OliverWyman | LAE Spin Off Institute of Supply Chain Management University of St.Gallen

IS E-COMMERCE GOOD FOR EUROPE?

Economic and environmental impact study

Independent study
commissioned by Amazon

This report is the result of an independent study led by Oliver Wyman with the support of Logistics Advisory Experts (LAE), a spin-off of the Institute of Supply Chain Management of St Gallen University. It has been conducted over a 12-week period and was commissioned by Amazon. The analysis is based on official statistics up to 2019 (unless stated otherwise) and publicly available information. The study does not use any private information from Amazon or other retailers or transport operators. Consumer behavior data is based on proprietary surveys conducted by Oliver Wyman in 2020 across Europe (France, Germany, Italy, Spain, United Kingdom).

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INTRODUCTION

After two decades of double-digit growth, what is the impact of e-commerce on the retail industry and the wider environment? This question is particularly important after 2020, a year dominated by the COVID-19 crisis, in which e-commerce played a critical role while many stores were closed. In 2019, e-commerce reached 11 percent of total retail sales in the eight European countries we studied for this report. Initial indications are that e-commerce grew by 31 percent from 2019 to 2020, following growth of 12 percent from 2018 to 2019. Data for 2020 and the following few years will be blurred by the effects of the COVID-19 crisis.

This report aims to provide information and long-term perspectives for stakeholders as they make decisions that will shape the future of retail. Regulators need to decide what would be the best frameworks to govern retail in the future. Businesses are constantly assessing which channels and geographies to expand into, and physical stores are adding online services that let them function as omnichannel retailers. Consumers increasingly understand that their choices influence the future of their neighborhoods and of the wider environment. To help these actors, the report focuses on two main areas affected by the growth of e-commerce: the evolution of retail and environmental impacts.

The first question is how e-commerce is impacting the retail industry: Is the growth of online shopping affecting brick-and-mortar outlets and jobs? How many new jobs is e-commerce generating — both directly in e-commerce companies and indirectly in areas such as delivery?

The second question is how e-commerce is impacting the environment: What is the end-to-end CO_2 equivalent (CO2e) impact? How much extra traffic is e-commerce delivery adding — and is this being offset by a reduction in car-based shopping trips? If e-commerce means more warehouses and fewer physical retail stores, are warehouses using land more or less efficiently?

Our study focuses on eight countries: France, Germany, Italy, the Netherlands, Poland, Spain, Sweden, and the United Kingdom. It is based on an analysis of official statistics, independent retailers' surveys conducted in 2020, and a proprietary CO_2e impact model. The study found that retail is being transformed at different speeds across the eight focus countries. The main changes are an evolution toward more organized retail, the growth of e-commerce, and a shift in household spending from goods to services.

Overall, retail is gaining jobs in net terms, and e-commerce is contributing. There were fewer retail outlets in 2019 than there were in 2005, but the total store surface area remained stable, as stores grew larger. Cities that are wealthy or growing tended to increase their number of retail jobs and outlets.

The environmental impact of e-commerce appears to be positive. Offline shopping results in between 1.5 and 2.9 times more greenhouse gas emissions than online shopping. While e-commerce needs delivery vans to circulate, these reduce car traffic by between 4 and 9 times the amount they generate. Land use for e-commerce is lower than for physical retail, when logistics, selling space, and related parking space are included.

This report does not provide recommendations. Instead, it is intended as a source of information, as actors map out their best options.

ECONOMIC IMPACT

Both online and offline retail create jobs, with physical retail surface area remaining stable despite a decreasing number of outlets

KEY TAKEAWAYS

Retail is going through three long-term shifts, which are visible through data analysis: from non-organized to organized retail, from offline to online, and from products to services. These changes tend to start in that order but are occurring at different speeds across Europe.

The balance of organized and non-organized retail and the number of stores per inhabitant vary significantly between countries, and e-commerce penetration is at different stages of maturity. These differences are expected to continue, yet there are some trends common to all geographies:

- On average, offline retail is growing. E-commerce is growing faster but only represents 11 percent of total retail sales in the eight countries under review.
- Organized retailers represent a growing proportion of physical retail and are increasingly operating in an omnichannel format, thereby nurturing the growth of e-commerce.
- Household spending is progressively shifting from products to services.
- The retail industry is creating net jobs both online and offline — and with comparable labor intensity.
- At the city level, the numbers of offline retail jobs and of outlets are primarily influenced by demographics and wealth, not e-commerce penetration.
- Physical stores that also sell online are growing faster than their pure offline peers.
- Both physical retail and e-commerce face new transformations (convergence of online and offline channels, social commerce, sustainable commerce) that have been accelerated by the COVID-19 pandemic.

RETAIL IS BEING TRANSFORMED AT DIFFERENT SPEEDS ACROSS EUROPE, AS PHYSICAL RETAIL RATIONALIZES, ONLINE SHOPPING GROWS, AND SPENDING SHIFTS TO SERVICES

Retail is being transformed by the growth of organized retail and e-commerce. Meanwhile it is creating jobs on a net basis and adapting its land footprint, which is on average stable in terms of total surface area despite a decrease in the number of outlets. Differences between cities mostly reflect different demographic trends.

METHODOLOGY AND DEFINITIONS

In this report, the evolution of retail has been analyzed based on official data (Eurostat) or public data (Euromonitor) that go up to 2019 and were published in 2020. The segmentation of retail types has been done at a banner level.

Organized retail: Organized retail includes any food or non-food chains — with a national or at least a regional footprint — and with sales greater than 0.01 percent of total national retail sales. That means revenues over €50 million in Germany, €30 million in France, or €12 million in Spain. Organized retailers are characterized by grouped sourcing; standardized offers and marketing; and, very often, a centralized organization. These organizations' data include the revenues both of their own shops and of affiliated or franchised shops. Most of organized retailers' revenue is generated through physical shops. Their share of e-commerce has grown over time, making them "omnichannel" retailers.

Physical retail: Physical retail, or offline sales, refers to retail sales made in a physical store (offline sales channel). Physical retailers are companies originally limited to such sales, but that also sell online (e-commerce) today. The report clearly indicates sales channels, by differentiating physical retailers' online and offline sales. The term "omnichannel physical retailer" is used for a physical retailer that sells both online and offline.

E-commerce: E-commerce refers to sales of products made via the online channel to individual consumers. These sales can be originated by either pure online retailers or physical retailers. E-commerce includes all products sold online, including groceries and items sold through click-and-collect. It excludes travel, tickets, and food services.

RETAIL GROWTH

Total retail revenues grew by an average annual rate of 2.0 percent from 2010 to 2019. Physical retail has by far the largest share of the total but is losing ground to e-commerce — which gained 7 percentage points to reach 11 percent of total retail sales — and to services, of which household consumption grew by an annual rate of between 1 and 2 percent.

Retail is growing

Total retail sales in the eight focus countries — France, Germany, Italy, the Netherlands, Poland, Spain, Sweden, and the UK — including both physical and online, increased by 2.0 percent a year between 2010 and 2019 to reach €2.189 trillion.[2]

Overall retail sales have been growing slightly faster than the total population of the eight countries studied. In comparing the growth of retail sales in real terms to population growth between 2010 and 2019, there is a small difference, of 0.3 percentage point. But there are variations between the countries (see Appendix for details).

Physical retail accounts for 89 percent of total retail sales across these eight countries. From 2010 to 2019, it increased by €174 billion, an annual rate of 1.0 percent, to a total of €1,938 billion. In real terms, however, physical retail revenue can be considered to be flat, due to an average annual inflation rate of 1.4 percent in these countries over the same period.[3]

E-commerce grew faster than physical retail in all the geographies studied. E-commerce accounted for 11 percent (€251 billion) of total retail sales across the eight countries in 2019, up from 4 percent (€73 billion) in 2010. It accounted for 51 percent of total retail growth since 2010 (€177 billion) and grew by an average annual rate of 14.6 percent between 2010 and 2019.

E-commerce is growing and penetration is converging across countries and categories

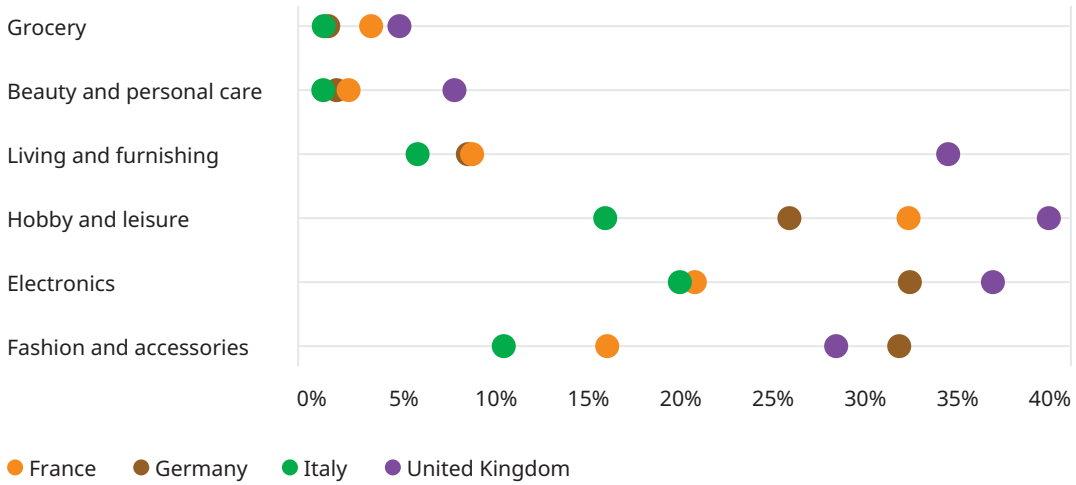
The e-commerce share of total retail sales ranged from 6 percent in Spain to 19 percent in the UK. Growth rates tend to be higher in those countries with the lowest penetration — for example, 22 percent annual growth in Italy between 2010 and 2019. Growth is often slower where penetration is higher — for example, 13 percent a year in the UK. This suggests that e-commerce penetration levels are converging across Europe.

The categories with the highest penetration (such as hobbies and leisure, electronics, and fashion) are mostly the same across Europe. However, food ranged from 12 percent of total e-commerce sales in the UK to 3 percent in Germany in 2019. One reason is different strategies for combining online sales with physical shopping — such as the French click-and-collect “driving” model, in contrast to home delivery in the UK. Another reason is consumer habits (see Exhibit 9).

Variations between product categories and countries mostly reflect a progressive extension from products easily sold online — that is, categories with a good ratio of revenues to delivery costs and a tangible price advantage. Penetration also grows as consumers gain confidence in online retailers’ service levels and payment solutions. In the future, penetration across categories is expected to converge and stabilize.

Physical retail accounts for 89 percent of total retail sales across these eight countries.

Exhibit 1: E-commerce penetration by category per country
2019, Share of e-commerce sales of total retail sales

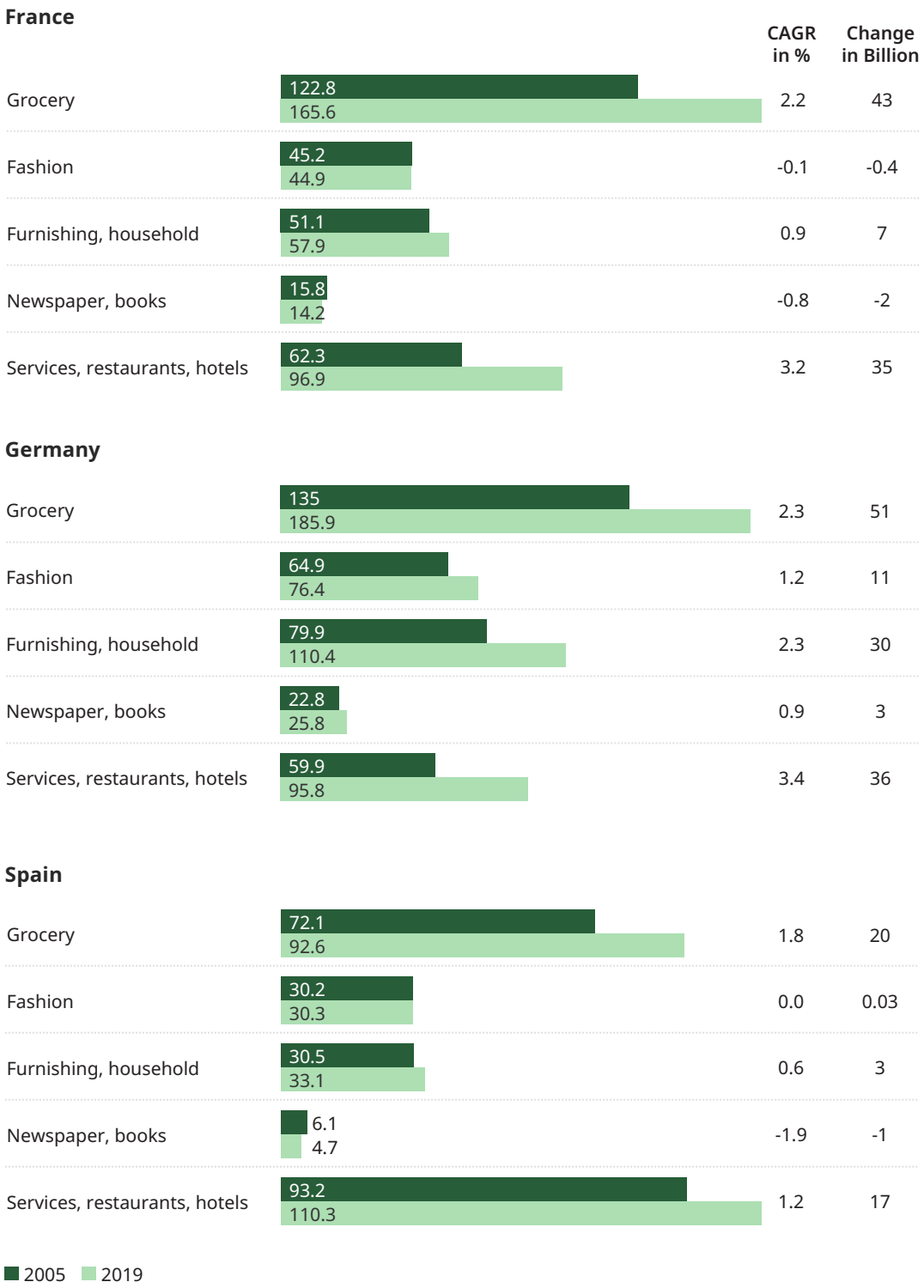


Sources: Euromonitor, Oliver Wyman analysis

Spending shifts towards services

In Germany, for example, household spending on services increased by an annual rate of 3.4 percent between 2005 and 2019, while spending on fashion, furnishings, household goods, and books only grew by 1.7 percent. In Spain, spending on services increased by 1.2 percent, while combined spending on fashion, furnishings, household goods, and books rose by 0.1 percent (see Exhibit 2).

Exhibit 2: Evolution of household consumption of selected categories
2005-2019, Spend per category, € Billion



Sources: Eurostat, Oliver Wyman analysis

THE TRANSFORMATION OF RETAIL

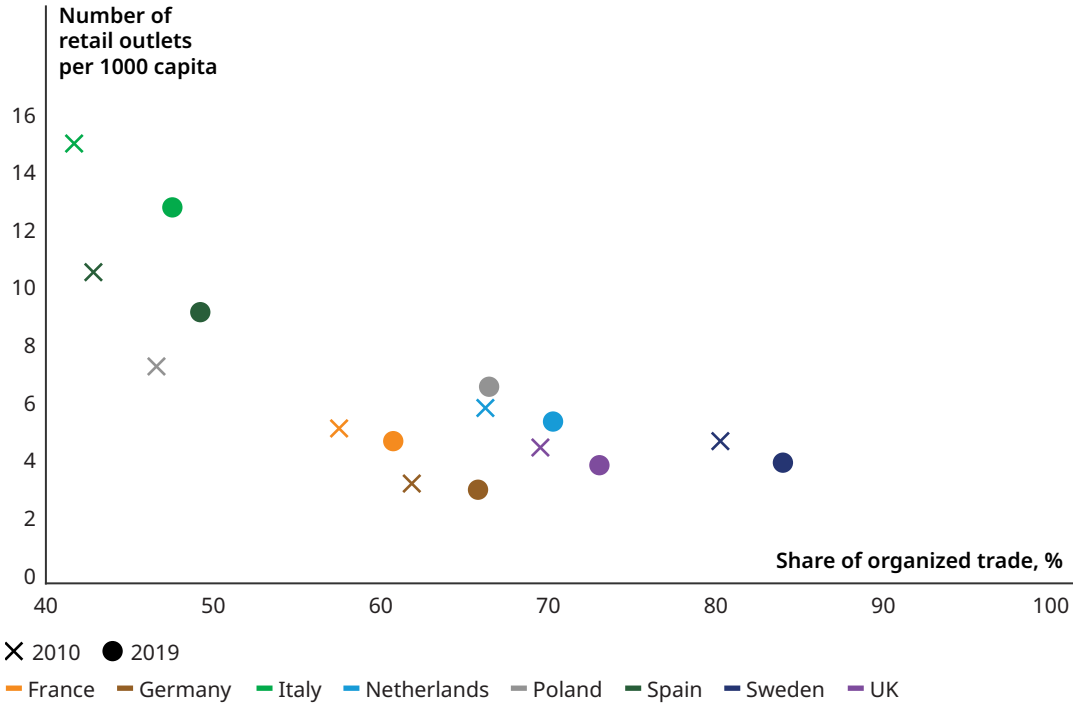
Rationalization and digitalization are happening at different speeds in different countries.

Rationalization: As organized retail grows, the number of stores is decreasing

Organized retail is growing as a share of overall retail. This evolution has nearly been completed in Sweden, the UK, Germany, and the Netherlands, where around 70 percent of physical retail sales are carried out via organized retailers, and the density of stores is relatively low — ranging from 3.3 stores per 1,000 people in Germany to 5.5 in the Netherlands. However, organized retailers' share of the physical retail segment has increased by less than 0.4 percent per year since 2010. This suggests that there is an asymptotic upper limit to the consolidation of physical stores by organized retailers of around three to four stores per 1,000 people.

In southern European countries such as Italy and Spain, organized trade is less mature. Organized retailers have a 50 percent share of physical retail sales, and there are more than nine stores per 1,000 people. Organized retailers' share of physical retail sales in Spain and Italy increased by 0.7 percent a year from 2010, suggesting that they are slowly catching up with the northern countries' model (see Exhibit 3).

Exhibit 3: Retail outlets per capita and share of organized trade



Sources: Euromonitor, Oliver Wyman analysis

In most of the northern and western European countries — that is, France, Sweden and UK, but not Germany — the decrease in the density of stores slowed down after 2010. In southern Europe, however, the density either decreased faster after 2010 (Spain), or else it decreased after having previously been on the rise (Italy) (see Exhibit 4).

