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How Do Investment Promotion Policies Affect Sustainability?*

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Abstract

Sustainability has become an imperative. Understanding the effects of countries' policies thereon has therefore acquired vital importance. This is particularly the case with ubiquitous policies such as investment promotion. In this paper, we address this timely policy question from an environmental perspective. We examine whether and how investment promotion policies affect Latin American economies' emissions of pollutants. To do so, we create and use a unique dataset that combines data on multinational firms' location, investment promotion agencies (IPAs)' assistance, and pollutant-specific emission intensities across countries and sectors over time. Our analysis yields three main findings. First, multinational firms operating in Latin America have higher emission intensities than those located in Europe and that this is primarily driven by their sectoral distribution. Second, IPA client portfolios are biased toward more polluting multinational firms and this is mainly associated with the type of sectors targeted by the IPAs. Third, while on average the effects of IPA assistance are similar across multinational firms with different pollution levels, these are stronger on more polluting ones within priority sectors. These findings highlight the need and relevance of data-based evidence to uncover potential tensions and balance different economic and sustainability goals.

Keywords: Investment Promotion, Multinational Production, Sustainability
JEL-Codes: F23, F13, F14, L23, L25, L52, O25

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1. Introduction

Earth is warming at an unprecedented rate, with the last decade being by far the warmest one on record. The severe implications of the implied climate change have made sustainability one of the most important challenges facing humanity and its imperative clearer than ever. Countries around the world have accordingly responded increasing the number of policies aiming to explicitly support the goals of climate change adaptation and mitigation, including through direct support provided to the private sector. For instance, the United States' Inflation Reduction Act (IRA) of 2022 provided US$ 369 billion in subsidies and tax credits aimed at cutting carbon emissions in half by 2030. Similarly, the European Commission has proposed an EU Green Deal industrial plan on February 2023. In addition, countries are introducing adjustments in existing industrial policies. This is specifically the case with a ubiquitous policy: investment promotion. Thus, nearly half of OECD investment promotion agencies (IPAs) have recently reported to have used indicators related to low-carbon transition to help better target their activities (see Sztajerowska and Volpe Martincus, 2021). This paper informs and provides rigorous and practical insights to guide these policy developments: it provides new empirical evidence on emission intensity of multinational firms operating in different countries and, for the first time to our knowledge, characterizes the emission intensity of multinational firms assisted by IPAs in these countries and assesses the relative effectiveness of these IPA assistance in attracting multinational firms with different levels of emission intensity.

The primary goal of investment promotion policies is the attraction of foreign direct investment (FDI). As such, the main metrics of those policies' success has thus-far been the number of attracted firms and the amount of investment, among others. By influencing the probability of multinational firms establishing foreign affiliates in the economy, those policies can, nevertheless, directly (and indirectly) affect its overall pollutant emission footprint. This naturally leads to the question of how the different policy goals (and the actions implemented to reach them) interact with each other and, particularly, whether there is a tension between the economic and environmental goals.[1] From a theoretical perspective, investment promotion could have positive or negative effects on domestic environmental performance. This depends on the characteristics of the multinational firms (i.e., with more or less emission intensity) and the design of the policy (e.g., IPAs can target sectors that develop new technologies that facilitate net-zero transition or sectors in which countries have comparative advantage and are relatively highly polluting). As virtually all countries worldwide have IPAs and, in some cases,

[1] Such potential tension goes back to the discussions regarding the pollution-haven hypotheses introduced over 30 years ago (see, e.g., Ambec et al., 2013 and Cole et al, 2017 for a review).

devote substantial resources to investment promotion policies, having a proper answer to this empirical question is crucial to understand the contribution of these policies to the global environmental efforts.[2] However, little is known thus-far about the effects of investment promotion policies on sustainability outcomes, in general, and on emissions of pollutants, in particular. This paper aims to fill in this gap in the literature by providing evidence on the direct effects of these policies on emission intensities.[3]

To do so, we leverage a unique dataset that includes detailed information on the distribution of multinational firms and their foreign affiliates across sectors and countries over time, firm-time specific assistance status by IPAs across 12 countries in Latin America (LA), and sector-country-specific data on pollution levels.[4] We use this dataset to, first, describe and compare the distribution of multinational firms' pollutant-specific emission intensities across regions and countries and compute and report respective summary measures. Second, we measure and contrast the relative emission intensity of IPAs-assisted and non-assisted multinational firms. Third, and finally, we use a difference-in-differences strategy (along a large set of control variables) to examine whether and to what extent assistance by IPAs have differential effects depending depending on multinational firms' relative emission levels.

Our results suggest that multinational firms operating in the region have higher emission intensities than those located in Europe and comparable to those active in North America. This is primarily driven by their sectoral composition–and not that of their geographical origins–. In addition, we find that IPA client portfolios are heavily tilted toward more polluting multinational firms. This occurs mainly due to the type of sectors targeted by the IPAs. Moreover, our estimates reveal that, on average, the effects of IPA assistance are similar across multinational firms with different pollution levels, but are stronger on more polluting multinational firms within priority sectors.

We contribute to three main strands of the literature. First, a large number of papers examine the patterns, determinants, and implications of multinational production (see, e.g., Alfaro and Chen, 2014; Egger et al., 2014; Ramondo et al., 2015; Conconi et al., 2016; Alviarez, 2019; Garetto et al., 2019; Head and Mayer, 2019).[5] These studies show that trade costs influence the level of multinational production and especially its extensive

[2] See Volpe Martincus and Sztajerowska (2019).

[3] Investment promotion policies can also have indirect effects on the level of emissions of host economies through labor turnover and input-output linkages between domestic firms and assisted established multinational firms, among other channels. Examining these indirect effects is beyond the scope of this paper and will be the subject of a dedicated study.

[4] Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Honduras, Mexico, Nicaragua, Peru, and Uruguay.

[5] Earlier contributions include Markusen (2002), Markusen and Maskus (2002), Yeaple (2003), Nunn and Trefler (2008), Antràs et al. (2009), Alfaro and Charlton (2009), Chen and Moore (2010), Antràs and Yeaple (2013), and Irarrazabal et al. (2013), among others.

margin (see, e.g., Head and Mayer, 2004; Ramondo, 2014). This is particularly the case with information frictions, which, despite progress in information and communication technologies, are still a major determinant of the geography of this production (see, e.g., Oldenski, 2012; Keller and Yeaple, 2013; Allen, 2014; Ramondo et al., 2015; Alfaro and Chen, 2018).[6]

Second, we extend the literature that evaluates the impact of investment promotion on FDI. Broadly speaking, these papers proxy such a policy through aggregate binary variables indicating either (i) the existence of an IPA or an IPA's office in the host or home country/city; or (ii) whether specific sectors are targeted by the IPA (see, e.g., Head et al., 1999; Bobonis and Shatz, 2007; Hayakawa et al., 2014; and Ni et al., 2017; and Alfaro and Charlton, 2007; Harding and Javorcik, 2011; and Crescenzi et al., 2021, respectively).[7] Most recent studies have combined and used firm-level data on both location of multinational firms' foreign affiliates and their IPA assistance status to assess the effects of investment promotion policies on the probability of these firms establishing a first or subsequent affiliates in a country and the channels and mechanisms thereof (see Volpe Martincus et al., 2021; Carballo et al., 2021).[8]

Third, we add to a rapidly growing literature on the role of multinational firms in shaping sustainability, in general, and pollutant emissions, in particular. Due to their size and unique characteristics (e.g., access to technologies, innovation intensity, wide and geographically spread business and trade networks), these firms can have an important impact on environmental outcomes. Studies in this literature accordingly quantify the overall contribution of multinational firms to global emissions (e.g., Borga et al., 2022; Zhang et al., 2020; Zhu et al., 2022), empirically assess the effects of specific policies or external shocks on firms' behavior and margins of adjustment within the business groups that are of relevance to environment (e.g., Chen et al., 2022; Brucal and Dechezleprêtre, 2021; Fontagné et al., 2023; and Fontagné and Schubert, 2023), and develop and use dedicated general equilibrium models to evaluate the effects of these policies and shocks on global carbon footprint associated with changes in multinational production (e.g., Garcia-Lembergman et al. 2023).[9]

[6] This is especially true in the current economic environment characterized by trade disputes, which are reshaping of global value chains due to increased uncertainty (see, e.g., Baldwin and Evenett, 2020; and Fajgelbaum et al., 2020).

[7] For instance, Harding and Javorcik (2011), one of the first papers and a key reference in this literature, use changing IPAs' sector targeting to identify the impact of investment promotion on FDI inflows.

[8] For instance, using an instrumental variables approach and event studies, Carballo et al., (2021) find that support from Costa Rica's IPA has has a positive and statistically significant effect on the probability of a multinational firm opening its first affiliate in the country and that such an effect is primarily driven by the reduction of information frictions.

[9] These papers find that firms adjust to policies and shocks in various ways, including by reducing their output, increasing efficiency, and altering production location within a group or across countries. For in-

In this paper, we complement these studies by examining whether and how investment promotion policies affect environmental outcomes in local economies. In so doing, we characterize the emission intensity of multinational firms active across a number of hosts countries and that of those supported by the respective national IPAs, estimate the effects of IPAs' support on the probability of multinational firms establishing a first or subsequent foreign affiliates in their territories depending on their emission footprint, and explore the mechanisms through which observed effects arise.

The rest of the paper is structured as follows: Section 2 outlines the methodological approach. Section 3 describes the data. Section 4 presents and discusses our estimation results, and Section 5 concludes.

2. Empirical Approach

We aim at characterizing the emission intensity of multinational firms operating in the countries and the emission intensity of the portfolio of IPAs' assistance to multinational firms, and estimating the effects of investment promotion assistance on multinational firms' decisions to establish an affiliate in the country, depending on their emission intensity.

To accomplish the first goal, we first construct country-level, pollutant-specific, summary measures of the distribution of expected emission intensities across multinational firms operating in each sample host country and of the distribution of expected emission intensities across multinational firms by investment promotion assistance status (i.e., assisted firms vs. non-assisted firms). These measures are computed as a weighted average of the emission intensities of multinational firms' home countries and sectors, whereby the weighting factors are the shares of multinational firms of a particular home country-sector combination in the total number of multinational firms operating in the country and in the total number of multinational firms assisted by the IPA, respec-

stance, Chen et al. (2021) show that large Chinese manufacturers subject to energy regulation cut output and shifted production to unregulated firms in the same conglomerate instead of improving their energy efficiency. Fontagné et al. (2023) find that French manufacturing firms reduced their energy demand, increased efficiency and optimized energy use across plants in reaction to idiosyncratic electricity shocks. Other relevant related papers are Shapiro (2016), Shapiro (2021), and Arkolakis and Walsh (2023). According to Shapiro (2016), regional carbon taxes on emissions from shipping would increase global welfare, yet, with important distributional consequences. Shapiro (2021) concludes that a smaller environmental bias in tariffs would reduce global CO2 emissions with little changes in real income. Arkolakis and Walsh (2023) show that the world's power system is likely to be dominated by renewables by 2040 in a range of scenarios, with substantial welfare gains, and that US IRA accelerates that uptake.

tively.[10] More formally:

$$Emissions_{ct}^{MP_p} = \sum_{cs} \Psi_{hcst} Emissions_{cst} \tag{1}$$

$$Emissions_{ct}^{IPA_p} = \sum_{cs} \Omega_{hcst} Emissions_{cst} \tag{2}$$

$$Emissions_{ct}^{\sim IPA_p} = \sum_{cs} \Phi_{hcst} Emissions_{cst} \tag{3}$$

where c, h, s, t, p denote host country, home country, sector, year, and pollutant, respectively; $Emissions_{ct}^{MP}$ correspond to the emission intensity of the multinational firms operating in host country c in year t; $Emissions_{ct}^{IPA}$ correspond to the emission intensity of the multinational firms assisted by (potential) host country' c IPA in year t; $Emissions_{ht}^{\sim IPA}$ correspond to the emission intensity of the multinational firms non-assisted by (potential) host country' c IPA in year t; Ψ_{hcst} is the share of multinational firms from home country h that belong to sector s in the total number of multinational firms operating in host country c in year t; Ω_{hcst} is the share of multinational firms from home country h that belong to sector s in the total number of multinational firms assisted by (potential) host country c's IPA; Φ_{hcst} is the share of multinational firms from home country h that belong to sector s in the total number of multinational firms non-assisted by (potential) host country c's IPA. Note that the latter two set of shares can be calculated for multinational firms no yet present in host country c (in which case the measure would correspond to IPA assistance for first establishment), multinational firms that are already present in in host country c (in which case the measure would correspond to IPA assistance for reinvestment), and both.

In addition, we examine the respective entire unconditional distributions of the expected emission intensities of multinational firms across home countries and sectors, both operating in the country and IPA assistance status, as estimated using kernel densities and the conditional patterns of these emission intensities when accounting for multinational firms' home countries and sectors in a given year as follows:

$$lnEmissions_{fchs}^{MP_p} = \sum_{i=1}^{I} \beta_i^{MP_p} \mathbb{I}(R_i) + \zeta_h^{MP_p} + \delta_s^{MP_p} + v_{chs}^{MP_p} \tag{4}$$

$$lnEmissions_{fchs}^{IPA_p} = \beta^{IPA_p} \mathbb{I}(IPA_{fchs}) + \zeta_h^{IPA_p} + \delta_s^{IPA_p} + v_{chs}^{IPA_p} \tag{5}$$

[10] See Section 3 for a discussion on why we use multinational firms' expected emission intensities based on their home countries and sectors and the alternative thereof.

where $\mathbb{I}(\mathrm{R_i})$ is set of binary indicators that take the value of one for each main world region as host economy $i = \{NorthAmerica, Europe, LAC, Asia\}$ and zero otherwise; and $\mathbb{I}(\mathrm{IPA_{fchs}})$ is a binary indicator that takes the value of one if the multinational firm from home country h and operating in sector s was assisted by (potential) host country h's national IPA and zero otherwise.

