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EU Emissions Trading: The Role of Banks and Other Financial Actors
Insights from the EU Transaction Log and Interviews

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Abstract

This paper is an empirical investigation of the role of the financial sector in the EU Emissions Trading Scheme (EU ETS). This topic is of particular interest because non-regulated entities are likely to have played an important part in increasing the efficiency of the EU ETS by reducing trading transaction costs and providing other services. Due to various reasons (new rules and regulations, reduced return prospects, VAT fraud investigations) banks have reduced their engagement in EU Emissions Trading and it is unclear how this will impact on the functioning of the carbon market. Our regression analysis based on data from the EU Transaction Log shows that large companies and companies with extensive trading experience are more likely to interact with the financial sector, which is why we expect banks' pulling out of the EU ETS to affect larger companies more significantly. The semi-structured interviews we conducted with representatives of the financial sector, as well as companies liable under the EU ETS, confirm that banks were involved in the EU carbon market in various capacities, specifically as hedging partners for larger companies in the energy sector. Whether this particular role may be taken on by other financial players is unknown at this stage.

Keywords: EU ETS, financial sector, banks, trading strategy, hedging, EUTL

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1. Introduction

Textbook theory of emissions trading usually focusses on trading activities of regulated entities. In reality, however, non-regulated entities are also actively involved in the market for emission allowances. They often act as intermediaries and can improve market efficiency by reducing transaction costs for regulated entities (Stavins 1995). To better understand their different roles is important, given that policy makers in countries that have introduced emissions trading (e.g., South Korea) are more and more reluctant to facilitate the involvement of non-regulated entities, which may be one of the reasons for the relatively low trading volumes observed for those schemes (Thomson Reuters Point Carbon, 2016). The reasons for this reluctance may be findings that non-regulated entities such as banks and exchanges have supported VAT fraud worth more than 3 billion euros in lost sales tax revenue to European governments (Frunza and Guegan 2011; Wei and Betz 2016).

In the context of the EU Emissions Trading Scheme (EU ETS), the financial sector has been particularly active on the market for EU Allowances (EUAs) while many of the regulated entities do not get involved in the market at all (Betz and Schmidt 2015). Our analysis of data from the EU Transaction Log (EUTL) highlights the importance of financial actors and dedicated trading accounts of large companies in the market, which were jointly responsible for about two-thirds of the 1.8 million traded EUAs during the first trading period (2005-2007).[1] In fact, 45% of that volume involved one or two accounts of non-regulated entities. As illustrated in Table 1, more than half of this volume goes through accounts of banks (24% of the total), via exchanges (8 %), and through a dedicated future clearing account (London Clearing House – LCH, 6%), the remainder via brokers, (own-account) trading houses, and trusts and pension funds (7%).

Table 1 Total amount of EUAs transferred through accounts of financial actors during the first trading period

	Bank	Exchange	LCH Clearnet	Broker/Trader/Other
Million EUA	844	287	225	248
% of total	24%	8%	6%	7%

Source: EUTL, own estimation

So far, the literature on the role of the financial sector in emissions trading is relatively sparse. Schopp and Neuhoff (2013) assessed the hedging behavior of liable companies (in particular utilities) in the EU ETS. They found that financial actors are often partners of electricity companies hedging their future electricity sales. However, that study is based solely on interviews rather than on historical data, focusing on the electricity sector rather than on its hedging partners. Neuhoff et al. (2015) assessed hedging behavior and the volume of hedges in order to project developments with regard to the demand for allowances (and surplus of allowances over time) in the context of the Market Stability Reserve (MSR) to be introduced in the EU ETS in 2019 (EU 2015). Again, the different roles of financial actors were not the focus of this research. Pana (forthcoming) analyzed the influence of different market participants on volatility using EUTL data and found that the financial sector was active during times of particularly low and high volatility, which reflects the important role of banks and other financial intermediaries as service providers in the market. However, that study did not assess the different types of services they offered. Several other authors have analyzed EUTL transfer data (Jaraitė-Kažukauskė and

[1] We only used trades that did not involve a government account ('administrative transfers' vs. 'market transfers') and that focused on transactions taking place between two different companies rather than between two accounts belonging to the same company.

Kažukauskas 2015; Jong et al. 2013; Martino and Trotignon 2013; Zaklan 2013), but without describing the role of banks and other financial actors in the EU ETS in any detail.

The scope of this paper is wider than that of previous studies. It addresses the research gap related to the behavior of financial actors in the EU ETS as identified by previous studies (Betz and Schmidt 2015; Jaraitė-Kažukauskė and Kažukauskas 2015; Wallner et al. 2014; Zaklan 2013) by exploring the following research questions:

- First, what types of financial actors are particularly relevant as trading partners for which liable entities?
- Second, given the importance of banks compared to other financial actors, what, specifically, are their different roles in EU emissions trading?

To answer these question, descriptive and regression analysis was performed on EUTL data from the first trading period of the EU ETS. In addition, interviews were conducted to elaborate on our data analysis. This allowed us to understand more recent developments beyond the first trading period of the EU ETS, which is particularly relevant since the introduction of MiFID prompted many banks to shut down their carbon trading desks at the start of the third trading period. Some banks had already left the market or reduced their activities when prices dropped, which made services less attractive (Wallner et al. 2014), or they were concerned about reputational risk from getting involved in VAT carousel fraud.

Our regression analysis indicates that large companies are more likely to engage in trades involving a range of financial players, in particular banks or exchanges. Smaller companies (such as those with lower emissions and those without special trading accounts), on the other hand, are more likely to sell emission permits to a broker. Thus, it seems that the changes due to MiFID have a higher impact on larger companies, which may need to find new hedging partners, while the impact on smaller companies is less severe.

Based on our data analysis and the interviews we conducted, we found that banks have played a variety of roles in the EU ETS: First, they acted as intermediaries to facilitate trading similar to brokers. Second, they directly managed accounts of their clients. Third, they published information about the market (market analysis). Fourth, they provided liquidity to the market as market makers. Fifth, they traded on their own account in order to generate profits (speculation). Sixth, they seem to have borrowed permits from companies, returning them with interest (i.e., not buying them but using them as speculative capital). Seventh, they were involved in maturity swaps for companies that preferred to raise cash by selling their permits and buying derivatives from the proceeds. Eighth, they helped liable companies to swap EUAs against Kyoto units. Ninth, they aggregated volumes by buying from many small companies and selling to larger clients. Tenth, they acted as hedging counterparties for regulated companies.

The remainder of this paper is structured as follows: Section 2 provides an overview of the data and includes a descriptive analysis of typologies of participants and trades, as well as the summary statistics of the dataset used in the regression analysis. Section 3 presents the methodologies applied. Section 4 includes the regression results. Section 5 describes the different roles of financial actors in EU emissions trading, with a particular focus on banks. A conclusion is provided in Section 6.

2. Data

The EUTL is an electronic database managed by the European Commission that records all transactions of European Union Allowances (EUAs), Certified Emissions Reductions (CERs), and Emissions Reduction Units (ERUs) carried out under the EU ETS, including the allocation and surrendering of allowances, but also all trades taking place between market participants. Due to the delay with which the data is published (previously five years, now three) and the substantial work involved in cleaning and augmenting the dataset (see also Jaraite et al. 2013), we employ data covering the whole first trading period (January 2005 – April 2008). April is chosen as an endpoint to the period as companies have to submit the allowances required for the previous year by the end of April of the following year, which results in a true-up period at the end of the first trading period (January 2008 to the end of April 2008). A further reason for focusing on this timeframe in the context of the data analysis is that trading volumes recorded during the second trading period (in particularly in 2009 and 2010) are distorted due to the large-scale VAT carousel fraud that took place mainly in the spot market for EUAs (Frunza and Guegan 2011; Wei and Betz 2016).

