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Barriers to European cross-border E-commerce

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Barriers to European Cross-border e-Commerce

Alex Coad and Néstor Duch-Brown

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Abstract

We analyse survey data to investigate the main barriers to European cross-border e-commerce. We investigate the determinants of selling online, as well as the frequency and determinants of cross-border e-commerce, and the role of barriers. Large firms, which are part of a group, are more likely to sell online. Firms generally make most of their online sales to their home country, although EU firms are more likely to engage in cross-border online trade with EU countries than non-EU countries. Firms report that they are facing a variety of barriers to e-commerce. Regulatory barriers are negatively associated with online sales. There is weak evidence that firms which use their own websites are more vulnerable to financial, market and information barriers. Firms that use a large platform experience fewer financial and market barriers. On the positive side, we find that small and young firms do not seem to be more vulnerable to barriers than large or more experienced firms.

Keywords: E-commerce; Digital Single Market; barriers; internationalization; obstacles

JEL codes : F31, L81

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1. Introduction

The single market has been one of the pillars of the European economic integration process. However, market conditions evolve through different practices and new technologies and can develop previously unimaginable facets. Today, more than 20 years since its completion, there are still concerns about how well the single market works, and policy makers debate about how to improve its governance (Egan and Guimarães, 2017). One of these fundamental changes is related to the rapid diffusion of digital technologies, and the implications this has for the way products and services are commercialised within and between countries. The Digital Single Market Strategy focuses precisely on achieving the benefits of the single market for the many transactions that today are mediated by the Internet¹. It has been shown recently (Duch-Brown et al., 2017) that despite diverting part of traditional sales, e-commerce does in fact expand the market. In this context, barriers to e-commerce can have adverse effects on producers and consumers.

E-commerce has grown at a remarkable pace during the past few years and, although it already plays an important role in the EU economy, it is expected to become still more important. In 2016, it represented on average 8.1% of total retail sales in the EU-28, and some forecasts place it at around 11% in 2020 (Euromonitor International, 2016). Despite this evolution, the advances are highly concentrated in domestic markets while online trade seems to be lagging behind. According to Eurostat, the proportion of individuals aged 16-74 buying online in 2016 was, on average for the EU-28, 55%, while the share of those buying online from businesses located in other EU countries was only 18%. Similarly, in 2015 18% of all EU firms with ten or more workers sold at least 1% of turnover online, but less than half of these (8%) sold products or services across the border. This figure may seem substantial when compared to the share of exporting firms in offline trade (Berthou et al., 2015) and may indicate that the most important obstacles are on the consumer side. However, regulatory and supply-side barriers may still play a part in holding back online trade flows.

Firms can benefit from e-commerce in multiple ways, since digital markets can help to mitigate factors traditionally considered as market frictions (Gorodnichenko and Talavera, 2017). Electronic markets can help reduce information asymmetries, the costs of searching for new customers, some transaction costs, and menu costs. In addition, e-commerce enables practices that are difficult to implement in offline markets such as increased personalisation (of price and attributes), dynamic pricing strategies, and disintermediation. These frictions affect different industries in non-equal ways. Hence, the expected benefits of e-commerce and also the barriers that block its diffusion will necessarily differ by sector and by country, due to productive and trade specialisations.

Previous studies have shown that geographical distance and national borders remain important factors in online trade (Hortacsu et al., 2009) and confirm the importance of demand-side barriers, such as consumer preference for domestic products, cultural and language differences, informational frictions, and also trust, as the main sources of cross-border online trade costs (Blum & Goldfarb, 2006; Hortacsu et al., 2009; Gomez et al, 2014). Meanwhile, shipping costs and distances in time zone play only a minor role in explaining the role of geographical distance on online trade (Hortacsu et al., 2009, Lendle et al., 2016). However, to the best of our knowledge there is no comparable evidence on the barriers to online trade faced by firms. Which firms report that they face

¹ Within the DSM Strategy, several initiatives have been adopted to tackle specific issues related to e-commerce. For more information, please consult <https://ec.europa.eu/digital-single-market/en/policies/ecommerce>. However, e-commerce initiatives date back to the turn of the century, when the e-commerce directive (2000/31/EC) was implemented. For details see <https://ec.europa.eu/digital-single-market/en/e-commerce-directive>.

(which) barriers? What are the effects of these barriers on performance? Which firms are more likely to abandon their online sales?

Scholars have commented on the lack of evidence regarding barriers to cross-border e-commerce, for example:

"more effort will have to go into the construction of more comprehensive and reliable online cross-border trade data sets that will enable a more detailed and rigorous testing of the drivers and impediments to online cross-border trade." Gomez-Herrera et al., (2014, page 94).

In addition, recent studies on international trade have taken a firm-level perspective: it is firms that trade, not nations. Following on from Melitz (2003), a large body of literature has developed around the idea that heterogeneous firms decide whether or not to export, depending on a number of factors that condition their choices (for a review see Bernard et al., 2012). To the best of our knowledge, this literature has not yet explored the issue of e-commerce. One of the main messages of this approach is that a deep understanding of the evidence at the firm-level is indispensable to be able to deliver high-quality policy making.

Hence, with a view to filling this gap in our knowledge, survey data was collected on the barriers to cross-border e-commerce. This data indicates that a large proportion of firms selling online also engage in online exports. However, many firms are blocked by existing barriers and restrict their electronic operations to their domestic markets. Regulatory barriers are among the most important obstacles firms find when they try to sell online across the border. These barriers, in turn, are also negatively associated with performance. On the positive side, we also find that small and young firms do not seem to be more vulnerable to any of these barriers than large or more experienced firms. In addition, firms which use e-commerce marketplaces (platforms) tend to have higher shares of online sales.

In the EU, many potential online trade barriers – for instance diverse tax regimes, complications with payments systems, heterogeneous consumer protection rules, cross country legal and regulatory barriers or vertical restrictions to selling online, among others – may stand in the way of a fully-integrated digital single market. Many of these potential online barriers were identified in early discussions (Coppel, 2000) and have become more relevant now that e-commerce has emerged as an important distribution channel.

The paper is structured as follows. The next section describes the data. Section 3 contains the main analysis. Section 4 offers some conclusions.

2. Data and descriptive statistics

In this section, we first describe the database used for the empirical analysis and discuss its representativeness. Second, we offer a more detailed characterisation of those firms that are carrying out online activities. In particular, we focus on the barriers to online trade.

2.1 Data

The firm-level data were collected through a specific questionnaire issued to a sample of 8,705 firms in 26 Member States² in early 2015. The sample includes (at least) 400 firms for the larger Member States, 300 firms for Croatia and Slovenia, 200 firms for Latvia, Hungary, Bulgaria and 100 firms for Luxemburg, Estonia and Slovakia³. The data covers four sectors: 1) manufacturing; 2) wholesale and retail trade; 3) accommodation and food and; 4) information and communication.

In order to check for potential sample biases, we compared the sample composition with other sources of information. In particular, we compared the weighted distribution of firms by country in our sample with firm level data from Eurostat's Structural Business Statistics (SBS). According to the results, Spain, Greece, the Netherlands, Sweden and Germany are slightly overrepresented; while Italy, Poland, Romania, Portugal and Bulgaria are somewhat underrepresented. In addition, we also checked potential sample bias by sector. The comparison of the weighted distribution of firms in the sample with that from Eurostat's SBS reveals that manufacturing, wholesale and retail trade and accommodation and food sectors are to some extent under-represented while the information and communication sector is marginally over-represented⁴. These sample biases are small (on average, a 3% deviation with respect to the population size distribution) and we did not find them to have a significant impact on the results⁵.

The dataset includes different blocks of questions. First, all firms were asked questions about their basic characteristics. The number of characteristics is sufficient to control for many different dimensions of the firms' operations and strategies: country, sector, age, size, ownership, activity and sales trend. Second, firms were asked if they use e-commerce to sell. In this case, additional questions were included about the channels used to sell online, and particularly important, if the firm was selling online in different countries. Firms exporting online were asked supplementary questions about the barriers they faced. Finally, firms were also asked a third block of questions about whether they used e-commerce to buy. As in the previous block, firms were subsequently asked about the main channels they used to procure inputs online, and whether they bought from suppliers located abroad. In this case, firms were also asked about the main barriers to online trade they faced.⁶

² All EU Member States except Cyprus and Malta.

³ These numbers are required in order to reach statistical significance. Firms were interviewed in a rolling basis until the reported numbers were reached. In some cases, there are a few more firms than the minimum required. See the technical specifications in the Flash Eurobarometer 413 (2015) for more information on sample design and statistical procedures.

⁴ Sample bias can also be introduced by differences in firms' size distribution, the proportions of the types of firms or the channels they use to sell/buy online. However, checking for sample bias in these cases is much more difficult because of the lack of appropriate data.

⁵ We conducted separated analysis with and without weights and the results were consistent. In addition, we computed new weights with the information obtained from Eurostat and we obtained almost identical results.

⁶ For a more detailed explanation, see the data description in Duch-Brown and Martens (2015).

In the next section, we will concentrate on blocks one and two, since the focus of this paper is on barriers to exports. Table 9 in the Annex provides a detailed description of the variables used for the analysis.

2.2 Descriptive statistics

In the sample, 3,945 firms (45%) declared they used e-commerce to sell their products and/or services. This average figure masks significant differences by country: 66% of firms in Slovenia are engaged in e-commerce, but only 30% of firms in Poland. Similarly, there are differences by sector. Only 38% of manufacturing firms declared they sold online, while the corresponding share in the accommodation and food sector was 54%. Size is also related to e-commerce. While two thirds of large companies are engaged in online sales, less than half of micro firms (41%) and of small firms (44%) use e-commerce to sell. As with other ICT technologies, the decision to adopt e-commerce requires large upfront investments. Only when the expected returns to such investments are high enough will firms engage.

Within the subset of firms selling online, the most frequent channel used is the firm's own website, used by 79% of firms in this group, followed by small platforms, large platforms and EDI-type transactions, used by 28%, 26% and 23% of firms selling online, respectively. Multi-channel strategies, defined as using two or more channels, are used by 40% of the firms, and the remaining 60% only use one channel for their e-commerce sales.

In the dataset, firms are more likely to buy online than to sell online. However, firms selling online are more likely to do so cross-border than firms purchasing online. The larger the firm, the more likely it is that it sells or buys online across the border. A firm is more likely to do cross-border e-commerce if it has expanded in the last two years – looking for new markets – but also if it has experienced difficulties with a declining turnover, in which case exports may be seen as a new source of revenues.

