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CARBON LEAKAGE: EVIDENCE FROM FRENCH TRADE DATA

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Abstract

Pollution leakage has existed as a concern of both trade theory and domestic policy since questions of the environmental impact of economic activity entered the literature. With the growing threat of climate change and the proliferation of carbon pricing policies around the world, the value of robust estimate of the extent of carbon leakage is particularly acute. Using a pseudo poisson maximum-likelihood (PPML) estimator, I examine French trade volumes to identify potential evidence of carbon leakage. To that end, the net carbon tax between France and its trading partners is regressed on the trade volume in 318 carbon intensive goods. Results show that the export percentage of trade volume is estimated to decrease by 1.1 percent in response to a dollar increase in the net carbon tax. Beyond that, the value of exports directly also decreases as the net tax increases. These variables are assessed at the industry level and across EU membership. The results suggest that environmentally damaging activity moves out from under policies designed to control the associated externalities.

Introduction

Recent measurements of global mean CO2 estimate that its atmospheric concentration has risen to over 415 parts per million [Stein, 2022]. These levels are comparable to over 4 million years ago when today's arctic tundra was home to sizable forests and sea levels were high enough to submerge land currently occupied by many major cities around the world. In the United States alone, 341 extreme weather and climate disasters have caused damage totaling $2.475 trillion since recording began in 1980 [Smith, 2022].

Despite this dire situation, there are policy tools available to combat climate change. Carbon emissions are a well recognized externality. Implementing a price on carbon commensurate with the social cost imposed by the pollution is the standard policy remedy. This can come in the direct application of a tax on CO2 emissions, or in a cap-and-trade system (also called an emissions trading system or scheme).

However, this theoretical picture is complicated greatly when we account for multiple nations and trade between them. Introducing trade introduces the possibility of leakage, that is, the movement of polluting activities out from under policies targeted at controlling them into jurisdictions without such policies. Leakage occurs because a price on carbon introduces a disadvantage for domestic goods on the international market relative to foreign goods. As a consequence, production shifts towards the goods without a carbon price and away from those with it.

The possibility of carbon leakage is problematic. It weakens the ability of the carbon price to control carbon pollution. After all, each unit of emissions which leaks out of domestic borders is a unit that is removed from the carbon price's coverage. Consequently, the damage associated with those units also moves from being priced– and therefore brought closer to the social optimum– to being unpriced.

Determining the extent to which carbon leakage occurs– if at all– is an empirical question given the tension between the switching costs associated with moving production to another nation and the incentive to move introduced by the carbon price. Direct estimates have not been possible previously due to a lack of nations with carbon pricing policies. This is no longer the case. Just 47 countries have implemented national carbon pricing policies of various sorts and scopes. Of these, several have been in place for approaching two or three decades. This opens the opportunity to estimate the extent to which carbon pricing induces changes in trade flows. If a carbon price significantly alters trade flows, this provides evidence that leakage occurs. The magnitude of these changes provides insight into the scale of the problem.

Using nation-level carbon price data and French trade data, I estimate the extent to which French trade flows change in response to changes in carbon pricing. Specifically, I use a pseudo poisson maximum-likelihood (PPML) estimator to assess both the relative change of exports to imports as well as the direct change in trade volume in response to changes in the net carbon tax between France and its trading partners. Results indicate relative trade flows respond in a manner consistent with theoretical predictions. In particular, as the net carbon tax increases— that is, as the tax becomes relatively more expensive in France or relatively cheaper in the trading partner— exports from France decrease. This is in line with theory since the carbon tax acts as a competitive disadvantage for French goods.

However, results also indicate that the imports respond counterintuitively. Theory predicts that imports should increase in response to an increase in the net tax as foreign goods become relatively more attractive. Instead, results indicate a decrease in import volume. This result is possibly due to several factors including a decrease in overall trade, differences in trade response by EU membership or Industry, and the impact of intermediate goods. In order to examine these factors, several additional layers of analysis are conducted, including the construction of a variable which measures what percent of overall trade of a given good with a given trading partner in a given year are exports.

Literature Review

One of the primary arguments in favor of international trade is that it makes the nations involved better off on net; nations and individuals can capture the gains from trade that are not available to them otherwise. These gains manifest as cheaper goods and services, access to novel markets, as well as efficiency gains. Ideally, trade allows everyone to enjoy more outputs from the same level of inputs relative to circumstances without trade [Bernhofen and Brown, 2018]. In this way, the link between international trade and national income is a theoretically tight relationship. Of course, international trade also comes with potential costs; environmental degradation looming large among them (assuming that externalities go uncorrected).

Beginning in the 1970s, questions about the relationship between economic growth, international trade, and environmental issues began to enter the literature [Markusen, 1975, Pethig, 1976, Siebert, 1977]. Much of the investigation focused on normative issues such as the optimum corrective tax structure [Markusen, 1975] or the growth/pollution trade-off [Siebert, 1977].

Later in the 1990s, Grossman and Krueger [Grossman and Krueger, 1991] began investigating the relationship between environmental measures and per capita income. These works ground the so-called 'environmental Kuznets curve', which posits a changing relationship between income and environmental quality such that in poor nations, increases in income are associated with decreases in environmental quality. Conversely, in rich nations, increases in income are associated with increases in environmental quality. In this way, the environmental Kuznets curve has an inverted U shape. This shape is in part motivated by the supposition that environmental quality is a normal good and thus is demanded at a greater rate at higher income levels once the critical inflection point is passed.

In the wake of these two major waves of research emerge questions about the potential auxiliary effects of trade on environmental measures. Primary among these auxiliary effects is leakage. That is, trade may facilitate a relocation of pollution, and polluting industries, away from nations with relatively stringent environmental policy and towards nations with relatively lax environmental policy. While such movement is facially problematic by way of weakening policies targeted at controlling externalities, it also implies equity concerns, potential chilling of environmental policy, and may increase global pollution relative to equilibrium without trade.

In regard to the possible movement of polluting industries between nations, Copeland and Taylor [Copeland and Taylor, 2004] distinguish between two types of leakage: the pollution haven effect on one hand, and the pollution haven hypothesis on the other. The key distinction between these two versions is the change in policy which incites the movement of polluting industries. More specifically, the 'effect' refers to emissions leakage in response to a increase in the strictness of domestic environmental regulation whereas the 'hypothesis' refers to emissions leakage in response to a reduction in the barriers to trade. Copeland and Taylor point out that since factors other than pollution regulation impact trade flows, it is possible to have the effect without also having the hypothesis, assuming such other factors are sufficiently strong.

Both these versions of leakage operate under similar theoretical mechanisms. In broad terms, trade facilitates the movement of polluting activity to places where the costs to operate are relatively low. This movement can be triggered by increasing the cost domestically– with a carbon tax for example– or becoming more open to international trade. In either case, relatively lax pollution regulation acts as a comparative advantage for pollution heavy industries. This in turn facilitates the specialization of nations with lax policy in pollution heavy production [Copeland and Taylor, 2004]. These shifts may manifest in changing trade flows, patterns of foreign direct investment, and/or plant location decisions.

However, changing the location of production does not necessarily change consumption preferences. Indeed, if such preferences are held constant before and after environmental regulation is made more stringent, then consumers can respond to the price changes in two ways: First, consumers facing higher prices on environmentally damaging goods may substitute toward goods which have comparatively less of an impact on the environment since such goods would be relatively cheaper. Second, consumers, facing higher prices on domestic produced goods, may substitute for relatively cheaper foreign produced goods[1] [Bernhofen and Brown, 2018].

This second possibility implies that the implementation of stringent environmental policies decreases the export and increases the import of environmentally damaging goods. After all, if consumption preferences remain constant and the domestic production of environmentally damaging goods falls, a domestic shortage is implied. This shortage is alleviated by increasing the import of environmentally damaging goods. Consequently, we predict that an increase in the stringency of environmental regulation— either by introducing new policy or increasing the strictness of existing policy— causes a decrease in the export and an increase in the import of environmentally damaging goods. Observing this shift thus constitutes evidence for the existence of leakage.

The empirical inquiry into leakage has focused primarily on the hypothesis that differences in environmental policy affect trade decisions, i.e. the hypothesized existence of the pollution haven effect. As mentioned, this may manifest in a variety of ways including plant location decisions [Levinson, 1996, Jaffe et al., 1995], movement of pollution heavy industries [Copeland and Taylor, 2004], or foreign direct investment [Poelhekke and Van der Ploeg, 2015, Manderson and Kneller, 2012].

Although early empirical consensus in the 1990's stated that environmental policies did not affect trade flows, more recent empirical work finds this conclusion to be lacking, in large part due to the limitations of earlier empirical models and data [Copeland and Taylor, 2004]. Instead, more recent econometric analysis has been mixed with respect to the existence of

[1]It seems reasonable to predict that both of these shifts occur concurrently with consumers substituting away from carbon intensive AND domestic goods and towards carbon light/ foreign goods since both pathways are parallel manifestations of the income effect. The magnitude of these shifts will depend on the own and cross price elasticities of the goods in question. Disambiguating the two from the consumption side may prove challenging.

leakage, finding evidence for it in some contexts [Tang, 2015, Poelhekke and Van der Ploeg, 2015] while finding contrary results in others [Martin et al., 2014, Manderson and Kneller, 2012]. For example, European manufacturing does not seem to exhibit carbon leakage in response to the EU's ETS [Naegele and Zaklan, 2019], yet in the US, listing on the EPA's Toxic Release Inventory (TRI) seems to induce leakage in the market for listed chemicals [Tang, 2015].

Such empirical work is further complicated by recognizing the interaction between the political decisions surrounding the implementation of environmental policy and existing trade flows [Levi et al., 2020]. Specifically, it may be the case that the carbon taxes which are implemented are constructed by policymakers in such a way as to minimize the impact created on trade flows or economic activity broadly. This type of concern is readily seen in South Africa's carbon tax [Mbadlanyana, 2013] which— while it covers the industry, power, and transport sectors— carves out sizable exemptions with between 60 and 95 percent of emissions exempted [Group, 2022]. Critically, exemptions are made on the basis of several factors including the degree of trade exposure.