To estimate the effects of investment promotion assistance on the probability of multinational firms establishing a first or subsequent foreign affiliates in a host country depending on their emission intensities requires to properly account for other relevant observed and unobserved factors that may affect location decisions, use of investment promotion services by firms, and emission intensities such as multinational firms' size, changing countries' comparative advantages, time-varying, country pair- and sector-specific characteristics and trade and investment policies. As such, we adopt the following linear probability model that allows for heterogeneous effects of IPA assistance on multinational firms' location decisions for different groups thereof:

$$\mathbb{I}(\mathrm{E_{fchst}}) = \sum_{k=0}^{\mathrm{K}} \sum_{j_p=1}^{J_p} \Theta_{\mathrm{k},j_p} \alpha_{\mathrm{k},j_p} \mathbb{I}(\mathrm{IPA_{fchst\text{-}}}) + \gamma^{\mathrm{p}}_{\mathrm{fchs}} + \lambda^{\mathrm{p}}_{\mathrm{fhst}} + \rho^{\mathrm{p}}_{\mathrm{hcst}} + \varepsilon^{\mathrm{p}}_{\mathrm{fhst}} \tag{6}$$

where $\mathbb{I}(\mathrm{E_{fchst}})$ is a binary indicator of either first establishment or expansion of a multinational firm in the country. More precisely, in the former case, the binary indicator takes the value of one if the (ultimate) parent firm f operating in sector s from home country h establishes its first affiliated firm in host country c in year t and zero otherwise, whereas in the latter case it takes the value of one if the parent firm f operating in sector s from home country h opens an additional affiliated firm in host country c in year t and zero otherwise. These dependent variables correspond to the cross-country firms' and within-country firms' extensive margins of multinational production, respectively.[11]

$\mathbb{I}(\mathrm{IPA_{fchst(\text{-}k)}})$ is a binary indicator that takes the value of one if the parent firm f operating in sector s from home country h was assisted by the national investment promotion agency of country c in year $t(-k)$ and zero otherwise, where $k \neq 0$ allows for non-contemporaneous supports to affect the outcome variable. j indexes the groups of

[11] The latter margin accounts for the largest share of the variation in bilateral flows of multinational production and for most of multinational firms' growth (see Ramondo et al., 2015; and Garetto et al., 2019). Thus, using data across 59 countries for the late 1990s, Ramondo et al. (2015) find that two-thirds of the increase in bilateral multinational production flows can be traced back to increase in the number of affiliates and only one third can be attributed to larger sales per affiliate. This is different from international trade where the intensive margin appears to be dominant. Furthermore, the extensive margin appears to be significantly more responsive to changes in standard gravity forces capturing bilateral trade costs, including those related to information barriers such as common language. For instance, Ramondo et al. (2015) show that having a common language increases the number of affiliates by 65% and sales per affiliate by only 11%.

firms with different expected levels of emission intensities of pollutant p and $\Theta_{.,j_p}$ is the corresponding group indicator. In particular, multinational firms are divided into three groups depending on their position in the distribution of expected emission intensities based on their home countries and their sectors: low levels of emission intensity (below the 25^{th} percentile), intermediate levels of emission intensity (between the 25^{th} and 75^{th} percentiles), and high levels of emission intensity (above the 75^{th} percentile). The coefficients on $\mathbb{I}$(IPA) for the different groups of multinational firms j, $\alpha_{.,\mathrm{j}}$ are therefore our main parameters of interest. If $\alpha_{.,\mathrm{j}} > 0$ ($\alpha_{.,\mathrm{j}} = 0$), then investment promotion support has a positive (no) impact on the probability of a multinational firm belonging to a particular group (i.e., with low, intermediate, or high emission intensities) establishing or increasing its number of affiliates in the country.

γ_{fchs}, λ_{fhst}, and ρ_{hcst} are sets of firm-host country(-home country-sector) fixed effects, firm(-home country-sector)-year fixed effects and home country-host country-sector-year fixed effects, respectively. These fixed effects control for time-invariant firm–host country-specific factors such as systematic differences in firms' propensity to locate in different countries as determined by the interplay between their business models and countries' comparative advantages; time-varying firm-level characteristics and performance measures such as size (e.g., total revenue, total number of affiliates, total number of countries in which the parent firm is present, and total number of sectors in which the parent firm operates across affiliates) and productivity; and time-varying, sector-specific variables such as relative market size, changing comparative advantages in given sectors (e.g., relative skilled labor endowments), sector-specific policies and differences in business cycles, the number of affiliates from the home country operating in the host country; the share of those firms that were assisted by the IPA; sectoral and actual country IPA prioritization; potential host country-specific information spillovers across parent firms in given sectors and home countries; exchange rates; trade-related procedures (port handling and customs processing times); transportation costs and tariffs (Alfaro and Chen, 2018); the existence of PTAs, BITs, DTTs, and differential tax rates between home and destination countries.[12] ε is the error term.

In all cases, standard errors will be clustered by firm for inference purposes, thus allowing for an unrestricted covariance structure over time within firms, which may differ across them.

[12] Admittedly, the strict sets of fixed effects included in the baseline specification substantially reduce the risk that our estimates suffer from endogeneity biases, but cannot entirely preclude it. Having said that, instrumental variable and event study estimates of a modified version of Equation (6) for a single country setting (Costa Rica) would indicate that endogeneity-driven upward bias would not appear to be a major concern (see Carballo et al., 2021).

3. Data

We combine three main databases to create the dataset used in this study: (i) data on multinational production over time; (ii) data on firm-specific IPA assistance over time; and (iii) home country-sector-pollutant-specific measures of emission intensity (over time). By combining these databases, we can characterize the emission footprint of multinational firms in new ways, depending on whether the firms received public support through IPA assistance or not, and assess whether and to what extent the effects of such an assistance correlate with multinational firms' emission intensities and the possible drivers thereof. The following subsections introduce each of the individual databases.

3.1. Multinational Production

To characterize the patterns and evolution of multinational production, we primarily rely on the WorldBase database (see, e.g., Alfaro and Chen, 2012 and 2014). The WorldBase is compiled by Dun and Bradstreet (DB). Data come from a wide range of sources including public, local mercantile, and chamber of commerce' registers, telephone directory and insolvency records, legal fillings, websites, and dedicated investigations, and their quality is verified centrally through multiple automated and manual checks (see, e.g., Alfaro and Chen, 2012; and DB, 2019).[13]

As of 2017, the WorldBase included about 260 million public and private firms in over 200 countries and territories. Most of these companies are stand-alone businesses with no formal linkages to other firms. We work with the sub-group of all (global ultimate) parent firms that, at some point of the sample period, have at least one subsidiary or branch in a different country (i.e., roughly 200,000 firms).

Admittedly, the coverage of the WorldBase is not perfect. This is particularly the case for developing countries such as those in our sample (see, e.g., Ramondo et al., 2015).[14] We therefore complement these data with databases kindly shared by the respective IPAs and other agencies.[15]

For each multinational firm, the WorldBase combined with national databases furnish us with data on home country, year of establishment, and sector of activity of the

[13] Comparisons with other databases such as those of UNCTAD and US' Bureau of Economic Analysis (BEA) suggest that the WorldBase can be considered one of the best estimations of the global population of multinational firms (see Alfaro and Charlton, 2009). For instance, in 2010 the WorldBase sample consisted of almost 150,000 multinational firms, 500,000 foreign affiliates, and around 1 million foreign plants. UNCTAD data for the same year recorded 103,000 multinational firms and approximately 900,000 foreign affiliates/plants.

[14] In these countries, sales of US foreign affiliates according to the WorldBase tend to be smaller than those reported in the US BEA database (see Alfaro and Charlton, 2009).

[15] For further description of the data see Volpe Martincus et al. (2021).

parent firm as well as data on location —i.e., host country—, year of establishment, and sector of activity for each of its affiliates.

Figures A1 and A2 in Appendix A shows the distribution of foreign affiliates across origin regions and sectors for a selected sample of Latin American countries.[16]

3.2. Investment Promotion Policies: IPA Assistance

We use data on IPA assistance to individual multinational firms over time that was kindly provided by the national IPAs of 12 Latin American countries: Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Honduras, Mexico, Nicaragua, Peru, and Uruguay. Table A1 in Appendix A reports the number of multinational firms assisted in each sample country and Figures A3 and A4 show the distribution of these assisted firms across origin regions and sectors.[17] Hence, this data allows us to track over time whether, and if so when, a given multinational firm from a given home country and active in given sector was assisted by the IPA of a given (potential) host country.

A large share of IPAs rely on priority sector lists to guide their activities (see Sztajerowska and Volpe Martincus, 2021). This makes prioritization an important channel through which the transmission of wider public policy goals can occur, including in regards to environment. Hence, we complement the IPA assistance data with information on IPAs' priority sectors from the IDB-OECD survey of IPAs (see Volpe Martincus and Sztajerowska, 2019).[18] Prioritization is typically associated with more and better support, in terms of both the quantity and the quality of services provided to firms (see Blyde et al., 2014). More precisely, when an IPA prioritizes a sector, it gears its activities particularly toward that sector. This can include: (i) creating dedicated sector teams and even departments; (ii) attending and/or organizing sector-specific events; (iii) gathering detailed, sector-specific data relevant to investors and publishing dedicated studies, brochures, and other information materials; and (iv) having a dedicated section on the IPA's website (Volpe Martincus and Sztajerowska, 2019). Furthermore, IPAs may have specific targets to meet in those sectors in terms of the number of firms or total investment.

[16] As explained in the next subsection, the sample of Latin American countries countries is determined by availability of data on IPA assistance.

[17] The data was shared by IPAs as part of a wider policy research project aimed to assess the effectiveness of IPA assistance. See Volpe Martincus et al. (2021) for additional details on this data.

[18] The IDB-OECD survey specifically asked IPAs about sectors that they prioritize in their activities. The information provided by the IPAs was mapped into the 4-digit ISIC classification. Similar data on IPA sector prioritization has been used in previous studies such as Alfaro and Charlton (2007) and Harding and Javorcik (2011).

3.3. Emission Intensity

The data on emission intensities come from EXIOBASE Global Emissions Database (see Stadler et al., 2018).[19] EXIOBASE is a global, detailed Multi-Regional Environmentally Extended Supply-Use Table (MR-SUT) and Input-Output Table (MR-IOT). It was developed by harmonizing and detailing supply-use tables for a large number of countries, estimating emissions and resource extractions by industry, and combining them to produce the MR-IOT. The data is available for 44 countries and 163 industries (4-digit NACE) for a long time period (2008-2018 used here) with information disaggregated by pollutant, including carbon emissions (CO_2), sulfur oxides (SO_x), nitrogen oxides (NO_x) and particular matter (PM10, PM25). These data allows us to apply a consistent and unified approach to measure multinational firms' emissions across countries and sectors that avoids the problems of double-counting and coverage. However, this does not come without a cost. As specified above, our approach abstracts from possible systematic differences between multinational firms (and between these and domestic firms) operating in the local economy beyond their distribution across different sectors and home countries (see Equations 1-3). Yet, recent studies suggest that multinational firms tend to apply in the host country the environmental technologies from their home country (see, e.g., Garcia-Lembergman et al. 2023). If that is the case, the metrics at the sector-country level could go a long way in explaining firm emission potential.[20]

Figures A5 and A6 in Appendix A present the average emission intensity for each main world region and each sector. These emission intensities are lower in Europe than in other regions and in the services sectors (especially, financial and nonfinancial services) than in the primary and manufacturing sectors.

We match the emissions data from the EXIOBASE to the ISIC classification, compute mean values by sector-country-year at the 2-digit ISIC level, and combine it with the data on multinational production and IPA assistance using multinational firms' home country and sector. The next section presents and discusses the results of applying the empirical approach outlined in Section 2 on this dataset.

[19] The data is available at: www.exiobase.eu [last accessed on 12th September 2023].

[20] We could alternatively assume that multinational firms use (or will use) the same technology as domestic firms, in which case country-level emissions associated with multinational production will be exclusively driven by their distribution across sectors, or that multinational firms use (or will use) the same technology as firms operating in countries that are close or similar to the host country for instance in terms of level of development, either in general o where their own foreign affiliates are located. These alternative approaches will be explored in separate analyses.

4. Results

4.1. Multinational Production and Emission Intensity

Figure 1 presents the summary measures of the distribution of multinational firms' expected emission intensities (see Equation 1) along with the respective kernel density estimate of the underlying unconditional distribution for each main world region and pollutant. This figure reveals that activities of multinational firms in LAC are generally associated with emission intensity levels that are higher than those located in Europe and lower than those active in Asia (see Figure B1 in Appendix B for evidence on each individual LA sample country).[21]

As discussed above, these patterns can be associated with the distribution of active multinational firms across home countries and sectors. Estimates of alternative specifications of Equation 3 presented in Table 1 suggest that this is indeed the case. When accounting for multinational firms' geographical origins through home country fixed effects and hence using the cross-sector variation within these home countries, those firms present in LAC have significantly higher levels of emission intensity than those in Europe, North America, and Asia (see Column 2 of Table 1). In contrast, when controlling for multinational firms' sector affiliation through sector fixed effects and thus exploiting the cross-home country variation within these sectors, those firms operating in LAC have significantly lower levels of emission intensity than in those other regions (see Column 3 of Table 1). It is worth mentioning that this holds across the different pollutants (see Table B1 in Appendix B for evidence on each individual LA sample country). Overall, these results indicate that, while coming from countries with relatively lower emission intensities, multinational firms active in LAC tend to be concentrated in relatively more polluting sectors.

4.2. Investment Promotion Policies and Emission Intensity

Figures 2 reports the summary measures of the distribution of expected emission intensities of multinational firms that have been assisted by a national IPA and that of their counterparts that have been not supported by these agencies (see Equations 2 and 3), along with the respective kernel density estimate of the underlying unconditional distributions.[22] These figures suggest that assisted multinational firms in LAC consistently have higher levels of emission intensity than non-assisted peers, regardless of the type of pollutant.

[21] In constructing these figures, we exclude outliers, i.e., we remove observations that are above the 99^{th} percentile and below the 1^{st} percentile of the distribution of emissions.

[22] As the data on IPA assistance is only available for the 12 LA countries, all results presented in this and the following subsections concern that subregion. Moreover, in this case, the sample is limited to multinational firms that established at least one foreign affiliate in the host countries. In this regard,

The question naturally arises of what drives these emission patterns associated with actual IPA assistance. As mentioned above, IPAs generally prioritize sectors and, in doing so, they gear their promotion efforts toward firms operating in these sectors. When systematically implemented, this strategy determines to a significant extent the kind of firms that receive support and, as consequence, can shape IPA assistance's environmental implications. To examine whether this is the case, we exploit agency-specific information on priority sectors and accordingly distinguish assisted multinational firms between those that belong to these priority sectors and those that do not belong to them. Figure 3 presents the results of these analysis. This figure reveals that the higher emission intensity of assisted multinational firms is primarily observed in prioritized sectors and hence is largely driven by such sector prioritization.