The average share of online sales over total turnover (excluding firms with null share) is 25%, but the median is 10%. However, 7% of firms selling online declared their turnover from online sales to be zero. In contrast, 5% of firms (165) are pure players, with their online sales representing 100% of their total turnover. Firms were also asked about the geographic destination of their online sales. While 98% of firms selling online do so domestically, 50% sell their products online across the border to other EU Member States and 26% also sell to third countries. The breakdown of the turnover from e-commerce is as follows: on average, 81% comes from online sales in the domestic market, 14% from sales to other EU Member States and the remaining 5% from third countries. In this last group, the US, Switzerland, Norway and Iceland are the most frequent destinations for online sales made by EU firms. In the case of cross-border e-commerce with other EU Member States, the average firm sells online to 4 different countries, Germany, the UK and Italy being the most frequent destination markets.

On the other hand, the countries with the highest proportion of firms selling online across the border are Luxembourg, Latvia and Portugal while those with the lowest proportion are Romania, Bulgaria and Finland. Table 1 shows the summary statistics of the sample. For more detailed discussions about the data used, see Duch-Brown and Martens (2015).

Table 1: Summary statistics for the variables used in the analysis

Variable	mean	median	Std Dev	min	max	N
VARIABLES OBSERVED FOR ALL FIRMS						
d1 How many employees (full-time equivalent) does your company currently have?	1.67	1	0.94	1	5	7894
Empl_dummy_1: 1 to 9 employees	0.57	1	0.49	0	1	7894
empl_dummy_2: 10 to 49 employees	0.25	0	0.44	0	1	7894
empl_dummy_3: 50 to 249 employees	0.13	0	0.33	0	1	7894
empl_dummy_4: 250 to 499 employees	0.03	0	0.16	0	1	7894
empl_dummy_5: 500 or more employees	0.02	0	0.15	0	1	7894
d5b: What was your company's total turnover in 2014?	2.86	3	1.41	1	6	6907
d6: Since January 2012 has your company's turnover ...?	2.72	3	1.04	1	5	7320
Salestrend_dummy_1: Fallen by more than 25%	0.05	0	0.22	0	1	7320
Salestrend_dummy_2: Fallen by between 5% and 25%	0.16	0	0.37	0	1	7320
Salestrend_dummy_3: Remained approximately the same	0.35	0	0.48	0	1	7320
Salestrend_dummy_4: Risen by between 5% and 25%	0.32	0	0.47	0	1	7320
Salestrend_dummy_5: Risen by more than 25%	0.11	0	0.32	0	1	7320
D2: When was your company established?	1.17	1	0.40	1	3	7880
Age_dummy_1: Before 1 January 2009	0.84	1	0.36	0	1	7894
age_dummy_2: Between 1 Jan 2009 & 1 Jan 2014	0.14	0	0.35	0	1	7894
age_dummy_3: After 1 Jan 2014	0.01	0	0.11	0	1	7894
b2b: D4.1 Does your company sell goods to individual consumers?	0.74	1	0.44	0	1	7894
b2c: D4.2 Does your company sell goods to companies and other organisations?	0.61	1	0.49	0	1	7894
D3: Is your company...?						
Independent	0.83	1	0.37	0	1	7878
Part of a national group	0.08	0	0.27	0	1	7878
Part of an international group	0.09	0	0.29	0	1	7878
A1: does your company sell online?	0.44	0	0.50	0	1	7884
VARIABLES ONLY OBSERVED FOR FIRMS SELLING ONLINE						
d7: Approximately what percentage of the value of your sales in 2014 came from online sales?	2.52	2	1.07	1	5	3251
Economic barriers						
brecon_fin	7.72	8	2.11	3	15	2393
brecon_mkt	11.51	12	2.13	4	20	2393
brecon_knw	5.17	5	1.37	2	10	2393
brecon_rgn	16.44	17	3.56	6	30	2393
brecon_inf	5.61	6	1.32	2	10	2393
Q2a Approximately what percentage of your online sales in 2014 came from the country where your company is located?	4.55	5	1.09	1	6	3494
Q2b Approximately what percentage of your online sales in 2014 came from other EU countries?	2.01	2	1.40	1	6	3494
Q2c Approximately what percentage of your online sales in 2014 came from countries outside the EU?	1.59	1	1.26	1	6	3494

Selling strategy						
own_website	0.79	1	0.41	0	1	3494
small_pltfrm	0.28	0	0.45	0	1	3494
large_pltfrm	0.26	0	0.44	0	1	3494
EDI	0.23	0	0.42	0	1	3494
VARIABLES ONLY OBSERVED FOR FIRMS SELLING ONLINE BUT NOT EXPORTING TO EUROPE						
q5: motives	4.44	5	1.04	1	6	1718
used_to_sell	0.03	0	0.17	0	1	1718
tried_gave_up	0.03	0	0.17	0	1	1718
trying	0.08	0	0.28	0	1	1718
considering	0.24	0	0.43	0	1	1718

The purpose of the questionnaire was to detect those barriers that are holding firms back from engaging in e-commerce transactions with partners located in other EU countries, i.e., barriers to European cross-border e-commerce. The questionnaire suggested 17 different issues that may eventually negatively affect the likelihood that a given firm carries out this kind of electronic operations. We have grouped the different barriers into five categories according to broad economic considerations, as shown in Table 2⁷. Hence, in what follows we will refer to these aggregations.

The share of firms that declared they were constrained by barriers in both financial and regulatory categories are the highest. In addition, these categories mostly affect micro and small firms, and firms in the manufacturing and retail and wholesale sectors. In contrast, infrastructure related barriers – mainly referring to broadband connections – are less prevalent in general, but have a large effect on firms in the accommodation and food industries. The data also shows strong differences in the perception of barriers by country. These may be closely related to the existing differences in regulatory quality and the role of institutions, as well as the degree of competition in the different national markets.

Table 2: aggregating the barriers variables according to economic considerations

Category	Barrier no.	Barrier label
Financial	1	Delivery costs are too high
	4	Payments from other countries are not secured enough
	6	Dealing with foreign taxation is too complicated or too costly
Market	9	Your suppliers restrict or forbid you to sell abroad
	10	Your suppliers do not allow you to use third platform to sell your products and/or services
	11	Your suppliers request you to sell abroad at a different price
	14	Your products and/or services are specific to your local market
Knowledge	3	You don't know the rules which have to be followed
	8	You lack the language skills to deal with foreign countries
Regulation	2	Guarantees and returns are too expensive
	5	Copyright prevents you from selling abroad or is too expensive to sell abroad
	7	Your product labelling has to be adapted
	12	You are concerned your data is not well protected when selling abroad
	13	For reasons of interoperability, you cannot provide your products and/or services
Infrastructure	17	Resolving complaints and disputes cross-border is too expensive
	15	Your company's Internet connection is not fast enough
	16	Clients abroad do not have a fast enough Internet connection

⁷ As an alternative, we also grouped the different barriers from a policy perspective and identified seven categories: i) cultural/linguistic; ii) competition; iii) delivery/payments; iv) contract law; v) redress; vi) other regulatory variables, and, vii) infrastructure/interoperability. The results obtained with the policy groupings were not relevant -maybe due to arbitrary grouping- and we decided to focus on the economic perspective.

Additionally, we have also aggregated the different countries in bigger regions, according to Holzl (2009) and Verspagen (2010). Table 3 contains summary statistics disaggregated by region. In our sample, Eastern European firms have a higher percentage of online sales, and are more likely to engage in B2C commerce. The largest firms are Northern European firms, followed by Southern European, followed by Eastern European firms. Northern European firms have the fastest sales growth trend, followed by Eastern Europeans, and Southern European firms have the slowest sales growth trend. Eastern European firms are slightly older. Northern European firms are more likely to engage in B2B commerce.

Regarding barriers, the differences between North and South are greater than the differences between North and East. Responses for the barrier variables were always, on average, highest for Northern European firms, and lowest for Southern European firms, with Eastern European firms in between.

Table 3: Summary statistics for three European regions

Variable	NORTH			EAST			SOUTH			t-test p-values		
	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	N vs E	N vs S	E vs S
% sales	2.738	1.361	1,508	2.868	1.421	1,242	2.638	1.231	744	0.0147	0.0921	0.0003
Employment	1.781	1.038	3,344	1.543	0.804	2,680	1.660	0.928	1,870	0.0000	0.0000	0.0000
Sales	3.252	1.462	2,915	2.350	1.239	2,327	2.876	1.322	1,665	0.0000	0.0000	0.0000
Sales trend (rev.coded)	2.582	0.961	3,082	2.728	1.070	2,497	2.960	1.072	1,741	0.0000	0.0000	0.0000
Age	1.164	0.410	3,341	1.186	0.411	2,673	1.140	0.370	1,866	0.0370	0.0417	0.0001
B2B	0.763	0.426	3,344	0.707	0.455	2,680	0.730	0.444	1,870	0.0000	0.0102	0.0802
B2C	0.584	0.493	3,344	0.643	0.479	2,680	0.596	0.491	1,870	0.0000	0.4228	0.0012
Economic barriers:												
Financial	7.884	1.895	993	7.832	2.230	901	7.212	2.217	499	0.5851	0.0000	0.0000
Market	11.747	1.904	993	11.506	2.215	901	11.056	2.337	499	0.0110	0.0000	0.0004
Knowledge	5.326	1.213	993	5.178	1.456	901	4.842	1.441	499	0.0155	0.0000	0.0000
Regulation	16.791	3.127	993	16.559	3.767	901	15.537	3.843	499	0.1451	0.0000	0.0000
Infrastructure	5.766	1.147	993	5.761	1.274	901	5.026	1.545	499	0.9286	0.0000	0.0000

Finally, firms that declared they were not involved in selling online across the border were asked if they had ever done so, or if they would like to start. Concretely, the survey distinguishes four groups: those that used to sell online across the border; those that tried and gave up; those that are trying at the moment of the questionnaire; and finally those that are considering it. These groups can also provide relevant information about the role of barriers to cross-border e-commerce.

