Building a New Reputation: The Impact of Adopting Voluntary Standards

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Abstract

Raising environmental awareness has led to the proliferation of environmental standards. These standards aim to help organisations reduce their environmental impact and increase their operating efficiency. Using detailed French administrative data, I estimate the effect of voluntary environmental certification on firms' export performance. I observe that environmental certification positively impacts the probability of exporting (extensive margin) and the value of exports (intensive margin) through an increase in the export price. The probability of export for certified firms increases by 1.4%, while the value of exports increases by 10.8% following certification, through a 2.2% increase in the price and a 9.6% increase in the quantity exported. The results are driven by a demand effect, which varies across destinations, products, and firms.

Keywords: Environmental certification, reputation, quality, firm, trade
JEL Codes: F14, F18, D22

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1 Introduction

Over the past decades, environmental awareness has been expanding in both developed and developing economies through their increased participation in committing to environmental goals, such as reducing greenhouse gas emissions in the Paris Agreement. As a result, we observe a proliferation of voluntary environmental standards. Environmental standards can able organisations to enhance their environmental image and confer external legitimacy (Bansal and Hunter, 2003). Improving the environmental quality of their products may allow firms to increase their profit. Several studies have shown that the environmental impact of products is becoming an important purchase criterion for many customers making consumers willing to pay a price premium for these products (Loureiro and Lotade, 2005, Aguilar and Vlosky, 2007, Sellers, 2016). For instance, Delgado et al. (2015) find that consumers are wiling to pay a price premium of 4.5% for hybrid cars. Secondly, standards might help facilities to increase their internal efficiencies and create competitive advantage opportunities and economic benefits (Coglianese and Nash, 2001). While standards might serve the scope of improving environmental quality, they might also have an adverse effect as it could increase the sales of products manufactured by non-certified firms in competitive markets (Mattoo and Singh, 1994; Sedjo and Swallow, 2002).

There is limited empirical evidence on the impact of voluntary environmental certification on a firm's export performance, which is unexpected considering the widespread adoption of such certifications. In 2020 alone, over 348,218 facilities across 176 countries were certified to ISO 14001.[1]

In this paper, I present evidence of the effect of environmental certification on trade draw-

[1] The ISO survey of management system standard certifications – 2020.

ing on French firm-level data. I rely on information provided by the "Antipol Survey", developed by the French national institute of public statistics (INSEE) over the period 2002-2018. An essential feature of the data is the availability of information on the voluntary environmental certification status of the plant, whether the plant is certified, not certified or in the process of certification. This precise certification status allows me to keep only plants that get certified over the period (2002-2018) for the empirical strategy. France provides an interesting setting with the availability of several certifications and numerous plants certified. France is among the ten most certified countries at the worldwide and European level: at least 5,803 French plants are certified with ISO 14001 standard, 41 plants are certified to the Eco-Management and Audit Scheme (EMAS) and more than 500 organisations are certified under *"1,2,3 environnement"* as of 2020.[2]

In order to study the role of environmental certification on firm's export performance, I combine this data with French custom data, providing information on export at the firm-product-destination level and with administrative database, producing firm's balance sheets information.

The first contribution of this paper is to estimate the effect of the implementation of a voluntary environmental standard on firm's export performance. To identify the causal effect of environmental certification on firm's trade margin, I build upon the time variation of certification in export margins of a firm for a given product sold in a destination, offsetting any firm-specific characteristics. I thus compare goods that are sold in similar markets and competition conditions except that some are sold by a certified firm. Secondly, the paper addresses some challenges in assessing the impact of the adoption of environmental standards on French exporters' performance. I control for endogeneity concerns using an instrumental variable (IV) and a propensity score matching (PSM)

[2]ISO survey (2020), EMAS Helpdesk (2021) & Chamber of commerce (2021).

methodologies. The institutional theory suggests that external forces, such as regulatory and market pressures, persuade organisations to undertake similar strategic actions. Hence, I instrument the share of certified facilities within a firm by the share of certified firms selling a similar product and located in the same sub-national region (*'département'*) excluding the firm itself, with firms competing for the same export market and thus facing similar market pressures. To further reduce the possible endogeneity issue in the standard's adoption timing, I am also employing a one-to-one dynamic PSM method. Every year, a certified firm is matched to a non-certified firm but which has the same probability to be certified given a set of confounders. Thirdly, I investigate the differential effect of certification across destination countries, products and firms.

I document four main facts. First, I find that the implementation of a voluntary environmental certification positively affects export. It increases both the probability to start exporting a product to a new destination and the value of exports of a given product to a given destination. The probability of exporting increases by 1.4% following the voluntary certification, highlighting that certification allows firms to access new markets. Secondly, the environmental certification leads to an increase of the value of exports by 10.8%. I observe that this increase can be explained by a price premium of 2.2% for certified firms. The voluntary environmental certification acts as a 'quality signal' allowing firms to charge a higher price for their product, passing through the additional costs of voluntary certification to customers. The quantity exported by certified firms increases by 9.6%, suggesting a demand effect for environmentally conscious products. Thirdly, my results are robust to both instrumenting the share of certified plants and to the use of a PSM matching, reducing endogeneity concerns. Fourthly, I find that these results are driven by a demand effect that is heterogeneous across destination countries, products, and firms. Indeed, this demand effect is only observed for final product producers, sug-

gesting that environmental certification matters more for final consumers. The quantity exported by certified firms to more environmentally conscious destinations increases by 17%. I measure the level of environmental awareness by the presence of environmental provisions in PTAs, implying that these countries demand more environmentally friendly goods. However, when measuring the level of environmental awareness using the share of green product imports, I find that the price only increases in countries importing more green products than the average. Using the firm's value added as a proxy for productivity, I find that the most productive firms are able to charge a higher price.

Related Literature My findings build on and contribute to several strands of the literature. Firstly, it builds on the literature assessing the use of private standards and their incentives (Nakamura et al., 2001, and Grolleau et al., 2007). Using German firm-level data, Frondel et al. (2008) find that firm's certification decision can be explained by the wish to foster corporate image however EMSs do not necessarily guarantee improved environmental performance. Fulponi (2006) focuses on major food retailers in the OECD countries and finds that investments in quality or quality control mechanisms (i.e through standards) can be seen as a way to build consumer loyalty and increase the value of a firm's reputation, once signalled to consumers. The author also highlights the expanded use of global business to business standards, which suggests the importance of comparing the effect of EMS on intermediate and final goods trade.

Second, several papers have documented the effect of environmental standards implementation on organisational and financial performance of a firm. Although environmental standards implementation simply provides a framework for managing environmental impacts and provides a starting point for developing firm level environmental strategies (Christmann and Taylor, 2001), an environmental standard can help enhance

firm's export performance by reducing waste and creating other efficiencies (Porter and Linde,1995a; 1995b). DeCanio and Watkins (1998) indicate that firm-specific variables such as firm size, earnings and insider shareholders are significant determinants of voluntary participation of US firms in the Green Lights program. ISO 14001 standard can represent a significant expense for non-profitable firms with high debt ratios and consequently profitable firms are more likely to see it as a useful investment (Chapple et al., 2001). Erauskin-Tolosa et al. (2020) present a meta-analysis of the effect of environmental standard, and more precisely of ISO 14001 and EMAS on environmental performance. Contrary to these studies, I focus on isolating the effect of environmental certification on firm's trade performance. The firm-product-destination level customs data enables me to study the effect of certification on firms' export location, value, quantity and prices.

The paper also links to the literature assessing the impact of quality labels on export. Curzi and Olper (2012) investigate the impact of product quality on Italian firms' export behaviour, using different proxy for product quality, including ISO 9000 certification. Martincus et al. (2010) estimate the impact of ISO 9000 certification on the export performance of Argentinian firms. They find that the certification is associated with a positive effect both on the extensive and intensive margins of trade. Bontemps et al. (2013) estimate the effect of European Union regulation on quality food products using protected designations of origin (PDO), on export performance of French firms in the cheese industry. They show that PDO implementation contributes to the increase of firms' survival in the dairy industry, especially for smaller firms. Using similar data, Duvaleix-Treguer et al. (2018) and Duvaleix et al. (2021) estimate the impact of PDO on French firms' export competitiveness in the cheese and cream industry. They observe a positive impact of labelling on the extensive margin of trade as well as on the trade unit value but no effect on the quantity. The effect is magnified within the European market,

highlighting the importance of assessing the heterogeneous effect across destinations. Roht-Arriaza (1997) suggests that Japanese firms' decision to implement ISO 14001 was driven by the will to penetrate the EU market. Cheptea et al. (2019) explore the effect of International Featured Standards (IFS) certification on exports of the retail sector and highlight their positive effect on the extensive (probability to export) and intensive (export value) margins. Fiankor et al. (2021) assess how cross-country differences in public mandatory food standards affect trade, prices and product upgrading in the agri-food sector. They find that differences in maximum residue limits hinder trade, however, conditional on exporting they increase product prices. More closely related, Blyde (2022) analyses the impact of ISO 14001 on export performance of Ecuadorian firms. The author finds a positive impact on the extensive margin.

Compare to the above works, this paper employs firm-level data to assess the impact of environmental certification on trade performance and the availability of customs data allows me to assess the impact of the difference in timing of certification across all sectors and differently by products, destinations, and firms' characteristics.

Another strand of the literature, the paper relates to is the literature assessing the impact of green washing and firm image. While one part of the literature is assessing the impact of positive reputation shocks (Landon and Smith, 1997, 2012), through labelling for instance, the other is looking into the impact of negative reputation shocks (Bai et al., 2017, and Koenig and Poncet, 2020). In addition, numerous enterprises consider ISO 14001 to be a 'green passport' granting entry to international markets; and the ISO 14001 standard can also improve a firm's image via increased environmental legitimacy (Jiang and Bansal, 2003). The Corporate Social Responsibility (CSR) literature also emphasises the role of public image and reputation on a firm's profit (Bazillier and Vauday, 2009, 2014, and Bazillier et al., 2017).

The remainder of the paper proceeds as follows. Section 2 presents the main theoretical mechanisms while section 3 describes the data and presents some stylised facts. Section 4 presents the empirical strategy. Section 5 discusses the main results while section 6 presents the potential drivers. Finally, section 7 concludes.

2 Theoretical mechanisms

This section presents the main mechanisms through which a voluntary environmental standard can have an effect on a firm export performance.

Institutional theory Firstly, institutional theory suggests that firm pressures shape organisational action. It emphasises the role of social and cultural pressures imposed on organisations that influence their practices and structures. Institutional theory distinguishes between different types of pressures a firm might face. First, an organisation's decision to get certified might be influenced by regulatory pressures, such as environmental regulations in place. Secondly, market pressures may also influence a firm's decision. Market pressures have been increasing due to consumers becoming more aware of companies' environmental activities. Markets are thus responding by creating opportunities for environmentally friendly firms, which demand a price premium for their products and services.

Signalling theory Closely related, the signalling theory, first developed by Spence (1978), addresses interactions with asymmetric information, in which one individual intends to convince another individual of a desired but not directly observable quality. Voluntary environmental standards may provide a vehicle for firms to signal their environmental awareness to market participants. This might help companies develop an

environmentally conscious reputation and establish new relationships with consumers and opportunities for collaboration with other organisations that value these firms. Therefore, firm's motivation to undertake a voluntary environmental action might partly be affected by pressures from regulators and markets. Indeed, organisations adopt proactive environmental strategies to obtain greater external legitimacy but there is also evidence that an organisation's complementary resources and capabilities might facilitate the adoption of more advanced environmental practices.