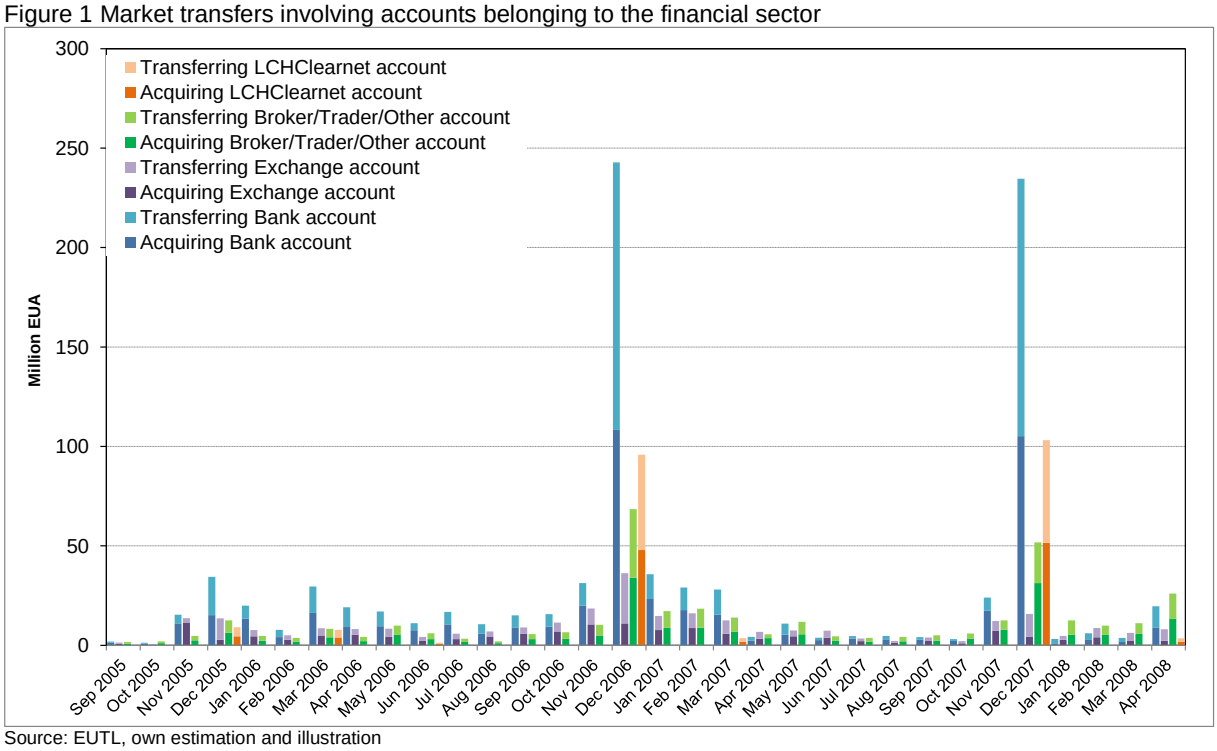
The EUTL contains additional information on the account holders that are party to a specific transaction. Besides government accounts, two different types can be observed: Operator Holding Accounts (OHAs) for all installations liable under the EU ETS and Person Holding Accounts (PHAs). PHAs are opened voluntarily, mostly as dedicated trading accounts of large regulated firms (in addition to their OHAs) or by non-regulated firms, most of which belong to the financial sector. These individual accounts were matched to parent companies for the purposes of this analysis. We drew on the information provided by the European University Institute (EUI) (Jaraite et al. 2013) that links OHAs and PHAs via their IDs to IDs in the company database ORBIS and their 'Global Ultimate Owner' (GUO), and we complement their aggregation efforts by additional desktop research, specifically focusing on financial actors.

We were thus able to divide the financial sector into three broad groups:

- Banks
- Exchanges (with the London Clearing House shown separately for some purposes)
- Brokers / trading houses / others (e.g., funds, insurance companies, or private persons) = 'BTO'.

Figure 1 below shows all those market transfers of Period I units that a PHA belonging to a financial entity was involved in. In general, financial accounts are most active at the beginning and end of each year, with a calmer period during the year. This probably has to do with the fact that December is the standard month when forward and future contracts are delivered and that by April liable entities have to surrender permits for the previous year's emissions. The special role of banks, among all financial actors, becomes evident. In December 2006 and 2007 – when the maturity dates for the standard forward and futures contracts fell – accounts belonging to banks transferred more EUAs than they acquired. This indicates that banks acted as hedging counterparties that delivered the amounts sold in these contracts in December. In the months leading up to December, on the other hand, accounts belonging to banks acquired more than they transferred, which indicates that these accounts bought the permits necessary to fulfill those contracts in December. All futures traded on the ECX (the most liquid futures exchange at the time) had to be cleared through the London Clearing House (LCH) (Martino and Trotignon 2013). This is why the LCH account exhibited a unique pattern, where large amounts of EUAs flowed into and out of this account in December 2006 and 2007 (see also Betz and Schmidt 2015).

Figure 1 Market transfers involving accounts belonging to the financial sector



Source: EUTL, own estimation and illustration

Note: For ease of illustration, and as volumes were initially very small, transactions are shown as starting in September 2005. The chart only shows 'market transfers' and transfers between two accounts not belonging to the same company.

2.1. TYPOLOGY OF PARTICIPANTS

More than 11,000 accounts of liable entities were active during the first period of the EU ETS (meaning they were either allocated allowances, had verified emissions or appeared in the transfer dataset, or all of the above; see Table 2 below). For these 11,000 installations, 4,783 liable parent companies could be identified. 4,608 of the liable companies only own operator holding accounts (OHAs), while 175 of them also have person holding accounts (PHAs).[2] At the same time, 1,078 PHAs actively participated in EU emissions trading during its first period. 472 of them were associated with a company that was also liable under the EU ETS. 606 PHAs were opened by entities that did not have liability under the EU ETS; this number can be aggregated to 433 at company level.

[2] It has to be noted that a number of banks also own OHAs and were therefore counted towards the 175 companies owning both OHAs and PHAs. This includes the following: ABENGOA S.A., ACCIONA S.A, BARCLAYS PLC, Dexia, EFFICIENCY DIRECT LIMITED, AGEAS SA/NV, DEUTSCHE BANK AG, and UNIONE DI BANCHE ITALIANE SCPA.

Table 2 Accounts and entities active during the first period of EU emissions trading

OHAs / Liable Entities			
Number of OHAs active in 1st TP	Number of parent companies owning at least one OHA	Number of parent companies owning only OHAs	Number of parent companies owning both OHAs and PHAs
11,141	4,783	4,608	175
PHAs / Non-Liable Entities			
Number of PHAs active in 1st TP	Number of PHAs associated with liable entity	Number of PHAs not associated with liable entity	Number of parent companies owning only PHAs
1,078	472	606	433

Source: EUTL, own estimation

The list of the most active banks during the first period of the EU ETS (see Table 3) reads like a who's who of the financial world. It also reveals a challenge in analyzing EUTL data, namely the fact that Barclays Bank, for example, seemingly sold more EUAs than it bought. In particular, one account of Barclays Bank transferred 8 million more allowances than it had acquired. Personal communication with the European Commission revealed that the main issue with transactions missing from the dataset is that in some cases, the 'status' of transfers changed from 'not completed' to 'completed' without it being recorded on the EUTL, and the transaction was therefore not displayed. Missing data also seems to have been responsible for higher sales volumes compared to purchase volumes for some of the other financial actors, although to a lesser extent. However, given the relatively small volumes of the missing data, we did not consider them to have a major impact on our findings.

On the other hand, we also observed banks that acquired more permits than they eventually sold. This applies, for example, to Morgan Stanley or Merrill Lynch. These banks may have pursued a strategy that led to a loss: Buying early at high prices and then being unable to sell all permits (or having to sell them at very low prices at the end of the period). The German bank KfW represents a special case. It bought permits on behalf of the German government in order to replenish the German new entrants reserve at the end of the first trading period. These permits were acquired mainly from other banks (e.g., from Barclays, Unicredit, and from auctions of Period I permits) and then transferred to the German government. In compensation, the KfW bank was given Period II permits by the German government, which it could sell on futures markets.

Banks often opened accounts in the British or French registries. This has to do with the fact that important exchanges (e.g., BlueNext or EEX) or clearing houses (e.g., LCH or ECX) were situated in those countries. For example, BlueNext required banks to hold an account in the same (in this case, French) registry. The majority of banks do not hold any OHA accounts. One prominent exception is Unicredit, which holds OHA accounts of sugar factories and is, therefore, an example of a bank that directly manages the liabilities of a company.

Table 3 Banks with total trading volume > 1 M EUA in the first period of EU emissions trading

Name of company	Volume of purchase (M EUA)	Volume of sales (M EUA)	Number of accounts (PHA/OHA)	Accounts opened in registries
BARCLAYS PLC	77	83	9 / 3	GB, NL, DE, FR, ES, DK, IT
UBS AG	74	71	4 / 0	FR, GB
AGEAS SA/NV	44	44	9 / 3	NL, GB, FR
Calyon Financial	40	40	2 / 0	FR, GB
BNP PARIBAS	24	22	3 / 1	GB, FR
MORGAN STANLEY	23	20	11 / 1	GB, DK, NL, DE, FR
SOCIETE GENERALE	19	18	4 / 0	GB, CZ, FR
COMMERZBANK AG	17	17	3 / 0	FR, DE, GB
GOLDMAN SACHS GROUP, INC	16	16	8 / 0	ES, GB, NL, DK
ROYAL BANK OF SCOTLAND GROUP PLC	11	15	3 / 1	GB, NL
MERRILL LYNCH & CO., INC.	13	11	4 / 0	FR, GB
UNICREDIT SPA	11	12	3 / 8	PL, DE
KFW BANKENGRUPPE	19	0	5 / 0	DE
DEUTSCHE BANK AG	11	8	7 / 1	GB, DE, ES
SAL. OPPENHEIM JR. & CIE. AG & CO. KGAA	9	9	2 / 0	DE, FR
SAS RUE LA BOETIE	7	7	3 / 1	GB, FR
JP MORGAN CHASE & CO.	6	5	7 / 0	FR, GB
BEAR STEARNS COMPANIES LLC, THE	2	2	1 / 0	GB
Royal Bank of Canada	2	2	2 / 0	GB
BANQUE DEGROOF SA	2	2	1 / 0	BE
LEHMAN BROTHERS HOLDINGS INC.	3	0	2 / 0	GB
BANK OF IRELAND	1	1	2 / 0	GB, IE
NATIXIS	1	1	5 / 0	GB, FR
BAYERNLB HOLDING AG	1	0.4	2 / 1	DE
KBC GROEP NV/ KBC GROUPE SA	1	1	3 / 0	SK, CZ
Sampo Bank	1	1	1 / 0	FR
SKANDINAVISKA ENSKILDA BANKEN AB	0.4	0.4	1 / 0	GB
CREDIT SUISSE GROUP AG	0.4	0.3	4 / 0	GB, FR
BANCO BILBAO VIZCAYA ARGENTARIA SA	0.4	0.2	1 / 0	ES