3. Analysis

We begin by examining the characteristics of firms selling online (Section 3.1) before looking at the determinants of cross-border online sales (Section 3.2). Section 3.3 looks at the factors associated with facing barriers to e-commerce, and Section 3.4 investigates whether these barriers affect firms' online sales performance. Finally, Section 3.5 looks at online sales experiences, which are defined according to the categories 'used to sell', 'tried and gave up', 'trying' and 'considering.'

3.1 Determinants of selling online

We mentioned before that the decision to adopt an e-commerce strategy implies a heavy investment. Although we do not have related information, we observe those firms that declare they are engaged in selling online. Hence, for those firms we assume that the expected returns of engaging in e-commerce are greater than those from opting not to do so. We observe a binary choice, and we explain this choice with a probit regression. The regression results (in Table 4 below) show the determinants of selling online. Firms are more likely to sell online if they are larger – the coefficients increase over the range of size dummies (number of employees) in a monotonic way, such that larger firms are more likely to sell online. Also, holding size constant, firms that are part of a group – especially if it is an international group – are more likely to make online sales. Firms selling to consumers are much more likely to engage in online sales than those selling online to business. Interestingly, age dummies do not appear to be significantly related to online sales. There is significant variation across regions and industry groups. Regarding our information on previous sales trends, firms that were in the central range of low growth were significantly less likely to engage in online sales.

These results are consistent with previous evidence in the literature that has analysed the adoption of ICT. Smaller firms tend to be financially constrained, which makes them less likely to undertake expensive ICT investments. Firms that belong to a group – particularly an international one - are more likely to do so since they are able to spread the costs of new technology adoption among more units (see for instance Battisti et al., 2009).

Similarly, previous literature has found that the effect of the age of the firm is unclear (Ben Aoun-Peltier and Vicente, 2012). This variable can simultaneously capture experience on the one hand, or less flexibility to adapt to new technologies on the other. In the case of e-commerce many recently created firms are born digital, but face intense competition from incumbents in their respective sectors.

In the context of ICT in general, early contributions indicated that geography was not a relevant factor, basically due to the effect of these technologies on the physical dispersion of economic activities (Mitchell, 1995; Cairncross, 2001). However, more recent research has demonstrated that geography is still relevant. Our results point to the existence of marked regional differences. These may be related to differences in broadband expansion and competition issues. These results are similar to those of Vicente and Lopez (2006), who showed that the differences observed in ICT diffusion trajectories in the EU countries were explained by socio-economic factors.

Competition and market structure may also have effect at sector level. New technologies may be better suited to serving core activities in specific sectors. Firms in highly competitive markets tend to adopt new technologies faster. Previous evidence has pointed to sector-specific technological diffusion trajectories. In the case of ICT, the rhythm of adoption tends to be faster in some service activities (such as finance, banking and business services) given that their operations are more dependent on these types of technologies to gain efficiency (van Ark et al., 2003). In summary, regional and

sectoral differences may be the outcome of geographic or technology spillovers that result from the interaction of firms (Haller and Siedschlag, 2011).

Table 4: Determinants of selling online

	(1)	(2)	(3)
VARIABLES	sellonline	sellonline	sellonline
empl_dummy_2	0.124*** (0.0353)	0.117*** (0.0370)	0.153*** (0.0375)
empl_dummy_3	0.495*** (0.0484)	0.477*** (0.0508)	0.567*** (0.0521)
empl_dummy_4	0.511*** (0.0930)	0.567*** (0.0968)	0.656*** (0.0986)
empl_dummy_5	0.788*** (0.108)	0.791*** (0.113)	0.867*** (0.114)
group_dummy_nat	0.126** (0.0560)	0.137** (0.0581)	0.118** (0.0584)
group_dummy_internat	0.191*** (0.0551)	0.215*** (0.0571)	0.215*** (0.0574)
b2c	0.505*** (0.0310)	0.507*** (0.0324)	0.450*** (0.0340)
b2b	-0.0770** (0.0338)	-0.0859** (0.0355)	-0.00880 (0.0370)
age_dummy_2	0.0479 (0.0423)	0.00860 (0.0452)	0.00302 (0.0454)
age_dummy_3	-0.0216 (0.135)	-	-
reg_dum_1	0.181*** (0.0388)	0.165*** (0.0405)	0.191*** (0.0408)
reg_dum_2	0.120*** (0.0373)	0.127*** (0.0392)	0.125*** (0.0394)
salestrend_d_2		-0.0641 (0.0745)	-0.0911 (0.0748)
salestrend_d_3		-0.248*** (0.0700)	-0.265*** (0.0703)
salestrend_d_4		-0.0983 (0.0709)	-0.124* (0.0712)
salestrend_d_5		-0.00175 (0.0798)	-0.0177 (0.0801)
2.naceb			0.337*** (0.0394)
3.naceb			0.448*** (0.0560)
4.naceb			0.241*** (0.0497)
Constant	-0.669*** (0.0448)	-0.526*** (0.0757)	-0.806*** (0.0829)
Observations	7,868	7,303	7,303
Pseudo-R2	0.0414	0.0442	0.0536

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Responses to the question "Does your company sell online and/or use EDI-type transactions (Electronic Data Interchange, e.g.: XML)? Selling by email is not considered online selling." Probit regressions with robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

3.2 Determinants of cross-border online sales

E-commerce has the potential to facilitate trade in several ways. This was recognised early in the literature (Coppel, 2000). For instance, buyers can search for potential sellers, irrespective of their locations, and can easily place orders. Similarly, the costs of distribution and marketing can be lower than for traditional trade. These developments were expected to overcome the traditional geographic market limits. However, the expansion and growth of e-commerce has been contained by national borders and cross-border e-commerce has remained limited. In this section, we analyse the main barriers to cross-border e-commerce in the EU.

Figure 1 below provides some initial information on the regional distribution of online sales across EU and non-EU regions. The vast majority of firms make most of their online sales and purchases in their home countries. A slender majority of firms make 0% of their online sales to other EU countries. Although the median firm in our data makes 0% sales to other EU countries, nevertheless many firms are active in cross-border e-commerce. The figures for the proportion of online sales to non-EU countries show that only about a quarter of firms engage in cross-border online sales with non-EU partners. Hence, in line with the 'gravity model' of trade, EU firms are more likely to engage in cross-border online trade with EU countries than they are with non-EU countries.

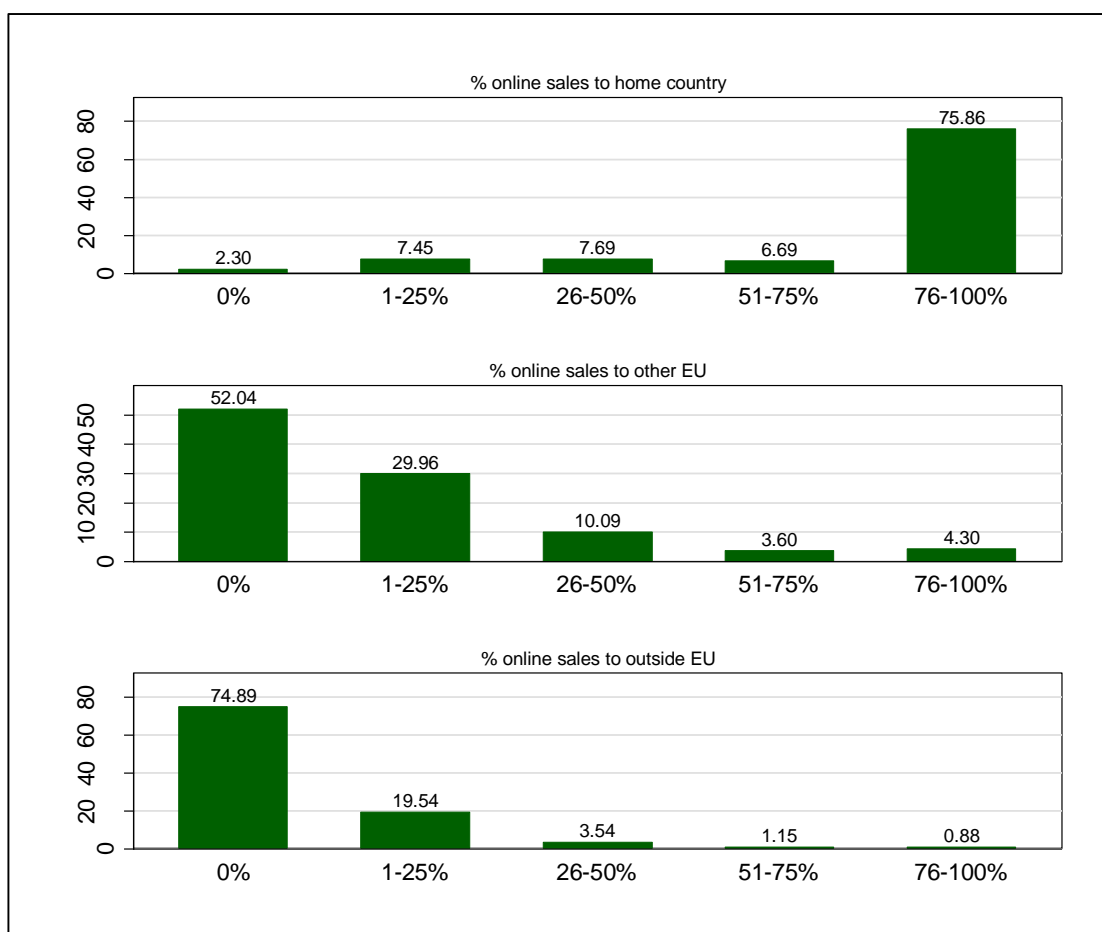


Figure 1: Survey responses to questions on online sales.

Note: Responses to the question: Approximately what percentage of your online sales in 2014 came from a) the country where your company is located?; b) other EU countries?; c) countries outside the EU? Note that non-responses are not reported here.

For those firms engaged in online exports to other EU countries, the additional costs of selling online to countries outside the EU – particularly if these are countries the EU has strong commercial relations with – should be insignificant. Hence, the decision to export online to these two different geographic areas should be somewhat correlated.

Table 5 below presents some bivariate probit regression results, using two of the variables from Figure 2. The first dependent variable refers to “% online sales from other EU”, with categories 0% or 1+% (i.e. four categories have been grouped together to form a new category 1+%). The second dependent variable refers to “% online sales to outside EU”, also with categories 0% or 1+% (i.e. four categories have been grouped together to form a new category 1+%). The two specifications shown in the table differ by the introduction of barriers to online trade in the second one. Estimating the two equations in the same bivariate probit model is warranted, because the error terms are significantly correlated. The positive sign of the correlation term indicates that these two decisions are reinforced; hence, they are complementary. Firms already engaged in online exports to one of these areas will find it easier to also export to the other area.