Broadly, the impact of political decision making can manifest in the construction of a carbon tax in several ways including what activities or sectors are taxed, whether to create exemptions and what to exempt, as well as pricing carbon below the willingness-to-pay of market participants[Levi et al., 2020]. These deviations from a theoretically optimum carbon tax are problematic when attempting to estimate the impact of a carbon tax because they confound the relationship between trade flows and the domestic policy environment, undercutting the ability to make reliable estimates of the tax's effect on trade flows. As a result, the only carbon taxes observed are those which are feasible to implement under political constraints. Concerns about the environmental impact of international trade have existed for decades. These concerns are motivated by the possible unintended consequences that may result from trade, environmental damage among them. In particular, trade theory predicts that relatively stringent environmental policies– such as a carbon price– are less effective than otherwise expected at controlling environmental externalities due to the leakage that such policy may induce.

Data and Methods

In 2014, France implemented its national carbon tax. It covers the emissions of the industry, building, and transport sectors as well as all fossil fuels [Group, 2022]. This policy came about after two previous carbon tax policies had been invalidated in the prior decade due to legal challenges [Rocamora, 2017]. Emerging from the political commitments of two governing factions– the Socialist Party and the Green Party specifically– the specific architecture of the 2014 tax was strongly influenced by the Committee for Ecological Taxation, a body formed in 2012 to provide recommendations on how the tax ought to be set up. Many of the committee's recommendations were implemented without significant change including a compensation scheme to combat the tax's distributional impacts, an increasing carbon price year over year, and a structure complementary with the EU's ETS so as to avoid taxing the same activity twice [Rocamora, 2017]. Beyond that, the tax was implemented into a global market where several other nations already had existing carbon taxes. Figure 1 below shows a map of all 34 carbon tax policies that have been implemented as of 2023 at a national or subnational level anywhere in the world [Group, 2022].

These policies vary substantially, both in terms of the economic activity they cover as well as how long the policy has been in place. The French policy is a good case study for its effect on trade because it is well constructed for estimation purposes along several dimensions including duration, coverage, and exemptions. First, the French tax has been in place for nine years which is a relatively long time for a national level carbon tax. This is desirable since a longer period yields more trade data. Other comparable policies have been in operation for substantially shorter periods. For example, The Canadian federal fuel charge was implemented in 2019, yielding only about five years worth of data.

Second, the French tax is a good case study because it covers quite a wide swath of the pollution generating activity (the industry, building, and transportation sectors specifically). Other taxes are rather narrow with respect to the activities being taxed. For example, the Spanish carbon tax was implemented the same year as the French tax but only covers

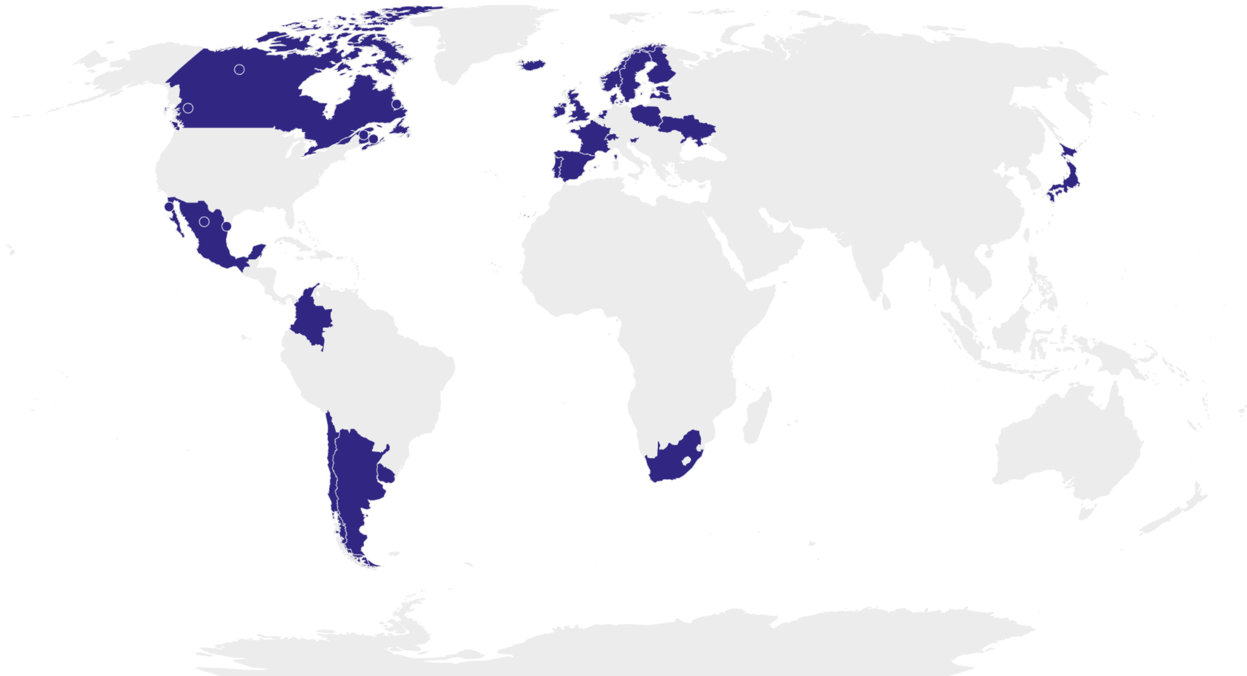

Figure 1: Map of implemented carbon taxes

fluoridated greenhouse gas emissions. The expansive coverage of the French tax is valuable for estimation purposes since it allows data to be drawn from a wider array of goods, thus reducing the possibility that any observed effects are due to a quirk in the type of good.

The final advantage of the French policy is its exemptions, or rather, the lack thereof. Unlike other nations, France does not include sweeping exemptions in its carbon tax regime. This is somewhat unique to France and is in part because of its domestic political environment. While carbon tax policies in other nations face critique and political challenge on the basis of international competitiveness, much of the opposition to France's carbon tax is on the basis of its distributional effects instead [Criqui et al., 2019, Driscoll, 2023]. As a result, the French carbon tax is better suited to estimate its effects on trade than other policies since its political constraints are unrelated to trade. By contrast, the Japanese carbon tax covers the CO2 emitted from fossil fuels across all sectors but contains exemptions within the industry, power, agriculture and transport sectors.

Taken together, the French carbon tax represents a good mix of qualities which recommend it as an excellent candidate for estimating the effect of a carbon tax on trade flows among the 34 candidate policies. To assess the extent to which this policy induces leakage, three basic data sources are needed: carbon pricing, trade flows, and gravity model data. The basic strategy is to regress the volume of trade in emissions-heavy goods between France and other trading partners on the net carbon price between France and each trading partner.

The World Bank compiles a data set on carbon taxes and emissions trading prices. As of April 2022, there are 47 countries which have implemented some form of carbon pricing at the national level, covering about 23% of global Greenhouse gas emissions [Group, 2022]. These carbon pricing regimes come in two varieties: explicit carbon taxes or emissions trading schemes. This data compiles annual prices for both varieties in US dollars per ton CO2 equivalent. Both carbon tax and ETS systems vary from nation to nation in terms of their price as well as the range of goods covered under the policy. For example, the Argentinian carbon tax of 4.99 USD per ton CO2 equivalent was implemented in 2018 and only covers most liquid fuels and some solid fuels. By contrast, the South African carbon tax of 9.84 USD per ton CO2 equivalent was implemented in 2019 and applies to all fossil fuels across the industry, power, and transport sectors. This sort of variation is also observed with ETS systems. The Chinese national ETS applies to only emissions from the power sector while the EU's ETS covers not only the power sector, but also manufacturing and aviation.

The Trade data was retrieved from the UN Comtrade database. It reports quantity traded– in millions of inflation adjusted dollars (USD)– for bilateral trade between any two given nations. The data retrieved was for the trade volumes between France and all its trading partners in a set of 318 goods over the period from 1994 to 2019. The lower bound of the window was selected to include the effects of early carbon tax policies— such as the Swedish Carbon tax. The upper bound of this window was selected to avoid confounding any potential observed effect with the shocks to international trade caused by Covid-19. During that duration France traded with 236 trade partners in those 318 goods [2] which include a variety of combustion fuels, industrial inputs, and manufactured goods [3]. Taken together, there are a total of 1,951,248 possible unique combinations. These observations include the value of imports and exports, the carbon price in the trading partner, and the collection of gravity variables. Of course, simply because a trade combination is possible, does not guarantee that France imported or exported a given good, in a given year, with a given partner. For example, in 1996 France both imported and exported about 20 million dollars worth of cold-rolled iron from Germany. However, this same good was not traded between France and Germany in the prior year. And so, this year-partner-good combination is 0 for both imports and exports in 1995 but about 20 million dollars in 1996.

Another important feature is the method of selecting the 318 good codes included in the panel. The European Commission, which exercises the executive authority of the European Union, administers the EU's ETS. As part of the program's compliance activities, the Commission maintains a Unified Registry of verified emissions originating in member states. These emissions are tracked based on several factors including the primary emitting activity and location [Vandenberghe, 2023]. For example, if a facility in Germany is emitting carbon as a byproduct of their pig iron production, the emissions produced are tracked by the nation, a unique institution identifier, and by the primary emitting activity (in this example, category 24: Production of pig iron or steel).

The Unified Registry is useful here because it provides a list of activities which verifiably produce carbon emissions. However, these activities are not directly translatable into goods as they are tracked in the trade data since the trade data use a higher degree of specificity and so a variety of goods can fall under a given activity. Moreover, these two systems were developed independently, and as such do not automatically correlate between their respective categories. Consequently, the goods selected for inclusion in the data were selected manually. This selection was done by comparing the descriptions of goods found in the US

[2] The full list of traded goods and trading partners can be found in the appendix.

[3] It should be noted that this list of goods is by no means comprehensive with respect to all emissions positive goods, nor does this list attempt to rank the goods therein by their emissions intensity. Instead, the point is to gather a sizable selection of goods from polluting industries, particularly those covered under France's carbon tax. That is sufficient for the project here, as the sheer volume of observations is expected to be sufficient to detect an effect, if it exists.

Census Bureau's Schedule B which organizes and categories goods for international trade against the descriptions of the emitting activities. A good was included in the data when the description of that good fell within one of the emitting activities as described in the Union Registry. For example, Disodium Carbonate– also known as soda ash– is included in the data because it falls rather squarely under the category of soda ash production. Similarly, alloy pig iron is included because it falls under the activity of pig iron or steel production. Following this method, each of the goods included in the data were individually selected for inclusion if and only if they fell within one of the emitting activities. This guarantees that each of the goods included in the data are associated with some level of carbon emissions. As a result of the diverse array of activities, the data includes a diverse array of goods from industrial chemicals, to various raw and processed metals, to glassware and paper products.