Source: EUTL, own estimation and illustration

All exchanges and clearing houses that were active during the first trading period are shown in Table 4 below. Note that organized exchanges did not develop until mid-2005, with EEX/Eurex (Germany) being the first to offer EUA spot contracts from 9 March 2005, followed by BlueNext (France) and EXAA in June 2005, and NordPool in October 2005 (Ellerman et al. 2010, p.134). The largest overall volume was transferred through one account belonging to the London Clearing House (LCH). As mentioned before, LCH is the clearing house associated with the clearing of future contracts traded on the ECX. The most liquid exchanges for spot contracts were BlueNext – which was called Powernext until 2007 – and NordPool.

In which countries the exchanges operated also played a role in the respective country's exposure to VAT fraud. The countries which were hit hardest by illegal activity of this kind (i.e., France, UK, and Germany) are countries where exchanges were situated (Wei and Betz 2016).

In total, we observed about 510 million Period I EUAs transacted into and out of accounts of exchanges. For the time span from January 2005 to April 2008, Point Carbon estimates exchanged volumes of 960 million. The fact that this number is higher reflects the fact that the EUTL only records physical transfers of allowances. This means that in the case of forwards and futures, only the physical delivery is recorded, rather than the trade of the contracts, which may have been sold and resold (see also Section 5).

Some exchanges seem to have attracted a large number of liable parties to trade directly. The most prominent example is SendeCO2, where a lot of liable companies from the Spanish ceramics industry transact directly with the exchange. At the EEX, where we counted 74 different liable companies, a lot of small German utilities ("Stadtwerke") were observed making transactions with this exchange. We also found that it was not necessarily dedicated trading accounts of companies (PHAs) but often the installation's direct account that carried out transactions with the exchange. In general, exchanges that also offer products in the electricity sector, e.g., NordPool and EEX, attract a lot of liable companies from this sector. This may be because those companies had already met prequalification requirements to trade at this exchange and could, therefore, start trading another product (i.e., emission permits) without going through the process again.

Table 4 Exchanges and clearing houses active during the first period of EU emissions trading

Name (Location) Products offered	Volume of purchase (M EUA)	Volume of sales (M EUA)	Number of active participants at the exchange
ICE / LCH Clearnet (UK) futures	113	113	Banks: 16; B/T/O: 4; Liable: 3
BlueNext SA (France) spot and futures	66	66	Banks: 9 ; B/T/O: 21; Exchange: 1; Liable: 31
NordPool (Norway) spot and futures	41	41	Banks: 4; B/T/O: 7; Liable: 55
Climex (Netherlands)	15	17	Banks: 3; B/T/O: 11; Exchange: 2; Liable: 22
EEX (Germany) spot and futures	12	12	Bank: 1; B/T/O: 11; Liable: 74
SENDECO2 (Spain)	6	6	Banks: 3; B/T/O: 5; Exchange:1; Liable: 222
CEB (Slovakia)	1	1	B/T/O: 4; Liable: 28
Mercatoelettrico (Italy)	1	1	B/T/O: 7; Liable:15
EXAA (Austria) spot	0.5	0.4	B/T/O: 3; Liable: 5
POLPX (Poland)	0.1	0.1	B/T/O: 2; Liable: 4
Chicago Climate Exchange (US)	0.0001	0	Liable: 1
Czech Moravian Commodity Exchange Kladno (Czech Republic)	0.00002	0.00001	B/T/O: 2; Liable: 1

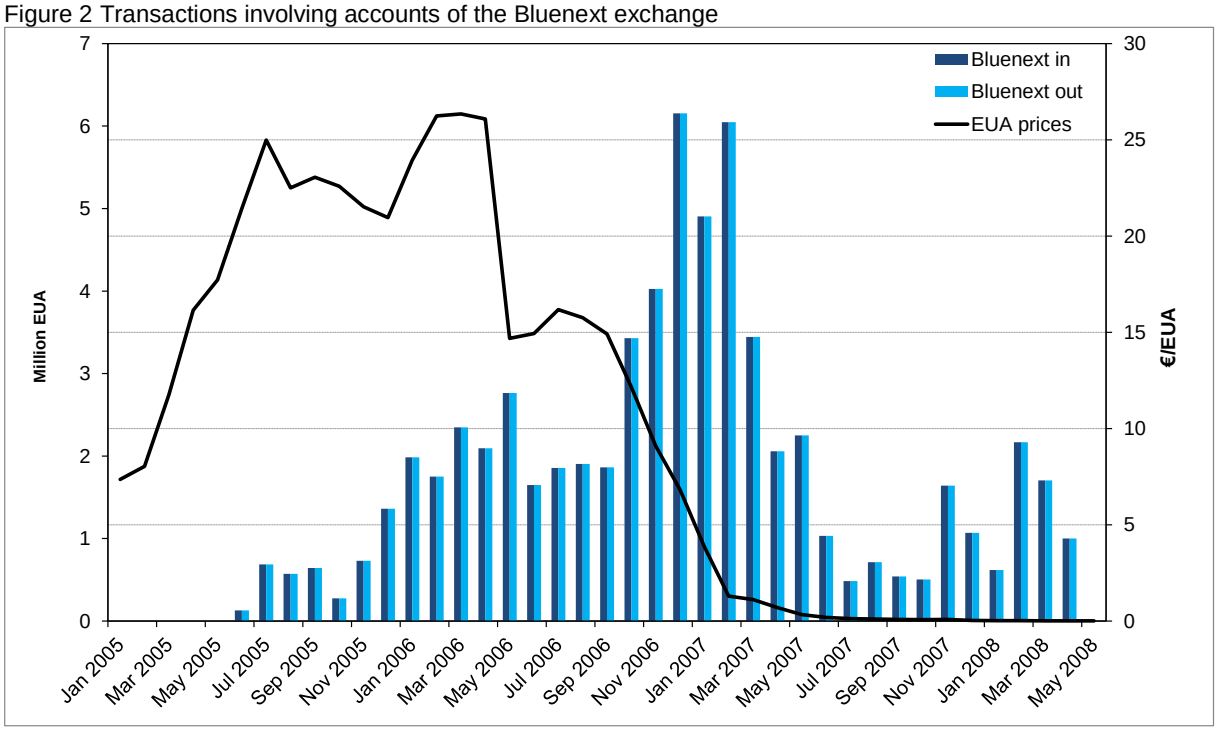
Source: EUTL, own estimation

Note: BlueNext was founded in December 2007 when NYSE Euronext and Caisse des Dépôts purchased the carbon market from PowerNext. ICE used to be called ECX. B/T/O = Brokers / Trading Houses / Others

Exchanges may also strategically choose a small country for their clearing subsidiaries due to VAT reasons. EEX, for example, clears its transactions through a subsidiary in Luxembourg (European Commodity Clearing Luxembourg). This is because the exchange buys most of the allowances within the country where VAT applies and sells the allowances across borders, which are VAT free. The EEX would have to finance the excess VAT in advance, but with its clearing house being located in a small country most trades are VAT free and will not need any VAT management by EEX (ECC 2009).

Using data from the EUTL, Figure 2 illustrates the physical amounts going into and out of the accounts of the BlueNext spot exchange. Volumes slowly started to pick up at the end of 2005 / beginning of 2006 and were generally highest at the end of 2006 / beginning of 2007. As prices dropped towards 0, trading volumes started to decrease again, but trades in Period I permits were being carried out through this exchange right up to the end of the first trading period (ending with the surrendering deadline at the end of April 2008).

Figure 2 Transactions involving accounts of the Bluenext exchange



Source: EUTL, Point Carbon, own estimation and illustration

Table 5 shows the brokerage and trading houses with the largest volumes traded during the first period of the EU ETS. According to Wallner et al. (2014), trading houses trade allowances as an investment and therefore often hold large positions (1-5 M EUAs) themselves, as an internal strategy. In contrast, brokerage companies focus on brokerage activities which may or may not involve permits being transferred through their own account. Given that we only observed physical transactions that were carried out our list of brokers or volumes observed in the EUTL itself may be incomplete as brokerage companies may have only facilitated trades, without being involved in the physical transaction of permits.