The resource-based view Thirdly, the resource-based view emphasises how firms develop their internal organisational capabilities in the face of institutional constraints. Firms strive to capture business opportunities that lead to creating sustainable competitive advantage and improving both environmental performance and economic benefits. This view suggests that a firm's performance is determined by the resources it has at its disposal, and the way these resources are used and configured enables the firm to perform and can provide a distinct competitive advantage. Therefore, a firm's decision to undertake voluntary environmental certification might lead to internal reorganisation and higher productivity.

An example of an organisation that gradually introduced an environmental certification is Audi AG with different adoption timing by plant. For the past 25 years, the group has developed its environmental policy and has started to implement EMAS standard in its facilities as an external validity of the environmental efficiency of its production facilities and technologies, as underlined by their slogan *"Vorsprung durch Technik"*. More specifically, EMAS was first introduced in the Audi Ingolstadt plant in 1997, where several

models are produced (Audi Q2, A3, A4 and A5).[3] In 2002, Audi Brussels, where all electric models are produced, adopted EMAS in the context of "Go to zero" emission objective. The facility has put in place several measures to protect the environment such as solar panels to reach the CO_2 neutrality objective.[4] In response to the 2015 Notice of Violation to Volkswagen issued by the US Environmental Protection Agency (EPA) detailing Clean Air Act violations, a third partial consent degree required Volkswagen to retain an independent third party to conduct an EMS audit in 2017, 2018 and 2019. The third party (Bureau Veritas) and Volkswagen selected the ISO 14001 standard as a guideline to evaluate the maturity and effectiveness of the system to fulfill compliance obligations with applicable environmental laws and regulations for, in particular, selling vehicles to the US market.[5]

As previously stated one can adopt an environmental standard for several reasons. Audi AG might have first decided to get certified to obtain an external validity of the environmental policies the firm put in place which might be important for electric cars' consumers and thus increase its sales. Secondly, the international reputation of the ISO standard might helped in regaining consumers' trust in the US market. Thirdly, the efficiency objective in the different steps of production might also lead to a higher productivity, and thus favours the adoption of the environmental certification.

Testable implications Following the institutional theory, environmental market pressures might explain the adoption of the standard. In this case, one might expect industry characteristics to influence a firm's decision to adopt certification. Secondly, growing environmental demand might create opportunities for certified firms. One should thus

[3] Neckarsulm, Györ, San José Chiapa, Crewe, Sant'Agata Bolognese and São José dos Pinhais plants are also ISO 14001 certified.

[4] Audi Environmental declaration, 2021.

[5] Bureau Veritas EMS Audit report, 2018.

observe both a demand effect (through an increase in quantity and the opening of new markets) and a price premium by providing external legitimacy (signaling theory). Lastly, the resource-based view suggests that certified firms become more productive once they adopt certification. One should thus expect a positive effect on productivity following certification.

3 Data and stylised facts

This section first presents the characteristics of an environmental standard before presenting the different data sources used for this analysis.

3.1 Environmental Certification Data

An environmental certification helps organisations identify, manage, monitor and control their environmental issues in a "holistic" manner. It aims at helping the organisation to reduce its environmental impacts and increase its operating efficiency. The certification steps consist of (i) a planning, (ii) an on-site audit, (iii) feedback from the external auditor, (iv) a review committee deliberation, (v) the decision notification and, (vi) a monitoring and certification renewal. Achieving certification requires thus a significant commitment of resources (Darnall and Edwards, 2006). The cost of certification depends on the size of the firm and the number of plants, but the average cost of certification ranges between $10,000 and $200,000 for bigger firms. Looking at French firms part of the agri-food sector, Allary (2002) estimates the average implementation and operating costs of getting an ISO 14001/EMAS certificate around, respectively, €148,000 and €50,000 per plant. Despite these high costs of certification, environmental standards do not impose specific objectives. The firm sets its own environmental objectives and the approach

to reach them. Contrary to other standards, environmental certification might increase firm's internal efficiencies and reduce its functioning costs, such as energy and logistic costs despite the high adoption cost. For the purpose of this analysis, I focus on three voluntary environmental standards.

ISO 14001 is an international standard for environmental management systems that was introduced in September 1996. It maps out a framework that a company or organisation can follow to set up an effective environmental management system. ISO 14001 provides requirements with guidance for use that relate to environmental systems. There are more than 348,218 certifications to ISO 14001 in 176 countries.[6] It helps organisations improving their environmental performance through a more efficient use of resources and reduction of waste, gaining a competitive advantage and the trust of stakeholders. To obtain an ISO certification, an organisation is required to pass a third-party audit conducted by an audit organisation or accredited certification agency who verifies whether the firm meets the requirements specified by the standard. A typical ISO 14001 implementation can take anywhere between 6 and 18 months (Corbett et al., 2005). Adoption of ISO 14001 signals firm's integrity regarding their environmental management activities. As an outcome, investors positively evaluate the adoption initiative. ISO (International Organization for Standardization) conducts a review of their standards every five to ten years. ISO 14001 was firstly introduced in 1996, then it was revised a first time in 2004 and in 2015 for a second time.[7] The latest revision is, among others, putting more emphasis on environmental performance monitoring.

The Eco-Management and Audit Scheme (EMAS) is a voluntary environmental management instrument, which was developed in 1993 by the European Commission. It enables

[6] The ISO survey of management system standard certifications – 2020.

[7] Note that companies certified against the 2004 revision will need to implement the new revision by September 2018.

organisations to assess, manage and continuously improve their environmental performance. As of October 2021, the EMAS Network counted 3,887 organisations and 12,022 sites.[8] EMAS was firstly introduced for European firms only, however, in 2010, EMAS III allows organisations outside the European Union to get certified (Murmura et al., 2018). EMAS goes beyond the requirements of ISO 14001, on the interpretation of how environmental processes are to be planned and managed. For example, the latest version of ISO 14001 requires you to identify your environmental aspects and impacts, while EMAS requires you to perform an initial comprehensive environmental review of your processes (Hammar, 2018).

"1.2.3 Environnement" is a model for the establishment and certification of an environmental standard in three main stages initiated by the Assembly of French Chambers of Commerce and Industry (ACFCI), which goal is to help organisation to reach ISO 14001 and/or EMAS certification. As of 2021, more than 500 organisations in France are either certified under *"1.2.3 Environnement"* or in the process of certification (Chamber of commerce, 2021). Under the first level, companies must fulfil requirements related to the initial environmental review, commitment of top management, establishment of an action plan, identification of the most significant environmental impacts, and compliance to legal obligations. Under the second level, companies must fulfil requirements related to the development of an environmental management program that is continuously reviewed and improved, anticipation of risks and an emergency preparedness plan, and training and awareness raising. Under the last level, companies must fulfil requirements related to regular internal audits and management review, documentation of planning and operation controls, checking, monitoring, and corrective actions, internal and external communications, and definition of roles and responsibilities.

[8] European Commission – EMAS Helpdesk (2021).

The "Antipol Survey" provides information on environmental protection studies and investments made by French plants. It is provided by the French national institute of public statistics (INSEE) over the period 2002-2018. The survey allows me to identify the plants that decided to implement an environmental certification or if the plant is in the process of certification. The environmental standard can either be the ISO 14001 standard, the Eco-Management and Audit Scheme (EMAS) or *"1.2.3 Environnement"*. The survey covers establishments that belong to divisions 05 to 35 of *"Nomenclature d'Activités Francaise"* classification system (NAF) rev.2, i.e: all manufacturing sectors, production and distribution of electricity, gas, water vapour, air conditioning and mining.[9] These are industrial establishments with 20 or more employees. Until 2005, the coverage was limited to establishments belonging to the most polluting sectors, its scope was later expanded to all manufacturing sectors, production and distribution of electricity, gas, water vapour, air conditioning and mining.

As the requirements of these three standards are quite heterogeneous, it would have been interesting to assess the effect of each standard on trade separately unfortunately, the survey does not provide the distinction between environmental standards.[10]

The survey also collects information on the plant's size (in terms of employees) and on the number of employees affected to environmental protection activities. It also contains information about firms' principal activity according to the French classification system (NAF). Below, I use principal activities to group firms by industries (Table 1).

I aggregate plant level data into legal unit level data using the first nine numbers of the national identification code of plants (SIRET) which is the legal unit's identification code

[9]NAF is mostly equivalent to the NACE system, the statistical classification of economic activities in the European Community.

[10]However, the EMAS requirements are based on the latest version of ISO 14001 and third level of *"1.2.3 Environnement"* also correspond to ISO 14001.

(SIREN) for the matching.

3.2 French Firm Level Trade Data

Custom data report the universe of declared trade flows over the period 2002-2018 by firm, country of destination and commodity. Commodities are coded at the national tariff line level (NC8), later aggregated at the HS-6 level (the most disaggregated product level common across countries). Over the period of interest there have been two revisions of the HS classification. Since differences in the granularity of the HS classification can induce mechanical changes in the number of HS codes traded by firms I convert the HS codes in different years using the correspondence tables provided by CEPII.[11]

Another potential consistency problem with custom data is due to the fact that Custom declaration requirements have been slightly revised over my period of interest. Before 2010 there was a declaration threshold set at €1,000 for trade flows extra-EU only. I investigate consistency across destinations and time, building on Bergounhon et al. (2018), and imposing the €1,000 threshold for years where this limit was not in place.[12] When matching the databases, the firms only present in the Antipol survey, and therefore not in the customs database, are treated as purely domestic firms while the firms only present in the customs database are not considered for this analysis. Indeed, it is not possible to know whether the firm is not part of Antipol because it did not answer, because it was not surveyed or because it is not certified.

The administrative data comes from two sources: (i) FICUS and (ii) FARE. These data are provided by the French national institute of public statistics (INSEE) and the Min-

[11] Note that even in the case of a one-to-one reclassification, one would observe a jump in the probability to add a product in correspondence with a revision.

[12] I do not observe significant changes in the number of firms and HS codes, nor in the share of intra-EU trade. Figure A.1 is comparing the export value with and without the threshold.

istry of Finance and combine information from the firm's tax reports. These two sources provide information, among other, on the number of employees and the value of sales.

To study the differentiated effect of certification across destinations, I control for the presence of environmental provisions in preferential trade agreements (PTAs) signed by the EU using the database developed by the World Bank. The World Bank PTA database maps technical barriers to trade in 269 preferential trade agreements that entered into force between 1960 and 2017.

3.3 Descriptive Statistics

As previously mentioned, the sector coverage of the Antipol survey is composed of establishments belonging to divisions 05 to 35 of NAF rev.2 classification. Table 1 displays the distribution of certified plants across NAF sectors. The majority of certified plants belongs to the manufacturing sector (70.9%) and the electricity, gas, steam and air conditioning supply sector (25.4%) while sector B and E of the NAF classification represent less than 4% of the plants combined.[13]

Table 1: Distribution of certified legal units

Naf Sector	# legal units	Percentage
B - Mining and Quarrying	157	1.6%
C - Manufacturing	6,981	70.9%
D - Electricity, Gas, Steam and Air Conditioning Supply	2,496	25.4%
E - Water Supply; Sewerage, Waste Management and Remediation Activities	208	2.1%

Figure 1 presents the distribution of certified over non-certified plants across the years. As observed on the graph, the number of certified plants increases over the sample period (in blue on the histogram). In particular, one can observe an increase in the number of

[13]The sampling method is stratification by industry, unit size and location (since the reference year 2014). The allocations are optimised on the amounts of research and development in previous surveys.

plants starting from 2006, following the increased scope of the survey (until 2005, the scope was limited to the establishments belonging to the most polluting sectors).

