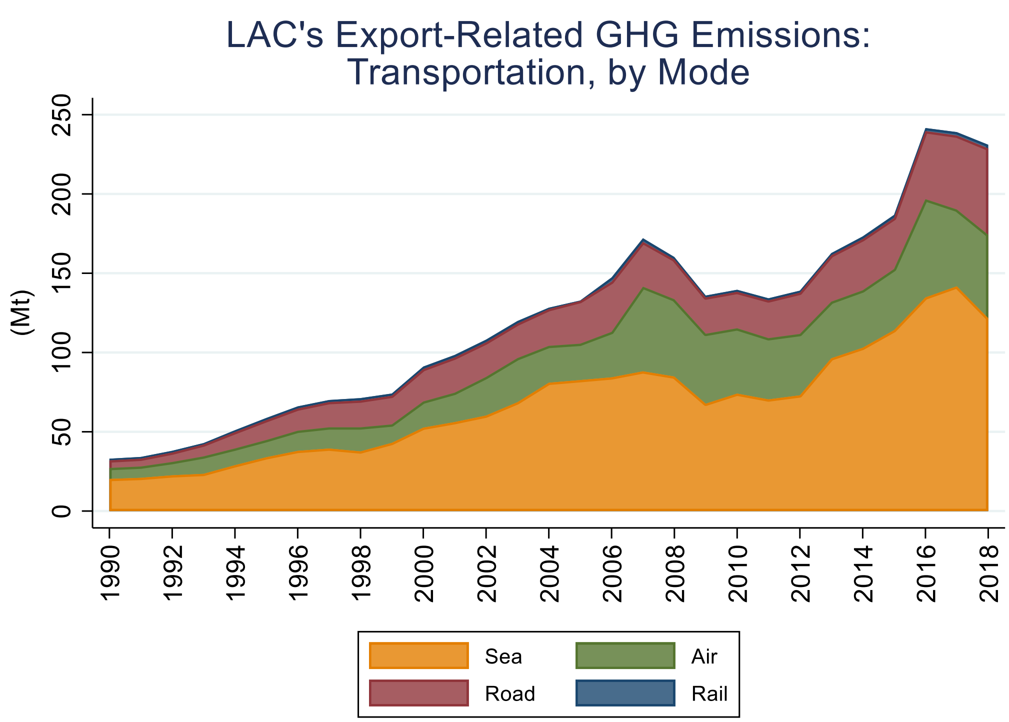


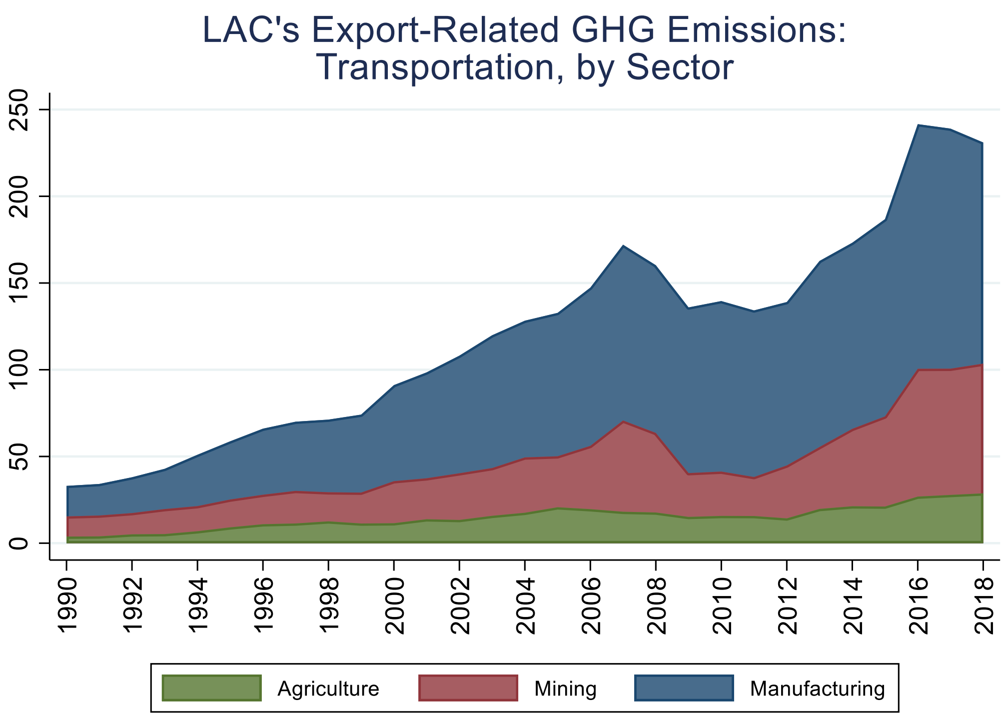
Figure 10



Turning to transportation modes, sea transportation contributes most to LAC's export-related transportation CO_2 emissions. Figure 10 plots LAC's export-related CO_2 emissions by the four transportation modes. In 2018, sea transportation accounted for 53% of LAC's total export-related transportation CO_2 emissions, air transportation for 23%, road freight for 23%, and rail for just 1%.

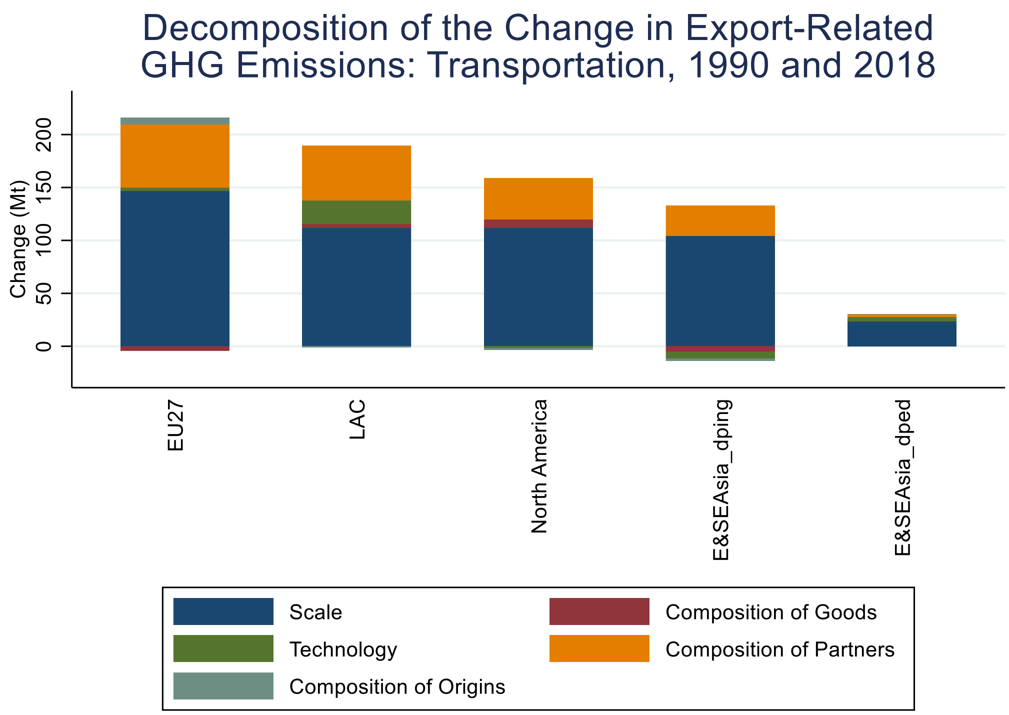
In terms of sectors, the manufacturing sector is the biggest contributor to LAC's export-related transportation CO_2 emissions. Figure 11 plots LAC's export-related transportation CO_2 emissions by sector. In 2018, the agriculture sector accounted for 12% of LAC's total export-related transportation CO_2 emissions, mining accounted for 32%, and manufacture for 55%.

Figure 11



Between 1990 and 2018, LAC's export-related transportation CO_2 emissions increased by 188 Mt. EU27 is the only region where emissions increased more than in LAC, as shown in figure 12. The scale effect accounted for 60% of the increase in LAC's export-related transportation CO_2 emissions, which are lower than those of all other regions. The composition of partners accounts for 27%, which is comparable to other regions. The technology effect accounts for 12% of the increase, higher than any other region. The composition of goods accounts for 2%, and composition of origins for -1%.