Finally, we turn to gravity variables. The gravity equation is based in part on the notion that trade flows are determined not only by economic factors such as comparative advantage, but also by an array of geographic, historical, and cultural factors such as distance, colonial history, and shared language. Introduced in 1954 by Walter Isard [Isard, 1954], gravity variables have come to be a staple of trade models, serving as a means to control for various qualitative and quantitative characteristics.

Gravity variables from the Dynamic Gravity Dataset (DGD) [Gurevich and Herman, 2021] published by The United States International Trade Commission are used here. It tracks gravity variables on a bilateral basis with an origin country and a destination country. To match the Comtrade data, only the subset of the DGD with France as the origin are included.

The gravity data includes indicator variables for if the destination was ever a colony of France, if the trading partners share a common legal origin, common language, or are contiguous, if the destination country is landlocked or an island, if the destination country is a member of the General Agreement on Tariffs and Trade (GATT), the World Trade Organization (WTO), the European Union (EU), and if the trading partners have a preferential trading agreement (PTA) in either goods or services, or a free trade agreement(FTA). The data also includes a polity scale which ranges from -10 to 10 and measures the type of government that the trading partner has with lower scores being more autocratic and higher scores being more democratic. The data also includes variables for the distance between the trading partners as well as the capital stock, GDP, population in both France and its trading partner.

A substantial fraction of the trade volumes in the data are zeros on both the import and export sides. Nevertheless, these observations are still important to include because without them information is lost. A data set which excluded the zeros is unable to identify the case where a good began to be traded or was no longer traded some time after changes in carbon pricing policy were implemented. However, the substantial fraction of zeros also presents an estimation challenge on two fronts. First, because the trade volume exhibits heteroscedasticity, OLS is a biased estimator. Ordinarily, this can be addressed via log-linearization with coefficients being interpreted as elasticities. However, because of the large quantity of zeros, log-linearization is not available without severely truncating the data. To accommodate for this, a pseudo poisson maximum-likelihood (PPML) method is used. This addresses the problem since the PPML does not require excluding zeros and the estimator is consistent in the presence of heteroscedasticity [Silva and Tenreyro, 2006]. Second, the more subtle problem is that there exist in the data goods that were not traded in any year with a given partner. This becomes problematic when partner fixed effects are applied since for some subset of goods there exists no variation in trade volume. This is addressed by excluding the observations for which there is zero trade in a partner-good combination over the entire time period.

With these three data sources in hand, there are several variables which were constructed from the data for the purpose of estimation. A net carbon tax variable is constructed for each bilateral relationship each year by subtracting the value of the partner's carbon tax in that year from the value of France's tax that year. If the partner has no carbon tax that year, then the difference is simply the value of France's carbon tax in that year. Similarly, a net ETS variable is constructed by subtracting the going price in the trading partner's ETS from the going price in the European Union's ETS. As such, for trading partners within the EU, this variable is always 0, whereas for non-EU partners, the value varies by the going price of the partner's ETS assuming that an ETS exists in the trading partner. Table 1 displays descriptive statistics.

Table 1: Descriptive Statistics

Statistic	N	Mean	St. Dev.	Min	Max
Imports (Dollars)	648,050	3,327,791	1.41e+8	0	3.12e+10
Exports (Dollars)	648,050	1,629,765	4.47e+7	0	1.01e+10
Export Percent	648,050	25.4890	41.8507	0	100
Net Tax (France less Partner)	648,050	5.8097	19.0336	−168.8257	55.2950
Net ETS (EU less Partner)	648,050	−.0146	.8688	−38.8210	17.3212
Distance (Miles, Thousands)	632,702	5.158	3.812	.6967	18.6283
Capital Stock (Dollars, Millions)	547,626	2.9878	8.0111	.0002	105.8493
GDP (Dollars, Millions)	548,047	.7935	2.1088	.0000	18.3838
Population, partner (Millions)	548,047	61.6456	189.6509	.0095	1409.517
Tax rate as percent GDP	648,050	11.0683	9.9861	−40.3805	24.5147

Empirical Model and Results

Following Silva and Tenreyro, [Silva and Tenreyro, 2006] a pseudo poisson maximum-likelihood (PPML) method is used to estimate the effect of the net carbon tax on trade flows as measured by both imports into and exports from France. The PPML estimator is used to account for the heteroscedasticity exhibited by the trade values and the large fraction of zeros. The basic estimating model is shown below where 'TradeValue' is the dollar value of either imports or exports between France and a given trading partner (k) in product (g), in year (t), 'CarbonPrice' is the net value of the carbon price from France's carbon tax less that of the trading partner, 'ETSprice' is the net value of the ets price from the EU ETS (which covers France) less that of the trading partner, and 'GravityVariables' is a vector of indicator and quantitative variables which impact the trade relationship such as distance, membership in various trade agreements, and political stability. The variable '$U_{t,k,g}$' is the error term.

$$Equation(1) : TradeValue_{t,k,g} = exp(CarbonPrice_{t,k} + ETSPrice_{t,k} + GravityVariables_{t,k}) + U_{t,k,g}$$

Results for the export and import versions of equation 1 with successive application of year, good and partner fixed effects are reported in tables 2 and 3 respectively. In both the import and the export specifications of the model, standard errors are clustered by good to correct for differences in variation between goods.

Beginning with column 1, the results in Table 2 indicate that for every dollar increase in the net carbon tax, exports decrease by 0.7 percent, significant at the one percent level. That reduction in trade volume seems small at only seven-tenths of one percent. However, considering the amount of trade annually between France and its partners, a 0.7 percent decrease can be quite substantial. For example, in 2018 France exported $35,150,408 worth of quicklime to Germany alone. A 0.7 percent reduction for this one product to this one partner is equal to $246,052. Across all partners, this change adds up to a $1.45 million reduction in the volume of quicklime traded.

These initial export results are consistent with theoretical predictions regarding the response to an increasing net carbon tax. Particularly, with French goods becoming relatively more expensive as the net tax is increased, the export of those goods decreases. Furthermore, as successive fixed effects are applied the direction and the statistical significance of the estimate are retained, with the estimate varying by less than a percentage point. With the full set of fixed effects in column 4 applied, for every dollar increase in the net carbon tax, exports decrease by 0.6 percent. This suggests that carbon leakage has occurred in response to France's carbon tax.

However, on the import side of things, the estimates show a similar magnitude of change at a similar degree of significance. Specifically, Table 3 shows that for every dollar increase in the net carbon tax, imports decrease by 0.6 to 1.1 percent, significant at the one percent level. This result is contrary to theoretical predictions about the response to a carbon tax. After all, as a domestic carbon tax rises, we expect imports to increase or display no change as domestic production relocates out from under the carbon tax, holding all else constant.

There are several potential explanations for the congruence between the theoretical predictions and the estimates on the export side, while at the same time observing estimates which diverge from theoretical predictions on the import side. It could be the case that the changes in trade behave differently for European Union members than non-members. In order to test for this, equation (1) was estimated with the full set of fixed effects using 4 subsets of the data: Imports from EU nations, Imports from non-EU nations, exports to EU nations, and exports to non-EU nations. Table 4 reports these results. In this and all subsequent tables, the control variables are suppressed since the net tax variable, and the net ETS variable are the only estimates of interest in explaining the initial import results.

Table 2: The Effects of Net Carbon Taxes on French Exports of 318 Carbon Intensive Goods from 1994-2019

	(1)		(2)		(3)		(4)	
Net Carbon Tax	-0.007	**	-0.006	**	-0.005	**	-0.006	**
	(0.002)		(0.001)		(0.002)		(0.001)	
Net ETS	-0.034	**	-0.020	**	-0.017		0.007	
	(0.009)		(0.008)		(0.009)		(0.008)	
Colony of France	-0.078		-0.146		-0.200			
	(0.395)		(0.430)		(0.454)			
Common Lega lOrigin	-0.326		-0.300		-0.137			
	(0.527)		(0.562)		(0.587)			
Contiguity	1.485	**	1.708	**	1.695	**		
	(0.293)		(0.246)		(0.250)			
Distance	-0.201	**	-0.231	**	-0.270	**		
	(0.052)		(0.059)		(0.076)			
Member of the EU	0.636	**	0.470	**	0.617	**	0.518	
	(0.077)		(0.094)		(0.090)		(0.273)	
Landlocked	-1.029	**	-1.180	**	-1.159	**		
	(0.124)		(0.149)		(0.142)			
Island	0.760	**	0.827	**	0.752	**		
	(0.123)		(0.106)		(0.134)			
Bilateral Trade Deal	0.712	**	0.544		0.581	*	0.143	
	(0.257)		(0.281)		(0.247)		(0.096)	
Capital Stock	0.019		-0.035		-0.039		-0.064	
	(0.019)		(0.028)		(0.028)		(0.042)	
GDP	0.217	**	0.374	**	0.420	**	0.245	
	(0.084)		(0.115)		(0.121)		(0.175)	
Population	-0.001	*	0.000		0.000		0.008	*
	(0.000)		(0.000)		(0.000)		(0.003)	
Common Language	0.255		0.233		0.285	*	0.270	
	(0.142)		(0.144)		(0.145)		(0.698)	
Tax rate as percent GDP	0.015	**	0.012	*	0.012	*	-0.005	
	(0.005)		(0.005)		(0.005)		(0.004)	
Log pseudolikelihood	-1.368e+12		-1.321e+12		-6.106e+11		-4.996e+11	
Number of observations	547914		547914		547914		547914	
Fixed Effects								
Year			Yes		Yes		Yes	
Good					Yes		Yes	
Partner							Yes	

Errors clustered by product (g)

** p<.01, * p<.05

Table 3: The Effects of Net Carbon Taxes on French Imports of 318 Carbon Intensive Goods from 1994-2019