Table 5 Brokers and trading houses with total trading volumes > 2 M EUA in the first period of EU emissions trading

Name of company	Volume of purchase (M EUA)	Volume of sales (M EUA)
Wallich	14	14
CONSUS S.A.	12	12
Vertis	10	9
carboncapitalmarkets	8	8
Sempra Energy Europe Limited (SEEL)	8	8
STX Services	8	7
Nordea	7	7
PCE Investors	8	4
GreenStream	5	5
Climatecorp	4	5
Atlantik	3	3
Blackstonegv	4	1
ECOPROGRESSO	2	2
SYNECO GMBH & CO. KG	2	2
E&T ENERGIE HANDELSGESELLSCHAFT M.B.H.	2	1
Carbon Warehouse	1	1
ECO WAY	1	1
NEAS ENERGY A/S	1	1
NATSOURCE LLC	1	1
Jane Street	2	0.6
Grup Rigaut 33	1	1
WIND TO MARKET	1	1
EcoWay	1	1
GEMB GESELLSCHAFT FUER EMISSIONSMANAGEMENT UND BERATUNG MBH	1	0.9
Stenmore Financial Ltd.	0.9	0.9
CM CAPITAL MARKETS HOLDING SA	0.9	0.7

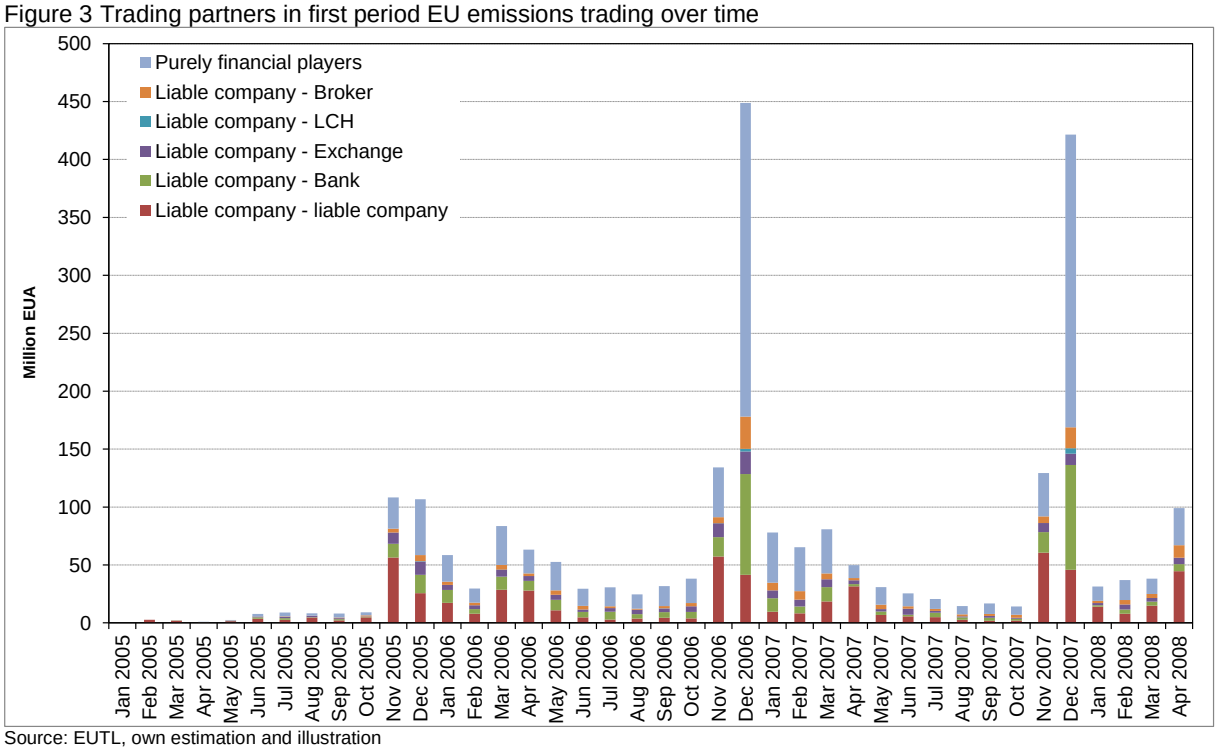
Source: EUTL, own estimation

2.2. TYPOLOGY OF TRADES

Prior to conducting a regression analysis (Section 4), we investigated the volumes traded between different types of market participants. During the first trading period, liable companies had the largest transaction volume directly with other liable companies (Figure 3), followed by transactions with banks, exchanges, and brokers. About twice the volume that was transacted between liable companies was transacted between purely financial players. These transactions included clearing activities, such as through the LCH, trading on behalf of liable clients, or speculation on the part of the financial entities.

As mentioned above, physical market transactions of EUAs cluster around the end of the year – and to some extent around the time when permits need to be surrendered. As Figure 3 illustrates, the involvement of financial actors in the trading activities of liable companies increased over time and purely financial player transfers took place especially in December, the time of futures clearing via LCH. The different roles of banks in futures trading are explained in more detail in Section 5.

Figure 3 Trading partners in first period EU emissions trading over time



Source: EUTL, own estimation and illustration

2.3. SUMMARY STATISTICS FOR VARIABLES USED IN REGRESSION ANALYSIS

The regression analysis enabled us to investigate with which types of financial actors liable companies carry out transactions. To this end, we used a dataset that included all companies liable during the first trading period and recorded whether they sold to, or bought from, banks, brokers, or exchanges. Although Barclays Bank is responsible for three OHAs, it was excluded from the analysis because of the problem with the missing transfers (see Section 2.1). As was shown earlier, banks were the most important financial traders in terms of volumes traded (Table 1). As Table 6 indicates, however, brokers were far ahead in terms of numbers of distinct trading partners among liable companies. While 9% of all liable companies sold to banks and 5% bought from banks, 19% and 13% did so with brokers.[3]

[3] Please note that the term 'broker' used in this section refers to the category of 'Broker/Trader/Other' established earlier.

Table 6 Summary statistics of variables used in regression analysis

	Observations	Mean	Min	Max
Sold to bank	4,783	0.09	0	1
Bought from bank	4,783	0.05	0	1
Sold to broker	4,783	0.19	0	1
Bought from broker	4,783	0.13	0	1
Sold to exchange	4,783	0.05	0	1
Bought from exchange	4,783	0.06	0	1
Traded	4,783	0.63	0	1
Number of trades	3,002	12.70	1	2,986
Short	4,783	0.27	0	1
Has PHA	4,783	0.04	0	1
Number of accounts	4,783	2.41	1	216
ln (maximum emissions)	4,783	10.02	1	19
ln (absolute position)	4,783	9.53	0	18
Electricity	4,783	0.10	0	1
Other combustion	4,783	0.53	0	1
Refineries	4,783	0.01	0	1
Iron, steel	4,783	0.03	0	1
Cement	4,783	0.03	0	1
Glass	4,783	0.04	0	1
Ceramics	4,783	0.16	0	1
Paper	4,783	0.10	0	1

Source: EUTL, own estimation

Next, in order to determine which characteristics influence a company's decision to sell or buy from either a bank, a broker, or an exchange, we used explanatory variables related to a company's sector, based on the NACE code of installations with the majority of emissions owned by this company (European Commission 2014), its size (measured by the logarithm of the year with the highest emissions in 2005-2007), the number of accounts the company owns, whether or not it has a PHA, whether it was short or long, and by to what extent and the number of trades carried out by this company.

3. Methods

Two different methods are used to answer the two main research questions. We use regression analysis to examine which types of liable companies interacted with different financial actors most frequently during the first trading period of the EU ETS. We also conducted a number of semi-structured interviews with key players active in EU emissions trading in order to better understand the various roles of different actors and gather insights on how the situation developed after the first trading period had ended. In this context, we interviewed both current and former employees of banks and electricity companies and tried to cover both large and small and both multinational and regional entities. It was somewhat challenging to find interview partners as many of the relevant persons had already left their positions following a reduction of involvement in EU emissions trading, in particular by banks.