Figure 12



Even though the composition of goods effect does not seem important for LAC at the aggregate level, it plays a very important role in causing emissions to increase in certain countries, especially Peru, Uruguay, and Venezuela, as shown in figure 13. At the country level, the decomposition patterns are quite different. The scale effect is the biggest driver for emissions increases in all LAC countries except Uruguay and Venezuela. The technology effect leads to emissions reductions in Brazil, Colombia, Peru, Uruguay, and Venezuela but leads to increases in Argentina, Bolivia, Chile, Ecuador, Mexico, and Paraguay. The composition of goods increases emissions in all countries except Mexico, and the composition of partners increases emissions in all countries. In all countries except Mexico, the composition of goods and the composition of partners play major roles in causing emissions to increase.

Figure 13

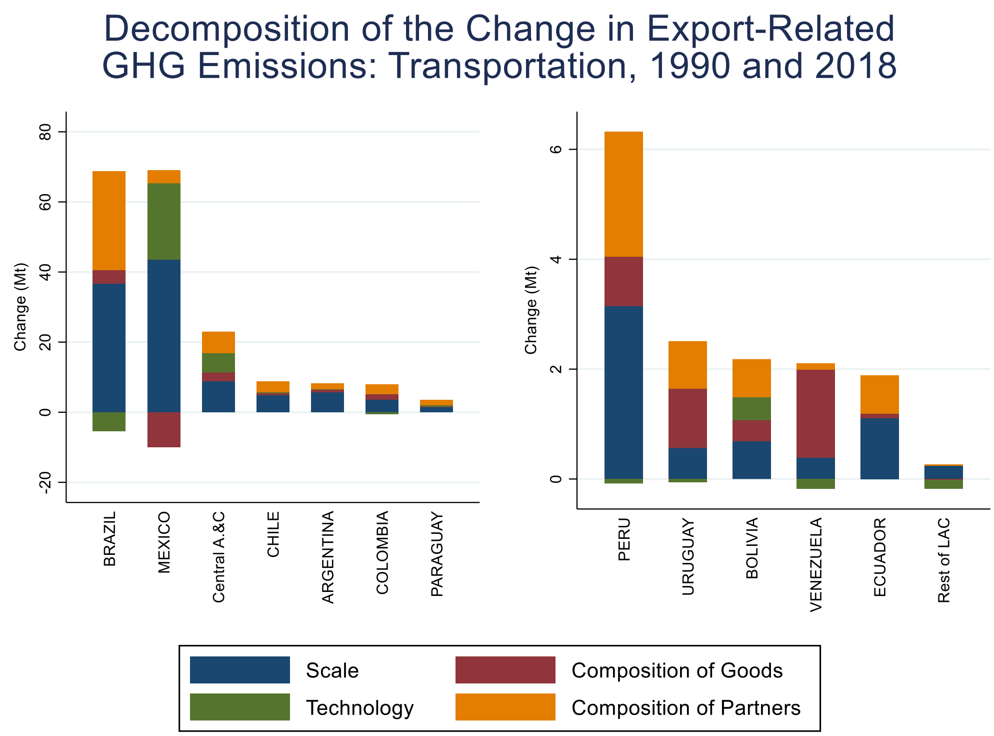
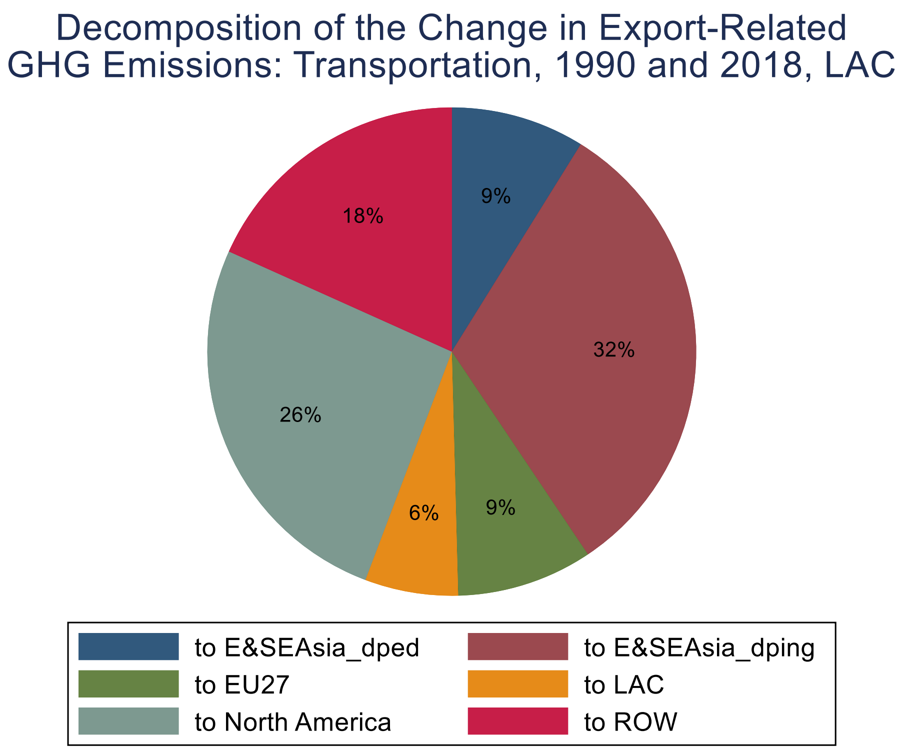


