Global Value Chains, Environment and Climate change

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Motivation

- In this context of **vertical fragmented production processes**, different stages of the same production, have been internationally dispersed, leading to the concept of "unbundling" of production.

- Global Value Chains (GVC) refers to “the full range of activities that firms perform to bring a specific product from its conception to its end use and beyond” (Gereffi and Fernandez-Stark, 2011).

- GVC have immensely increased during the last years. According to the World Trade Organization (WTO) report (2020), more than **two-thirds** of the international trade is performed through GVC.

Motivation

- The World Trade Organization (WTO)'s commitment « … *to the protection and preservation of the environment through its objective of ensuring sustainable development* … »

- Rising awareness of environmental concerns in the present-day globalized world.

- COPs: not really successful.

- Can trade and GVC have a role in this complex relationship?

Question

- How can climate change affect GVC?
- How can we study the complex relationship between GVC and environment?
- How this analysis can be done at the macro and micro levels?

Outline

- GVC and Climate Risks: Physical and Transition Risks
- How Do GVCs Affect the Environment?
- Do Environmental Measures Determine GVCs?
- Conclusion

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GVC and Climate Change

- The fragmentation of production along GVCs results in an increased carbon footprint from goods crossing the borders several times, which can have severe environmental impacts.
  - The expansion of GVCs has been linked to the relocation of the most polluting activities to (developing) countries with lax environmental regulations to avoid strict ones at home.
  - The expansion of GVCs has been accompanied by an increasing concern about the environmental impact of these, and by growing awareness of the necessity to transition to cleaner production systems. GVC participation can also encourage developing countries to adopt stricter environmental policies.

Two risks

- Developing countries face a double- risk that could affect their participation in GVCs:
  - A “physical risk” associated with natural disasters and resulting in output losses, reduced FDI, and reduced participation in GVCs.
  - A “transition risk” related to the necessary adjustments in regulations, production techniques, and energy deployment, which may reduce their comparative advantage in carbon-intensive intensive sectors and, consequently their participation in GVCs.

Exploring the Channels

- The increase in global temperatures and the frequent occurrence of natural disasters can affect the smooth functioning of GVCs:
  - Climate change can affect factors of production, especially in developing countries, and therefore alter their comparative advantages and, consequently, their participation in GVCs.
- Climate mitigation and adaptation policies represent a challenge for many developing countries that do not have the necessary financial and institutional capacities to implement these policies.
  - The cost of these policies can also alter the comparative advantage of some developing countries and affect their participation in GVCs.

Physical Risk: Channels

- Unexpected weather conditions and natural disasters can directly affect international trade and GVCs by affecting trade routes, transportation, and infrastructure, which causes supply chain disruptions.
- Climate change can indirectly affect GVCs by changing the production structure of economies.
- Natural disasters can affect the factors of production (labor, land, capital), leading to altered comparative advantages in developing countries, and a change in their production structures and trade specialization along GVCs.
  - Examples include changes in crop yields, loss of land, capital, or labor productivity changes (Dellink et al., 2017).

Physical Risk: Channels

- Companies and financial institutions evaluate the risks from climate change along their value chains (Canevari-Luzardo et al., 2019) and reconsider the balance between efficiency and resilience in production (Freund et al., 2022).
  - This may entail some reshoring, near-shoring and diversification, especially as automation has already reduced the importance of labor costs (Javorcik, 2020) and can contribute to mitigating the risks from overreliance on humans to perform value chain tasks (Gölgeci et al., 2023).
- Thus, the physical risk from climate change can reshape GVCs and eventually divert trade away from high-risk countries or regions.

Physical Risk: Evidence

- Climate change risks (physical risks) has been gaining increasing importance in the literature on international finance (Krueger et al., 2022; Beirne et al., 2020; Lanfear et al., 2019; Krutti et al., 2019).
- Other studies on natural disasters and value chains are either country- or sector specific (for example, see Freund et al. (2022)'s study of the long-term impact of the 2011 Japan earthquake on the automobile and electronics supply chains, or Nakano (2021)'s study of climate change risks for automotive supply chains in the USA, Japan, Germany, and China).
- A recent study by Han and Lee (2023) explores the impact of natural disasters on GVC disruption and found that natural disasters reduce total exports by 1.53%, intermediate exports by 1.71%, forward linkages by 1.92%, and backward linkages by 1.83%.
- Er-Kara et al. (2021) explored the impact of climate change risk on supply chain performance and found that sourcing, manufacturing, and logistics were the three most vulnerable activities to climate change.

Transition Risk

- The literature on GVCs and transition towards environmentally sustainable practices has been framed within the international business literature and has predominantly focused on lead firms or large first-tier suppliers (Krishnan et al., 2022, Liu et al., 2023; De Marchi et al., 2013, among others)
- Some studies examine how environment friendly measures can increase GVC (Fayek and Zaki, 2023). Thus, investing in clean production techniques helps firms overcome the sunk costs from internationalization.
- Najarzadeh et al. (2021) investigated the impact of the Kyoto Protocol on participation in GVCs through forward and backward linkages:
  - The Kyoto Protocol ratification reinforced the downstream position of committed countries along GVCs by decreasing their forward participation and increasing their backward participation.
  - The share of foreign intermediate goods and services in their exports increased.