This complementarity is explained by several factors. The results show that firms belonging to international groups are more likely to make online sales abroad (EU or outside EU). This is consistent with the nature of subsidiaries of international groups, which are more likely to carry out international operations. However, from the data we are not able to distinguish if the online trade reported here means sales to subsidiaries of the same group located in different countries, including headquarters, or simply exports to final consumers or independent distributors.

Firms selling goods to consumers (B2C) are less likely to make online sales abroad (EU or outside EU). This result supports several explanations. First, as with traditional trade, even if consumers can order online, goods have to be transported. In some cases, delivery costs can be high or logistics can be complicated – for instance in bringing goods to remote locations – and thus making it hard for firms to be willing to export. Second, in other cases suppliers may restrict distributors from selling in different countries by means of exclusive territory contracts or selective distribution agreements. Similarly, manufacturers could ban online sales for reputation issues. This is evident in the specification including the barriers variables. Firms that declare that they receive to requests from suppliers to charge different prices in different markets are less inclined to online exports, and particularly to other EU countries.

Depending on sector characteristics, firms differ in the rate of adoption of e-commerce, mainly due to the value attached to its use for commercialisation purposes. Table 5 shows that there are relevant sectoral differences. Firms in the accommodation and food industry are more likely than manufacturing firms – used as a benchmark – to engage in online exports. Retailers and wholesalers, however, are less likely to export online, due to the restrictions imposed by their suppliers.

Regional differences also matter. Taking as a reference firms located in southern Europe, firms in the eastern part of Europe are less likely to engage in online exports, while no difference is observed with respect to firms from the Northern areas. These differences might be due to the late incorporation of these countries to the European integration process as well as differences in broadband expansion on those countries.

In general, responses to questions about barriers can be interpreted in terms of revealed barriers or deterring barriers (D'Este et al., 2012). In our context, revealed barriers hinder firms from when they start to engage in cross-border e-commerce, while deterring barriers totally prevent firms from even starting to engage in cross-border e-commerce. An example of a revealed barrier would be wind resistance, that slows down fast cars, and which would become more important at higher speeds (i.e. there would be

a positive association between the barrier and performance). In contrast, an example of a deterring barrier would be a dead car battery, which would totally prevent a car from starting (and there would be a negative association between the barrier and performance).

Firms reporting that they don't know the rules that have to be followed when selling online across the border are more likely to be making online sales abroad (EU or outside EU). This result is mostly driven by firms that are in the lower part of the learning curve and are discovering the different procedures and regulations as they engage in online exports. Hence, this barrier is revealed by exporting. On the contrary, firms that declare that their broadband connection is rather slow are less likely to export online (EU or outside EU).

Table 5: Bivariate probit regression results: determinants of non-zero online sales (1=yes, 0=no) to EU & non-EU countries

	(1)	(2)	(3)	(4)
	Online sales to EU	Online sales outside EU	Online sales to EU	Online sales outside EU
empl_dummy_2	0.0211 (0.0590)	-0.00596 (0.0633)	0.0693 (0.0750)	-0.0156 (0.0728)
empl_dummy_3	-0.0495 (0.0770)	-0.0320 (0.0814)	0.105 (0.107)	0.0230 (0.0980)
empl_dummy_4	0.154 (0.140)	-0.00992 (0.148)	0.512** (0.216)	0.00180 (0.182)
empl_dummy_5	0.260* (0.142)	0.223 (0.140)	0.183 (0.183)	0.168 (0.161)
group_dummy_nat	-0.115 (0.0857)	-0.0591 (0.0920)	0.0374 (0.121)	0.0733 (0.109)
group_dummy_internat	-0.0261 (0.0825)	0.219** (0.0862)	0.226* (0.118)	0.380*** (0.105)
b2c	-0.213*** (0.0548)	-0.141** (0.0597)	-0.178** (0.0750)	-0.114 (0.0703)
b2b	-0.0176 (0.0583)	-0.00202 (0.0643)	-0.00561 (0.0774)	0.0202 (0.0760)
salestrend_d_2 -5 to -25%	0.132 (0.115)	-0.106 (0.130)	0.223 (0.154)	-0.0481 (0.158)
salestrend_d_3: About same	0.0908 (0.108)	-0.0253 (0.123)	0.0952 (0.145)	0.0243 (0.150)
salestrend_d_4: 5 to 25%	0.395*** (0.109)	0.213* (0.122)	0.344** (0.145)	0.225 (0.149)
salestrend_d_5: >25% sales gr	0.364*** (0.122)	0.249* (0.136)	0.202 (0.158)	0.184 (0.163)
own_website	0.223*** (0.0613)	0.168** (0.0672)	0.151* (0.0810)	0.0693 (0.0794)
small_pltfrm	0.227*** (0.0537)	0.149*** (0.0564)	0.169** (0.0708)	0.117* (0.0655)
large_pltfrm	0.311*** (0.0545)	0.211*** (0.0575)	0.243*** (0.0724)	0.109 (0.0675)
edi	0.0801 (0.0586)	0.0203 (0.0624)	0.0376 (0.0781)	-0.0284 (0.0719)
Industry: 2.naceb	-0.336*** (0.0618)	-0.313*** (0.0684)	-0.0988 (0.0793)	-0.181** (0.0815)
Industry: 3.naceb	0.619*** (0.0892)	0.666*** (0.0894)	0.764*** (0.134)	0.694*** (0.110)
Industry: 4.naceb	-0.0535	0.146*	-0.000773	0.224**

	(0.0814)	(0.0863)	(0.103)	(0.101)
age_dummy_2	-0.00933	-0.0657	-0.0230	-0.177*
	(0.0722)	(0.0820)	(0.0899)	(0.0925)
reg_dum_1	0.0311	-0.239***	-0.187**	-0.345***
	(0.0660)	(0.0713)	(0.0892)	(0.0844)
reg_dum_2	0.0277	-0.113*	0.0514	-0.104
	(0.0628)	(0.0671)	(0.0895)	(0.0820)
barr_1 - delivery			0.0334	-0.0110
			(0.0395)	(0.0397)
barr_2 - guarantees			0.0154	0.0631
			(0.0426)	(0.0427)
barr_3 - rules			0.149***	0.0962**
			(0.0468)	(0.0450)
barr_4 - payments			-0.0664	-0.116**
			(0.0470)	(0.0452)
barr_5 - copyright			-0.0263	0.0164
			(0.0450)	(0.0442)
barr_6 - taxation			-0.0220	-0.0454
			(0.0391)	(0.0374)
barr_7 - labelling			0.0684	0.0613
			(0.0464)	(0.0462)
barr_8 - language			0.0275	0.0724
			(0.0470)	(0.0458)
barr_9 - suppliers forbid			0.109**	0.0367
			(0.0535)	(0.0514)
barr_10 - suppliers restrict			0.0239	-0.0219
			(0.0488)	(0.0466)
barr_11 - suppliers dif price			-0.128***	-0.101**
			(0.0496)	(0.0475)
barr_12 - data			-0.0590	-0.0289
			(0.0479)	(0.0469)
barr_13 - interoperability			0.0544	-0.0645
			(0.0413)	(0.0402)
barr_14 - product specificity			0.0897*	0.0420
			(0.0465)	(0.0461)
barr_15 - own connection			-0.117**	-0.0859*
			(0.0504)	(0.0455)
barr_16 - client's connection			0.00916	0.0228
			(0.0440)	(0.0421)
barr_17 - disputes			0.0842**	0.0442
			(0.0357)	(0.0358)
Constant	-0.395***	-0.777***	-0.470*	-0.412
	(0.136)	(0.149)	(0.273)	(0.259)
rho	0.7615***	0.7615***	0.6907***	0.6907***
SE for rho	0.0186	0.0186	0.0288	0.0288
Observations	3,072	3,072	2,096	2,096
Log Pseudolikelihood	-3186.8747	-3186.8747	-2185.416	-2185.416

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

3.3 Factors associated with facing barriers

The last section looked at the determinants of online exports, to the EU and to the Rest of the World. There, we introduced the barrier variables to analyse their influence on the decision to export online. In this section, we look more specifically at the factors that are more frequently associated with the fact that firms face barriers to online trade. In this case, the barriers are the dependent variables. For this purpose, we rely on the economic aggregations discussed in Section 2.

Estimation results, using OLS, are presented in Table 6 where columns 1-5 refer to the set of firms that are selling online across the border and columns 6-10 show results for firms of different online exporting status. The dataset includes additional information on the situation of the firm regarding cross-border e-commerce. A firm declaring that is not exporting online was asked if it "used to sell" across the border, or "tried and gave up". Similarly, firms were asked if they were "trying" or "considering" exporting online. Figure 3 shows this information by plotting the frequencies of firms in these categories. The responses of these firms with respect to barriers will be valuable in terms of understanding if barriers might be hindering firms from succeeding with online sales.