Exhibit 4: Retail outlets per 1,000 people and organized retailers' segment share of total physical sales

Annual growth rate 2005-2010 and 2010-2019

		Number of stores	
		CAGR 2005-2010	CAGR 2010-2019
Northern and Western Europe	France	**-0.6%**	-0.2%
	Germany	-0.2%	**-1.1%**
	Sweden	**-1.0%**	-0.6%
	United Kingdom	**-1.4%**	-0.7%
Southern Europe	Italy	0.4%	**-1.3%**
	Spain	-0.6%	**-1.2%**

Sources: Euromonitor, Oliver Wyman analysis

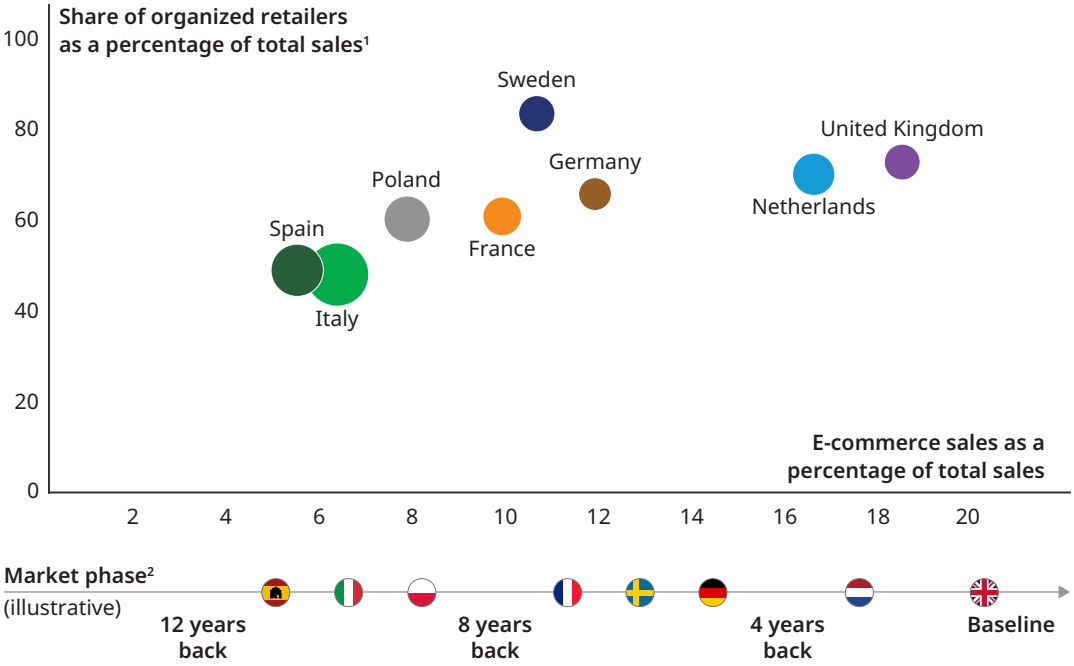
Digitalization: E-commerce has a higher share where retail is more organized

The e-commerce share of retail sales is higher in countries where retail is more organized, as established organized retailers have moved faster toward omnichannel retailing. The UK has the highest e-commerce penetration, at 19 percent of total retail sales in 2019. Italy and Spain have the lowest, at 6 percent.

In the UK, the 50 largest retailers (including both physical and pure online) accounted for 81 percent of total e-commerce sales in 2019. In Italy, the 50 largest retailers generated just 56 percent.

The e-commerce share of retail sales is higher in countries where retail is more organized, as established organized retailers have moved faster toward omnichannel retailing.

Exhibit 5: Maturity of organized trade and penetration of e-commerce sales
2019, Organized retailers sales and e-commerce sales as a share of total national sales, %



1. Retail sales of chain's (>0.1% market share); 2. Relative positioning of countries based on e-commerce share of total sales progression — as observed in the UK.

Sources: Euromonitor, Eurostat, Oliver Wyman analysis

These past trends suggest that the transformation of retail happens in sequence — and that a convergence of country models is to be expected. The difference in speeds suggests that the geographies with the lowest rates of organized retail might transform more slowly.

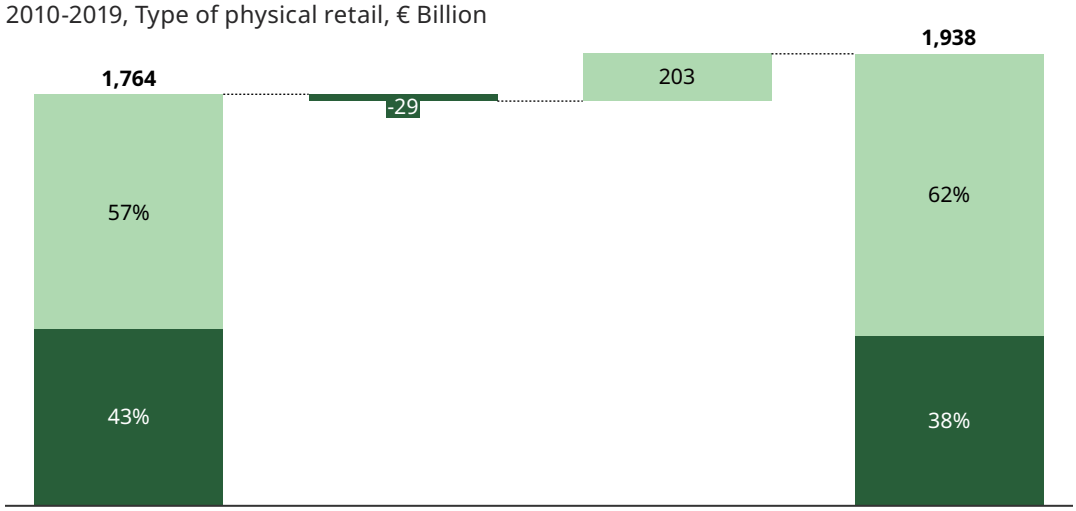
PATTERNS OF EVOLUTION BY COUNTRY

Organized retailers represent a growing proportion of physical retail: They gained 5 percentage points of share in the eight countries from 2010 to reach a 62 percent share in 2019. They also are going omnichannel, as they accounted for 23 percent of the growth in online sales from 2010 to 2019.

Organized physical retailers are gaining share from non-organized physical retailers in both food and non-food segments in all countries: They gained 5 percentage points between 2010 and 2019. The sales of non-organized retailers decreased by an average of 0.4 percent a year in the eight countries, while large organized retailers grew by 2.1 percent[4] (see Exhibit 6). Large organized retailers reported an average annual increase of 16.0 percent in online sales between 2010 and 2019 and accounted for 23 percent of the growth in online sales since 2010.[5]

Exhibit 6: Breakdown of growth in physical retail sales across the eight European countries

2010-2019, Type of physical retail, € Billion



	Physical retail sales 2010	Non-organized physical retail	Organized physical retail[2]	Physical retail sales 2019
Total sales change		-17%	117%	
CAGR 2010-2019		-0.4%	2.1%	1.0%

Non-organized physical retail Organized physical retail

1. £, SEK and PLN converted into €, using constant exchange rates of 2019 average; 2. Organized retailer with segment share above ~0.01%. on national level, ~100-150 retailers per country.

Sources: Euromonitor, Oliver Wyman analysis

Organized physical retailers are growing at different speeds across Western Europe — with two main patterns. Northern and western European countries (France, Germany, Sweden and UK) already have a high share of organized retail (60 percent of sales or higher). The decrease in the revenues of non-organized shops in these countries was limited, ranging from 0.2 percent a year to 0.3 percent a year between 2010 and 2019. But in southern countries (that is, Italy and Spain), organized physical retail is starting from a lower point (below 50 percent of offline sales) and is still gaining sizable share. That led to decreases in non-organized physical retail revenue of 1.5 percent a year in Italy and 0.6 percent per year in Spain between 2010 and 2019.

The case studies below suggest that both physical organized retailers (online and offline) and pure online retailers are growing faster than independent physical stores up to a given limit (around three or four outlets per 1,000 inhabitants). Both segments can keep growing after reaching that limit with lower effects on independent stores' revenues.

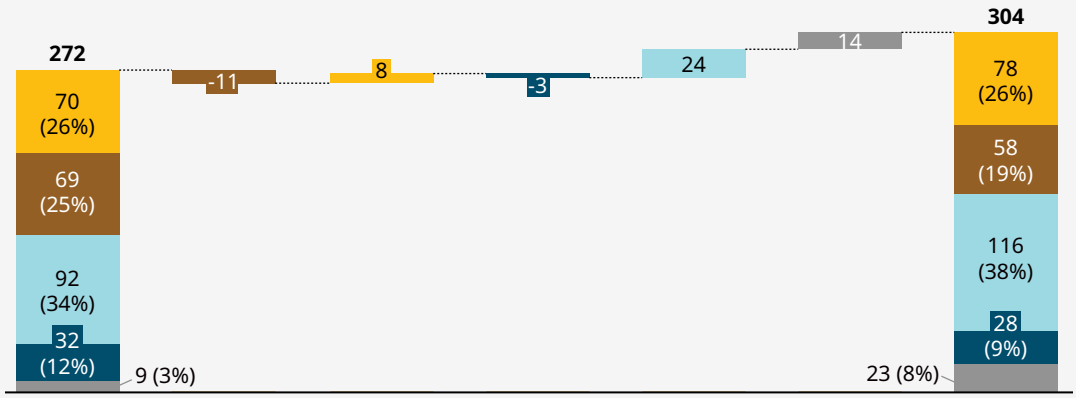
Example 1

UK: Organized physical retailers gain ground over smaller stores before moving online

In the UK, sales for non-organized physical retailers decreased by £14 billion between 2005 and 2010, while offline sales for organized physical retailers increased by £32 billion (7 percentage points growth in segment share, from 62 percent in 2005 to 69 percent in 2010) (see Exhibit 16). During this period, organized physical grocery grew faster than non-organized grocery shops (as online grocery was only in its early stage), leading to an annual decrease of 2 percent in the sales of independent food stores. Both physical and pure online retailers grew faster than non-organized, non-food physical retailers, leading to a decrease in sales of 3 percent a year for independent non-food stores.

Exhibit 7: Historic evolution of retail sales by type of retailer and e-commerce in the United Kingdom

2005-2010, £ Billion



	Total sales 2005	Non-organized non-food physical retail	Organized non-food physical retail	Non-organized grocery physical retail	Organized grocery physical retail	Online Sales	Total sales 2010
Total sales change		-35%	26%	-11%	75%	45%	
CAGR 2005-2010		-3%	2%	-2%	5%	21%	2%

Online sales; Non-organized grocery physical retailers; Organized grocery physical retailers; Non-organized non-food physical retailers; Organized non-food physical retailers

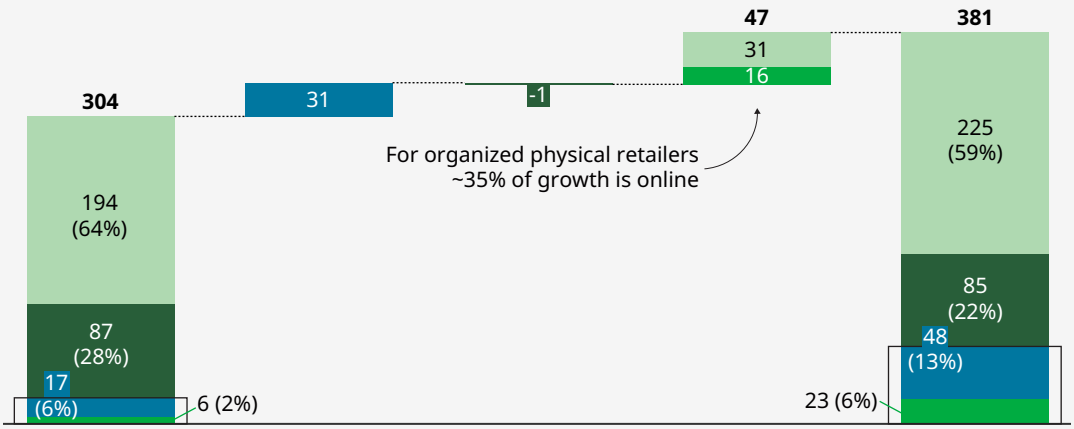
1. Organized retailer with market share above ~0.01% on national level, ~150 retailers.

Sources: Euromonitor, Oliver Wyman analysis

Since 2010, the decrease in non-organized physical retail has nearly halted (falling by just 0.2 percent a year), while pure online retailers have been growing by more than 10 percent a year (see Exhibit 17). Organized physical retail (online and offline combined) kept growing, by over 2 percent a year. Part of that growth came from leading physical retailers that deployed omnichannel strategies and established additional online sales channels.

Overall, since 2010 in the UK, 62 percent of total retail sales growth (combining offline and online) has been generated by organized physical retailers. Of this, 35 percent has come through online channels and 65 percent through physical stores.

Exhibit 8: Breakdown of growth in retail sales (in-store and online) in the UK
2010-2019, Type of retailer, £ Billion



	Total retail sales 2010	Pure online retailers	Non-organized "independent" physical retailers	Organized physical retailers[1]	Total retail sales 2019
Total sales change		40%	-2%	62%	
CAGR 2010-2019		10%	-0.2%	2%	3%

Online sales of organized retailers; Pure online retailers; Online sales
Non-organized "independent" physical retailers; Offline sales of organized retailers

1. Organized retailer with segment share above ~0.01% on national level, ~150 retailers.
Sources: Euromonitor, Oliver Wyman analysis

In the UK, 19 of the top 50 e-merchants are established physical retailers. Those 19 accounted for 32 percent of total e-commerce sales in 2019, and since 2010 their share has increased by 5 percentage points.

Example 2

France: Established physical retailers captured most of the growth through their stores

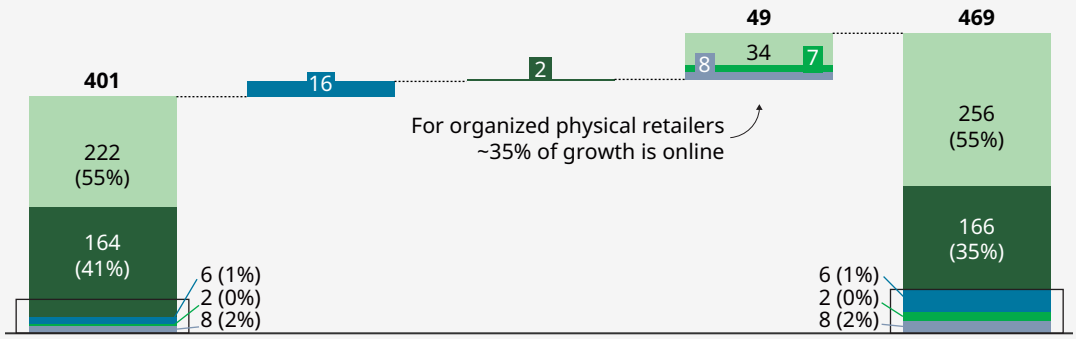
A similar picture can be observed in France. The leading organized physical retailers accounted for more than 70 percent of total growth in retail sales between 2010 and 2019. Of this, 15 percent came through their online channels, 16 percent through drive-in (large grocery retailers' click-and-collect services), and 69 percent through offline sales (see Exhibit 9).

Revenues for non-organized physical retailers were flat for 2010-2019. These retailers lost 7 percentage points of total physical non-food sales, from 62 percent in 2010 to 55 percent in 2019; and in grocery, their share was flat, rising just 0.3 percentage point.

Both organized physical retailers and pure online players grew faster than non-organized non-food physical retailers. Overall, non-organized physical stores' revenues did not decrease. The decline of non-organized non-food physical retail (€6 billion) was compensated for by an increase in sales of €8 billion at non-organized physical food retailers.

Similar to the UK, there are 26 established physical retailers among the top 50 e-commerce retailers, and they generated 31 percent of total e-commerce sales in 2019.

Exhibit 9: Breakdown of growth in retail sales (in-store and online) in France
2010-2019, € Billion



	Total retail sales 2010[2]	Pure online retailers	Non-organized "independent" physical retailers	Organized physical retailers[1]	Total retail sales 2019
Total sales change		24%	3%	73%	
CAGR 2010-2019		10%	0%	2%	2%

Drive (click & collect of large grocery retailers) · Online sales of organized retailers · Online sales
Pure online retailers · Non-organized "independent" physical retailers
Offline sales of organized retailers

1. Organized retailer with market segment above ~0.01% on national level, ~150 retailers; 2. Total sums up to 99 due to rounding.

Sources: Euromonitor, Oliver Wyman analysis

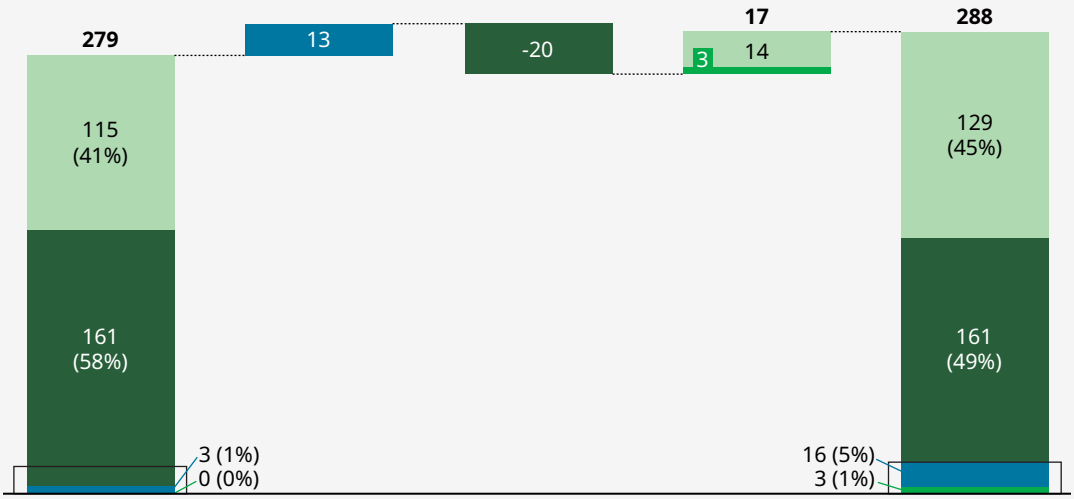
Example 3

Italy: Both e-commerce and organized retailers grow faster than small physical retailers

Italy shows a different pattern, which illustrates that it is at an earlier stage in the evolution toward organized retail. Retail was flat overall between 2010 and 2019, but its structure changed. Non-organized physical retail had a 42 percent share in 2010, and there were 15 stores per 1,000 people. Non-organized physical retailers' sales decreased by around €20 billion between 2010 and 2019, an annual decline of 1.5 percent. Over the same period, organized physical retailers' offline sales increased by around €14 billion. They gained six percentage points, from 42 to 48 percent of total physical retail sales (see Exhibit 10). Their online sales increased by €3 billion. The sales of pure online retailers grew by €13 billion over this period — that is, less than the sales of organized physical retailers. Put simply, both pure online retailers and organized physical retailers gained ground from non-organized physical retailers over this period, and non-organized retailers' revenues decreased.

Exhibit 10: Breakdown of growth in retail sales (in-store and online) by type of retailer in Italy

2010-2019, € Billion



	Total retail sales 2010	Pure online retailers	Non-organized "independent" physical retailers	Organized physical retailers[1]	Total retail sales 2019
Total sales change		134%	-212%	179%	
CAGR 2010-2019		19.7%	-1.5%	1.5%	0.4%

Online sales of organized retailers; Pure online retailers; Online sales; Offline sales of organized retailers; Non-organized "independent" physical retailers

1. Organized retailer with market share above ~0.01%. on national level, ~100 retailers.

Source: Euromonitor, Oliver Wyman analysis

E-COMMERCE GROWTH BY COUNTRY

E-commerce growth varies by country: Pure players account for at least for 50 percent of the growth in France and up to 90 percent in Germany.

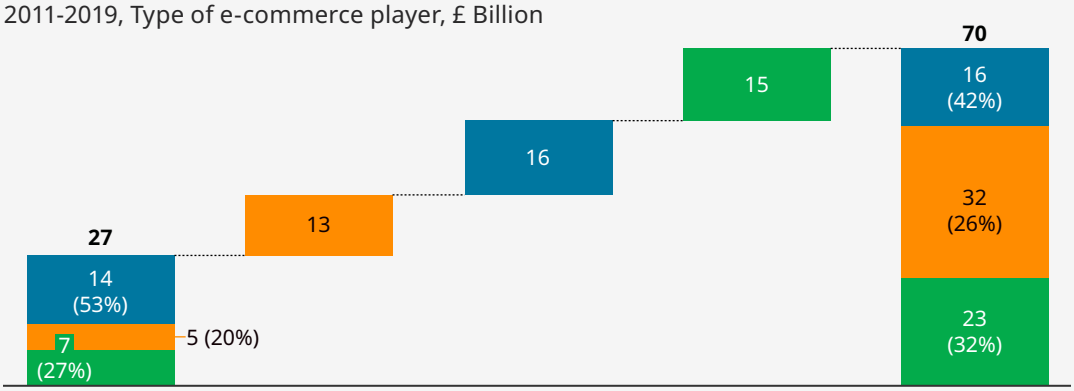
Despite similar patterns in the evolution of organized physical retail in northern and western Europe, e-commerce has been growing according to different structures in different countries. The differences mainly reflect how organized physical retailers have reacted to the rise of e-commerce. The following examples illustrate these patterns.

Example 1

UK: Growth of e-commerce sales shared equally between established physical retailers, pure online retailers, and third-party merchants

In the UK, pure online retailers, third-party merchants selling on marketplaces, and physical retailers each generated one-third of the growth in e-commerce sales between 2011 and 2019. Omnichannel physical retailers captured 35 percent of the growth in e-commerce sales, reflecting their ability to adapt to the evolution from offline to online retail. Third-party merchants selling on marketplaces[6] captured slightly less of the total growth, but they still achieved the highest annual growth rate of the three groups, at 16 percent (see Exhibit 11).