Regarding the regression analysis, we decided to model the decision of a liable company to trade or not to trade with a specific financial actor using a probit model with a binary outcome, where y_2^* describes the propensity to trade with a certain actor (unobservable to us) and y_2 reflects the binary outcome we observed (trade / no trade with a particular actor).

$$y_2^* = x_2'\beta_2 + u_2$$
$$y_2 = \begin{cases} 1 \; if \; y_2^* > 0 \\ 0 \; if \; y_2^* \leq 0 \end{cases}$$

Since not all the companies (in fact, only 63% of them) did any trading at all, be it with or without financial intermediaries, we decided to model the decision to sell or buy from one of the financial entities as a two-step process: In a first step, a company decides whether or not to engage in trading at all, and in a second step whether to trade with one of the financial intermediaries.

$$y_1^* = x_1'\beta_1 + u_1$$
$$y_1 = \begin{cases} 1 \; if \; y_1^* > 0 \\ 0 \; if \; y_1^* \leq 0 \end{cases}$$

In this context, y_1^* represents the propensity to trade. Therefore, the binary outcome y_1 indicates whether a company traded or not during the first period. The outcome y_2, in turn, can only be observed for companies that did any trading. In other words, in this model setup, y_2 can only be observed if $y_1^* > 0$:

$$y_2 = \begin{cases} (y_2^* > 0) \; if \; y_1^* > 0 \\ not \; observed \; if \; y_1^* \leq 0 \end{cases}$$

$$\mathrm{Cov}(u_1, u_2) = \rho$$

If unobserved characteristics exist which are correlated both with variables that influence the decision whether or not to trade and with variables that determine the decision to trade with a certain type of financial actor, estimating them separately would lead to omitted variable bias. Only if the errors are uncorrelated and $\rho = 0$ would it be correct to estimate the equation for y_2 separately. Since it is likely that companies are not randomly selected into trading or not trading and, in particular, that unobserved variables affecting this (self-)selection also have a significant effect on the companies' decision to trade with a certain type of financial actor, a correlation in the errors of the separate estimations needs to be taken into account. This can be done by applying a probit model that accounts for self-selection (Heckman 1979; Van de Ven and Van Praag 1981).

In general, the same regressors can be included in both the selection and the outcome equation. However, if this is the case, the identification relies on the nonlinear functional form of the selection equation and the specification may, therefore, be fragile. Therefore, exclusion restrictions, i.e., variables that determine the decision of whether or not to trade, but not the decision which type(s) of intermediaries to trade with, may be desirable (Puhani 2000). Following Pinkse et al. (forthcoming), we used the logarithm of the absolute value of the allocation position (= total

amount of allowances allocated during the first trading period – total emissions in the same period) as an exclusion restriction for identification. It is important to note that this variable influences the decision to engage in trading but does not have an effect on the decision to trade with a particular financial intermediary. The decision of whether or not to engage in trading depends on whether a company views the potential payoff related to trading higher than the potential risks/costs associated with trading. A high absolute value of the allocation position implies a high level of either over- or underallocation. While a high level of overallocation would imply higher potential gains following a decision to engage in trading as these could be sold on the market, a high level of underallocation implies large costs associated with not engaging in the market (i.e., paying a penalty). We, therefore, expected this variable to have a positive influence on the decision of whether or not to engage in trading. Regarding the assumption that the variable is not correlated with the decision to buy to or sell from a certain financial actor, we assumed that the absolute value of over- or underallocation should not necessarily influence the decision with which type of financial actor to trade, except via the size channel, which we controlled for in the outcome equation. Furthermore, the outcome variable differentiates between purchases and sales. While the absolute value of over- or underallocation is expected to influence the decision to trade or not, it should not correlate highly with the decision to either sell or buy.

4. Regression Analysis

Regression results are displayed in Table 7. The short dummy is significant and has the expected sign, i.e., if a company was short it was more likely to buy from any of the financial intermediaries, while if it was long, it was significantly more likely to sell to any of the financial actors. Using the logarithm of maximum emissions as a measure of the size of a company indicates that larger companies were more likely to engage in trading activities with any of the financial intermediaries, with one exception: Smaller companies (again measured by emissions) were significantly more likely to engage in selling to a broker.

Whether or not a company had opened a PHA seems important as it may increase the likelihood of the company engaging in trades with both banks and exchanges. However, the coefficients are insignificant for regressions involving a broker. This might again point to the fact that smaller companies or companies with less trading experience that did not open a PHA were equally likely to interact with brokers but less likely to interact with banks or exchanges. The impact of the sector dummies is varied and no clear pattern emerges. Against the reference category of electricity generation, other sectors seem to be less likely to interact with exchanges. This does not, however, hold for ceramics. On the other hand, cement and glass companies seem to be more likely to engage in trades with banks than electricity generating companies. This may be due to the fact that some sectors are quite heterogeneous. (Consider, for example, the German electricity market with its four large and many small utilities.)

Turning to the selection equation, as expected a higher absolute amount of the allocation position was found to have a positive effect on the decision to engage in trading. The size of a company, if measured by verified emissions and the number of accounts, also has a positive impact on the decision to engage in trading, although the level of verified emissions is only marginally significant. It can also be noted that a number of sectors are significantly less likely to engage in trading at all when compared to the reference category of electricity generation. Rho is significant in a number of the regressions indicating that the selection process may indeed play an important role, although not for all of the regressions run. (See below where we checked this by running a simple probit regression).

Table 7 Regression results: Probit model with sample selection

	Sold to bank	Bought from bank	Sold to broker	Bought from broker	Sold to exchange	Bought from exchange
Short	-0.63***	0.47***	-0.67***	0.45***	-0.61***	0.54***
	(0.11)	(0.07)	(0.11)	(0.05)	(0.11)	(0.07)
ln(maximum emissions)	0.14***	0.20***	-0.07***	0.08***	0.04	0.10***
	(0.04)	(0.02)	(0.01)	(0.01)	(0.03)	(0.02)
Number of accounts	0.003	0.002	-0.002	0.01***	-0.005	0.004
	(0.01)	(0.005)	(0.004)	(0.01)	(0.004)	(0.005)
Has PHA	0.40***	0.41***	0.07	-0.02	0.67***	0.68***
	(0.14)	(0.14)	(0.11)	(0.14)	(0.15)	(0.14)
Number of trades	0.005***	0.004***	0.003***	0.003***	0.006***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Other combustion	0.27***	0.20	0.04	0.05	-0.31***	-0.05
	(0.10)	(0.12)	(0.07)	(0.08)	(0.11)	(0.12)
Refineries	-0.07	0.01	-0.10	-0.36	-1.05**	-0.20
	(0.25)	(0.26)	(0.21)	(0.24)	(0.41)	(0.29)
Iron, steel	0.23	0.23	0.05	-0.23	-0.62**	-0.43
	(0.19)	(0.19)	(0.15)	(0.17)	(0.29)	(0.27)
Cement	0.43**	0.05**	0.42***	0.16	-0.20	-0.11
	(0.17)	(0.19)	(0.13)	(0.14)	(0.22)	(0.21)
Glass	0.63***	0.47***	-0.16	-0.13	-0.18	0.23
	(0.16)	(0.18)	(0.13)	(0.15)	(0.20)	(0.18)
Ceramics	0.15	-0.10	0.34***	0.05	0.24*	0.62***
	(0.14)	(0.18)	(0.09)	(0.10)	(0.13)	(0.13)
Paper	0.16	-0.28	0.05	-0.04	-0.36**	0.28*
	(0.14)	(0.19)	(0.10)	(0.11)	(0.17)	(0.15)
Constant	-2.35***	-4.27***	0.78***	-2.16***	-1.44***	-3.12***
	(0.53)	(0.30)	(0.19)	(0.17)	(0.47)	(0.26)
			Selection equation			
ln(absolute position)	0.11***	0.09***	0.12***	0.09***	0.09***	0.09***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
ln(maximum emissions)	0.02	0.03*	0.02	0.02*	0.02*	0.03*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Number of accounts	0.16***	0.16***	0.12***	0.17***	0.16***	0.16***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Other combustion	-0.08	-0.10	-0.08	-0.10	-0.09	-0.09
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Refineries	-0.04	-0.01	0.02	0.01	0.01	0.01
	(0.23)	(0.23)	(0.23)	(0.23)	(0.23)	(0.23)
Iron, steel	-0.12	-0.13	-0.15	-0.12	-0.12	-0.13
	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)	(0.13)
Cement	-0.39***	-0.39***	-0.36***	-0.44***	-0.38***	-0.40***
	(0.13)	(0.13)	(0.12)	(0.13)	(0.13)	(0.13)
Glass	-0.05	-0.05	-0.02	-0.05	-0.04	-0.05
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Ceramics	-0.16**	-0.17**	-0.17**	-0.18**	-0.17**	-0.18**
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Paper	-0.15	-0.16**	-0.15*	-0.18**	-0.16*	-0.17*
	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Constant	-0.98***	-0.93***	-1.06***	-0.95***	-0.94***	-0.93***
	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
rho	-0.62***	1.00	-0.85***	0.89***	-0.30	0.89
p-value LR test	(0.005)	(0.11)	(0.001)	(0.000)	(0.25)	(0.10)
Observations			3002 (4783)			

Source: EUTL, own estimation

Note: Standard errors in parentheses (***significant at the 99% level; ** significant at the 95% level; *significant at the 90% level)

These results imply that, generally, companies with high emission volumes are generally more likely to interact with financial actors. The important exception is selling to a broker. Companies with fewer emissions are more likely to interact with these players. Furthermore, the coefficient of whether or not a liable company opened a PHA indicates that if it did, it is again more likely to interact with banks or exchanges, but that a company without a PHA is equally likely to engage in trades involving brokers. Assuming that large (measured by verified emissions) and more professionalized companies in terms of trading activities (measured by whether or not a company opened a PHA) conduct trades involving large amounts, of a potentially recurring, standardized nature, one could argue that banks and exchanges might be important for these types of trades, while brokers may be responsible for the smaller, less standardized ones. This would also tie in with the fact that while banks transact the largest amount of any financial actor (Table 1) and may, therefore, cater to large clients, in terms of number of trading partners, brokers are more important as they interact with many smaller clients.

