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Barriers to Cross-border eCommerce in the EU Digital Single Market

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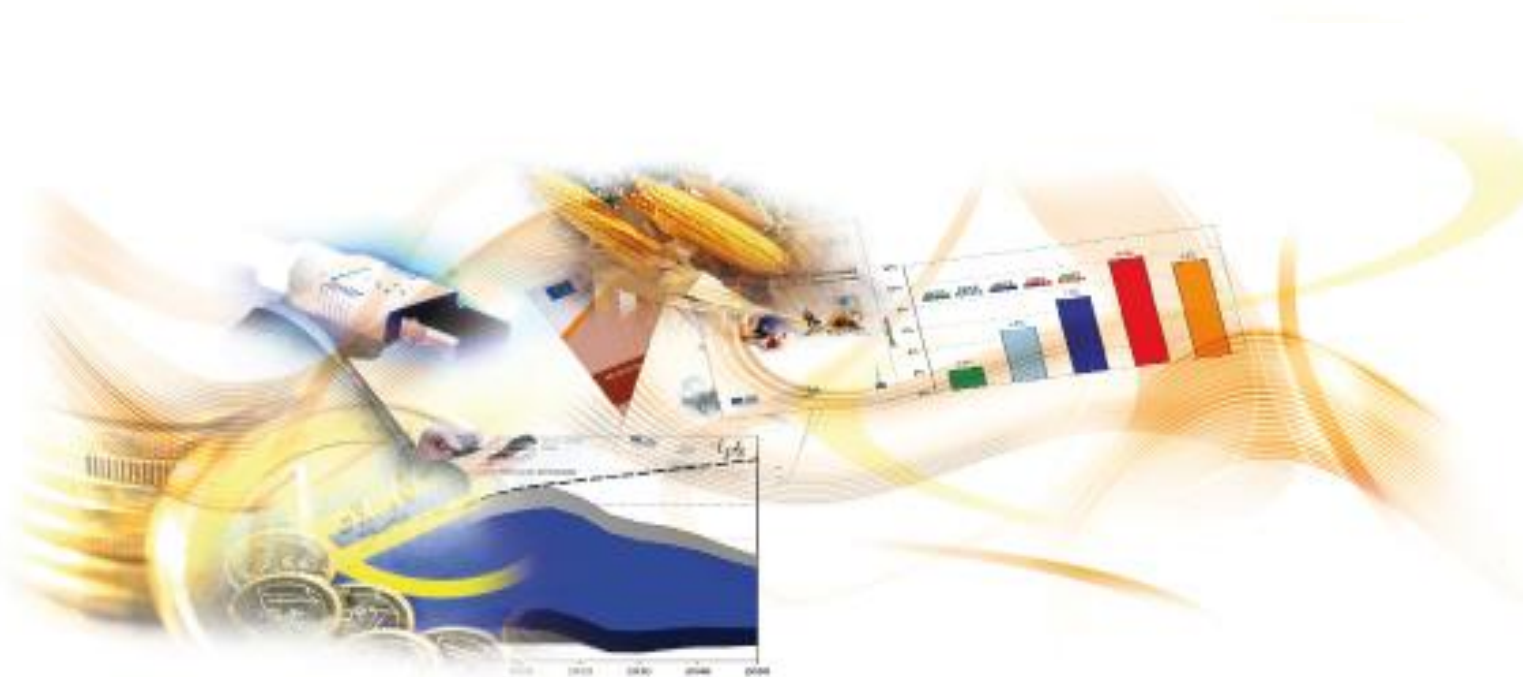
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Barriers to Cross-border eCommerce in the EU Digital Single Market

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2015

European Commission

Joint Research Centre

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Abstract

This report presents empirical evidence about the internationalisation of European online firms. After describing some characteristics that define the internationalisation of firms engaged in online activities, it mainly focuses on the obstacles that these firms face when trying to sell their products and/or services to other EU Member States. It relies on data from a firm survey carried out in January-February 2015 in four different sectors (manufacturing, wholesale and retail, accommodation and food and information and communication) and is complemented with additional sources of information. We find that a limited number of barriers really matter for online trade. These include settling the costs of cross-border disputes, suppliers' restrictions to selling cross-border, delivery costs, taxation rules, and knowledge of the rules abroad. In line with the offline trade literature, the data confirm that they matter mostly for small firms, which find it harder to overcome the fixed trade costs associated with these barriers.

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¹ Both authors are researchers at the JRC/IPTS in Seville (Spain). The views and opinions expressed in this report are the authors' and do not necessarily reflect those of the JRC or the European Commission. This research was co-financed by DG CNECT.

Summary

This report presents empirical evidence about the internationalisation of European online firms. After describing some characteristics that define the internationalisation of firms engaged in online activities, it mainly focuses on the obstacles that these firms face when trying to sell their products and/or services to other EU Member States. It relies on data from a firm survey carried out in January-February 2015 in four different sectors (manufacturing, wholesale and retail, accommodation and food and information and communication) and is complemented with additional sources of information. We find that a limited number of barriers really matter for online trade. These include settling the costs of cross-border disputes, suppliers' restrictions to selling cross-border, delivery costs, taxation rules, and knowledge of the rules abroad. In line with the offline trade literature, the data confirm that they matter mostly for small firms, which find it harder to overcome the fixed trade costs associated with these barriers.

Table of Contents

Acknowledgments	3
Summary	4
1. Introduction	6
2. Data and methodology	8
2.1 Data structure and potential sample bias	8
2.2 Firm characteristics	9
2.3 Firms' online activities	10
2.4 Methodology	13
3. Online internationalisation: a small numbers phenomenon	14
4. The structure of target markets in online trade	17
5. E-commerce premia	20
6. Productivity and specialisation	26
7. Barriers to cross-border e-commerce	30
7.1 Barriers to engage in cross-border e-commerce (extensive margin)	32
7.2 Barriers that limit the volume of cross-border e-commerce (intensive margin)	34
8. Conclusions	36
References	38
Annex	39

1. Introduction

E-commerce plays an important role in the EU economy. It has been growing at impressive rates during the past 15 years. In 2014, it represented on average 7% of total retail sales in the EU-28. However, growth is concentrated mainly in domestic markets while cross-border e-commerce seems to be lagging behind. The Digital Agenda Scoreboard (2014) reports that more than 50% of all consumers buy online but only 15% buy online across the border. On the other hand, in 2013, 15% of all firms sold online and nearly half of them (7%) sold across the border². This looks substantial when compared to the share of exporting firms in offline trade (Berthou et al., 2015) and might indicate that the most important barriers are on the consumer side. Still, the rapid rise of the Internet in the last two decades has nurtured the idea of the "death of distance" (Cairncross, 1997) where all online services, both domestic and cross-border, would only be a click away. We know today that the concept was largely overstated and geographical distance and national borders remain important factors in online trade in goods and services (Blum & Goldfarb, 2006; Lendle et al, 2012; Gomez et al, 2014; Alaveras & Martens, 2015). Gomez et al (2014) report that in 2011 only 18% of all B2C e-commerce spending in the EU was cross-border spending between Member States (MS). These studies seem to confirm the importance of barriers on the consumer side, such as consumer preference for home markets (home bias) and cultural and language differences, as the main sources of cross-border online trade costs. However, there may still be a margin for regulatory and supply-side barriers in holding back online trade flows.

While policy makers cannot change geographical distance or language, they may be in a position to reduce the regulatory trade costs associated with crossing national borders. Indeed, this has been the main preoccupation of traditional offline trade policy. Since many offline sources of trade costs continue to apply online, the reduction or elimination of regulatory barriers that induce trade costs remains relevant online as well. Moreover, new barriers may appear in online trade. Many potential online barriers were identified years ago (Coppel, 2000) and they have become more relevant now that e-commerce has emerged as an important distribution channel. 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 in the EU. The EU's Digital Single Market policy package targets many barriers that are believed to hinder cross-border e-commerce. The removal of these barriers is crucial in boosting economic integration in both the digital economy and the more traditional offline Single Market. Both consumers and firms would greatly benefit from the reduction of these trade costs. The main objective of this study is to identify the barriers to cross-border e-commerce in the EU that really matter from a supply-side or firm perspective. For this purpose, the European Commission

² Data from Eurostat's survey on the usage of information and communication technologies in enterprises, which refers to companies with at least 10 employees and does not consider the financial sector.

launched a Eurobarometer firm-level survey in early 2015 with a specific focus on the barriers to cross-border e-commerce. The survey combines evidence on firms' perceptions of barriers to cross-border e-commerce with information on actual cross-border e-commerce activity of these firms. The Eurobarometer report (Flash Eurobarometer 413, 2015) shows that several barriers are frequently mentioned as relevant by firms of all sizes, sectors and distribution channels. In this study we go a step further and compare the perceived barriers with observed cross-border activity in order to check consistency while controlling for a number of factors that might affect the relationship between these two. In line with standard trade models, we split the analysis of cross-border e-commerce between an extensive margin (whether a firm engages in cross-border e-commerce or not) and an intensive margin (cross-border e-commerce as a share of total e-commerce).

We find that several perceived barriers in the survey have a statistically significant negative impact on cross-border e-commerce, especially for small firms. These include the trade costs associated with cross-border complaints and disputes, suppliers' restrictions to selling abroad, high delivery costs, dealing with foreign tax regulation and the lack of knowledge of the rules in other countries. These findings provide empirical evidence for some of the barriers targeted in the Digital Single Market Strategy paper and mainly for small firms. The findings are in line with offline cross-border trade research where smaller firms find it harder to overcome the fixed costs associated with cross-border trade.

The next section describes the survey data, the characteristics of firms in the survey sample and explains the methodology used. Section 3 describes the online internationalisation status of EU firms that derives from the survey. Section 4 analyses the markets targeted by firms selling and buying online. Section 5 addresses the issue of both e-commerce premia and cross-border e-commerce premia. Section 6 describes the productivity and specialisation patterns related to online activities. Section 7 discusses the results related to the barriers to cross-border e-commerce in the EU, both in terms of engagement (extensive margin) and sales (intensive margin). In addition, a distinction is made in terms of firms selling online and firms buying online. The last section offers conclusions and some policy recommendations.

2. Data and methodology

2.1 Data structure and potential sample bias

The data used in this report were collected by TNS on the basis of a questionnaire applied to a sample of 8,705 firms in 26 Member States³ in early 2015. The data are unique: there is no comparable data source on perceived barriers to cross-border e-commerce by firms in the EU. The data were first reported in the Flash Eurobarometer 413 (2015). Survey data are inevitably subject to difficulties. The sample has to be representative of the population. Bias can come from difficulties in defining the appropriate population to be sampled; from under-coverage, when parts of the population are inadequately represented; from non-response, when the survey is full of missing entries; or also from measurement error due to the presence of leading questions or the respondents' behaviour.

There is no inventory of the population of online firms in the EU. Hence, sampling had to start from the universe of EU firms. TNS used the Orbis database on EU firms to construct the sample for all the countries except the UK and Ireland. Since the actual sampling procedure applied by TNS is not known, we can only verify the outcome of the sampling procedure by comparing sample composition with other sources of information, in this case Eurostat's statistical surveys on firms, business registers or from various administrative source (as compiled in the Structural Business Statistics –SBS– section of Eurostat's database).

The sample includes 400 firms for the larger Member States, 300 firms for Croatia and Slovenia, 200 firms for Latvia, Hungary, Bulgaria and 100 firms in the case of Luxemburg, Estonia and Slovakia. The data covers four sectors: manufacturing, wholesale and retail trade, accommodation and food and information and communication. The data can be appropriately weighted to better represent the universe of European firms⁴. We compare the weighted distribution of firms by country with firm survey data from Eurostat (SBS). We find that Spain, Greece, the Netherlands, Sweden and Germany are slightly overrepresented; while Italy, Poland, Romania, Portugal and Bulgaria are somewhat underrepresented. This sample bias may affect the analysis since these countries differ in their proportions of firms doing e-commerce and cross-border e-commerce and hence these differences may not be captured by the survey data.

Additionally, we checked for potential sample bias at the sector level. Again, comparing the weighted distribution of firms in the sample with that from Eurostat, we noticed that manufacturing, wholesale and retail trade and accommodation and food sectors are under-represented whereas the information

³ The survey does not include data for Cyprus and Malta.

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.

and communication sector is over-represented in the sample. Accommodation and food has one of the highest proportions of firms engaged in e-commerce according to Eurostat.

The structure of the database is represented in Figure A1 in the Annex. The figure shows strong attrition in the number of replies as the questionnaire progresses towards the barrier questions. This may present a difficulty in adequately identifying the effects of these barriers. Another potential source of attrition bias comes from segmentation. A simple sample truncation by firm size and sector for firms selling online leaves us with a small number of observations in some of the partition cells. Moreover, these few firms often share the same attributes and hence drop out of the estimations because they are considered constants. For instance, this is a problem with large firms since they only represent 6% of the total number of firms (see below). As a result, a partition by firm size may create problems. However, despite the database's minor limitations, it does help us to understand the behaviour of European firms in terms of their online and cross-border activities.

2.2 Firm characteristics

Some basic features of the sample of firms are presented in Table 1. Apart from country and sector, firm characteristics include age, size, type, activity and sales trend. Firm size is defined in terms of employment. We have defined four categories: micro firms with 1 to 9 employees (56%)⁵; small firms with 10 to 49 employees (25%); medium-sized companies employing between 50 and 249 individuals (13%) and large firms with 250 or more employees (6%). We also split the sample into two age groups, young firms created after 2009 (15%) and old firms already in operation before that date (85%). Firms can also be characterised by type: independent (82%), part of a national group (8%) or part of an international corporation (10%). The dynamics of firm performance is captured by sales trends. Firms were asked about the trend of their turnover from the moment of the interview back to January of 2012: sales growing by more than 25% (12%); between 5 and 25% (32%); remained roughly the same (35%); decreased between 5 and 25% (16%); and decreased by more than 25% (5%). Finally, firms are classified by the nature of the online markets in which they operate. Firms can operate in several markets simultaneously, hence the sum of the shares does not add up to 100%: firms selling goods to consumers (62%) or other firms (75%); selling digital services online to consumers (9%) or other firms (13%); or providing traditional services offline to consumers (29%) or other firms (39%). More firms are apparently involved in Business-to-Business (B2B) than in Business-to-consumer (B2C) trade.

Table 1 shows that 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

⁵ The figure in parenthesis is the un-weighted share of firms in each category.

has expanded in the last two years –looking for new markets- and also if it has experienced difficulties with a declining turnover, in which case exports may be seen as a new source of revenues.

Table 1: Characteristics of firms doing e-commerce

	Selling		Buying	
	Total	Cross-border*	Total	Cross-border*
Age				
Old	41.6%	46.7%	85.6%	41.0%
Young	38.9%	53.2%	88.1%	47.6%
Size				
Micro	39.4%	47.2%	87.1%	41.1%
Small	44.9%	49.0%	82.5%	47.7%
Medium	56.1%	50.8%	77.3%	48.7%
Large	76.4%	60.3%	80.0%	59.8%
Type				
Independent	40.1%	47.5%	86.2%	42.0%
National group	47.7%	47.5%	85.9%	41.3%
International group	50.8%	52.8%	84.6%	51.2%
Activity				
Goods to consumers	48.5%	45.7%	83.9%	39.8%
Goods to firms	42.0%	46.3%	87.2%	45.1%
Digital services to consumers	67.7%	55.4%	83.1%	50.0%
Digital services to firms	53.5%	53.2%	87.9%	56.4%
Services to consumers	48.1%	53.1%	86.9%	42.3%
Services to firms	39.3%	53.2%	90.8%	47.2%
Sales trend				
Fall by more than 25%	45.8%	42.5%	88.2%	39.4%
Fall between 5% and 25%	43.0%	44.0%	83.7%	39.2%
Remained the same	36.5%	39.5%	87.0%	38.9%
Rise between 5% and 25%	42.4%	55.7%	85.5%	44.9%
Rise by more than 25%	44.2%	58.4%	89.8%	54.7%

* Cross-border figures are calculated with respect to the number of firms selling or buying online.