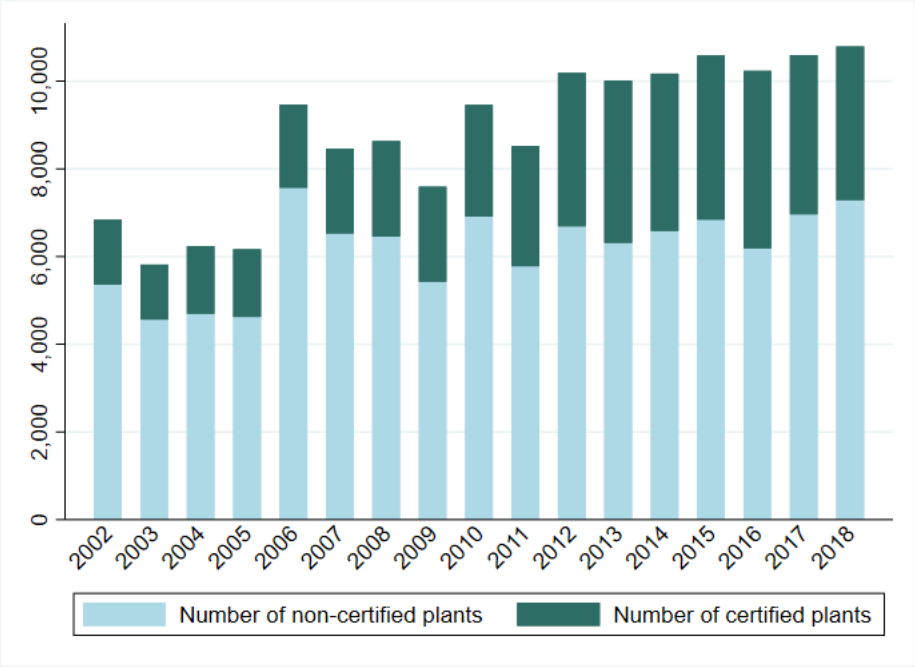


Figure 1: Distribution of certified local units

On average, firms are surveyed 5 times across the period 2002-2018 and are composed of 2.24 plants, while the median number of plants per firm is 1. The majority of the sample is thus composed of one plant firm. On average, firms have 34% of their plants certified. 86% of firms with at least one plant certified have all their plants certified while 3.02% have only half of their plants certified. On average, plants stay certified for slightly less than 8 years while the certification process lasts, on average, less than 3 years (Table 2).[14]

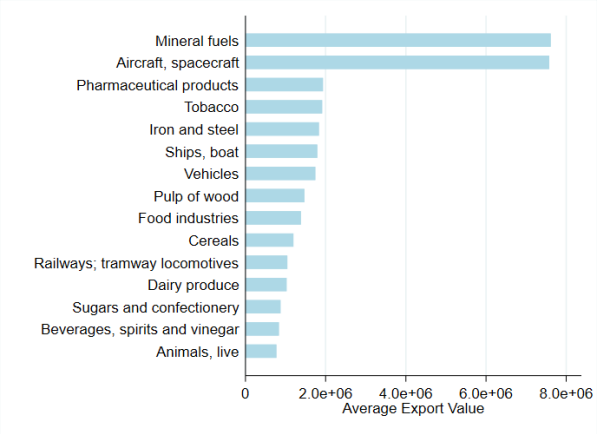
Figure 2 represents the distribution of the top 15 exported products by certified firms. Certified firms mostly export products in the sectors of 'Mineral Fuels', 'Aircraft, space-

[14]The certification process timing is calculated using only the firms starting and finishing the certification process between 2002 and 2018.

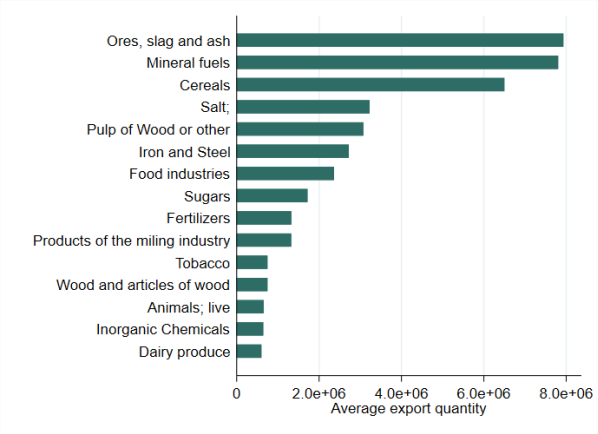
Table 2: Average duration at the firm-year level

Variable	Mean	Std. Dev.	Min	Max	Obs	Median
Firm duration	4.95	3.87	1	17	139,595	4
Nbr of plants by f-t	2.24	5.73	1	544	4,351,426	1
Certification Share	0.53	0.47	0	1	4,351,426	0.61
Certification Duration	7.87	4.53	1	17	45,042	7
Certification Process	2.79	1.85	1	14	6,571	2

craft, and Parts Thereof', pharmaceutical products, and tobacco products. They also often export raw materials, such as iron and steel and pulp of wood products based on the export value (Figure 2a). Based on the quantity exported, certified firms principally export products in the ores, slag and ash, mineral fuels, and cereals sectors (Figure 2b). Figure 3 plots the main products certified firms export ranked on their average export share. Nuclear reactors, electrical machinery and vehicles have the largest export share based on value (Figure 3a) while iron and steel, mineral fuels and salt have the largest export share based on the quantity exported. Figure 4 presents the main destination markets certified export to. They mostly export to Germany, the United States and Italy (Figure 4a). Based on the quantity exported, certified firms principally export to European partners, namely, Germany, Belgium, and Spain (Figure 4b).

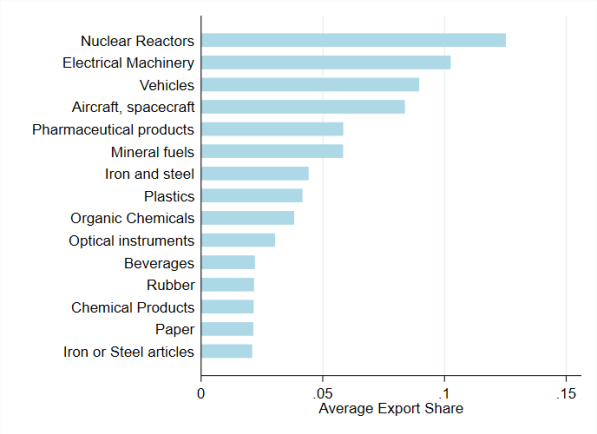


(a) Distribution based on export value

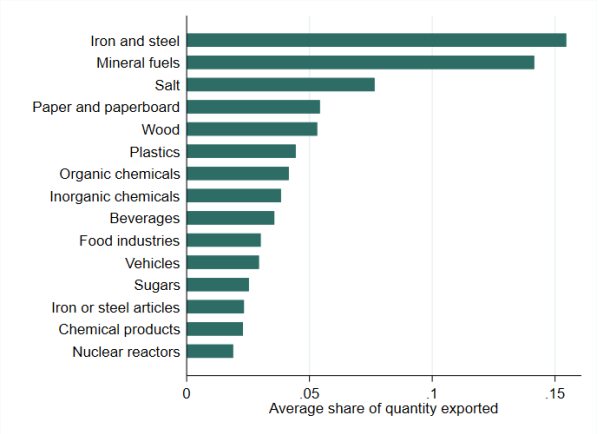


(b) Distribution on export quantity

Figure 2: Distribution of top exported products by certified firms

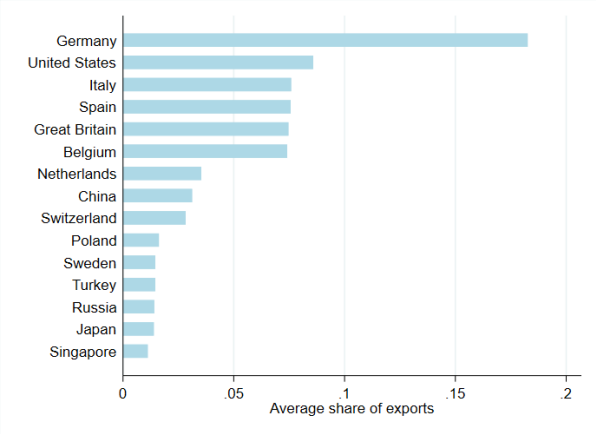


(a) Distribution based on export value

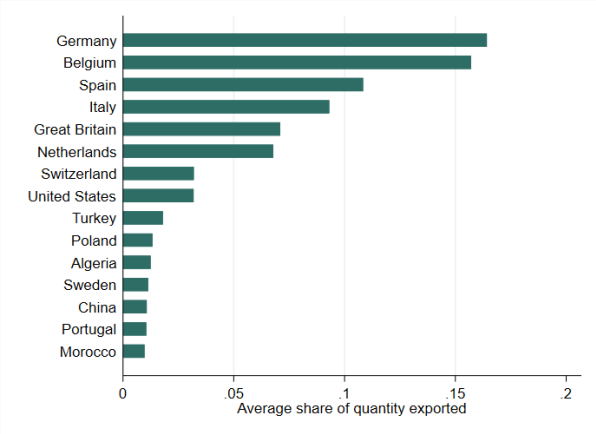


(b) Distribution on export quantity

Figure 3: Distribution of top exported products by certified firms



(a) Distribution based on export value



(b) Distribution on export quantity

Figure 4: Distribution of top exported destination by certified firms

4 Empirical Strategy

This section describes how I estimate the effect of certification on French firms' exporting activities. I start by presenting the empirical strategy used, before developing the methods employed to reduce any endogeneity concerns.

4.1 Empirical Strategy for Firm Level Estimation

4.1.1 Identification strategy

To investigate the effect of environmental certification, I estimate the following linear regression model:

$$y_{fpdt} = \beta_1 Certification_{ft} + \beta_2 EMS_{ft} + \phi_f + \delta_{pdt} + \epsilon_{fpdt} \quad (1)$$

Where $y_{f,p,d,t}$ denotes the trade margin of firm f of product HS6 p from destination d in year t. To assess the level of certification of a firm in a given year, I use the share of certified plants by firm-year combination ($Certification_{ft}$).[15] Secondly, to account for any possible learning effect, i.e. if it is easier for a firm to get certified if it already went through a similar process, I control for the presence of another environmental management system, using the share of plants with another EMS by firm-year combination (EMS_{ft}). I include firm fixed effects (ϕ_f). These fixed effects control for factors specific to the firm that are time invariant. I also add product-destination-year fixed effects to control for factors such as business cycles, export-demand shocks, the market and competition conditions the firm is facing when selling a good p to market d at year t.

The identification strategy of equation 1 consists in exploiting the time variation of cer-

[15] In a robustness check, a dummy variable taking the value 1 if the firm has at least one plant certified is used.

tification in trade margins within firms that export the same hs6 product to the same destination market, after offsetting market characteristics that are product, destination and time specific. More specifically, the identification relies on one assumption, it requires that the expectations of the firm's trade margin without certification follows a similar trend over time for all the firms that sell a product p to a destination d. The standards errors of the coefficients for all estimations are clustered at the (f, t), firm-year level: at the assignment of the treatment in my research design. The standard errors thus accounts for the possibility that firms' trade margins may be correlated in the same period between units that are shocked by the certification.[16]

4.1.2 Definition of firm's import margin

To reduce any potential selection into certification issue, I only keep the firms that get certified within the period of interest, 2002-2018. In other words, the control group is composed of "not-yet treated" observations.

To evaluate the impact of an environmental certification on a firm's export performance, I start by estimating the impact of certification on the intensive margin of French firms. I estimate the impact of certification on the export value, on the quantity exported, and on the export prices, imperfectly proxied by unit value.

I estimate the impact on export value, and on quantity exported using a PPML estimator to control for the possible presence of heteroskedasticity in the data (Silva and Tenreyro, 2006). The effect of certification on the unit value is estimated using a linear estimator. Table 3 presents the results of the estimation of certification on the intensive margin.