Transition Risk

- Participation in GVCs may lead to environmental upgrading as firms in developing countries are often obliged to comply with standards imposed by lead firms:
  - Firms that participate in GVCs perform environmentally better than non-GVC firms (Siewers et al., 2024).
  - Tunisian firms that operate in the olive oil value chain adopt norms and abide by environmental standards (Achabou et al., 2017)
  - Firms in coffee and wine value chains accumulate “green profits” from mainstreaming sustainable practices, while pushing costs of compliance on upstream suppliers (Ponte, 2022) .

Preliminary Findings

- We distinguish between two channels through which climate change can affect participation in GVCs: the physical risk from natural disasters, and the transition risks from climate mitigation.
- We use data from the EORA MRIO dataset during the time period 1995 to 2018 to measure total GVC participation, as well as forward and backward linkages.
- Our findings suggest that physical risk from climate change (measured by natural disasters and death from natural disasters) is negatively, yet weakly associated with participation in GVCs.
- CO2 emissions (per-capita and from manufacturing) have a negative impact on GVC participation, while increasingly shifting to renewables increases GVC participation.

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Related Literature

- Environmental effects of trade have been widely explored in the literature (Grossman and Krueger 1991, Copeland and Taylor 2003, and Costantini and Mazzanti, 2011).

- Theoretical literature is divided into two main strands: the Pollution Haven Hypothesis (PHH) and the Porter Hypothesis (PH).
  - PHH: differences in environmental regulations causes pollution-intensive industries to relocate from high income countries with stringent environmental regulations to low-income countries with lax environmental regulations (Copeland and Taylor, 2003).
  - PH: predict that polluting firms can benefit from environmental policies, arguing that well-designed and stringent environmental regulation can stimulate innovations, which in turn increase the productivity of firms or the product value for end users (Costantini and Mazzanti, 2011).

Related Literature

- GVC are found to have an effect on environment via several channels:
  - Technique and competition effects: Green technologies and ecofriendly products benefit the environment and enhance its quality (but not in early stage participation in GVC) (Wang et al., 2019).
  - International transport related to trade is linked to increases in carbon emissions (OECD, 2017). Transport pollution is higher in GVC compared to standard trade since product crosses border many times.
  - Countries with weak environmental laws (WDR, 2020): multinational firms operate in countries with lenient environmental laws in order to avoid costly environmental requirements (Ben David et al., 2020).

- At the empirical level, the impact of GVC participation on the environment has revealed inconclusive results. It could depend on the type of task or activity in value chain. Some GVC activities are linked to forward participation and other to backward participation (Balié et al. (2017) and Cheng et al., (2013)).

Related Literature

- A second strand of the literature focused on the role of environmental provisions (EPs) included in Regional Trade Agreements (RTAs) and its effect (Ramzy and Zaki, 2018, Martínez-zarzozo and Núñez-Rocha, 2018, Baghdadi et al., 2013, and Baghdadi and Guedidi, 2020, Martínez-zarzozo et al., 2024).
- There could be two effects of regional integration depending on the type of agreement (with or without environmental provisions).
- Regarding the strand of the literature related to national legislations (NL), several studies point out that the effects of trade on environment are further improved with complementary policies such as NL (Jug and Mirza, 2005, De Santis, 2012, and Nie et al., 2021).

Data

- Bilateral carbon emissions are taken from Eora Database for carbon footprints. CO2 emissions are a proxy of air quality. They report flows of embodied CO2 from each origin/emitter country to each destination/consumer country. Units are Gg CO2 (15 gigagram (Gg) = 1 kiloton (Kt)). CO2 accounts for emissions associated with imported and exported goods.

- Bilateral exports are taken from Eora input-output MRIO database constructed by Alvim, Atienza and Sanquinet, 2021. A dataset for five years from 1995 to 2015, using the International Monetary Fund (IMF) algorithm, available by (Aslam et al., 2017)