Note: Figures are computed using weights.

Source: own calculations with data from Eurobarometer 413.

2.3 Firms' online activities

The questionnaire tackled two main blocks of online activities by firms: sales and purchases. A schematic representation of the data is shown in Figure A1 in the Annex. Questions about online sales included the channel used (own website, small or large third party platforms, EDI-type transactions) and whether the firm sells domestically, across the border to other EU countries or to third countries (US, China, Japan, etc.). Firms engaged in e-commerce also responded to questions addressing the importance of some pre-defined barriers to cross-border sales. Questions about online purchases followed a similar structure, asking for the main channels, the geographic origin and the barriers faced.

In the sample, 3,945 firms (45%) declared they use e-commerce to sell their products and/or services. Within this subset of firms, the most frequent channel used is the firm's own website (79%), followed by small platforms, large platforms and EDI-type transactions, used by 28%, 26% and 23% of firms selling online, respectively. Multi-channel strategies are used by 40% of the firms, and the remaining 60% only use one channel for their e-commerce sales.

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 declare 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 are 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 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 MS 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, being Germany, the UK and Italy the most frequent destination markets..

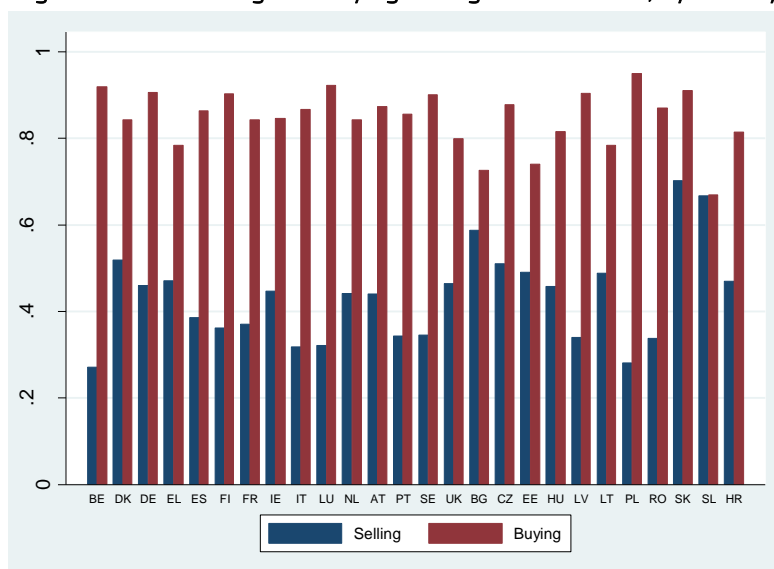
Looking at online purchases, 7,156 firms (83%) answered that they purchase online. In this group, firms basically use the provider's website to buy online (68%). While the proportion of firms that uses small platforms (39%) and large platforms (37%) are quite similar, the proportion of firms using EDI-type electronic transactions is rather low (20%). The proportion of firms using just one channel to buy online is 57% -similar to that for selling, meaning that the multi-channel strategy is used by the remaining 43% of firms.

On average, the share of purchases online (excluding observations with zero value) is 23%, and the median is again 10%. In this case, 4% of firms, which state that they buy online, indicate that their share of online purchases is 0%, while some 3% of firms declare that their share of online purchases is 100%. Similarly, we know whether the firms purchase online from their domestic providers or go across the border to procure items. On average, the share of purchases coming from the domestic market accounts for 77% of purchases online, while 18% comes from other EU Member States and 5% from third countries. In the case of online purchases, 93% of firms purchase online domestically, 49% purchase across the border from other EU Member States and 21% buy from third countries.

The data shows that there are some significant differences between selling and purchasing online. For all the Member States, firms are more likely to purchase online than sell online (Figure 1). As a matter of fact, in the majority of countries the proportion of firms purchasing online is above 80%. However, if we

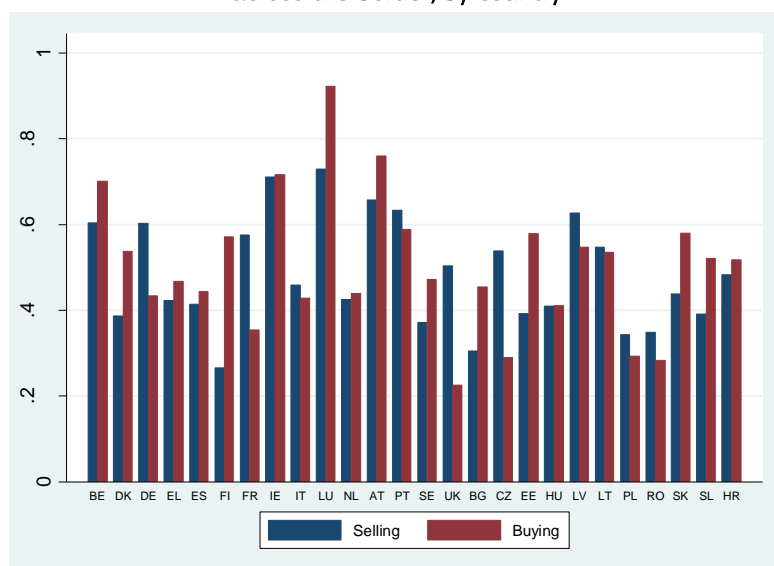
look at the cross-border dimension, this difference is no longer valid. First, for some countries the proportion of firms selling online across the border is higher than the proportion of firms buying online across the border. In addition, for the remaining countries the differences are much less pronounced than in the previous case (Figure 2). This indicates that even if purchasing online is a more frequent activity domestically, purchasing cross-border is as likely to face barriers as selling cross-border.

Figure 1: Firms selling and buying through e-commerce, by country



Source: own calculations with data from Eurobarometer 413

Figure 2: Firms selling and buying through E-commerce across the border, by country



Source: own calculations with data from Eurobarometer 413

Table 2: Cross-border e-commerce, by sector

	Engagement (%)		Intensity (share)	
	Selling	Buying	Selling	Buying
Total	47.8%	42.2%	10.3	12.2
Manufacturing	45.6%	40.7%	9.1	11.6
Wholesale and retail trade	36.7%	38.9%	5.9	12.9
Accommodation and food	76.7%	31.3%	23.9	7.2
Information and communication	57.0%	56.0%	12.4	13.7

Note: Figures are computed using weights.

Source: own calculations with data from Eurobarometer 413.

The analysis of the incidence of barriers to cross-border e-commerce needs to take into account both the decision to engage in sales and/or purchases across the border and the intensity with which the firms do it. Table 2 shows some statistics by sector, weighted to better represent the overall EU picture. The accommodation and food sector has the highest engagement rate for sales, since 77% of online firms sell across the border. The equivalent for purchases is the information and communication sector, where 56% of firms purchase electronically across the border. The picture is the same if we look at the intensity of the cross-border activity: the accommodation and food sector has the highest share of e-commerce turnover from sales to other EU countries, while information and communication firms show the highest share of electronic purchases across the border over total electronic purchases. To sum up, this is a unique and rich dataset that provides useful evidence on the barriers to cross-border e-commerce sales and purchases in the EU.

2.4 Methodology

To assess the real impact of many of these barriers, we move beyond the descriptive statistics presented and discussed in the previous section⁶. In the following sections, we will rely on two broad categories of methodologies. First, we compute indicators to address specific topics related to the process of online internationalisation of European companies and compare with their corresponding offline values or across countries or sectors. Second, we rely on econometric analysis to find robust evidence of the process of online internationalisation of European companies. This approach allows us to make a direct comparison of the results of this report with previous studies, both in terms of firm-level evidence on the (offline) internationalisation process and evidence on cross-border e-commerce.

Given the nature of the survey data and the absence of relevant counterfactuals, the regression results presented in the following sections should be seen as correlations rather than causal effects. Still, the results should point to some factors that hinder firms' cross-border sales and purchases. Due to the

⁶ Additional descriptions of the data are provided by Flash Eurobarometer 413 (2015).

analytical nature of this report, the results and interpretations may differ from the findings published in the Eurobarometer (2015) report.

3. Online internationalisation: a small numbers phenomenon

This section uses micro-data to show that online internationalised firms are few and, among these few, only a handful of firms account for the bulk of aggregate online exports.

If we focus on online trade, we can rank each country's firms in terms of their individual online exports to other EU Member States and then we can analyse this distribution. Table 3 shows the contribution of different segments of the ranking to aggregate exports for the total EU economy and for each sector included in the data. In particular, the table shows the contribution to total exports of the top 1%, 5% and 10% of cross-border exporters. With the exception of information and communication activities, the top 1% of online exporters account for around 90% of aggregate online exports; the top 5% for more than 97% of online exports; and the top 10% almost reaches 100%. The results for the information and communication sector are somewhat less extreme. Overall, Table 3 shows even more concentration in online exports than the existing evidence on traditional offline exports. For instance, the top 1% of offline exporters in Germany carry out 59% of exports, while the top 5 carry out 81%. In Italy, the corresponding figures are 32% and 59%, respectively (Meyer and Ottaviano, 2007).

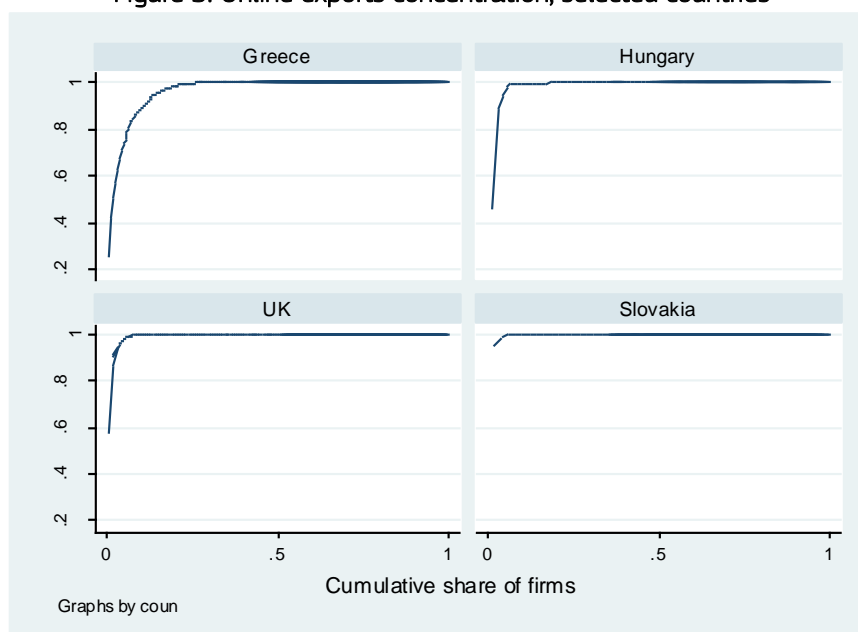
Table 3: Share of EU cross-border exports for top online exporters

	Top 1%	Top 5%	Top 10%
Total	89	97	98
Manufacturing	91	98	99
Wholesale and retail	94	99	99
Accommodation and food	93	98	99
Information and communication	35	90	97

Source: own calculations with data from Eurobarometer 413

Next, we look at different country cases where we detect various degrees of concentration. Figure 3 shows four selected cases, while the full picture with all the countries in the sample can be found in the Annex (Figure A2). For comparisons, a line representing the case in which all firms export the same value would be a diagonal connecting the left-bottom and right-upper vertex. Hence, the further away the curve is from this imaginary diagonal, the more concentrated the aggregate exports are in the hands of a few firms. The figure shows a very high concentration of online exports for most countries. A particularly striking feature is that as we move from Greece to Slovakia, the initial point also moves up, meaning that the top online exporter represents a higher share of aggregate online exports.

Figure 3: Online exports concentration, selected countries



Source: own calculations with data from Eurobarometer 413

An interesting alternative is to look at the online export intensity. Table 4 does precisely that, and also compares online exports with offline exports. The table indicates that almost 2% of firms in Belgium that are selling online across the border have a share of online exports over turnover at least equal to 75%. In the case of offline trade, that share is 1.4%. The countries with the highest online export intensity are Luxembourg (9.7%), Slovenia (7.4%) and Austria (6.2%). These countries are also among those with the highest offline export intensity, to which we should add Slovakia (5.2%). At the other end of the distribution, the countries with the lowest online export intensity are Estonia, Finland and Czech Republic. In the offline case, the countries with the lowest export intensity are the UK, France and Germany. These results show that, even though only a small subset of firms exports a major share of their turnover, they still account for a large fraction of total exports. In addition, this happens in both online and offline exports.

What Table 4 shows is that only a handful of firms export a large fraction of their turnover, both online and offline. On aggregate, only around 2% of firms export more than 75% of their turnover online. Similarly, around 3% of firms export more than 75% of their turnover offline. Comparing these percentages with the ones reported in Table 3 reveals that the fraction of firms with top export intensity is larger than the fraction of top exporters. Hence, top online exporters do not necessarily exhibit top export intensity.

In summary, aggregate online exports are determined by a few top online exporters that are relatively big. This points to the existence of a process, similar to what has already been found offline (Meyer and Ottaviano, 2007) through which only firms that are large enough and have other attributes that make

them different from the average firm can survive international competition. We will explore some of these characteristics in Section 5. Before that, in Section 4, we will have a look at the different markets (domestic, EU, or Rest of the World –RoW–) online firms' target.

In Section 2.2, we showed that the average EU firm sells on average to 4 export markets. The larger the number of markets a firm serves, the larger their average distance from the firm's country of origin. Hence, distance affects aggregate trade flows mostly by reducing the number of exporters rather than by reducing the average exports per firm. Unfortunately, the available data do not allow us to compare these effects. Hopefully, future research will target these very relevant issues.

Table 4: Distribution of the sample of online exporters by cross-border export intensity

	Share of cross-border sales over total turnover greater than					
	Online			Offline		
	75%	50%	25%	75%	50%	25%
Luxemburg	9.7	13.1	16.4	15.5	20.1	24.2
Slovenia	7.4	8.1	11.0	3.7	8.2	13.2
Austria	6.2	14.5	17.8	6.3	11.1	17.6
Ireland	3.7	9.9	16.7	2.6	4.5	12.8
Portugal	3.0	5.9	10.4	2.4	5.8	10.5
Lithuania	2.9	5.9	13.3	2.1	5.2	9.4
Belgium	1.9	4.5	6.5	1.4	3.7	12.7
Greece	1.8	4.2	9.0	2.1	3.3	7.2
Slovakia	1.8	8.4	10.4	5.2	10.1	16.2
Latvia	1.5	3.0	7.5	2.9	7.6	14.5
Denmark	1.4	2.5	4.9	3.9	9.5	15.8
Spain	1.2	2.1	5.9	2.3	4.2	9.2
Sweden	1.2	1.4	3.4	2.2	5.5	10.3
Germany	1.1	2.2	6.1	0.7	3.1	7.9
Romania	0.9	2.5	3.5	3.4	5.9	7.6
Croatia	0.8	4.7	7.9	2.4	5.7	10.4
Bulgaria	0.7	2.2	3.9	2.3	3.6	5.7
Poland	0.5	0.9	1.9	3.6	5.6	9.2
Italy	0.5	5.0	6.9	1.3	4.5	6.9
France	0.4	2.3	5.5	0.4	2.9	7.8
Hungary	0.2	1.2	3.6	1.8	6.6	11.8
UK	0.1	1.5	2.0	0.2	2.4	5.5
Netherlands	0.1	1.0	4.2	1.1	5.7	8.9
Czech Republic	0.1	3.6	7.6	1.6	4.5	8.6
Finland	0.0	1.6	3.2	1.5	2.7	6.0
Estonia	0.0	2.5	8.2	3.1	7.9	17.1
EU average	1.9	4.4	7.6	2.9	6.2	11.0

Source: own calculations with data from Eurobarometer 413

4 The structure of target markets in online trade

This section looks at the distribution of online sales and purchases in different target markets for firms. For this purpose, we define three target markets: domestic, cross-border EU and rest of the world. It also compares online sales with offline sales.