Exhibit 11: Breakdown of growth in e-commerce sales[1] in the UK
2011-2019, Type of e-commerce player, £ Billion

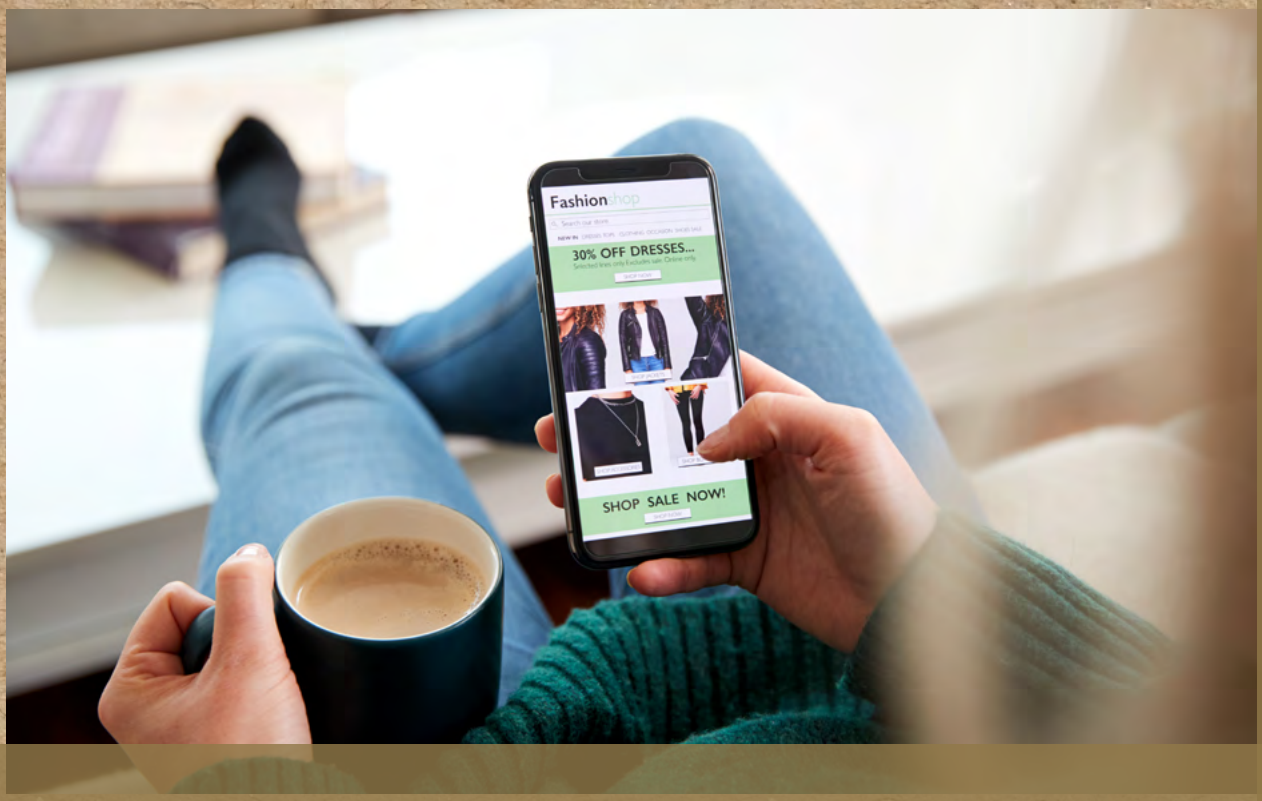


	E-commerce sales 2011	3rd party merchants' on marketplaces	Pure online retailers	Online sales of organized physical retailers	E-commerce sales 2019
Total sales change		29%	36%	35%	
CAGR 2011-2019		16%	10%	15%	13%

Online sales of organized physical retailers
3rd party merchants' on marketplaces
Pure online retailers

1. Includes grocery.

Sources: Euromonitor, Oliver Wyman analysis



Despite similar patterns in the evolution of organized physical retail in northern and western Europe, e-commerce has been growing according to different structures in different countries.

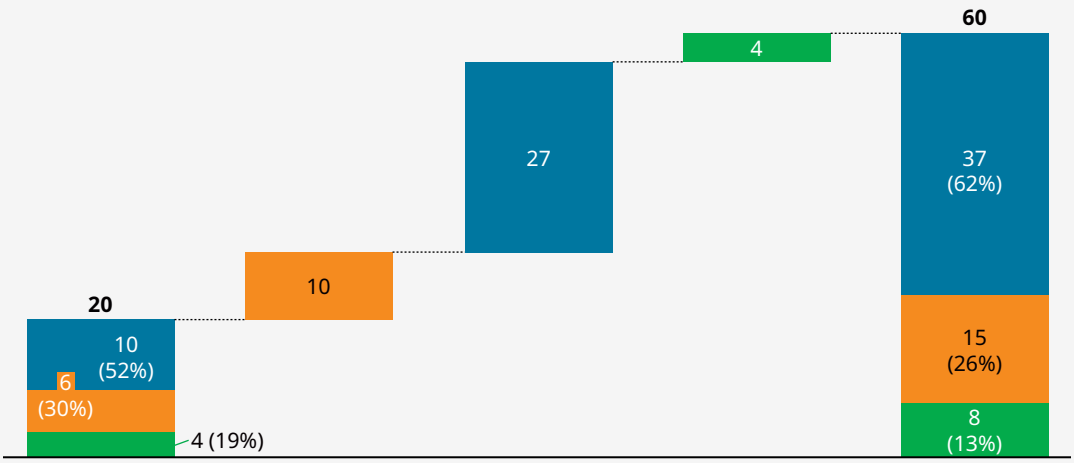
Example 2

Germany: Pure online retailers driving e-commerce growth

In Germany, pure online retailers captured 66 percent of the growth in e-commerce sales between 2011 and 2019, while omnichannel physical retailers captured only 10 percent. Despite a comparable evolution toward organized retail in the UK and Germany (in both countries, it accounts for around 70 percent of physical retail), fewer organized physical retailers managed to generate growth online. Similar to the UK, third-party merchants selling on marketplaces in Germany captured 24 percent of the growth in e-commerce sales.

Exhibit 12: Breakdown of growth in e-commerce sales[1] in Germany

2011-2019, Type of e-commerce player, € Billion



	E-commerce sales 2011	3rd party merchants' on marketplaces	Pure online retailers	Online sales of organized physical retailers	E-commerce sales 2019[1]
Total sales change		24%	66%	10%	
CAGR 2011-2019		13%	18%	10%	15%

Online sales of organized physical retailers
3rd party merchants' on marketplaces
Pure online retailers

1. Total sums up to 101 due to rounding

Source: Euromonitor, Oliver Wyman analysis

Example 3

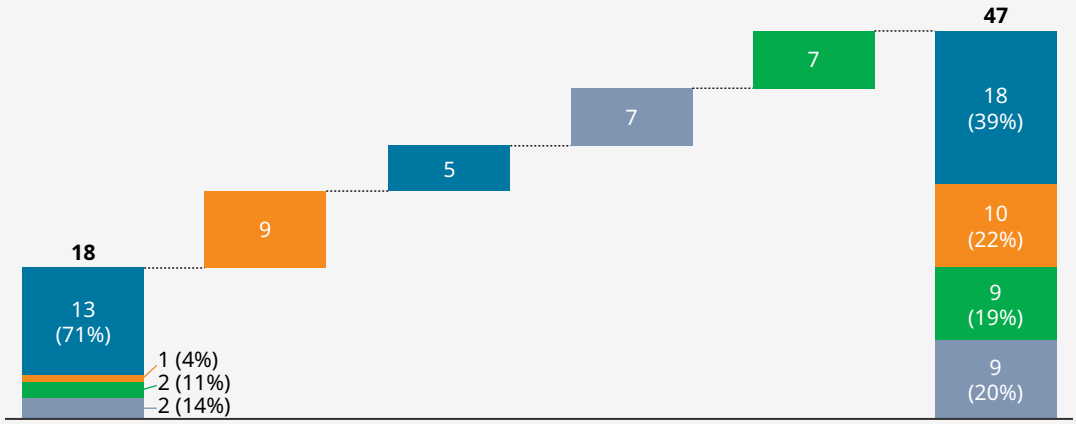
France: Omnichannel retailers, pure players and marketplaces share the growth in e-commerce sales since 2011

In France, non-food omnichannel physical retailers captured 24 percent of the growth in e-commerce sales between 2011 and 2019. Organized physical food retailers reacted to the evolution from offline to online shopping by establishing drive-in and click-and-collect options. These captured 24 percent of total growth in e-commerce sales.

Over the same period, pure players captured 19 percent of growth: E-commerce sales from pure online retailers accounted for 39 percent of total e-commerce sales in 2019. Finally, third-party merchants selling on marketplaces captured 32 percent of growth and accounted for the remaining 22 percent of total e-commerce sales in 2019, up from 6 percent in 2011.

Exhibit 13: Breakdown of growth in e-commerce sales in France

2011-2019, Type of e-commerce player, € Billion



	E-commerce sales 2011	3rd party merchants' on marketplaces	Pure online retailers	Drive	Online sales of organized physical retailers	E-commerce sales 2019
Total sales change		32%	19%	24%	24%	
CAGR 2011-2019		38%	5%	18%	20%	13%

Drive[1] Online sales of organized physical retailers
3rd party merchants' on marketplaces Pure online retailers

1. Drive refers to click and collect of large physical retailers grocery stores.

Source: Euromonitor, Oliver Wyman analysis

IMPACT ON JOBS: IN THE CONTEXT OF LONG-TERM TRANSFORMATION, THE RETAIL INDUSTRY IS CREATING NET JOBS BOTH ONLINE AND OFFLINE WITH COMPARABLE LABOR INTENSITY

METHODOLOGY

The evolution of direct employment in the retail sector (both e-commerce and physical was analyzed based on official public data from Eurostat. In addition, cross-checks were carried out against data from national trade associations and national statistics institutes. Self-employed jobs are not accounted for in these official data for subsections of economic activities. (Please see Section 1.2.E for sensitivity analysis.) Labor intensity is defined below as the revenue per direct full-time equivalent employee (FTE).

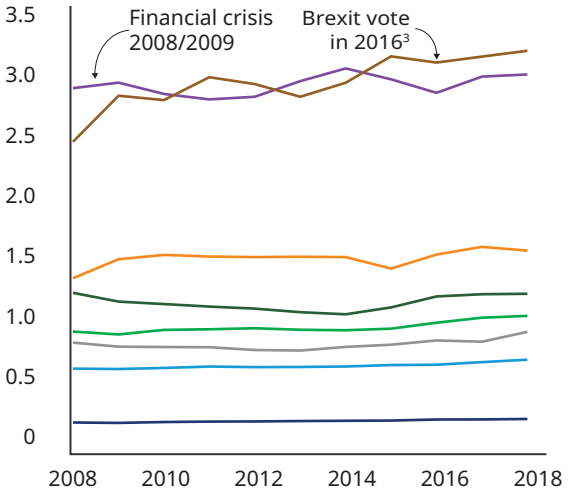
JOB CREATION IN RETAIL

Retailers in Europe created 1.3 million net direct jobs between 2008 and 2018, of which 300,000 were in e-commerce[7].

Direct employment[8] in the retail sector[9] across the eight European countries[10] amounted to 12.5 million employees in 2018, of whom 480,000 work in e-commerce. Between 2008 and 2018, 1.3 million net direct retail jobs were created in the eight countries, corresponding to a compound annual growth rate of 1.2 percent. Employment in the sector thus grew faster than population, which grew by an annual average rate of 0.4 percent[11] (see Exhibit 1).

Exhibit 14: Evolution of employment in the retail[1] sector in absolute values

Retail employees[2] (full- and part-time), Million



	CAGR 2008-2018	
	Number of employees	Number of population
Germany	2.6%	0.1%
United Kingdom	0.4%	0.8%
France	1.4%	0.5%
Spain	-0.1%	0.2%
Italy	1.2%	0.3%
Poland	0.9%	0.0%
Netherlands	1.0%	0.5%
Sweden	1.1%	1.0%

12.5 Million employees across the eight countries in 2018

1. Eurostat, "Retail trade, except of motor vehicles and motorcycles" (G47 in NACE 2007), excluding employees of sales, via stalls and markets; 2. Number of employees is defined by Eurostat and ILO as persons who work for an employer and have a contract, includes full- and part-time employees, excludes self-employment and temporary employees.

Sources: Eurostat, National trade associations, Oliver Wyman analysis

Both types of retailer generated a net increase in jobs over the period. Physical retailers added 1 million direct net jobs, or annual growth of 1 percent. During the same period, the number of net direct jobs created by e-commerce retailers more than doubled (12 percent average annual growth) to reach 300,000 in 2018.

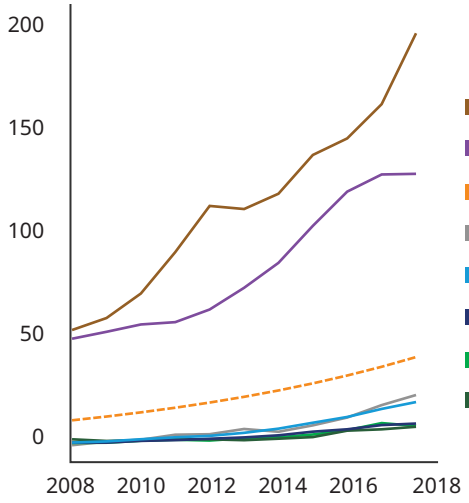
In the eight countries taken together, the two main creators of jobs have been non-food physical retail and e-commerce. Non-food physical retailers created 900,000 net direct jobs between 2008 and 2018, even though non-food is the segment that has been penetrated the furthest by online retail.

E-commerce retailers created 300,000 net direct jobs over the same period — employees at headquarters, in IT, and in internal fulfilment roles. The variation between countries in e-commerce job growth mostly reflects different stages of penetration, though there are exceptions. In the UK, the country with the highest e-commerce penetration (19 percent of total retail sales in 2019), the first signs of a deceleration in e-commerce job creation became visible in 2016, when penetration passed 15 percent. Poland, where penetration was 8 percent in 2019, had average annual job growth of 21 percent, due to a combination of a later start than other geographies and the development of fulfilment centers to service Germany. Spain, which had 6 percent penetration in 2019, is an outlier with just 6 percent growth — most likely due to the intensity of the Spanish economic crisis and the very high fragmentation of Spanish retail (see Exhibit 14).

Retailers in Europe created 1.3 million net direct jobs between 2008 and 2018, of which 300,000 were in e-commerce.

Exhibit 15: Evolution of direct e-commerce employees[1]

Employees[2] (full- and part-time), thousand



	CAGR 2008-2018	E-commerce jobs created 2008-2018	E-commerce penetration[4] 2018
Germany	13%	144,000	11%
United Kingdom	9%	80,000	17%
France[3]	10%	31,000	9%
Poland	21%	24,000	7%
Netherlands	16%	20,000	14%
Sweden	10%	9,000	9%
Italy	10%	8,000	5%
Spain	6%	6,000	5%
Total	**12%**	**322,000**	**10%**
480,000 employees across the eight countries in 2018			

1. Eurostat, employees of retail sales via internet, phone and mail; 2. Number of employees is defined by Eurostat and ILO as persons who work for an employer and have a contract, includes full- and part-time employees, excludes temporary employees; 3. 2018 value based on INSEE, previous years calculated based on 10% CAGR; 4. Share of e-commerce sales of total retail sales.

Sources: Eurostat, INSEE, Euromonitor, Oliver Wyman analysis

DIRECT AND INDIRECT JOBS

E-commerce generates 1.2 indirect jobs in fulfilment and delivery for each direct job, compared with 0.2 required for physical retail.

METHODOLOGY

Official statistics only report direct jobs in e-commerce for companies registered as online retailers. Comparing the labor intensity of physical retail and e-commerce requires that the share of outsourced fulfilment and transportation activities be integrated for both segments. In this evaluation, indirect jobs only include fulfilment and delivery activities. No distinction is made between fulltime, part-time, and temporary jobs.

For e-commerce, delivery jobs have been estimated based on e-commerce parcel volumes in 2018 and the average productivity of delivery operations. (Between 60 and 115 parcels were delivered per day per fulltime employee.) The numbers of outsourced fulfilment jobs have been estimated based on the e-commerce industry's typical outsourcing rate in each country[12].

For physical retail, indirect jobs in transportation have been estimated based on the average costs of transportation (about 2 percent of revenue) and average number of drivers needed, at a cost of between €30,000 and €40,000 per driver per year. Fulfilment jobs have been evaluated based on the average surface area required for a standard retailer; the number of fulltime employees required for that surface (for example, 15 employees for 1,000 square meters, including temporary employees); and the industry's outsourcing rate (between 25 and 50 percent) (see Exhibit 16. For further details see Appendix).

Exhibit 16: E-commerce required indirect jobs in delivery and fulfilment
2018, Per country

	E-commerce jobs[1]	Fulfilment jobs of internal e-commerce jobs	Outsourcing rate of e-commerce fulfilment[2]	Total outsourced fulfilment jobs	Parcels delivered per FTE/day	Total delivery jobs
France	47,130	75%	20%-32%	9,000-17,000	70-115	23,000-42,000
Germany	204,317		30%-35%	66,000-83,000	68-100	87,000-128,000
Italy	13,683		20%-25%	2,500-4,000	60-70	22,000-26,000
Netherlands	25,293		40%-45%	13,000-16,000	68-100	15,000-22,000
Poland	28,718		30%-35%	9,000-12,000	68-100	13,000-19,000
Spain	13,301		18%-30%	2,000-4,000	60-75	19,000-23,000
Sweden	14,856		20%-25%	4,000-5,000	68-100	3,000-5,000
United Kingdom	136,082		40%-50%	68,000-102,000	69-75	102,000-111,000
Total	**483,380**			**175,000-238,000**		**286,000-376,000**
Jobs required for 1 e-commerce job				**0.4-0.5**		**0.6-0.8**

1 Employees includes full- and part-time; 2. Interpolated numbers with lower confidence in Italy.
Sources: EU Commission WIK report, CEP study, Hans-Böckler-Association, German Logistic Association, Euromonitor, Oliver Wyman analysis

Key results

One direct e-commerce job generates 0.7 indirect delivery job and 0.5 outsourced fulfilment job. Based on these ratios, it is estimated that in 2018 there were at least 580,000 indirect employees in e-commerce (including temporary workers) in the eight countries. Combining direct and indirect jobs, e-commerce is estimated to have employed 1.1 million people in these countries in 2018, 120 percent more than the number of direct jobs.

One direct physical retail job requires 0.2 indirect job[13] (0.1 indirect transportation job and 0.1 outsourced fulfilment job). The physical retail sector is estimated to have employed at least 1.9 million people indirectly in the eight countries in 2018, or 16 percent more than it employed directly (see Exhibit 17).

These ratios mostly reflect the e-commerce business model, where delivery is almost fully outsourced, and fulfilment is carried out (outsourced or not) by operators, which have to pick consumer units instead of pallets of goods.