Figure 14 plots the contribution of each partner region to growth in LAC's transportation CO_2 emissions. Its exports to Asian developing countries account for 32% of its total transportation CO_2 emissions increase, and North America for 26%. Dividing LAC's export-related transportation CO_2 emissions to different regions (see figure A3) reveals that the positive effect of the composition of partners mainly comes from LAC's exports to Asia developing countries. The positive effect of technology comes from LAC's exports to the US and Canada.

Figure 14



Conclusion

This paper begins by building a database of export-related production and transportation GHG emissions for 1990 to 2014. It then analyzes the trend and growth in LAC's export-related emissions over this period. LAC's total export-related GHG emissions increased steadily from 136 Mt CO_2eq in 1990 to1,049 Mt CO_2eq in 2004, then decreased gradually to 640 Mt CO_2eq in 2011, before increasing again to 708 Mt CO_2eq in 2014. We divide the total export-related emissions into production emissions and international transportation emissions.

In 2014, LAC's export-related production GHG emissions stood at 535 Mt CO_2eq and only accounted for 4% of the world total. The top ten contributors to this were Brazil, Mexico, Trinidad and Tobago, Chile, Argentina, Colombia, Bolivia, Ecuador, Peru, and Costa Rica. Looking at sectors, manufacturing sector exports accounted for 72%, agricultural exports for 10%, and mining exports for 18%. LAC's export-related production emissions increased by 375% between 1990 and 2014. The scale effect was the main driver of this increase. In contrast, technology, the composition of goods, and the composition of origin countries diminished emissions.

LAC is one of the regions with the highest export-related transportation CO_2 emissions, accounting for 17% of the world's total export-related transportation CO_2 emissions in 2018. In terms of transportation modes, sea transportation contributes the most to LAC's export-related transportation CO_2 emissions. Turning to sectors, the manufacturing sector is the greatest contributor. Between 1990 and 2018, LAC's export-related transportation CO_2 emissions increased by 188 Mt. The scale effect accounted for 60% of this increase, the composition of partners for 27%, the technology effect for 12%, the composition of goods for 2%, and the composition of origins for -1%.

References

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Cristea, A., Hummels, D., Puzzello, L., & Avetisyan, M. (2013). Trade and the greenhouse gas emissions from international freight transport. *Journal of environmental economics and management*, *65*(1), 153-173.