These results are echoed in a survey of German companies liable under the EU ETS (Grünig et al. 2014), which found that companies with large trading volumes are more likely to follow a diversified trading strategy using different channels, such as the secondary market, OTC, or intermediaries. Companies with small trading volumes, on the other hand, often interact exclusively with one intermediary. This intermediary is often a broker or trader, but sometimes a bank or other financial institution. The authors found that reasons for a singular trading strategy via one intermediary are mostly related to the relatively high cost associated with other trading channels, which are only warranted at higher trading volumes – or if, for example, a company already has access to a particular exchange (e.g., EEX), since it also trades energy products there.

Comparing the results of the outcome equation to an ordinary probit regression, without accounting for the selection process (Table 9 in the Annex), we see that the estimation results are very similar, both in terms of the magnitude and the significance of the coefficients. For those regressions where we estimated a significant correlation between the error terms of the two equations, in particular ‘sold to broker’ and ‘bought from broker’, we found some differences in the magnitude and significance of coefficients. In the ordinary probit regression ‘sold to broker’, the coefficient on the logarithm of maximum emissions is no longer significant (while owning a PHA becomes marginally significant). This indicates that ex-ante smaller firms are more likely to sell to a broker (taking the selection process into account). Among the companies that traded, on the other hand, small and large companies are equally likely to sell to a broker. In the ordinary probit regression ‘bought from broker’, the sector dummy on cement becomes significant, indicating that ex-ante companies in the cement sector are not significantly more likely to buy from a broker than electricity companies, which holds for the subset of companies that traded. These variables are therefore likely to be affected by the unobservable variables driving the selection process in these two cases.

5. The Different Roles of Banks

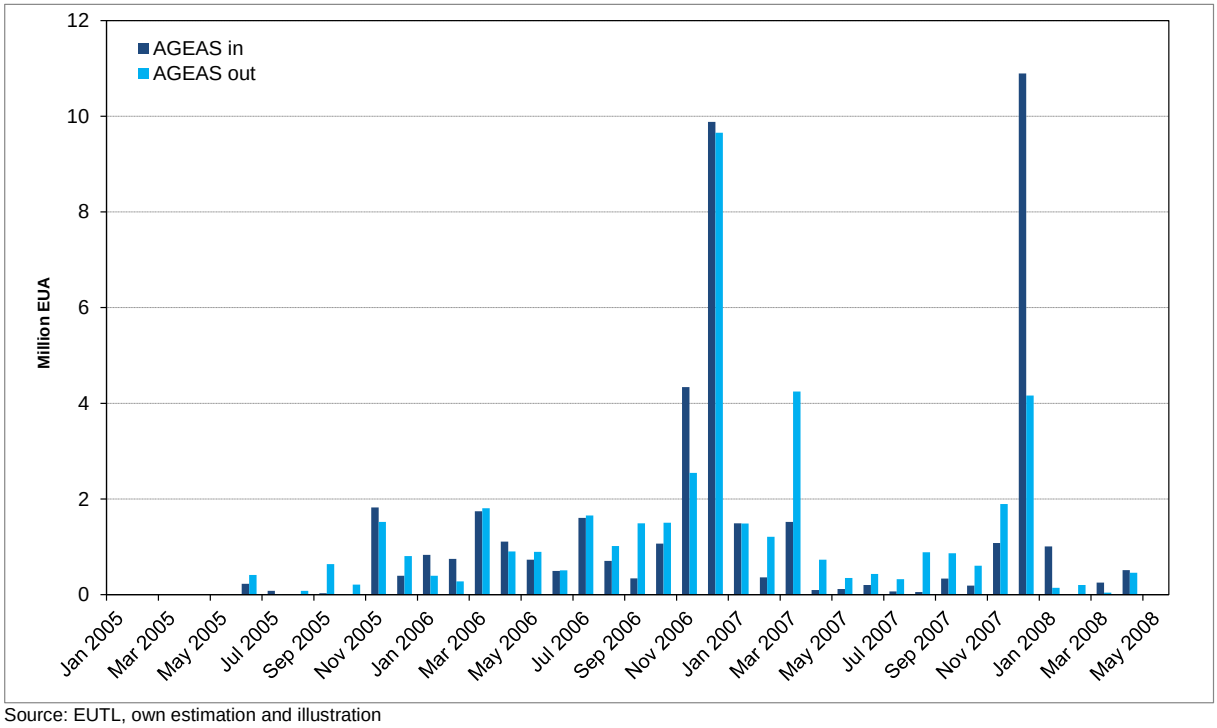
In order to better understand the implications of banks exiting the market for EUAs on ETS companies, we extended the regression analysis of the previous section by means of semi-structured interviews with financial players and their clients. These interviews also give insights into the different roles banks played in and beyond the first trading period. While the focus of this section is on banks, many of these roles may have been played by trading houses or brokers as well, albeit on a smaller scale (e.g., for smaller clients or involving smaller volumes).

In general, banks use a vertical or horizontal approach as their strategy in emissions trading. In this context, vertical means that they offer a broad set of services to their clients ranging from management services, brokerage, and information provision to hedging (e.g., Barclays Bank). A horizontal approach would focus, for example, on the entirety of services for companies in the energy sector. In this context, banks with a horizontal approach may target some services related to emissions trading in order to show competence on the carbon market. These banks, however, rather expect profits from larger energy infrastructure projects or activities on other energy markets than from trading on the carbon market as such. Most of the banks with lower transaction volumes on the market for EUAs fall under this category.

Based on EUTL data analysis and interviews, the roles banks played in EU emissions trading can be classified into the following ten categories.

First, similar to exchanges, banks facilitate trading in that they offer a platform on which other entities can carry out trades or offer the service to facilitate trades. We would expect that a bank that specializes in brokerage and acts as an **intermediary** would a) have transactions dispersed across the whole year, b) transact with a large number of trading partners, and c) have the same amount of EUAs flow out of its account as flow into the account during a short period of time. The bank AGEAS (Figure 4) may be a good example of this behavior as it traded with 118 distinctive partners during the first trading period, many of which were liable companies, while selling to 88 distinct trading partners. AGEAS acquired permits in 652 transactions with an average size of 68,000 EUAs and sold in 1,084 transactions with an average size of 41,000 EUAs. Transactions were dispersed throughout the year, although the spikes in December each year (a delivery month for forwards and futures) still play a big role.

Figure 4 AGEAS Bank as an example of an intermediary/brokerage role



Source: EUTL, own estimation and illustration

Second, banks may go beyond the intermediary role by providing further services by **directly managing accounts**. AGEAS, for example, is the direct account holder of three installations. It is not the only bank that managed liable accounts directly. In fact, Unicredit even managed the accounts of eight installations directly, as can be deduced from the information on Operator Holding Accounts (OHA) available on the EUTL.

Third, some banks provide **market information** to their clients by publishing newsletters (e.g., Deutsche Bank or Barclays) and market analysis reports.

Fourth, although most of the activities of banks increased liquidity on the market, some banks actually acted as a **market maker**, as did some utilities or oil companies (Betz and Schmidt 2015). Market makers have to constantly place bids and asks within a certain price corridor on exchanges and are rewarded by being granted access to these exchanges as well as special conditions. This role was also played by Barclays Bank, which in part accounts for it being responsible for the highest volume traded by any bank (Table 3).

Fifth, banks may trade on their own account in order to generate profits. In contrast to ‘management service providers’, which make returns related to service activities offered (e.g., brokerage) or ‘technical service providers’, which make returns related to fees and charges, ‘speculative traders’ try to generate returns by speculating on the market for EUAs. Speculative trading may involve very short time periods in order to make profits within hours or days. Information on **speculative activities** was difficult to obtain in any of the interviews since those are often carried out by a different department within the same bank. According to Wallner et al. (2014), most banks have reduced purely speculative trading behavior given that this needs to be backed up with nearly the same amount of equity in order to comply with regulatory standards for banks. It is also very difficult to infer from the EUTL data whether banks might have made a profit or a loss from EU emissions trading. As noted above, the EUTL only displays physical transactions and no information about the price related to a transaction (if any), which complicates the estimation of gains and losses as prices have to be matched to trading volumes. The fact that banks were often counterparties in futures trading (see below) makes it even harder to estimate potential gains they made from trading, as the forward or futures contract could have been sold at any point in time before the physical transaction took place.

Sixth, banks may also **borrow permits from companies** and return them with interest (not buying them but rather using them as speculative capital). However, borrowing permits from other companies was not very common as the contract negotiations were burdensome as mentioned by our interview partners.