Data

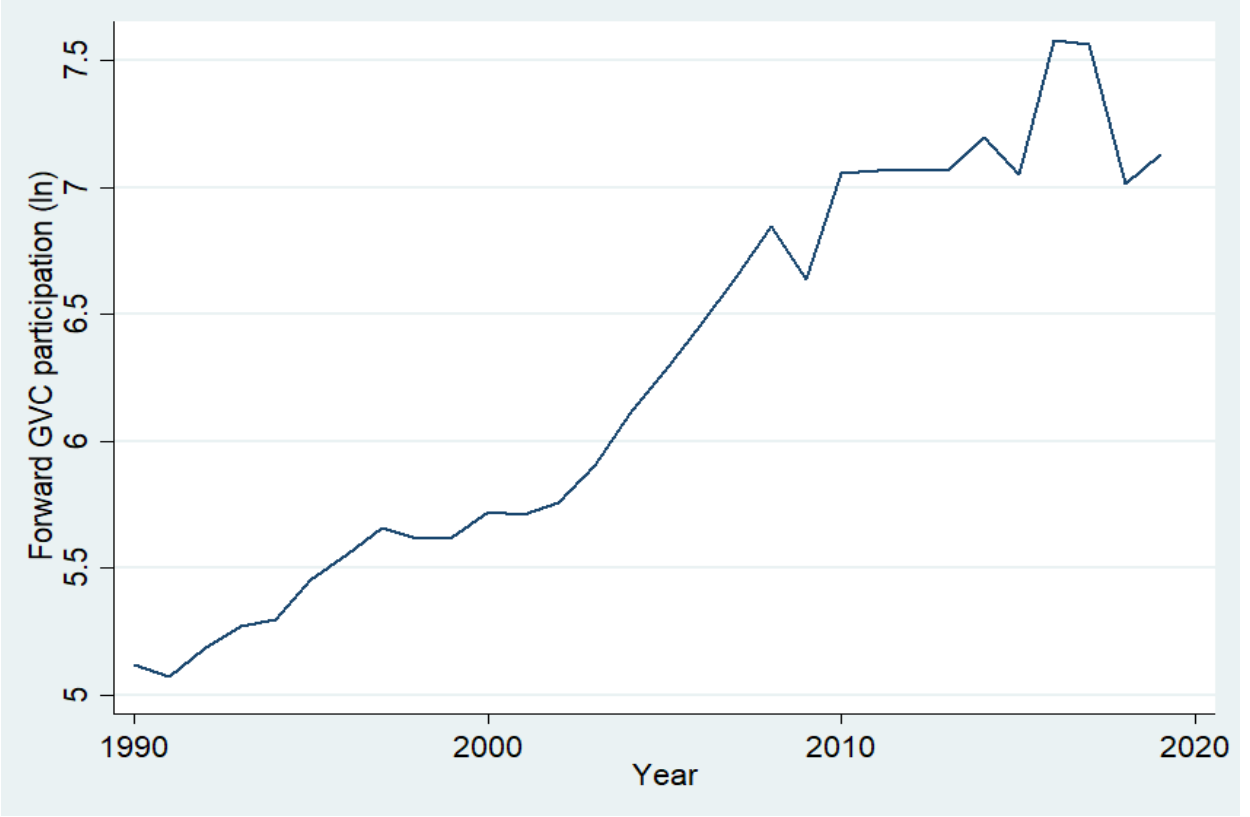
- The Eora Global Supply Chain database allows using global input–output tables to measure the forward GVC participation- bilateral domestic value added in exports absorbed abroad by destination.
  - Forward GVC participation is defined as how much each country's domestic value added enters as intermediate input in the value added exported by other countries (WDR, 2020).

- Bilateral data on environmental provisions in preferential trade agreements (PTAs) are from the Deep Trade Agreements database (World Bank) (Hofmann et al. (2017)). This database includes all RTAs notified to the World Trade Organization (WTO) until the year 2019.
  - This data maps 52 provisions in PTAs, including environmental ones, notified at WTO signed between 1958 and 2019.

- National legislations variable is taken from the Ecolex database. The environmental regulation variable are laws that countries have passed.

Stylized Facts

Fig.1 Forward GVC participation (1990-2019)



Source: Author's elaboration based on data from Eora Global Supply Chain Database.
Note: Forward GVC participation corresponds to indirect domestic value added (DVX). It indicates domestic production that will be exported again to a third economy.

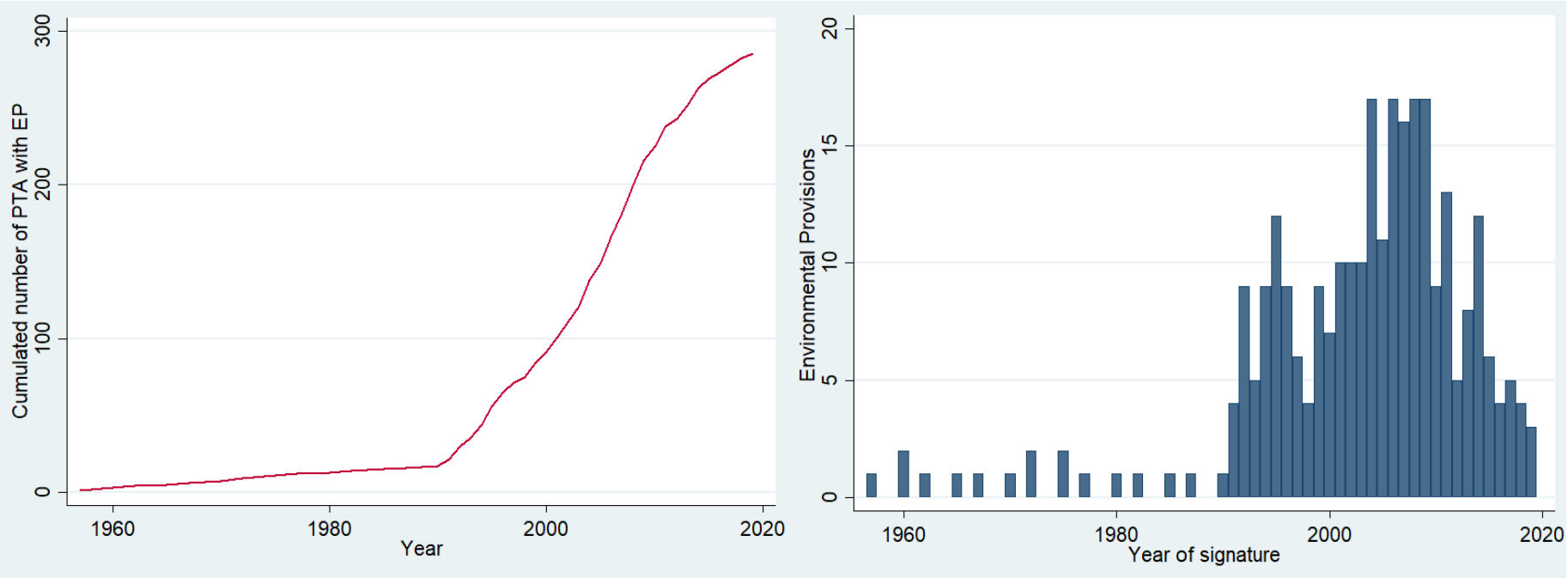
Stylized Facts

Fig.2 Embodied Carbon emissions

Source: Author's elaboration based on data from Eora Global Supply Chain Database.