Exhibit 17: Physical retail jobs direct and indirect transportation and fulfilment jobs
2018, Per country

	Physical retail jobs	Outsourcing rate of physical retail fulfilment	Total outsourced fulfilment job	Outsourcing rate of physical retail transportation	Total transportation jobs
France	1,613,665	50%	232,000	65%	135,000
Germany	3,080,468	35%	199,000	65%	209,000
Spain	1,289,462	25%	60,000	65%	95,000
Total	**5,983,595**		**491,000**		**440,000**
Jobs required for 1 physical retail job			**~0.1**		**~0.1**

Note: Scope of the analysis has been limited to countries with robust data available for the outsourcing rate.
Source: Contracts logistics outsourcing estimate: Oliver Wyman

LABOR INTENSITY

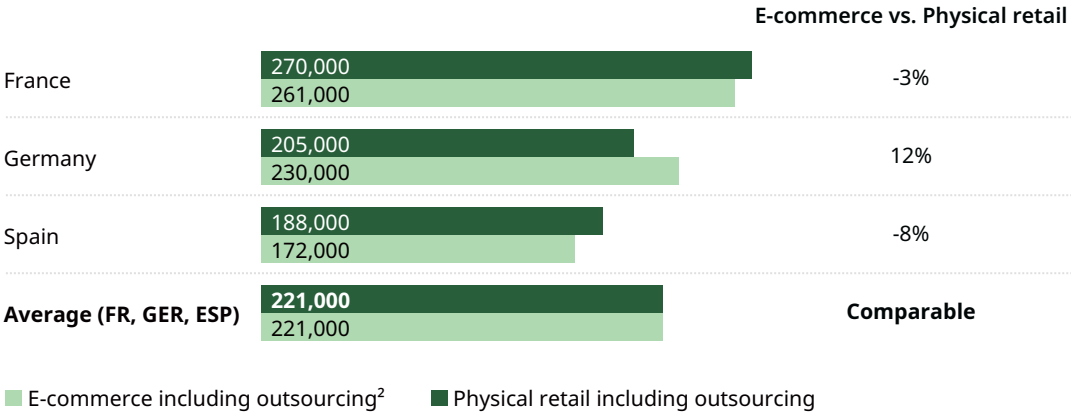
End-to-end e-commerce and physical retail have a similar labor intensity.

When looking at full-time equivalent direct employees only (FTE), the ratio between sales and the number of FTE in e-commerce is on average 80 percent higher than that in physical retail. That might suggest — incorrectly — that e-commerce is less labor intensive. On average (across France, Germany, and Spain) the ratio between sales and the number of direct employees in e-commerce is €467,000, compared to €258,000 for physical stores (see Appendix 1.2).[14]

In an end-to-end comparison including delivery and outsourced activities (based on the methodology described above), the ratio between sales and the number of full-time equivalent employees is similar for physical retail and e-commerce, at around €220,000. (The variation is about 10 percent) (see Exhibit 18).[15] In other words, €1 million of sales requires about five full-time employees in both online and offline retail.

Exhibit 18: End-to-end sales per FTE comparison between physical retail and e-commerce[1] including outsourcing

2018, €



Note: Scope of the analysis has been limited to countries with robust data available for the outsourcing rate, e.g., Italy has been excluded due to the large presence of temporary employment agencies.

1. Average value of sales per FTE based on lower end and higher end assumptions for outsourcing rate (margin of error of ~10%) of e-commerce, due to the lack of official outsourcing data.

Sources: Eurostat, Oliver Wyman analysis

Despite the similarity in revenue per fulltime employee, the two modes of retail provide economic value for the consumer in different ways. E-commerce offers unit picking and last-mile transportation to consumers' homes as part of its value proposition — both very labor-intensive activities. Consumers that buy from a physical store carry out these activities themselves. Physical stores of course provide a part of the transportation of a product by taking it to the retail outlet. But, most importantly, they offer on-the-spot availability and a live experience, which require additional expenses for buildings and personnel. E-commerce is certainly creating fewer direct retail jobs, but it is generating more indirect jobs in logistics and at least as many jobs in total.

Looking forward, continued digitalization and automation are expected to generate further productivity enhancements for both kinds of retail. In physical retail, these will come from self-checkout, automated inventory and replenishment, and growing warehouse automation. E-commerce can become more productive by automating fulfilment and through the consolidation of deliveries, for example, by increasing the proportion of deliveries made to parcel lockers.

PERSONNEL COSTS

The cost per fulltime employee is 15 to 20 percent higher in e-commerce than physical retail for direct jobs — but comparable once indirect jobs are taken into account.

As the cost per direct fulltime employee in e-commerce is 15-20 percent higher, that may suggest these jobs are better paid than jobs in physical retail.[16] But the difference diminishes when indirect jobs are included. The data analyzed below compare the economic value of direct jobs created — not the compensation levels for individual employees.[17]

The direct personnel cost (including salaries as well as employers' social security costs) per fulltime employee averages €40,000 a year in e-commerce, 18 percent higher than the average of €34,000 in physical retail. The cost per direct employee is over 20 percent higher in e-commerce than physical retail in France, Germany, Italy, the Netherlands, Poland and Spain. The cost per direct employee is closer in the countries with the highest e-commerce penetration: In Sweden, they are the same, while in the UK, the cost is 4 percent higher in physical retail (see Exhibit 19).

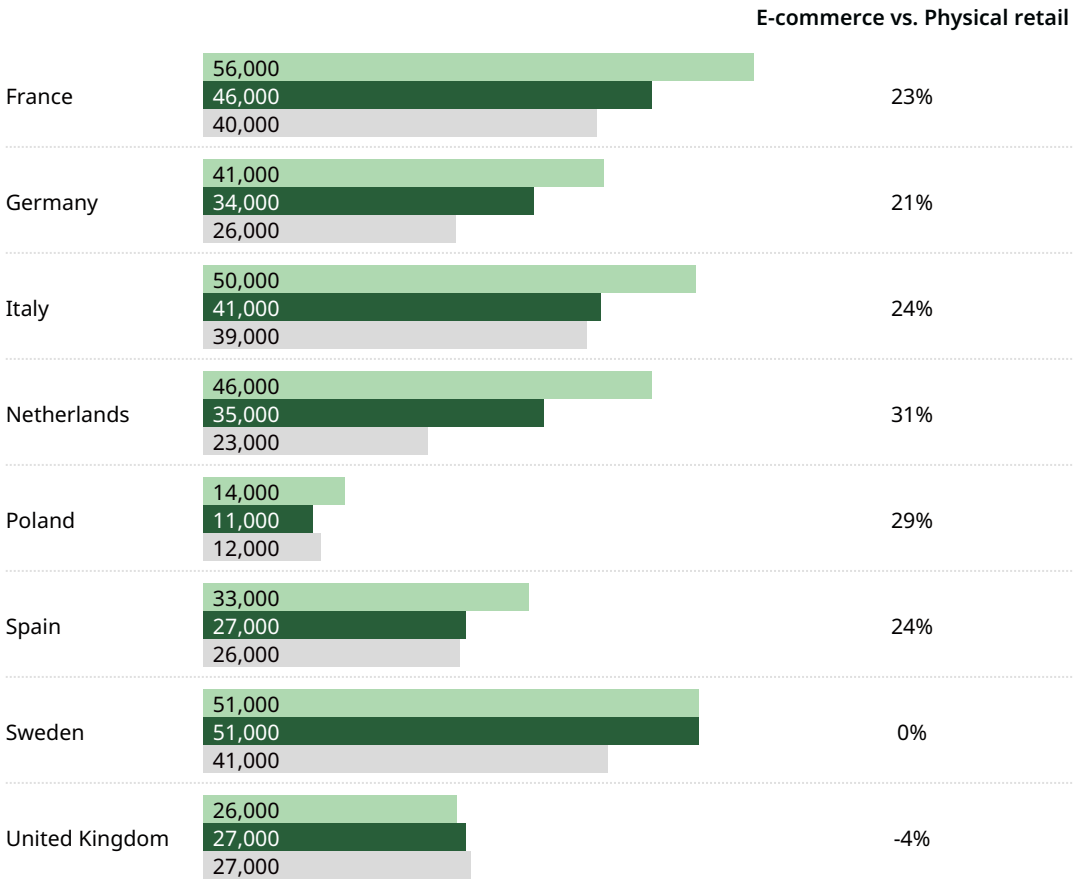
The difference in personnel costs between physical retail and e-commerce is mainly driven by their different job mixes. E-commerce features a higher share of jobs at headquarters and in IT, while physical retail has a higher share of sales assistance jobs. But this difference in cost seems to decrease as e-commerce penetrates further, as online retailers gain scale and branch out into new categories.

The UK can partly be considered an illustration of the convergence between offline and online as e-commerce penetration grows. It has the second lowest average cost per full-time employee, and several online retailers have already increased in scale: The top 50 generate more than 80 percent of total e-commerce sales. Grocery's share of e-commerce also is higher in the UK (12 percent of total e-commerce sales in 2019, compared with 3 percent in Germany), with the particularity that the largest online grocery players carry out delivery themselves instead of outsourcing it.

E-commerce creates more jobs in the logistics sector and fewer in retail.

Exhibit 19: Personnel cost for e-commerce, physical retail and delivery FTE

2018, Average personnel cost[1] per FTE, €



On average +18% difference between e-commerce and physical retail across the EU-8

E-commerce Physical retail Delivery[2]

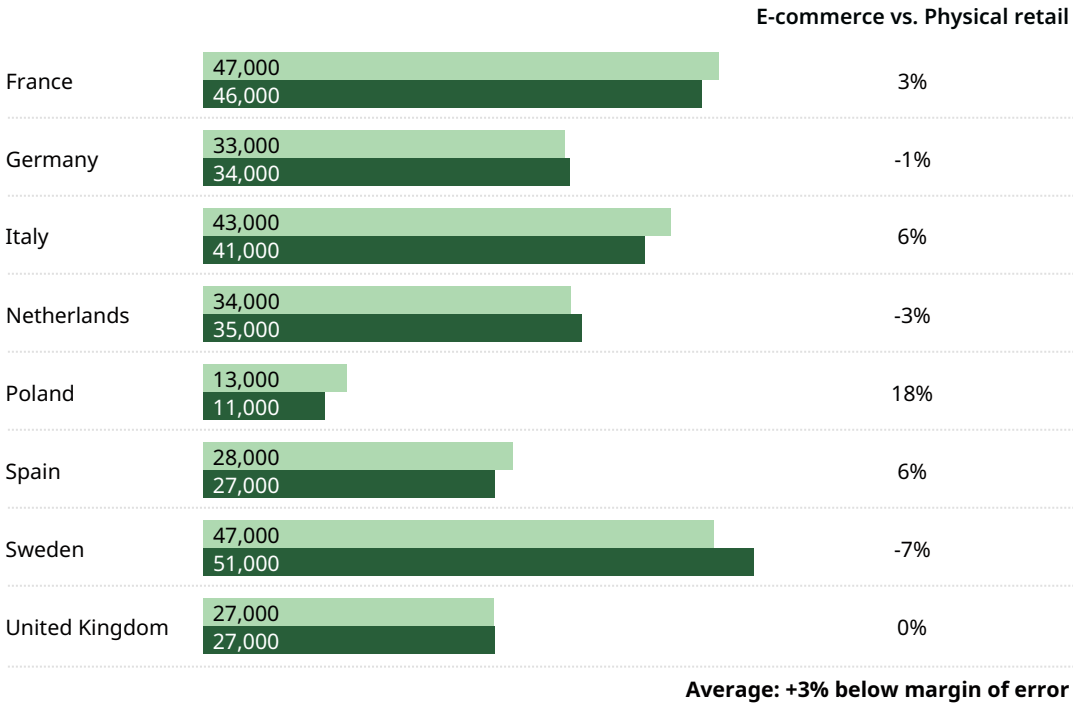
1. Personnel costs include wages, salaries and employers' social security costs; 2. Average personnel cost for postal and courier activities, for Poland only 2017 value available.

Sources: Eurostat, Euromonitor, Oliver Wyman analysis

When indirect fulfilment and delivery jobs are included in an end-to-end perspective (based on the methodology described in this section),[18] the cost per fulltime employee is similar in physical retail and e-commerce (with a variation of around 10 percent). Poland is an outlier, with cost per fulltime employee 18 percent higher in e-commerce. This is most likely due to the development of fulfilment centers serving Germany.

Exhibit 20: End-to-end personnel cost for e-commerce including outsourcing[2] vs. physical retail

2018, Average personnel cost[1] per FTE, €



1. Personnel costs include wages, salaries and employers' social security costs; 2. Weighted averaged of e-commerce personnel cost and delivery personnel cost based on indirect e-commerce job ratio per country.

Sources: Eurostat, Euromonitor, Oliver Wyman analysis

TYPE OF EMPLOYMENT: FULLTIME, PART-TIME, SELF-EMPLOYMENT

Fulltime and part-time employment are evolving at a similar pace.

The proportion of full-time employment in physical retail varies across the eight countries and has remained broadly stable at 84 percent in France, 71 percent in Germany, and 70 percent in the UK.[19] In countries where there has been an evolution — such as Spain and the Netherlands, where there has been a decline of 6 percentage points — this has been in line with national employment shifts. Only in Italy has there been a greater shift in retail than in the country overall: The proportion of full-time jobs decreased from 83 percent in 2008 to 72 percent by 2018.[20]

The share of full-time direct employment in e-commerce also has remained mostly flat; over 80 percent of employees were full time in the eight countries between 2014 and 2018. The Netherlands is an exception: Full-time direct employment declined 5 percentage points between 2014 and 2019, which is in line with the national trend.[21]

Available official statistics do not properly capture the share of temporary workers by industry. Anecdotal evidence shows that activities related to e-commerce will use a higher proportion of temporary workers, to manage greater variations in sales.

Official statistics report self-employment for the wholesale and retail sector as a whole, without breaking it down into individual segments. That means that, if self-employed people working in non-organized retail (for example owners of independent retail stores) transfer to jobs in organized retail, this transfer could show up as an increase in retail jobs — even though it would just be a shift from one type of retail to another.

The extent of this potential error was calculated from the annual growth rate in the number of self-employed people and the proportion of self-employed people working in the wholesale and retail sector. On average for the eight countries, this resulted in overestimating annual retail sector employment growth by around 0.3 percentage point.

Adjusting the 1.2 percent average annual growth in direct employment in the retail sector by this margin of error would still result in a growth rate of 0.9 percent since 2008 in the eight countries taken as a whole. In countries with a higher share of non-organized retail (Italy, Spain, and Poland), the margin of error was slightly higher: Employment growth was overestimated by around 0.5 percentage point. This would result in roughly stable direct retail employment in Italy and Poland — a growth rate of 0.4 percent between 2008 and 2018. Spain's rate of decrease in direct retail employment would be slightly greater, at 0.5 percent, compared with an unadjusted decrease of 0.1 percent.[22]

IMPACT ON COMMERCIAL FOOTPRINT: LOCAL JOBS AND PHYSICAL RETAIL OUTLETS ARE PRIMARILY INFLUENCED BY DEMOGRAPHICS AND WEALTH

FOOTPRINT OF PHYSICAL RETAIL

The number of physical retail outlets is decreasing (by an annual average of 0.9 percent from 2005 to 2019), but the total surface area is stable (growth of 0.3 percent a year from 2005 to 2019).

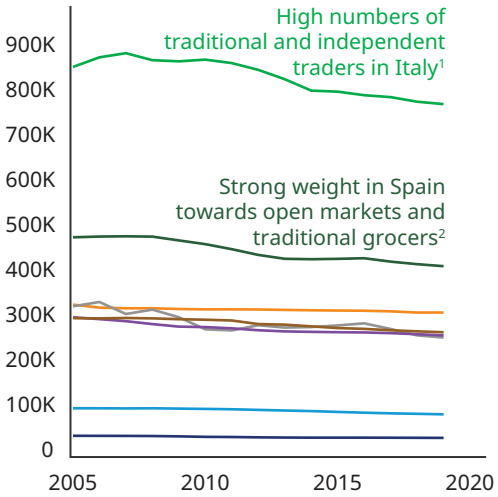
METHODOLOGY

The evolution of physical retail's footprint at national level has been analyzed based on data up to 2019 and published in 2020 by Euromonitor and Statistics Poland.

There are fewer outlets in the eight countries, but the total store surface remained stable, as stores grew larger. The number of physical retail outlets steadily declined from 2005 to 2019, by an average of 0.9 percent a year. That corresponds to a reduction of about 320,000 stores over the period. The annual decline in outlet numbers ranges from 0.4 percent in France to 1.6 percent in Poland, reflecting different stages of transition to organized retail (see Exhibit 21).

Exhibit 21: Evolution of physical retail outlets

Number of physical retail outlets



	CAGR 2005-2019		
	Number of outlets	Number of outlets	Number of population
Italy	-0.7%	-83,000	0.4%
Spain	-1.0	64,000	0.7%
France	-0.4%	-18,000	0.5%
Germany	-0.8%	-31,000	0.1%
United Kingdom	-1.0%	-4,000	0.9%
Poland	-1.6%	69,000	0.0%
Netherlands	-0.9%	13,000	0.5%
Sweden	-0.7%	-5,000	1.1%
Total	**-0.9%**	**-323,000**	**0.4%**

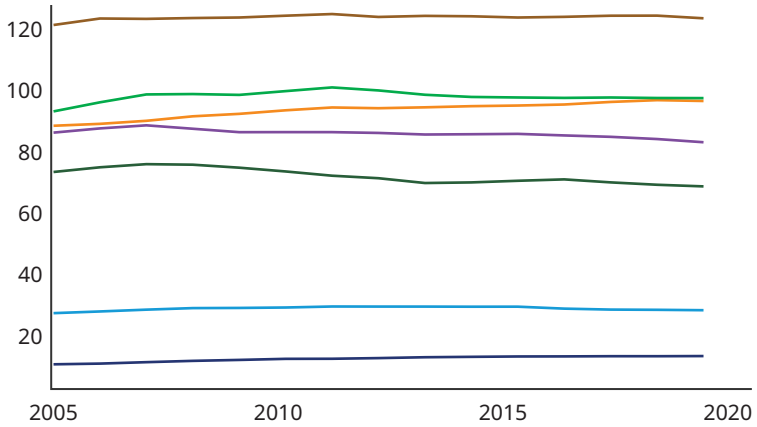
1. Large numbers of independent food shops and traders in market (compared to UK and Germany). Italian grocery retail highly fragmented; 2. Strong trend of fresh produce in total food consumption which is mostly bought in open markets and specialised players, traditional grocers and neighbourhood stores, high fragmentation and preference of proximidity.

Sources: Euromonitor, Statistics Poland, Oliver Wyman analysis

Overall retail surface area remained stable from 2005 to 2019, growing by an annual average of 0.3 percent,[23] with some variation across countries — ranging from -0.5 percent in Spain to 1.6 percent in Sweden (see Exhibit 22).

Exhibit 22: Evolution of physical retail store space[1]

Space, Million sqm of total physical retail stores per country



CAGR 2005-2019	
Germany	0.1%
Italy	0.3%
France	0.6%
United Kingdom	-0.3%
Spain	-0.5%
Netherlands	0.2%
Sweden	1.6%
Total	**0.3%**

1. Data not available for Poland.

Sources: Euromonitor, Oliver Wyman analysis

LOCAL JOBS AND OUTLETS

At a city level, offline retail jobs and outlets are primarily influenced by demographics and wealth, not e-commerce penetration.

METHODOLOGY

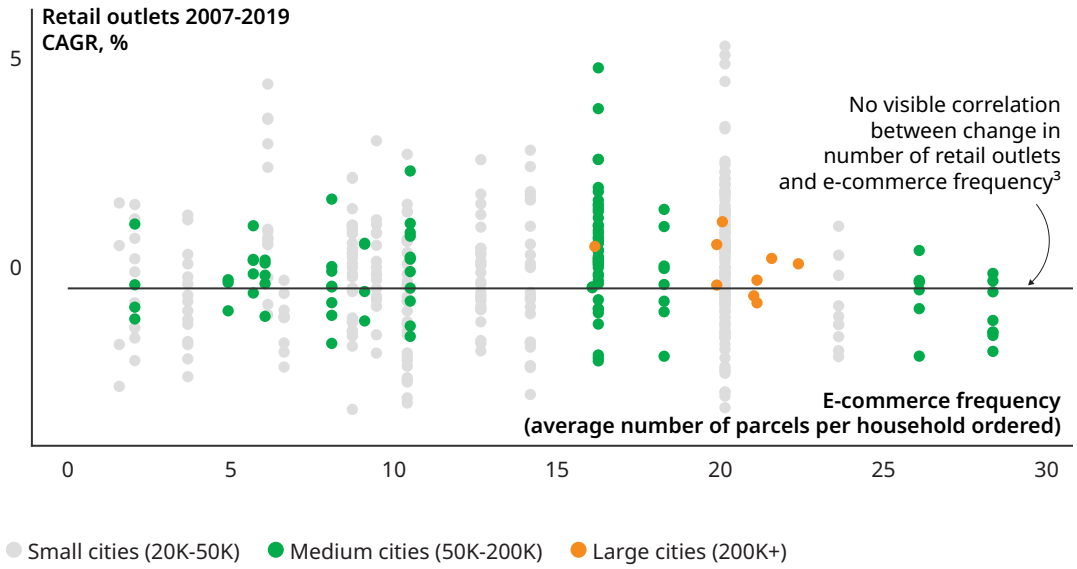
Cities were selected for their availability of data, how well they represented the countries in scope, and to provide variety in size and economic context. In addition to the analysis of city cases, country-level statistical analyses were performed for France and Italy. These countries were selected for the availability of data in a consistent format over a long period of time. French cities were analyzed based on a sample of 450 cities of more than 20,000 inhabitants. Italian cities were analyzed based on a sample of 15 Italian cities of between 50,000 and 200,000 inhabitants. Cities were selected at random under set criteria so as to have a mix of different regions and of both coastal and inland geographies (see Appendix for further details).