In a second stage, I estimate the impact of certification on the extensive margin of French

[16]In Abadie et al. (2017), the authors discuss this experimental design reason for clustering, which is when cluster of units, rather than individual units, are assigned to a treatment. The estimations are also run with a clustering at the firm level (Table A.2) and the results are robust.

firms, on the probability to export. $Probability(Export_{fpdt})$ equals to one if the value of exports is positive. In order to compute the probability to export dummy and track a given firm-product-destination combination over the entire period, I square the dataset and include zeros when the firm does not export into a given product-destination. In order to reduce the bias from occasional exporters (churning), I retain firms that export at least three times during the period 2002-2018.

Despite the dichotomous nature of the dependent variable, I estimate equation 1 via OLS. To avoid the incidental parameter problem due to the sizeable set of fixed effects I include in all regressions, I rely on simple linear probability model (LPM) rather than on non-linear models (probit or logit models).

4.2 Endogeneity of export trade and environmental certification

Equation 1 might suffer from an endogeneity bias because of an omitted-variable bias, sample selection and/or reverse causality. The former is reduced by the use of product-destination-year and firm fixed effects: these control for most of the potential unobserved variables affecting firms' export behaviour by country of destination and product market. The results are also robust to the inclusion of firm-product-destination and year fixed effects, and to the inclusion of firm-product-destination and product-destination-year fixed effects, controlling for any composition effect within the firm and any time varying factors specific to a product-market combination. Furthermore, when exploring the potential mechanisms, the effects are robust to the inclusion of firm-year fixed effects controlling for any omitted variable specific to a firm and varying over time such as a productivity shock.

The selection issue is reduced by the choice of control group, only composed of firms

that will get certified during the period of interest. Indeed, one may fear that only a sub-sample of firms are able/willing to get certified. However, by keeping only the firm that will receive the certification, the treated and control groups are more comparable and the identification strategy can exploit the time variation of the certification on the firm's export performance.

Reverse causality may come about if the firm's export performance affects its decision to get certified, i.e. if the best exporters and the most productive firms are the ones adopting the environmental standard. This issue may bias my results if both the exporting and certification decisions are taken within the firm. The certification decision is taken at the plant level while the export decision is taken at the firm level, reducing the endogeneity issue. However, 86% of the firms have all their plants certified suggesting that the decision might be taken by the firm. The parallel trend assumption requires that the expectation of the trade margins without environmental certification follows a similar trend over time for all firms that sell a product p to a destination d. Figure 5 plots the log change in French exports for certified firms, conditional on destination and product time-variant characteristics. The lack of pre-trend preceding the certification slightly reduces the reverse causality issue.

4.2.1 Instrumental Variable

To test for this possible endogeneity bias, I first rely on an instrumental variable strategy. As mentioned in Section 2, firms might decide to get certified as a response to market pressures. It suggests that external forces persuade organisations to undertake similar strategic actions as it creates business opportunities for environmentally conscious firms. If market pressures indeed lead firms to behave in a similar way, a firm might adopt an environmental certification to model its neighbouring competitors. To test for this

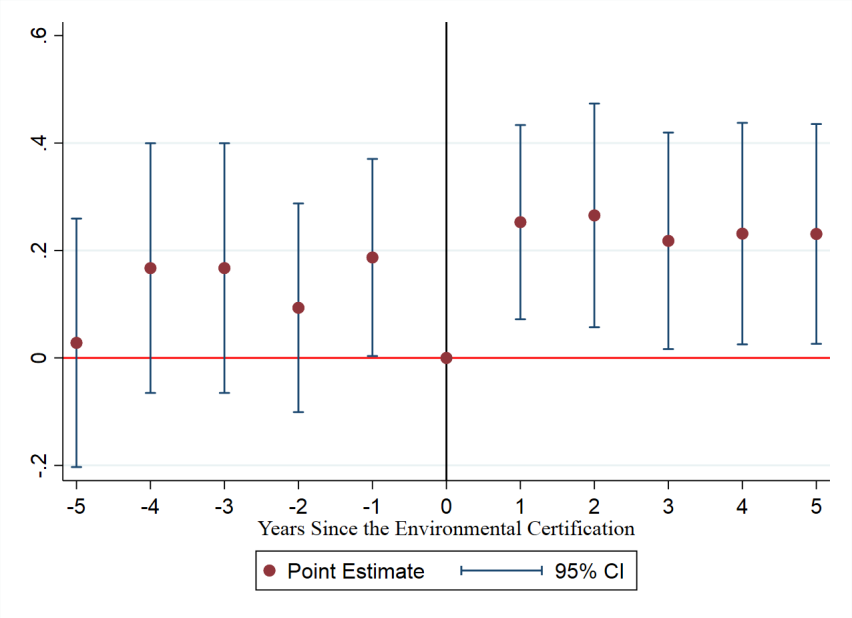


Figure 5: French export dynamics around environmental standard certification

possibility, I construct the instrumental variable using information on the certification of neighbouring firms that produce similar products. For each firm and year in the sample, I compute the share of certified plants from the same sub-national region (*'département'*) producing the same product part of the same $HS4$, excluding the firm itself.

$$IV_{ft} = \frac{\sum_{f,t} Certif_{f,t}^{Dep-HS4}}{\sum_{f,t} Firms_{f,t}^{Dep-HS4}} \tag{2}$$

The instrument described above is positively correlated with the share of certified plants per firm-year (and also with the certification dummy) suggesting the relevance of the instrumental variable in explaining the (potential) endogenous variable. Neighbouring firms compete with each other for the same export share, leading to mutually dependent certification strategies. First stage results of my 2 SLS strategy are reported in Table A.6, first stage coefficients are always positive and statistically significant. These results along with the F-statistics above 10 (rule of thumbs for avoiding weak instrument problem),

reported at the bottom of Table 3, show the relevance of the instrument.

The exclusion restriction (or validity) of my instrumental variable is related to the fact that certification choice of neighbouring firms is unlikely to affect the firm's decision to export nor the export price. They are rather driven by firm's specific factors, such as productivity, destination-specific trade costs, and size. Bernard and Jensen (2004) find that entry costs matter while spillovers from the export activity of other plants are negligible. Using French firm-level export data, Koenig et al. (2010) do not find evidence of the presence of export spillovers on the exported volume. To support the validity of my instrumental variable, I show in Figure A.4 the correlation between my instrumental variable and the different dependant variables: export value in Figure A.4a, quantity in Figure A.4b and unit value in Figure A.4c. The exogeneity of the instrument is qualitatively supported by the absence of correlation between the instrument and the dependent variables. Table A.7 also presents some qualitative evidence supporting the exclusion restriction.

Results on 2SLS estimations are reported in Table 3 and confirm the main results. For the effect of environmental certification on export value and the exported quantity, I am relying an IV-PPML method. It refers to the PPML estimator combined with the control function approach suggested by Lin and Wooldridge (2019), allowing to deal with endogeneity in non-linear models. The first-stage results are presented in Table A.6.

I also test the robustness of the estimations by using a lagged version of the instrument, to mitigate any simultaneity issue. Results are displayed in Table A.5 and shows the same results.

4.2.2 Propensity Score Matching

To further reduce the possible endogeneity in the certification's adoption timing, I am also employing a one-to-one dynamic propensity score matching (PSM) method. The propensity score can be defined as the conditional probability of assignment to a treatment given a vector of covariates including the values of all treatment confounders (Rosenbaum and Rubin, 1983). Every year, a certified firm is matched to a non-certified firm but which has the same probability of getting certified given a set of confounders. Following the literature, I allow for a broad range of firm characteristics that may influence the potential for a firm to implement an environmental certification. I include indicators for export status, the firm's sector of activity, and the number of destinations the firm is exporting to, as determinants of a firm's selection into certification. I estimate the probability that a firm f with characteristics X_{ft} adopts a certification in period t using a logit model: $p(X_{ft}) \equiv \bigwedge(X_{ft})$. I match firm within sector, year-by-year, and implement the nearest-neighbour matching procedure without replacement. Therefore, every year a treated firm is match to a non-treated firm with the same probability to be certified based on this propensity score. The results from the logit estimation are reported in Table A.8.

5 Results and Discussion

5.1 Intensive Margin

The estimation of environmental certification on the intensive margin of firm is presented in Table 3, Columns (1) to (3) present the baseline results while Columns (4) to (6) present the estimations where the share of certified firms is instrumented. An increase by one standard deviation in the share of certified plants is associated with a 4.9% increase

of the export value.[17] This positive effect is explained by the positive effect environmental certification has on the price of exported products, proxied by unit value and on the quantity exported. The implementation of an environmental certification requires the implementation of new production processes, often at the cost of foregone economies of scale, resulting in firms passing through the additional costs to the consumers. The environmental certification also acts as a quality signal and allows firms to charge a price premium for their goods and to increase the quantity they exported. The increase in the quantity exported of certified firms also suggests a demand effect. Environmental certification seems to allow firms to export more, suggesting it creates business opportunities. The results found when the share of certified plants within a firm is instrumented are similar to the baseline results: environmental certification positively impacts the export value through an increase in the exported price. The instrumental variable passes the F-test of excluded instruments and is significantly above the cut-offs. Despite the sign of the coefficients being the same between the two methods, the magnitude of the IV coefficients are larger. This suggests that less productive firms are the ones getting certified. Certification seems to serve as a way of increasing their export thanks to a demand effect. It also hints that less productive firms might use certification as a way of avoiding competition.

5.2 Propensity Score Matching (PSM) Estimation

Table 4 presents the results of the PSM estimation. The results found are similar to the ones found in the baseline regression. The environmental certification positively impacts

[17] This coefficient is estimated as $(exp(\beta_1 * s.d.) - 1) * 100$, the standard deviation of the certification share is equal to 0.47.

Table 3: Estimation of the effect of certification on firm's export performance - Share

	(1) Export PPML	(2) Quantity PPML	(3) ln(unit value) OLS	(4) Export IV PPML	(5) Quantity IV PPML	(6) ln(unit value) 2SLS
Certif $Share_{ft}$	0.103***	0.092**	0.022**	0.457**	0.112*	0.083**
	(4.16)	(2.32)	(2.28)	(0.22)	(0.28)	(2.22)
EMS $Share_{ft}$	0.028	0.131***	0.016	0.200**	0.144**	0.045**
	(1.00)	(3.07)	(1.60)	(2.41)	(2.12)	(2.18)
	Quantification Effect of Certification:					
with one s.d. ↗ in Certif. Share	+4.9%	+4.4%	+1.02%			
Observations	3,115,812	3,115,812	3,115,812	2,804,971	2,804,971	2,804,963
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
First-stage F-Stat						1,029.27

Clustered standard errors in parentheses
*$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

the export value, by increasing both the quantity exported and the export price, proxied by unit values.

Table 4: Estimation of the effect of certification on firm's performance - PSM Estimation

	(1) Export	(2) Quantity	(3) ln(unit value)
Certif $Share_{ft}$	0.095***	0.089**	0.023**
	(3.81)	(2.20)	(2.31)
EMS $Share_{ft}$	0.023	0.128***	0.018*
	(0.82)	(2.96)	(1.71)
	Quantification Effect of Certification:		
with one s.d. ↗ in Certif. Share	+4.57%	+4.27%	+1.01%
Observations	3,093,586	3,093,586	3,093,586
Firm FE	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes

Clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5.2.1 Effect on sales

Table 5 presents the effect of certification on sales.[18] Environmental certification positively impacts the effect on sales, one standard deviation increase in the share of certified plants increases sales by 2.9% while it increases exports by 4.3%. The share of exports in total sales is also positively impacted by the certification (+3.4%).