Stylized Facts

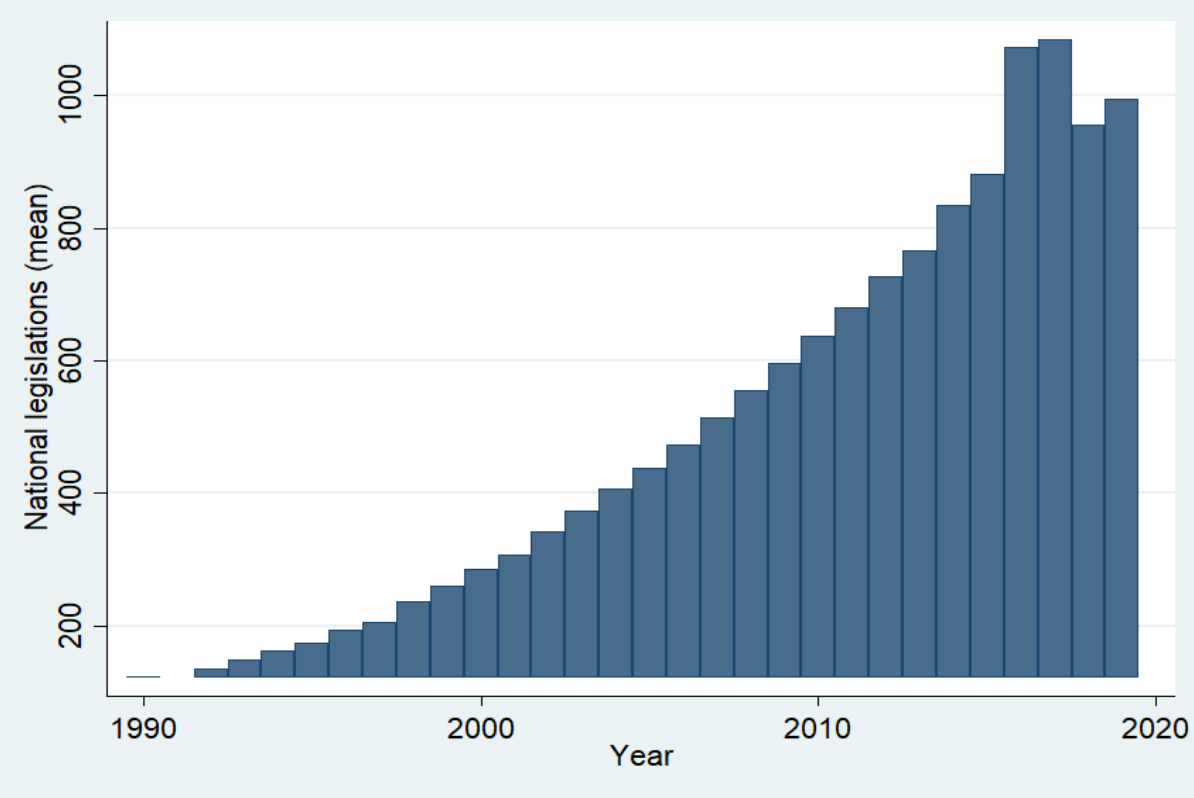
Fig.3 Evolution of Environmental Provisions in PTA



Source: Author's elaboration based on the World Bank's Deep Trade Agreements database.

Stylized Facts

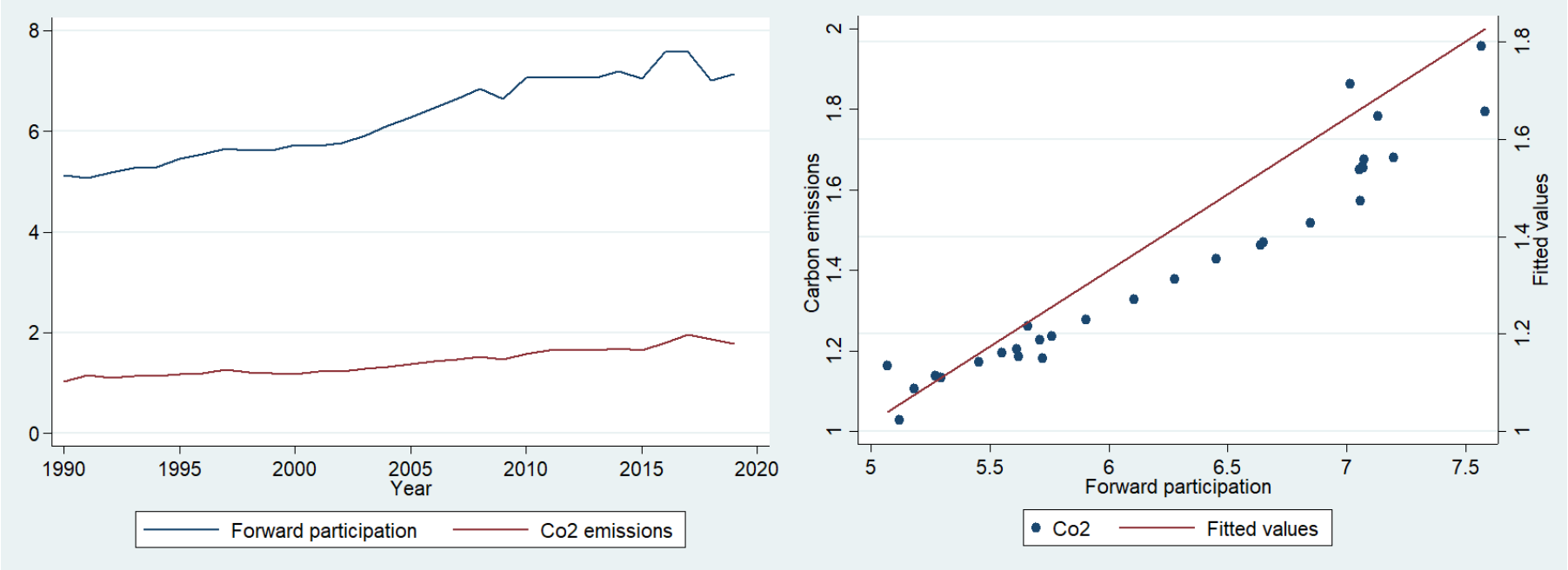
Fig.4 Evolution of the number of National legislations