The survey supplies information about the markets that firms target. Figures A4a and A4b show the target markets for online sales by firm size and sector, respectively. In order to be able to compare this distribution with the one that corresponds to offline sales, Figures A5a and A5b show the target markets for offline sales, by firm size and sector, respectively. Finally, we also look at the distribution of target markets for firms buying online. In this case, Figures A6a and A6b show the corresponding plots for firm size and sector. All these tables are in the statistical Annex.

Each figure portrays two types of information. First, it gives an account of the number of firms in each segment (number of circles in each triangle). Additionally, each triangle also gives the location of each one of these firms in the target market space. The figures show that most points are concentrated in or around the top vertex, meaning that the majority of firms are mostly targeting their domestic markets. This result is pervasive: it happens within the different segmentations by size and by sector and also occurs for the different activities that firms perform - online sales (Figures A4a and A4b), offline sales (Figures A5a and A5b) and online purchases (Figures A6a and A6b).

In order to compute a summary statistic that allow us to obtain more information about the importance of the different target markets for the firms in the sample, we compute the distances with respect to an hypothetical centroid defined as the top vertex. Then, we computed the average distance of each firm from this hypothetical centroid. The results are shown in Table 5 by firm size and by sector. This variable measures how far on average firms in each segment are from this point, where all firms would be concentrating exclusively on the domestic market. This distance has been normalized and lies between 0, when the firm is located exactly in the hypothetical centroid, and 100 when it is located at the maximum possible distance (i.e. in another vertex).

**Table 5: Average distance to hypothesised
Gravitational vertex, by size and sector**

	Online	Offline
By size:		
Micro	10.9	7.5
Small	12.2	12.8
Medium	15.1	19.2
Large	12.7	20.8
By sector:		
Manufacturing	12.8	16.9
Wholesale and retail	7.5	7.3
Accommodation and food	25.5	13.0
Information and communication	11.7	9.8

Note: distance has been normalised and lies between 0 and 100. In this case, 0 means average location at the gravitational vertex, defined as 100% sales to the domestic market and 0% sales to other EU and RoW markets. A value of 100 would indicate average location at the maximum possible distance (i.e. in one of the alternative vertex).

The results from Table 5 are interesting. First, we should note that the average distances from the hypothetical centroid are similar for online and offline sales in the two cases portrayed, i.e. by firm size and by sector. Second, note that these distances are small and close to zero in the majority of cases. This means that the mass of firms selling online and offline is located quite close to the top vertex. In other words, the propensity to sell in the domestic market is very high whereas the propensity to export –to other EU markets or to the RoW markets– is very low.

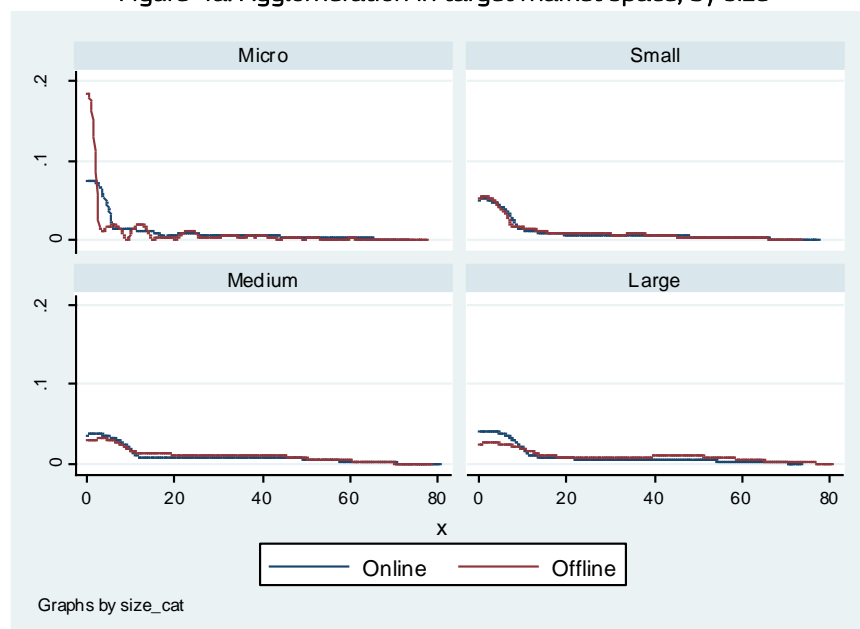
Looking at these results in more detail, we detect several interesting issues. First, looking at the values of this indicator by firm size, we see that average distance is higher in online sales than offline sales for micro firms, while it tends to be equal for small firms. However, it tends to be lower for medium-sized and large firms. This indicates that micro firms rely more on online sales to be more active in international markets whereas large firms tend to be more internationalised offline than online. When looking at the results by sector, we see that manufacturing tends to be more open to international markets offline than online, but that the reverse is true for both the accommodation and food and information and communication sectors.

Finally, we have plotted the distribution of these distances comparing between online and offline. Figure 4a shows the plots by firm size and Figure 4b by sector. As can be seen from the different panels of the figures, the majority of firms are concentrated in low values of the distance index, meaning that domestic markets are more important than foreign markets. The proportion of firms lying far away from the hypothetical centroid as defined previously is very small, corroborating the previous results. Finally,

the figures also show that the differences between the online and offline distributions are modest. With a very few exceptions given by specific ups and downs, both distributions generally have the same shape.

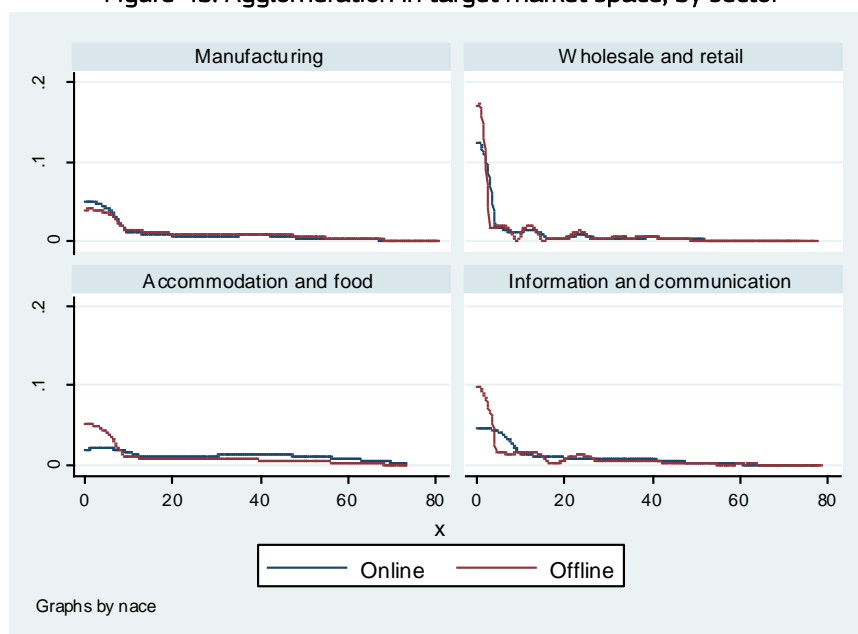
The decisions to target the domestic market instead of foreign markets, or to export online to other EU or RoW countries instead of selling on the domestic market are not independent. A firm will decide its strategy based on the expected profits to be obtained by each decision. To model these choices simultaneously, a multivariate discrete choice model is needed. So, in order to account for possible systematic correlations between decisions to sell online in different target markets, we estimate a trivariate probit model with binary equations for each outcome (Cappellari and Jenkins, 2006). The estimate for the cross equation correlation –presented in Table A6 in the Annex- is positive, indicating complementarities between the three decisions (bottom lines of the table). The results from the estimation indicate that a small number of factors affect the probability of selling on foreign markets. Hence, most channels for selling online –with the exception of EDI-type transactions- significantly increase the likelihood of selling online in all three target markets. Firms in the Accommodation and food sector are more likely to be targeting all three markets. Being in the wholesale and retail sector has a negative effect on the probability of targeting foreign markets, either other EU or RoW. Finally, the fact that firms sell digital services to consumers also impacts positively on targeting the domestic and RoW markets, although it has no impact on cross-border online trade with other EU Member States.

Figure 4a: Agglomeration in target market space, by size



Source: own elaboration with data from Eurobarometer 413.

Figure 4b: Agglomeration in target market space, by sector



Source: own elaboration with data from Eurobarometer 413.

5. E-commerce premia

This section shows that firms doing e-commerce score better than offline firms in various performance measures. However, this distinction is less clear between online and offline exporters.

One important dimension of the growing use of e-commerce is that it is a form of technological change which raises the firm's value added per unit of input, i.e. its productivity. Business-to-Business (B2B) e-commerce can improve productivity, for instance, by permitting better inventory control, by allowing the procurement of more suitable and cheaper inputs, and lowering transaction and information costs, among many other reasons. Similarly, Business-to-Consumers (B2C) e-commerce can also boost productivity by reducing time and costs in making transactions, by reducing handling costs and facilitating better customer relationships. Hence, in this section, we look at some of the differences that these transformations may have made in firms doing e-commerce. We also look at the productivity differences for firms doing online trade.

Table 6a reports employment, turnover, wage and value added⁷ e-commerce premia⁸, defined as ratios of firms doing e-commerce over firms not doing e-commerce. The message from this table is that in the great majority of cases, e-commerce firms perform better than non-e-commerce firms. These

⁷ These variables were not originally included in the survey. The inclusion of wages and value added was made possible by matching the survey with data from the Orbis database (Bureau van Dijk, 2015). For this reason, the number of firms in these cases is lower than the total number of available firms.

⁸ Strictly speaking, employment and turnover cannot be considered performance indicators. We deal with this issue below.

differences are particularly acute in the case of employment and wages, for which the EU average premia are the highest. However, as expected, there is huge cross-country variation in all items.

The overall e-commerce premia are particularly high for Bulgaria, Germany, Denmark and Croatia while they are quite disadvantageous for Greece, Latvia, Lithuania and Slovakia. Looking at particular cases, the employment premium is quite high in Austria while unfavourable in Greece; the turnover premium is highest in Bulgaria and lowest in Slovakia; and the wage premium is also most unfavourable for e-commerce firms in Slovakia while it turns out to be quite high for e-commerce companies in Poland. Finally, an important variable is the value added premium, quite high in Hungary, Germany and Bulgaria, and quite unfavourable in Greece, Ireland and Luxemburg. In addition, Table 6b shows that there is a strong (and statistically significant) correlation between these variables, especially those more closely related to performance (added value and wages).

Table 6a: Comparative performance: e-commerce

	Employment	Turnover	Wage	Added value
Austria	5.4	5.1	1.5	1.7
Ireland	5.4	1.1	2.3	0.5
Denmark	5.3	2.8	5.0	
Netherlands	3.4	0.8	2.1	
Croatia	3.3	6.5	3.2	
Hungary	3.2	2.0	3.3	4.6
Germany	3.2	4.4	4.3	5.6
Sweden	2.5	2.1	2.0	2.1
Belgium	2.3	2.7	2.3	1.1
Spain	2.3	1.2	1.7	1.7
France	2.2	3.0	1.9	1.9
Bulgaria	2.0	9.1	2.6	5.8
Romania	2.0	6.5	3.1	3.0
Portugal	1.9	1.0	2.3	1.9
Poland	1.8	0.6	5.9	3.5
Italy	1.6	0.9	1.5	1.5
Finland	1.5	3.0	1.5	1.0
Slovenia	1.2	0.6	1.3	1.1
UK	1.2	0.9		
Estonia	1.0	1.9	3.6	
Luxemburg	1.0	1.3	0.7	0.6
Slovakia	0.8	0.4	0.7	1.5
Czech Republic	0.8	4.9	0.9	0.8
Lithuania	0.7	0.8		
Latvia	0.7	0.7		
Greece	0.5	0.5	0.9	0.3
EU average	2.3	2.0	2.3	2.2

Source: own calculations with data from Eurobarometer 413

Table 6b: Rank correlation of performance indicators				
	Employment	Turnover	Wage	Added value
Employment	1			
Turnover	0.471**	1		
Wage	0.555***	0.316	1	
Added value	0.442*	0.358	0.740***	1

Note: * indicate significant at the 10% level, ** significant at the 5% level and *** significant at the 1% level.

Additional computations to those shown in table 6a can be performed by comparing firms that are doing cross-border e-commerce with firms that are exporting offline to other EU Member States. The results of this exercise are presented in Table 7. In this case, the picture is not as clear as it was with e-commerce. Here, 15 out of the 26 countries show overall positive premia, the values are in general lower than those observed in the previous case, and the country rankings in each category are more variable than in the previous case.

Table 7: Comparative performance: cross-border e-commerce				
	Employment	Turnover	Wage	Added value
Ireland	2.0	0.6	1.4	0.3
Spain	1.6	0.9	1.5	1.5
Finland	1.5	2.2	1.6	1.0
Denmark	1.5	1.3	1.6	1.0
Netherlands	1.4	0.7	1.8	
Poland	1.4	0.3	2.6	1.2
Austria	1.4	2.0	1.3	1.4
Romania	1.2	0.2	1.9	3.4
France	1.2	0.9	1.1	1.0
Slovenia	1.2	0.6	1.1	1.1
Slovakia	1.2	0.3	1.2	3.5
Croatia	1.1	6.7	1.2	1.0
Italy	1.0	0.4	0.9	0.8
Sweden	1.0	1.2	1.4	1.6
Belgium	1.0	2.0	1.0	0.7
Hungary	0.9	3.2	0.9	1.5
Portugal	0.8	0.2	0.8	0.7
Germany	0.8	0.4	0.3	0.3
Latvia	0.8	0.8		
Estonia	0.8	0.7	1.2	
Lithuania	0.6	0.9		
Luxemburg	0.6	0.7	0.5	0.6
Bulgaria	0.5	1.2	0.6	0.6
Greece	0.3	0.2	1.5	0.6
Czech Republic	0.3	0.3	0.5	0.4
UK				
EU average	1.0	1.0	1.1	1.1

Source: own calculations with data from Eurobarometer 413

Before entering into a more robust analysis, we computed the average performance of different groups of firms and for a set of indicators more related to performance at the aggregate EU level. The results are shown in Table 8. There, we defined four comparison groups: i) exporters vs. non-exporters; ii) firms doing e-commerce vs. the rest; iii) firms doing cross-border e-commerce against the rest, and; iv) firms doing cross-border e-commerce vs. firms doing cross-border traditional commerce. The table shows that on average, exporters perform better than the rest. Firms doing e-commerce perform on average better in terms of labour productivity and investment per employee, while they perform worse than other firms in terms of R&D intensity and also show a lower average profit margin. Finally, firms doing cross-border e-commerce perform better than the rest of firms in value added per employee, R&D intensity and investment per employee. This group also performs better than firms doing traditional trade to other EU Member States in terms of investment and profit rate. These indicators are simply weighted means. Many factors – such as the size distribution of firms – can affect these ratios. A more robust methodology would be required to effectively assess the premia associated to superior performance by exporting firms.