Seventh, banks are **partners for so-called maturity swaps** of companies, which thus benefit from better conditions to obtain cash compared to the conventional credit conditions offered by banks. In this context, a company sells permits against cash on the market and at the same time buys a future from the exchange backed by a bank (which will only need to be paid for at the delivery date, with the exception of margins). Interviewees reported that companies did this over longer periods, which would require them to use their permits allocated for future years for compliance (borrowing) and buy a future or forward contract that would mature, for instance, at the end of the trading period.

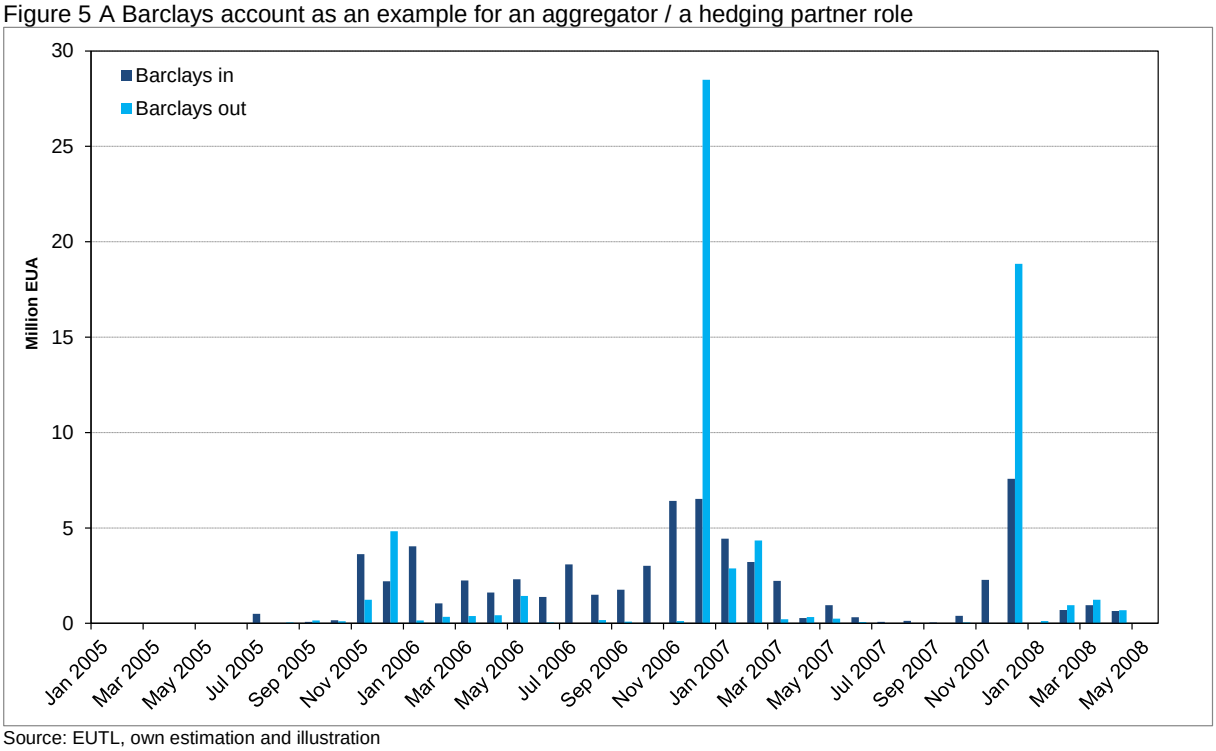
Eighth, from the second trading period onwards, when Kyoto units of the Clean Development Mechanism (CERs) or Joint Implementation (ERUs) were traded, banks helped companies in **swapping EUAs against Kyoto units**. This means they were swapping EUAs for CERs or ERUs by selling EUAs and simultaneously buying CERs or ERUs. This is a risk-free way of generating additional cash as long as there is a price differential between CERs/ERUs and EUAs. However, this swapping option is not unlimited since regulated companies can only use a certain share of Kyoto units for compliance. As KfW/ZEW (2009) noted, in Germany it is mostly large companies that take advantage of the ability to swap – even at relatively low spreads while other companies demand larger spreads due to perceived risks and transaction costs involved in swapping Kyoto units for EUAs.

Ninth, some banks lower transaction costs by trading with their smaller credit clients which prefer to get all their services from their main bank (Heindl 2012a, 2012b).[4] In this case, a bank will play the role of an **aggregator** and collect the surplus allowances of its clients to bring them on the market. These allowances may then be sold on the spot market or, as they often are, used to deliver forwards or futures, in particular to electricity companies.

Finally, as indicated before, banks are major **hedging partners** and develop and offer derivative products to help manage price risk for regulated companies. In particular, electricity generators buy derivatives to hedge power forward sales. They acquire futures rather than EUAs in auctions or on the spot market due to higher capital costs and financial liquidity restrictions. These hedges are usually carried out by dedicated trading accounts (PHAs) of the electricity companies, rather than the accounts of individual installations. It is attractive for a bank to serve as a hedging partner, as it is given access to cheap capital and can, therefore, pursue cost-of-carry arbitrage; it can, for example, buy spot from a manufacturer, hold EUAs, and sell forwards or futures to electricity generators. KfW / ZEW (2014; 2015) also mentioned hedging as an important motive for becoming active on the market for the German companies surveyed in their report.

[4] Note, however, that Grünig et al. (2014) found that, at least in Germany, the main bank is often not the favored intermediary for small firms, but rather banks with dedicated carbon desks, or brokerage and trading houses.

Figure 5 A Barclays account as an example for an aggregator / a hedging partner role



Source: EUTL, own estimation and illustration

Figure 5 shows how the role of aggregator and hedging partner might have worked using one of the accounts of Barclays Bank as an example. This account purchases smaller quantities throughout the year and then transfers a large amount (approximately equal to the sum of purchases) in December each year. As December was and is the standard maturity month for EUA forwards and futures, it is very likely that these peaks were deliveries of these derivatives. In a sense, therefore, a bank (account) that acted as an aggregator on the market for EUAs may at the same time have been a 'hedging partner'.

In order to give a broader indication of which companies were active in the forward and futures markets, Table 8 shows those companies with the highest (absolute) transaction volumes on the days when forwards and futures were cleared. These companies were jointly responsible for 86 % of transaction volumes on those days. The largest total volume went through the account of LCH Clearnet (17 % of the total volume on those days), followed by financial actors, many of which had registered accounts at LCH Clearnet and were, therefore, able to clear futures (marked with an asterisk). Table 8 also shows the share of the respective company's total trading volume during the first trading period that was conducted on one of those 16 days. In fact, LCH Clearnet transacted 91 % of its total transaction volume on those days, followed by Calyon Financial and UBS with 89 % and 82 %, respectively. We were also able to observe large utilities with considerable activity during those dates, as well as energy companies and a couple of industrial companies. However, even many of the smaller companies had a large share of their total transfers during the first trading period on these days (overall mean of 40 % for all companies in the dataset). This may be due to the fact that at the end of each year companies will have the best estimate of total verified emissions and their respective liability.

Table 8 Companies active on forward and future delivery days

Company	Vol on clearing days (M EUA)	Share of company's total trading volume	Share of total trading volume on these days	Company	Vol on clearing days (M EUA)	Share of company's total trading volume	Share of total trading volume on these days
Clearinghouse, exchanges				Utilities			
LCH Clearnet	204	91%	17%	ELECTRICITE DE FRANCE	40	67%	3%
NordPool	9	11%	1%	RWE AG	28	42%	2%
BlueNext	6	5%	1%	E.ON SE	25	35%	2%
Financial actors				SSE PLC	22	60%	2%
UBS AG*	11 9	82%	10%	ENEL SPA	18	27%	2%
Calyon Financial*	71	89%	6%	ENBW AG	18	57%	1%
BARCLAYS PLC*	68	43%	6%	GDF	16	19%	1%
AGEAS SA/NV*	34	38%	3%	ESSENT N.V.	16	59%	1%
BNP PARIBAS*	33	72%	3%	ALLIANDER N.V.	15	41%	1%
MORGAN STANLEY*	25	58%	2%	IBERDROLA SA	14	67%	1%
GOLDMAN SACHS GROUP*	25	78%	2%	CENTRICA PLC	13	35%	1%
SOCIETE GENERALE	18	48%	1%	DRAX GROUP PLC	12	56%	1%
ROYAL BANK OF SCOTLAND	13	49%	1%	CEZ A.S.	12	67%	1%
COMMERZBANK AG	13	37%	1%	VATTENFALL AB	12	35%	1%
SAL. OPPENHEIM JR. & CIE. *	9	53%	1%	Deeside Power Limited	8	25%	1%
NUCLEAR LIABILITIES FUND	9	74%	1%	VEOLIA ENVIRONNEMENT	7	33%	1%
PCE Investors	8	67%	1%	Sempra Energy Europe Ltd.	7	44%	1%
MERRILL LYNCH & CO.*	8	34%	1%	Energy			
DEUTSCHE BANK AG*	6	33%	1%	ROYAL DUTCH SHELL*	24	41%	2%
Industry				BP PLC	18	41%	1%
SAINT GOBAIN SA	19	39%	2%	BHP BILLITON LIMITED	9	76%	1%
RHODIA SA	10	43%	1%	TOTAL S.A.	8	56%	1%