Source: Author's elaboration based on the Ecolex database.

Stylized Facts

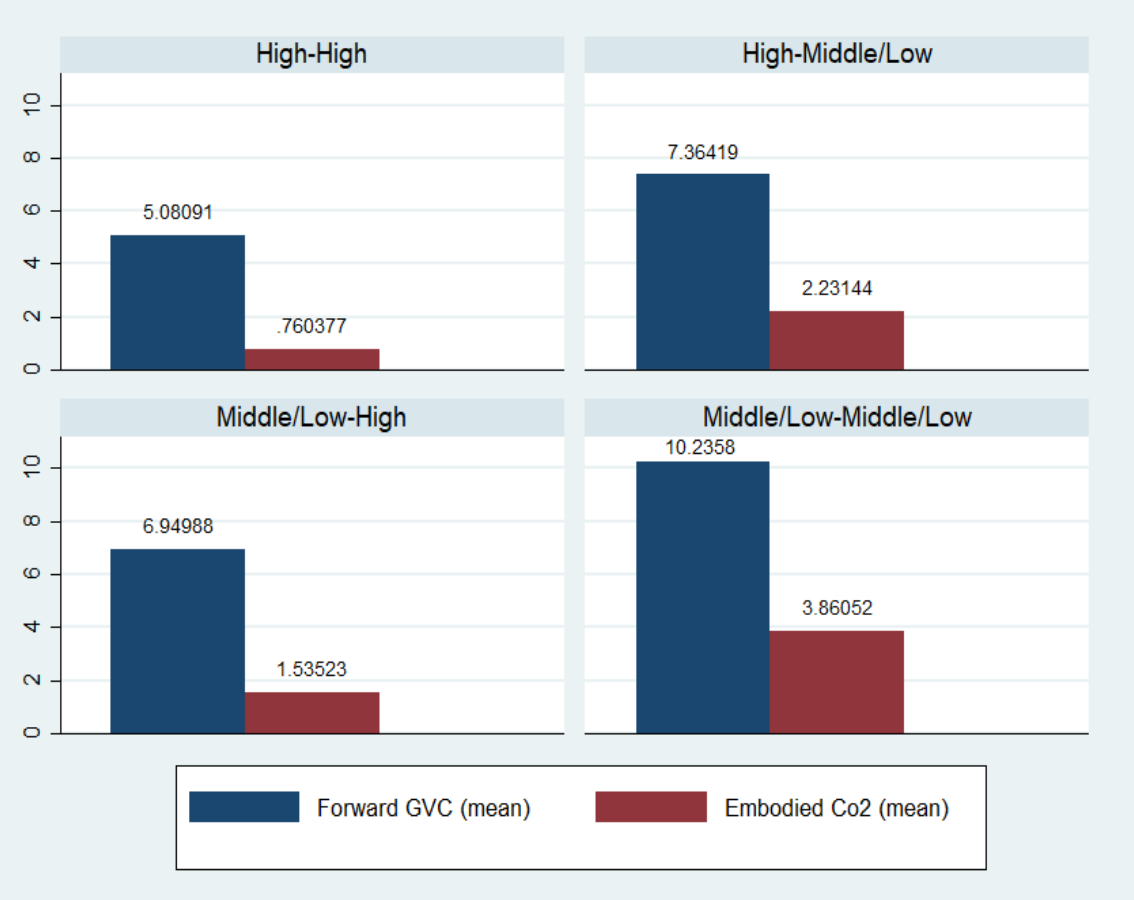
Fig.5 Forward GVC participation and Embodied Co2 emission in trade flows



Source: Author's elaboration using the Eora Global Supply Chain database

Stylized Facts

Fig.6 Forward linkages and Embodied CO2 by income levels of the trade partner



Source: Author's elaboration based on data from Eora Global Supply Chain and World Bank, historical income levels

Main Findings

- Using a structural gravity model (Yotov et al., 2016), we examine the effect of forward Global Value Chains (GVC) on carbon emissions in GVC flows.
- We also see how national legislations and environmental provisions in trade agreements can help mitigate this.
- Results indicate that GVC participation has a positive impact on CO2 emissions. This indicates that engaging in forward linkages raises carbon emissions and have an environmental downgrading.
- We single out the scale, composition and technique effects.
- Moreover, national legislations, from the Ecolex database, negatively affect CO2 emissions and decrease pollution. This effect is amplified by environmental provisions in trade agreements.