Estimates of Equation 4 and a variant thereof that allows for different effects for priority and non-priority sectors formally confirm these patterns (see Table 2). While, on average, IPA assistance is associated with higher expected levels of emission intensity when no controls are included or when multinational firms' home countries are accounted for through fixed effects, this only seems to hold for priority sectors when distinguishing between these and non-priority sectors (see Columns 1 and 2). Moreover, expected levels of emission intensity implicit in IPA assistance are lower when multinational sector affiliation is controlled for through fixed effects (Column 3). Together, these estimates indicate that IPAs tend to assist multinational firms operating in less "clean" priority sectors but, within (these) given sectors, firms from "cleaner" countries (see Figure B2 and Table B2 in Appendix B for evidence on each individual LA sample country for which the number of assisted multinational firms is large enough to allow for meaningful patterns). These results reveal a non-trivial, unintentional environmental bias in the composition of IPA priority sectors, which can affect the contribution of their activities towards wider emission reduction goals. These findings make it clear that it is necessary to factor in the sustainability dimension when defining or at least assessing these sectors to explicitly and properly balance economic goals with such environmental goals.

it is worth mentioning that the distributions of pollutants' emission intensities for multinational firms that have been assisted by the IPAs and have established at least one foreign affiliate in the respective countries are virtually identical to those for the multinational firms that have been assisted by the IPAs but have not established a foreign affiliate in the such countries (see Figure A7 in Appendix A). Hence, focusing on assisted multinational firms with foreign affiliates in the LA countries can be expected to generate similar results to considering all multinational (i.e., with and without foreign affiliates in the subregion).

4.3. The Effects of Investment Promotion Policies and Emission Intensity

Finally, armed with the insights on the patterns of multinational firms' emission intensities and that of those associated with IPA support across several countries, we evaluate the impact of such support on the probability of multinational firms establishing a first foreign affiliate (first establishment) or subsequent foreign affiliates (reinvestment) depending on their emission intensity levels. To do so, we estimate Equation 6 and, given the results presented in Subsection 3.3, a variant thereof that allows for different estimated effects for prioritized and non-prioritized sectors. Estimates for first establishment are reported in Panel A of Tables 3 and 4, whereas those for reinvestment are shown in Panel B of these tables.

These estimates indicate that the effectiveness of IPAs in attracting new multinational firms to their countries' territories or inducing already established multinational firms to expand their presence therein through the opening of additional foreign affiliates does not seem to vary systematically with the firms' emission intensity, regardless of the specific type of pollutant (see Table 3, Panels A and B).

Interestingly, in the case of first establishment, the estimated effects of IPA assistance tend to be stronger for multinational firms with the highest (CO_2 and SO_x) or intermediate levels of emission intensity (NO_x, $PM10$, and $PM25$) within priority sectors and for multinational firms with the lowest levels of emission intensity within non-priority sectors, albeit differences between these groups are not always statistically significant (see Table 4, Panel A). The patterns are broadly comparable for reinvestment. IPA support appears to be more effective when multinational firms have emission intensities that are intermediate (SO_x, NO_x, and $PM10$) or high (CO_2) within priority sectors and when multinational firms have emission intensities that are low (CO_2 and NO_x) or low/intermediate (SO_x, $PM10$ and $PM25$) within non-priority sectors.

Overall, these findings suggest that IPA choice of priority sectors is an important channel through which investment promotion policies can affect local environmental outcomes. Hence, it is worth considering and assessing how such a choice be can be aligned more closely with the goals of emission reductions. Thus, for instance, prioritization of sectors that directly contribute to climate change adaption and mitigation policies may translate into reduced environmental bias currently present in IPAs' assistance portfolios and, in turn, result in more frequent establishment of foreign affiliates of multinational firms operating in these sectors in the domestic economies.

5. Concluding Remarks

This paper contributes to the rapidly growing literature on multinational production and sustainability by examining the link between investment promotion policies

and environmental outcomes. More specifically, we have explored whether these policies support or hamper the achievement of broader environmental goals. To do so, we have exploited a novel, unique dataset that combines data on multinational firms' location over time, IPA assistance to individual multinational firms across 12 different LA countries also over time, country-sector-specific levels of emissions by pollutant.

Our results suggest, first, that IPAs' portfolio of assisted multinational firms is skewed towards heavier polluters and that this is primarily driven by these agencies' sector prioritization strategies. Second, our difference-in-differences estimates indicate that, while, on average, IPAs seem to be equally effective in attracting multinational firms with different levels of emission intensities, their promotion efforts appear to have stronger impacts on the location decisions of more polluting multinational firms within priority sectors. Hence, the choice of priority sectors can be an important mechanism through which IPA can redirect their interventions towards sectors or economic activities that support more closely the attainment of environmental goals.[23] In other words, adequate adjustments to IPAs' priority lists can be crucial to ensure both effective investment promotion policies and better environmental outcomes. This could be for instance the case if IPAs target new technologies that favor climate adaption and mitigation.

The empirical approach proposed in this paper can be extended in several dimensions. First, provided that IPA support data is accessible, the country coverage can be easily expanded, thus allowing for useful cross-region comparisons. In so doing, alternative sources of emission data can be used (e.g., Climate Trace). Second, as firm-level emission data is becoming increasingly available through both national pollutant registers and proprietary databases (e.g., Refinitiv, MSCI, Bloomberg, S&P, and Sustainalytics, etc.), computation of summary measures and estimation of distributions and effects of IPA assistance across the emission intensity spectrum can be adapted to exploit this more granular information and achieve higher levels of accuracy (see Tables 5-7 and Figures 4 and 5 for a preliminary application using firm-level emission data from Brazil's IBAMA). Third, the approach can be used to assess the link between investment promotion policies and other sustainability dimensions. Thus, it can be applied on country-sector level data on gender composition of employment (e.g., from ILO) to characterize multinational firms and IPA assistance and evaluate the effects of the latter on these firms' decision to establish a first or subsequent foreign affiliates along the gender dimension. Fourth, our analysis has strictly focused on the direct effects of investment promotion on host economies' environmental performance. It can also be adapted to incorporate the indirect effects through labor turnover and input-output

[23] Many Latin American countries have abundant natural resources and specialize in activities that use them intensely. If IPA priority sectors are selected based on countries' comparative advantage, they might perpetuate the creation of negative environmental externalities.

linkages between multinational firms and domestic firms. This can be accomplished by using data on intersectoral labor mobility and input-output matrices or, even better, on individuals' employment trajectories from social security records and firm-to-firm sales and purchases from tax records. This is precisely the next step in our research agenda.

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Table 1
Expected Emission Intensity of Multinational Firms, by Host Region and Pollutant (Relative to the Rest of the World)

CO2

		(1)	(2)	(3)
LAC		0.1154***	0.1050***	-0.1378***
		(0.0077)	(0.0072)	(0.0052)
Asia		0.2377***	0.0050	0.0983***
		(0.0061)	(0.0058)	(0.0042)
Europe		-0.1591***	-0.0267***	-0.1037***
		(0.0044)	(0.0040)	(0.0030)
North America		0.1486***	0.0237***	-0.0329***
		(0.0068)	(0.0063)	(0.0046)
Fixed Effects				
	Home Country	No	Yes	No
	Sector	No	No	Yes
Observations		581,462	581,462	581,462

SOX

		(1)	(2)	(3)
LAC		-0.0299***	0.0957***	-0.2704***
		(0.0083)	(0.0070)	(0.0059)
Asia		0.2020***	0.0024	0.0351***
		(0.0065)	(0.0057)	(0.0047)
Europe		-0.2872***	-0.0342***	-0.1979***
		(0.0047)	(0.0039)	(0.0033)
North America		0.0458***	0.0180***	-0.1322***
		(0.0073)	(0.0061)	(0.0052)
Fixed Effects				
	Home Country	No	Yes	No
	Sector	No	No	Yes
Observations		581,462	581,462	581,462

NOX

		(1)	(2)	(3)
LAC		0.0320***	0.0945***	-0.2042***
		(0.0080)	(0.0076)	(0.0054)
Asia		0.1178***	-0.0022	-0.0217***
		(0.0063)	(0.0062)	(0.0043)
Europe		-0.1789***	-0.0295***	-0.1115***
		(0.0045)	(0.0042)	(0.0031)
North America		0.0899***	0.0275***	-0.0772***
		(0.0070)	(0.0066)	(0.0048)
Fixed Effects				
	Home Country	No	Yes	No
	Sector	No	No	Yes
Observations		581,462	581,462	581,462

PM10

	(1)	(2)	(3)
LAC	-0.0900***	0.0978***	-0.3295***
	(0.0086)	(0.0076)	(0.0061)
Asia	0.1762***	0.0101	0.0147***
	(0.0068)	(0.0062)	(0.0048)
Europe	-0.2643***	-0.0217***	-0.1899***
	(0.0049)	(0.0043)	(0.0035)
North America	0.0801***	0.0378***	-0.1036***
	(0.0076)	(0.0067)	(0.0054)
Fixed Effects			
Home Country	No	Yes	No
Sector	No	No	Yes
Observations	581,462	581,462	581,462

PM25

	(1)	(2)	(3)
LAC	-0.1031***	0.0956***	-0.3291***
	(0.0084)	(0.0076)	(0.0060)
Asia	0.1168***	0.0048	-0.0291***
	(0.0067)	(0.0062)	(0.0047)
Europe	-0.2547***	-0.0209***	-0.1841***
	(0.0048)	(0.0042)	(0.0034)
North America	0.0614***	0.0383***	-0.1081***
	(0.0074)	(0.0066)	(0.0053)
Fixed Effects			
Home Country	No	Yes	No
Sector	No	No	Yes
Observations	581,462	581,462	581,462

Source: Authors' calculations based on data from WorldBase, national IPAs of sample countries, and EXIOBASE.
The tables report estimates of alternative specifications of Equation (4) for specific pollutants. *** denotes significant at the 1% level; ** denotes significant at the 5%level; and * denotes significant at the 10% level.

Table 2
Expected Emission Intensity of Multinational Firms,
by IPA Assistance Status, IPA Sector Prioritization Status, and Pollutant

CO2

		(1)	(2)	(3)
𝕀(IPA)		0.2365***	0.1763***	-0.1526***
		(0.0193)	(0.0171)	(0.0132)
𝕀(IPA) x Priority Sector		0.8572***	0.6029***	-0.0434*
		(0.0386)	(0.0341)	(0.0264)
𝕀(IPA) x Non-Priority Sector		0.0301	0.0340*	-0.1888***
		(0.0223)	(0.0198)	(0.0152)
Fixed Effects				
	Home Country	No	Yes	No
	Sector	No	No	Yes
Observations		581,462	581,462	581,462

SOX

		(1)	(2)	(3)
𝕀(IPA)		0.2365***	0.1763***	-0.1526***
		(0.0193)	(0.0171)	(0.0132)
𝕀(IPA) x Priority Sector		0.8986***	0.6949***	-0.0934***
		(0.0417)	(0.0335)	(0.0296)
𝕀(IPA) x Non-Priority Sector		-0.0691***	-0.0015	-0.2540***
		(0.0241)	(0.0194)	(0.0170)
Fixed Effects				
	Home Country	No	Yes	No
	Sector	No	No	Yes
Observations		581,462	581,462	581,462

NOX

		(1)	(2)	(3)
𝕀(IPA)		0.2365***	0.1763***	-0.1526***
		(0.0193)	(0.0171)	(0.0132)
𝕀(IPA) x Priority Sector		0.7158***	0.5510***	-0.0673**
		(0.0401)	(0.0360)	(0.0271)
𝕀(IPA) x Non-Priority Sector		-0.0129	0.0286	-0.2340***
		(0.0232)	(0.0208)	(0.0156)
Fixed Effects				
	Home Country	No	Yes	No
	Sector	No	No	Yes
Observations		581,462	581,462	581,462

PM10

		(1)	(2)	(3)
𝕀(IPA)		0.2365***	0.1763***	-0.1526***
		(0.0193)	(0.0171)	(0.0132)
𝕀(IPA) x Priority Sector		0.8615***	0.7066***	-0.0954***
		(0.0434)	(0.0363)	(0.0306)
𝕀(IPA) x Non-Priority Sector		-0.0757***	0.0148	-0.2826***
		(0.0250)	(0.0210)	(0.0176)
Fixed Effects				
	Home Country	No	Yes	No
	Sector	No	No	Yes
Observations		581,462	581,462	581,462

PM25

		(1)	(2)	(3)
𝕀(IPA)		0.2365***	0.1763***	-0.1526***
		(0.0193)	(0.0171)	(0.0132)
𝕀(IPA) x Priority Sector		0.7551***	0.6327***	-0.1006***
		(0.0425)	(0.0361)	(0.0299)
𝕀(IPA) x Non-Priority Sector		-0.0746***	0.0204	-0.2777***
		(0.0245)	(0.0209)	(0.0173)
Fixed Effects				
	Home Country	No	Yes	No
	Sector	No	No	Yes
Observations		581,462	581,462	581,462

Source: Authors' calculations based on data from WorldBase, national IPAs of sample countries, and EXIOBASE.
The tables report estimates of alternative specifications of Equation (5) for specific pollutants. *** denotes significant at the 1% level; ** denotes significant at the 5%level; and * denotes significant at the 10% level.

Table 3
Impact of Investment Promotion Assistance,
by Expected Levels of Emission Intensity of Pollutants

A. Multinational Firms' First Establishment

	CO2 (1)	SOX (2)	NOX (3)	PM10 (4)	PM25 (5)
$\mathbb{I}$(IPA)$_{fchst}$ x Emission Intensity$_{hs}$					
Low: Below P^{25}	0.076***	0.077***	0.079***	0.077***	0.076***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Intermediate: P^{25}-P^{75}	0.077***	0.077***	0.074***	0.078***	0.078***
	(0.007)	(0.007)	(0.006)	(0.007)	(0.007)
High: Above P^{75}	0.077***	0.074***	0.070***	0.069***	0.073***
	(0.009)	(0.010)	(0.009)	(0.009)	(0.009)
Fixed Effects					
Firm-Host Country	Yes	Yes	Yes	Yes	Yes
Firm-Year	Yes	Yes	Yes	Yes	Yes
Home Country-Host Country-Sector-Year	Yes	Yes	Yes	Yes	Yes
Observations	11,474,654	11,474,654	11,474,654	11,474,654	11,474,654

B. Multinational Firms' Reinvestment

	CO2 (1)	SOX (2)	NOX (3)	PM10 (4)	PM25 (5)
$\mathbb{I}$(IPA)$_{fchst}$ x Emission Intensity$_{hs}$					
Low: Below P^{25}	0.093***	0.088***	0.092***	0.077***	0.080***
	(0.023)	(0.023)	(0.024)	(0.022)	(0.022)
Intermediate: P^{25}-P^{75}	0.080**	0.110***	0.078**	0.129***	0.116***
	(0.040)	(0.037)	(0.034)	(0.040)	(0.037)
High: Above P^{75}	0.107*	0.059	0.173***	0.077*	0.113**
	(0.060)	(0.056)	(0.056)	(0.043)	(0.047)
Fixed Effects					
Firm-Host Country	Yes	Yes	Yes	Yes	Yes
Firm-Year	Yes	Yes	Yes	Yes	Yes
Home Country-Host Country-Sector-Year	Yes	Yes	Yes	Yes	Yes
Observations	82,042	82,042	82,042	82,042	82,042

Source: Authors' calculations based on data from WorldBase, national IPAs of sample countries, and EXIOBASE.
The tables report estimates of alternative specifications of Equation (6) for specific pollutants. *** denotes significant at the 1% level; ** denotes significant at the 5%level; and * denotes significant at the 10% level.