Table 8: Relative performance between relevant firm groups

	exporters vs. others	e-commerce vs. others	cross-border e-commerce vs. others	cross-border e-commerce vs. cross-border traditional commerce
Labour productivity	1.01	1.04	0.68	0.61
Value added per employee	1.21	1.09	1.04	0.96
R&D intensity	1.69	0.49	1.23	0.87
Investment per employee	1.57	1.09	1.42	1.25
Profit margin	1.03	0.91	0.97	1.11

Source: own calculations with data from Eurobarometer 413 and Orbis.

Since the contribution of Melitz (2003), literature on firm heterogeneity and international trade has focused on the main determinants of exports at the firm level, based on productivity differentials. There is a large amount of empirical literature assessing these different approaches, with an equivalently large number of different methodologies, covering many industries and a great deal of countries. However, the analysis of the factors explaining export performance for e-commerce firms has received very little attention. This could be due to different factors such as the difficulties in accessing data on this industry at the firm level, the high heterogeneity of the firms that form this industry, the peculiarities of the products they produce, distribute -and eventually export- among many others.

As a second exercise, we take a closer look at the relationship between exports and productivity. Recent empirical studies about exporting firms have accumulated a great deal of evidence showing that exporters are more productive than non-exporters. The exporter productivity premium has become a

stylized fact, present in almost every country and industry for which there is firm-level data, independently of the productivity measure used and, in some cases, it turns out to be robust when controlling for unobserved firm characteristics.

In the literature on international trade and firm heterogeneity, the exporter productivity premium is defined as the relative productivity differential between exporting and non-exporting firms of the same size and from the same industry. Econometrically, it is estimated by regressing the log of productivity to a dummy variable equal to one when the firm is an exporter and zero otherwise. In addition, the number of employees and its squared value, and dummy variables for the industries (and years when panel data at firm level is available) are included to control for firm size, industry affiliation and time trend.

In what follows, we apply this approach first to investigate the "e-commerce productivity premia", comparing firms that are doing e-commerce with firms that are not doing e-commerce. Secondly, we focus on cross-border e-commerce productivity premia, comparing in this case the sub-sample of firms that are exporting online to other EU Member States with the rest. As a first step, the e-commerce productivity premium is estimated using pooled data for the complete sample including dummy variables to control for time and industry effects. The results obtained for the e-commerce productivity premia with an OLS estimator are shown in column 1 of Table 10. Then, using a similar specification, and in order to deal with some of the problems derived from having a dependent variable with extreme values, we use quantile regressions to assess the validity of the results in different positions of the distribution of the dependent variable. We run regressions at the 0.25, 0.5, 0.75 and 0.9 quantiles and the results are shown in columns 2, 3, 4 and 5 of Table 10. In a further step, we look at robust estimation⁹ of the e-commerce productivity premium, by means of which one can give a more precise account of outliers in the database¹⁰.

Results are reported in Table 9. The first column of the table shows the standard OLS estimation and indicates that the estimated export premium is positive, statistically significant and relevant from an economic point of view –e-commerce firms are on average (all things being equal) 3.4% more

⁹ Full robustness in a regression based on cross-section data can be achieved by using the so-called MM-estimator that can resist contamination of the data set of up to 50% of outliers (i.e., that has a breakdown point of 50 % compared to 0% for OLS (ordinary least squares)). A more detailed description of the method is beyond the scope of this report, but the interested reader can consult Verardi and Wagner (2011).

¹⁰ Productivity differences between firms can be related to other variables besides firm size and industry affiliation that are not included in the empirical model defined above to estimate the exporter productivity premium. Not controlling for these frequently unobserved factors can lead to biased estimates for the exporter premium. A standard solution for this problem that is widely used in the literature on the micro-econometrics of international firm activities is the estimation of fixed effects models for panel data. For obvious reasons, this approach is impossible for our analysis (Verardi and Croux, 2009).

productive than non-e-commerce firms¹¹. When we move up in the productivity distribution, the differences widen as well, passing from a premium of 0.7% in the 0.25 quantile to a 4% premium in the 0.9 quantile. When we use the robust estimator to avoid contamination from outliers, the estimated premium is still positive and statistically significant, though much lower in value terms (0.9%).

Table 9: Productivity premia (in %)						
	OLS	Quantile				MM Robust
		(0.25)	(0.5)	(0.75)	(0.9)	
E-commerce	3.4	0.7	1.3	2.3	4.0	0.9
Online exporter	3.6	0.9	1.5	3.8	7.5	1.1

Source: own estimations with data from Flash Eurobarometer 413.

For the analysis of cross-border e-commerce premia, we follow a similar strategy. First, the online exporter's productivity premium is estimated using OLS with the cross-section of firms. Second, we estimate quantile regressions in order to assess the differential effects by means of parameter estimates at different positions of the distribution of the dependent variable. Finally, we use robust estimation to take into account more accurately the problem of outliers.

Estimation results for the online exporter productivity premium are shown in the second row of Table 9. Results from the OLS estimator are in column 1 while results using quantile regressions are reported in columns 2, 3, 4 and 5. Overall, the picture is similar to the results already presented. The estimated exporter premium is statistically different from zero, positive, and large from an economic point of view both for the OLS results (3.6%) and for the four considered quantiles, ranging from 0.9% for the lowest quantile (0.25) to 7.5% for the largest one (0.9). Column 6 of Table 9 gives the estimated results from the robust estimator. The estimated exporter productivity premium is again statistically highly significant and very large from an economic point of view. When controlling for outliers, the point estimate is smaller than the point estimate reported for the application of the non-robust standard approach using OLS (1.1%) but still significant in economic terms. These results are in line with previous findings concerning the exporter productivity premium in different countries and industries (Wagner, 2012; Vogel and Wagner, 2011; and Temouri et al., 2010).

Finally, Table 10 shows the results of the online exporter productivity premium by sector using the robust estimator to control for the presence of outliers in the data. From the table we can see that the

¹¹ The estimated coefficient for the e-commerce (cross-border e-commerce) dummy has been transformed by $100(\exp(\beta)-1)$. The transformation shows the average percentage difference in labour productivity (all things being equal) between e-commerce (cross-border e-commerce) and non-e-commerce (non-cross-border e-commerce).

premium is positive and statistically significant for three of the four sectors considered. The only sector where there are no productivity differences between online exporters and other firms is in accommodation and food. For the other three, the premium amounts to 1% in the case of manufacturing, 1.4% for wholesale and retail, and 1.1% in the information and communication activities.

Table 10: Online exporters' productivity premia, by sector (in %)

	Manufacturing	Wholesale and retail	Accommodation And food	Information and communication
Online exporter	1.0	1.4	0.3*	1.1

* Not statistically different from zero.

Source: own estimations with data from Flash Eurobarometer 413.

An important limitation of this analysis is not being able to control for firm fixed effects. We would need panel data to be able to take these into account. However, the findings described in this report are relevant and novel. The productivity premium for e-commerce firms and, more interestingly, for online exporters, is relevant. In sum, online exporters, according to these results, tend to be approximately 2% more productive than offline-exporters. Although this figure seems plausible, productivity differences between firms could be related to other variables besides firm size and industry affiliation that are not included in the empirical model to estimate the exporter productivity premium, either because information is missing or because they are unobservable to a researcher. More research would be needed to address this issue.

6 Productivity and specialisation

In this section, we look into some sector specificities that have not been properly analysed in previous sections. In particular, we look at the relationship between online revealed and estimated comparative advantages at the sector and country levels. Previous empirical evidence on the internationalisation of firms shows that countries generate more highly productive firms (and therefore internationalised firms) in some industries than in others. In order to elucidate these differences, explanations rely on national specificities of the entry and exit process at the industry level as a key driver of international competitiveness.

So far, firm-level evidence (Melitz and Ottaviano, 2007) has shown that, while low-performing firms are active in their own domestic markets only, better performing ones are also active in foreign markets. The more efficient these firms are, the more they sell abroad thanks to richer product lines and more numerous destinations. A country's penetration of foreign markets is thus mainly driven by those

extensive margins. How do we reconcile this recent firm-level view with the traditional macro-view of aggregate export performance as determined by countries' inter-industry cost differentials?

In the traditional view, a country specialises in the production of those goods that its firms are able to supply at a relatively low cost compared with their competitors in other countries. This pattern of specialisation in production then implies a corresponding pattern of specialisation in exports: a country is a (net) exporter of the products in which it exhibits a relative ('comparative') cost advantage. Accordingly, the observed pattern of trade can be used to infer a country's pattern of comparative advantage (and disadvantage) across industries. This is the idea behind the 'index of revealed comparative advantage' (henceforth, simply RCA) defined as:

$$(1) \quad RCA = \frac{X_{cs}/X_s}{X_{ws}/X_w}$$

where X refers to exports, c is the country label, s is the industry¹² label and w is the label for the group of countries under consideration (in our case the EU-26). The index is larger (smaller) than one if the exports of country c are more (less) specialised in industry s than the exports of the other countries. In this case, country c is said to exhibit a revealed comparative advantage (disadvantage) in industry s. In addition, since this index is not bounded from above, it is common to normalise it to restrict its values to between -1 and 1 as follows:

$$(2) \quad SRCA = \frac{RCA-1}{RCA+1}$$

where SRCA stands for Symmetric RCA. Figure A6 in the Annex plots the SRCA calculated for online and offline exports for the EU-26 countries included in the survey. Looking at the different panels of the graph, some patterns emerge. For instance, one group of countries (Germany, Finland, Netherlands, and Sweden, among others) show many sectors in the upper-left part of the graph. This means that its online export specialisation is on average higher than the corresponding offline export specialisation in those sectors. The opposite is true for the group of countries including Spain, France, Latvia, Lithuania, and others. In these countries, the majority of sectors lie in the bottom-right area of the plot, meaning that their offline export specialisation is higher than the corresponding online specialisation in those sectors. The other EU countries included in the survey fall between these two extremes.

¹² In this section, we use the NACE classification at two digit level, which in our case gives us information for 35 different sectors. A list of these sectors is included in Table A10 in the annex.

On the other hand, Figure A7 in the Annex plots the SRCA of selected countries against their index of ‘estimated comparative advantage’ (ECA) across several sectors included in the survey. The ECA is defined as:

$$(3) \quad ECA = \frac{P_{cs}/P_s}{P_{ws}/P_w}$$

where P is productivity, c is the country label, s is the industry label and w is the label for the group of the countries under consideration (the EU-26 as in the previous case). The index is larger (smaller) than one if country c is relatively more (less) productive in industry s than the other countries. In this case, country c is said to exhibit an estimated comparative advantage (disadvantage) in industry s. As in the previous case, the index was normalised to restrict its values between -1 and 1 (see formula 2), and is termed Symmetric ECA (SECA).

The different panels of the figure reveal a somewhat positive correlation between the online SRCA and SECA. The latter is obviously only a crude measure of comparative advantage in online trade, as it does not take into account important determinants of international competitiveness such as differences in factor prices and accessibility across countries. Nevertheless, the figure creates a bridge between the micro and the macro perspectives.

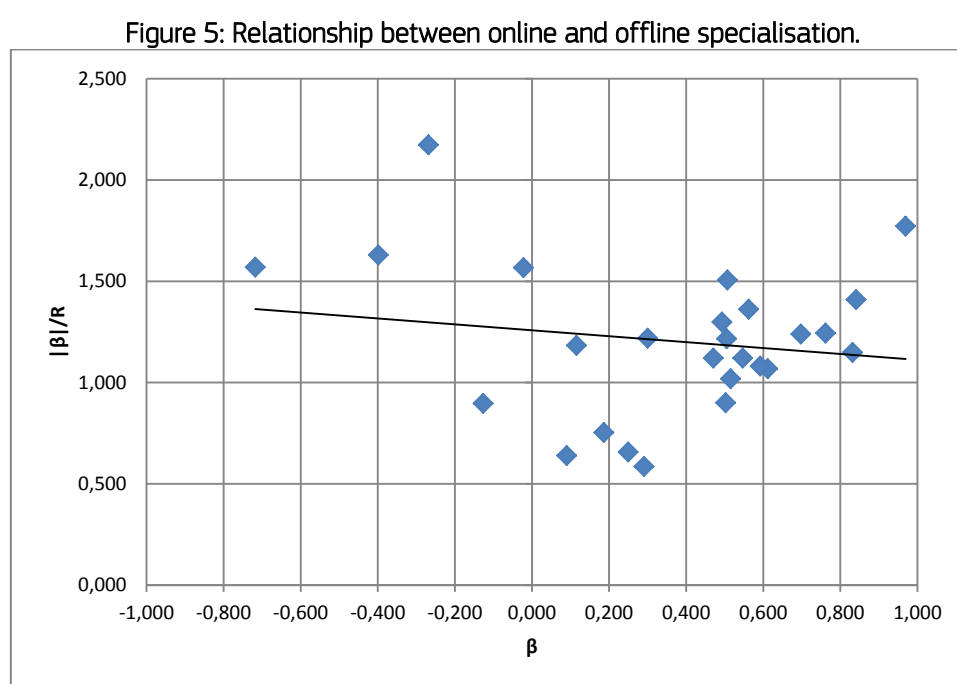
We have already established that countries generate larger numbers of highly productive firms in some industries than in others. As these are the firms that will be able to compete in international markets, the aggregate online export performance of a country is therefore better in some industries than in others. This confirms that national specificities of the entry and exit process at the industry level also constitute the key driver of international competitiveness in online internationalisation. Hence, we have provided evidence that the relative online export performance of countries at the macro level is positively correlated with the relative productivity of their firms measured at the micro level.

But what is the relationship between online and offline specialisation? In order to answer this question, we rely on a regression methodology that relates both measures¹³. The degree of specialisation similarity can be tested by means of the following regression equation (country by country):

$$SRCA_{ij}^{online} = \alpha_i + \beta SRCA_{ij}^{offline} + \epsilon_{ij}$$

¹³ The methodology will only briefly be presented in this paper, while the reader can consult Dalum, Laursen and Villumsen (1998) in particular (or Cantwell, 1989), for further details.

The superscripts Online and Offline refer to the activities carried out by the firms, respectively. The dependent variable, SRCA of online activities for firm i in sector j , is tested against the independent variable which is the value of the offline SRCA. Here, α and β are standard linear regression parameters and ϵ is a residual term. Basically, the size of β measures how similar the online specialisation pattern of a country is with respect to its offline specialisation pattern. If β is low, one can talk about a small degree of specialisation overlap, while the specialisation pattern can be said to be identical if β is not significantly different from one. In addition, β/R , where R is the correlation coefficient from the regression, would measure whether the level of specialisation is higher online than offline. If $\beta/R > 1$, online specialisation is higher, while offline specialisation is higher if $\beta/R < 1$. Figure 5 shows the results (which are also presented in Table A5 in the Annex).



Source: own elaboration with data from Eurobarometer 413 and results from table A5.