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Motivation

- Many business entities still prioritize profits over environmental protection and perceive these two goals as inherently incompatible.

- This topic becomes even more important with the increasing participation of developing countries into global value chains (GVC) that represent nearly 70% of the current trade flows.

- With more stringent environmental regulations at the national and international levels, adopting green tools might increase the likelihood of firms to integrate GVC. Such firms must be able to compete internationally and abide by different environmental standards.

- Another strand of the literature analyzes the impact of GVC participation on environmental performance (Agostino et al, 2023 and Siewers et al, 2023).

Motivation

- We bridge the gap between three strands of the literature
  - *Firms' performance and environment*: The adoption of environment protection actions does not only generate social benefits as the reduction of pollution for instance but also generates benefits specific to the firm as productivity gains and performance upgrading (Berman and Bui, 2001; Delmas and Pekovic, 2012; Dangelico and Pontrandolfo, 2013; Ramzy and Zaki, 2018).
  - *Environment and exports*: a positive significant effect of the adoption of environmentally oriented investments on the firm's export performance (Alpay et al., 2001, Galdeano-Gómez, 2010 and Antonietti and Marzucchi, 2013).
  - *GVC determinants*: a large literature but not on environmental ones (Antras and Choi, 2022).

Data

- We rely on firm-level data from the “Business Environment and Enterprise Performance Survey (BEEPS)” (between 2018 and 2020).
- It includes cross-country data that cover almost 28,000 enterprises in 41 countries in four different regions, namely the European Union, Eastern Europe, Central Asia and Middle East and North Africa.
- The sixth round of BEEPS (BEEPS 18-20) includes a Green Economy module that comprises questions about the green investments and the environmental actions adopted by the firms.

GVC variables

- At the extensive margin (Dovis and Zaki, 2020):
  - GVC 1: the laxest one as it considers all two-way traders, hence firms simultaneously exporting and importing.
  - GVC 2: includes two-way traders who hold an international quality certification.
  - GVC 3: includes two-way traders with foreign ownership.
  - GVC 4: entails exclusively two-way traders with foreign ownership who hold an international quality certification.
- At the intensive margin (Urata and Baek, 2020)
  - The share of the firm's exports multiplied by the share of its imported inputs.

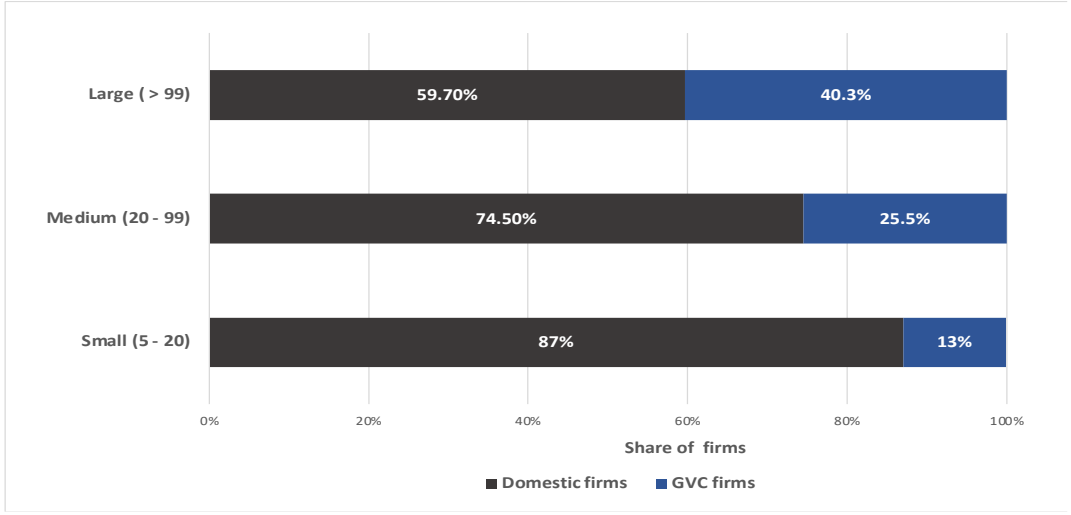
$$GVC\ Index = \left(\frac{Exports}{Total\ Sales}\right) * \left(\frac{Imported\ inputs}{Total\ procurements}\right)$$

Environmental variables

- The environmental actions are divided into three dimensions, following Dangelico and Pontrandolfo (2013):
  - Environmental actions related to raw materials usage include the adoption of waste minimization, recycling and waste management, and the adoption of water management.
  - Actions related to energy usage include the adoption of more climate-friendly energy generation on site, the adoption of energy management and the adoption of any measures to enhance energy efficiency.
  - Actions related to pollution are represented by the adoption of air pollution control measures.