Table 4
Impact of Investment Promotion Assistance,
by IPA Sector Prioritization Status and Expected Levels of Emission Intensity of Pollutants

A. Multinational Firms' First Establishment

	CO2 (1)	SOX (2)	NOX (3)	PM10 (4)	PM25 (5)
$\mathbb{I}(IPA)_{fchst}$ x Priority $Sector_{cs}$ x $Emission\ Intensity_{hs}$					
Low: Below P^{25}	0.059***	0.064***	0.057***	0.055***	0.058***
	(0.011)	(0.012)	(0.011)	(0.011)	(0.011)
Intermediate: P^{25}-P^{75}	0.098***	0.098***	0.127***	0.130***	0.131***
	(0.019)	(0.018)	(0.022)	(0.022)	(0.024)
High: Above P^{75}	0.134***	0.116***	0.105***	0.100***	0.099***
	(0.030)	(0.030)	(0.026)	(0.026)	(0.025)
$\mathbb{I}(IPA)_{fchst}$ x Non-Priority $Sector_{cs}$ x $Emission\ Intensity_{hs}$					
Low: Below P^{25}	0.079***	0.079***	0.084***	0.082***	0.080***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Intermediate: P^{25}-P^{75}	0.073***	0.072***	0.066***	0.069***	0.069***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
High: Above P^{75}	0.065***	0.064***	0.062***	0.062***	0.067***
	(0.010)	(0.010)	(0.009)	(0.010)	(0.010)
Fixed Effects					
Firm-Host Country	Yes	Yes	Yes	Yes	Yes
Firm-Year	Yes	Yes	Yes	Yes	Yes
Home Country-Host Country-Sector-Year	Yes	Yes	Yes	Yes	Yes
Observations	11,474,654	11,474,654	11,474,654	11,474,654	11,474,654

B. Multinational Firms' Reinvestment

	CO2 (1)	SOX (2)	NOX (3)	PM10 (4)	PM25 (5)
$\mathbb{I}(IPA)_{fchst}$ x Priority $Sector_{cs}$ x $Emission\ Intensity_{hs}$					
Low: Below P^{25}	0.070	0.061	0.028	0.067	0.051
	(0.092)	(0.089)	(0.081)	(0.087)	(0.071)
Intermediate: P^{25}-P^{75}	0.130*	0.199***	0.221***	0.182***	0.210***
	(0.077)	(0.071)	(0.074)	(0.069)	(0.076)
High: Above P^{75}	0.211***	0.116	0.170***	0.128*	0.208***
	(0.077)	(0.087)	(0.054)	(0.067)	(0.049)
$\mathbb{I}(IPA)_{fchst}$ x Non-Priority $Sector_{cs}$ x $Emission\ Intensity_{hs}$					
Low: Below P^{25}	0.095***	0.091***	0.097***	0.079***	0.083***
	(0.025)	(0.025)	(0.026)	(0.024)	(0.024)
Intermediate: P^{25}-P^{75}	0.069	0.087**	0.048	0.114**	0.098**
	(0.044)	(0.041)	(0.036)	(0.045)	(0.040)
High: Above P^{75}	0.050	0.030	0.166**	0.046	0.053
	(0.073)	(0.063)	(0.072)	(0.052)	(0.070)
Fixed Effects					
Firm-Host Country	Yes	Yes	Yes	Yes	Yes
Firm-Year	Yes	Yes	Yes	Yes	Yes
Home Country-Host Country-Sector-Year	Yes	Yes	Yes	Yes	Yes
Observations	82,042	82,042	82,042	82,042	82,042

Source: Authors' calculations based on data from WorldBase, national IPAs of sample countries, and EXIOBASE.
The tables report estimates of alternative specifications of Equation (6) for specific pollutants. *** denotes significant at the 1% level; ** denotes significant at the 5%level; and * denotes significant at the 10% level.

Table 5
Emission Intensity of Established Multinational Firms in Brazil, by Home Region and Pollutant
(Relative to the Rest of the World)

	CO2		SOX		NOX		PM	
Asia	-2.062**	-1.150	-2.311***	-1.209	-1.820***	-0.621	-1.243**	-0.552
	(0.844)	(0.970)	(0.758)	(0.746)	(0.603)	(0.765)	(0.515)	(0.603)
Europe	-1.666**	-1.340*	-1.211**	-1.065*	-0.953*	-0.948	-0.539	-0.653
	(0.705)	(0.707)	(0.602)	(0.613)	(0.545)	(0.607)	(0.455)	(0.485)
LAC	-0.814	-0.311	-0.116	-0.236	-1.126	-0.774	-1.238	-0.824
	(1.393)	(1.567)	(1.085)	(1.235)	(0.847)	(0.935)	(0.907)	(0.961)
North America	-1.871**	-1.633*	-2.052***	-1.311	-1.463**	-1.045	-1.417***	-1.692***
	(0.828)	(0.930)	(0.690)	(0.865)	(0.615)	(0.799)	(0.499)	(0.594)
Fixed Effects								
Sector	No	Yes	No	Yes	No	Yes	No	Yes
Year	No	Yes	No	Yes	No	Yes	No	Yes
Observations	1,030	1,030	831	831	1,225	1,225	1,762	1,726

Source: Authors' calculations based on data from WorldBase, Central Bank of Brazil, APEX, RAIS, and IBAMA.
The tables report estimates of alternative specifications of Equation (4) for specific pollutants. *** denotes significant at the 1% level; ** denotes significant at the 5%level; and * denotes significant at the 10% level.

Table 6
Emission Intensity of Established Multinational Firms in Brazil, by IPA Assistance Status, and Pollutant

	CO2		SOX		NOX		PM	
𝕀(IPA)	-0.005**	0.001	-0.001	-0.001	-0.006***	-0.002	0.011	0.011
	(0.002)	(0.005)	(0.001)	(0.001)	(0.002)	(0.005)	(0.015)	(0.011)
Fixed Effects								
Sector	No	Yes	No	Yes	No	Yes	No	Yes
Home Country	No	Yes	No	Yes	No	Yes	No	Yes
Year	No	Yes	No	Yes	No	Yes	No	Yes
Observations	1,136	1,136	913	913	1,291	1,291	1,823	1,823

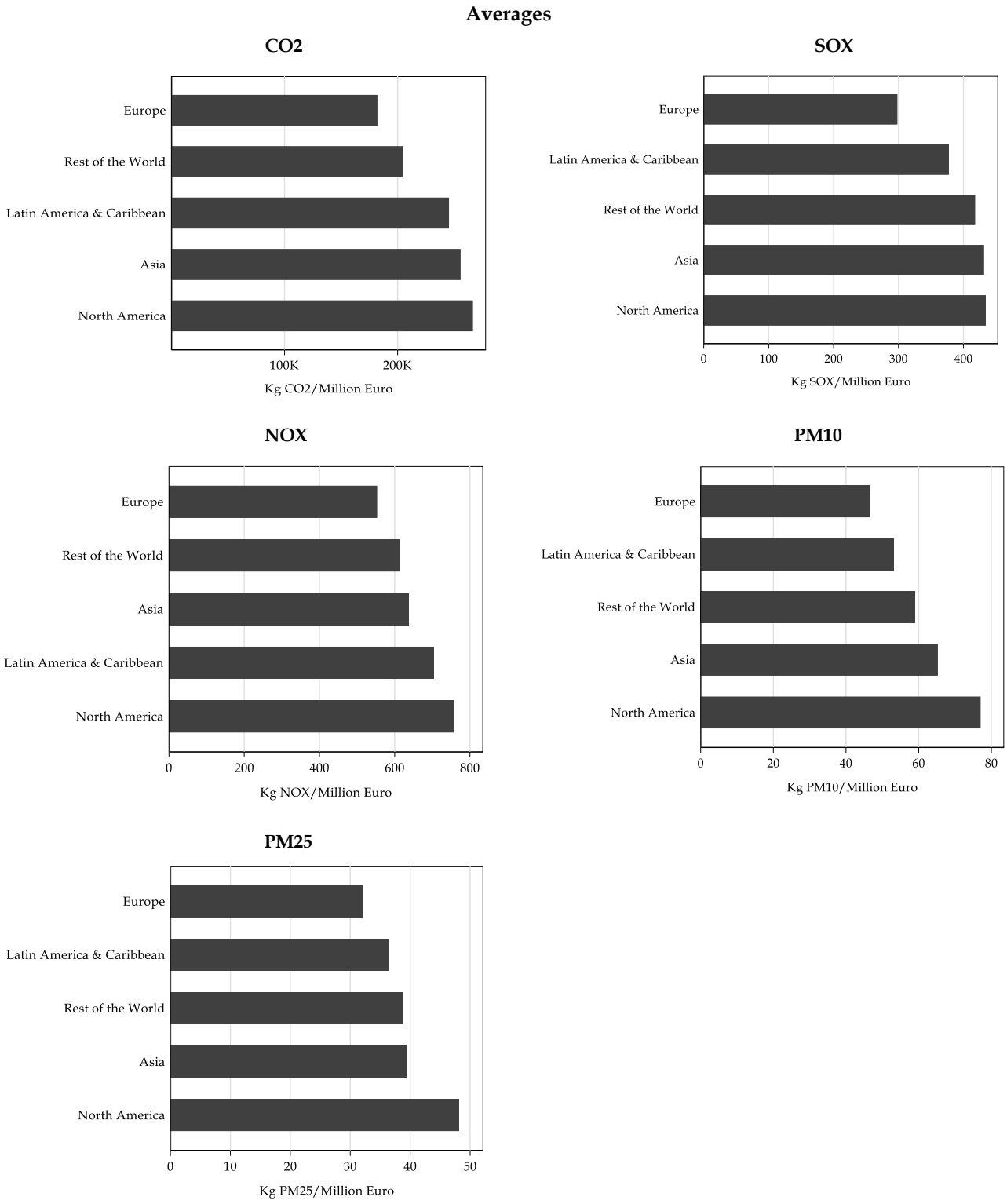
Source: Authors' calculations based on data from WorldBase, Central Bank of Brazil, APEX, RAIS, and IBAMA.
The tables report estimates of alternative specifications of Equation (5) for specific pollutants. *** denotes significant at the 1% level; ** denotes significant at the 5%level; and * denotes significant at the 10% level.

Table 7
Impact of Investment Promotion Assistance on Reinvestment in Brazil, by Levels of Emission Intensity of Pollutants

	CO2		SOX		NOX		PM	
𝕀(IPA) x Emission Intensity								
Low: Below P^{25}	0.154	0.194	0.233**	0.289***	0.104	0.149	0.096	0.119*
	(0.149)	(0.147)	(0.111)	(0.095)	(0.105)	(0.112)	(0.068)	(0.070)
Intermediate: P^{25}-P^{75}	0.050	0.081	0.259*	0.243*	0.137	0.164*	0.203**	0.192*
	(0.079)	(0.083)	(0.140)	(0.145)	(0.095)	(0.097)	(0.100)	(0.010)
High: Above P^{75}	0.307*	0.295*	0.326	0.286	0.223	0.270	0.299**	0.285**
	(0.184)	(0.172)	(0.219)	(0.201)	(0.180)	(0.170)	(0.130)	(0.137)
Fixed Effects								
Sector	No	Yes	No	Yes	No	Yes	No	Yes
Country	No	Yes	No	Yes	No	Yes	No	Yes
Year	No	Yes	No	Yes	No	Yes	No	Yes
Observations	1,136	1,136	913	913	1,291	1,291	1,823	1,823

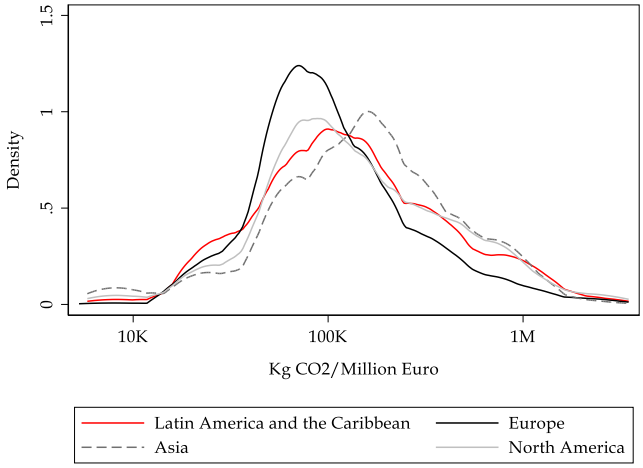
Source: Authors' calculations based on data from WorldBase, Central Bank of Brazil, APEX, RAIS, and IBAMA.
The tables report estimates of alternative specifications of Equation (6) for specific pollutants. *** denotes significant at the 1% level; ** denotes significant at the 5%level; and * denotes significant at the 10% level.