National averages combine different local situations, and larger, demographically dynamic cities show above-average retail job creation despite higher e-commerce penetration.

Multiple correlations were tested between e-commerce penetration (average frequency of orders per geographical area) and the evolution of the number of retail outlets, retail employment, and drivers such as disposable income, population growth, and age. No statistically significant correlation was found: See Exhibit 22, which shows no visible correlation between e-commerce frequency (number of parcels ordered per household) and the change in the number of retail outlets. See also the Appendix for correlations with other tested drivers.

The main drivers of changes in the numbers of retail outlets and jobs in a city are the evolution of its population and its level of wealth — that is, how attractive the city is (see Exhibit 24). Most dynamic cities with a growing population and above-average wealth also show above-average e-commerce penetration. For example, in 60 percent of French mid- and small-sized cities with above-average wealth and a growing number of retail outlets and jobs, e-commerce frequency is above average.[24]

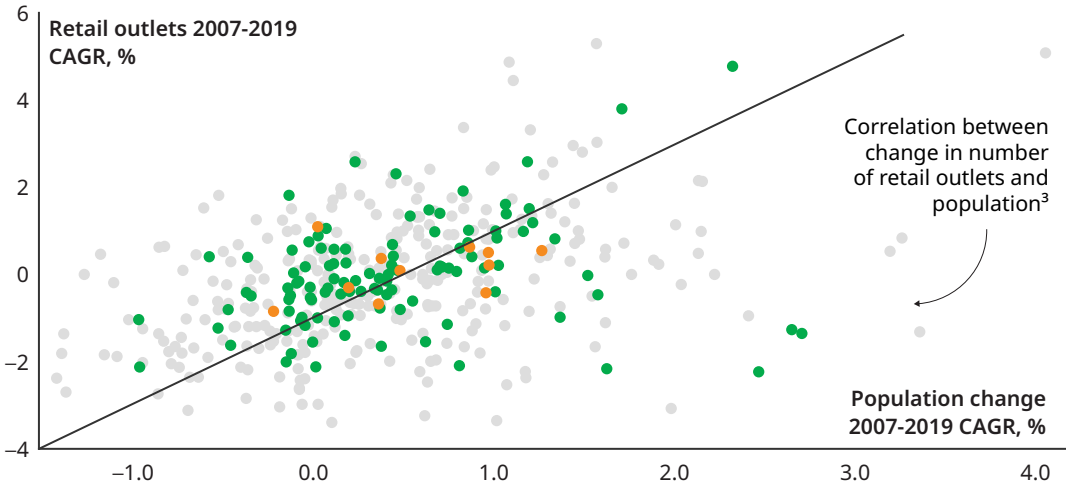
Exhibit 23: Evolution of physical retail retail outlets with e-commerce metric in France
2007-2019, French cities[1], retail outlets (CAGR) and average parcels received[2]



1. Includes all cities in metropolitan France with a population above 20,000 ACOSS, excluding outliers; 2. Based on average parcels ordered per household, at a city size level within each French metropolitan region; based on OW-run survey with demographic weighting; 3. R2 value (correlation retail outlet CAGR and e-commerce frequency), large cities (200,000+) = 0.22; medium cities (50,000-200,000) = 0.01; small cities (20,000-50,000) = 0.01.

Sources: ACOSS, Oliver Wyman analysis

Exhibit 24: Evolution of physical retail retail outlets with population change in France
2007-2019, French cities[1], retail outlets (CAGR) and population change[2]



1. Includes all cities in metropolitan France with a population above 20,000, excludes outliers. ACOSS; 2. Based on population change 2007-2019; 3. R2 value (correlation retail outlet CAGR and e-commerce frequency), large cities (200,000+) = 0.16; medium cities (50,000-200,000) = 0.07; small cities (20,000-50,000) = 0.1.

Sources: ACOSS, INSEE, Oliver Wyman analysis

Multi-factor and single-factor correlations are relatively low and not comprehensive enough to describe retail evolution in different cities. However, three city patterns can be isolated that characterize the evolution of physical retail.

Large cities: cities with more than 200,000 inhabitants (such as London, Paris, Manchester, and Hamburg). Large cities — not including their surrounding metropolitan areas — are home to 25 percent of the population of Germany and 9 percent[25] of the population of France.[26] These large cities also have the highest level of e-commerce penetration.

Growing cities: smaller cities (20,000 to 200,000 inhabitants) with a growing or relatively wealthy population. These account for about 20 percent of the French population. They are above average both in number of retail outlets and job evolution, and they have above-average e-commerce penetration.

Decreasing cities: cities and suburbs with decreasing population and below-average wealth. These account for about 8 percent of the French population. They show both a lower rate of e-commerce penetration and declining physical retail.

There are fewer outlets in the eight countries, but the total store surface remained stable, as stores grew larger.

THE BIGGEST CITIES

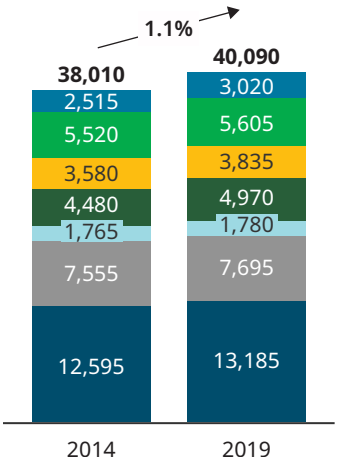
These exhibit both higher e-commerce penetration and a growing or stable number of retail employees and outlets.

The examples of three large cities below suggest that physical retail can grow even where e-commerce is higher than (or similar to) average.

In **London**, the number of retail outlets grew by an average of 1.1 percent a year from 2014 to 2019, and the number of retail jobs by 2.1 percent from 2010 to 2018. This growth was higher than in the UK overall, where outlets decreased by a rate of 0.6 percent per year from 2014 to 2019, and jobs grew by 0.7 percent from 2010 to 2018. London's e-commerce frequency is estimated to be 9 percent higher than the national average.[27]

Physical retail in individual product categories, including those with high e-commerce penetration, also is evolving more favorably in London than elsewhere in the UK. The number of fashion stores increased by an average annual rate of 0.3 percent in London from 2014 to 2019 and decreased by 0.9 percent per year in the UK as a whole (see Exhibit 25).

Exhibit 25: Physical retail retail outlets in London
2014-2019, Number of outlets[1]



CAGR 2014-2019	London		United Kingdom	
	Number of outlets			
Total[2]	1.1%	2,100	-0.6%	-7,700
Health/Beauty	3.7%	500	0.4%	500
Apparel/Footwear	0.3%	100	-0.9%	-1,600
Leisure	1.4%	300	-0.4%	-600
Home/Garden	2.1%	500	-1.2%	-1,700
Electronics/Appliances	0.2%	0	-2.8%	-1,100
Other	0.4%	100	-0.2%	-400
Grocery	0.9%	600	-0.6%	-2,700

1. ONS UK Business Counts, Local Units by 4 Digit SIC codes for the London region (covered by Greater London Authority), population ~9mil. Aggregated to compare with Euromonitor national retail categories. 2. Rounding may cause total to not align with total of individual categories shown here.

Sources: ONS (UK Gov), Euromonitor, Oliver Wyman analysis

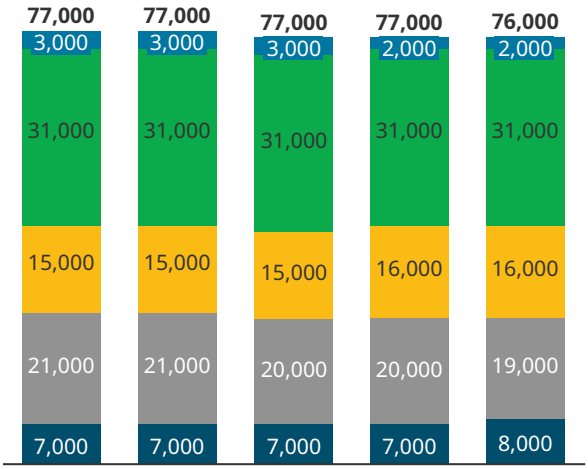
London's favorable evolution has been supported by its attractiveness as a city with a high level of disposable income,[28] a buoyant tourist industry,[29] and a population that grew faster than the national average between 2014 and 2019 — by an average annual rate of 1.1 percent, compared to 0.7 percent nationally.

Hamburg, Germany, which has 1.84 million inhabitants,[30] exhibits a similar pattern. Physical retail sales grew by an annual rate of 1.6 percent from 2010 to 2019, and physical retail jobs increased by a rate of 1.0 percent. E-commerce has higher penetration in Hamburg: 71.2 percent of people there bought something online over the course of a year, compared to 64.8 percent in Germany as a whole.[31] Fashion sales in Hamburg also grew faster, by an average annual rate of 1.3 percent from 2010 to 2019, than in Germany as a whole, where they grew by 0.4 percent.

In **Paris**, e-commerce frequency (the number of parcels ordered per household) is estimated to be 30 percent higher than the national average.[32] The number of physical retail outlets declined by an average annual rate of 0.4 percent between 2005 and 2017, while the number of retail jobs increased by a rate of 0.9 percent between 2007 and 2019. Beneath these changes, two shifts occurred at the category level.

First, there was a shift from retail to services such as restaurants and personal care. Though the number of occupied commercial premises was stable overall (0 percent average annual growth from 2005 to 2017), the number of non-retail outlets[33] grew by a rate of 0.3 percent over that period.

Exhibit 26: Evolution of commercial outlets in Paris
2000-2017, Number of outlets[1] by type



CAGR 2005-2017	Number of outlets	
Total outlets	-0.2%	-1.5
Total retail outlets	-0.4%	-1.4
Total non-retail outlets (including wholesale)[2]	0%	-0.1
Total non-retail outlets (excluding wholesale)[2]	**0.3%**	**1.7**
Wholesale	-5.9%	-1.7
Other services	0%	0.1
Restaurants, hotels	0.8%	1.6
Non-food retail	-0.8%	-1.9
Food retail	0.6%	0.5
Population growth: 0.1%[3]		

1 Paris Urbanism Agency (APUR) dataset covering city outlets, in Paris city region (population ~2.1MN); 2. Does not include vacant properties; 3. Population of Paris has declined in recent years, for example population growth 2014 to 2017 was 0.5% per year (Eurostat).

Sources: APUR, Euromonitor, Oliver Wyman analysis

Second, the number of non-food retail outlets decreased by an average annual rate of 0.8 percent in Paris from 2005 to 2017, over which period the number of food retail stores grew by a rate of 0.6 percent. The number of non-food retail outlets decreased faster in Paris than at the national level, as the electronics, leisure, and home-and-garden categories lost more shops, in the context of consolidation and rent pressure in prime locations.[34] At the same time, the number of local grocery shops increased.

GROWING CITIES

Medium-sized and small cities with growing, relatively wealthy populations have better-than-average evolutions for numbers of retail outlets and jobs.

Retail in small and medium-sized cities is sensitive to population growth and the average disposable income of the population. Cities with dynamic and wealthy populations often have above-average e-commerce frequency and either experienced growth in their number of physical retail outlets and jobs (as in France) or showed a higher resistance to retail outlet decline (as in Italy). Of French cities that have above-average wealth and a growing number of retail outlets and jobs, 60 percent also have above-average e-commerce frequency.[35]

In France, two-thirds of mid-size (50,000 to 200,000 inhabitants) and small (20,000 to 50,000 inhabitants) cities had growing or stable populations between 2007 and 2019. This had a positive impact on the number of retail jobs and outlets. There is also a moderate correlation[36] between the level of disposable income and the evolution of retail outlets: Outlet numbers have been growing where the average local disposable income is above the national average.

In addition, some mid-sized and small cities benefit from special circumstances, such as a high seasonal influx of tourists. For example, Biarritz, a French coastal city, had a decrease in population from 2007 to 2019 and yet an increase in the numbers of retail outlets and jobs, which grew by average annual rates of about 2 percent. This evolution is likely driven by a relatively high average household disposable income, which has been boosted by the tourism industry.[37] In Italy too, tourism helps retail — if not to expand, then at least to resist decline.

CITIES WITH DECLINING POPULATIONS

Physical retail is declining in medium-sized and small cities and suburbs with falling populations and below-average wealth.

Physical retail employment and outlet numbers are falling in medium-sized and smaller cities (with between 20,000 and 200,000 inhabitants) with declining populations and in smaller cities located in the suburbs of metropolises or larger cities. In addition, most of these types of city have below-average e-commerce frequency. These trends can be observed in the UK, Italy, and France.[38]

Suburban areas compared to megalopolises

In the UK, Stockport, a Manchester suburb, showed retail employment decreasing by an annual rate of 2 percent from 2015 to 2018, while in Manchester, retail employment grew by a rate of 3 percent over that period. In France, similarly, the number of retail jobs grew by an annual average of 0.7 percent between 2007 and 2019 in the Ile-de-France region, while in the city of Paris at the region's center, jobs grew twice as fast, by 1.6 percent.

Other small and medium cities

One-third of mid-sized and small cities in France suffered population declines between 2007 and 2019. In 75 percent of these cities, the number of retail outlets fell, and in 60 percent the number of retail jobs fell. The decreases were even greater where the local level of wealth was below the national average. Furthermore, e-commerce frequency was below average in 75 percent of mid-sized and small French cities with declining populations, employment, and numbers of retail outlets.[39]

PHYSICAL STORES THAT ALSO SELL ONLINE ARE GROWING FASTER THAN THEIR PURE OFFLINE PEERS

METHODOLOGY

Independent store managers' visions of the benefits and limits of e-commerce were analyzed based on the results of an independent retailer survey conducted by Oliver Wyman during the fourth quarter of 2020. The survey looked at about 300 independent retailers in Germany and 400 in France (see Appendix B for further details). The online penetration of small retail enterprises has been analyzed based on official public data (Eurostat).

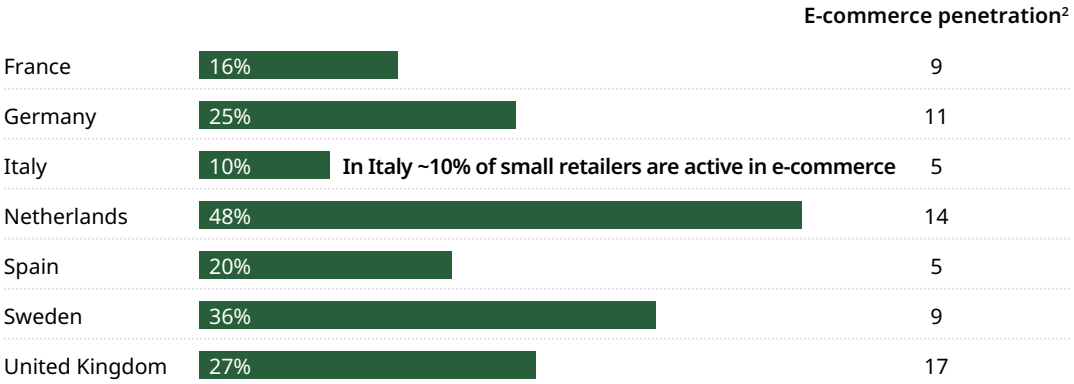
SMALL PHYSICAL RETAILERS

In countries with high e-commerce penetration, small physical retailers show higher use of the online channel.

The proportion of small physical retailers (with nine to 49 employees) active in e-commerce varies considerably across the eight European countries. In Italy they are an estimated 10 percent of the total, while in the Netherlands they are 48 percent (see Exhibit 27).[40] The online presence of smaller stores grows with a country's overall e-commerce penetration — with the notable exception of France, where more than 16 percent of small retailers would be expected to have e-commerce sales, given the country's overall e-commerce sales penetration.

Exhibit 27: Online penetration of small retail enterprises[1]

2018, Small retailers (9 to 49 employees) with e-commerce sales in percentage of total retailers (9 to 49 employees)



1. Retail trade, except of motor vehicles and motorcycles, includes enterprises with sales via internet, enterprises with 9 to 49 employees; Based on European ICT (Information and Communication Technologies) usage survey 2018 (n=160000) of retailers; Online penetration based on assumption that all retail enterprises with more than 50 employees are active in e-commerce, Poland missing, given no data availability; 2. Share of e-commerce sales of total retail sales.

Sources: Eurostat, Oliver Wyman analysis

STORES WITH ONLINE PRESENCE

52 percent of stores with an online presence are growing, compared to 39 percent of stores that are only offline.

Small independent physical retailers[41] with an online store are more likely to have increased their sales in the past three years than retailers without an online presence, regardless of the type of store (see Exhibit 28). In Germany, 51 percent of surveyed stores that sold online claimed that their sales had increased over the past three years, against 38 percent of those without online sales.[42] In France, 53 percent of respondents who sell online said their sales had increased over the past three years, compared with 40 percent of those without online sales.[43]

Exhibit 28: Sales performance of independent retailers in France and Germany

2020 Q4 survey

Note: Multiple answers possible, France n=193, Germany n= 112.

Source: Oliver Wyman-run survey and analysis

52 percent of stores with an online presence are growing, compared to 39 percent of stores that are only offline.

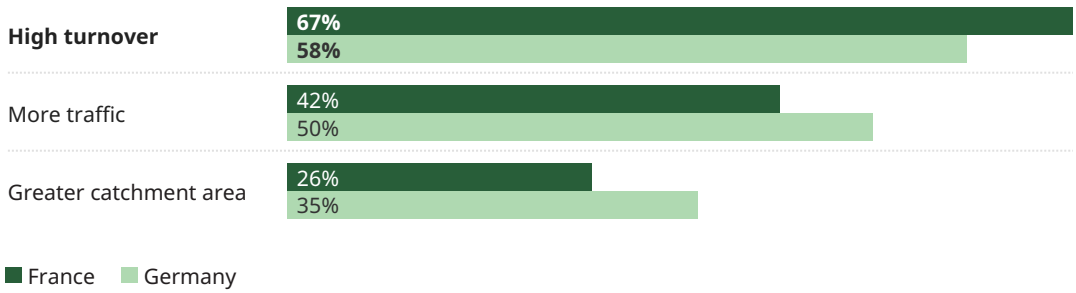
Moreover, digitalization has not cannibalized offline sales: for 99 percent of independent retailers with online sales in France and 93 percent in Germany, offline sales have either increased or not changed since they started selling online. This is in line with a survey by ACSEL, the Association of the Digital Economy in France, according to which 56 percent of respondents considered e-commerce to be a lever for their offline sales.[44]

BENEFITS OF SELLING ONLINE

Revenues mostly increase through traffic generated at own shop.

Besides higher sales, selling online generates more traffic, according to 50 percent of small independent retailers with online sales responding in Germany and 42 percent in France. Online sales also increase a small retailer's catchment area, according to 35 percent of respondents with online sales in Germany and 26 percent in France[45] (see Exhibit 29). During the COVID-19 crisis, online sales have been crucial, in particular during periods of lockdown. Some small independent retailers also mentioned the opportunity to sell internationally and to destock.