GVC participation

Figure 7: Share of domestic firms versus GVC firms, by firm size



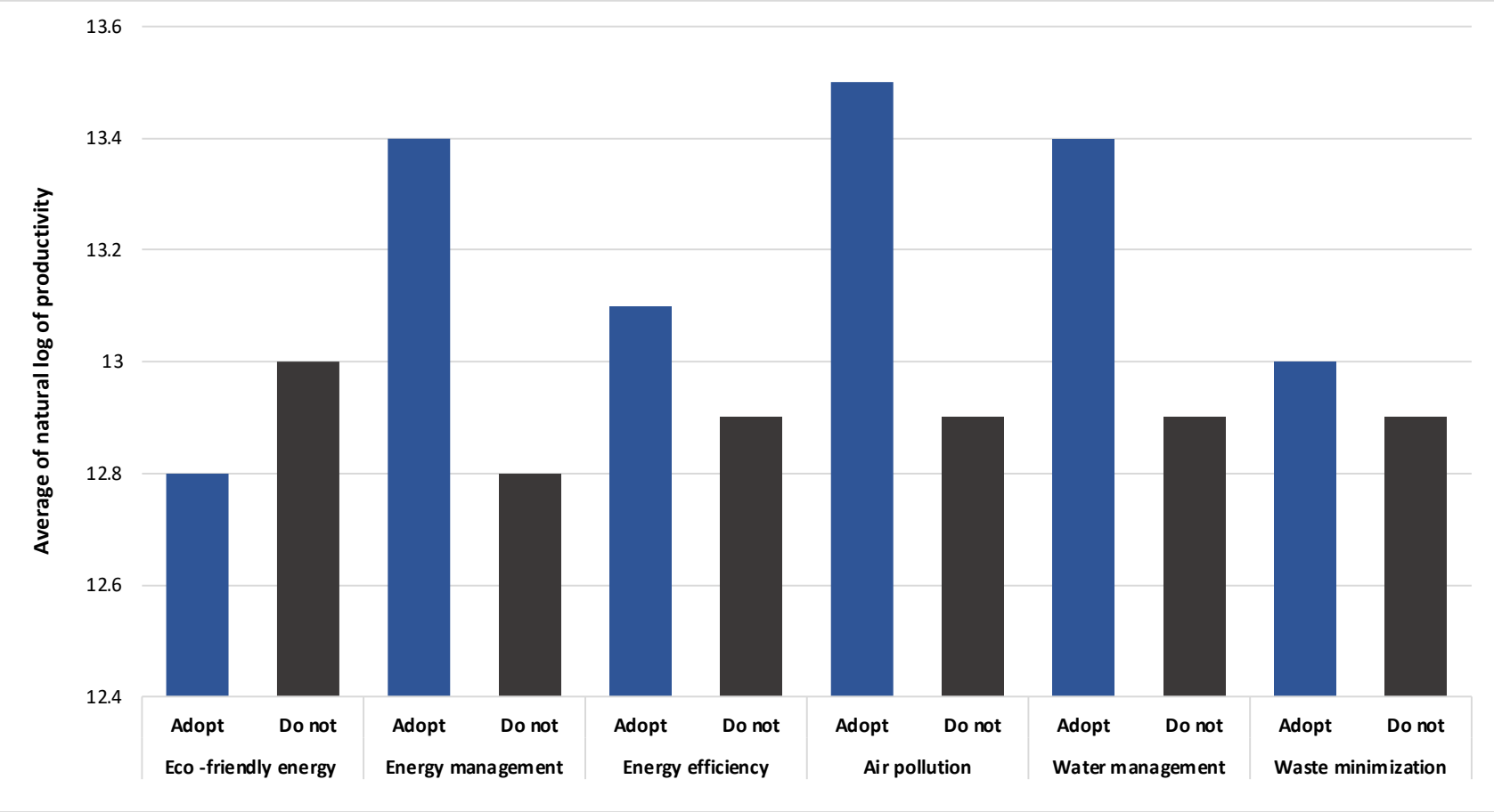
Source: Authors' own elaboration using BEEPS data for 2018 – 2020.

Table 1: Distribution of GVC firms by region (%)

	GVC 1	GVC 2	GVC 3	GVC 4
European Union	31.9	17.6	6.8	4.5
Eastern Europe	24.8	10.1	4.2	1.9
MENA Region	17.6	7.6	3.9	1.6
Central Asia	12.9	5.4	2.4	1.1
All	22.9	10.9	4.6	2.5

Source: Authors' own elaboration using BEEPS data for 2018 – 2020.