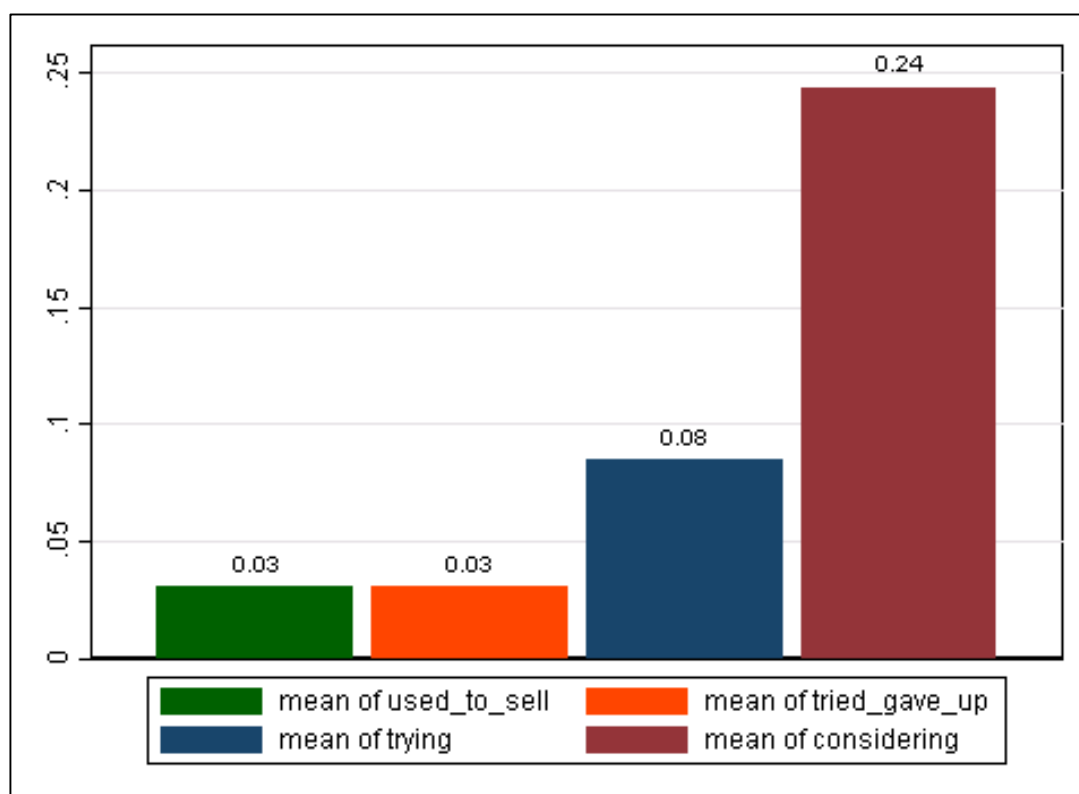


Figure 2: frequencies of firms in the categories of 'used to sell', 'trying', 'tried and gave up', and 'considering'.

Figure 2 indicates that the proportion of firms that ceased to export online or that tried and gave up eventually is rather low, 3% in each case. However, 8% of firms declared they were trying to sell online across the border and an additional 24% indicated they were considering the possibility. In order to understand how these different statuses can be related to the identified barriers, the next set of regression results in Table 6 focuses on the factors associated with facing particular economic barriers.

Table 6 shows that, interestingly, there are no strong results relating to firm size. Overall, it is perhaps encouraging that small and young firms are not particularly more vulnerable to economic (or policy) barriers. Although seemingly counter-intuitive results, in the context of e-commerce adoption and intensity of use for firms in Luxembourg, Ben Aoun-Peltier and Vicente (2012) also find that size is not a relevant factor in e-commerce. Similarly, the age of the firm is not a relevant factor associated with facing barriers to online exports.

Firms in groups can access resources from within their group that might help reduce their exposure to some barriers. However, the results for group membership are not strong, and moreover they are surprising, in that firms in international groups are more likely to face knowledge barriers and infrastructural barriers. An explanation could be that firms in international groups are more ambitious and attempt more knowledge-intensive and infrastructure-intensive business projects.

Exporting firms (whether they export to the EU or the rest of the world) are more likely to face knowledge barriers. These barriers are associated with the procedures to be followed in order to sell abroad or to the language skills required to interact with foreign customers. This result is consistent with the learning-by-exporting hypothesis, by means of which firms improve their performance after entering export markets (de Loecker, 2013). In this case, firms that enter foreign markets by means of online sales discover the rules and procedures that have to be fulfilled and other relevant information to be successful in these new markets. Hence, these knowledge barriers are 'revealed barriers' that only arise for firms that choose to face up to the challenges of exporting.

Sales trends are significantly related to vulnerability to market barriers. Firms enjoying rapid sales growth might struggle to enter new markets. These barriers are related to restrictions imposed by suppliers in many dimensions – bans to selling in different countries due to exclusive distribution agreements or requests to charge different prices in different countries – or by the specificity of the firms' products to local tastes.

Channels used by firms selling online are associated with sensitivity to barriers. In particular, use of "Your own website or apps" is positively related to financial, market, and infrastructure barriers, in some regressions. Hence, the use of a firm's own website or apps is associated with a higher vulnerability to barriers. Using a large platform is associated with less vulnerability to (financial and market) barriers when compared to a firm's own website.

With respect to the different online export statuses, the estimation results present weak evidence that firms that 'tried and gave up' are relatively less likely to face barriers relating to finance, market, and knowledge. In contrast, firms in the omitted baseline category 'used to sell' are relatively more likely to face barriers relating to finance, market, and knowledge. Better understanding the difficulties faced by these firms that 'used to sell' could shed light on how to prevent firms from abandoning their cross-border online sales. Hence, there is perhaps a role for encouraging firms that are trying to sell more online by setting up policies to remove barriers relating to knowledge (and perhaps market).

As in previous results, sectors and regions matter, in the sense that some sectors and regions are less sensitive to certain barriers. Again, the explanation lies in sectoral and national differences in terms of technological and/or geographical spillovers that have heterogeneous effects on the perception of barriers among the surveyed firms.

Another observation is that the R2 is rather low. We have not found the main determinants of facing barriers. There is considerable heterogeneity across firms

regarding whether they face barriers. Indeed, previous work has found that firms' self-reported perceptions of barriers are noisy indicators (Holzl and Janger, 2013).

Table 6: OLS regressions for the factors associated with facing particular economic barriers.

The last 5 columns are only estimated for firms selling cross-border online. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	brecon_fin	brecon_mkt	brecon_knw	brecon_rgn	brecon_inf	brecon_fin	brecon_mkt	brecon_knw	brecon_rgn	brecon_inf
empl_dummy_2	-0.0216 (0.111)	-0.112 (0.115)	0.0469 (0.0747)	-0.180 (0.190)	-0.0358 (0.0695)	0.00462 (0.225)	0.0537 (0.211)	0.0688 (0.145)	0.00383 (0.376)	0.0105 (0.132)
empl_dummy_3	-0.147 (0.143)	-0.241 (0.147)	0.0641 (0.0957)	-0.327 (0.244)	0.0993 (0.0890)	-0.472 (0.312)	-0.000480 (0.293)	0.0415 (0.202)	-0.460 (0.522)	0.0346 (0.184)
empl_dummy_4	-0.151 (0.264)	0.205 (0.271)	0.247 (0.177)	-0.245 (0.450)	0.117 (0.164)	-0.708 (0.757)	0.101 (0.711)	0.139 (0.489)	-0.965 (1.267)	0.362 (0.446)
empl_dummy_5	0.0598 (0.256)	0.280 (0.264)	0.131 (0.172)	-0.336 (0.437)	0.145 (0.160)	-0.375 (0.570)	-0.433 (0.535)	-0.131 (0.368)	-0.368 (0.954)	-0.162 (0.336)
group_dummy_nat	-0.0545 (0.167)	-0.181 (0.172)	0.104 (0.112)	-0.125 (0.285)	-0.121 (0.104)	0.243 (0.391)	0.339 (0.367)	0.415 (0.253)	0.298 (0.654)	0.225 (0.230)
group_dummy_int ernat	0.271* (0.162)	-0.0566 (0.166)	0.322*** (0.108)	0.423 (0.276)	0.155 (0.101)	0.363 (0.397)	-0.376 (0.373)	0.470* (0.256)	-0.0230 (0.664)	0.392* (0.234)
exports_eu	0.00111 (0.00206)	0.00133 (0.00212)	0.00369*** (0.00138)	0.00100 (0.00351)	0.00368*** (0.00128)	0.00117 (0.00645)	-9.62e-05 (0.00606)	0.00920** (0.00417)	0.00807 (0.0108)	-0.000360 (0.00380)
exports_row	-0.00230 (0.00327)	0.00197 (0.00337)	0.00456** (0.00219)	0.000892 (0.00558)	-0.00105 (0.00204)	0.00722 (0.00952)	0.00116 (0.00895)	0.00658 (0.00615)	0.00544 (0.0159)	-0.00202 (0.00561)
b2c	-0.445*** (0.108)	-0.332*** (0.111)	-0.119 (0.0726)	-0.741*** (0.185)	-0.0732 (0.0675)	-0.230 (0.240)	-0.0786 (0.225)	-0.0127 (0.155)	-0.268 (0.402)	0.0179 (0.141)
b2b	-0.0449 (0.116)	0.0724 (0.120)	0.00130 (0.0779)	-0.0582 (0.198)	0.0311 (0.0724)	-0.0557 (0.233)	0.122 (0.219)	0.123 (0.150)	-0.0406 (0.390)	0.162 (0.137)
salestrend_d_2	-0.0661 (0.233)	0.351 (0.239)	-0.222 (0.156)	-0.435 (0.397)	-0.135 (0.145)	0.104 (0.434)	0.398 (0.408)	-0.0234 (0.281)	-0.420 (0.727)	-0.0151 (0.256)
salestrend_d_3	-0.0992 (0.222)	0.439* (0.229)	-0.107 (0.149)	-0.176 (0.379)	-0.0594 (0.138)	0.158 (0.410)	0.389 (0.385)	0.0883 (0.265)	-0.0152 (0.686)	0.0338 (0.241)
salestrend_d_4	0.0165 (0.221)	0.439* (0.228)	-0.0889 (0.148)	-0.199 (0.378)	-0.123 (0.138)	0.0466 (0.417)	0.231 (0.392)	0.0285 (0.269)	-0.356 (0.698)	-0.128 (0.246)
salestrend_d_5	-0.0625 (0.243)	0.507** (0.250)	-0.0159 (0.163)	-0.241 (0.414)	0.0104 (0.151)	0.141 (0.442)	0.439 (0.415)	0.135 (0.286)	-0.186 (0.740)	0.156 (0.260)
own_website	-0.0926 (0.117)	0.127 (0.121)	-0.0602 (0.0785)	0.00200 (0.200)	0.0370 (0.0730)	0.421* (0.239)	0.574** (0.225)	0.237 (0.155)	0.435 (0.401)	0.330** (0.141)
small_pltfrm	-0.123 (0.0997)	-0.159 (0.103)	-0.0450 (0.0669)	-0.0620 (0.170)	-0.0775 (0.0622)	-0.0278 (0.215)	-0.0180 (0.202)	0.0430 (0.139)	0.121 (0.360)	-0.190 (0.127)