The figure shows that there are three groups of countries:

- i) those that show a degree of online specialisation similar to their offline specialisation (values of β close to one);
- ii) those that show slightly different specialisation patterns from their offline or traditional specialisation (values of β between 0 and 0.5) and;
- iii) those that have totally different specialisation configurations online than they do offline (negative values of β).

The downward sloping relationship between the similarity of specialisation patterns and the overall intensity of specialisation shows that those countries more specialised in online activities are those countries where the similarity with the offline specialisation is lower. However, the majority of countries

tend to be more specialised online than offline, a result given by the fact that the scope of online activities still tends to be more limited than that of traditional trade activities.

7. Barriers to cross-border e-commerce

In this section, we turn our attention to the effects of the barriers on cross-border e-commerce between the different Member States. We follow a two-step strategy, as is typically done in traditional international trade models (Mayer and Ottaviano, 2007). First, we estimate the impact of the barriers on a firm's decision to sell across the border. This is equivalent to the number of firms that sell cross-border– the extensive margin. The decision to sell implies a medium to long-term strategic decision by the firm to be present in export markets. Clearly, perceived barriers will play an important role in this decision. The decision is a binary variable, taking the value 1 if the firm is selling online cross border and 0 otherwise. The appropriate estimation methodology is a logit or probit regression model that assesses the impact of a series of independent explanatory variables which include the respondents' perceptions of the barriers to the probability of engaging in online trade. Formally, we assume that there is an auxiliary random variable, so that:

$$Y^* = X'\beta + \varepsilon$$

where $\varepsilon \sim N(0,1)$. X is a vector that contains variables representing firms' characteristics and the perceived barriers. Y can then be viewed as an indicator for whether this latent variable is positive:

$$Y = \begin{cases} 1 & \text{if } Y^* > 0 \\ 0 & \text{Otherwise} \end{cases}$$

Given data on these observations, the model is estimated by Maximum Likelihood. We expect to find negative signs for the estimated coefficients for the barrier dummy variables in the regression analysis: a barrier would normally reduce the propensity to sell across the border.

The second step seeks to explain the impact of these perceived barriers on the volume of cross border e-commerce –the intensive margin of cross-border trade. Volume is measured as the share of total cross-border e-commerce; hence it is a variable that can take any value in the interval [0-100]. Here we also expect to see negative signs on the coefficients for the barrier dummy variables in the regression analysis. We use a generalised linear regression model (Papke and Wooldridge, 1996) to allow non-normally distributed errors, as is the case for shares. In a generalized linear model (GLM), each outcome of the dependent variables, Y , is assumed to be generated from a particular distribution in the exponential family (a large range of probability distributions that includes the normal, binomial, Poisson

and gamma distributions, among others). The mean, μ , of the distribution depends on the independent variables, X , through:

$$E(Y) = \mu = g^{-1}(X\beta)$$

where $E(Y)$ is the expected value of Y ; $X\beta$ is the linear predictor, a linear combination of unknown parameters β ; g is the link function. As before, this model is usually estimated by Maximum Likelihood. While both the extensive and intensive margin models use the same explanatory variables, we expect to see differences in the coefficients between the two.

The right-hand side dependent variables in the regression models are more objectively measurable factors while the explanatory variables include more subjective perceptions of the relative importance of barriers to cross-border trade. By combining the two in a single regression, we check which perceived barriers have a statistically significant impact on actual firm behaviour. Respondents may have flagged some barriers as relevant but if this does not transpire in firms' actual behavioural outcomes the regression analysis will demonstrate the statistical insignificance of these barriers. We also run the regressions separately for firms' cross-border sales and purchases.

We run the regression analysis by firm size group because we expect to see differences in the relative importance of barriers between small and large firms, based on the findings from traditional offline trade. It is important to highlight that when the regressions are run on the weighted sample data, all statistical significance disappears. We discard these results because we have no information on the weightings carried out by TNS and prefer the original un-weighted data.

Small firms have a harder time coping with fixed cost barriers because they cannot write off these fixed costs over a large market size. The traditional trade literature also finds that there are few exporting firms and their distribution is highly skewed: exporters are bigger, generate higher value added, pay higher wages, employ more capital per worker and more skilled workers and have higher productivity than non-exporting firms (Mayer and Ottaviano, 2007). In theory, e-commerce should bring trade costs down, in particular those related to transport (in terms of time), search costs, information costs, and distribution costs. To what extent this expected reduction in trade costs suffices to engage more and smaller firms in international trade or deepen their internationalisation is an empirical research question that we address in this study.

7.1 Barriers to engage in cross-border e-commerce (extensive margin)

In this section, we will first refer to the results associated with the characteristics of firms, which are common for the analysis of selling and buying online across the border. Secondly, we discuss the specific results regarding the barriers firms face vis-à-vis their decision to engage in cross-border sales or to carry out cross-border purchases. Tables A6 and A7 in the Annex, respectively, show the full set of results. The first column displays the overall (aggregated) results; the following columns show the results by firm size. Stars next to the coefficients show the level of statistical significance. As can be observed, in general many coefficients are not significant and should be considered as zero (i.e., having no effect on the decision to sell or buy across the border). The table shows the marginal effects or the impact of each of the independent variables on the probability of doing cross-border e-commerce.¹⁴

Contrary to our expectations, Tables A6 and A7 show that size and age have no impact on the companies' decisions to sell or buy cross-border. This is a somewhat strange result since the importance of firm size in online exports has been confirmed by other studies (Alaveras & Martens, 2015). In this respect, little is known about the role of size for online imports. Since we are dealing with marginal effects, an alternative interpretation is that size and age do not affect the probability of engaging in cross-border sales and purchases. Hence, factors other than size and age should have a more relevant role in these decisions.

For instance, distribution channels do have an impact. Firms using their own websites or third-party platforms are more likely to sell cross-border, particularly micro and small firms. This effect disappears for medium-sized firms and even turns negative for large firms. Firms using their providers' websites are more likely to be purchasing across the border. This factor is driven exclusively by micro firms. Firms using EDI-type channels to purchase electronically are also more likely to buy across the border, a result mainly driven by small firms. The use of small platforms seems to be correlated with the probability of large firms buying from other EU countries online, consistent with anecdotal evidence on the role of B2B platforms for intermediate goods transactions.

The type of products sold by firms also has no significant impact on cross-border e-commerce. This result is surprising since we are considering specifically two categories in which firms sell digital services online. Apparently, these firms are focused exclusively on their domestic markets, or other factors like copyright laws restrict them from selling across the border. A possible alternative explanation is that most firms declare they are engaged in several activities at the same time, and these multiple answers could have an effect on the estimated coefficients. Here it would be interesting to explore the effects of diversification on the decision to sell across the border. On the other hand, firms selling goods to

¹⁴ More detailed results are available from the authors upon request.

consumers are less likely to buy cross-border while firms selling goods to firms are more prone to cross-border electronic purchases, again consistent with a B2B interpretation of these data. This last result is driven mainly by micro firms.

Results by sector show that taking the manufacturing sector as a reference, firms in the accommodation and food sector, basically related to tourism activities, are more likely to place their services across the border. This result is consistent for any size class within this sector. No significant differences are found for the remaining sectors, except for the case of large firms in the wholesale and retail trade sector, which are less likely than their manufacturing counterparts to engage in cross-border online sales.

In terms of the barriers to cross-border online sales, the results including the full sample show that the strategic decision to sell across the border is related to three barriers: high delivery costs; suppliers' restrictions to selling abroad; and the cost of resolving complaints and disputes (see Table 11 for a summary by firm size). According to these results, lowering the delivery costs could represent an increase of 7.5% in the number of firms engaged in selling online across the border. Similarly, getting rid of the vertical restrictions imposed by suppliers would boost the number of firms selling online by 10.6%. Finally, an additional 9% in the number of firms selling online cross-border could be achieved by lowering the costs of resolving cross-border complaints and disputes. However, the incidence of these barriers differs across firm size. For instance, delivery costs are more relevant for larger firms. Suppliers' restrictions and dispute resolution costs matter only for smaller firms. Other statistically significant barriers include copyright in the case of micro firms; and taxation and product labelling costs for small firms. It should be noted that the effects by firm size are more important than the results at the aggregated level. For instance, removing the restrictions imposed by suppliers could increase the number of small firms selling online across the border by 40%.

Table 11: Statistically relevant barriers to cross-border e-commerce sales by firm size: extensive margin

Barrier	Firm size			
	Micro	Small	Medium	Large
Delivery costs are too high			-15.3%	-17.8%
Copyright prevents you from selling abroad or is too expensive to sell abroad	-14.6%			
Dealing with foreign taxation is too complicated or too costly		-21.1%		
Your product labelling has to be adapted		-13.3%		
Your suppliers restrict or forbid you to sell abroad		-40.2%		
Resolving complaints and disputes cross-border is too expensive	-9.8%	-10.5%		

Source: own estimations with data from Flash Eurobarometer 413.

Turning to purchases, the three main relevant barriers for cross-border purchases are related to security of payments, language skills and the cost of resolving complaints and disputes. The elimination of these barriers would increase the number of firms engaging in online purchases across the border by 5%, 7%

and 12%, respectively. As before, these barriers are more relevant for smaller than for larger firms, with the exception of dispute resolution, which was also found to be significant for large firms (see table 12).

Table 12: Statistically relevant barriers to cross-border e-commerce purchases by firm size: extensive margin

	Firm size			
	Micro	Small	Medium	Large
Payments to other countries are not secure enough	-7.7%			
You lack the language skills for dealing with foreign countries	-6.7%			
Resolving complaints and disputes cross-border is too expensive	-14.0%	-9.6%		-21.5%

Source: own estimations with data from Flash Eurobarometer 413.

These results indicate that some barriers are statistically significant but with a puzzling positive sign. In the aggregated results for online sales these are data protection concerns and firms' slow internet connection; while in the case of online purchases this only occurs for product labelling. This also happens for some other barriers with the results disaggregated by firm size. However, a positive sign suggests that a barrier actually increases cross-border trade. This is implausible. We therefore discard these results.¹⁵

7.2 Barriers that limit the volume of cross-border e-commerce (intensive margin)

In this section, we look at the effects of barriers on the volume of cross-border sales and purchases. As we did in the previous section, we first briefly offer an overview of the effects of the different firm's characteristics and then we proceed to a more detailed analysis of the incidence of the different barriers on cross-border volumes of sales and purchases, respectively. The main results are presented in Tables A8 and A9 in the annex. As before, the first column shows the aggregated results, while the following columns display the results by firm size. The table shows the marginal effects or the impact of each of the independent variables on the share of cross-border e-commerce over total trade. Statistically significant coefficients have stars attached to them.

Results from Tables A8 and A9 show that firm size is positively correlated with online export intensity. Hence, larger firms generate a larger share of revenue from online exports than smaller firms. However, this is not the case with online imports. In the case of the intensive margin, age is not significant in both equations. In addition, in the overall results the different distribution channels have no effect. However, medium-sized firms using large platforms are likely to have higher shares of cross-border e-commerce sales. The same correlation occurs with EDI-type transactions and large firms.

¹⁵ This result could also arise from problems related to the appropriate definition of the sample. Unfortunately, we are not able to appropriately control for biases included in the sample.

The different activities carried out by firms are seldom relevant. In the overall sample, only those firms that sell goods to consumers are less likely to sell online across the border, a result that is mainly driven by the smaller size classes (micro and small). In addition, medium-sized firms selling goods to firms are also less likely to go online across the border. The rest of the activities do not show significant correlations with the decision to engage in cross-border e-commerce. However, if we look at purchases, the type of market matters more, since firms selling goods to consumers and firms selling traditional services to firms show a significantly lower intensity of cross-border purchases than firms performing other activities, and particularly traditional services to consumers. In terms of the differences by size-class, these results are again mainly driven by micro and small firms, whereas medium-sized firms selling services to consumers carry out more online cross-border purchases.

Taking the manufacturing sector as a reference, firms in the wholesale and retail trade and in the information and communication industries are less likely to sell online across the border. This result applies to all size classes except micro firms in the case of wholesale and retail and only to medium-sized firms in the information and communication sector. However, firms in the accommodation and food industry are more likely to do cross-border e-commerce, a result driven particularly by micro firms. In terms of purchases, both accommodation and food and information and communication sectors are less likely to purchase across the border (with respect to the baseline of the manufacturing sector), while the opposite is true for wholesale and retail activities.

Looking at the effects of barriers on export intensity, the results indicate that five barriers are statistically significant: i) delivery costs; ii) guarantees and returns; iii) foreign taxation; iv) suppliers' restrictions to selling abroad; and v) product and/or services specificity. In this case too, these barriers have more impact on smaller firms than on larger ones (See Table 13). Of these five relevant barriers, only guarantees and returns are correlated with the export intensity of large firms. In the case of large firms, there are two additional barriers: knowledge about the rules to be followed and interoperability issues. Security of payments is a relevant barrier for medium-sized firms and language skills for small firms.

By removing any of these barriers at the aggregate level, the volume of cross-border sales could increase: from 3.2% in the case of lowering the costs of guarantees and returns, to 6% if the restrictions imposed by suppliers were effectively eliminated.

Table 13: Relevant barriers to cross-border e-commerce sales by firm size: intensive margin

	Firm size			
	Micro	Small	Medium	Large
Delivery costs are too high	-4.2%		-13.5%	
Guarantees and returns are too expensive				-25.1%
You don't know the rules which have to be followed				-45.1%
Payments from other countries are not secured enough			-15.1%	
Dealing with foreign taxation is too complicated or too costly	-5.4%			
You lack the language skills to deal with foreign countries		-7.1%		
Your suppliers restrict or forbid you to sell abroad		-10.7%	-21.8%	
For reasons of interoperability, you cannot provide your products/services				-17.2%
Your products and/or services are specific to your local market		-11.4%		

Source: own estimations with data from Flash Eurobarometer 413.

The results from the analysis of cross-border online purchases show that in aggregate terms, language skills and the cost of disputes are correlated with a low intensity of online cross-border purchases. Language skills affect all size classes negatively except large firms. The costs of complaints and disputes resolution have an effect on the intensity of cross-border electronic purchases of both micro and large firms. As can be seen in Table 14 –a summary of the results by firm size– large firms also face the additional barrier of high delivery costs and medium-sized firms' concerns about protection of their data seem to be also negatively affecting their share of online purchases across the border.

Table 14: Relevant barriers to cross-border e-commerce purchases by firm size: intensive margin

	Firm size			
	Micro	Small	Medium	Large
Delivery costs are too high				-14.8%
Payments to other countries are not secure enough	-3.6%			
You lack the language skills for dealing with foreign countries	-5.3%	-7.1%	-8.7%	
Resolving complaints and disputes cross-border is too expensive	-9.9%			-18.1%
You are concerned your data is not well protected when purchasing abroad			-6.8%	

Source: own estimations with data from Flash Eurobarometer 413.

8 Conclusions

The main objective of this study was to identify the barriers to cross-border e-commerce in the EU that really matter from a firm's perspective. We find that the most relevant barriers to cross-border sales, including the firm's decision to export and the resulting volume of online sales, are delivery costs and suppliers' restrictions. The most important barriers to a firm's cross-border online purchases are the lack of language skills and the costs associated with resolving complaints and disputes across the border. Other barriers appear to be less important or only significant for specific firm sizes, such as dealing with foreign tax regulation, or the security of payments, among others. A fully-integrated Digital Single Market would be facilitated by removing these barriers.