Average level of productivity and adoption of environment friendly measures

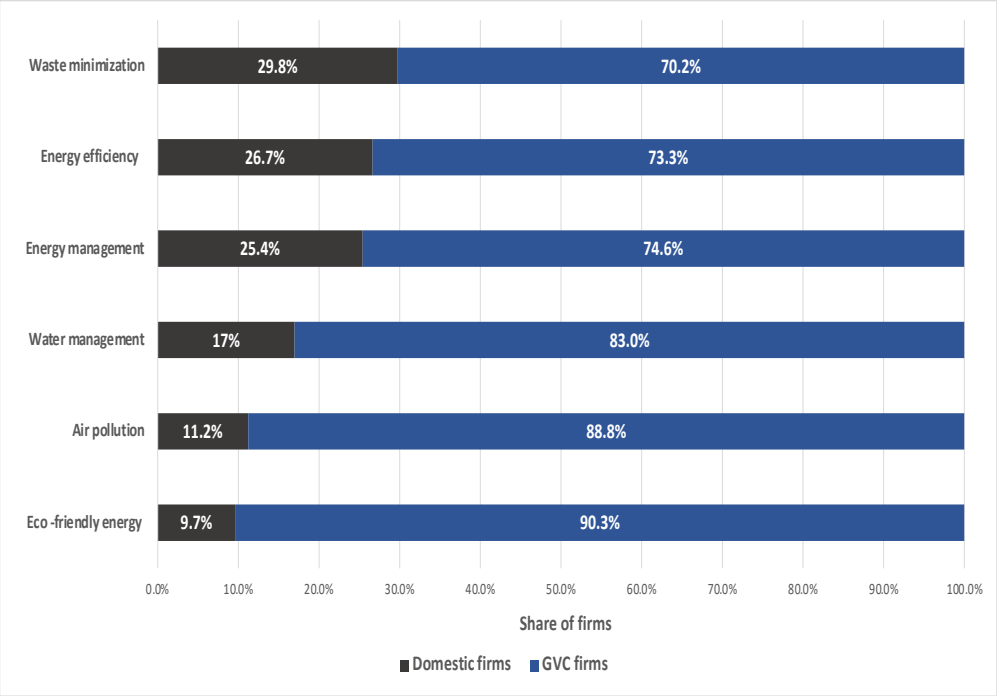


Source: Authors' own elaboration using BEEPS data for 2018 – 2020.

GVC and environment (1)

- The share of GVC firms, among those who adopt environmental actions, is higher than the corresponding share of domestic firms.

- GVC firms tend to have a higher environmental performance (Girma et al., 2008 and Cui et al., 2016).

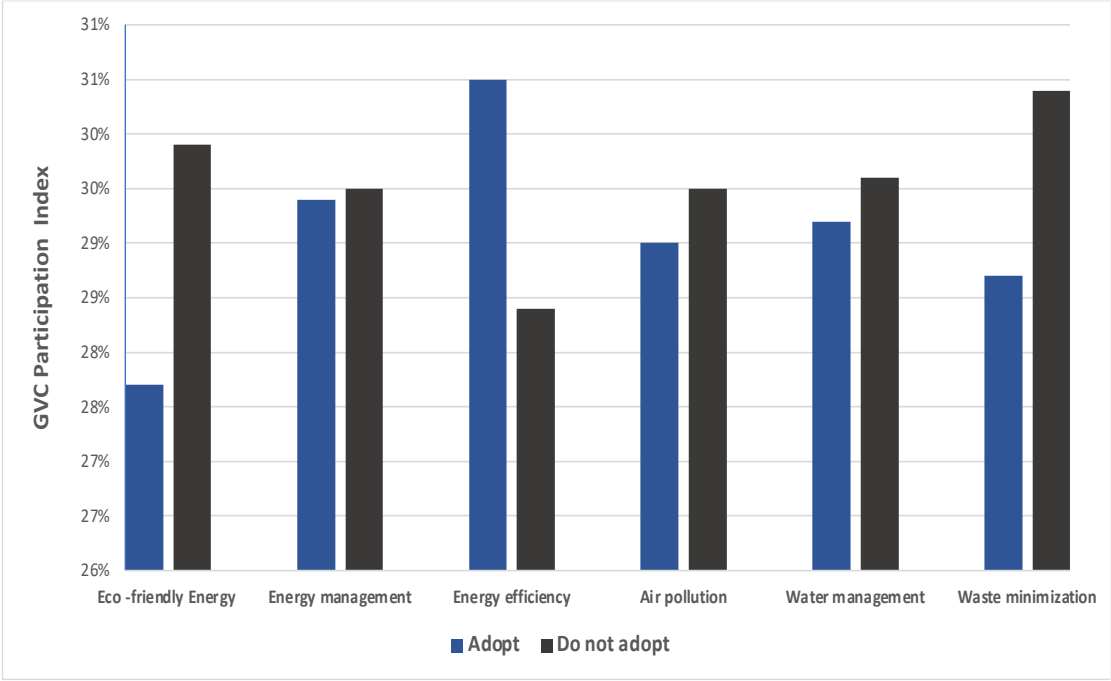


Source: Authors' own elaboration using BEEPS data for 2018 – 2020.

GVC and environment (2)

- This figure does not show noticeable evidence of a positive association between environmental upgrading and the intensity of participation in GVCs.

- Environmental performance may be affecting the probability of integration in GVCs rather than the intensity of GVC participation



Source: Author's own elaboration using BEEPS data for 2018 – 2020.

What we do?

- Using firm-level data in 41 countries from the Business Environment and Enterprise Performance Survey (BEEPS).
- We assess the impact of adopting environment protection actions on the probability of integrating GVCs (extensive margin) and on the degree of participation (intensive margin) in GVCs.
- We control for the selection bias we have in the data and the endogeneity between GVCs and environmental measures.

Main Findings

- We show that firms could raise their opportunity to participate in GVCs by adopting environment protection actions through the mediation of productivity gains.
- The impact of adopting such actions on the intensity of GVC participation tends to be negligible.
- Green investments could be considered as an additional source of firm heterogeneity that can help firms overcome the sunk costs of internationalization.
- Larger firms are more likely to experience a raise of their chance to participate in international trade through environmental upgrading rather than their smaller counterparts. This applies to more productive firms

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Conclusion

- The relationship between GVC, environment and climate change is complex.
- GVC affect the environment:
  - More enforced legislations are needed.
  - A more environment friendly trade policy
- Major and significant environmental challenges that threaten sustainable development have forced the elaboration of multiple national and international environmental policies and regulations, though few significant positive outcomes have been achieved in terms of sustainable development (Cui et al., 2016).
- While the process is costly, as predicted by Porter and Linde (1995), the elaboration of well-designed environmental regulations should result in productivity gains owing to the firms' investments in clean and innovative technologies, which may partially, sometimes fully, or more than fully « *offset* » the initial costs of complying with the regulations.

References

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Thank you for your attention