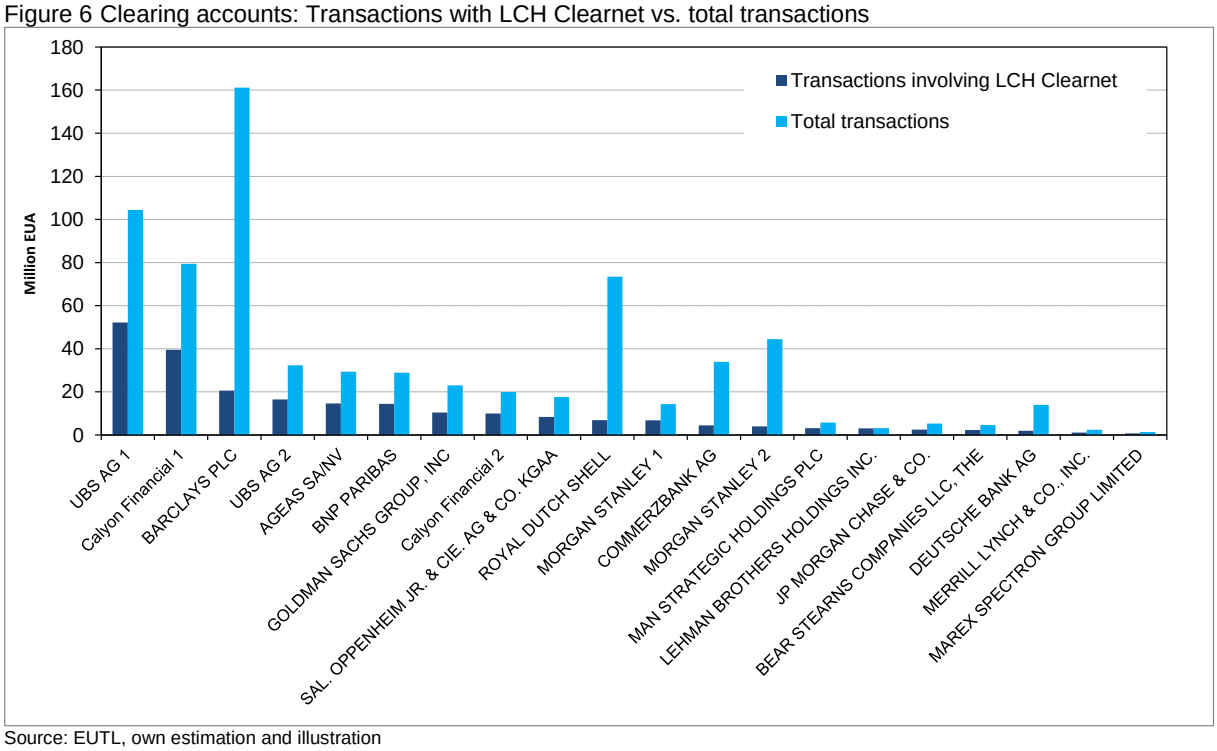
* Have direct transactions with LCH Clearnet ('clearing accounts')

Source: EUTL, own estimation and illustration

Note: All of the companies shown are involved in at least 1 % of the total volume transacted on the defined days (30/11-01/12/05; 19/21-21/12/05; 30/11-01/12/06; 18-21/12/06; 30/11/07; 03/12/07; 17-19/12/07); * denotes accounts that had direct transactions with LCH Clearnet, which serves as the clearinghouse for the ECX ('clearing accounts').

Liable companies barely transacted with the London Clearing House directly. In fact, Shell was the only liable company owning a PHA that was able to trade with the LCH. In total, only 27 accounts (of a total of 11,000 OHAs and 1,000 PHAs) had any transactions with the LCH. Figure 6 shows 20 of these accounts, sorted by volumes transacted with the LCH. Transactions involving the LCH are compared with overall transactions of these accounts, indicating that some of them were, to a large extent, being used for clearing activities of futures contracts.

Figure 6 Clearing accounts: Transactions with LCH Clearnet vs. total transactions



Source: EUTL, own estimation and illustration

6. Conclusions

This paper analyzes the role of the financial sector in EU emissions trading using both descriptive and regression analysis on the EUTL transfer dataset, as well as semi-structured interview techniques. It contributes to the literature by identifying and exploring the different roles which financial actors play in emissions trading and by suggesting why these may be important in facilitating trading, particularly at the beginning of a scheme. The result of the regression analysis indicates that different types of liable companies interact with financial actors to differing degrees. While larger companies with trading experience are more likely to interact with many different financial actors, in particular banks or exchanges, smaller, less professionalized companies are more likely to follow a singular trading strategy and to interact with brokers while they do this.

Based on further EUTL data analysis and the outcomes of interviews with relevant stakeholders, we were able to show that banks, in particular, play several roles as participants in the EU ETS, acting as intermediaries, hedging partners, or service providers. Our results indicate that the fact that banks have been pulling out of the market, due to various reasons, might pose a bigger problem to those companies that rely on them to offer trades in large quantities and/or standardized products, such as forward or futures contracts. It is unclear at this stage if banks will continue to play this role or if other service and trading companies will take over their role - in particular as hedging counterparties - since they do not fall under the new EU regulations regarding financial markets (MiFID). Many of the other roles of banks as identified in this paper have in fact been played by other financial intermediaries as well (e.g., CER/ERU swaps). Therefore, we do not expect a major impact of the disengagement of banks on companies wishing to make use of these types of services.

Since banks have also been responsible for the largest overall trading volume and have acted as market makers, their pulling out of the market may also raise concerns over liquidity - in particular, when one observes the rather low trading volumes recorded for emissions trading schemes without the participation of the financial sector, such as the South Korean scheme (Thomson Reuters / PointCarbon 2016). However, given the frequent and high auction volumes under the EU ETS since the start of the third trading period in 2013, the liquidity of the market seems to be less of a worry at present.

Given that our data analysis is based on data for the first trading period (2005-2007), future research using data from the second trading period may be interesting and give additional insights on the more recent roles of the financial sector. However, researchers need to be aware of the major role banks and exchanges played in the VAT fraud, which is likely to have distorted the transfer data available for the second trading period substantially. It may, furthermore, be worthwhile to leave the level of companies active in emissions trading and take the viewpoint of a regulator that has to decide whether, and to what extent, non-liable financial actors should be allowed to participate in a trading scheme, thus enabling a more comprehensive view of the costs and benefits of the inclusion of the financial sector in emissions trading.

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Table 9 Regression results: Probit model without sample selection

	Sold to bank	Bought from bank	Sold to broker	Bought from broker	Sold to exchange	Bought from exchange
Short	-0.78***	0.56***	-1.06***	0.59***	-0.66***	0.64***
	(0.09)	(0.08)	(0.06)	(0.05)	(0.09)	(0.07)
ln(maximum emissions)	0.21***	0.18***	-0.001	0.04**	0.06***	0.07***
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Number of accounts	0.010	-0.0004	0.003	0.01**	-0.004	0.002
	(0.01)	(0.004)	(0.003)	(0.00)	(0.004)	(0.004)
Has PHA	0.51***	0.36**	0.26*	-0.09	0.74***	0.65***
	(0.14)	(0.15)	(0.14)	(0.14)	(0.14)	(0.15)
Number of trades	0.005**	0.005**	0.002**	0.003***	0.006***	0.005***
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
Other combustion	0.29***	0.21*	-0.003	0.08	-0.32***	-0.03
	(0.11)	(0.11)	(0.08)	(0.09)	(0.11)	(0.13)
Refineries	-0.10	0.01	-0.19	-0.35	-1.09***	-0.18
	(0.25)	(0.26)	(0.25)	(0.28)	(0.41)	(0.34)
Iron, steel	0.19	0.28	-0.05	-0.20	-0.66***	-0.42
	(0.20)	(0.21)	(0.17)	(0.18)	(0.25)	(0.29)
Cement	0.33*	0.16	0.28*	0.34**	-0.26	-0.01
	(0.18)	(0.19)	(0.16)	(0.16)	(0.22)	(0.22)
Glass	0.70***	0.52***	-0.29*	-0.12	-0.19	0.27
	(0.16)	(0.18)	(0.16)	(0.16)	(0.20)	(0.20)
Ceramics	0.09	-0.07	0.32***	0.14	0.22	0.76***
	(0.15)	(0.18)	(0.10)	(0.11)	(0.14)	(0.14)
Paper	0.13	-0.28	-0.07	0.01	-0.39**	0.34**
	(0.15)	(0.20)	(0.12)	(0.12)	(0.18)	(0.15)
Constant	-3.61***	-3.87***	-0.34*	-1.55***	-1.90***	-2.62***
	(0.31)	(0.28)	(0.18)	(0.19)	(0.27)	(0.26)
Observations	3002					

Source: EUTL, own estimation

Note: Robust standard errors in parentheses (***significant at the 99% level; ** significant at the 95% level; *significant at the 90% level)

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