	(1)	(2)	(3)	(4)
Net Carbon Tax	-0.006 *	-0.005 **	-0.005 **	-0.011 **
	(0.002)	(0.002)	(0.002)	(0.003)
Net ETS	-0.007	0.017	0.022	0.017 *
	(0.017)	(0.016)	(0.023)	(0.009)
Colony of France	-1.322	-1.230	-0.662	
	(0.910)	(0.659)	(0.819)	
Common Legal Origin	1.192	1.095	0.290	
	(0.797)	(0.628)	(0.697)	
Contiguity	1.312 *	1.709 *	1.675 **	
	(0.668)	(0.757)	(0.597)	
Distance	-0.244 *	-0.273 *	-0.248	
	(0.112)	(0.120)	(0.137)	
Member of the EU	-0.043	-0.253	0.008	0.061
	(0.296)	(0.281)	(0.275)	(0.147)
Landlocked	-2.236 **	-2.477 **	-2.133 **	
	(0.466)	(0.549)	(0.377)	
Island	0.038	0.258 **	-0.043	
	(0.125)	(0.093)	(0.181)	
Bilateral Trade Deal	-1.111	-1.312 *	-0.850	0.034
	(0.642)	(0.619)	(0.542)	(0.285)
Capital Stock	-0.004	-0.094 *	-0.070	-0.015
	(0.013)	(0.042)	(0.038)	(0.048)
GDP	0.252 *	0.514 **	0.419 **	0.070
	(0.120)	(0.128)	(0.091)	(0.362)
Population	-0.001 **	-0.001 **	-0.000	0.007
	(0.000)	(0.000)	(0.001)	(0.004)
Common Language	0.403	0.319	0.148	-2.774 **
	(0.349)	(0.391)	(0.266)	(0.661)
Tax rate as Percent GDP	-0.010	-0.013	-0.023	-0.006
	(0.023)	(0.025)	(0.021)	(0.010)
Log pseudolikelihood	-4.12e+12	-3.948e+12	-1.734e+12	-1.241e+12
Number of observations	319224	319224	319224	319224
Fixed Effects				
Year		Yes	Yes	Yes
Good			Yes	Yes
Partner				Yes

Errors clustered by product (g)

** p<.01, * p<.05

If trade behaves differently for EU member states in a way that explains the initial results, we expect the sign of the estimate to be different when comparing the EU import estimate against the non-EU import estimate. Instead, the sign is the same and negative for both EU and non-EU nations with only the EU estimate being statistically significant. This implies that both directions of trade indeed respond differently to the net carbon tax depending on the membership status of the partner nation, but not in a way which explains the initial results.

Table 4: The Effects of Net Carbon Taxes on Trade Volume of 318 Carbon Intensive Goods from 1994-2019 by EU Membership

	EU Imports		NonEU Imports	EU Exports		NonEU Exports
Net Carbon Tax	-0.012	**	-0.007	-0.008	**	-0.005
	(0.003)		(0.008)	(0.002)		(0.002)
Net ETS			0.013			0.013
			(0.009)			(0.013)
Tax rate as percent GDP	-0.004		-0.015	0.008	*	-0.016
	(0.006)		(0.011)	(0.003)		(0.010)
Log pseudolikelihood	-5.12e+11		-5.41e+11	-3.00e+11		-1.73e+11
Number of observations	114441		204783	126738		421176

Errors clustered by product (g)

** p<.01, * p<.05

Specifically, imports from EU nations decrease by 1.2 percent in response to a 1 dollar increase in the net carbon tax while the change for imports from non-EU nations is indistinguishable from zero.

This pattern is also observed on the export side. Exports to EU nations decrease by 0.8 percent in response to a 1 dollar increase in France's carbon tax, significant at the 1 percent level while the estimate is indistinguishable from zero for non-EU exports. This behavior of the exports reinforces the idea that changes in trade differ by membership status. It also reinforces the theoretical predictions generally since falling exports are the expected behavior. However, this does not explain the counterintuitive behavior of the imports.

Another possible explanation is that one or more industries have characteristics which cause counterintuitive behavior in response to a carbon tax and this is what is driving the initial results. In order to examine this possibility, equation (1) was estimated with the full set of fixed effects while subsetting the data by EU membership and Industry. Table 5 reports these results. In order for this to be a plausible explanation of the initial results, it needs to be the case that on the import side some number of industries display the counterintuitive behavior while others display the behavior predicted theoretically at some level of significance.

For all industries whose import estimate is significant the sign is negative. Since only the counterintuitive behavior is seen, the idea that industry level quirks are driving the initial results is undercut. The estimate for the base metals industry for example is both negative and significant at the one percent level for both EU and non-EU imports as seen in the fourteenth row of Table 5.

Interestingly, while most industries display the expected behavior on the export side, the stone products industry is the single export estimate that displays counterintuitive behavior. As shown in the sixth row of Table 5, stone products see a 1.9 percent increase in exports in response to a one dollar increase in the carbon tax.

A third potential explanation is that intermediate goods— that is goods which are used as inputs for other goods— are driving the initial import results. This explanation is best understood with an example. In order for a French wine maker to produce their product they need both the grapes to ferment, but also the glass bottles to put the finished product in before it can be sold. The glass is a good whose production creates carbon emissions. The hypothetical winemaker must source their bottles from somewhere, and one might buy them domestically, or import them— or the raw materials– from another nation or some combination of the two. How might this winemaker respond to an increase in the net carbon tax? One potential response is to relocate their bottling processes to another nation in

Table 5: The Effects of Net Carbon Taxes on Trade Volume of 318 Carbon Intensive Goods from 1994-2019 by EU Membership and Industry

Industry	EU Import	EU Export	Non-EU Import	Non-EU Export
Cement	-0.016 **	-0.015 **	0.007	-0.010 *
	(0.000)	(0.005)	(0.015)	(0.004)
Mineral Fuels	-0.022 *	-.005	-0.004	0.001
	(0.010)	(0.004)	(0.015)	(0.002)
Inorganic Chemicals	-0.003	-0.004	-0.006	0.001
	(0.009)	(0.003)	(0.005)	(0.007)
Wood Products	0.000	-0.006	-0.011	0.073
	(0.002)	(0.005)	(0.020)	(0.040)
Paper Products	-0.001	-0.005	-0.015 *	-0.002
	(0.002)	(0.004)	(0.007)	(0.003)
Stone Products	-0.008	-0.009	-0.006)	0.019 **
	(0.007)	(0.005)	(0.028)	(0.005)
Glass Products	-0.028 *	-0.041 **	-0.014	-0.002
	(0.014)	(0.011)	(0.016)	(0.006)
Precious Metals	-0.034 *	-0.041 **	-0.010	-0.023 **
	(0.017)	(0.010)	(0.008)	(0.007)
Iron Products	-0.009 **	-0.005 *	-0.008)	0.002
	(0.002)	(0.002)	(0.004)	(0.003)
Cu Products	-0.015 **	-0.001	0.006	-0.002
	(0.005)	(0.004)	(0.006)	(0.003)
Ni Products	-0.010 *	-0.002	-0.014	-0.018 **
	(0.004)	(0.002)	(0.008)	(0.004)
Al Products	-0.010	-0.007 **	-0.010 *	-0.013) *
	(0.005)	(0.002)	(0.005)	(0.006)
Pb Products	-0.015	-0.025 **	0.042	0.014
	(0.028)	(0.006)	(0.021)	(0.018)
Base Metals	-0.016 **	-0.005	-0.023 **	0.001
	(0.004)	(0.003)	(0.005)	(0.004)

Errors clustered by product (g)

** p<.01, * p<.05

Table 6: The Effects of Net Carbon Taxes on the Percentage of Exports of 318 Carbon Intensive Goods from 1994-2019

	(1)	(2)	(3)	(4)
Net Carbon Tax	-0.004 **	-0.004 **	-0.004 **	-0.011 **
	(0.000)	(0.000)	(0.000)	(0.001)
Net ETS	-0.024 **	-0.023 **	-0.026 **	0.003
	(0.001)	(0.002)	(0.002)	(0.002)
Colony of France	-0.105 **	-0.084 *	-0.102 **	
	(0.039)	(0.038)	(0.038)	
Common Legal Origin	0.357 **	0.327 **	0.393 **	
	(0.047)	(0.047)	(0.047)	
Contiguity	0.130 **	0.169 **	0.229 **	
	(0.026)	(0.026)	(0.026)	
Distance	0.021 **	0.016 **	0.015 **	
	(0.003)	(0.003)	(0.003)	
Member of the EU	0.208 **	0.166 **	0.230 **	0.363 **
	(0.022)	(0.022)	(0.020)	(0.033)
Landlocked	-0.098 **	-0.109 **	-0.137 **	
	(0.017)	(0.017)	(0.017)	
Island	-0.174 **	-0.160 **	-0.205 **	
	(0.021)	(0.021)	(0.021)	
Bilateral Trade Deal	0.406 **	0.374 **	0.430 **	0.129 **
	(0.025)	(0.024)	(0.023)	(0.026)
Capital Stock	-0.008 **	-0.012 **	-0.014 **	-0.021 **
	(0.002)	(0.002)	(0.002)	(0.003)
GDP	0.077 **	0.087 **	0.111 **	0.123 **
	(0.009)	(0.008)	(0.008)	(0.016)
Population	0.000 **	0.000 **	0.000 **	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Common Language	0.118 **	0.110 **	0.138 **	0.857 **
	(0.016)	(0.016)	(0.015)	(0.195)
Tax Rate as percet GDP	-0.001 *	-0.002 **	-0.003 **	-0.004 **
	(0.001)	(0.001)	(0.001)	(0.001)
Log pseudolikelihood	-179,076,642	-177,775,165	-16,536,148	-15,581,622
Number of observations	547626	547626	547626	547626
Fixed Effects				
Year		Yes	Yes	Yes
Good			Yes	Yes
Partner				Yes

Errors clustered by product (g)

** p<.01, * p<.05

response to the rising cost of glassware. In such a case, the bottles they would have imported into France instead are imported into whatever nation their bottling moved into. This in turn would reduce the amount of glassware into France. Across all the goods observed here, this has the counterintuitive effect of decreasing imports into France for the specific goods in the data.

The effect of recognizing intermediate goods introduces the potential for imports to respond ambiguously to an increase in the net carbon tax. It may be the case that imports rise, fall, or remain unchanged as the tax changes depending on what proportion of trade is in intermediate goods. However, because exports are still expected to decrease regardless, we can look to the relative change in exports to imports to gain additional insight. To investigate this, a variable was constructed which measures the percent of total trade which are exports. This export percent variable is defined as $Exports_{t,k,g}/(Exports_{t,k,g} + Imports_{t,k,g})$ where 'Exports' is the volume of exports in a given good traded with a given partner in a given year, and 'Imports' is the volume of imports in a given good traded with a given partner in a given year. This variable is useful because it captures the change in exports relative to the change in imports. If exports fall relatively more than imports in response to an increase in the carbon tax, then the estimate overall is negative. This is the observation expected if leakage occurred. Table 6 reports the estimates of equation (1) with export percent as the dependent variable.