Figure 1
Expected Emission Intensity of Multinational Firms,
by Host Region and Pollutant

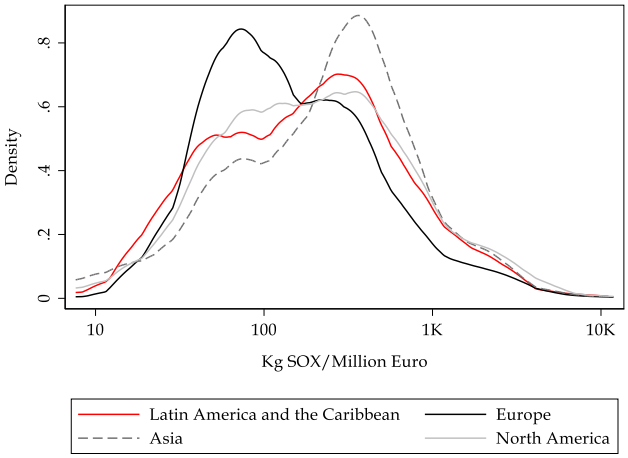


Distributions

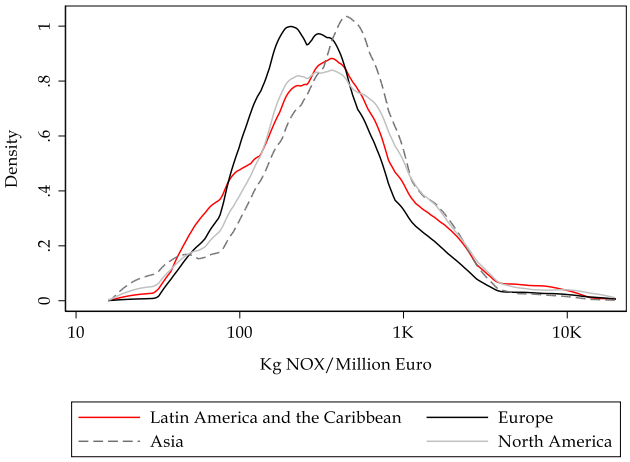
CO2



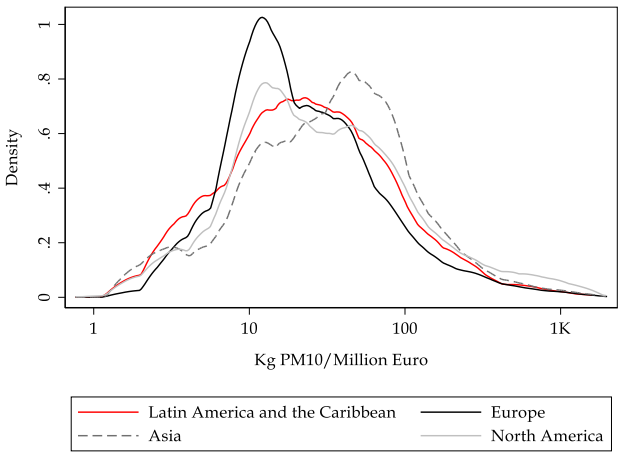
SOX



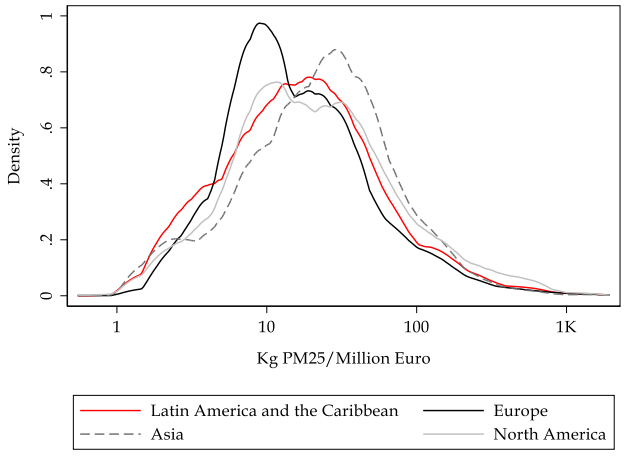
NOX



PM10

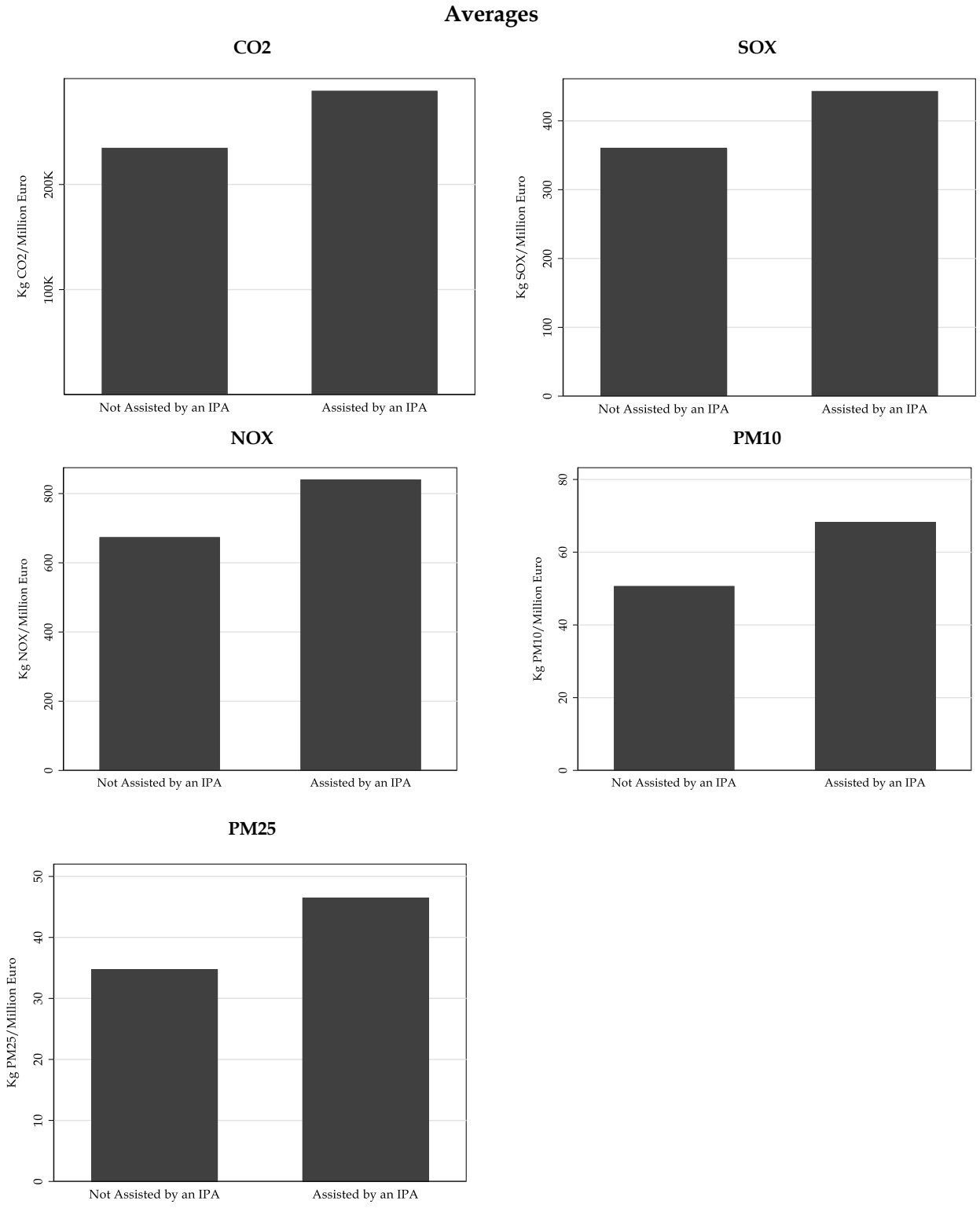


PM25



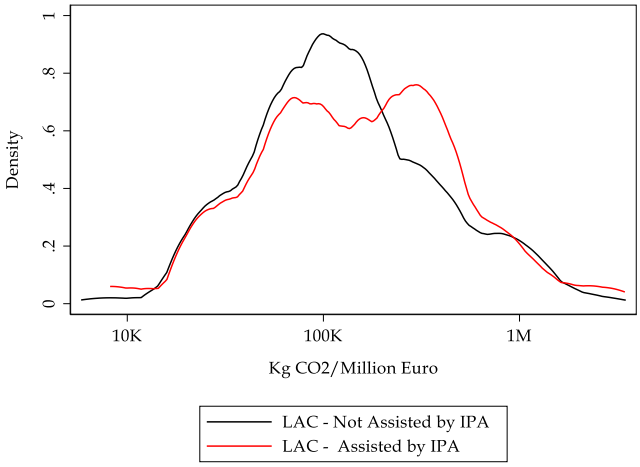
Source: Authors' calculations based on data from WorldBase, national IPAs of sample countries, and EXIOBASE.

Figure 2
Expected Emission Intensity of Multinational Firms, by IPA Assistance Status and Pollutant