Exhibit 29: Main advantages of online sales channel for independent retailers selling online in France and Germany



Note: Multiple answers possible, France n=193, Germany n= 112.
Source: Oliver Wyman-run survey and analysis

A majority of small independent retailers with online sales (including those that only offer click-and-collect) have their own web shop: 94 percent in Germany and 74 percent in France. In addition, 25 percent of small physical retailers with online sales in France and 9 percent in Germany are selling via a marketplace. In Germany, 85 percent of small physical retailers surveyed said they sell exclusively through their own website, while in France 53 percent said this.[46]

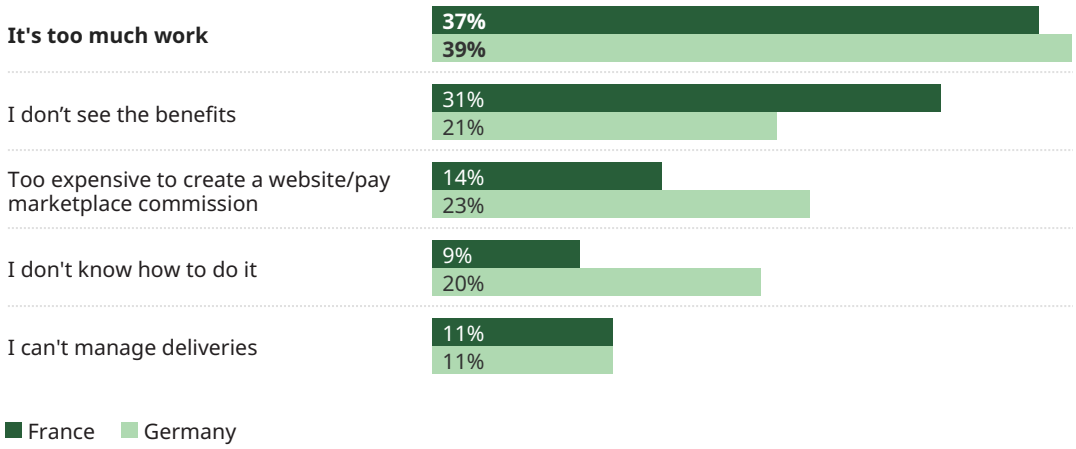
From an operational point of view, delivery through a third party remains the most popular option — for 76 percent of respondents in Germany and 75 percent in France. While 69 percent of respondents in France offer click-and-collect, in Germany only 39 percent do. In addition, 22 percent of German respondents and 20 percent of French carry out delivery themselves.[47]

REASONS FOR NOT SELLING ONLINE

Reasons include knowledge, effort, and cost.

Some small independent physical retailers are reluctant to start online sales. The main reason cited by 39 percent of survey respondents (small retailers without online sales) in Germany and 37 percent in France was that it is too much work to handle at a store level.[48] A further reason is the cost of going online, either because creating a web shop is perceived as too expensive or because of marketplace commissions. This was stated by 23 percent of small physical retailers without online sales in Germany and 14 percent in France.[49]

Exhibit 30: Barriers to entry of independent retailers not selling online in France and Germany



Note: Multiple answers possible, France n=194, Germany n= 139.
Source: Oliver Wyman-run survey and analysis, Q4 2020

Of small physical retailers without online sales, 21 percent in Germany and 31 percent in France don’t see the benefit of selling online. One reason is that it is not appropriate for their products — for example, made-to-measure products, products that are cheap relative to the cost of delivery, and fresh products that are difficult to deliver. Another reason is that these retailers prefer to promote customer contact, service, and proximity. Among those small physical retailers not seeing the benefits of selling online, a large proportion are located in mid-sized and small cities: 80 percent in Germany and 57 percent in France.[50]

COVID-19 AS AN ACCELERATOR OF RETAIL TRANSFORMATION

METHODOLOGY

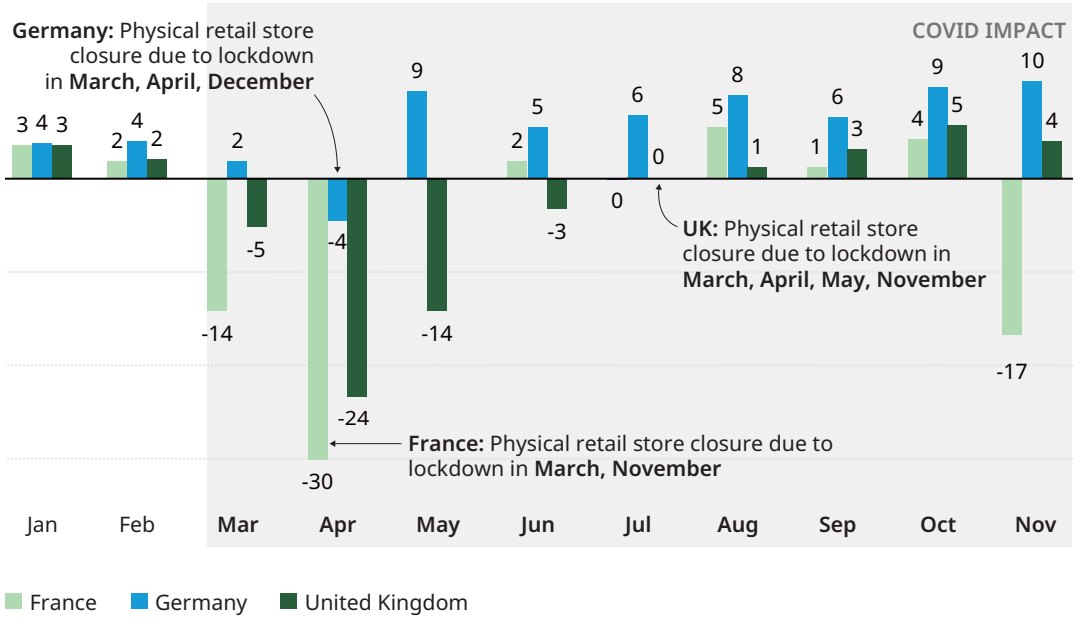
The impact of COVID-19 on the retail sector has been analyzed based on official data (Eurostat). The analysis mostly concerns the period to the end of November 2020, due to data availability. Changes in consumer behavior in the light of COVID-19 have been analyzed based on a consumer survey performed by Oliver Wyman in April 2020 (see Appendix B for further details).

COVID IMPACT ON SALES

While lockdown effects have differed across Europe, e-commerce has accelerated everywhere.

COVID-19 heavily impacted the retail sector in 2020. Though there were some differences between countries, the basic trends were the same. The impact on overall retail sales (in-store and e-commerce) was strongest in April and May at the height of the restrictions (including lockdowns) (see Exhibit 31).

Exhibit 31: Monthly total retail sales (in-store and e-commerce)[1], YOY change[2]
2020, In France, Germany and United Kingdom, %



1. Based on turnover index which is a value index (price multiplied by quantity/volume) and is a direct index in that it compares the current period with the fixed period in the base year (2015=100); 2. Year-on-year change in nominal terms based on calendar adjusted data, not seasonally adjusted data.

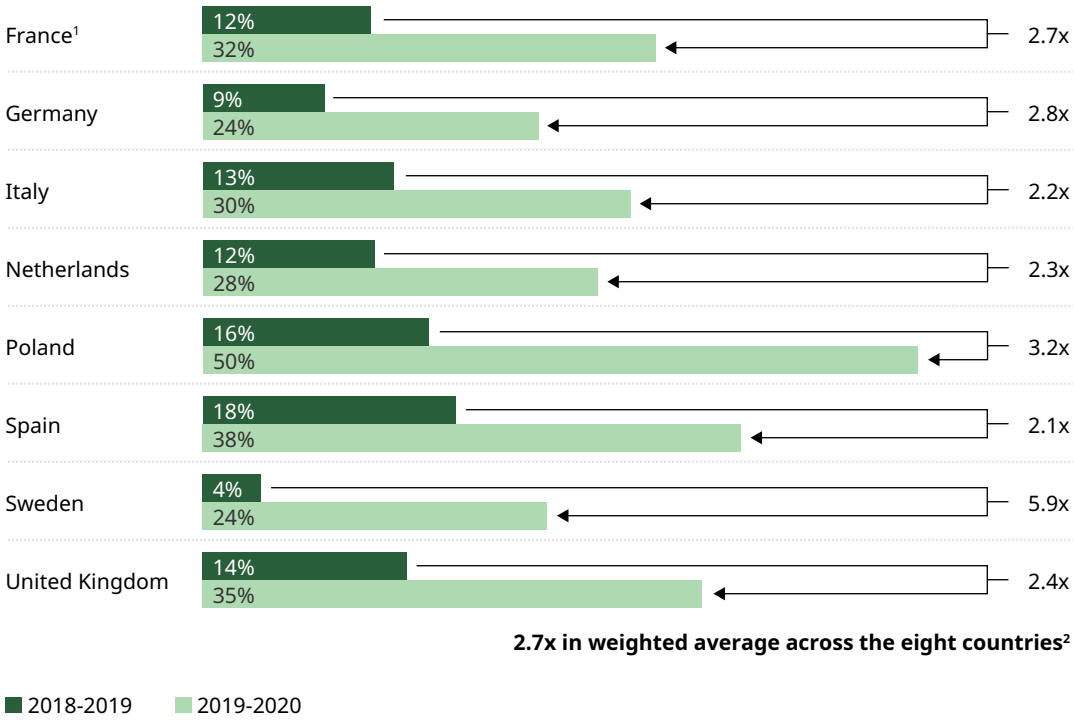
Sources: Eurostat, Oliver Wyman analysis

The trends in total retail sales were mixed. In four of the eight countries, sales declined in 2020 (January to November) from the same period in 2019: Sales fell by 8.4 percent in Italy, 2.4 percent in the UK, 4.4 percent in France, and 8.2 percent in Spain.[51] In the other four countries, total retail sales increased over 2019 — by 5.3 percent in Germany (despite a 3.5 percent decline in GDP),[52] 3.8 percent in Poland, 4.9 percent in the Netherlands, and 1.9 percent in Sweden.[53] These trends mostly reflect the countries' health situations and corresponding lockdown policies, but they were also affected by a transfer of consumer spending from out-of-home services to one-off equipment and groceries.

In parallel, COVID-19 accelerated the adoption of online retail in all eight countries, boosting the increase from 2019 to 2020 to three times that from 2018 to 2019 (see Exhibit 32).[54]

Exhibit 32: E-commerce sales growth by country

2018-2020 YOY growth rate (January-November)



Note: Preliminary data on year over year growth for the month January to November 2019 vs. January to November 2020.

1. France based on FEVAD data, as Euromonitor data was not available; 2. Weighted average based on e-commerce sales 2019.

Sources: Eurostat, FEVAD

CONSUMER BEHAVIOR: STRUCTURAL CHANGES IN CONSUMER BEHAVIORS BEYOND ONE-OFF EFFECTS

Changes in 2020 such as consumers' accelerated adoption of online shopping were in line with longer-term trends. The biggest change in consumer behavior expected from COVID-19 is in grocery shopping — at least in countries with a high degree of e-commerce penetration. In a recent survey, the proportion of consumers saying they would switch permanently to online grocery shopping ranged from 2 percent in Germany to 11 percent in Italy.[55]

Some of the demand shifts in 2020 are expected to be temporary. Due to restaurant closures and increased home consumption, essential categories such as groceries grew faster in the January-November period compared to the previous year — ranging from 2.7 percent expansion in Spain to 8.1 percent in Germany.[56] Several equipment categories benefited from a one-off or anticipation effect, as people made purchases to perform at home tasks that normally would be done elsewhere. For example, they bought home-use hair products due to the closure of hair salons and home-office equipment to aid working at home. But sales in some non-essential categories fell: In fashion, sales declined by 26.8 percent year-on-year in Italy and 21.2 percent in Germany.[57] Some categories slumped and then recovered before the end of 2020. Sales of electrical goods and furniture, for example, fell by 55 percent in April 2020 over April 2019 in the UK — but sales for Jan-Nov 2020 were only 0.1 percent down compared to the same period in 2019. Categories such as fashion, which suffered heavier impacts, are expected to recover over a longer period — and only partially, because spending was already decreasing before the crisis.

Both online stores and grocery stores benefited from channel shifts. During lockdowns, about 20 percent[58] of consumers on average shifted part of their non-food expenditure to physical food retailers, such as large supermarkets and hypermarkets. The other 80 percent of consumers shifted to online shopping.[59]

SMALL PHYSICAL RETAILERS' RESPONSE

Selling online only partly mitigates COVID-19 impacts.

Beyond official statistics of industry-level sales, it is still too soon to evaluate the impact of the COVID-19 crisis on small stores. However, stores that were already selling online are expected to show greater resilience (see previous section).

The crisis has, unsurprisingly, accelerated retailers' intentions to sell online. Among small independent physical retailers without online sales, 29 percent in France and 54 percent in Germany have changed their intentions or plans to sell online. Surprisingly, managers of independent stores in Germany are more willing to open online channels despite being less severely impacted than their French peers.

Local policies from authorities and trade associations are emerging to facilitate the digitalization of small independent retailers.[60] In France, some regions have developed online marketplaces to support local retailers, while others are subsidizing access to existing marketplaces.

OUTLOOK: ALL RETAIL WILL GO THROUGH NEW TRANSFORMATIONS

The next trends in retail most likely will combine a further shift to organized retail, greater online sales, an emphasis on service, new uses of social media, and sustainable practices. To adapt, both physical and online retailers will have to invest further — in marketing, sourcing logistics, and technology.

For small physical retailers, these changes present both a challenge and an opportunity. As expectations rise for information, delivery, speed, and customer care, they will need to keep up with these developments. They might do this independently or look to larger platforms for technical and financial support. Either way, they will need to invest to keep up with the speed of these transformations.

The opportunity for small independent stores comes from their competitive advantages in customized services, proximity, and convenience. Small stores that manage to raise their service levels and market their green credentials will see a difference. In addition, the COVID-19 crisis has led to an emphasis on local and sustainable sourcing, making this an even more important part of retailers' agendas.

Below are some projections for the wider retail sector, which are quite likely to evolve. They are mostly based on the observations in the previous sections, combined with more-qualitative insights from our teams across Europe.

E-commerce

Physical stores will still be the main retail channel over the next decade, although an increasing number will function as omnichannel retailers, whether organized or not. If e-commerce sales grow by 15 percent a year, as they did in the eight countries between 2010 and 2019, e-commerce will exceed 30 percent of total retail by around 2029.[61] If e-commerce sales grow by 10 percent a year, as happened from 2017 to 2019, this level will be reached in 2035.

The deceleration of e-commerce sales that started before COVID-19 in most countries (except for Sweden, the Netherlands, and Poland) might have been a good assumption before the pandemic and the resulting abrupt changes in consumer behavior. But sustained, steady growth seems more likely now.

The next trends in retail most likely will combine a further shift to organized retail, greater online sales, an emphasis on service, new uses of social media, and sustainable practices.

Differences between countries will remain in the share of organized retail and in e-commerce penetration, but these will most likely diminish. E-commerce penetration is most likely to grow along with organized retail.

Product categories

In the next five years, categories with relatively low e-commerce penetration, such as grocery and personal care (both at 1 percent in Germany; grocery at 3 percent and personal care at 2 percent in France) are expected to catch up to categories such as fashion, where penetration is high. These low-penetration categories have seen an acceleration of e-commerce growth in recent years: Between 2017 and 2019, online sales in Germany grew by 21 percent a year in grocery and 15 percent in beauty and personal care; in France they grew by 8 percent in grocery and 15 percent in beauty and personal care.

This growth is expected to continue as customer-facing technologies evolve. Within the next five to 10 years, leading retailers and parcel operators are likely to find the right business models to increase e-commerce penetration in all categories. The upper limit is still unclear. In some categories, e-commerce penetration already has reached about 40 percent — for example, in hobby and leisure products[62] in the UK.

Number of stores

The convergence in the number of stores per capita in northern, western, and southern Europe might continue for more than a decade. It has been assumed that total physical retail revenue will follow past evolution and that growth will remain low — about 1.5 percent a year.

Today, southern European countries such as Spain and Italy have an average of 11 stores per 1,000 people, significantly higher than the 4.5 stores per 1,000 in northern and western European countries. Over a five-year horizon, the number of stores per capita will decline in southern European countries, with a transfer of surface area to organized retail.

Northern and western European countries should see their store ratios stabilize — unless the one-off effect of the COVID-19 crisis accelerates the decrease in non-organized physical retailers. Past trends suggest that there is an asymptotic upper limit to the consolidation of physical stores by organized retailers, and that northern and western countries have already neared this.

Trends in stores

The trend toward omnichannel retail will continue, and large physical retailers will further expand their e-commerce activities, most likely amplifying e-commerce growth. In a second stage, they will reduce the size of their largest stores, as the value proposition of physical stores moves toward convenience and services, especially in dynamic urban areas. Global brands will accelerate their direct-to-consumer online expansions, as they realize the importance (and possibility) of controlling their online presences and of better measuring their returns on marketing investments.

Subsequently, physical stores — while still instrumental as sales channels — are expected to offer a greater degree of interaction. A wider range of services will include personal customer service and aftersales services, which will be extended online with a larger portfolio of products. Stores will focus even more on delivering a superior customer experience.

Trends in cities

The shift in cities from retail stores to service outlets will continue, as the barrier between the two becomes blurred. Larger, more dynamic cities have seen higher growth in physical retail. In the future, these cities increasingly will be the locations for flagship physical retail stores, as the number of physical retailers declines. In less dynamic cities, physical retail likely will continue to evolve, with organized retail aiming for scale and price rather than convenience.

Consumer trends

Repeated lockdowns during the COVID-19 crisis accelerated e-commerce penetration and might even change online grocery and food consumption patterns. Online shopping has evolved from planned purchases to seek better prices to more impulsive shopping fueled by social media and, now, social commerce.[63]

Social media are increasingly introducing features to facilitate the buying process on their services. Strong brands are already getting feedback from customers through direct engagement on social media, and they have realized that direct sales might no longer be beyond reach. Leading brands in fashion, luxury, and sportswear that are already mature in e-commerce are expected to lead the way in social commerce.

Smaller brands (including digital natives) also will use social media to become better known and to expand their e-commerce sales before they eventually open physical stores. These physical outlets will act as a hallmark of their success and reverse the traditional direction of channel transformation.

CONCLUSION

The COVID-19 crisis has reminded us to be humble when making projections for long-term, industry-wide changes. One thing is certain though: the opposition between online and offline retail will make less and less sense moving forward — both for large and small retailers. The pandemic has clearly accelerated the transformation of retail, revealing pent-up demand from consumers even ahead of retailers' latest innovations. Consumers are demanding faster information and delivery, as well as proximity, customer care, and customized services — all provided with seamless quality of service across channels. And they increasingly want everything done in an environmentally sustainable way.

For some of these developments, large organizations — digital or not — are currently well placed to deliver, and smaller retailers might have to work with these large companies to keep up. Other trends should be small retailers' natural domain, and it will be crucial for them to strengthen — and play up — those areas where they have a natural advantage. Marketing the green credentials of proximate retail will be particularly important. (See next section.)

ENVIRONMENTAL IMPACT

On average, in Europe, e-commerce has a lower end-to-end environmental impact than physical non-food retail

SCOPE, METHODOLOGY AND DEFINITIONS

This study captures the most important externalities of retail: greenhouse gas (GHG) emissions, traffic, and land use or occupation. The greenhouse gases reported are CO_2, CH_4, N_2O, CF_4, CHF_3, and SF_6. They are measured in CO_2-equivalent, abbreviated as CO_2e. Other pollution externalities such as noise and emissions of particulate matter are not studied here. One reason is a lack of data sources; another is the assumption that most conclusions would be similar to those related to CO_2e and traffic.

The study covers books and media, small consumer electronics, and apparel, as these are the most important (non-food) categories sold online. Data on online and offline consumer behavior used in the CO_2e impact model was collected for covered geographies (France, Germany, UK, Spain, Italy) and product categories through targeted surveys addressed to more than 10,000 consumers and carried out in December 2020.

KEY TAKE-AWAYS

CO_2e emissions: Offline retail causes 1.5 to 2.9 times the amount of CO_2e as online retail. Disparities between countries mostly reflect their energy mixes. Differences between categories are mostly driven by store productivity, distance of travel to the store, and packaging weight.

Traffic: E-commerce saves 4 to 9 times the traffic it generates. E-commerce deliveries in urban areas such as Paris, Berlin, and London generate 0.5 percent of total traffic (in vehicle-km); physical retail generates 11 percent.

Land use: Land use is higher for physical retail than for e-commerce when factoring in space for logistics, selling, and parking.

NOMINAL CASE: DRIVING TO A STORE RESULTS IN BETWEEN 3 AND 6 TIMES THE CO_2E AS ORDERING A PRODUCT ONLINE

END-TO-END IMPACT METHODOLOGY

The environmental impact of retail is evaluated from factory to home, excluding production.