Table 5: Estimation of the effect of certification on firm's Sales

	(1) $ln(Sales)$	(2) $ln(Export)$	(3) $ln(Export/Sales)$	(4) $ln(Sales)$	(5) $ln(Export)$	(6) $ln(Export/Sales)$
Certif $Share_{ft}$	0.068**	0.105***	0.072**	0.061*	0.093***	0.072**
	(1.97)	(5.23)	(2.13)	(1.78)	(4.69)	(2.14)
EMS $Share_{ft}$	-0.007	0.006	0.036	-0.015	-0.005	0.037
	(-0.19)	(0.25)	(0.90)	(-0.36)	(-0.24)	(0.91)
$asinh(Size_{ft})$				0.034***	0.056***	-0.003
				(3.18)	(8.11)	(-0.24)
	Quantification Effect of Certification:					
with one s.d. ↗ in Certif. Share	+3.20%	+4.93%	+3.38%	+2.87%	+4.37%	+3.38%
Observations	17,361	31,553	15,760	17,361	31,553	15,760
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Clustered standard errors in parentheses
*$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5.3 Extensive margin

Table 6 shows the results of certification on the probability that a firm f exports a product p to a destination d in year t. Columns (1) and (2) present the results using the share of certified plants. I found that the probability to export increases for certified firms by 1.41%. Being regulated under the Seveso directive does not affect your probability to export.[19] Column (3) presents the results where I instrument the certification status

[18] Estimations are run at the firm-year level as sales data is on available at this level.

[19] The European directive Seveso, on the control of major-accident hazards involving dangerous substances lays down the rules for prevention of major industrial accidents involving hazardous substances and for limiting the consequences of such accidents for human health and the environment.

of the firm by the share of certified neighbouring firms. The results are similar to the baseline ones, certification positively impacts the probability to export a product p to a destination d in a year t. These results suggest that certification also acts as a way to penetrate new market.

Table 6: Estimation of the effect of certification on firm's performance - Extensive margin

	(1) LPM	(2) LPM	(3) 2 SLS
Certif $Share_{ft}$	0.014***	0.014***	0.043***
	(2.90)	(2.90)	(3.00)
EMS $Share_{ft}$	0.005	0.005	0.019***
	(1.12)	(1.07)	(2.62)
$Seveso_{ft}$		0.002	
		(0.38)	
	Quantification Effect of Certification:		
with one s.d. ↗ in Certif. Share	+0.65%	+0.65%	+2.01%
Observations	17,163,651	17,163,651	16,918,144
Firm FE	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes
First-stage F-Stat			533.58

Clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5.4 Robustness Checks

5.4.1 Additional proxy of environmental certification

As a robustness to the share of certified plants within a firm, I use a dummy variable taking the value 1 if the firm has at least one plant certified is used. The results are robust to the use of certified dummy and are presented in Table 7.

Table 7: Estimation of the effect of certification on firm's performance - Using Certification dummy

	(1) Export	(2) Quantity	(3) ln(unit value)	(4) Extensive	(5) Extensive
Certif Dum_{ft}	0.070***	0.067**	0.010	0.023***	0.037***
	(3.17)	(2.31)	(1.09)	(5.79)	(3.19)
EMS Dum_{ft}	0.009	0.104***	0.006	0.010***	0.015***
	(0.42)	(2.99)	(0.69)	(2.99)	(3.25)
Observations	3,115,812	3,115,812	3,115,812	17,163,651	16,918,144
Firm FE	Yes	Yes	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes	Yes	Yes
First-stage F-Stat					726.62

Clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5.4.2 Different estimator

In this study, the timing of the treatment is staggered, i.e. the time of the enforcement of certification varies across establishments. In presence of a staggered adoption design, De Chaisemartin and d'Haultfoeuille (2020) show that a two-way fixed effect estimator might give misleading results whenever the treatment effects are heterogeneous. In particular, they show that the average treatment effect might even be of the opposite sign than the coefficient estimated with OLS whenever the variance of the treatment period is large, because the two-way fixed effect estimator is a weighted average where weights can get negative in a staggered adoption framework. In my setting, an establishment is treated for slightly less than 8 years, with a standard deviation of 4.7 years, making this concern plausible. I show in the Appendix A.3 that my results are however stable to the use of the estimator proposed by De Chaisemartin and d'Haultfoeuille (2020) that re-scale the weights of the treatments to avoid negative ones (Figures A.2 and A.3).

5.4.3 Additional controls

I am first using a variable to control for the presence of "Seveso" plants within the firm (Table 8). In France, a classification of 'dangerous' activities for the environment performed by firm exists. It classifies activities among three levels: (i) the classified activities, (ii) the activities requiring firms to do a statement to the prefecture, and (iii) the activities that require an authorisation from the prefecture. This classification can be linked to the European directive Seveso, on the control of major-accident hazards involving dangerous substances lays down the rules for prevention of major industrial accidents involving hazardous substances and for limiting the consequences of such accidents for human health and the environment. Table A.1 presents the correspondence table between the two classifications. As the production of 'dangerous activities' might affect the probability to get certified, I control for the presence of Seveso plant within the firm ($Seveso_{ft}$). To this aim, I am using a dummy variable equals to 1 if the firm has at least one plant classified under the EU directive 'Seveso'.[20]

Secondly, the size of the firm might be correlated to both the export performance and the probability to get certified, so to reduce possible omitted variable bias, I am controlling for the size of the firm, in terms of employment.

Columns (1) to (3) of Table 8 control for the presence of Seveso plants while Columns (4) to (6) control for the size of the firm (in terms of employment, in ln). Column (7) to (9) also control for the size of the firm, but using the inverse hyperbolic sine transformation instead of the logarithmic transformation.[21] The results are robust to the baseline results reducing a possible omitted variable bias in the baseline regression.

[20]The dummy Seveso takes the value one if the share of plant which requires an authorisation is larger than 0, following the ICPE classification, Table A.1.

[21]The inverse hyperbolic sine transformation is close to the logarithm but has the advantage of being defined for any real number, including zero.

Table 8: Estimation of the effect of certification on firm's export performance - Share

	(1) Export	(2) Quantity	(3) ln(unit value)	(4) Export	(5) Quantity	(6) ln(unit value)	(7) Export	(8) Quantity	(9) ln(unit value)
Certif $Share_{ft}$	0.106*	0.092*	0.017*	0.078***	0.068*	0.018	0.102***	0.091**	0.022**
	(4.42)	(2.33)	(1.66)	(4.64)	(1.68)	(1.58)	(4.11)	(2.31)	(2.26)
EMS $Share_{ft}$	0.030	0.131**	0.013	0.028	0.131***	0.017*	0.027	0.130***	0.016
	(1.07)	(3.02)	(1.21)	(1.00)	(3.08)	(1.66)	(0.98)	(3.05)	(1.59)
$Seveso_{ft}$	-0.016	-0.004	0.034**						
	(-0.58)	(-0.09)	(2.30)						
$ln(Size_{ft})$				0.080***	0.090**	0.009			
				(3.33)	(2.56)	(0.91)			
$asinh(Size_{ft})$							0.003	0.022	0.001
							(0.42)	(1.61)	(0.49)
Observations	3,115,812	3,115,812	3,115,812	2,570,846	2,570,846	2,570,846	3,115,812	3,115,812	3,115,812
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Clustered standard errors in parentheses
*$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5.4.4 Different fixed effects

Secondly, I am controlling for the robustness of the baseline estimations to the use of different set of fixed effects. To control for any possible composition bias following the adoption of an environmental certification, I use firm-product-destination fixed effects, that control for any firm unobserved, time invariant characteristics that are product and market specific and are likely to shape idiosyncratic exporters' behaviour. I also control for time fixed effects to absorb any year-specific shock. The results are robust to my baseline specification. The environmental certification positively impacts export value, through an increase in quantity and price (Table 9).

To control for any possible composition bias following the adoption of an environmental certification, and any time varying market-product factors, I use firm-product-destination fixed effects and product-destination-year fixed effects. The baseline results are robust to the inclusion of these new fixed effects. The environmental certification positively impacts export value, the quantity exported and the export price (Table 10).

The results are also robust to the use of a different cluster, at the firm level (Table A.2).

Table 9: Estimation of the effect of certification on firm's export performance - New set of fixed effects

	(1) Export	(2) Quantity	(3) ln(unit value)
Certif $Share_{ft}$	0.126***	0.157***	0.019**
	(3.44)	(3.51)	(2.45)
EMS $Share_{ft}$	0.025	0.099**	0.005
	(0.79)	(2.53)	(0.63)
Observations	3,461,523	3,461,523	3,461,523
Firm-Product-Dest FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Estimation of the effect of certification on firm's export performance - Different set of fixed effects

	(1) Export	(2) Quantity	(3) ln(unit value)
Certif $Share_{ft}$	0.076***	0.109***	0.014*
	(4.52)	(3.09)	(1.91)
EMS $Share_{ft}$	0.036**	0.167***	0.008
	(1.97)	(4.65)	(1.00)
Observations	2,578,311	2,578,311	2,578,311
Firm-Product-Dest FE	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes

Clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

5.4.5 Restricted sample

As previously mentioned in Section 3, the Antipole survey starts covering all manufacturing sectors, production and distribution of electricity, gas, water vapour, air conditioning and mining from 2005. I thus, re-run the regressions restricting the sample to the period 2005-2018, to remove the effect of coverage change. Table 11 displays the results. The results are similar to the ones found when using the whole sample period, however the effect on quantity is no longer significant.

Table 11: Estimation of the effect of certification on firm's trade - Restricted sample

	(1) Export	(2) Quantity	(3) ln(unit value)
Certif $Share_{ft}$	0.055**	0.063	0.021*
	(1.99)	(1.57)	(1.86)
EMS $Share_{ft}$	0.020	0.132**	0.014
	(0.63)	(2.90)	(1.15)
Observations	2,683,998	2,683,998	2,683,998
Firm FE	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes

Clustered standard errors in parentheses
*$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The results are also robust to restricting the sample to the one used for the IV estimation (Table A.3).

Thirdly, I also test for the robustness of the effect to restricting the sample to single plant firms. Table 12 shows the results. The results are robust to the inclusion of only single-plant firms.

Table 12: Estimation of the effect of certification on firm's trade - Single plant firms

	(1) Export	(2) Quantity	(3) ln(unit value)
Certif $Share_{ft}$	0.043**	-0.003	0.017*
	(2.05)	(-0.07)	(1.73)
EMS $Share_{ft}$	0.034	0.051	0.002
	(1.49)	(0.98)	(0.22)
Observations	1,513,415	1,513,415	1,513,415
Firm FE	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes

Clustered standard errors in parentheses
*$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

6 Exploring possible mechanisms

In this section, I further explore the possible mechanisms driving the effect of certification on trade. The positive impact of certification can result from increased demand in various markets, improved productivity of certified firms, or pressure from regulators and markets.

6.1 The signalling mechanism

As previously discussed, environmental certification may enable certified firms to signal their environmentally friendly processes and incentivise consumers to pay a premium for their products. I first explore this mechanism across different type of products.

6.1.1 Product heterogeneity

I first estimate the differentiated impact of certification depending on product characteristics. To this aim, I compare the effect of certification on intermediate and final goods producers, using the Broad Economic Categories (BEC) classification, developed by the United Nations Statistical Commission. Surprisingly, the effect on export value and export price is not different between intermediate and final good producers (Table 13). However, the effect on quantity differs, the quantity of final goods increases while it reduces by 3.92% for intermediate products. It suggests that environmental certification seems to matter more for final consumers, they demand more environmentally friendly goods. While for intermediate goods, the increase in export is due to a price premium that more than even out the decrease in quantity exported.