As expected, export percent falls as the net carbon tax increases. Specifically, column 4 of table 6 shows that the percentage of exports falls by 1.1 percent in response to a one dollar increase in the net carbon tax (with all of year, good, and partner fixed effects applied) and is significant at the one percent level. This result provides support for the notion that the French carbon tax has induced leakage in the trade of these 318 goods. This is because export of these goods has fallen relative to their import, which is exactly in line with theoretical predictions while accounting for the effect of intermediate goods.

Additionally, when the regression is conditioned on EU membership, the same result is observed. As shown in table 7, export percent falls in response to an increase in the net carbon tax. For EU members, the measure falls by 0.015 percent for every dollar increase in the net tax while that number is 0.008 percent for Non-EU members. This would seem to imply that the leakage effect is stronger for EU members. This result is sensible; after all, if production is moving as a result of the tax it is likely easier, quicker, and/or cheaper to relocate to another EU nation. This result is consistent with both the initial export percent results and theoretical predictions of carbon leakage.

Table 7: The Effects of Net Carbon Taxes on the Percentage of Exports of 318 Carbon Intensive Goods from 1994-2019 by EU membership

	EU Export Percent	Non-EU Export Percent
Net Carbon Tax	-0.015 **	-0.008 **
	(0.001)	(0.001)
Net ETS		-0.001
		(0.002)
Log pseudolikelihood	-3,391,593	-11,947,851
Number of observations	126690	420936

Errors clustered by product (g)

** p<.01, * p<.05

Finally, a fourth potential explanation is that individuals and businesses may be substituting away from carbon intensive goods. For example, consumers may be switching from gas to electric vehicles as the carbon tax increases, effectively substituting away from gasoline and towards electricity. This matches the observations here since substituting away from carbon intensive goods corresponds to a decrease in demand for the goods being observed, and thus likely contributes to a decrease in the trade of these goods across the board. It is possible that this substitution is occurring alongside any carbon leakage that occurs.

Conclusion

In conclusion, these results are mixed with respect to their support for the theoretical predictions of leakage in response to a carbon tax. Primarily, the relative change in trade volume was estimated using the export percent variable. Those results provide support for the existence of leakage since the change in exports relative to the change in imports accounts for the potentially ambiguous sign on imports. The relative change is predicted to be negative and this is true of the observations here.

Beyond the relative change, observations on the export side directly also support the idea that leakage occurs at every level of the analysis. The initial results show statistically significant reductions in trade volume as the net carbon tax increases under each set of fixed effects. This is expected since the carbon tax acts as a competitive disadvantage on the international market. Furthermore, the analysis along EU membership reinforces this, with significant reductions in exports to EU members. Finally, aside from the stone products industry, this behavior is also exhibited at the industry level.

However, the import side of the analysis displays counterintuitive behavior at each level of the analysis. Estimates are significant and negative in the initial results. This is despite trade theory predicting positive or null estimates as foreign goods received a competitive advantage relative to domestic goods. Furthermore, both additional levels of analysis undercut potential explanations for this since they exhibit the same counterintuitive behavior with negative estimates in both the EU and industry levels. Despite this, it is possible within the theoretical framework to account for this result by recognizing the effects of intermediate goods.

These results are a substantial step toward a robust estimation of the leakage that may result from carbon pricing. The estimated effects on trade flows are partially in line with the theoretical predictions of a domestic carbon tax. The decrease in exports fits particularly well within that framework. Further investigation into carbon leakage in response to domestic taxation is needed to more completely disentangle the effect of intermediate goods on the rate of import of carbon intensive goods.

Appendix 1: Trading Partners

Country	Code
Afghanistan	AFG
Albania	ALB
Algeria	DZA
American Samoa	ASM
Andorra	AND
Angola	AGO
Anguilla	AIA
Antarctica	ATA
Antigua and Barbuda	ATG
Argentina	ARG
Armenia	ARM
Aruba	ABW
Australia	AUS
Austria	AUT
Azerbaijan	AZE
Bahamas (the)	BHS
Bahrain	BHR
Bangladesh	BGD
Barbados	BRB
Belarus	BLR
Belgium	BEL
Belize	BLZ
Benin	BEN
Bermuda	BMU

Bhutan	BTN
Bolivia (Plurinational State of)	BOL
Bonaire, Sint Eustatius and Saba	BES
Bosnia and Herzegovina	BIH
Botswana	BWA
Bouvet Island	BVT
Virgin Islands (British)	VGB
Brazil	BRA
Brunei Darussalam	BRN
Bulgaria	BGR
Burkina Faso	BFA
Burundi	BDI
Cabo Verde	CPV
Cambodia	KHM
Cameroon	CMR
Canada	CAN
Cayman Islands (the)	CYM
Central African Republic (the)	CAF
Chad	TCD
Chile	CHL
China	CHN
Hong Kong	HKG
Macao	MAC
Christmas Island	CXR
Cocos (Keeling) Islands (the)	CCK
Colombia	COL
Comoros (the)	COM
Congo (the)	COG

Cook Islands (the)	COK
Costa Rica	CRI
Croatia	HRV
Cuba	CUB
Curaçao	CUW
Cyprus	CYP
Czechia	CZE
Côte d'Ivoire	CIV
Korea (the Democratic People's Republic of)	PRK
Congo (the Democratic Republic of the)	COD
Denmark	DNK
Djibouti	DJI
Dominica	DMA
Dominican Republic (the)	DOM
Ecuador	ECU
Egypt	EGY
El Salvador	SLV
Equatorial Guinea	GNQ
Eritrea	ERI
Estonia	EST
Eswatini	SWZ
Ethiopia	ETH
Micronesia (Federated States of)	FSM
Faroe Islands (the)	FRO
Falkland Islands (the) [Malvinas]	FLK
Fiji	FJI
Finland	FIN
French Southern Territories (the)	ATF

France	FRA
French Guiana	GUF
French Polynesia	PYF
Gabon	GAB
Gambia (the)	GMB
Georgia	GEO
Germany	DEU
Ghana	GHA
Gibraltar	GIB
Greece	GRC
Greenland	GBL
Grenada	GRD
Guadeloupe	GLP
Guam	GUM
Guatemala	GTM
Guinea	GIN
Guinea-Bissau	GNB
Guyana	GUY
Haiti	HTI
Holy See (the)	VAT
Honduras	HND
Hungary	HUN
Iceland	ISL
India	IND
Indonesia	IDN
Iran (Islamic Republic of)	IRN
Iraq	IRQ
Ireland	IRL

Israel	ISR
Italy	ITA
Jamaica	JAM
Japan	JPN
Jordan	JOR
Kazakhstan	KAZ
Kenya	KEN
Kiribati	KIR
Kuwait	KWT
Kyrgyzstan	KGZ
Lao People's Democratic Republic (the)	LAO
Latvia	LVA
Lebanon	LBN
Lesotho	LSO
Liberia	LBR
Libya	LBY
Lithuania	LTU
Luxembourg	LUX
Madagascar	MDG
Malawi	MWI
Malaysia	MYS
Maldives	MDV
Mali	MLI
Malta	MLT
Marshall Islands (the)	MHL
Martinique	MTQ
Mauritania	MRT
Mauritius	MUS

Mayotte	MYT
Mexico	MEX
Mongolia	MNG
Montenegro	MNE
Montserrat	MSR
Morocco	MAR
Mozambique	MOZ
Myanmar	MMR
Northern Mariana Islands (the)	MNP
Namibia	NAM
Nauru	NRU
Nepal	NPL
Neth. Antilles	ANT
Netherlands (the)	NLD
New Caledonia	NCL
New Zealand	NZL
Nicaragua	NIC
Niger (the)	NER
Nigeria	NGA
Niue	NIU
Norfolk Island	NFK
Republic of North Macedonia	MKD
Norway	NOR
Oman	OMN
Pakistan	PAK
Panama	PAN
Papua New Guinea	PNG
Paraguay	PRY

Peru	PER
Philippines (the)	PHL
Pitcairn	PCN
Poland	POL
Portugal	PRT
Qatar	QAT
Korea (the Republic of)	KOR
Moldova (the Republic of)	MDA
Romania	ROU
Russian Federation (the)	RUS
Rwanda	RWA
Réunion	REU
Saint Barthélemy	BLM
Saint Helena, Ascension and Tristan da Cunha	SHN
Saint Kitts and Nevis	KNA
Saint Lucia	LCA
Sint Maarten (Dutch part)	SXM
Saint Pierre and Miquelon	SPM
Saint Vincent and the Grenadines	VCT
Samoa	WSM
San Marino	SMR
Sao Tome and Principe	STP
Saudi Arabia	SAU
Senegal	SEN
Serbia	SRB
Serbia and Montenegro	SCG
Seychelles	SYC
Sierra Leone	SLE

Singapore	SGP
Slovakia	SVK
Slovenia	SVN
Solomon Islands	SLB
Somalia	SOM
South Africa	ZAF
South Georgia	SGS
South Sudan	SSD
Spain	ESP
Sri Lanka	LKA
Palestine, State of	PSE
Sudan (the)	SDN
Suriname	SUR
Sweden	SWE
Switzerland	CHE
Syrian Arab Republic	SYR
Tajikistan	TJK
Thailand	THA
Timor-Leste	TLS
Togo	TGO
Tokelau	TKL
Tonga	TON
Trinidad and Tobago	TTO
Tunisia	TUN
Turkey	TUR
Turkmenistan	TKM
Turks and Caicos Islands (the)	TCA
United States of America (the)	USA

Uganda	UGA
Ukraine	UKR
United Arab Emirates (the)	ARE
United Kingdom of Great Britain and Northern Ireland (the)	GBR
Tanzania, United Republic of	TZA
United States Minor Outlying Islands (the)	UMI
Uruguay	URY
Uzbekistan	UZB
Vanuatu	VUT
Venezuela (Bolivarian Republic of)	VEN
Viet Nam	VNM
Wallis and Futuna	WLF
World	WLD
Yemen	YEM
Zambia	ZMB
Zimbabwe	ZWE