We have also examined several dimensions of the process of internationalisation of European online firms. We have detected some stylised facts that correspond with evidence from the literature on offline firms. We find that aggregate online exports are driven by a few top exporters, that the share of exports in turnover remains limited and that the number of online exporters is one of the main determinants of aggregate online exports. We have also provided original evidence related to online export productivity premiums and the relationship between online and offline specialisation patterns. Many of these findings are in line with those from offline cross-border trade research (Mayer and Ottaviano, 2007) where smaller firms find it harder to meet the fixed costs associated with cross-border trade. According to the present survey data, channelling sales through an established online platform does not really seem to make it any easier for small firms to overcome these costs: they still need to deal with many issues.

The results presented in this report help to identify relevant Digital Single Market policy implications:

- What matters most for a country's online trade performance is the number of firms that engage in exporting. Hence, policies should focus on expanding the online export base, particularly by making it easier for small and medium-sized firms to export online.
- Even though they seem to be few and small, the costs associated with online internationalisation matter because they reduce the number of exporters significantly. Hence, measures that efficiently remove these barriers would help to foster cross-border e-commerce.
- Some sectors have greater unexploited export potential than others. They are characterised by a larger presence of small, low-productivity firms. They are more likely to react to online import competition through the exit of the worst-performing firms and therefore have greater potential for unexploited productivity gains.

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Annex:

Table A1: Triprobit estimations of e-commerce target markets

	Domestic	E-commerce Cross-border	Rest world
Size (baseline: micro firms)			
Small	0.380*** (0.0766)	0.0354 (0.0534)	-0.00717 (0.0581)
Medium	0.382*** (0.114)	-0.0226 (0.0671)	0.0325 (0.0697)
Large	0.572*** (0.188)	0.109 (0.0948)	0.0543 (0.0990)
Young	0.146 (0.0934)	0.0938 (0.0610)	-0.0917 (0.0684)
Own website	0.259*** (0.0851)	0.236*** (0.0566)	0.196*** (0.0613)
Small platform	0.200*** (0.0761)	0.182*** (0.0498)	0.169*** (0.0516)
Large platform	0.579*** (0.0935)	0.272*** (0.0506)	0.185*** (0.0537)
EDI type	0.335*** (0.102)	0.0656 (0.0530)	0.0597 (0.0554)
Goods to consumers	0.415*** (0.0708)	-0.227*** (0.0525)	-0.168*** (0.0591)
Goods to firms	-0.0659 (0.0644)	0.0380 (0.0543)	-0.00704 (0.0578)
Digital services to consumers	0.268** (0.123)	0.108 (0.0838)	0.167* (0.0908)
Digital services to firms	-0.159 (0.110)	0.113 (0.0836)	0.0199 (0.0910)
Services to consumers	-0.196*** (0.0687)	0.0939 (0.0625)	0.00883 (0.0709)
Services to firms	0.153** (0.0647)	-0.0671 (0.0602)	-0.00199 (0.0690)
Structure (baseline: independent)			
National group	0.456** (0.202)	-0.0780 (0.0798)	-0.107 (0.0856)
International group	-0.113 (0.116)	0.0298 (0.0754)	0.167** (0.0781)
Sector (baseline: manufacturing)			
Wholesale & retail	0.313*** (0.0649)	-0.289*** (0.0568)	-0.302*** (0.0627)
Accommodation and food	0.558*** (0.140)	0.570*** (0.0797)	0.651*** (0.0811)
Information and communication	0.303*** (0.0954)	-0.0375 (0.0805)	0.0804 (0.0829)
Constant	0.661*** (0.110)	-0.233*** (0.0870)	-0.798*** (0.0956)
Observations	3,489	3,489	3,489
ρ_{12}	-0.291***	(0.0538)	
ρ_{13}	-0.351***	(0.0475)	
ρ_{23}	0.800***	(0.0366)	

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table A2: E-commerce productivity premia

	OLS	Quantile				MM Robust
		(0.25)	(0.5)	(0.75)	(0.9)	
E-commerce	0.0332*** (0.0113)	0.00697*** (0.00191)	0.0127*** (0.00334)	0.0230*** (0.00736)	0.0388* (0.0202)	0.00852*** (0.00212)
Size	-1.07e-05 (3.37e-05)	2.49e-05*** (5.30e-06)	5.33e-05*** (1.02e-05)	0.000105*** (2.34e-05)	2.32e-05 (4.86e-05)	0.000113*** (2.24e-05)
Size ²	-5.76e-10 (4.63e-09)	-3.48e-09*** (6.14e-10)	-6.91e-09*** (1.32e-09)	-1.25e-08*** (2.82e-09)	-6.54e-09 (5.42e-09)	-3.53e-08*** (6.79e-09)
Constant	0.187*** (0.0119)	0.0355*** (0.00205)	0.0837*** (0.00356)	0.163*** (0.00737)	0.344*** (0.0190)	0.0698*** (0.00215)
Observations	6,922	6,922	6,922	6,922	6,922	6,922

Note: all regressions include sector fixed effects. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A3: Online exporters' productivity premia

VARIABLES	OLS	Quantile				MM Robust
		(0.25)	(0.5)	(0.75)	(0.9)	
Online exporter	0.0352** (0.0141)	0.00885*** (0.00232)	0.0152*** (0.00410)	0.0377*** (0.00934)	0.0727*** (0.0262)	0.0110*** (0.00284)
Size	-5.30e-06 (3.36e-05)	2.64e-05*** (5.26e-06)	5.65e-05*** (1.03e-05)	0.000109*** (2.33e-05)	2.38e-05 (4.84e-05)	4.74e-05*** (1.66e-05)
Size ²	-1.09e-09 (4.63e-09)	-3.63e-09*** (6.07e-10)	-7.25e-09*** (1.33e-09)	-1.29e-08*** (2.81e-09)	-6.61e-09 (5.36e-09)	-5.27e-09*** (1.63e-09)
Constant	0.194*** (0.0114)	0.0367*** (0.00196)	0.0859*** (0.00341)	0.165*** (0.00702)	0.346*** (0.0181)	0.0744*** (0.00200)
Observations	6,933	6,933	6,933	6,933	6,933	6,933

Note: all regressions include sector fixed effects. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A4: Online exporters' productivity premia, by sector

	Manufacturing	Wholesale and retail	Accommodation And food	Information and communication
Online exporter	0.0101*** (0.00380)	0.0140*** (0.00509)	0.00321 (0.00199)	0.0110** (0.00466)
Size	0.000200*** (2.72e-05)	0.000162*** (4.26e-05)	5.57e-05*** (1.63e-05)	4.16e-05 (2.78e-05)
Size ²	-1.94e-07*** (3.39e-08)	-7.11e-08** (2.91e-08)	-4.42e-08*** (1.01e-08)	-6.70e-09 (4.44e-09)
Constant	0.159*** (0.0122)	0.235*** (0.0259)	0.104*** (0.00636)	0.160*** (0.0159)
Observations	1,877	3,099	810	1,147

Note: all estimations performed with the MM estimator. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table A5: Online vs. offline specialisation, by country

	β	$ \beta /R$
Czech Republic	<u>0.969</u>	1.772
Portugal	0.841	1.409
Ireland	0.832	1.149
Netherlands	0.762	1.244
UK	0.697	1.240
Spain	0.612	1.068
Croatia	0.592	1.081
Latvia	0.562	1.362
Estonia	0.547	1.121
Belgium	0.515	1.019
France	0.507	1.506
Bulgaria	0.505	1.216
Slovenia	0.502	0.900
Greece	0.493	1.298
Austria	0.470	1.121
Italy	0.300	1.219
Denmark	0.291	0.586
Slovakia	0.250	0.657
Romania	0.187	0.753
Lithuania	0.115	1.183
Finland	0.090	0.639
Hungary	-0.022	1.567
Poland	-0.127	0.897
Germany	-0.269	2.174
Sweden	-0.399	1.630
Luxemburg	-0.718	1.570

Note: All coefficients statistically different from zero and from one at the 90% except bold coefficients, which are not statistically different from zero and underlined coefficients, which are not statistically different from one.

Source: own estimations with data from Eurobarometer 413.

Table A6. Barriers to cross-border e-commerce in the EU: decision to sell cross-border

	(1)Total	(2)Micro	(3)Small	(4)Medium	(5)Large
Log(Size)	0.00458				
Young	-0.0354	-0.0539	0.0343	0.142	
Channel:					
Own website	0.0645**	0.0773*	0.235***	0.0238	-0.341**
Small platform	0.0379	0.0632	0.140***	-0.0966	-0.0966
Large platform	0.0872***	0.148***	0.110*	0.0184	-0.0130
EDI type	0.0399	0.00997	0.0456	0.00384	0.0728
Market:					
Goods to consumers	-0.0383	-0.0403	0.0113	-0.0635	-0.0153
Goods to firms	-0.00599	0.0194	-0.120*	-0.0260	0.0133
Digital services to consumers	-0.0413	-0.102*	-0.0374	0.124	-0.542
Digital services to firms	0.0391	0.0461	0.0701	-0.0275	0.754
Services to consumers	0.0178	0.0665	0.0128	0.0463	-0.200*
Services to firms	-0.0153	-0.0135	0.0235	-0.0356	-0.157*
Sector (wrt manufacturing):					
Wholesale and retail trade	-0.0121	0.0379	-0.00751	-0.00349	-0.235***
Accommodation and food	0.270***	0.246***	0.429***	0.278**	
Information and communication	-0.0387	-0.0290	0.00787	-0.0274	0.0863
Barriers:					
Delivery costs are too high	-0.0747***	-0.0668	-0.0204	-0.153**	-0.178*
Guarantees and returns are too expensive	-0.0157	-0.0564	0.113*	-0.0844	0.0298
You don't know the rules which have to be followed	-0.0260	-0.0303	0.0886	-0.155	0.0371
Payments from other countries are not secured enough	-0.0450	-0.0518	-0.00790	-0.161	
Copyright prevents you from selling abroad or is too expensive to sell abroad	-0.0746	-0.146**	0.120	0.0318	-0.00921
Dealing with foreign taxation is too complicated or too costly	-0.0352	0.00892	-0.211***	-0.0473	-0.125
Your product labelling has to be adapted	-0.0271	-0.0648	-0.133*	0.0361	0.0906
You lack the language skills to deal with foreign countries	-0.000585	-0.00504	-0.0340	0.0582	0.301
Your suppliers restrict or forbid you to sell abroad	-0.106**	-0.0239	-0.402***	-0.139	0.171
Your suppliers do not allow you to use third platform to sell your products and/	-0.0229	0.00307	-0.109	0.144	
Your suppliers request you to sell abroad at a different price	0.0804	0.00217	0.226*	0.396***	-0.0757
You are concerned your data is not well protected when selling abroad	0.120**	0.143**	0.382***	-0.0531	-0.153
For reasons of interoperability, you cannot provide your products and/or service	-0.0398	-0.0796	0.0129	-0.0867	-0.0925
Your products and/or services are specific to your local market	-0.0202	-0.0186	-0.0139	0.371*	-0.167
Your company's Internet connection is not fast enough	0.105**	0.198***	-0.0773	0.0541	-0.0251
Clients abroad do not have a fast enough Internet connection	-0.0100	-0.0163	-0.101	-0.120	
Resolving complaints and disputes cross-border is too expensive	-0.0904***	-0.0980**	-0.105*	0.00198	-0.0622
Observations	1,376	701	344	223	91

Table A7. Barriers to cross-border e-commerce in the EU: decision to buy cross-border

	(1)Total	(2) Micro	(3) Small	(4)Medium	(5) Large
Log(Size)	0.00751				
Young	0.00762	0.00833	0.0357	-0.0208	
Channel:					
Provider website	0.0489***	0.0497**	0.0369	0.0681	-0.0696
Small platform	-0.00192	0.0127	-0.0590**	0.0301	0.126*
Large platform	0.0291*	0.00647	0.108***	0.0155	-0.0441
EDI type	0.0543***	0.0396	0.0663*	0.0694	-0.0875
Market:					
Goods to consumers	-0.0401**	-0.0305	-0.0390	-0.0672	-0.0995
Goods to firms	0.0460**	0.0530**	0.0570	-0.0424	0.136
Digital services to consumers	0.0285	0.0232	0.129*	-0.123	-0.181
Digital services to firms	0.0220	0.0216	-0.0581	0.141*	0.0352
Services to consumers	0.0209	0.0173	0.00892	0.0750	0.0264
Services to firms	0.00527	-0.00721	0.0723*	-0.0275	-0.0393
Sector (wrt manufacturing):					
Wholesale and retail trade	-0.00933	-0.0142	0.0348	-0.0206	0.0501
Accommodation and food	-0.0185	-0.0108	0.0278	-0.0751	-0.00169
Information and communication	-0.0240	-0.00898	-0.0281	-0.0611	-0.0111
Barriers:					
Delivery costs are too high	0.00151	0.00924	-0.0308	-0.00233	0.0503
Payments to other countries are not secure enough	-0.0508**	-0.0773***	-0.0351	-0.0364	0.178**
The product labelling has to be adapted	0.129***	0.144***	0.105**	0.104*	0.106
You lack the language skills for dealing with foreign countries	-0.0670***	-0.0675***	-0.0562	-0.0495	-0.112
Copyright prevents foreign suppliers from delivering to your country or makes it	-0.0150	-0.0334	-0.00248	0.0665	0.0777
Foreign suppliers refuse to deliver to your country	-0.00981	0.0172	-0.0505	-0.0525	-0.142
Resolving complaints and disputes cross-border is too expensive	-0.118***	-0.140***	-0.0964***	-0.0565	-0.215***
You are concerned your data is not well protected when purchasing abroad	0.0305	0.0389	0.0651*	-0.0537	0.0353
For reasons of interoperability, you cannot use foreign products and/or services	0.00668	-0.0107	0.0364	0.0305	0.0809
Observations	3,325	1,941	841	400	142

Table A8. Barriers to cross-border e-commerce in the EU: Volume of sales

	(1)Total	(2)Micro	(3)Small	(4)Medium	(5)Large
Log(Size)	0.00851**				
Young	0.0116	0.0179	0.000929	-0.0312	
Channel:					
Own website	-0.0150	-0.0171	0.0651	-0.0351	-0.0435
Small platform	-0.0149	0.00466	-0.00100	-0.0478	0.0122
Large platform	0.00219	-0.00358	-0.00898	0.0969***	0.00297
EDI type	0.00770	-0.0188	0.00968	-0.00780	0.174***
Market:					
Goods to consumers	-0.0603***	-0.0762***	-0.0334*	-0.0248	0.0269
Goods to firms	-0.00598	0.0174	-0.0259	-0.0976**	-0.0132
Digital services to consumers	-0.0311	-0.0343	-0.0292	-0.0839	0.0533
Digital services to firms	0.0260	0.0114	0.0673	-0.0184	0.0514
Services to consumers	0.0108	0.0436	-0.0339	-0.0441	-0.165
Services to firms	-0.0169	-0.0254	0.0276	0.0240	-0.0560
Sector (wrt manufacturing):					
Wholesale and retail trade	-0.0660***	-0.00784	-0.118***	-0.103**	-0.140**
Accommodation and food	0.0597*	0.0774**	0.0650	-0.0324	
Information and communication	-0.0727**	-0.0464	-0.0568	-0.171**	0.0230
Barriers:					
Delivery costs are too high	-0.0486**	-0.0420**	-0.00595	-0.135**	-0.0390
Guarantees and returns are too expensive	-0.0321*	-0.0117	0.0104	-0.0995	-0.251***
You don't know the rules which have to be followed	0.0116	0.000625	0.0631	-0.000154	-0.451***
Payments from other countries are not secured enough	-0.0256	-0.0253	0.0376	-0.151*	
Copyright prevents you from selling abroad or is too expensive to sell abroad	0.00710	-0.0553	0.0735	0.181	0.312**
Dealing with foreign taxation is too complicated or too costly	-0.0497**	-0.0536**	-0.0784	-0.0376	0.138**
Your product labelling has to be adapted	-0.0172	-0.0449	0.000166	-0.185	0.387***
You lack the language skills to deal with foreign countries	-0.0161	-0.0114	-0.0709*	0.0288	0.193***
Your suppliers restrict or forbid you to sell abroad	-0.0595**	-0.0234	-0.107*	-0.218***	0.0815
Your suppliers do not allow you to use third platform to sell your products and/	0.0441	0.0261	0.00625	0.161**	
Your suppliers request you to sell abroad at a different price	0.0497*	0.0216	0.0554	0.101*	0.253**
You are concerned your data is not well protected when selling abroad	0.0494**	0.0897***	0.0445	0.0491	-0.00874
For reasons of interoperability, you cannot provide your products and/or service	0.0178	0.00930	0.00956	0.115	-0.172*
Your products and/or services are specific to your local market	-0.0517*	-0.0255	-0.114***	-0.122	-0.204
Your company's Internet connection is not fast enough	0.0488**	0.0676**	0.0361	0.0439	-0.175
Clients abroad do not have a fast enough Internet connection	-0.0194	-0.0339	-0.0401	0.0466	
Resolving complaints and disputes cross-border is too expensive	-0.000105	0.00820	0.0107	-0.0288	-0.255
Observations	1,376	701	344	223	91