large_pltfrm	-0.329*** (0.102)	-0.290*** (0.105)	-0.0947 (0.0684)	-0.275 (0.174)	-0.0221 (0.0636)	-0.302 (0.229)	-0.170 (0.215)	-0.192 (0.148)	-0.193 (0.383)	0.00860 (0.135)
edi	-0.150 (0.112)	-0.260** (0.115)	-0.117 (0.0748)	-0.597*** (0.190)	-0.101 (0.0696)	-0.110 (0.238)	-0.126 (0.224)	-0.0404 (0.154)	-0.651 (0.399)	-0.185 (0.140)
used_to_sell (omitted)						-	-	-	-	-
tried_gave_up						-0.809* (0.466)	-0.864** (0.438)	-0.509* (0.301)	-1.125 (0.781)	-0.275 (0.275)
trying						-0.224 (0.389)	-0.237 (0.366)	-0.257 (0.252)	0.134 (0.652)	-0.208 (0.229)
considering						-0.356 (0.356)	-0.574* (0.335)	-0.603*** (0.230)	-0.458 (0.597)	-0.221 (0.210)
_Inaceb_2	0.0366 (0.120)	-0.410*** (0.123)	0.107 (0.0802)	-0.198 (0.204)	0.0717 (0.0747)	-0.223 (0.227)	-0.908*** (0.213)	0.246* (0.146)	-0.757** (0.379)	-0.0880 (0.133)
_Inaceb_3	1.247*** (0.156)	0.345** (0.161)	0.130 (0.105)	1.687*** (0.267)	-0.177* (0.0974)	0.445 (0.484)	-0.0261 (0.454)	-0.0421 (0.313)	0.965 (0.810)	-0.354 (0.285)
_Inaceb_4	0.0844 (0.155)	-0.439*** (0.160)	-0.0961 (0.104)	0.120 (0.265)	0.00281 (0.0967)	-0.266 (0.306)	-0.813*** (0.288)	-0.134 (0.198)	-0.332 (0.513)	-0.128 (0.180)
age_dummy_2	-0.107 (0.138)	-0.153 (0.142)	-0.148 (0.0926)	-0.0654 (0.236)	-0.106 (0.0862)	-0.252 (0.260)	-0.130 (0.244)	-0.0469 (0.168)	-0.151 (0.435)	-0.196 (0.153)
age_dummy_3	-	-	-	-	-	-	-	-	-	-
reg_dum_1	0.813*** (0.125)	0.488*** (0.129)	0.344*** (0.0838)	1.312*** (0.213)	0.689*** (0.0780)	1.068*** (0.258)	0.817*** (0.242)	0.258 (0.167)	1.713*** (0.432)	0.662*** (0.152)
reg_dum_2	0.782*** (0.122)	0.633*** (0.125)	0.407*** (0.0816)	1.431*** (0.208)	0.664*** (0.0759)	0.942*** (0.274)	0.672*** (0.258)	0.192 (0.177)	1.503*** (0.459)	0.576*** (0.162)
o.reg_dum_3	-	-	-	-	-	-	-	-	-	-
Constant	7.453*** (0.275)	11.11*** (0.283)	4.958*** (0.184)	16.14*** (0.469)	5.258*** (0.172)	6.865*** (0.614)	10.84*** (0.577)	4.567*** (0.397)	15.22*** (1.029)	5.062*** (0.362)
Observations	2,099	2,099	2,099	2,099	2,099	585	585	585	585	585
R-squared	0.081	0.051	0.045	0.073	0.075	0.071	0.097	0.067	0.072	0.086

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

3.4 Do barriers affect performance?

So far, we have analysed how barriers affect adoption and the factors associated with facing barriers. We now focus on the effect of barriers on performance. We have seen that e-commerce adoption differs significantly by sector and country, and previous research has also shown that the rate of adoption of e-commerce does not match the increase in the value of online sales (Almansour et al., 2013). This would point towards a small number of firms carrying out a major share of online transactions, which should also have an impact on their performance.

Table 7 investigates the effect of barriers on performance, where performance is measured in terms of the proportion of sales coming from online sources. First of all, some barriers appear to be relevant in explaining performance. Knowledge barriers are positively associated with online sales performance, indicating that some knowledge-intensive firms that are enjoying a successful online sales performance are nonetheless facing difficulties in obtaining the necessary knowledge they need for their business. On the other hand, regulatory barriers are negatively associated with online sales. This could indicate that policy could help boost online sales by streamlining existing regulations. In our context, regulatory barriers refer to rules regarding guarantees and returns, copyright, product labelling, data protection, interoperability and complaints and disputes. In all these cases, the scenario in Europe is fragmented, and many laws and procedures have been developed and enforced at national level. This regulatory fragmentation is having an effect on both the adoption of e-commerce and on the performance of those companies that are able to circumvent the barriers at the adoption stage. Finally, financial barriers do not appear to be a significant obstacle to online sales. Firms facing financial barriers can nonetheless enjoy an unimpeded online sales performance.

In relation to size, our results indicate that the omitted baseline category (up to 9 employees) performs well compared to other size categories in terms of the percentage of sales coming from online sales. Hence, large firms seem to have a smaller share of their sales from online sources. This is an interesting complement to what was observed in Table 4, where large firms were more likely to engage in online sales – although they are more likely to sell online, their intensity of online sales appears to be lower. Inconclusive results with respect to the relationship between size and performance/intensity are frequently found in the literature (see Ben Aoun–Peltier and Vicente, 2012 for a review).

It is also worth highlighting the fact that firms belonging to an international group are more likely to show a higher proportion of online sales. Similarly, firms exporting to the rest of the world are associated with higher performance. Finally, firms who sell through platforms (especially large platforms) tend to have a higher share of online sales. On the other hand, business-to-business firms tend to have *ceteris paribus* lower online sales.

Again, sector and region dummies picture a situation of uneven impacts across firms, industries and regions. However, in this case, the different statuses regarding cross-border e-commerce do not have an impact on performance.

Table 7: regressions for the effects of barriers on performance

Dependent variable: "Approximately what percentage of the value of your sales in 2014 came from online sales?"

	(1)	(2)	(3)	(4)
Dep. Var. % sales from online	Ordered probit	Ordered probit	OLS	OLS
Barriers:				
Financial	0.00267 (0.0199)	0.00461 (0.0374)	0.0147 (0.0161)	0.0272 (0.0234)
Market	-0.000687 (0.0175)	0.0165 (0.0354)	0.00228 (0.0143)	-0.000936 (0.0224)
Knowledge	0.0371 (0.0258)	0.122** (0.0508)	0.0287 (0.0212)	0.0742** (0.0320)
Regulation	-0.00478 (0.0126)	-0.0491** (0.0233)	-0.00898 (0.0102)	-0.0383*** (0.0147)
Infrastructure	-0.0371 (0.0248)	0.0131 (0.0506)	-0.0275 (0.0204)	0.00957 (0.0323)
Status:				
Used to sell		0.0477 (0.214)		-0.119 (0.183)
Tried and gave up		0.129 (0.216)		
Trying		0.0191 (0.138)		-0.0908 (0.148)
Considering		-		-0.138 (0.137)
Size (employees)				
10-49	-0.380*** (0.0663)	-0.422*** (0.142)	-0.293*** (0.0538)	-0.261*** (0.0874)
50-249	-0.345*** (0.0847)	-0.266 (0.197)	-0.275*** (0.0688)	-0.204* (0.123)
250-499	-0.491*** (0.159)	-0.519 (0.491)	-0.379*** (0.126)	-0.324 (0.288)
500 and more	-0.331** (0.158)	0.270 (0.348)	-0.307** (0.127)	0.188 (0.221)
Group				
National	-0.0427 (0.0995)	-0.102 (0.241)	-0.0648 (0.0809)	-0.132 (0.153)
International	0.172* (0.0964)	0.00531 (0.241)	0.156** (0.0793)	-0.00982 (0.152)
Exports				
EU	-0.00339*** (0.00121)	-0.00362 (0.00390)	-0.00242** (0.000994)	-0.00140 (0.00248)
Rest of the world	0.00348* (0.00189)	-0.00522 (0.00559)	0.00356** (0.00157)	-0.00320 (0.00362)
Target				
B2C	-0.0752 (0.0638)	-0.0515 (0.148)	-0.116** (0.0524)	-0.0736 (0.0923)
B2B	-0.130* (0.0680)	-0.249* (0.140)	-0.102* (0.0561)	-0.110 (0.0913)
Sales trend				
Fall by 5%-25%	0.0387 (0.138)	0.0305 (0.271)	0.0470 (0.112)	0.0617 (0.167)
Remained the same	0.134 (0.132)	0.159 (0.253)	0.0959 (0.107)	0.123 (0.158)
Risen by 5%-25%	0.146 (0.131)	0.0482 (0.258)	0.0975 (0.106)	0.0659 (0.160)
Risen > 25%	0.377*** (0.143)	0.159 (0.274)	0.303*** (0.116)	0.0909 (0.171)

Channel				
Own website	0.134*	0.120	0.0498	
	(0.0689)	(0.145)	(0.0569)	
Small platform	0.0393	0.285**	0.0127	
	(0.0583)	(0.130)	(0.0480)	
Large platform	0.278***	0.285**	0.195***	
	(0.0598)	(0.139)	(0.0493)	
EDI	0.216***	-0.0738	0.182***	
	(0.0658)	(0.147)	(0.0543)	
Sector				
Wholesale/retail	0.0103	-0.0767	0.0159	-0.0435
	(0.0719)	(0.143)	(0.0581)	(0.0895)
Accommodation/food	0.487***	0.434	0.372***	0.313
	(0.0943)	(0.318)	(0.0775)	(0.204)
Information/communication	-0.0217	0.140	-0.0141	0.101
	(0.0925)	(0.189)	(0.0751)	(0.120)
Age				
2009 - 2014	0.142*	0.248	0.169**	0.205**
	(0.0787)	(0.152)	(0.0660)	(0.0993)
Region				
East	0.195***	0.392**		0.233**
	(0.0753)	(0.166)		(0.102)
North	0.107	0.141	-0.0677	0.105
	(0.0730)	(0.177)	(0.0503)	(0.109)
South			-0.160***	
			(0.0616)	
Constant cut1	-1.629***	-1.529***		
	(0.231)	(0.469)		
Constant cut2	0.680***	1.258***		
	(0.228)	(0.468)		
Constant cut3	1.294***	1.799***		
	(0.229)	(0.471)		
Constant cut4	1.699***	2.049***		
	(0.230)	(0.473)		
Constant			2.548***	2.387***
			(0.190)	(0.301)
Observations	1,967	557	1,967	557
(Pseudo-) R-squared	0.0454	0.0614	0.092	0.086

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 8: Probit and OLS regressions.