Appendix 2: Carbon Intense Goods

Description	Product Code
Gypsum and Plasterboard	252, 010
Quicklime	252, 210
Slaked Lime	252, 220
Hydraulic Lime	252, 230
Cement Clinker	252, 310
Anthracite	270, 111
Bituminous coal	270, 112
Other coal	270, 119
Fuels manufactured from coal	270, 120
Lignite	270, 210
Agglomerated lignite	270, 220
Petroleum oils and oils, not biodiesel, light oils and preperations	271, 012
Petroleum oils and oils, not biodiesel, other	271, 019
Petroleum oils and oils , containing biodeisel	271, 020
Liquified natural gas	271, 111
Ethane	271, 119
Gaseous natural gas	271, 121
Other gaseous petroleum gases	271, 129
Carbon Black	280, 300
Hydrogen	280, 410
Argon	280, 421
Other synthetic gasses	280, 429
Nitrogen	280, 430
Oxygen	280, 440

Nitric acid; sulfonitric acids	280, 800
Anhydrous ammonia	281, 410
Ammonia in aqueous solution	281, 420
Disodium carbonate (soda ash)	283, 620
Biodiesel and mixtures thereof	382, 600
Mechanical woodpulp	470, 100
Chemical woodpulp, dissolving grades	470, 200
Unbleached coniferous chemical woodpulp	470, 311
Unbleached nonconiferous chemical woodpulp	470, 319
Bleached coniferous chemical woodpulp	470, 321
Bleached nonconiferous chemical woodpulp	470, 329
Unbleached coniferous chemical woodpulp, sulfite	470, 411
Unbleached nonconiferous chemical woodpulp, sulfite	470, 419
Bleached coniferous chemical woodpulp, sulfite	470, 421
Bleached nonconiferous chemical woodpulp, sulfite	470, 429
Wood pulp obtained by mechanical and chemical pulping processes	470, 500
Handmade paper and paperboard	480, 210
Paper, base for photo-sensitive, heat-sensitive or electro-sensitive paper	480, 220
Wallpaper base (hanging paper)	480, 240
Other paper weighing less than 40 g/m2	480, 254
Other paper weighing between 40 g/m2 and 150 g/m2	480, 255
Other paper weighing less than 40 g/m2 in sheets	480, 256
Other paper weighing between 40 g/m2 and 150 g/m2 in sheets	480, 257
Other Paper weighing more than 150 g/m2	480, 258
Paper and paperboard in rolls	480, 261
Paper and paperboard in unfolded sheets	480, 262
Other paper and paperboard	480, 269
Unbleached kraft paper and paperboard	480, 411

Other unbleached kraft paper and paperboard	480,419
Unbleached sack (shipping) kraft paper	480,421
Other sack (shipping) kraft paper	480,429
Unbleached wrapping (including packaging) paper	480,431
Other wrapping (including packaging) paper	480,439
Unbleached other kraft paper	480,441
Uniformly bleached kraft paper	480,442
Other bleached kraft paper	480,449
Other unbleached kraft paper and paperboard weighing 225 g/m2 or more	480,451
Uniformly bleached kraft paper and paperboard weighing 225 g/m2 or more	480,452
Other bleached kraft paper and paperboard weighing 225 g/m2 or more	480,459
Other uncoated pape, semi chemical fluting paper	480,511
Other uncoated paper, straw fluting paper	480,512
Other uncoated paper, other	480,519
Other uncoated paper, test liner weighing 150 g/m2 or less	480,524
Other uncoated paper, test liner weighing more than 150 g/m2	480,525
Other uncoated paper, sulfite wrapping paper	480,530
Other uncoated paper, filter paper and paperboard	480,540
Other uncoated paper, felt paper and paperboard	480,550
Other uncoated paper, other weighing 150 g/m2 or less	480,591
Other uncoated paper, other weighing more than 150 g/m2 but less than 225 g/m2	480,592
Other uncoated paper, other weighing 225 g/m2 or more	480,593
Other paper, paperboard, cellulose wadding and webs of cellulose fibers:	481,190
Carbon paper, self-copy paper	481,620
Carbon paper, other	481,690
Bobbins, spools, cops and similar supports of a kind used for winding textile yarn	482,210
Bobbins, spools, cops and similar supports, other	482,290
Slag wool, rock wool and similar mineral wools	680,610

Boards, sheets, panels, tiles faced or reinforced with paper or paperboard only	680,911
Boards, sheets, panels, tiles, or similar of plaster, other	680,919
Articles of plaster, other	680,990
Ceramic articles of percelain or china	691,410
Ceramic articles, other	691,490
Glass waste and scrap excluding from cathode ray tube or other activated glass	700,100
Glass in balls	700,210
Glass in rods	700,220
Glass in tubes of fused quartz or other silica	700,231
Glass in tubes of other glass with a linea coefficeint not exceeding 5x10-6 per Kelvin	700,232
Glass, other forms	700,239
Cast glass and rolled glass colored thoughtout, opacified, flashed	700,312
Cast glass and rolled glass, other	700,319
Cast glass and rolled glass in wired sheets	700,320
Float glass, nonwired, having an absorbent, reflecting or nonreflecting layer	700,510
Float glass, colored throughout the mass, opacified, flashed or merely surface ground	700,521
Float glass, other	700,529
Float glass, wired	700,530
Multiple-walled insulating units of glass	700,800
Glassware used for table, kitchen, toilet, office, indoor decoration	701,310
Stemware drinking glasses of lead crystal	701,322
Stemware drinking glasses, other	701,328
Other drinking glasses of lead crystal	701,333
Other drinking glasses, other	701,337
Silver powder	710,610
Silver, unwrought	710,691
Gold powder	710,811
Gold, other unwrought forms	710,812

Gold, other semimanufactured forms	710,813
Gold, monetary	710,820
Platinum, unwrought or powder	711,011
Palladium, unwrought or powder	711,021
Palladium, other	711,029
Rhodium, unwrought or powder	711,031
Rhodium, other	711,039
Iridium, unwrought or powder	711,041
Iridium, other	711,049
Nonalloy pig iron containing by weight 0.5 percent or less of phosphorus	720,110
Nonalloy pig iron containing by weight more than 0.5 percent of phosphorus	720,120
Alloy pig iron	720,150
Ferromanganese containing by weight more than 2 percent of carbon	720,211
Ferromanganese, other	720,219
Ferrosilicon containing by weight more than 55 percent of silicon	720,221
Ferrosilicon, other	720,229
Ferrosilicon manganese	720,230
Ferrochromium containing by weight more than 4 percent of carbon	720,241
Ferrochromium, other	720,249
Ferrosilicon chromium	720,250
Ferronickel	720,260
Ferromolybdenum	720,270
Ferrotungsten and ferrosilicon tungsten	720,280
Ferrotitanium and ferrosilicon titanium	720,291
Ferrovanadium	720,292
Ferroniobium	720,293
Ferrous metals, other	720,299
Ferrous products obtained by direct reduction of iron ore	720,310

Ferrous products obtained by direct reduction of iron ore, other	720, 390
Pig iron, granules	720, 510
Powders of alloy steel	720, 521
Other iron or steel powders	720, 529
Iron and nonalloy steel in ingots	720, 610
Iron and nonalloy steel, other forms	720, 690
Pickled Flat-rolled iron or nonalloy steel in coils	720, 810
Pickled Flat-rolled iron or nonalloy steel in coils of 4.75 mm or more	720, 825
Pickled Flat-rolled iron or nonalloy steel in coils of 3 mm or more but less 4.75 mm	720, 826
Pickled Flat-rolled iron or nonalloy steel in coils of less that 3 mm	720, 827
Flat-rolled iron or nonalloy steel in coild of exceeding 10 mm	720, 836
Flat-rolled iron or nonalloy steel in coils of 4.75 mm or more but not exceeding 10 mm	720, 837
Flat-rolled iron or nonalloy steel in coils of a thickness 3 mm or more but less 4.75 mm	720, 838
Flat-rolled iron or nonalloy steel in coils of a thickness less than 3 mm	720, 839
Flat-rolled iron or nonalloy steel not in coils	720, 840
Flat-rolled iron or nonalloy steel not in coils of a thickness exceeding 10 mm	720, 851
Flat-rolled iron or nonalloy steel not in coils of a thickness 4.75 mm or more but not exceeding 10 mm	720, 852
Flat-rolled iron or nonalloy steel not in coils of a thickness 3 mm or more but less 4.75 mm	720, 853
Flat-rolled iron or nonalloy steel not in coils of a thickness less than 3 mm	720, 854
Cold-rolled iron or nonalloy steel in coils of a thickness 3 mm or more	720, 915
Cold-rolled iron or nonalloy steel in coils of a thickness exceeding 1 mm but less than 3 mm	720, 916
Cold-rolled iron or nonalloy steel in coils of a thickness exceeding .5 mm but less than 1 mm	720, 917

Cold-rolled iron or nonalloy steel in coils of a thickness less than .5 mm	720, 918
Cold-rolled iron or nonalloy steel not in coils of a thickness 3 mm or more	720, 925
Cold-rolled iron or nonalloy steel not in coils of a thickness exceeding 1 mm but less than 3 mm	720, 926
Cold-rolled iron or nonalloy steel not in coils of a thickness exceeding .5 mm but less than 1 mm	720, 927
Cold-rolled iron or nonalloy steel not in coils of a thickness less than .5 mm	720, 928
Flat-rolled iron or nonalloy steel not clad, plated, or coated; universal mill plate	721, 113
Flat-rolled iron or nonalloy steel not clad, plated, or coated; other of a thickness 4.75 mm or more	721, 114
Flat-rolled iron or nonalloy steel not clad, plated, or coated; of a thickness less than 4.75 mm	721, 119
Flat-rolled iron or nonalloy steel not clad, plated, or coated; less than .25 percent carbon by weight	721, 123
Flat-rolled iron or nonalloy steel not clad, plated, or coated; .25 precent carbon or more by weight	721, 129
Flat-rolled iron or nonalloy steel not clad, plated, or coated; other	721, 190
Iron or steel bars and rods in irregularly wound coils, concrete reinforcing	721, 310
Iron or steel bars and rods in irregularly wound coils, of free cutting steel	721, 320
Iron or steel bars and rods in irregularly wound coils of circular cross section measuring less than 14 mm in diameter	721, 391
Iron or steel bars and rods in irregularly wound coils, other	721, 399
Other bars or rods of iron or nonalloy steel not further worked, forged	721, 410
Other bars or rods of iron or nonalloy steel not further worked, concrete reinforcing bars or rods	721, 420
Other bars or rods of iron or nonalloy steel not further worked, of free cutting steel	721, 430
Other bars or rods of iron or nonalloy steel not furher worked, of rectangular cross section	721, 491