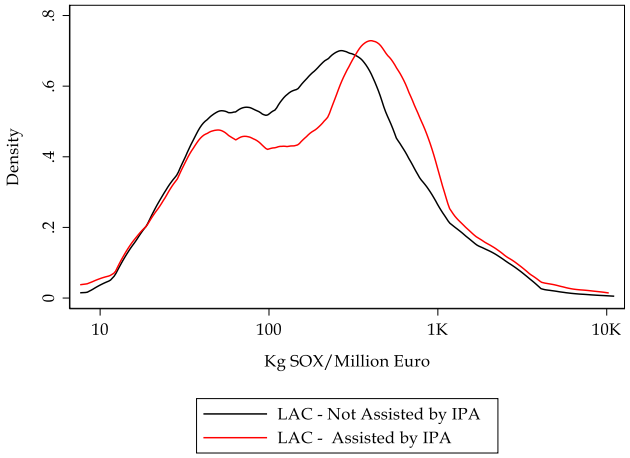


Distributions

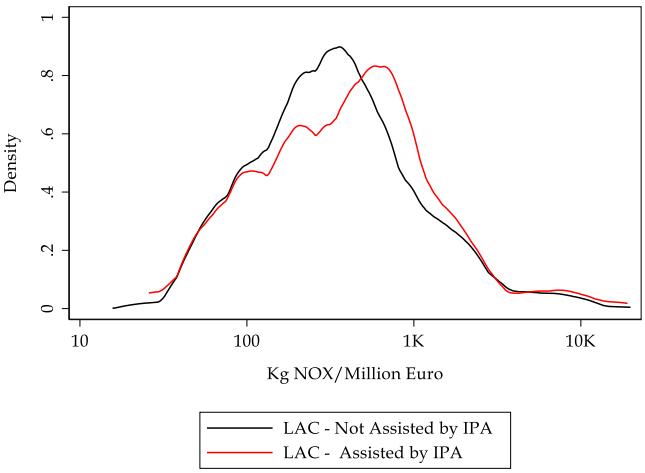
CO2



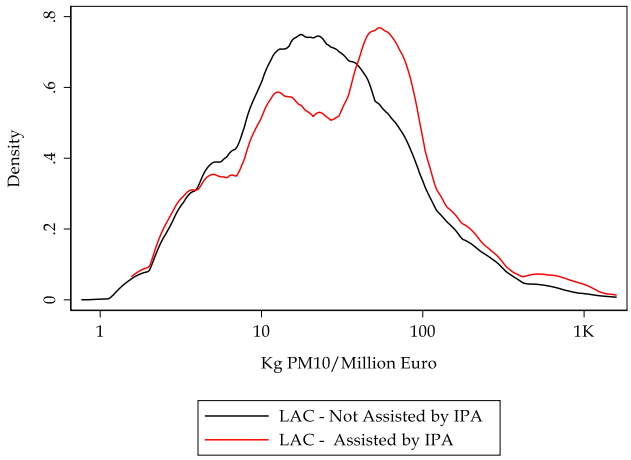
SOX



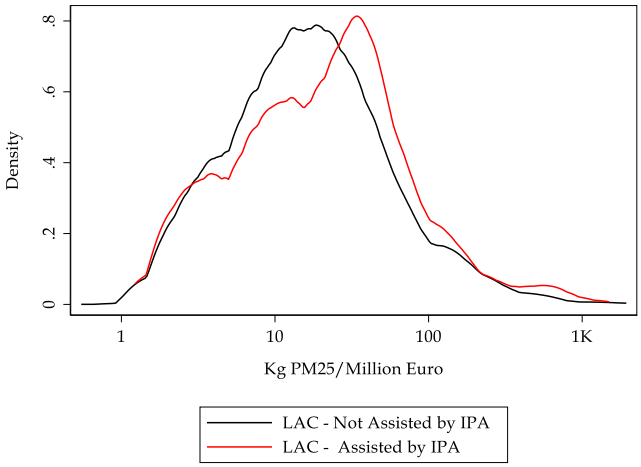
NOX



PM10

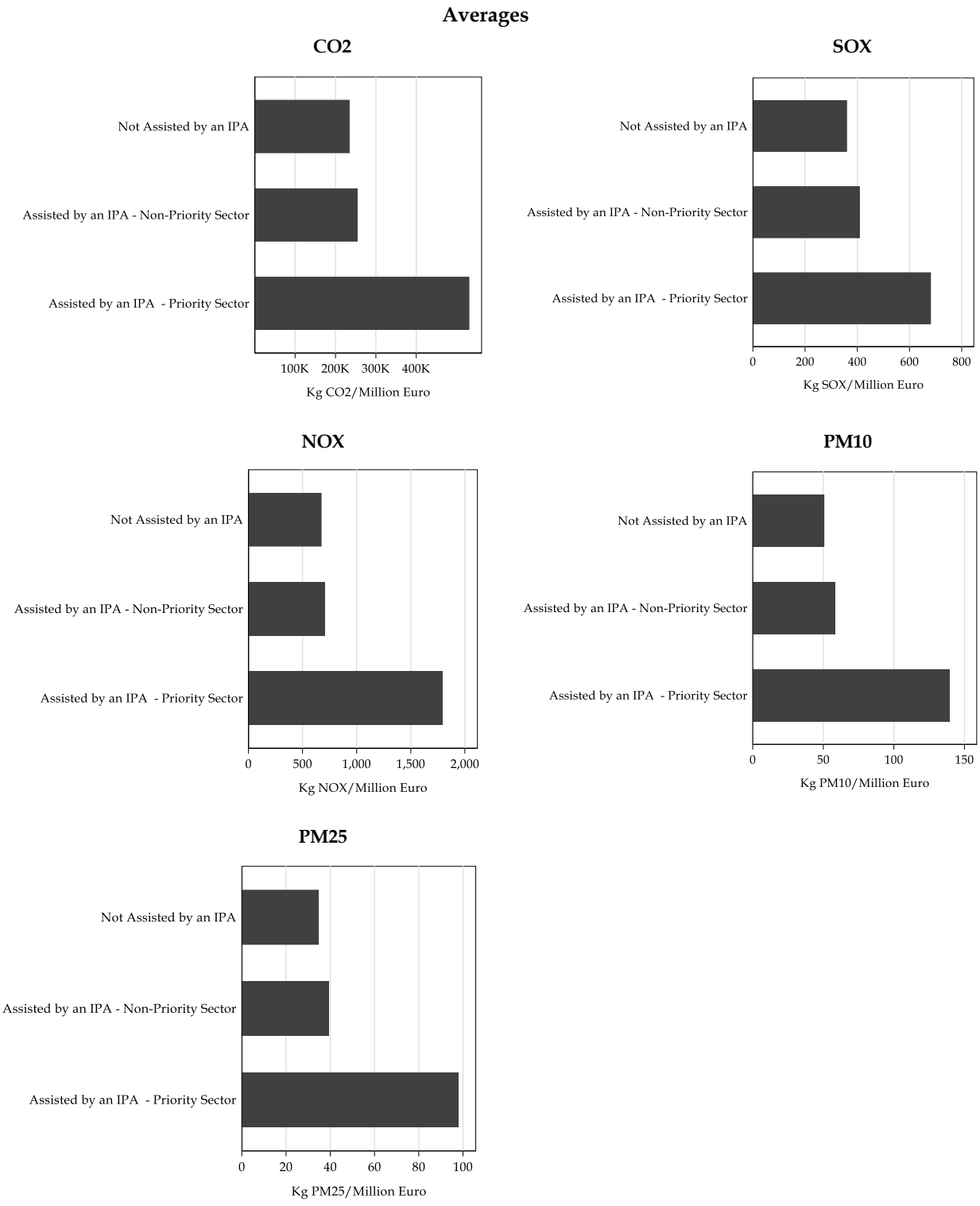


PM25

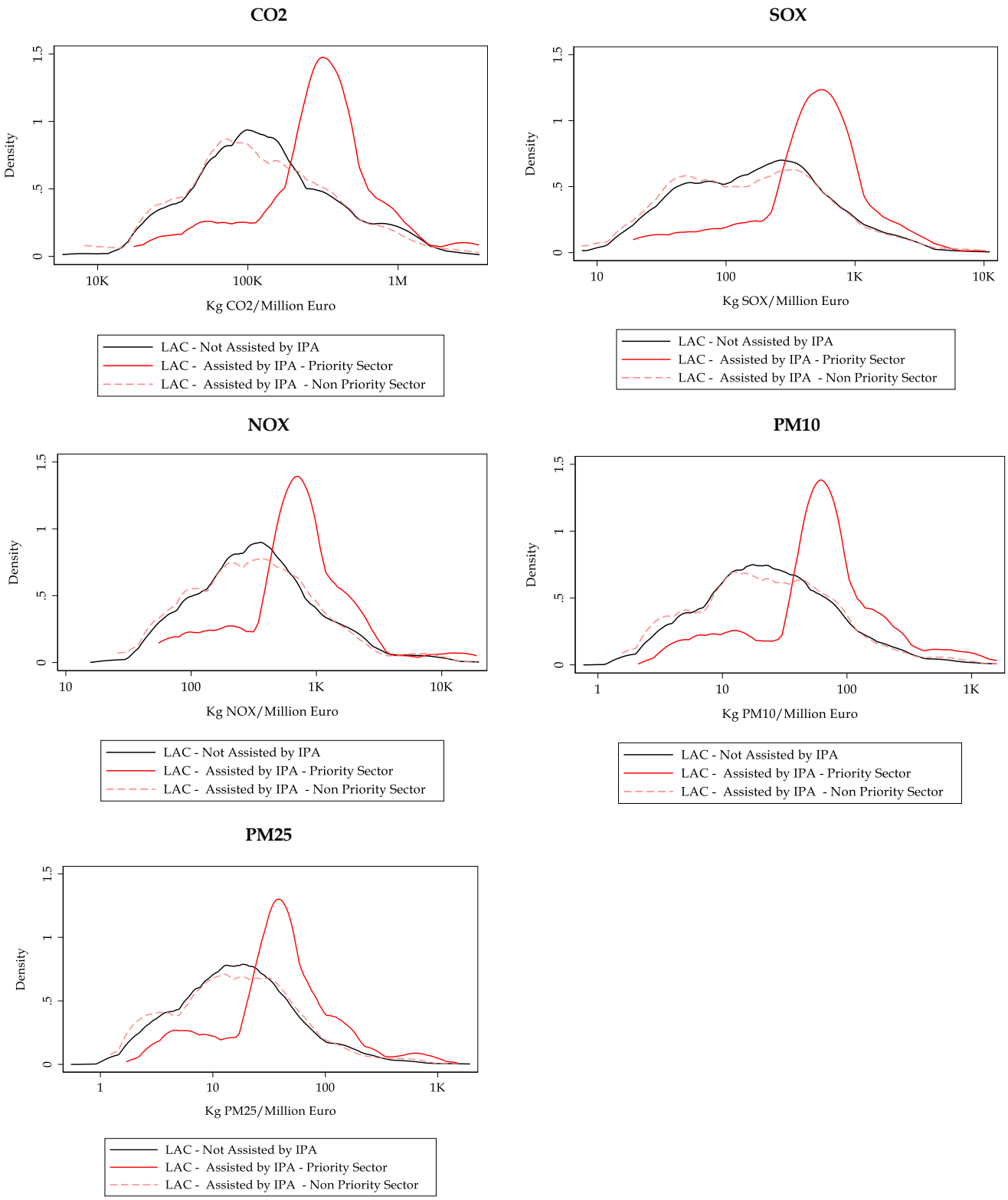


Source: Authors' calculations based on data from WorldBase, national IPAs of sample countries, and EXIOBASE.

Figure 3
Expected Emission Intensity of Multinational Firms,
by IPA Assistance Status, IPA Sector Prioritization Status, and Pollutant



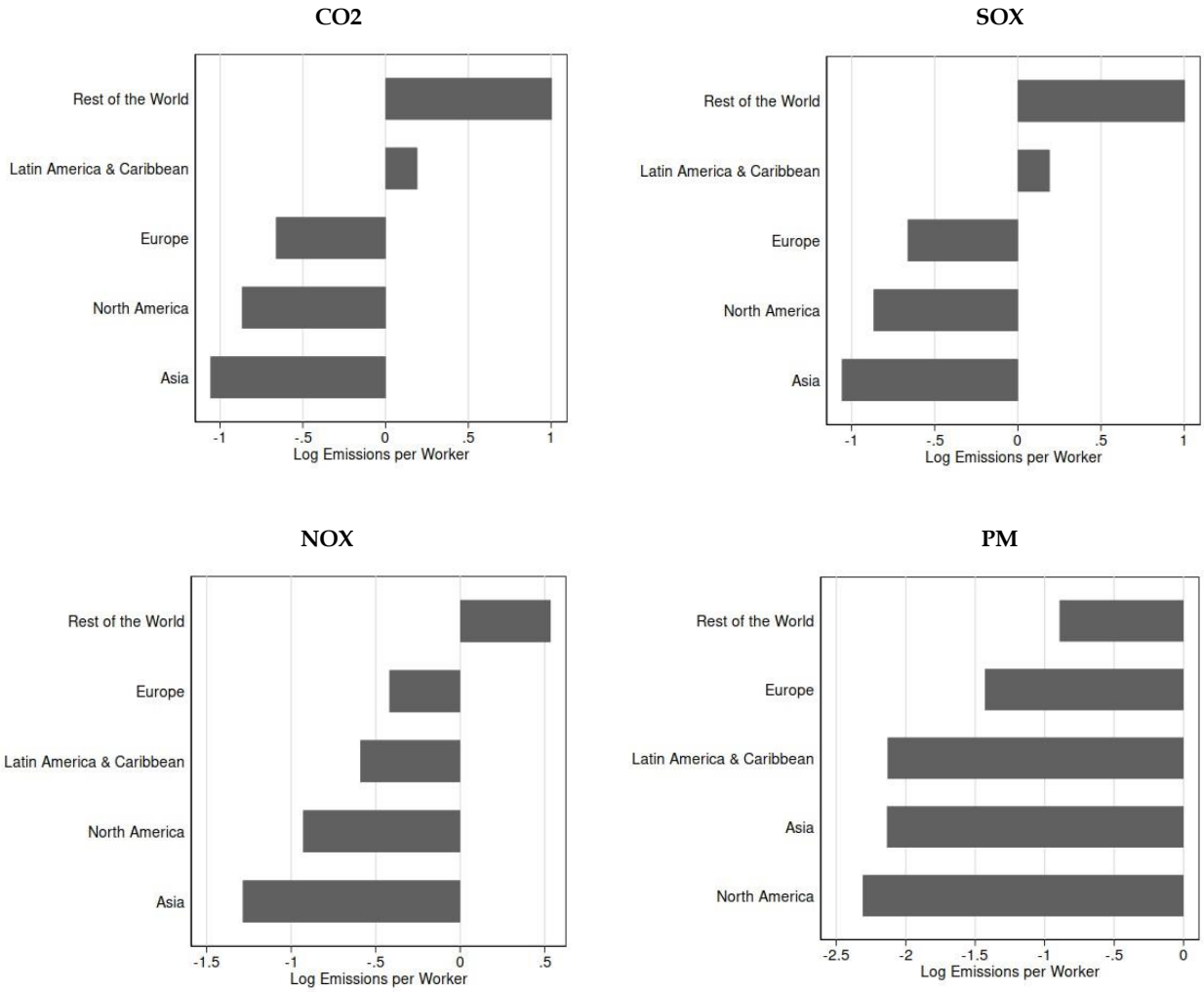
Distributions



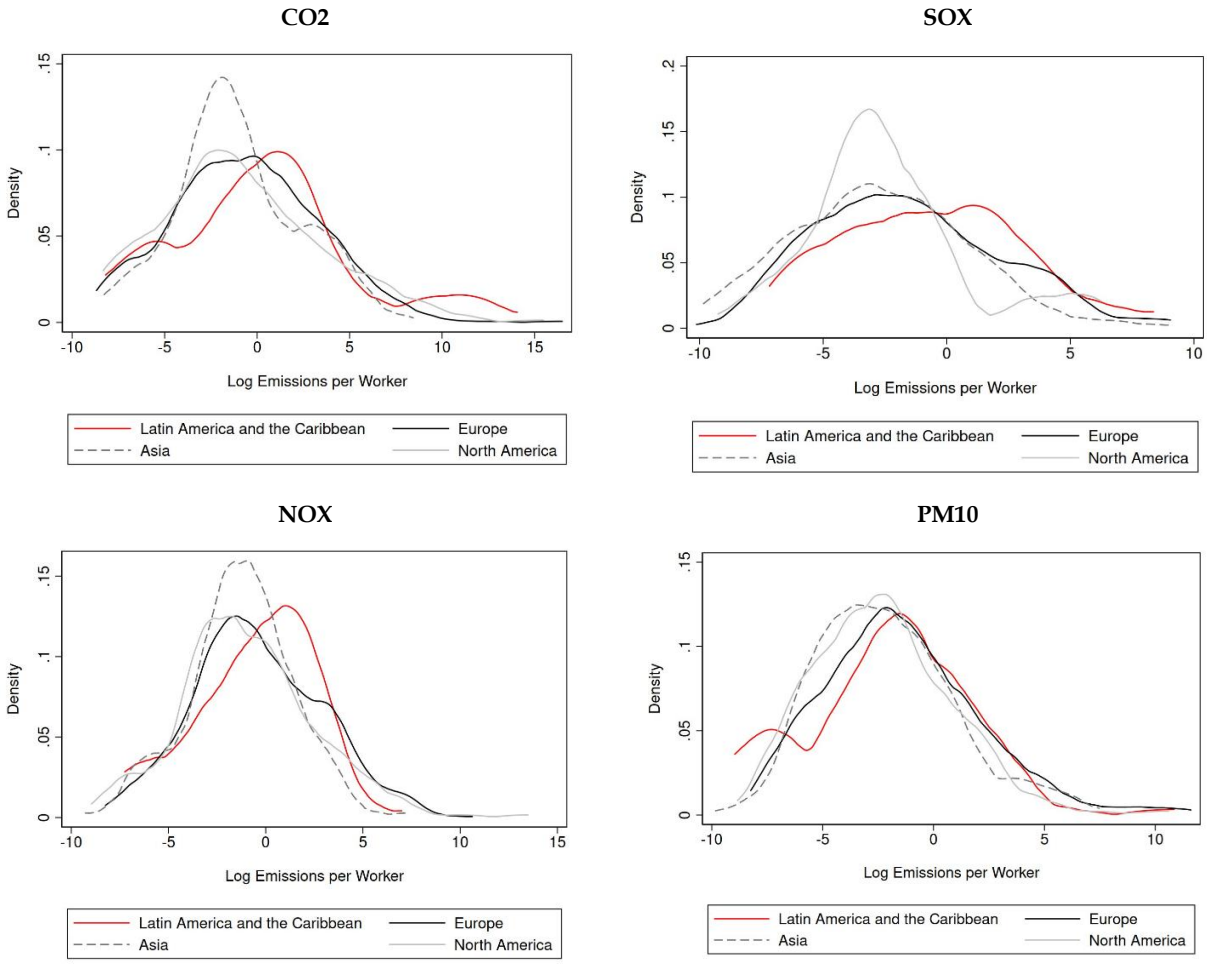
Source: Authors' calculations based on data from WorldBase, national IPAs of sample countries, and EXIOBASE.