Table 13: Estimation of the effect of certification on firm's performance - BEC classification

	(1) Export	(2) Quantity	(3) ln(unit value)
Certif $Share_{ft}$	0.112***	0.233***	0.030**
	(3.16)	(3.48)	(2.33)
EMS $Share_{ft}$	0.021	0.129***	0.016
	(0.75)	(2.85)	(1.60)
Certif $Share_{ft} * Intermediate_p$	-0.035	-0.273***	-0.013
	(-0.86)	(-3.76)	(-1.03)
Observations	3,120,885	3,120,885	3,120,885
Firm FE	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes

Clustered standard errors in parentheses
*$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

6.1.2 Destination heterogeneity

Secondly, the impact of environmental certification might be different across destination market. This effect could be magnified in markets where consumers' environmental awareness is higher.

To this aim, I first look at the effect of certification across different destination markets, based on their level of development (Table 15). Consumers in developed economies might have more knowledge of environmental standards and might have a higher willingness to pay for these products than consumers in less developed economies. The positive impact of environmental certification on the value of export is only observed for developed and developing destination market. While the export value to least developed countries by certified firms is reduced. The price charged to developed destination markets by certified firms increases by 0.80% while it increases by 10% in least developed economies. The results are robust to the inclusion of firm-year fixed effects.

Secondly, I investigate the differential effect of certification across intra-EU and extra-EU sources. While the positive effect on export value is only observed within EU-sources, the effect on the unit value is not different regardless of whether the destination market

Table 14: Estimation of the effect of certification on firm's performance by level of development

	(1) Export	(2) Quantity	(3) ln(unit value)	(4) Export	(5) Quantity	(6) ln(unit value)
Certif $Share_{ft} \times Developing_{dt}$	0.414***	-0.428	-0.055	0.439***	-0.274	-0.069
	(3.17)	(-1.55)	(-1.18)	(3.52)	(-1.01)	(-1.53)
Certif $Share_{ft} \times Developed_{dt}$	0.486***	-0.291	-0.093*	0.451***	-0.257	-0.110**
	(3.69)	(-1.02)	(-1.90)	(3.49)	(-0.99)	(-2.39)
Certif $Share_{ft}$	-0.366***	0.394	0.104**			
	(-2.75)	(1.32)	(2.10)			
EMS $Share_{ft}$	0.028	0.128***	0.016			
	(1.00)	(3.10)	(1.56)			
Observations	3,115,812	3,115,812	3,115,812	3,113,922	3,113,922	3,113,922
Firm FE	Yes	Yes	Yes	No	No	No
Firm-Year FE	No	No	No	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Clustered standard errors in parentheses
*$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

is part of the EU. On the other hand, the increase in quantity exported by certified firms is larger when trading with EU countries than extra-EU markets. These results also hold when controlling for any time variant firm characteristics.

Table 15: Estimation of the effect of certification on firm's performance within EU

	(1) Export	(2) Quantity	(3) ln(unit value)	(4) Export	(5) Quantity	(6) ln(unit value)
Certif $Share_{ft} \times EU_{dt}$	0.207***	0.284***	-0.009	0.181***	0.309***	-0.016
	(4.85)	(3.48)	(-0.43)	(3.82)	(2.97)	(-0.65)
Certif $Share_{ft}$	-0.031	-0.142*	0.028*			
	(-0.80)	(-1.86)	(1.72)			
EMS $Share_{ft}$	0.027	0.120***	0.016			
	(0.99)	(3.01)	(1.60)			
Observations	3,115,812	3,115,812	3,115,812	3,113,922	3,113,922	3,113,922
Firm FE	Yes	Yes	Yes	No	No	No
Firm-Year FE	No	No	No	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Clustered standard errors in parentheses
*$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Fourthly, I am using a dummy variable equals to 1 if the EU signed a preferential trade agreement (PTA) with environmental provisions. Table 16 presents the results using this

variable. The increase in export value is observed only for these partner countries while the price premium applied by certified firms is the same across destination markets, suggesting that the signalling effect of certification is true in every market. However, certified firms are only able to increase the quantity sold to the destination markets with whom the EU has signed a deep PTA, by 17%, for which the demand for more environmental conscious products is larger. These results hold when introducing firm-year fixed effects.

Table 16: Estimation of the effect of certification on firm's performance - PTA with Environmental Provisions

	(1)	(2)	(3)	(4)	(5)	(6)
	Export	Quantity	ln(unit value)	Export	Quantity	ln(unit value)
Certif $Share_{ft}$	-0.027	-0.033	0.026*			
	(-0.70)	(-0.49)	(1.76)			
EMS $Share_{ft}$	0.031	0.131***	0.016			
	(1.14)	(3.15)	(1.59)			
Certif $Share_{ft} * PTAEnv_{jt}$	0.213***	0.182**	-0.022	0.190***	0.187	-0.021
	(4.93)	(2.14)	(-0.76)	(4.12)	(1.53)	(-0.66)
Observations	3,393,706	3,392,530	3,354,234	3,391,850	3,390,652	3,352,363
Firm FE	Yes	Yes	Yes	No	No	No
Firm-Year FE	No	No	No	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Clustered standard errors in parentheses
*$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Thirdly, I am using the list of "green" products published by the OECD to estimate the share of "green imports" of each country, as a proxy of environmental awareness (Table 17). Export to a destination with an average share of green import increases through a demand effect, an increase in the quantity exported.[22] On the other hand, certified firms are able to charge a higher price only to destination with a higher share of green imports. The results are still true even when controlling for any time-varying firm's characteristics, highlighting the importance of the demand effect.

[22]The results are standardised using the average value of green imports, thus the interaction term's effects are obtained by multiplying the coefficient by the standard deviation of green imports.

Table 17: Estimation of the effect of certification on firm's performance - Share of Green Import

	(1) Export	(2) Quantity	(3) ln(unit value)	(4) Export	(5) Quantity	(6) ln(unit value)
Certif $Share_{ft}$	0.313***	0.250**	-0.005			
	(4.81)	(2.47)	(-0.35)			
Certif $Share_{ft} * GreenImp_{jt}$	-0.215***	-0.175*	0.026*	-0.208***	-0.177*	0.028**
	(-3.32)	(-1.85)	(1.79)	(-3.09)	(-1.75)	(1.96)
EMS $Share_{ft}$	0.028	0.132***	0.016			
	(1.02)	(3.09)	(1.58)			
Observations	3,090,988	3,090,988	3,090,988	3,089,105	3,089,105	3,089,105
Firm FE	Yes	Yes	Yes	No	No	No
Firm-Year FE	No	No	No	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Clustered standard errors in parentheses
*$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

6.1.3 Firm's heterogeneity

Thirdly, the effect of certification might also depend on firm's characteristics, such as the productivity level of the firm. I am controlling for the productivity of the firm by calculating the value-added per worker in the base year.

The export of the average certified firms increases by 11.4% while the effect is slightly reduced for a firm with a productivity higher by one standard deviation than the average firm.[23] This result is in line with the IV results suggesting that less productive firms are the ones getting certified. The quantity exported by certified firms is not affected by the productivity level however, more productive firms are able to charge a higher price premium in comparison to the average firm (Table 18).

The effect of the certification might also depend on the firm size. Figure 6 displays the impact of the certification by firm size's percentile. The effect is larger for smaller firms while the effect is not statistically different from zero for firms in larger size percentile.

[23]The results are standardised using the average value of productivity.

Table 18: Estimation of the effect of certification on firm's trade - Productivity

	(1) Export PPML	(2) Quantity PPML	(3) ln(unit value) OLS
Certif $Share_{ft}$	0.108***	0.089**	0.035***
	(4.63)	(2.35)	(2.76)
EMS $Share_{ft}$	0.026	0.129***	0.017*
	(0.95)	(3.13)	(1.65)
Certif $Share_{ft} * ln(Productivity_f)$	-0.055**	0.015	0.011**
	(-2.54)	(0.52)	(1.97)
Observations	3,097,486	3,097,486	3,097,486
Firm FE	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes

Clustered standard errors in parentheses

*$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

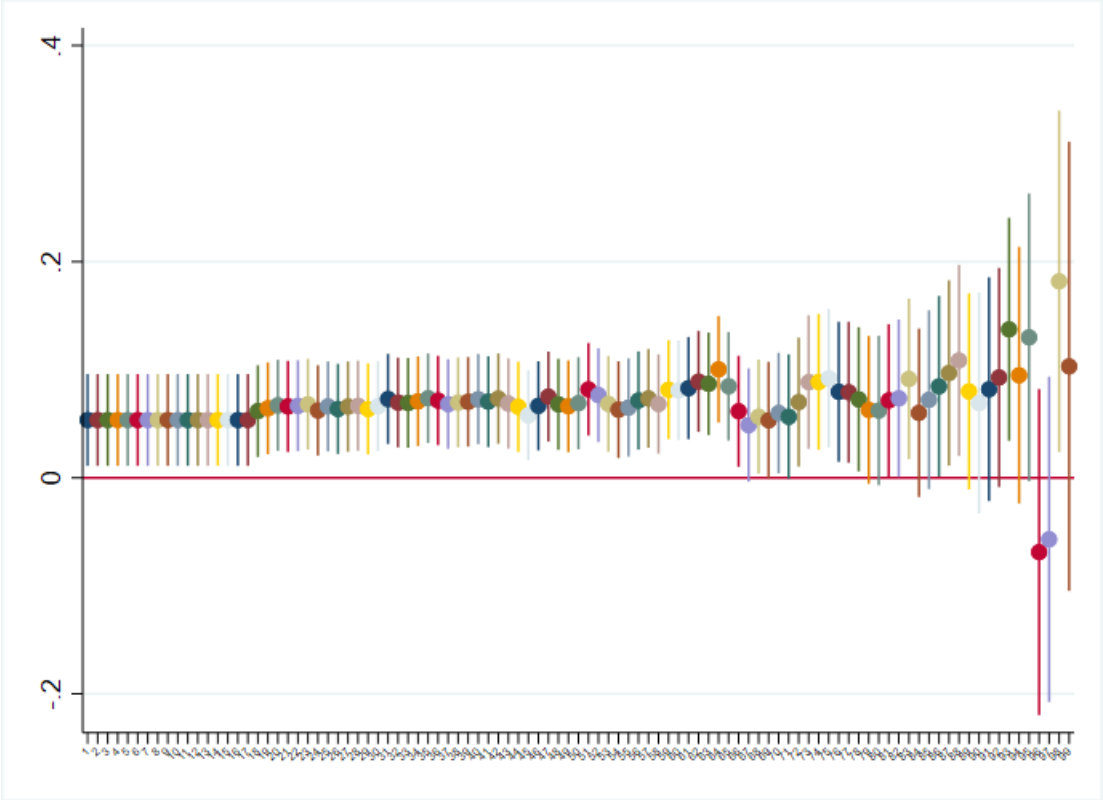


Figure 6: Effect of the certification by firm size

6.2 The resource-based mechanism

The resource-based view posits that a firm's performance hinges on the effective utilisation and configuration of its resources, which can confer a unique competitive edge. Hence, opting for voluntary environmental certification could prompt internal restructuring and enhance productivity.

Figure 7 plots the effect of environmental certification on the productivity level of the firm. Productivity is proxied by the value added per worker. Following the adoption of certification, the productivity level of the firm is not affected. There is also no difference in productivity before certification, certified and non-certified firms are not different in their productivity before the certification. This result suggests that the resource-based mechanism is not at play in this context.