Other bars and rods, of iron or nonalloy steel of freecutting steel	721,510
Other bars and rods, of iron or nonalloy steel, other; not further worked than cold-formed or cold-finished	721,550
Other bars and rods, of iron or nonalloy steel, other	721,590
Angles, shapes and sections of iron or nonalloy steel, cold formed or cold-finished from flat-rolled products	721,691
Angles, shapes and sections of iron or nonalloy steel, other	721,699
Wire of iron or nonalloy steel, not plated or coated	721,710
Wire of iron or nonalloy steel, plated or coated with zinc	721,720
Wire of iron or nonalloy steel, plated or coated with other base metals	721,730
Wire of iron or nonalloy steel, other	721,790
Stainless steel in ingots or other primary forms; semifinished products of stainless steel	721,810
Flat-rolled products of stainless steel, in coils of a width of 600 mm (23.6 in.) or more, of thickness exceeding 10 mm	721,911
Flat-rolled products of stainless steel, in coils of a width of 600 mm (23.6 in.) or more, of thickness 4.75mm or more but not exceeding 10mm	721,912
Flat-rolled products of stainless steel, in coils of a width of 600 mm (23.6 in.) or more, of thickness 3mm or more but not exceeding 4.75mm	721,913
Flat-rolled products of stainless steel, in coils of a width of 600 mm (23.6 in.) or more, of thickness of less than 3 mm	721,914
Flat-rolled products of stainless steel, not in coils of a width of 600 mm (23.6 in.) or more, of thickness exceeding 10 mm	721,921
Flat-rolled products of stainless steel, not in coils of a width of 600 mm (23.6 in.) or more, of thickness 4.75mm or more but not exceeding 10mm	721,922
Flat-rolled products of stainless steel, not in coils of a width of 600 mm (23.6 in.) or more, of thickness 3mm or more but not exceeding 4.75mm	721,923

Flat-rolled products of stainless steel, not in coils of a width of 600 mm (23.6 in.) or more, of thickness of less than 3 mm	721, 924
Flat-rolled products of stainless steel, cold-rolled in coils of a width of 600 mm (23.6 in.) or more, of thickness exceeding 10 mm	721, 931
Flat-rolled products of stainless steel, cold-rolledin coils of a width of 600 mm (23.6 in.) or more, of thickness 4.75mm or more but not exceeding 10mm	721, 932
Flat-rolled products of stainless steel, cold-rolledin coils of a width of 600 mm (23.6 in.) or more, of thickness 3mm or more but not exceeding 4.75mm	721, 933
Flat-rolled products of stainless steel, cold-rolled in coils of a width of 600 mm (23.6 in.) or more, of thickness exceeding 1mm but less than 3 mm	721, 934
Flat-rolled products of stainless steel, cold-rolled of a width of 600 mm (23.6 in.) or more of thickness less than .5mm	721, 935
Flat-rolled products of stainless steel, of a width of 600 mm (23.6 in.) or more, other	721, 990
Flat-rolled products of stainless steel, of a width of less than 600 mm (23.6 in.), of thickness 4.75mm or more	722, 011
Flat-rolled products of stainless steel, of a width of less than 600 mm (23.6 in.), of thickness less that 4.75mm	722, 012
Flat-rolled products of stainless steel, of a width of less than 600 mm (23.6 in.), not further worked than cold-rolled	722, 020
Flat-rolled products of stainless steel, of a width of less than 600 mm (23.6 in.), other	722, 090
Bars and rods, hot-rolled, in irregularly wound coils, of stainless steel	722, 100
Wire of stainless steel	722, 300
Other alloy steel in ingots or other primary forms; semifinished products of other alloy steel	722, 410
Flat-rolled products of other alloy steel, grain-oriented	722, 511
Flat-rolled products of other alloy steel, not grain-oriented	722, 519
Flat-rolled products of other alloy steel, not further worked than hot-rolled, in coils	722, 530

Flat-rolled products of other alloy steel, not further worked than hot-rolled, not in coils	722,540
Flat-rolled products of other alloy steel, not further worked than cold-rolled (cold-reduced)	722,550
Flat-rolled products of other alloy steel, Electrolytically plated or coated with zinc	722,591
Flat-rolled products of other alloy steel, otherwise plated or coated with zinc	722,592
Flat-rolled products of other alloy steel, other	722,599
Flat-rolled products of other alloy steel, of a width of less than 600 mm, grain-oriented	722,611
Flat-rolled products of other alloy steel, of a width of less than 600 mm, not grain-oriented	722,619
Flat-rolled products of other alloy steel, of a width of less than 600 mm, of high-speed steel	722,620
Flat-rolled products of other alloy steel, of a width of less than 600 mm, not further worked than hot-rolled	722,691
Flat-rolled products of other alloy steel, of a width of less than 600 mm, not further worked than cold-rolled	722,692
Flat-rolled products of other alloy steel, of a width of less than 600 mm, other	722,699
Bars and rods, hot-rolled, in irregularly wound coils, of other alloy steel, of high-speed steel	722,710
Bars and rods, hot-rolled, in irregularly wound coils, of other alloy steel, of silico-manganese steel	722,720
Bars and rods, hot-rolled, in irregularly wound coils, of other alloy steel, other	722,790
Other bars and rods of other alloy steel; angles, shapes and sections, of other alloy steel, bars and rods of high-speed steel	722,810
Other bars and rods of other alloy steel; angles, shapes and sections, of other alloy steel, bars and rods of silico-manganese steel	722,820

Other bars and rods of other alloy steel; angles, shapes and sections, of other alloy steel, bars and rods not further worked than hot-rolled, hot-drawn or extruded	722,830
Other bars and rods of other alloy steel; angles, shapes and sections, of other alloy steel, other bars and rods not further worked than forged	722,840
Other bars and rods of other alloy steel; angles, shapes and sections, of other alloy steel, other bars and rods not further worked than cold-formed or cold finished	722,850
Other bars and rods of other alloy steel; angles, shapes and sections, of other alloy steel, other bars and rods	722,860
Other bars and rods of other alloy steel; angles, shapes and sections, of other alloy steel, angles, shapes and sections	722,870
Wire of other alloy steel, of silico-manganese steel	722,920
Wire of other alloy steel, other	722,990
Copper mattes; cement copper (precipitated copper)	740,100
Unrefined copper; copper anodes for electrolytic refining	740,200
Refined copper, unwrought, other	740,319
Copper-zinc base alloys (brass)	740,321
Copper-tin base alloys (bronze)	740,322
Other copper alloys	740,329
Master alloys of copper	740,500
Copper powders and flakes, non-lamellar	740,610
Copper powders and flakes, lamellar	740,620
Copper bars, rods and profiles, of refined copper	740,710
Copper bars, rods and profiles, of copper-zinc base alloys	740,721
Copper bars, rods and profiles, other	740,729
Copper wire of refined alloys, other	740,819
Copper wire of copper-zinc base alloys,	740,821
Copper wire of copper-nickel base alloys	740,822
Copper wire, other	740,829

Copper plates, sheets and strip, of a thickness exceeding 0.15 mm, of refined copper in coils	740,911
Copper plates, sheets and strip, of a thickness exceeding 0.15 mm, of refined copper, other	740,919
Copper plates, sheets and strip, of a thickness exceeding 0.15 mm, of copper-zinc base alloy in coils	740,921
Copper plates, sheets and strip, of a thickness exceeding 0.15 mm, of copper-zinc base alloy, other	740,929
Copper plates, sheets and strip, of a thickness exceeding 0.15 mm of copper-tin base alloys in coils	740,931
Copper plates, sheets and strip, of a thickness exceeding 0.15 mm of copper-tin base alloys, other	740,939
Copper plates, sheets and strip, of a thickness exceeding 0.15 mm, of copper-nickel base alloys	740,940
Copper plates, sheets and strip, of a thickness exceeding 0.15 mm of other copper alloys	740,990
Nickel mattes	750,110
Nickel oxide sinters and other intermediate products of nickel metallurgy	750,120
Unwrought nickel, not alloyed	750,210
Unwrought nickel alloys	750,220
Nickel powders and flakes	750,400
Nickel bars, rods, and profiles of nickels not alloyed	750,511
Nickel bars, rods, and profiles of nickel alloys	750,512
Nickel wire, not alloyed	750,521
Nickel wire, alloys	750,522
Nickel plates, sheets, strip and foil, not alloyed	750,610
Nickel plates, sheets, strip and foil, alloys	750,620
Unwrought aluminum, not alloyed	760,110

Unwrought aluminum, alloys	760, 120
Aluminum powders and flakes, of nonlamellar structure	760, 310
Aluminum powders and flakes, of lamellar	760, 320
Aluminum bars, rods and profiles, not alloyed	760, 410
Aluminum bars, rods and profiles, alloyed with hollow profile	760, 421
Aluminum bars, rods and profiles, alloyed other	760, 429
Aluminum wire not alloyed of which the maximum cross-sectional dimension exceeds 7 mm	760, 511
Aluminum wire not alloyed, other	760, 519
Aluminum wire alloys of which the maximum cross-sectional dimension exceeds 7 mm	760, 521
Aluminum wire alloys, other	760, 529
Aluminum plates, sheets and strip, of a thickness exceeding 0.2 mm, rectangular not alloyed	760, 611
Aluminum plates, sheets and strip, of a thickness exceeding 0.2 mm, rectangular alloys	760, 612
Aluminum plates, sheets and strip, of a thickness exceeding 0.2 mm, other not alloyed	760, 691
Aluminum plates, sheets and strip, of a thickness exceeding 0.2 mm, other alloys	760, 692
Aluminum foil, not backed rolled but not further worked	760, 711
Aluminum foil, not backed, other	760, 719
Aluminum foil, backed	760, 720
Unwrought refined lead	780, 110
Unwrought lead, containing by weight antimony as the principal other element	780, 191
Unwrought lead, other	780, 199
Lead, sheets, strip and foil of a thickness (excluding any backing) not exceeding 0.2 mm	780, 411
Lead plates, sheets, strip and foil, other	780, 419