Determinants of used to sell (52 obs), tried & gave up (52 obs), trying (146 obs) and considering (419 obs).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	used_to_sell	tried_gave_up	trying	considering	used_to_sell	tried_gave_up	trying	considering
Size (employees)								
10-49	-0.525*** (0.195)	-0.0169 (0.166)	-0.0348 (0.113)	0.0840 (0.0921)	-0.0289*** (0.00937)	-0.00122 (0.0123)	-0.00259 (0.0184)	0.0277 (0.0278)
50-249	-0.956*** (0.352)	-0.631** (0.276)	-0.212 (0.157)	0.0699 (0.121)	-0.0365*** (0.00938)	-0.0270** (0.0109)	-0.0291 (0.0213)	0.0267 (0.0346)
250-499			0.122 (0.241)	-0.751** (0.327)	-0.0443*** (0.00921)	-0.0356*** (0.0102)	0.0267 (0.0480)	-0.150*** (0.0449)
500 and more	0.00543 (0.500)		0.110 (0.294)	0.461** (0.229)	-0.0133 (0.0259)	-0.0399*** (0.0115)	0.0151 (0.0452)	0.127* (0.0715)
Group								
National	-0.0998 (0.323)	0.0503 (0.269)	-0.149 (0.179)	-0.329** (0.143)	-0.00725 (0.0125)	0.00253 (0.0143)	-0.0157 (0.0242)	-0.0831** (0.0333)
International		0.248 (0.262)	-0.347* (0.188)	-0.352** (0.143)	-0.0193*** (0.00674)	0.0142 (0.0156)	-0.0443** (0.0214)	-0.0888** (0.0352)
Exports								
EU	0.00700 (0.00568)	-0.000577 (0.00524)	0.00339 (0.00294)	0.00586** (0.00266)	0.000119 (0.000330)	-2.71e-05 (0.000294)	0.000507 (0.000566)	0.00164* (0.000887)
Rest of the world	-0.214 (0.143)	0.00480 (0.00538)	0.0117*** (0.00422)	-0.00379 (0.00410)	-0.000697*** (0.000161)	0.000334 (0.000511)	0.00265** (0.00129)	-0.00101 (0.00102)
Target								
B2C	0.0274 (0.183)	0.0317 (0.152)	-0.114 (0.114)	0.200** (0.0913)	0.00216 (0.00997)	0.00268 (0.00924)	-0.0148 (0.0176)	0.0592** (0.0250)
B2B	-0.0849 (0.162)	0.0146 (0.169)	0.150 (0.120)	0.0517 (0.0950)	-0.00862 (0.0119)	0.00226 (0.0115)	0.0188 (0.0166)	0.0174 (0.0269)
Sales trend								
Fall by 5%-25%	-0.289 (0.265)	-0.117 (0.267)	0.275 (0.229)	0.237 (0.179)	-0.0298 (0.0260)	-0.0121 (0.0251)	0.0392 (0.0300)	0.0665 (0.0456)
Remained the same	-0.166 (0.237)	-0.0608 (0.249)	0.178 (0.221)	0.246 (0.170)	-0.0250 (0.0259)	-0.00955 (0.0242)	0.0276 (0.0275)	0.0676 (0.0435)
Risen by 5%-25%	-0.0764 (0.248)	-0.292 (0.272)	0.322 (0.221)	0.326* (0.173)	-0.0209 (0.0261)	-0.0201 (0.0241)	0.0461 (0.0287)	0.0935** (0.0452)
Risen > 25%	-0.254 (0.299)	0.00765 (0.295)	0.465* (0.241)	0.530*** (0.190)	-0.0287 (0.0275)	-0.00370 (0.0269)	0.0698** (0.0348)	0.162*** (0.0547)
Channel								
Own website	0.0628 (0.179)	0.0771 (0.172)	0.179 (0.127)	0.0908 (0.0950)	0.00307 (0.00989)	0.00444 (0.0107)	0.0243 (0.0181)	0.0268 (0.0270)

Small platform	-0.00245 (0.167)	-0.0536 (0.161)	0.102 (0.111)	0.0999 (0.0872)	0.00143 (0.00979)	-0.00420 (0.00960)	0.0147 (0.0181)	0.0299 (0.0253)
Large platform	-0.109 (0.171)	-0.0541 (0.176)	0.218* (0.112)	-0.0217 (0.0902)	-0.00440 (0.00971)	-0.00317 (0.0103)	0.0338* (0.0190)	-0.00439 (0.0258)
EDI	0.283* (0.163)	-0.0914 (0.181)	-0.194 (0.126)	0.146 (0.0937)	0.0131 (0.0107)	-0.00488 (0.00961)	-0.0271 (0.0178)	0.0390 (0.0270)
Sector								
Wholesale/retail	-0.237 (0.173)	-0.0454 (0.170)	-0.212* (0.121)	-0.189** (0.0948)	-0.0122 (0.0122)	-0.00177 (0.0116)	-0.0327 (0.0206)	-0.0548* (0.0292)
Accommodation/food			-0.102 (0.208)	-0.576*** (0.179)	-0.0368*** (0.0115)	-0.0293** (0.0117)	-0.0199 (0.0338)	-0.151*** (0.0436)
Information/communic.	-0.154 (0.224)	0.141 (0.227)	-0.0635 (0.161)	0.00576 (0.129)	-0.00447 (0.0175)	0.0107 (0.0181)	-0.00972 (0.0285)	0.00563 (0.0411)
Age								
2009 - 2013	-0.180 (0.225)	-0.277 (0.236)	-0.375** (0.163)	0.365*** (0.110)	-0.0126 (0.0135)	-0.0165 (0.0128)	-0.0482** (0.0200)	0.118*** (0.0382)
2014 and after	-	-	-	-	-	-	-	-
Region								
East	-0.0301 (0.189)	-0.178 (0.167)	-0.0246 (0.129)	0.534*** (0.106)	0.00245 (0.0122)	-0.0121 (0.0142)	-0.00386 (0.0216)	0.159*** (0.0295)
North	-0.0765 (0.192)	-0.429** (0.182)	-0.162 (0.126)	0.0893 (0.105)	0.000326 (0.0110)	-0.0252** (0.0126)	-0.0255 (0.0196)	0.0182 (0.0260)
South	-	-	-	-	-	-	-	-
Constant	-1.272*** (0.321)	-1.492*** (0.340)	-1.582*** (0.274)	-1.468*** (0.227)	0.0807*** (0.0297)	0.0598** (0.0288)	0.0618 (0.0380)	0.0276 (0.0594)
Observations	1,227	1,335	1,531	1,531	1,531	1,531	1,531	1,531
(Pseudo-) R-squared	0.0762	0.0484	0.0458	0.0768	0.020	0.015	0.028	0.082

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

3.5 Determinants of online exports experiences

As a final exercise, we analyse the main factors associated with the different online export statuses already described in Section 2. Table 8 investigates the determinants of being in the following categories: 'used to sell' (52 obs), 'tried and gave up' (52 obs), 'trying' (146 obs) and 'considering' (419 obs).

Previous evidence regarding the adoption patterns of ICT in general and e-commerce in particular has indicated differences between domestic and foreign firms (Haller and Siedschalg, 2011). In our case, firms in an international group are less likely to be in the categories 'trying' and 'considering', perhaps because they have the resources to enter directly into an active online sales category.

Of particular interest, for theoretical reasons, are the sales trend variables as determinants of the four categories. For example, do firms that abandon online sales in foreign countries do so because of poor overall performance (stagnating sales)? Our regression results find no significant relation between being in the categories 'used to sell' and 'tried and gave up' and the sales trend variables. Therefore, firms that abandoned their online exports have nevertheless been able to continue with their domestic online operations or in traditional offline sales markets. However, it is interesting to observe that firms in the 'trying' and 'considering' categories are observed to have more favourable sales trends. This could be that firms who are enjoying sales growth are looking to enter into new (online) markets to continue their expansion.

Additional results indicate that age is negatively associated with 'trying', but positively related to 'considering'. However, age has no significant impact on 'used to sell' and 'tried and gave up', indicating that lack of experience is not a factor for failure when trying to export online. B2C firms are more likely to be 'considering' online sales, which is not surprising given the gains to online sales for B2C firms. Businesses operating with large platforms are more likely to be in the 'trying' category.

Again, these regressions have a low R². It is hard to predict which firms will be in which category. Firms that experienced difficulties ('used to sell' and 'tried and gave up') were not necessarily associated with having poor performance in terms of their recent sales trend.

4. Conclusion

Today, e-commerce is an established business practice. However, there are still key barriers that hinder its growth, in particular when expanding the reference markets beyond traditional physical boundaries. Many of these barriers were rightly identified in the past, and have become more pressing as the increasing potential benefits of e-commerce for firms and individuals are documented and the number of firms that can take advantage of e-commerce grows. Barriers such as complex tax regimes, problems related to international payments, issues related to consumer protection; and in some cases cross country legal differences are significant challenges that hold back e-commerce development in Europe. As mentioned in the introduction, however, in Europe there are a number of initiatives to tackle e-commerce barriers (see footnote 1) that even if not in place when the survey was realised, indicate that the EC has been active to address some of the identified barriers.

E-commerce offers an adequate mechanism that can help domestic firms internationalise and meet the global demand for goods and/or services. In our data, 48% of firms that engage in e-commerce are selling online to other EU countries. This means that some firms are able to overcome existing barriers to global e-commerce and their products are reaching those demanding them in foreign markets. Other firms are blocked by existing barriers and therefore sell only domestically. However, our data indicates that a large share of firms is 'considering' engaging in cross-border e-commerce. Perhaps more worrying, firms that declare they are "trying" to engage in cross-border e-commerce are more likely to face regulatory barriers. These barriers, in turn, are negatively associated with online sales performance. This, and demand-side barriers, prevent the European Digital Single Market from being fully integrated, Hence the potential efficiency gains that could be realised if cross-border e-commerce were easier are underscored.

The results presented here, however, indicate that small and young firms do not seem to be more vulnerable to any of these barriers than larger or more experienced firms. In addition, we present weak evidence that firms which use their own websites are more vulnerable to financial, market and information barriers. Nevertheless, use of a large platform is associated with lower financial and market barriers. Besides, firms which sell through platforms tend to have higher shares of online sales, emphasizing the important role played by platforms in overcoming some traditional market frictions.