Table A1. Sectors

1	Agriculture and Fishing
2	Mining and Quarrying
3	Food and Beverages
4	Textiles and Wearing Apparel
5	Wood and Paper
6	Petroleum, Chemical, and Non-Metallic Mineral Products
7	Metal Products
8	Electrical and Machinery
9	Transportation Equipment
10	Other Manufacturing and Recycling

Table A2. Regions

North America (2 regions)	Canada, United States
LAC (Latin America and the Caribbean) (13 regions)	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, Paraguay, Uruguay, Venezuela, Rest of South America, Other countries of Central America and the Caribbean
Europe (18 regions)	Austria, Belgium-Luxembourg, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, United Kingdom, Other EU27, Russia, Other CEE and Other CIS, Other Europe
South Asia (2 regions)	India, Other South Asia
E&SEAsia_dping (Developing countries in East and Southeast Asia) (5 regions)	China-Hong Hong, Malaysia-Indonesia, Taiwan, Other East Asia, Other Southeast Asia
E&SEAsia_dped (Developed countries in East and Southeast Asia) (3 regions)	Japan, Korea, Singapore
Middle East/Africa (3 regions)	South Africa, Middle East and North Africa, Sub-Saharan Africa
Oceania Countries (1 region)	

Figure A1

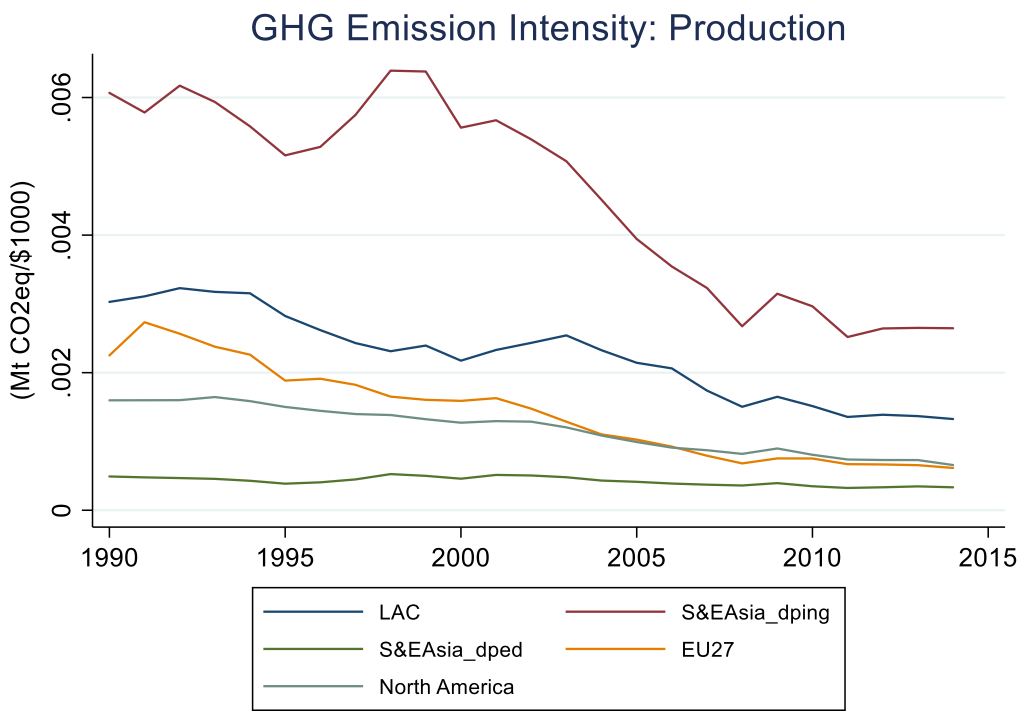


Figure A2

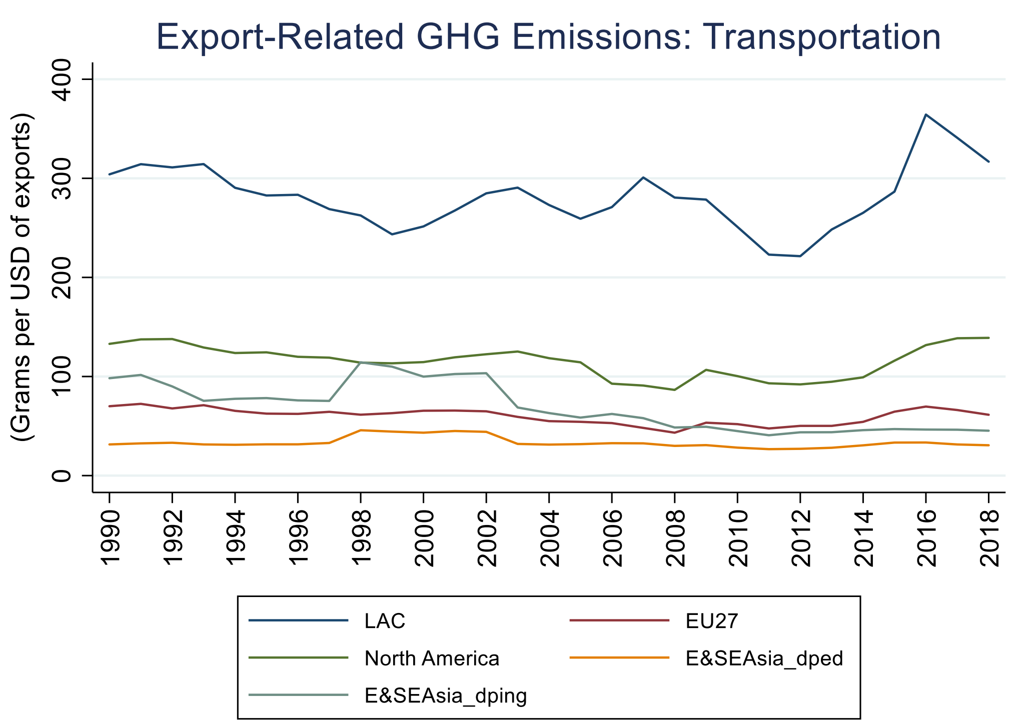
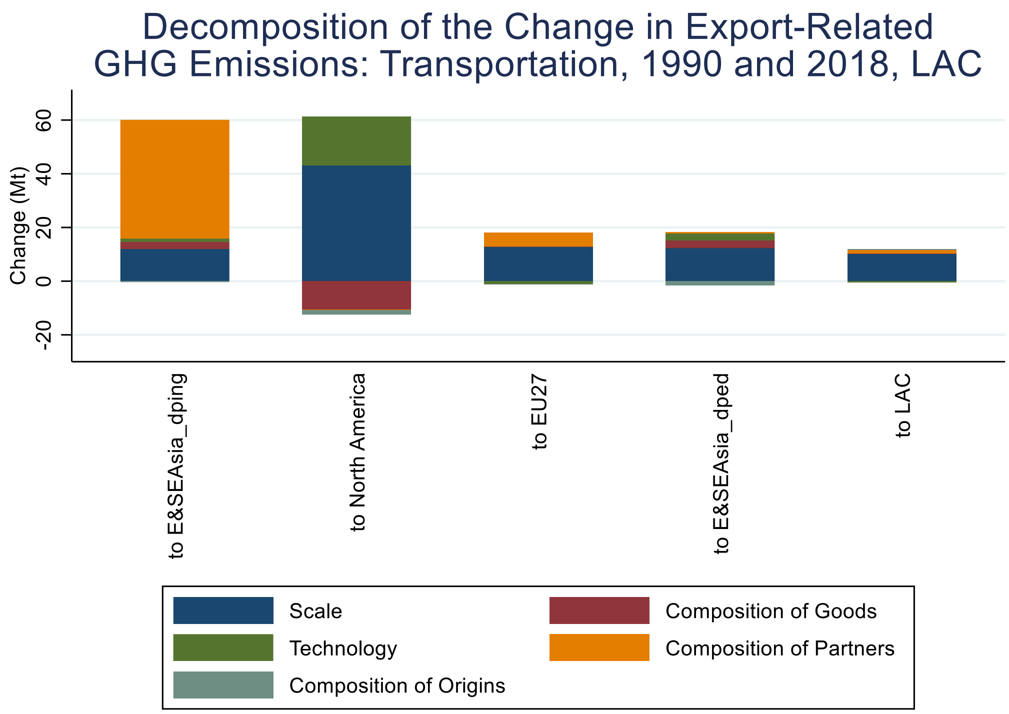


Figure A3


Decomposition of the Change in Export-Related
GHG Emissions: Transportation, 1990 and 2018, LAC
Change (Mt)
60
40
20
0
-20
to E&SEAsia_dping
to North America
to EU27
to E&SEAsia_dped
to LAC
Scale
Composition of Goods
Technology
Composition of Partners
Composition of Origins