Figure 4
Emission Intensity of Multinational Firms Established in Brazil, by Home Region and Pollutant

Averages

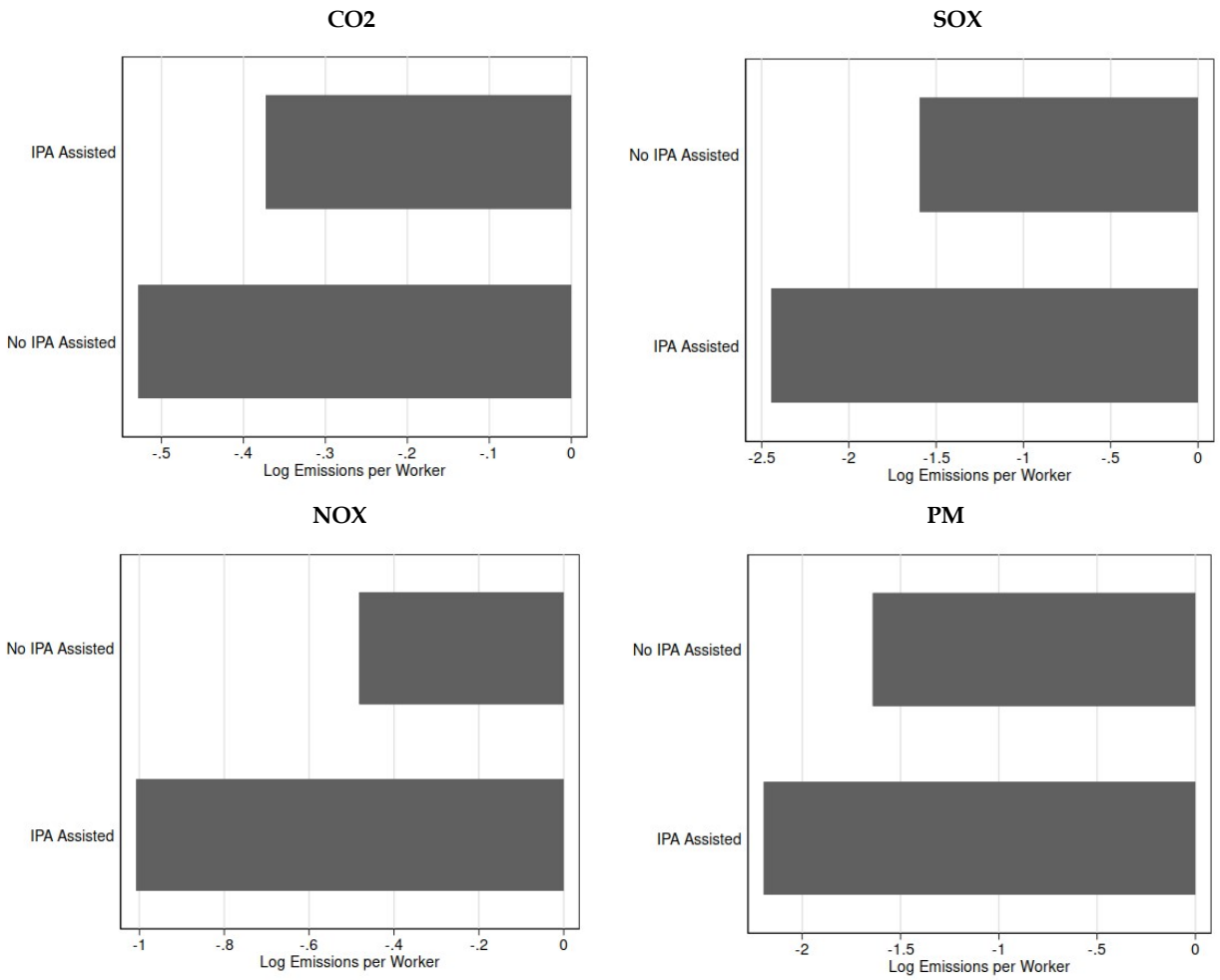


Distributions

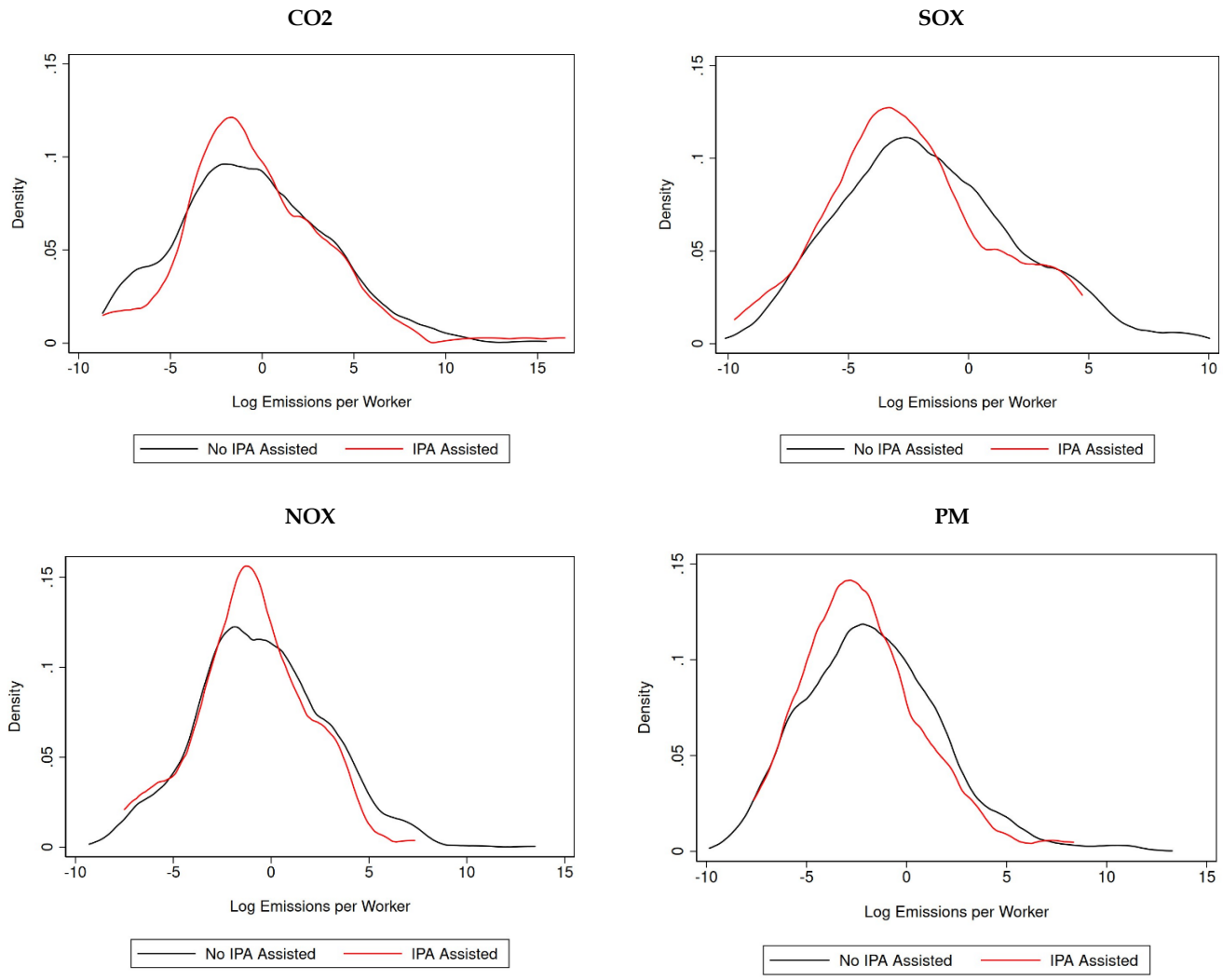


Source: Authors' calculations based on data from WorldBase, Central Bank of Brazil, APEX, RAIS, and IBAMA.

Figure 5
Emission Intensity of Multinational Firms Established in Brazil, by IPA Assistance Status and Pollutant



Distributions



Source: Authors' calculations based on data from WorldBase, Central Bank of Brazil, APEX, RAIS, and IBAMA.

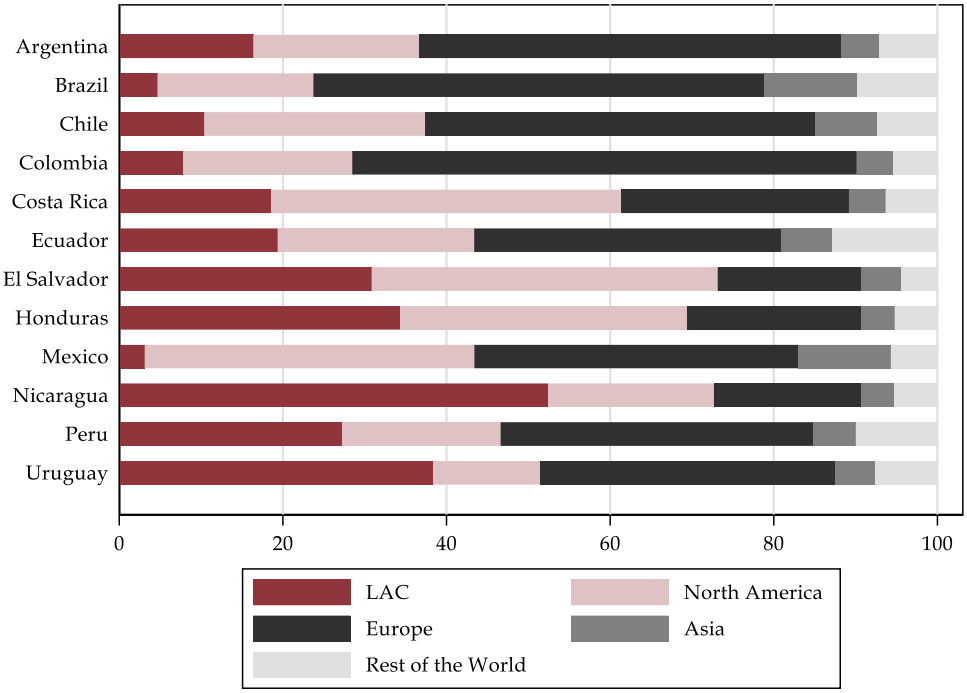
Appendix A

Table A1
Number of Firms Assisted Multinational Firms by Country

Country	IPA	Sample Years	Number of Firms Assisted
Argentina	AAICI	2015-2017	339
Brazil	APEX	2009-2017	529
Chile	InvestChile	2016-2017	102
Colombia	PROCOLOMBIA	2009-2017	222
Costa Rica	CINDE	2000-2016	170
Ecuador	PROECUADOR	2014-2017	61
Honduras	FIDE	2011-2017	26
Mexico	PROMEXICO	2008-2017	2,285
Nicaragua	PRONICARAGUA	2010-2017	55
Peru	PROINVERSION	2012-2017	166
El Salvador	PROESA	2010-2017	137
Uruguay	URUGUAY XXI	2000-2017	208

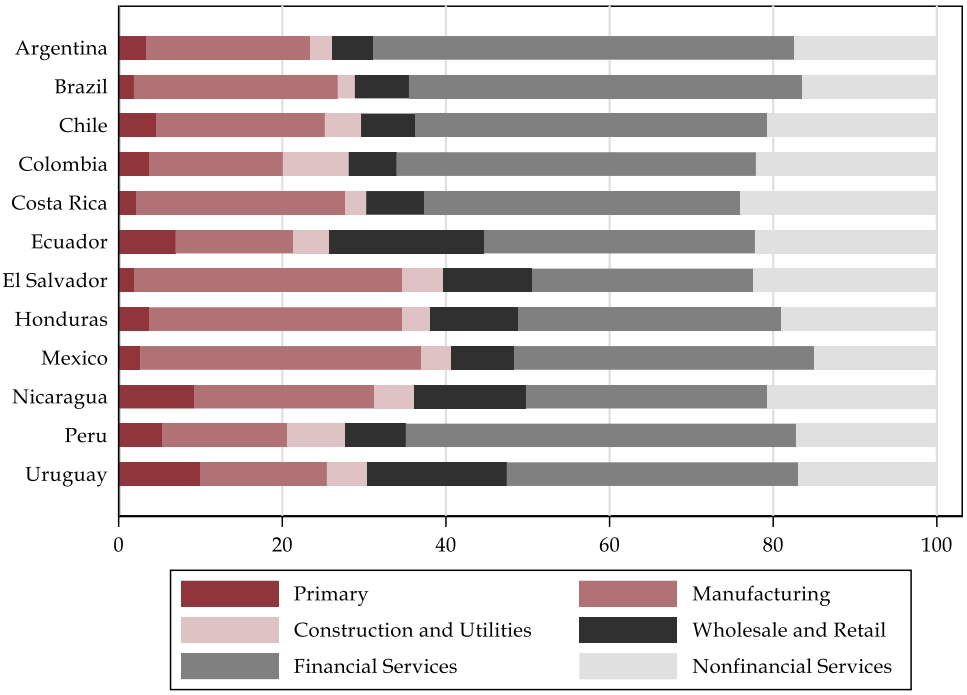
Source: Authors' calculations.

Figure A1
Distribution of Multinational Firms' Foreign Affiliates by Host Country and Home Region



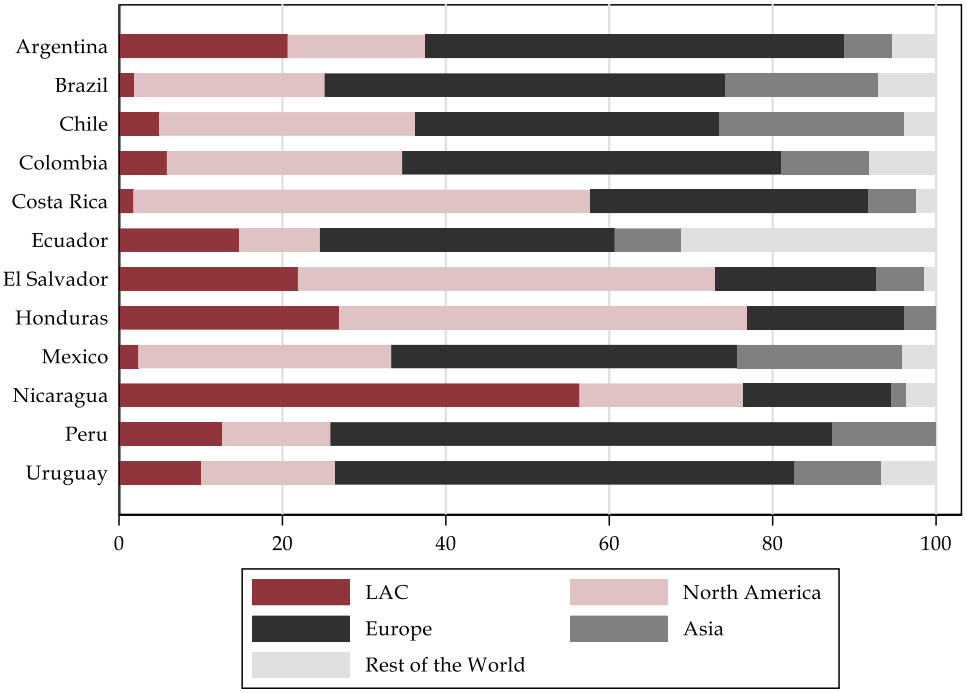
Source: Authors' calculations based on data from WorldBase and national IPAs of samples countries.