The CO_2e impact of retail has been evaluated based on the full logistics flow from factory to home — including transportation of goods and consumers' transport modes. The study

focuses on direct variable effects where physical and e-commerce can be compared, such as transportation, packaging, and energy consumption. It does not take into account the impact of product manufacturing, as goods are similarly processed, nor that of constructing buildings or manufacturing any vehicles used.

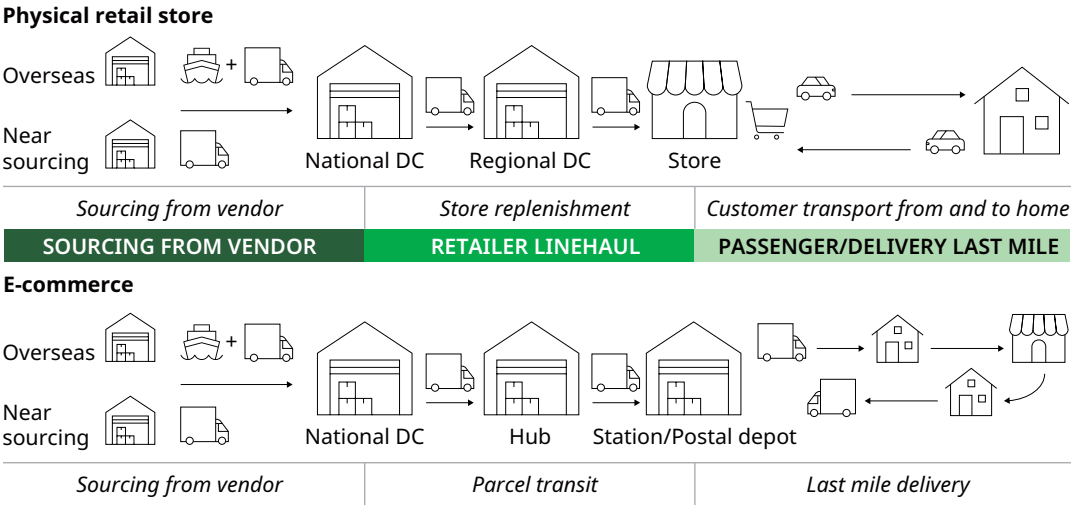
The main drivers of CO_2e impact are transport, building and IT energy consumption, and packaging (see Appendix for detailed definitions).

Transportation: transportation of the product from the vendor's warehouse to the consumer's home.

Building and IT energy consumption: energy used for warehouses, stores, and other buildings, as well as energy used to order online and manage inventory (servers and computers). This is converted to CO_2e emissions using each country's residual mix factor, i.e., emissions from the production of energy in its power grid, which depend on the proportion of electricity generated from different sources, such as coal, gas, nuclear, and renewables.

Packaging: the quantity and material of over-packaging used for packing goods into a parcel — applied to e-commerce only. Primary and secondary packaging (for example, packaging used to send goods in pallets from vendors to warehouses) is considered to be the same in different channels. Carrier bags provided for in-store purchases are considered as marginal compared to total physical store impact and are thus not accounted for. Over-packaging is converted into CO_2e by calculating the emissions used to produce and transport it.

Exhibit 33: Supply chain scope
Factory to consumer



Note: DC — Distribution Center
Source: Oliver Wyman analysis

The impacts of physical retail and e-commerce are compared in two steps. First, the "nominal" or most common case is built to give the model structure and identify the main impact drivers to be refined. Second, an "average" case reflects an average between multiple real life situations, factoring in the complexity and diversity of the impact drivers — notably consumer behavior.

The e-commerce Nominal Case simulates a consumer purchasing a single non-food product online, which is delivered to their home and not returned. The physical retail Nominal Case models a consumer driving to a store to buy a single product and not returning it.

Exhibit 34: Differences between the Nominal and the Average Case

Impact category	Key variables	Nominal Case	Average Case
Transportation	Cross-border (e-commerce)	No cross-border e-commerce: The retailer warehouse is in the destination country — that is, in France for an order placed by a consumer in Paris.	Cross-border e-commerce considered: The retailer warehouse is either in the destination country, another European country or Asia (split varies by country).
	Return rates (both ecommerce and physical stores)	No returns.	Return rates are calculated by product category and geography; the impact and energy consumption of all transportation are taken into account (except sourcing from vendor).
	Mobility for shopping trips (physical stores)	The consumer drives to the store. Distances used differ by product and geography based on collected data.	Various forms of mobility are applied, depending on geography and product category, including use of a private car, public transport, and walking.
	Number of items purchased per trip / online order	One item per online order or shopping trip.	Various numbers of items per order/trip are considered, depending on geography and product category.
Energy consumption (buildings and information technology)	Energy consumed per product sold (both ecommerce and physical stores)	Differentiated by product category and geography.	Same as for the nominal case. Additional energy consumption is assumed for returned products.

RESULTS FOR THE NOMINAL CASE

A consumer driving to a store causes between 3 and 6 times the CO_2e emissions as a consumer buying the same product via e-commerce. The variations are mostly due to the energy mixes in different European countries.

Overall results

Several configurations were considered to account for the variety of distances involved in delivery or shopping trips according to geography, population and delivery densities, and energy mix. The configurations include different countries, as well as large cities and national averages. (See Appendix B for details.)

Exhibit 35: Comparison of national e-commerce to average in-store shopping in the nominal case

Impact in grams of CO_2e and ratio of results for physical retail and e-commerce

	Fashion			Books			Consumer Electronics			Average cross-product[1]		
Product weight (g)[2]	400			350			250					
	Online	Physical retail by car	Ratio	Online	Physical retail by car	Ratio	Online	Physical retail by car	Ratio	Online	Physical retail by car	Ratio
France (Paris)	452	2,208	4.9x	299	1,888	6.3x	337	2,529	7.5x	350	2,121	6.1x
France (National)	547	2,959	5.4x	394	2,219	5.6x	432	2,283	5.3x	445	2,441	5.5x
Germany (National)	1,051	7,526	7.2x	898	2,355	2.6x	936	2,775	3.0x	987	5,126	5.2x
Italy (National)	1,096	4,197	3.8x	943	2,545	2.7x	981	2,834	2.9x	1,020	3,339	3.3x
Spain (National)	953	4,036	4.2x	801	3,353	4.2x	839	3,225	3.8x	871	3,586	4.1x
United Kingdom (London)	617	4,678	7.6x	464	2,309	5.0x	502	2,383	4.7x	548	3,500	6.4x
United Kingdom (National)	969	4,517	4.7x	816	2,800	3.4x	854	2,490	2.9x	900	3,584	4.0x
Min	**452**	**2,208**	**3.8x**	**299**	**1,888**	**2.6x**	**337**	**2,283**	**2.9x**	**350**	**2,121**	**3.3x**
Max	**1,096**	**7,526**	**7.6x**	**943**	**3,353**	**6.3x**	**981**	**3,225**	**7.5x**	**1,020**	**5,126**	**6.4x**
Average[3]	**952**	**5,505**	**5.8x**	**799**	**2,548**	**3.2x**	**837**	**2,656**	**3.2x**	**879**	**4,052**	**4.6x**

1. Weighted by e-commerce sales per product category for each country (Euromonitor, 2019); 2. Obtained from sampling; 3. Weighted by the number of e-commerce parcels per country. (Oliver Wyman estimate, 2019).

Source: Oliver Wyman analysis

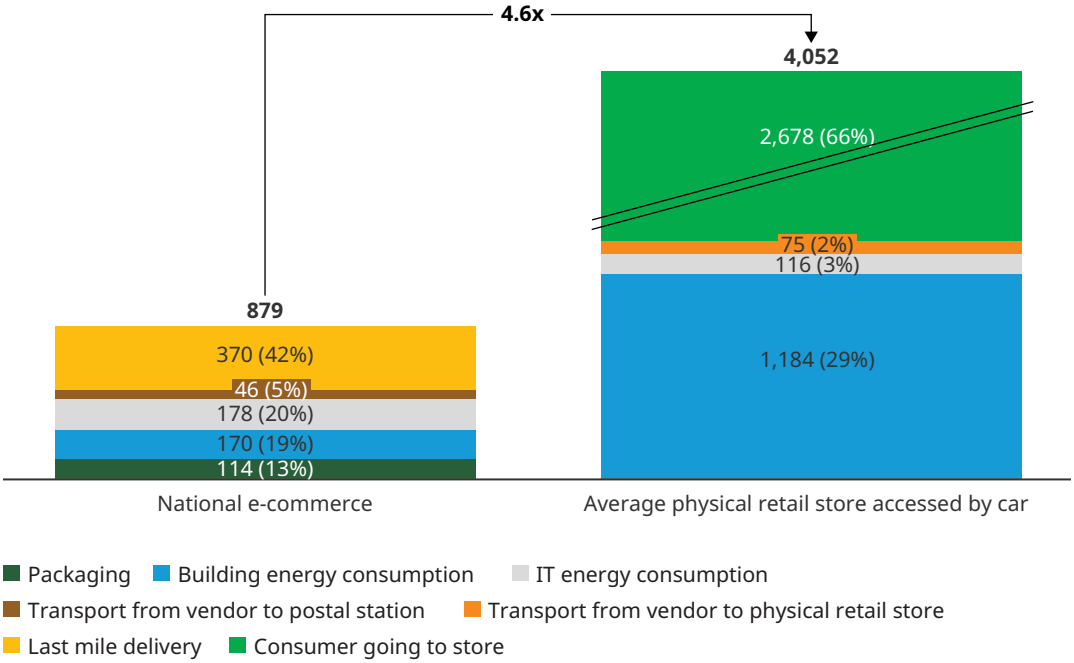
Across the non-food categories considered in Europe, the average end-to-end CO_2e impact for an item weighing between 250 g and 400 g is about 900 g CO_2e for an online purchase and about 4,100 g CO_2e for a purchase of the same product by a consumer driving to a store. That is, on average 4.6 times the amount of CO_2e is generated when the consumer drives to a store.

Considering all product categories together, the CO_2e impact ranges between configurations from 350 g to 1,020 g CO_2e for e-commerce and from 2,120 g to 5,130 g CO_2e for a consumer driving to a store. That means a product bought by a consumer driving to a store results in between 3.3 and 6.4 times as much CO_2e as when the product is bought and delivered through e-commerce.

Key drivers of difference

Exhibit 36: CO_2e impact of a product purchased through different sale channels (Nominal case)

In grams of CO_2 equivalent emissions for an average non-food product, Europe



Source: Oliver Wyman analysis

The two biggest factors causing this gap are transportation and buildings. Last-mile transportation causes an average of 370 g CO_2e in emissions with online shopping, when products are delivered by parcel or postal services; it causes 2,680 g CO_2e with offline shopping, when consumers drive to stores. Energy consumption related to buildings results in 170 g CO_2e with online shopping, due to the energy needs of warehouses; it results in 1,180 g CO_2e with offline shopping, due to the need to run both warehouses and physical stores. (See details in Appendix.)

Transportation

For last-mile impact, the benefits of consolidated delivery of online purchases over trips by individual consumers are quite simple to picture. In a simplified case, one van might drive 80 km to deliver 100 parcels ordered online — that is 0.8 km per parcel. In physical retail, 100 consumers might each drive 8 km[64] to buy their product. This would lead to e-commerce emissions that are one-tenth of those for physical shopping.

In real life, today's vans emit more GHG than personal cars — 365 g CO_2e per km for vans and 280 g CO_2e per km for cars in an urban environment in Germany[65]; deliveries are not always successful — in general, between 5 and 10 percent of first delivery attempts fail[66]; the productivity of van delivery varies on average between 70 and 115 parcels a day at a national

level[67]; and a consumer's travel distance typically varies between 5 and 15 km.[68] Therefore, when factoring in more exact data[69] in France, for example, a car trip to the store to buy a 350 g book might emit 8.6 times more CO_2e than delivering the book by van. Of course, consumers will not always travel by car — a case explored extensively in the next section.

The emissions gap between e-commerce and physical shopping is wider in large urban areas than at national level: Physical shopping causes 6.1 times as much CO_2e as e-commerce in Paris, compared with 5.5 times as much for France as a whole; it causes 6.4 times as much CO_2e as e-commerce in London, compared with 4.0 times as much for the UK overall. This gap is mostly caused by differing densities of delivery routes and average driving distances to stores. These vary according to the configuration of a city:

- The density of delivery is higher in large cities: Vans deliver on average between 70 and 115 parcels a day at a national level. In large cities, they deliver 180[70]— and up to 250 per day in peak periods.
- Consumers' driving distances[71] are similar in large cities and at national level:
  - **Greater London area**: In the United Kingdom, consumers at national level drive 7.0 km to buy books, compared with 6.7 km in London. For fashion, they drive 12.9 km at national level and 13.6 km in London.
  - **Paris area**: In the Paris area,[72] consumers drive 10.2 km to buy consumer electronics, compared to 9.2 km at a national level. But they drive 7.5 km in the Paris area for books, compared to 8.9 km nationally; and 8.5 km for fashion in the Paris area, compared to 11.6 km nationally.

Exhibit 37: Use of car and distances for shopping trips by geography based on Oliver Wyman survey (December 2020)

	France	Germany	Italy	Spain	United Kingdom
Motorisation rate (use of car for shopping trips) at National level per product category, %					
Fashion	58	45	54	53	76
Books	47	51	52	44	56
Consumer Electronics	49	54	54	53	61
Distance for shopping trips[1] in cars at National level per product category, in km					
Fashion	11.6	15.1	7.3	8.1	12.9
Books	8.9	5.0	7.3	8.3	8.3
Consumer Electronics	9.2	6.4	8.4	7.8	7.0

1. The distance covered during the shopping trip is computed as an average weighted by the number of shopping trips made by the respondents for a given category.

Source: Oliver Wyman consumer survey, Q4 2020, Fashion: n= 5000, media/books: n=7000

Energy

The differences in GHG emissions at a country level are mostly driven by countries' energy mixes, which have direct impacts on the energy consumed by buildings and IT. E-commerce usually uses less than 1 kWh of energy per item and physical retail between 1 kWh and 4 kWh.[73] When transportation is also taken into consideration, the lowest national-level average impact for all product categories is in France, at 2,441 g CO_2e: France has a comparatively low residual mix factor of 43 g CO_2e per kWh, because its electric power is based mainly on nuclear energy. The highest national-level impact is 5,126 g CO_2e, in Germany, where the residual mix factor is 609 g CO_2e per kWh.[74] German electricity production is more GHG-intensive, being based more heavily on sources such as coal.

Packaging

The importance of packaging varies significantly by product type. The over-packaging of products bought through e-commerce represents 23 percent of total parcel weight in fashion, 10 percent in books, and 18 percent in consumer electronics.

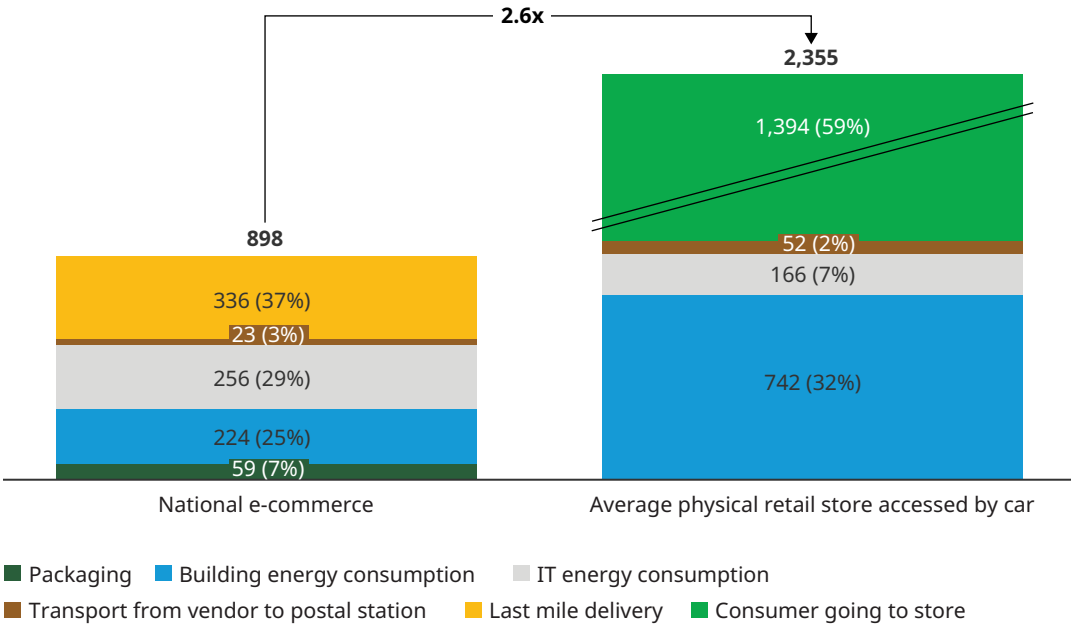
Comparisons between categories

Fashion has the biggest impact of the three categories in both types of channel and in all the countries considered. Buying a fashion item online has an impact of 952 g CO_2e, compared with between 799 g CO_2e and 837 g CO_2e for books and consumer electronics. When a consumer drives to a store to buy a fashion item, the overall impact is 5,505 g CO_2e, compared with between 2,548 g CO_2e and 2,656 g CO_2e for books and consumer electronics. Beyond the effect of packaging, fashion shows the highest values for most of the other variables that increase CO_2e emissions. The average distance a consumer travels to a store is 11 km for fashion, compared to 8 km for books and consumer electronics. The rotation of products in stores is slower for fashion too: an annual average of 100 items per square meter compared with more than 200 for books and consumer electronics.[75]

Fashion has the biggest CO_2e impact of the three categories (fashion, books and consumer electronics) in both types of channel and in all the countries considered.

Exhibit 38: CO_2e impact of a book purchased through different sale channels in Germany (Nominal case)

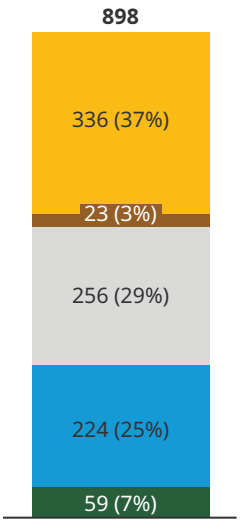
In grams of CO_2 equivalent emissions for a 350g book, national level



Source: Oliver Wyman analysis

Exhibit 39: CO_2e impact of a book purchased through national e-commerce in Germany (Nominal case)

In grams of CO_2 equivalent emissions for a 350g book, national level

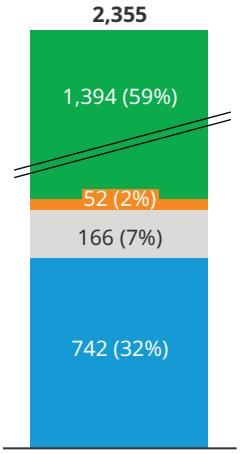


Last mile delivery	=	Van CO_2e (**367gCO_2e/km**) x Delivery loop distance (**80km**) ÷ number of parcel delivered (**100**) x Average number of delivery attempts (**1.06**)
Transportation to parcel station	=	(Sourcing) Road freight from vendor to DC (12gCO_2e) (Distribution) Road freight from DC to depot (11gCO_2e)
IT energy consumption[1]	=	Energy from data centres (**0.32kWh**) + Energy from computer network (**0.11kWh**) x Residual mix factor (**0.61 kgCO_2e/kWh**)
Building energy consumption[1]	=	Energy from warehouses (**150kWh/sqm**) ÷ number of item/sqm in warehouse (**500 item/sqm**) x Residual mix factor (**0.61kgCO_2e/kWh**) + Emissions for delivery buildings energy (e.g. sorting centres) (**~46gCO_2e**)
Packaging impact	=	GHG emissions linked to production (**1.45gCO_2e/g**) x weight of packaging (**10%** of parcel weight)

Source: Oliver Wyman analysis

Exhibit 40: CO_2e impact of a book purchased in a physical retail store reached by car in Germany (Nominal case)

In grams of CO_2 equivalent emissions for a 350g book, national level



Customer driving to the store (last mile)	=	Car CO_2e (**281gCO_2e/km**) x distance to and from store (**5km**)
Transportation to physical retail store	=	(Sourcing from vendor) Road freight from vendor to DC (**12gCO_2e**), for 500km (Retailer linehaul: store replenishment) Road freight from DC to store (**40gCO_2e**), for 265km
IT energy consumption	=	Energy from data centres (**0.27kWh**) x Residual mix factor (**0.61 kgCO_2e/kWh**)
Building energy consumption[1]	=	Energy from warehouses (**150kWh/sqm**) ÷ number of items/sqm in warehouse (**1,100 item/sqm**) + Energy from stores (**250kWh/sqm**) ÷ number of items/sqm in stores x (**~210 item/sqm**) x Residual mix factor (**0.61 kgCO_2e/kWh**)

Source: Oliver Wyman analysis

In the Nominal Case, consumers driving to a store to buy all categories of product (that are similar to books, consumer electronics, and apparel) generate between 3 and 6 times the CO_2e impact as those who order a product online.