We believe that the evidence presented here is an important contribution to the literature on e-commerce, and particularly to a better understanding of its cross-border dimension. However, it has several limitations. The data used here comes from a cross-sectional survey. Hence, our results have to be interpreted more as associations or correlations and we cannot claim causality. This is particularly problematic for making policy recommendations, because policy interventions should be based on a deep understanding of cause-effect relationships.

For this reason, future work should try to analyse some of the issues raised here with a dynamic perspective, in order to identify causality. Moreover, a broader approach to the online internationalisation of firms would be also relevant. Finally, the role of platforms in online trade – at least from the results obtained in this contribution – also deserves a more detailed and thorough analysis.

Some key barriers still impede the further growth of e-commerce for industries and individuals. Some of these barriers, such as the need for Internet infrastructure, have been successfully dealt with. However, other barriers remain significant. Our results indicate that European firms face a variety of barriers relating to financial, market, knowledge, regulatory and infrastructural factors. The need to remedy these barriers has become more pressing now as the potential number of e-commerce users and sellers is

growing rapidly and more firms are entering the marketplace to take advantage of the potential of the Internet for commerce.

References

- Alaveras, G. and B. Martens (2015) "Online trade in services in the EU Digital Single Market", JRC/IPTS Digital Economy Working Papers, 2015/08.
- Ben Aoun – Peltier, L. and M. R. Vicente (2012), E-commerce diffusion: exploring the determinants of the adoption and extent of usage at firm-level. Working papers du STATEC n. 57.
- Bernard, A. B., J. B. Jensen, S. J. Redding, and P. K. Schott (2012) The Empirics of Firm Heterogeneity and International Trade. *Annual Review of Economics* Vol. 4:283-313
- Berthou, A., E. Dhyne, M. Bugamelli, A.M. Cazacu, C.V. Demian, P. Harasztosi, T. Lalinsky, J. Meriküll, F. Oropallo and A.C. Soares (2015) Assessing European firms' exports and productivity distributions: the CompNet trade module. European Central Bank Working Paper 1788.
- Blum, B. and A. Goldfarb (2006) Does the Internet Defy the Law of Gravity? *Journal of International Economics* 70(2), 384–405.
- Cairncross, F., 2001. *The Death of Distance*. Harvard Business School Press, Boston.
- Coppel, J. (2000), "E-Commerce: Impacts and Policy Challenges", OECD Economics Department Working Papers, No. 252, OECD Publishing
- de Loecker, J. (2013). Detecting learning by exporting. *American Economic Journal: Microeconomics*, 5(3): 1-21.
- D'Este M, Iammarino S, Savona M, von Tunzelmann N (2012). "What hampers innovation? Revealed barriers versus deterring barriers". *Research Policy* 41, 482-488
- Disdier, A. C., & Head, K. (2008). The Puzzling Persistence of the Distance Effect on Bilateral Trade. *The Review of Economics and Statistics*, 90(1), 37-48.
- Duch-Brown N., Martens B., (2015). Barriers to Cross-border eCommerce in the EU Digital Single Market. Institute for Prospective Technological Studies, Digital Economy working paper 2015/-07.
- Duch-Brown N., Grzybowski L., Romahn A., and Verboven F., The impact of online sales on consumers and firms. Evidence from consumer electronics, *International Journal of Industrial Organization*, Volume 52, May 2017, Pages 30-62, <http://dx.doi.org/10.1016/j.ijindorg.2017.01.009>.
- Egan, M., and Guimarães, M. H. (2017) The Single Market: Trade Barriers and Trade Remedies. *JCMS: Journal of Common Market Studies*, 55: 294–311. Doi: <https://doi.org/10.1111/jcms.12461>.
- Gomez-Herrera E., Martens B., Turlea G. (2014). The drivers and impediments for cross-border e-commerce in the EU. *Information Economics and Policy*, (28), 83-96
- Gorodnichenko, Y., & Talavera, O. (2017). Price setting in online markets: Basic facts, international comparisons, and cross-border integration. *American Economic Review*, 107(1), 249-282.
- Helpman, E., Melitz, M., & Rubinstein, Y. (2008). Estimating Trade Flows: Trading Partners and Trading Volumes. *Quarterly Journal of Economics*, 123(2), 441-487.
- Holz W., (2009). Is the R&D behaviour of fast-growing SMEs different? Evidence from CIS-III data for 16 countries. *Small Business Economics* 33, 59-75.
- Hölzl, W., and Janger, J. (2013). Does the analysis of innovation barriers perceived by high growth firms provide information on innovation policy priorities? *Technological Forecasting and Social Change*, 80(8), 1450-1468.

- Hortaçsu, A., Martínez-Jerez, F., & Douglas, J. (2009). The geography of trade in online transactions: Evidence from eBay and mercadolibre. *American Economic Journal: Microeconomics*, 1(1), 53-74.
- Lendle, A., Olarreaga, M., Schropp, S., & Vézina, P. L. (2013). eBay's anatomy. *Economics Letters*, 121(1), 115-120.
- Lendle, A., Olarreaga, M., Schropp, S., & Vézina, P. L. (2016). There goes gravity: eBay and the death of distance. *The Economic Journal*, 126(591), 406-441.
- Mayer, T. and G. I. P. Ottaviano (2007), "The Happy Few: The internationalisation of European firms. New facts based on firm-level evidence". Bruegel Blueprint Series.
- Mitchell, W.J., 1995. *City of Bits: Space, Place and the Infobahn*. CambridgeMIT Press.
- Van Ark, B., Inklaar, R., McGuckin, R.H., 2003. 'Changing Gear': Productivity, ICT and Service Industries in Europe and the United States. In: Christensen, J.F., Maskell, P. (Eds.), *The Industrial Dynamics of the New Digital Economy*. Edward Elgar, Cheltenham.
- Verspagen, B., (2010). The spatial hierarchy of technological change and economic development in Europe. *Annals of Regional Science* 45:109–132.
- Vicente, M.R., Lopez, A.J., 2006. Patterns of ICT diffusion across the European Union. *Economics Letters* 93 (1), 45–51.
- Wagner, J. (2012) *New Methods for the Analysis of Links between International Firm Activities and Firm Performance: A Practitioner's Guide*. University of Lüneburg Working Paper Series in Economics No. 227.

Annex

Table 9: Description of the variables.

Questions asked to all firms	
Firm size	
<i>Employees</i>	How many employees (full-time equivalent) does your company currently have? 5 categories: 1 to 9; 10 to 49; 50 to 249; 250 to 499; 500 or more employees
<i>Turnover</i>	What was your company's total turnover in 2014? 6 categories: Less than 100 000 euros; From 100 000 to 500 000 euros; More than 500 000 to 2 million euros; More than 2 to 10 million euros; More than 10 to 50 million euros; More than 50 million euros.
Group dummies	Independent or part of a group. 3 categories: Independent; Part of a national group; Part of an international group
b2c	"Does your company sell goods to individual consumers?" Yes=1, No=0.
b2b	Does your company sell goods to companies and other organisations Yes=1, No=0.
Age dummies	3 categories. Before 1 January 2009; between 1 January 2009 and 1 January 2014; After 1 January 2014.
Origin of online sales	
<i>Domestic online sales</i>	Approximately what percentage of your online sales in 2014 came from the country where your company is located? 5 categories: 0%; 1-25%; 26-50%; 51-75%; 76-100%
<i>EU online sales</i>	Approximately what percentage of your online sales in 2014 came from other EU countries? 5 categories: 0%; 1-25%; 26-50%; 51-75%; 76-100%
<i>ROW online sales</i>	Approximately what percentage of your online sales in 2014 came from countries outside the EU? 5 categories: 0%; 1-25%; 26-50%; 51-75%; 76-100%
Sell online?	Does your company sell online and/or use EDI-type transactions (Electronic Data Interchange, e.g.: XML)? Selling by email is not considered online selling. Yes=1, No=0.
exports_eu	In 2014, approximately what percentage of your traditional sales, meaning NOT online, came from sales in other EU countries? Integers from 0% to 100%
exports_row	In 2014, approximately what percentage of your traditional sales, meaning not online, came from sales in countries outside the EU? Integers from 0% to 100%
sales trend	Since January 2012 has your company's turnover ...? (5 categories): Risen by more than 25%; Risen by between 5% and 25%; Remained approximately the same; Fallen by between 5% and 25%; Fallen by more than 25%. Reverse-coded, such that 1 = low performance and 5 = high performance
NACE	NACE codes (converted into dummies): C - Manufacturing; G - Wholesale and retail trade, repair of motor vehicles and motorcycles; I - Accommodation and food service activities; J - Information and communication
Region	Firms from different EU countries are grouped together into three categories, North, South, and East, following Holzl (2009) and Verspagen (2010). Countries in "North": "BELGIQUE", "DANMARK", "DEUTSCHLAND", "SUOMI", "IRELAND", "LUXEMBOURG", "NEDERLAND", "ÖSTERREICH", "SVERIGE", "UK". Countries in "South": "ELLADA", "ESPANA", "FRANCE", "ITALIA", "PORTUGAL". Countries in "East": "BALGARIJA", "CESKA REPUBLIKA", "EESTI", "MAGYARORSZAG", "LATVIA", "LIETUVA", "POLSKA", "ROMANIA", "SLOVENSKA REPUBLIC", "SLOVENIJA", "HRVATSKA"

Variables only observed for firms selling online	
% online sales	Approximately what percentage of the value of your sales in 2014 came from online sales?
E-commerce integration	If the same rules for e-commerce between your company and customers were applied in all EU Member States, do you think that your firm would start or increase its sales online in other EU countries? 4 categories and "Don't know/not applicable"
Selling strategy	In order to sell your products and/or services online, which of the following do you use? (MULTIPLE ANSWERS POSSIBLE):
<i>own website</i>	Your own website or apps
<i>small_pltfrm</i>	A small commercial platform (e.g.: a specialised website or one with only a few products or brands)
<i>large_pltfrm</i>	A large commercial platform (e.g.: a generalist website selling a lot of different products or brands)
<i>EDI</i>	EDI-type transactions (Electronic Data Interchange, e.g.: XML)
Variables only observed for firms selling online but not exporting to Europe	
"Motives"	Categories of used to sell (52 obs), tried & gave up (52 obs), trying (146 obs) and considering (419 obs).

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