Table A9. Barriers to cross-border e-commerce in the EU: Volume of purchases

	(1)Total	(2)Micro	(3)Small	(4)Medium	(5)Large
Log(Size)	-0.00134				
Young	0.0262	0.0240	0.0377	0.000779	
Channel:					
Provider website	0.00235	0.0119	0.000419	0.00234	-0.0639
Small platform	-0.0198	-0.0104	-0.0205	-0.0401	0.00173
Large platform	-0.0131	-0.0138	0.00147	-0.0135	-0.0375
EDI type	0.00999	-0.0163	0.0313	0.0224	-0.0320
Market:					
Goods to consumers	-0.0371**	-0.0307	-0.0677***	-0.0329	-0.0375
Goods to firms	0.0218	0.0149	0.0740***	-0.00739	-0.0419
Digital services to consumers	-0.0260	-0.0165	-0.0183	-0.0880	-0.0873
Digital services to firms	0.0213	-0.00433	0.0442	0.0487	0.0805
Services to consumers	0.0325*	0.0265	0.0236	0.146***	0.0611
Services to firms	-0.0282**	-0.0458**	0.00876	-0.0366	0.0252
Sector (wrt manufacturing):					
Wholesale and retail trade	0.0330*	0.0376*	0.0841**	-0.0405	0.00508
Accommodation and food	-0.0516*	-0.0206	-0.0316	-0.212***	-0.154
Information and communication	-0.0521***	-0.0381	-0.0137	-0.138***	-0.172*
Barriers:					
Delivery costs are too high	-0.0133	-0.0143	0.00507	-0.00984	-0.148**
Payments to other countries are not secure enough	-0.0175	-0.0365*	-0.0201	0.0427	0.0663
The product labelling has to be adapted	0.0201	0.0181	0.0331	-0.00701	0.0789
You lack the language skills for dealing with foreign countries	-0.0620***	-0.0534***	-0.0713***	-0.0874**	-0.0345
Copyright prevents foreign suppliers from delivering to your country or makes it	-0.0162	-0.0222	-0.0270	0.0486	-0.0240
Foreign suppliers refuse to deliver to your country	0.0282	0.0280	0.0162	0.0156	0.0955
Resolving complaints and disputes cross-border is too expensive	-0.0743***	-0.0987***	-0.00560	-0.0577	-0.181***
You are concerned your data is not well protected when purchasing abroad	0.00691	0.0103	0.0359	-0.0680**	0.0666
For reasons of interoperability, you cannot use foreign products and/or services	-0.00542	-0.00968	-0.0130	0.0113	0.0313
Observations	3,325	1,941	841	400	142

Table A10. Sectors at the 2 digit NACE classification

Code	Sector
10	Manufacture of food products
11	Manufacture of beverages
12	Manufacture of tobacco products
13	Manufacture of textiles
14	Manufacture of wearing apparel
15	Manufacture of leather and related products
16	Manufacture of wood and of products of wood and cork
17	Manufacture of paper and paper products
18	Printing and reproduction of recorded media
19	Manufacture of coke and refined petroleum products
20	Manufacture of chemicals and chemical products
21	Manufacture of basic pharmaceutical products
22	Manufacture of rubber and plastic products
23	Manufacture of other non-metallic mineral products
24	Manufacture of basic metals
25	Manufacture of fabricated metal products
26	Manufacture of computer, electronic and optical products
27	Manufacture of electrical equipment
28	Manufacture of machinery and equipment n.e.c.
29	Manufacture of motor vehicles, trailers and semi-trailers
30	Manufacture of other transport equipment
31	Manufacture of furniture
32	Other manufacturing
33	Repair and installation of machinery and equipment
45	Wholesale and retail trade and repair of motor vehicles and motorcycles
46	Wholesale trade, except of motor vehicles and motorcycles
47	Retail trade, except of motor vehicles and motorcycles
55	Accommodation
56	Food and beverage service activities
58	Publishing activities
59	Motion picture, video and television production, sound recording and music publishing activities
60	Programming and broadcasting activities
61	Telecommunications
62	Computer programming, consultancy and related activities
63	Information service activities

Figure A1: Structure of the survey

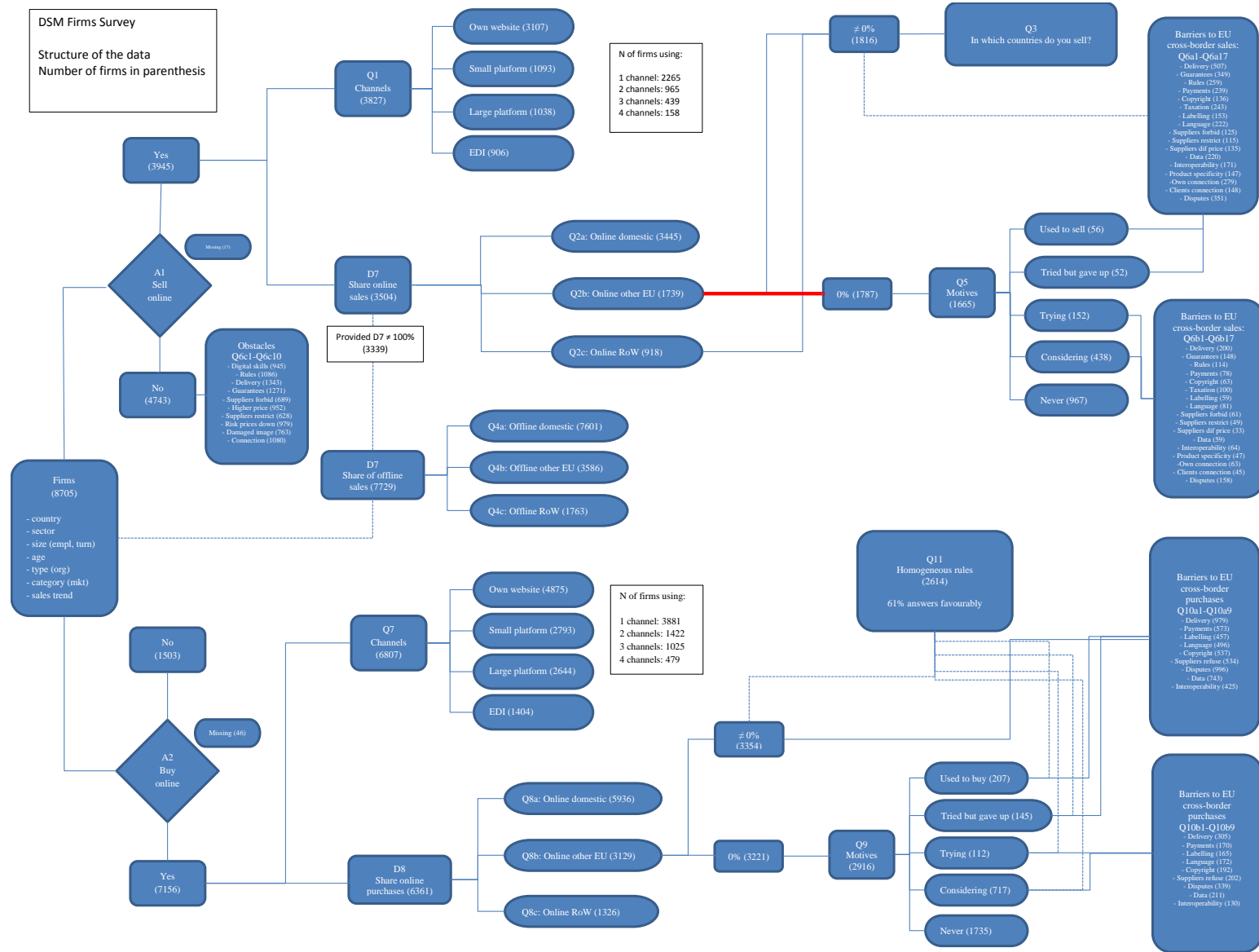
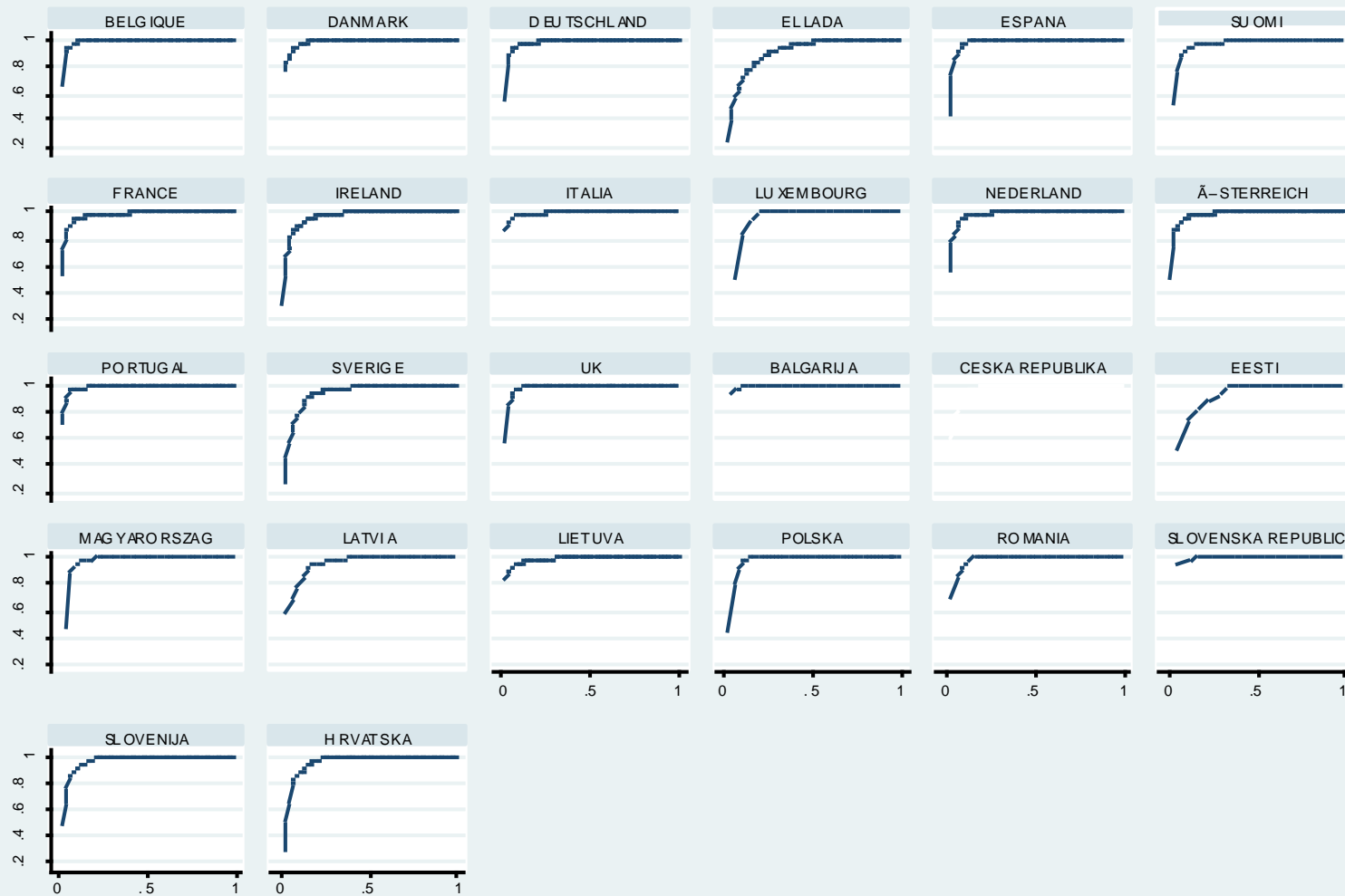