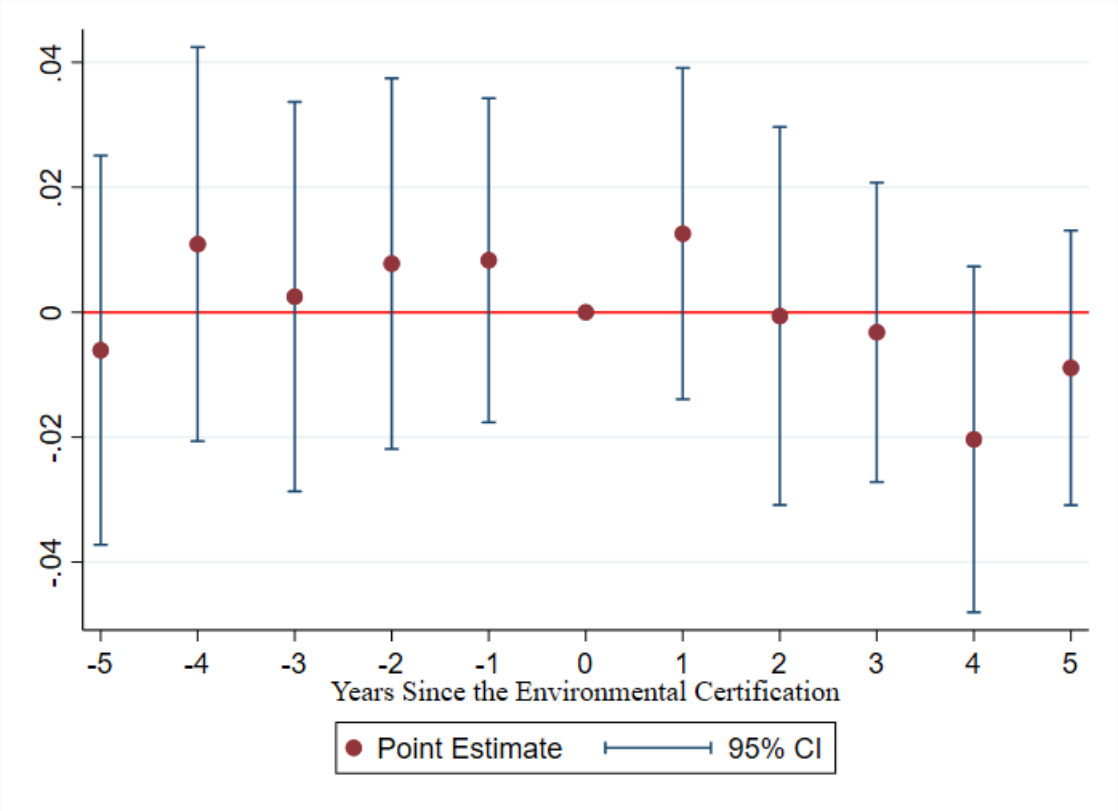


Figure 7: Effect of the certification on the productivity

7 Conclusion

This paper estimates the effect of the voluntary adoption of an environmental standard on firms' export performance. By creating new economic opportunities, environmental certification might allow firms to enhance their export performance. However, it might also have adverse effects if the costs associated with implementing environmental certification are too high or if the firm cannot pass-through the costs on to consumers due to low environmental awareness.

This work overcomes the empirical challenges linked to the identification of the impact of certification on export performance, by first, using a novel plant-level survey on environmental performance, and by developing an IV strategy as well as a propensity score matching method to reduce any endogeneity concern.

Firstly, I found that environmental certification is associated with a positive effect on export value through an increase in export prices. Environmental certification acts as a 'quality signal', enabling firms to pass on their costs to consumers by raising prices. Certification also increases the quantity exported, indicating the creation of new economic opportunities. Secondly, I found that environmental certification increases the probability that a firm f exports a product p to a destination d. These results are robust to the use of an instrument variable: when the share of certified plants within a firm is instrumented by the share of certified neighbouring firms and to the use of a PSM method.

The baseline results remain robust when employing different fixed effects, sample periods, clustering methods, estimators, and additional controls.

Notably, these results are driven by a demand effect that varies across products, destinations, and firms. Certified firms are able to increase their exported quantity to

environmentally-aware destinations and charge higher prices. More productive firms can also charge higher prices, while certification only positively impacts trade for final goods, suggesting it matters more for final consumers. However, the resource-based mechanism does not appear to play a role in this context.

To the best of my knowledge, this is the first paper to empirically assess the impact of voluntary environmental certification on firm's export performance. I leave to further research to explore the effect of environmental certification on environmental performance along with trade performance.

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A Appendix

A.1 Additional Figures

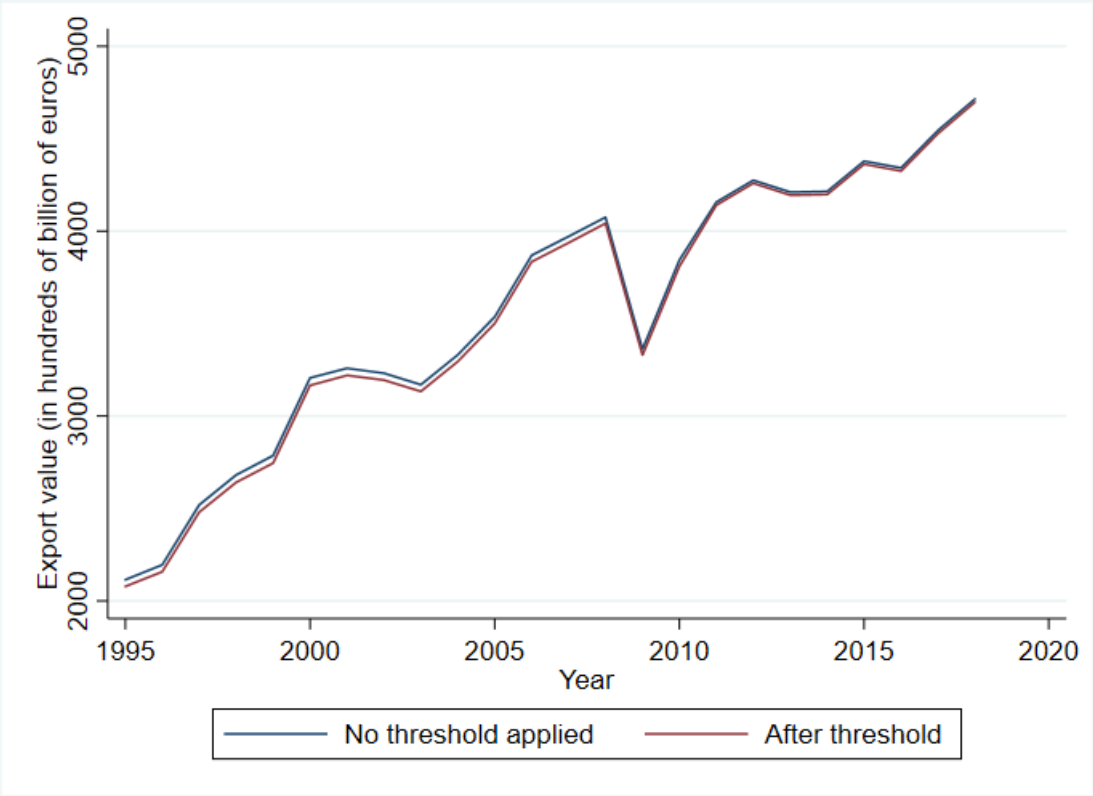


Figure A.1: Distribution of exports by year - Comparison

A.2 Additional Tables

Table A.1: Correspondence between ICPE (Installation Classified for the Protection of the Environment) and Seveso

Nature of the risk	**ICPE Classification**	**SEVESO Classification**
Quite important risk	Statement	-
Quite important risk	Authorisation	-
Important Risk	Authorisation	Low threshold
Major Risk	Authorisation with public utility easement	High threshold

Source: DRIEAT ile-de-France

Table A.2: Estimation of the effect of certification on firm's trade - Different cluster

	(1) (Export)	(2) Quantity	(3) ln(unit value)
Certif $Share_{ft}$	0.094***	0.092*	0.022*
	(3.00)	(1.75)	(1.69)
EMS $Share_{ft}$	0.022	0.130*	0.017
	(0.62)	(2.32)	(1.41)
Observations	3,120,885	3,115,812	3,120,885
Firm FE	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes

Clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A.3: Estimation of the effect of certification on firm's export performance - IV Sample

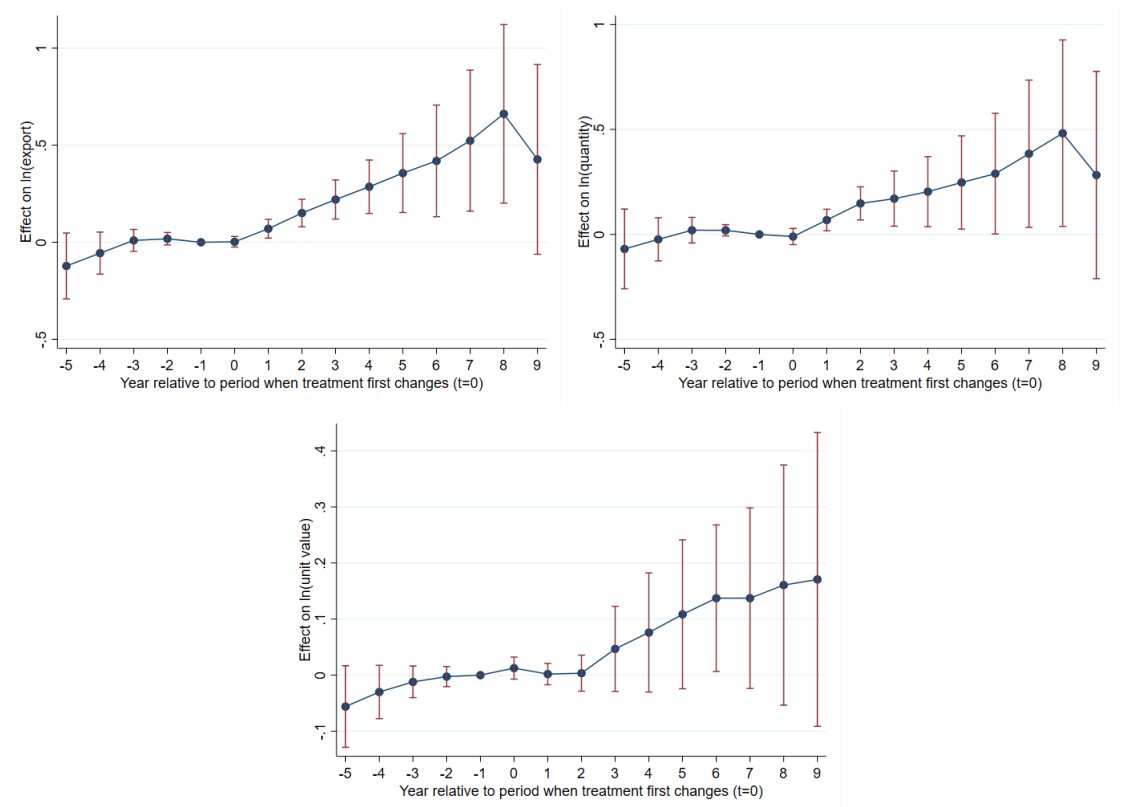
	(1) Export	(2) Quantity	(3) ln(unit value)
Certif $Share_{ft}$	0.095***	0.088**	0.025**
	(3.74)	(2.20)	(2.43)
EMS $Share_{ft}$	0.012	0.127***	0.015
	(0.41)	(2.95)	(1.40)
Observations	2,804,937	3,078,785	2,804,937
Firm FE	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes

Clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

A.3 Two-Way Fixed Effects Estimators with Heterogeneous Treatment Effects

As an additional robustness check, we use the two-way fixed effects estimators with heterogeneous treatment effects, developed by De Chaisemartin and d'Haultfoeuille (2020) to account for the difference staggered adoption designs of our treatment.