Lead powder and flakes	780, 420
Other articles of lead	780, 600
Molybdenum powders	810, 210
Unwrought molybdenum by sintering	810, 294
Unwrought molybdenum other than sintering	810, 295
Magnesium containing at least 99.8 percent by weight	810, 411
Magnesium containing less than 99.8 by weight	810, 419
Magnesium, other	810, 490
Cobalt mattes and other intermediate products of cobalt metallurgy	810, 520
Cobalt, other	810, 590
Bismuth containing more than 99.99 percent by weight	810, 610
Bismuth , other	810, 690
Unwrought antimony; powders	811, 010
Antimony, Other	811, 090
Manganese and articles thereof, including waste and scrap	811, 100
Beryllium unwrought; powders	811, 212
Chromium unwrought; powders	811, 221
Chromium, other	811, 229
Hafnium unwrought; waste and scrap; powders	811, 231
Hafnium, other	811, 239
Rhenium unwrought; waste and scrap; powders	811, 241
Rhenium, other	811, 249
Cadmium, other	811, 269
Other, Unwrought; waste and scrap; powders	811, 292
Other metals, other	811, 299
Cermets and articles thereof, including waste and scrap	811, 300

Appendix 3: Detailed Industry level results

Table 10: The effects of net taxes on French Imports from EU nations by industry

	Cement	Mineral Fuels	Inorganic Chemicals	Wood Products
Net Carbon Tax	-0.016 **	-0.022 *	-0.003	0.000
	(0.000)	(0.010)	(0.009)	(0.002)
Net Tax as part GDP	-0.008 **	0.005	-0.005	0.005
	(0.000)	(0.009)	(0.009)	(0.004)
Log likelihood	-7.28e+08	-1.52e+11	-3.67e+09	-7.49e+09
Number of observations	1661	4157	3729	3699

Errors clustered by product (g)

** p<.01, * p<.05

Table 11: The effects of net taxes on French Imports from EU nations by industry cont.

	Paper Products	Stone Products	Glass Products	Precious Metals	Iron Products
Net Carbon Tax	-0.001	-0.008	-0.028 *	-0.034 *	-0.009 **
	(0.002)	(0.007)	(0.014)	(0.017)	(0.002)
Net Tax as part GDP	-0.019	0.010	0.016 **	-0.049	-0.004
	(0.014)	(0.012)	(0.004)	(0.141)	(0.007)
Log pseudolikelihood	-2.98e+10	-1.08e+09	-4.42e+09	-1.08e+10	-9.98e+10
Number of observations	15429	1609	7471	3322	44825

Errors clustered by product (g)

** p<.01, * p<.05

Table 12: The effects of net taxes on French Imports from EU nations by industrys cont.

	Cu Products	Ni Producst	Al Products	Pb Products	Base Metals
Net Carbon Tax	-0.010 **	-0.010 *	-0.010	-0.015	-0.016 **
	(0.004)	(0.004)	(0.005)	(0.028)	(0.004)
Net Tax as part GDP	0.012 *	-0.009	0.014	0.010	0.021
	(0.006)	(0.030)	(0.008)	(0.014)	(0.020)
Log pseudolikelihood	-6.36e+09	-2.53e+09	-2.38e+10	-9.39e+08	-1.54e+09
Number of observations	9369	3624	7739	2143	5291

Errors clustered by product (g)

** p<.01, * p<.05

Table 13: The effects of net taxes on French Exports from EU nations by industry

	Cement		MineralFuels	InorganicChemicals	WoodProducts	
Net Carbon Tax	-0.015	**	-0.005	-0.004	-0.006	
	(0.005)		(0.004)	(0.003)	(0.005)	
Net Tax as part GDP	0.024	*	0.001	0.005	0.016	*
	(0.011)		(0.003)	(0.006)	(0.007)	
Log pseudolikelihood	-1.50e+09		-5.95e+10	-2.74e+09	-3.46e+09	
Number of observations	2169		4594	4483	3296	

Errors clustered by product (g)

** p<.01, * p<.05

Table 14: The effects of net taxes on French Exports from EU nations by industry cont.

	Paper Products	Stone Products	Glass Products		Precious Metals		Iron Products	
Net Carbon Tax	-0.005	-0.009	-0.041	**	-0.041	**	-0.005	*
	(0.004)	(0.005)	(0.011)		(0.010)		(0.002)	
Net Tax as part GDP	0.000	-0.004	0.009		-0.025	**	0.012	*
	(0.004)	(0.005)	(0.006)		(0.008)		(0.005)	
Log pseudolikelihood	-1.24e+10	-5.70e+08	-4.94e+09		-9.75e+09		-9.94e+10	
Number of observations	17703	1961	8540		3957		48258	

Errors clustered by product (g)

** p<.01, * p<.05

Table 15: The effects of net taxes on French Exports from EU nations by industry cont.

	Cu Products	Ni Products	Al Products		Pb Products		Base Metals
Net Carbon Tax	-0.001	-0.002	-0.007	**	-0.025	**	-0.005
	(0.004)	(0.002)	(0.002)		(0.006)		(0.003)
Net Tax as part GDP	0.002	0.011	-0.012		-0.010	**	-0.036
	(0.006)	(0.014)	(0.008)		(0.001)		(0.021)
Log pseudolikelihood	-4.66e+09	-1.68e+09	-1.69e+10		-4.87e+08		-6.90e+08
Number of observations	10416	4370	8569		2511		5509

Errors clustered by product (g)

** p<.01, * p<.05

Table 16: The effects of net taxes on French Imports from Non-EU nations by industry

	Cement		MineralFuels		InorganicChemicals		WoodProducts	
Net Carbon Tax	0.007		-0.004		-0.006		-0.011	
	(0.015)		(0.015)		(0.005)		(0.020)	
Net ETS	0.089	**	-0.019	*	-0.001		0.017	
	(0.015)		(0.009)		(0.006)		(0.014)	
Net Tax as part GDP	-0.117	**	-0.013		-0.028	**	-0.064	**
	(0.006)		(0.028)		(0.008)		(0.010)	
Log pseudolikelihood	-6.29e+08		-3.05e+11		-4.19e+09		-1.12e+10	
Number of observations	3691		11725		7779		4956	

Errors clustered by product (g)

** p<.01, * p<.05

Table 17: The effects of net taxes on French Imports from Non-EU nations by industry cont.

	Paper Products	Stone Products	Glass Products	Precious Metals	Iron Products
Net Carbon Tax	-0.015 *	-0.006	-0.014	-0.010	-0.008
	(0.007)	(0.028)	(0.016)	(0.008)	(0.004)
Net ETS	0.045 **	-0.096	-0.005	-0.008	0.011
	(0.013)	(0.132)	(0.012)	(0.013)	(0.014)
Net Tax as Part GDP	-0.035	0.053	-0.119 **	0.031	-0.021 **
	(0.021)	(0.033)	(0.025)	(0.024)	(0.008)
Log pseudolikelihood	-6.32e+09	-2.60e+08	-1.33e+09	-6.75e+09	-3.07e+10
Number of observations	27459	3605	15380	6287	69268

Errors clustered by product (g)

** p<.01, * p<.05

Table 18: The effects of net taxes on French Imports from Non-EU nations by industry cont.

	Cu Products	Ni Producst	Al Products		Pb Products	Base Metals	
Net Carbon Tax	0.006	-0.014	-0.010	*	0.042	-0.023	**
	(0.006)	(0.008)	(0.005)		(0.021)	(0.005)	
Net ETS	-0.046	-0.017	0.039	*	0.022	0.003	
	(0.034)	(0.021)	(0.017)		(0.143)	(0.006)	
Net Tax as part GDP	-0.006	-0.013	0.004		0.041	-0.065	**
	(0.014)	(0.010)	(0.005)		(0.024)	(0.022)	
Log pseudolikelihood	-3.01e+09	-9.72e+09	-2.61e+10		-3.15e+08	-3.10e+09	
Number of observations	15588	5946	20659		3503	8353	

Errors clustered by product (g)

** p<.01, * p<.05

Table 19: The effects of net taxes on French Exports from Non-EU nations by industry

	Cement		MineralFuels	InorganicChemicals	WoodProducts
Net Carbon Tax	-0.010	*	0.001	0.001	0.073
	(0.004)		(0.002)	(0.007)	(0.040)
Net ETS	-0.010		0.022	0.005	-0.112
	(0.006)		(0.021)	(0.008)	(0.066)
Net Tax as part GDP	0.023		0.009	0.012	0.008
	(0.018)		(0.011)	(0.010)	(0.023)
Log pseudolikelihood	-6.64e+08		-4.28e+10	-1.05e+09	-1.92e+09
Number of observations	7509		16478	19415	7540

Errors clustered by product (g)

** p<.01, * p<.05

Table 20: The effects of net taxes on French Exports from Non-EU nations by industry cont.

	Paper Products	Stone Products	Glass Products	Precious Metals	Iron Products
Net Carbon Tax	-0.002	0.019 **	-0.002	-0.023 **	0.002
	(0.003)	(0.005)	(0.006)	(0.007)	(0.003)
Net ETS	0.007	0.068 **	0.002	0.018 **	0.009
	(0.004)	(0.025)	(0.017)	(0.006)	(0.010)
Net Tax as part GDP	-0.008	-0.009	-0.003	-0.002	-0.061 **
	(0.007)	(0.007)	(0.018)	(0.043)	(0.007)
Log pseudolikelihood	-7.11e+09	-2.31e+08	-4.56e+09	-2.95e+09	-4.88e+10
Number of observations	71157	8698	34108	7242	147519

Errors clustered by product (g)

** p<.01, * p<.05

Table 21: The effects of net taxes on French Exports from Non-EU nations by industry cont.

	Cu Products	Ni Producst	Al Products	Pb Products	Base Metals
Net Carbon Tax	-0.002	-0.018 **	-0.013 *	0.014	0.001
	(0.003)	(0.004)	(0.006)	(0.018)	(0.004)
Net ETS	-0.058 **	-0.003	-0.048 **	-0.273 **	-0.016
	(0.021)	(0.003)	(0.017)	(0.060)	(0.019)
Net Tax as part GDP	-0.005	-0.038 *	0.005	0.016	0.000
	(0.010)	(0.017)	(0.008)	(0.016)	(0.027)
Log pseudolikelihood	-3.71e+09	-1.80e+09	-9.94e+09	-6.20e+08	-7.51e+08
Number of observations	32961	12043	34940	7893	12359

Errors clustered by product (g)

** p<.01, * p<.05

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