Figure A2
Distribution of Multinational Firms' Foreign Affiliates, by Host Country and Sector



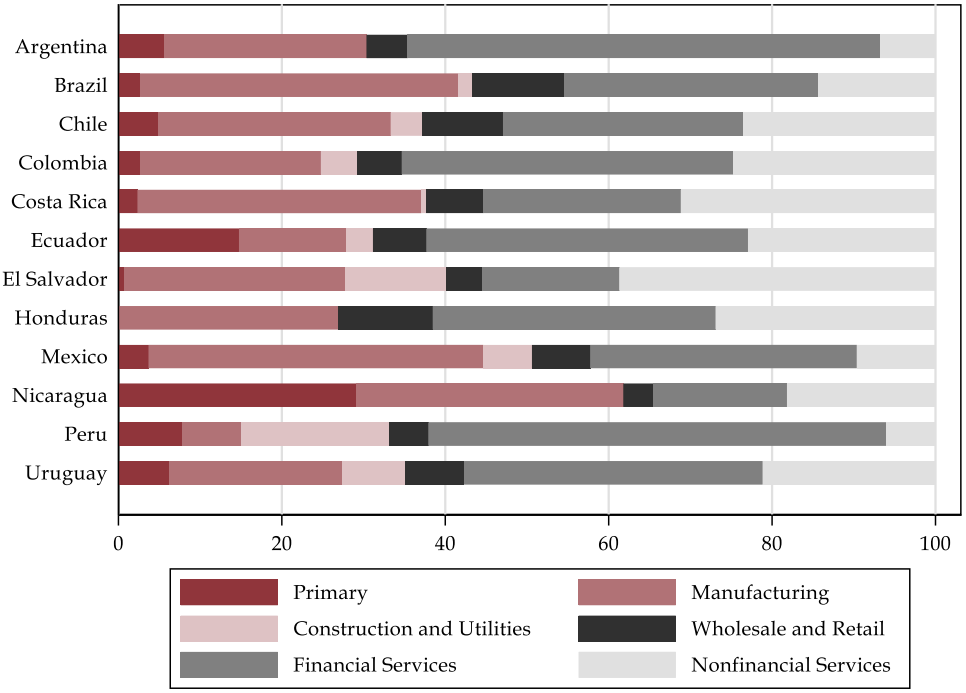
Source: Authors' calculations based on data from WorldBase and national IPAs of samples countries.

Figure A3
Distribution of Assisted Established Multinational Firms, by Host Country and Home Region



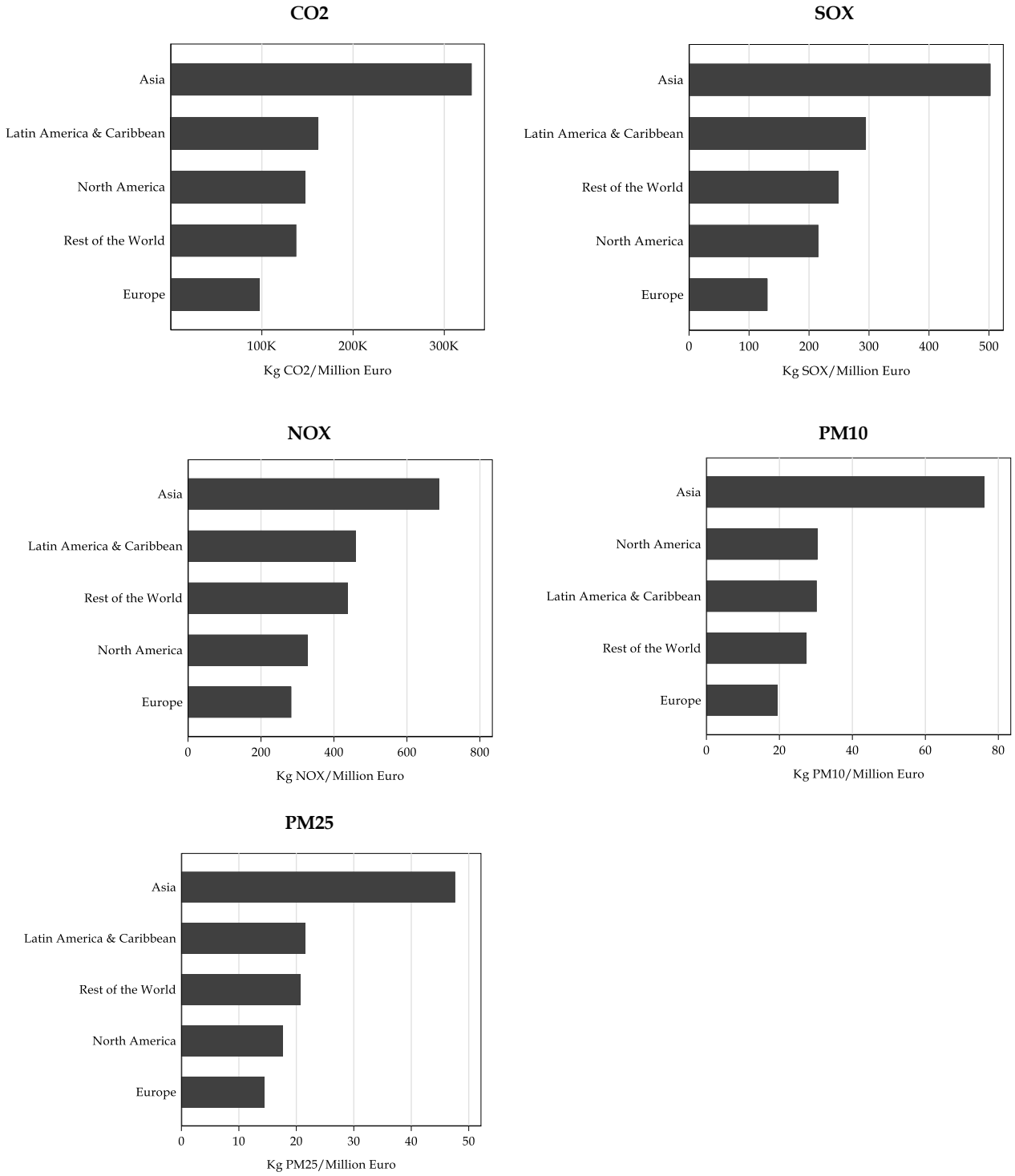
Source: Authors' calculations based on data from WorldBase and national IPAs of samples countries.

Figure A4
Distribution of Assisted Established Multinational Firms, by Host Country and Sector



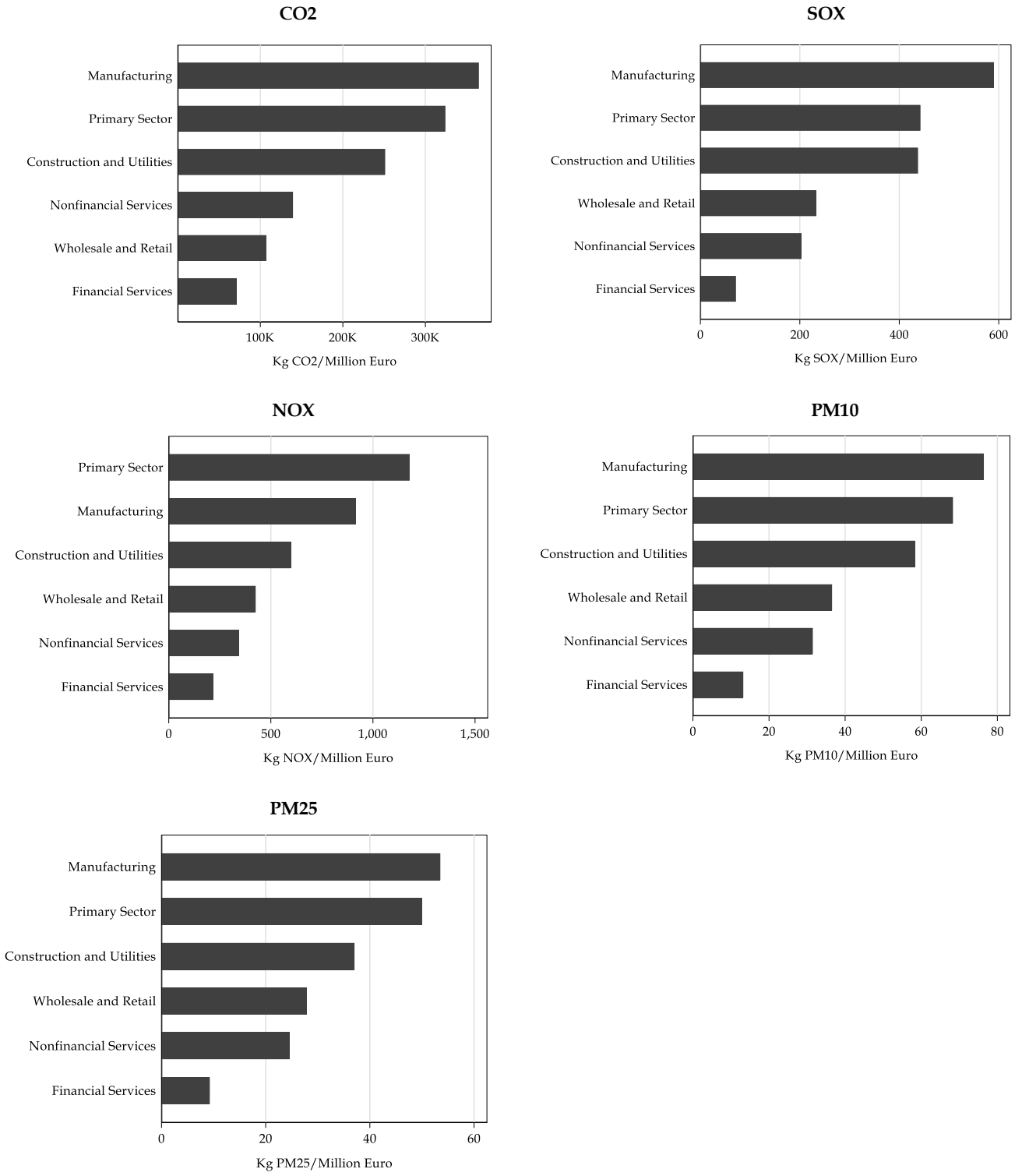
Source: Authors' calculations based on data from WorldBase and national IPAs of samples countries.

Figure A5
Average Expected Emission Intensity of Multinational Firms, by Home Region



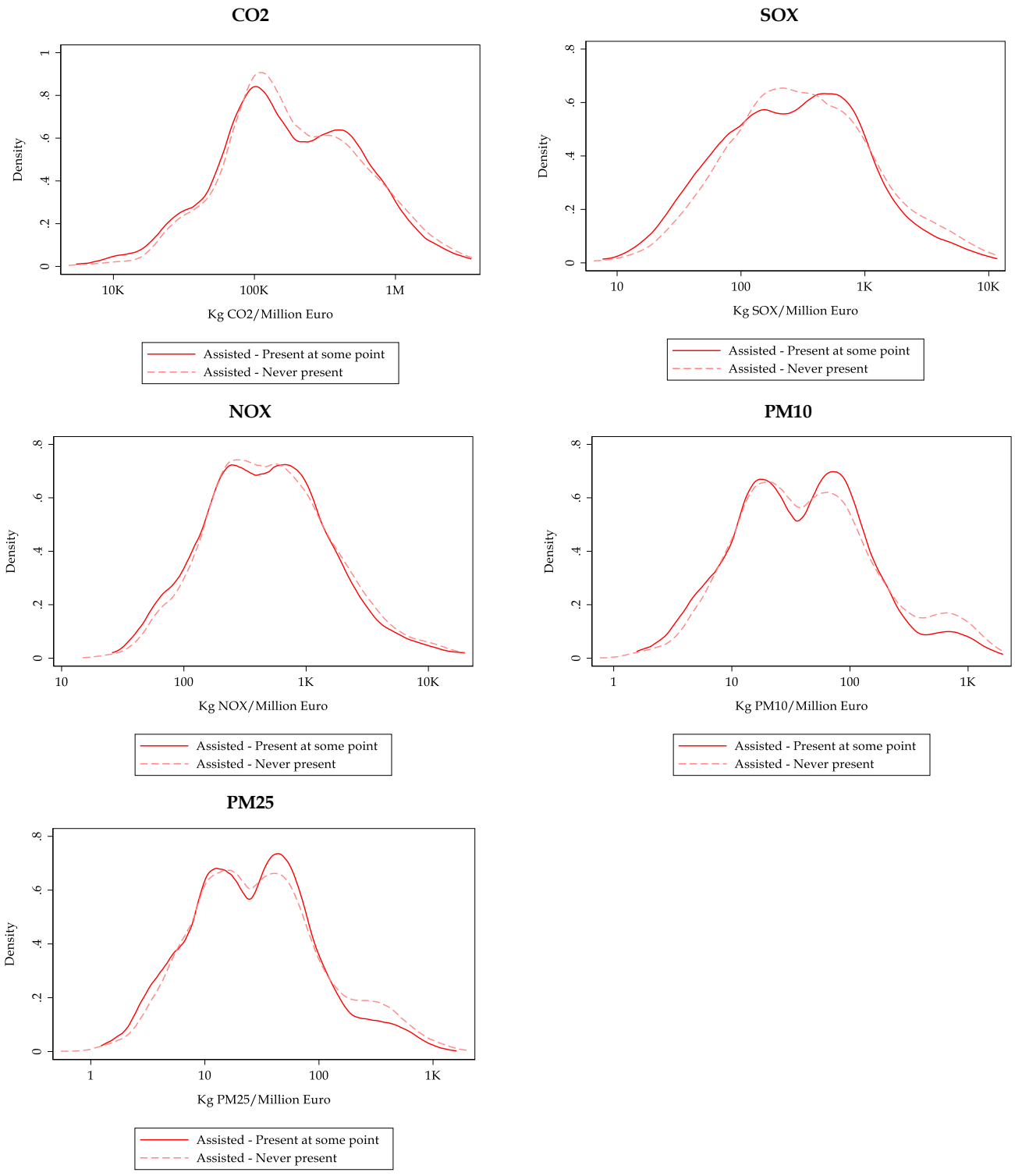
Source: Authors' calculations based on data from WorldBase, national IPAs of samples countries, and EXIOBASE.

Figure A6
Average Expected Emission Intensity of Multinational Firms, by Sector



Source: Authors' calculations based on data from WorldBase, national IPAs of samples countries, and EXIOBASE.

Figure A7
Expected Emission Intensities of Assisted Multinational Firms, by Establishment Status in the Countries



Source: Authors' calculations based on data from WorldBase, national IPAs of samples countries, and EXIOBASE.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