Figure A2: Online export concentration



Cumulative share of firms

Graphs by B Country

Figure A3a: Structure of online sales by target markets and firm size

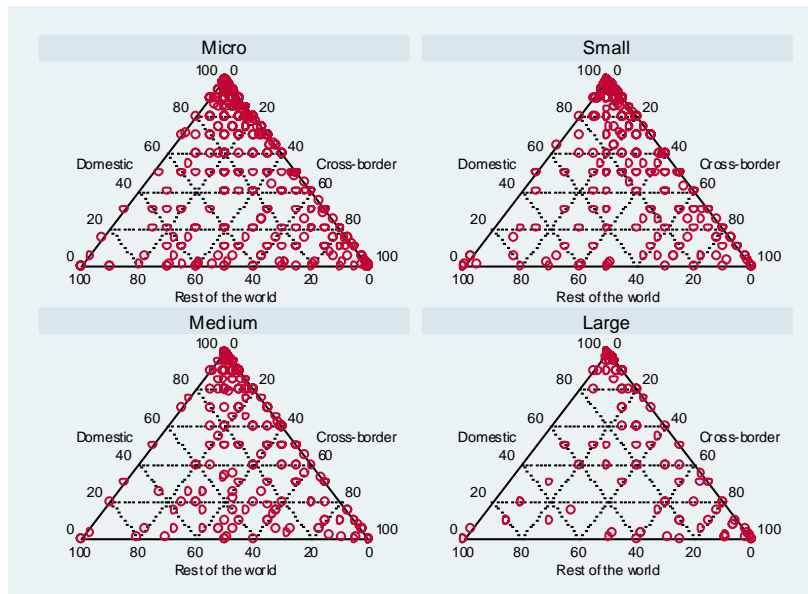


Figure A3b: Structure of online sales by target markets and sector

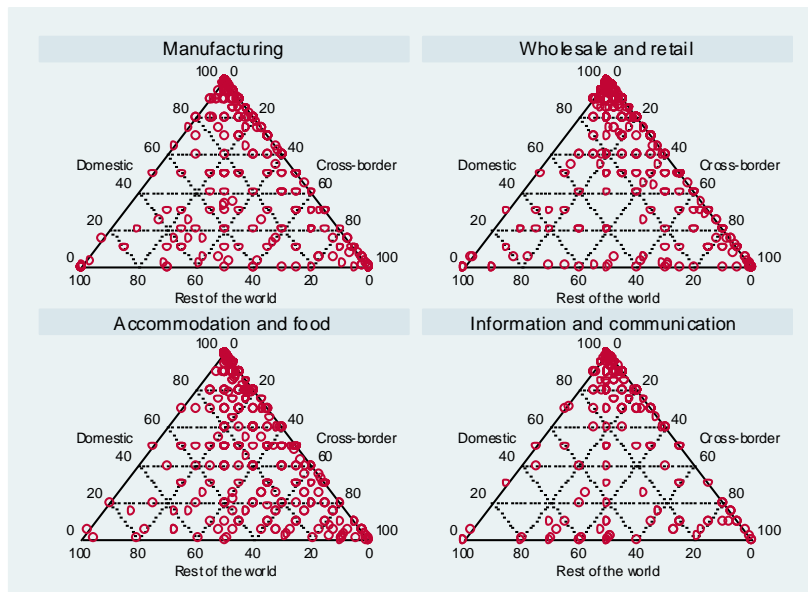


Figure A4a: Structure of offline sales by target markets and firm size

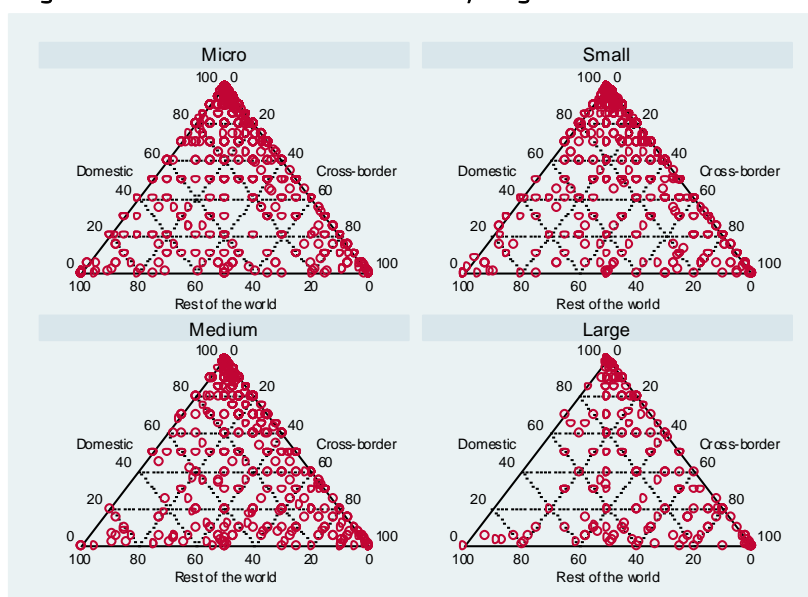


Figure A4b: Structure of offline sales by target markets and sector

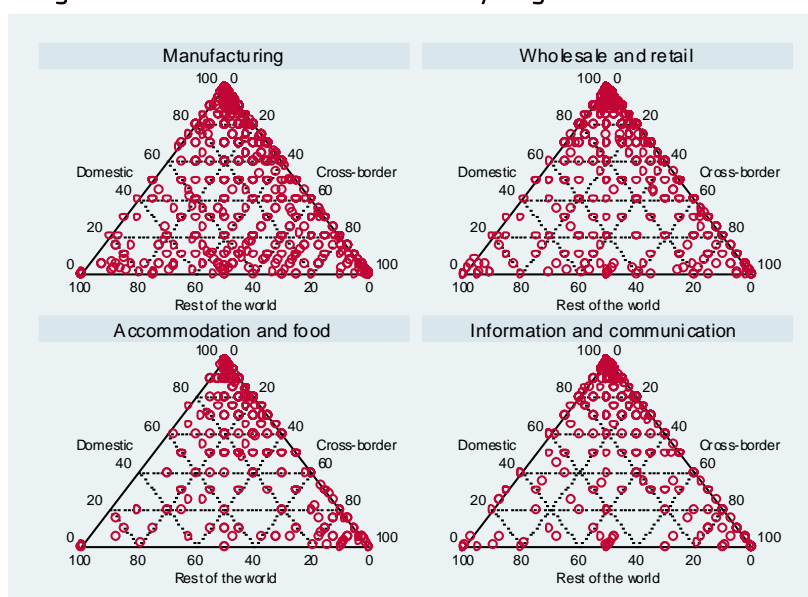


Figure A5a: Structure of online purchases by target markets and firm size

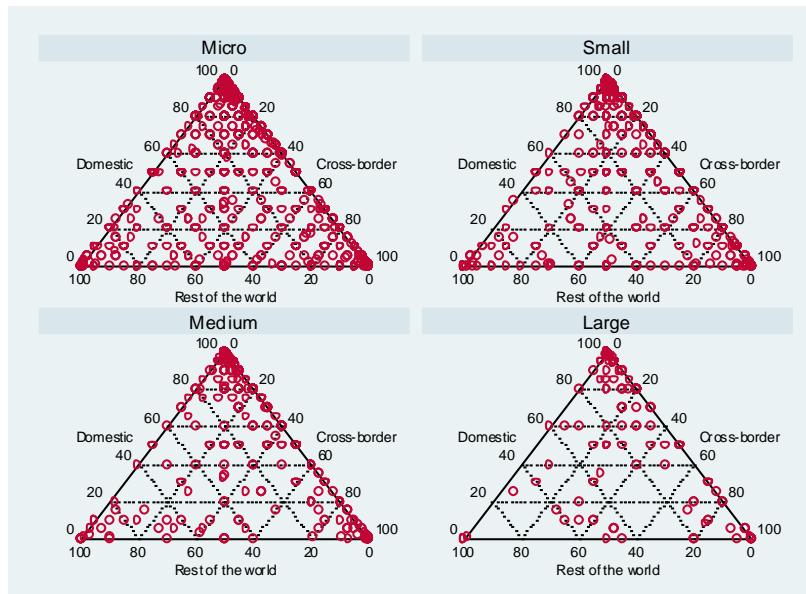


Figure A5b: Structure of online purchases by target markets and sector

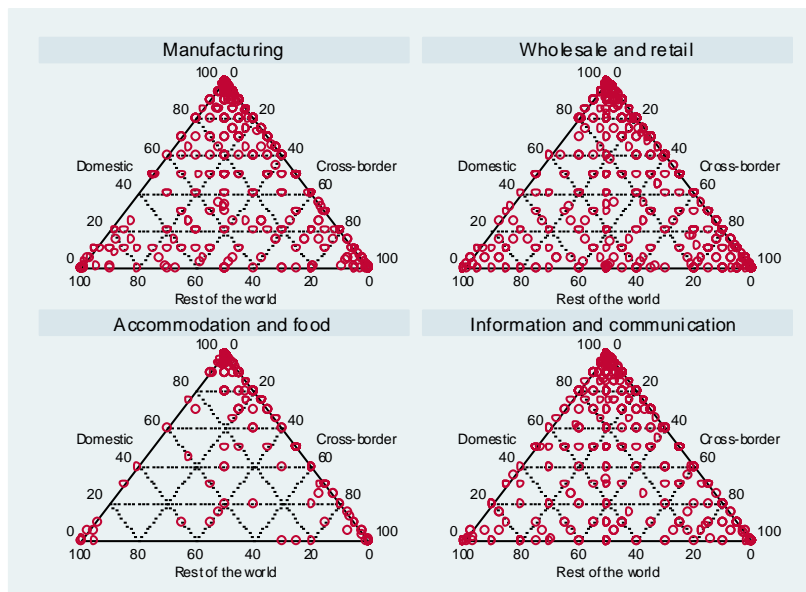
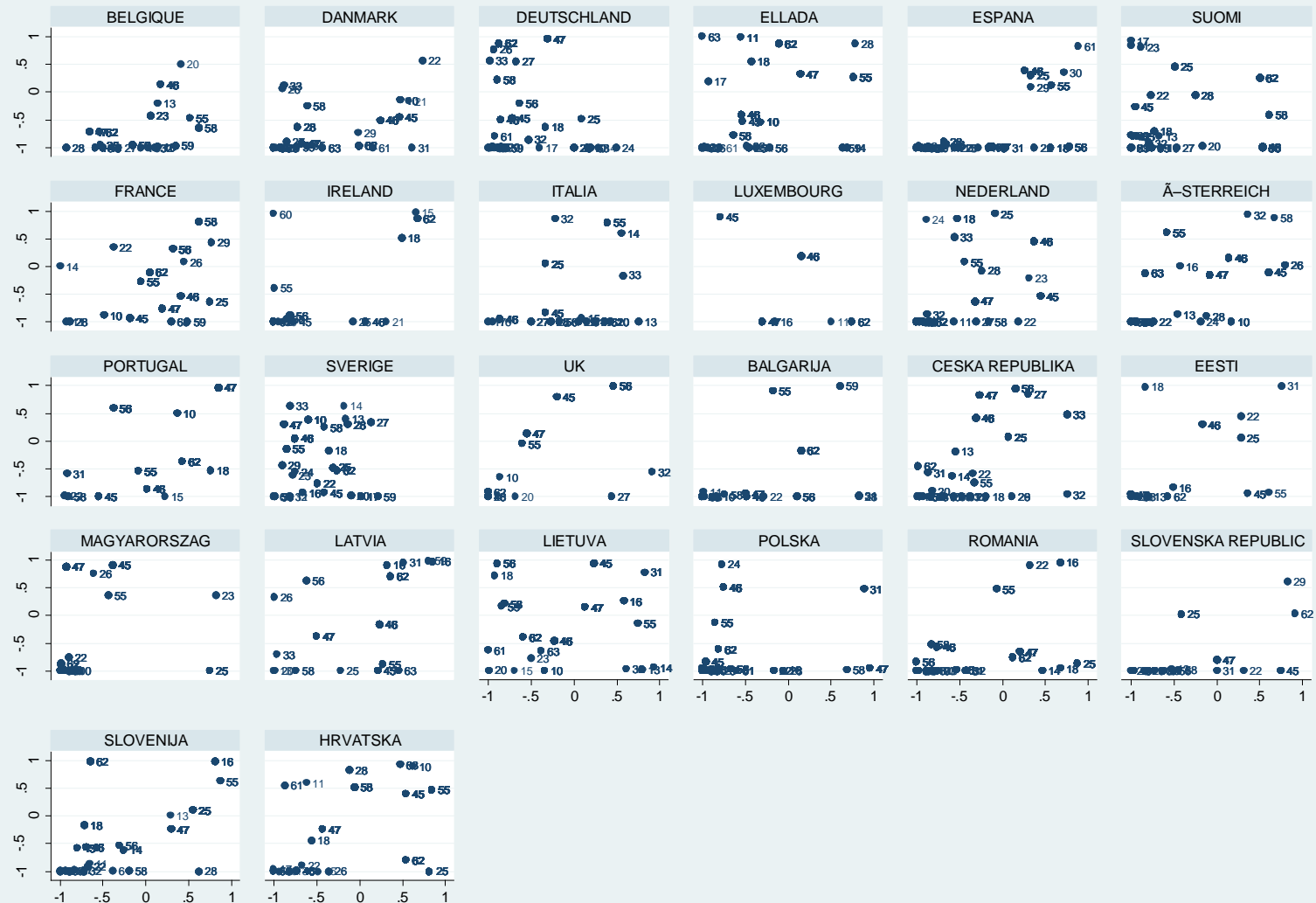
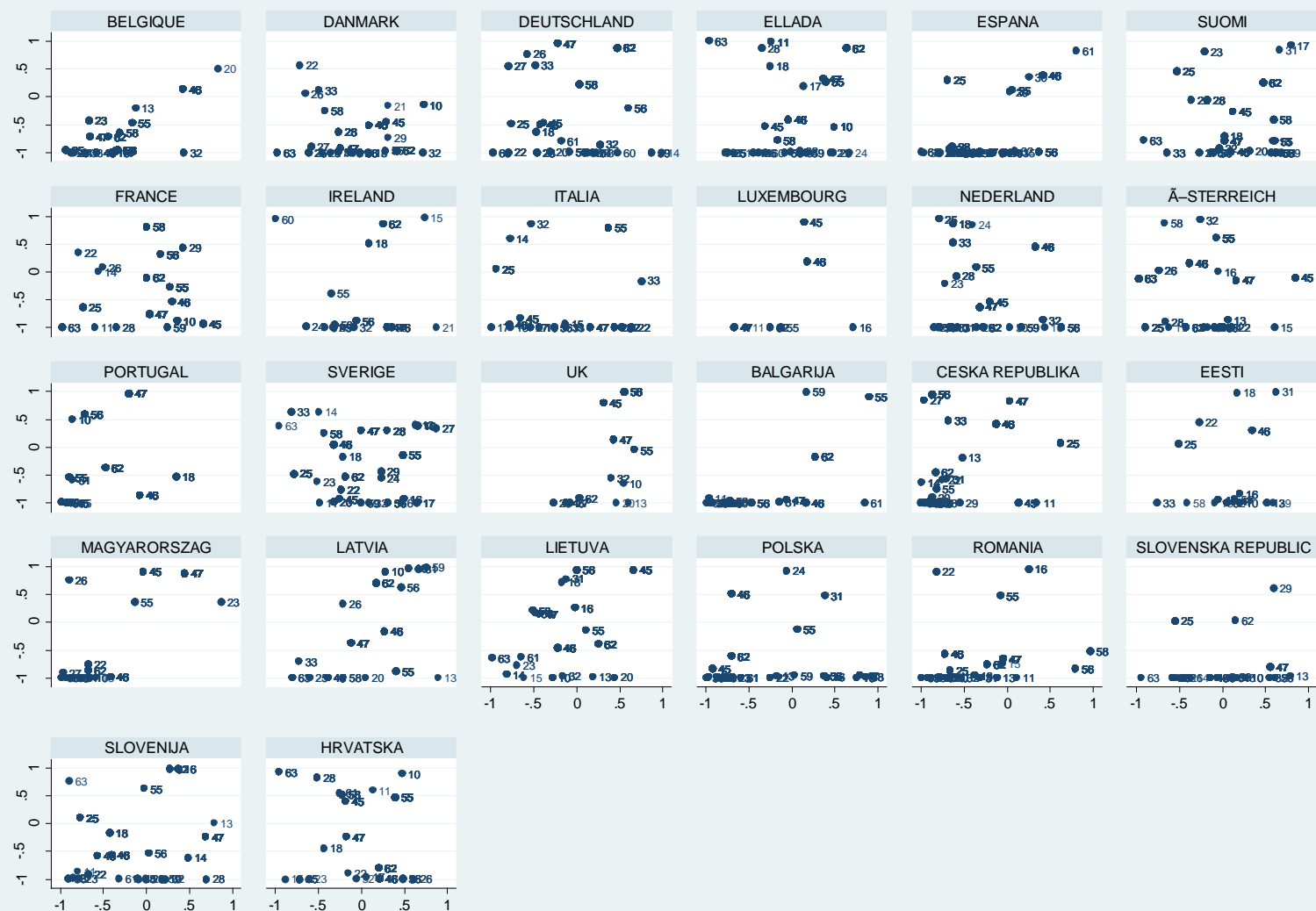


Figure A6: Revealed comparative advantage: online vs. offline



Symmetric Revealed Comparative Advantage - Offline

Figure A7: Revealed vs. estimated comparative advantage



Symmetric Estimated Comparative Advantage

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