Figure A.2: Two-Way Fixed Effects Estimators with Heterogeneous Treatment Effects Estimator - Using switchers only

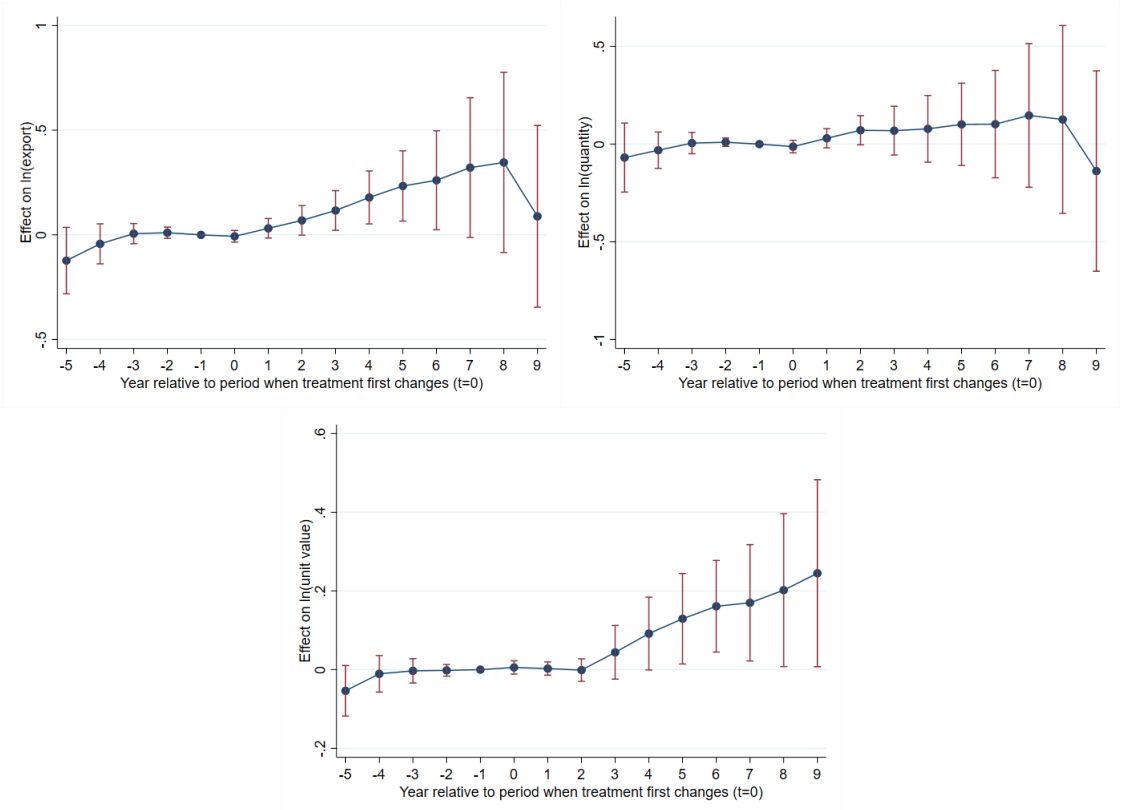


The treatment variable is equal to 1 if firm f has at least one plant certified in year t. Group (firm-product-destination) fixed effects are included, along with product-destination-year fixed effects. The standard errors are clustered at the firm-year level, the level of the treatment.

Figure A.2 keeps only the switchers in the sample. Following the certification, the export value of certified firms increases from the first year until $t+8$ after the certification. One

can observe a similar growing trend in the quantity exported from $t+1$ to $t+8$. On the other hand, the increase in unit value is only significant few years after the certification, highlighting the demand effect for certification.

Figure A.3: Two-Way Fixed Effects Estimators with Heterogeneous Treatment Effects Estimator



The treatment variable is equal to 1 if firm f has at least one plant certified in year t. Group (firm-product-destination) fixed effects are included, along with product-destination-year fixed effects. The standard errors are clustered at the firm-year level, the level of the treatment.

We observe that following the certification, the export value of certified firms increases from the second year until $t+6$ after the certification. On the other hand, one can only observe a small increase in the quantity exported at $t+2$ while the increase in unit value starts 3 years after the certification and lasts up to $t+8$. This suggests that the

certification mostly acts as a 'quality signal' allowing firms to pass through their costs to consumers.

A.4 Instrumental variable estimation

Table A.4: First stage of 2 SLS estimations controlling for endogeneity

	Intensive Margin			Extensive Margin	
	IV PPML - Export	IV PPML - Quantity	2SLS	2SLS	
	Explained instrumented Variable			Explained instrumented Variable	
Instrumental Variables	Certif $Share_{ft}$	Certif $Share_{ft}$	Certif $Share_{ft}$	Certif $Share_{ft}$	Certif Dum_{ft}
Certif $Share_{ft}^{dep-hs4}$	0.618***	0.558***	0.618***	0.613***	0.760***
	(56.33)	(73.13)	(0.010)	(0.026)	(0.028)
EMS $Share_{ft}$	-0.473***	-0.461***	-0.473***	-0.457***	-0.305***
	(-63.67)	(-61.75)	(0.007)	(0.013)	(0.016)
Observations	2,804,971	3,078,785	2,804,895	16,918,144	16,918,144
Firm FE	Yes	Yes	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes	Yes	Yes
F-Stat			3,173.40	533.58	726.62

Standard errors in parentheses clustered at the department-hs4 level

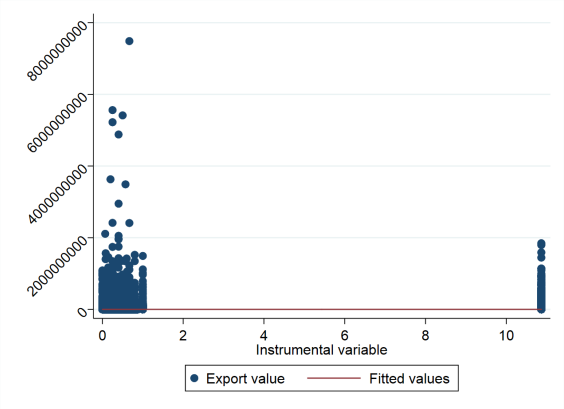
*$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A.5: Lagged IV Estimation

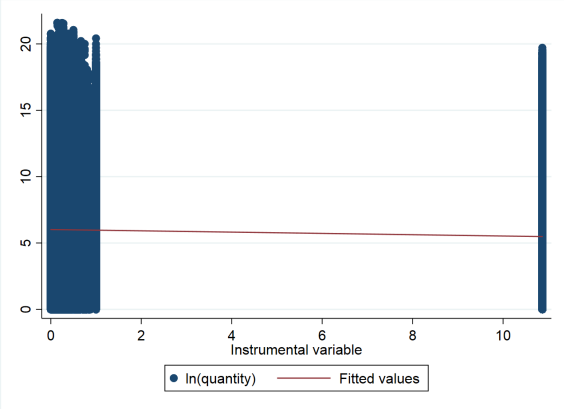
	(1) Export IV PPML	(2) Quantity IV PPML	(3) ln(unit value) 2SLS
Certif $Share_{ft}$	0.938**	0.641*	0.223***
	(0.32)	(0.38)	(2.95)
EMS $Share_{ft}$	0.466**	0.437*	0.121***
	(2.74)	(2.12)	(3.01)
Observations	2,794,986	2,794,986	2,794,986
Firm FE	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes
First-stage F-Stat			772.73

Clustered standard errors in parentheses

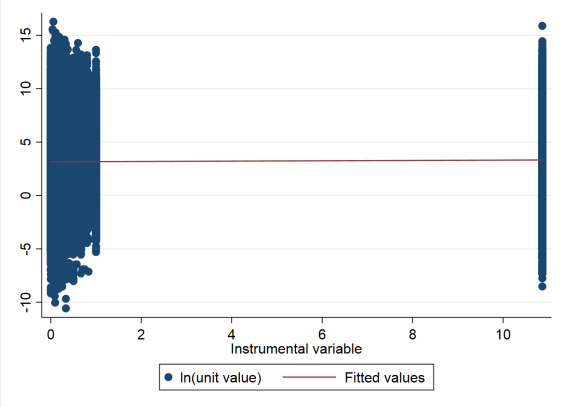
*$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$



(a) Correlation between export value and the instrumental variable



(b) Correlation between quantity exported (ln) and the instrumental variable



(c) Correlation between unit value (ln) and the instrumental variable

Figure A.4: Orthogonality of Instrumental Variable

Table A.6: First stage of 2 SLS estimations using lagged IV

	Intensive Margin		
	IV PPML	2SLS	
	Explained instrumented Variable		
Instrumental Variables	Certif $Share_{ft}$	Certif $Share_{ft}$	Certif Dum_{ft}
Certif $Share_{ft-1}^{dep-hs4}$	0.234***	0.233***	0.259***
	(27.80)	(0.008)	(0.008)
EMS $Share_{ft}$	-0.512***	-0.512***	-0.344***
	(-63.79)	(0.008)	(0.008)
Observations	2,794,986	2,794,986	2,794,986
Firm FE	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes
F-Stat			772.73

Standard errors in parentheses clustered at the department-hs4 level
*$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A.7: Qualitative support of the IV estimation

	(1)	(2)	(3)
	Export	Quantity	ln(unit value)
Certif $Share_{ft}$	0.051	0.138**	0.027***
	(1.32)	(2.70)	(2.83)
Certif $Share_{ft}^{dep-hs4}$	0.167	-0.074	0.039
	(1.48)	(-1.11)	(1.37)
EMS $Share_{ft}$	0.010	0.201***	0.013
	(0.25)	(4.68)	(1.61)
Observations	2,233,494	2,465,121	2,233,494
Firm FE	Yes	Yes	Yes
Product-Dest-Year FE	Yes	Yes	Yes

Standard errors in parentheses clustered at the department-hs4 level
*$p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

A.5 Propensity Score Matching estimation

Tables A.8 contains results from propensity score matching specifications and balancing tests referenced in the manuscript. I match French firms that get certified to observationally equivalent firms within year and within sector. Each column in Table A.8 reports

coefficient estimates from logit specifications for each individual year in my sample, with the results of the balancing tests immediately below.

Table A.8: Logit estimates - First stage of Propensity Score Matching analysis

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
First-stage PSM Results																	
$Exporter_f$	-0.390	-0.810***	-0.810***	-0.467**	1.078***	1.092***	0.783***	0.536***	0.168	0.459***	0.099	-0.033	0.325***	0.437***	0.411***	0.129	0.316***
	(0.316)	(0.293)	(0.228)	(0.185)	(0.134)	(0.129)	(0.120)	(0.114)	(0.106)	(0.103)	(0.111)	(0.105)	(0.106)	(0.099)	(0.093)	(0.089)	(0.091)
$Sector_f$	0.017***	0.018***	0.030***	0.018***	-0.000	0.002***	0.005***	0.006***	0.011***	0.008***	0.012***	0.014***	0.011***	0.006***	0.005***	0.008***	0.007***
	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$\#Destination_f$	0.013***	0.011***	0.008***	0.008***	0.012***	0.012***	0.012***	0.014***	0.012***	0.012***	0.015***	0.015***	0.015***	0.016***	0.015***	0.016***	0.016***
	(0.001)	(0.001)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Observations	33,544	28,531	29,884	29,138	40,120	35,871	34,917	23,023	29,297	31,354	33,697	32,209	33,320	33,774	36,095	37,109	37,683

Logit estimate with robust standard errors

$*p < 0.1$, ** $p < 0.05$, *** $p < 0.01$