AVERAGE CASE: CONSIDERING AVERAGE BEHAVIOR, PHYSICAL RETAIL RESULTS IN BETWEEN 1.5 AND 2.9 TIMES AS MUCH CO2E PER PRODUCT AS E-COMMERCE

METHODOLOGY: DIFFERENCES BETWEEN THE NOMINAL AND THE AVERAGE CASE

The Average Case factors in average consumer behavior and different supply chain configurations on top of the nominal case described above. Data on consumer behavior were collected for different geographies and product categories through a survey carried out in December 2020 (see the section on detailed methodology).

The following elements were surveyed:

- **Mobility for shopping trips**: share of car, public transportation, and walking.
- **Number of products purchased** per online order and shopping trip.
- **Return rates**, both offline and online, including consumers who use their cars to return a parcel to a local post office.

- **Cross border e-commerce share**:[76] Even though most of the parcels shipped come directly from local warehouses (located in the same country as the consumer), a variable share of goods is shipped from other European countries (mostly by road) or even from Asia (mostly by air).

The following elements are not considered, because it is relatively difficult to capture reliable data, and they make a relatively low contribution to total CO_2e impact. Ad hoc sensitivity analysis (or case analysis based on non-public data) confirm that these factors are of second rank and do not significantly affect overall results.

- **Window shopping and showrooming**: consumers visiting stores to test or discover new products and then either leaving without buying anything or buying online. Factoring in window shopping would show an increased impact for physical retail related to car trips. Factoring in showrooming would transfer part of the car-related emissions for physical retail to e-commerce.
- **On-the-way shopping (or delivery)**: consumers stopping by stores while traveling to another destination — for example on the way home. Factoring in on-the-way stops would reduce part of the car-related impact of physical retail. This factor could have a material impact for recurrent purchases such as groceries, but the lower frequency of the categories analyzed in this report makes it less significant. Likewise, e-commerce parcel deliveries could have been considered as marginal deliveries — that is, deliveries made on top of, say, mail or B2B parcel deliveries to stores — which is only the case when e-commerce volumes are low.
- **Multiple categories purchased**: consumers purchasing goods in multiple categories during their shopping trips (such as three books and two fashion items) or in their online order. As with on-the-way shopping, this factor might have a material impact for recurrent purchases such as groceries, but the lower frequency of the categories analyzed in this report makes it less significant.
- **Waste/destruction of products**: Products that have a low sales rate might end up discounted (or sold to discounters) and eventually destroyed. This factor is not considered to vary between online and offline shopping for most categories — even though the return and destruction rates of books sold in physical stores is known to be higher than that for books sold online (this difference is due to bookstores' push distribution model, but no public data are available).
- **Inventory level to ensure high availability**: Physical retailers require a higher level of inventory to enable high on-shelf availability. They need multiple layers of inventory (central, regional, and store-level), whereas e-commerce players keep their inventory more centralized. This might result in a higher indirect emissions impact for physical retailers. However, the modeling assumed that extra inventory would be discounted rather than destroyed, which might have a significant financial impact but would not have an environmental impact.
- **Delivery to pick-up-drop-off stations (PUDO)**: Consumer visits to PUDO can be partly motorized in non-urban regions, adding a car trip to a delivery. On the other hand, retailers' deliveries to PUDO can be more efficient than home delivery in an urban area, with up to 20 parcels per stop. However, usage of PUDO and lockers is secondary at European level: To date, only France and Poland show a material penetration rate, with PUDO representing 15 percent of volumes in France.

RESULTS FOR THE AVERAGE CASE

On average, CO_2e emissions from physical shopping are between 1.5 and 2.9 times higher per product sold than emissions per product sold through e-commerce.

Overall impact results

In Europe for the Average Case, the end-to-end CO_2e impact for a non-food product weighing between 250 g and 400 g is about 800 g CO_2e for an online purchase and 2,000 g CO_2e for an offline purchase of the same product. That is, the impact is 2.3 times higher for physical retail.

Exhibit 41: Comparison of impacts from e-commerce and physical shopping in the Average case
Impact in grams of CO_2e and ratio of the impact for physical shopping to that for e-commerce

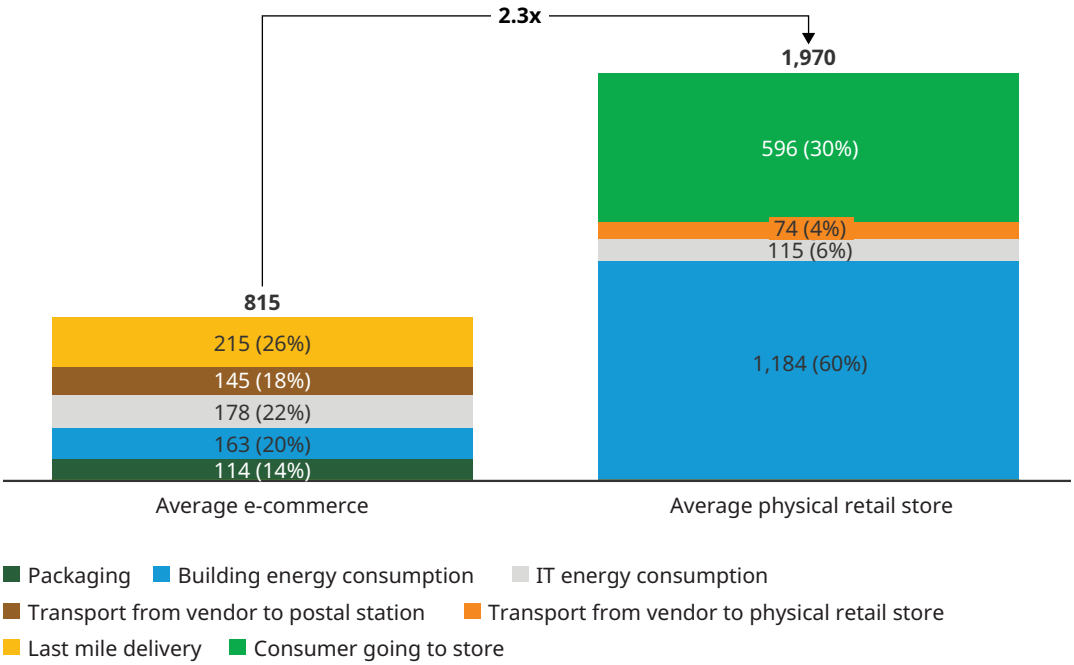
	Fashion			Books			Consumer Electronics			Average cross-product[1]		
Product weight (g)[2]	400			350			250					
	Online	Physical retail	Ratio	Online	Physical retail	Ratio	Online	Physical retail	Ratio	Online	Physical retail	Ratio
France (Paris)	561	1,016	1.8x	227	224	1.0x	375	525	1.4x	354	513	1.5x
France (National)	593	972	1.6x	273	427	1.6x	428	427	1.0x	397	580	1.5x
Germany (National)	1,096	4,291	3.9x	829	1,256	1.5x	914	1,390	1.5x	988	2,853	2.9x
Italy (National)	1,047	2,763	2.6x	696	1,072	1.5x	870	960	1.1x	898	1,764	2.0x
Spain (National)	1,166	2,311	2.0x	605	1,599	2.6x	860	1,732	2.0x	897	1,916	2.1x
United Kingdom (London)	700	1,422	2.0x	425	804	1.9x	528	876	1.7x	584	1,126	1.9x
United Kingdom (National)	854	1,972	2.3x	583	974	1.7x	638	860	1.3x	729	1,444	2.0x
Min	**561**	**972**	**1.6x**	**227**	**224**	**1.0x**	**375**	**427**	**1.0x**	**354**	**513**	**1.5x**
Max	**1,166**	**4,291**	**3.9x**	**829**	**1,599**	**2.6x**	**914**	**1,732**	**2.0x**	**988**	**2,853**	**2.9x**
Average[3]	**954**	**2,888**	**2.9x**	**653**	**1,065**	**1.6x**	**757**	**1,088**	**1.4x**	**815**	**1,970**	**2.3x**

1. Weighted by e-commerce sales per product category for each country (Euromonitor, 2019); 2. Weighted by the number of e-commerce parcels per country (Oliver Wyman estimate, 2019).

Source: Oliver Wyman analysis

Exhibit 42: CO_2e impact of a product purchased through different sale channels in Europe (Average case)

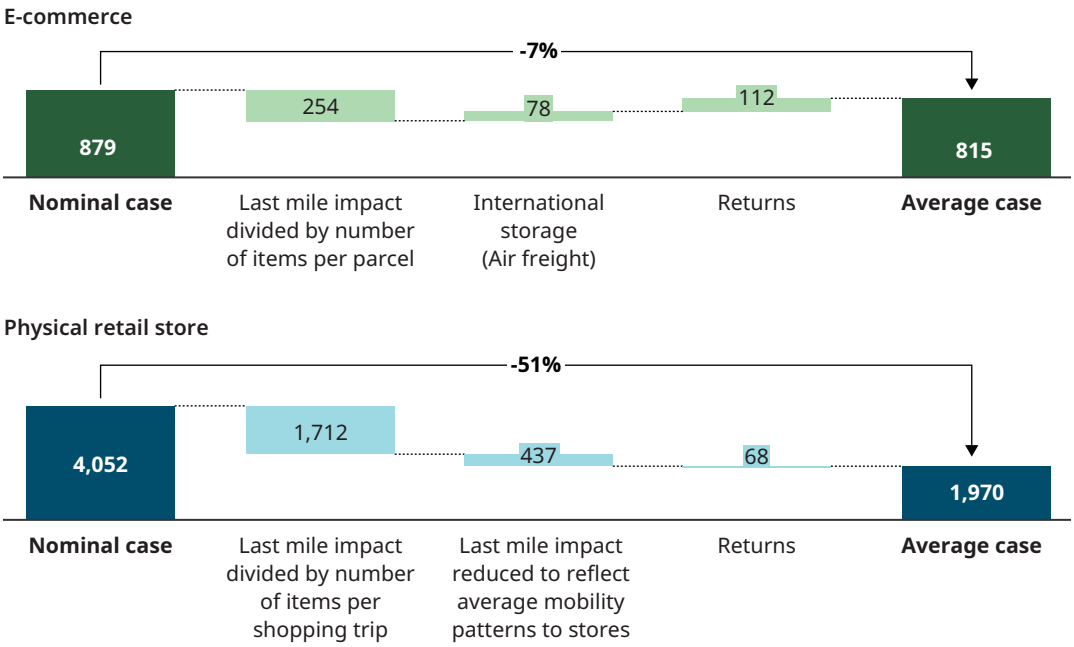
In grams of CO_2 equivalent emissions for an average non-food product



Source: Oliver Wyman analysis

Exhibit 43: CO_2e impact of a product purchased through different sale channels in Europe (Nominal to Average case)

In grams of CO_2 equivalent emissions for an average non-food product



Source: Oliver Wyman analysis

The differences between the Nominal and Average Cases are as follows:

E-commerce: minus 64 g CO_2e (minus 7 percent). The last-mile impact is decreased by 254 g CO_2e, as van delivery impact is divided by the number of items per parcel (about three). On the other hand, cross border delivery adds 78 g CO_2e, mainly because of air freight from outside Europe. Returns (for about 15 percent of deliveries) add another 112 g CO_2e.

Physical shopping: minus 2,082 g CO_2e (minus 51 percent). The last-mile impact is decreased by 2,149 g CO_2e: The last-mile impact of consumers going to a store is reduced by 1,712 g CO_2e due to buying several items per shopping trip; and a lower motorization rate (55 percent using a car and 45 percent using alternative transportation modes including public transport and walking) reduces emissions by another 437 g CO_2e. But returns (7 percent) increase the impact by 68 g CO_2e.

This means that, for a product such as a book, consumer electronics device or item of apparel, online shopping in the Average Case still has a smaller CO_2e impact than when consumers go to a store to buy the same item. The emissions from physical shopping are between 1.5 times (France) and 2.9 times (Germany) greater than for e-commerce. At 815 g CO_2e, e-commerce results in 58 percent lower emissions in the Average Case than physical shopping, which produces 1,970 g CO_2e.

SENSITIVITY ANALYSIS

Variations to the Average Case can apply, but they do not change the overall impact gap between e-commerce and physical retail.

Various factors can cause the CO_2e impact to diverge from the Average Case. To confirm that the Average Case is representative, several different configurations were tested for the following variables: passenger last-mile transportation, delivery last-mile transport, and merchandise transport (between the vendor, warehouses, and stores).

Consumer visiting store (last mile — 30 percent of the emissions impact in physical retail)

Consumers shopping offline can influence their last-mile impact per product in various ways: their transportation mode — which can be car, bike, foot, or public transportation; the number of items they purchase per trip; and the number of items they return.

- **Transportation mode**
  Use of cars for shopping trips (based on surveyed population):[77]
  - More than 50 percent of shopping trips for the categories studied are done by car; the highest percentage is 75 percent, for fashion shopping in the UK. Except for Italy, the denser an area is, the less people use their car — this was tested for fashion. Car use varies between 40 and 60 percent of trips in large cities and 50 and 80 percent in rural areas.

For a product such as a book, consumer electronics device or item of apparel, online shopping in the Average Case still has a smaller CO_2e impact than when consumers go to a store to buy the same item.

- Consumers drive on average between 5 km and 15 km to get to a store and back. In France, Italy and Spain, the distances driven decrease with the density of the location: a round trip of 12 km to 14 km in rural areas but 6 km to 8 km in large cities. In Germany and the UK, the shortest round-trip distances driven to shops (8 km to 12 km) are in medium-dense areas, while the distances driven are 13 km to 15 km in large cities and 18 km to 20km in rural areas. Except for Italy and Spain, consumers drive farther for fashion shopping (12 km to 15 km) than for the other categories (5 km to 9 km).
- The average emissions from personal cars are similar for each country. They range from 240 g CO_2e per km (France) to 280 g CO_2e per km (Germany) in an urban environment.

- **Shopping by foot**
  A consumer driving to a store generates on average 600 g CO_2e, or 30 percent of the average impact of buying an item in a physical store.

Exhibit 44: Comparison of C0$_2$e impacts from e-commerce and physical shopping when consumers walk to stores

Impact in grams of CO_2e and ratio of the impact for physical shopping to that for e-commerce

	Fashion			Books			Consumer Electronics			Average cross-product[1]		
Product weight (g)[2]	400			350			250					
	Online	Physical retail	Ratio	Online	Physical retail	Ratio	Online	Physical retail	Ratio	Online	Physical retail	Ratio
France (Paris)	561	1,016	1.8x	227	96	0.4x	375	111	0.3x	354	129	0.4x
France (National)	593	972	1.6x	273	96	0.4x	428	111	0.3x	397	129	0.3x
United Kingdom (London)	700	1,422	2.0x	425	600	1.4x	528	614	1.2x	584	841	1.4x
United Kingdom (National)	854	1,972	2.3x	583	605	1.0x	638	620	1.0x	729	846	1.2x
Germany (National)	1,096	4,291	3.9x	829	960	1.2x	914	975	1.1x	988	2,157	2.2x
Italy (National)	1,047	2,763	2.6x	696	647	0.9x	870	661	0.8x	898	1,363	1.5x
Spain (National)	1,166	2,311	2.0x	605	1,129	1.9x	860	1,144	1.3x	897	1,423	1.6x
Min	**561**	**972**	**1.6x**	**227**	**96**	**0.4x**	**375**	**111**	**0.3x**	**354**	**129**	**0.3x**
Max	**1,166**	**4,291**	**3.9x**	**829**	**1,129**	**1.9x**	**914**	**1,144**	**1.3x**	**988**	**2,157**	**2.2x**
Average[3]	**954**	**2,888**	**2.9x**	**653**	**721**	**1.0x**	**757**	**736**	**0.9x**	**815**	**1,374**	**1.5x**

1. Weighted by e-commerce sales per product category for each country (Euromonitor, 2019); 2. Weighted by the number of e-commerce parcels per country (Oliver Wyman estimate, 2019).

Source: Oliver Wyman analysis

When the impact of car trips is excluded, on average in Europe, emissions related to ordering books and consumer electronics products online are comparable to those for when a consumer walks to a physical store and shops there. However, emissions for fashion ordered online are half those for in-store shopping (see Exhibit 44). Physical store emissions are largely due to stores' higher energy consumption (for lighting and heating), except in France, where the energy mix results in relatively low emissions.

- **Shopping by public transportation**
  In our model for the Average Case, all consumers not driving to the store are considered to be walking. This underestimates the impact of physical shopping. Between 10 and 25 percent of consumers shop using public transportation across the geographies studied, adding on average up to 60 g CO_2e, or 3 percent, to the emissions from physical retail.
  - In large urban areas, where the use of public transportation for shopping is highest (25 percent[78] in London and 9 percent in the Paris area[79]), consumers mainly use trains and subways, which emit less than 10 g CO_2e per passenger-km.[80] The additional emissions per product are therefore up to 30 g CO_2e for a 10 km ride to purchase three items, so on average they contribute less than 8 g CO_2e (or 2 percent) to the impact of physical shopping.
  - At national level, the use of public transportation for shopping is lower (11 percent[81] for fashion in the UK). When consumers do use public transport, it is mainly in the form of buses, which emit less than 150 g CO_2e per passenger-km.[82] The additional emissions per product are up to 500 g CO_2e (for a 10 km ride to buy three items), which adds less than 60 g CO_2e (3 percent) to the average impact of physical shopping.

Consumer behavior

Number of items bought per shopping trip: The greater the number of items purchased per trip, the lower the marginal last-mile emissions impact of each item.

Number of items per trip in the same category: Except for the UK, consumers tend to buy more fashion items (between 2.8 and 3.2 on average) when buying online than when they shop in stores (2.5 to 3.0 on average). The difference is even greater in large cities, with 3.2 to 4.1 items for an average online order compared to 2.4 to 2.8 items for a physical shopping trip. For books, consumers in the UK, France, and Germany tend to buy more items when they shop in stores (2.8 on average) than online (2.5 items).

Combining the purchase of multiple items from different categories in the same shopping trip: In the Average Case, the number of items per trip to a physical store is around three for a given category, leading to an average 600 g CO_2e per item due to consumer travel. Combining multiple categories in the same trip only reduces the impact of the consumer traveling to the store. Whatever the number of items purchased, each item will still have to be delivered to the store and will still take up some selling space. That will lead to a minimum impact of 1,374 g CO_2e per item — which is still above the e-commerce impact of 815 CO_2e per item. Results by products and geographies are documented in the "walking case" section (see Sensitivity section).

Combining grocery and non-food shopping (not factored into the Average Case): In the Average Case, consumers driving to a store are considered to be on a car trip dedicated to that store, which might lead to an overestimation of the emissions impact of physical retail. In fact, consumers can combine non-food shopping trips with grocery shopping. Taking this into account could decrease the impact of physical shopping by up to 85 g CO_2e per item. For example, in France, 15 percent[83] of non-food sales were realized in hypermarkets and

supermarkets in 2018 (down from 16 percent in 2010). In France, a shopping trip results in emissions of about 450 g CO_2e. Adjusting for trips combined with grocery shopping would decrease emissions per item by 65 g CO_2e. For all the European countries in the study, the average decrease would be 85 g CO_2e, or 4 percent of the impact.

Returns: Returning a product means going back to the store and repeating the passenger last-mile impact.

The offline return rate for fashion (the only category tested) ranges from 11 to 13 percent. That is lower than the online return rate, which is between 13 and 19 percent across countries. The other two categories are less prone to returns, and an offline return rate of 5 percent was considered as a maximum. Offline returns generate last-mile transportation only for consumers.

Delivery last-mile transportation: delivery or postal vans delivering parcels (26 percent of the e-commerce emissions impact)

Many elements influence the last-mile impact per product bought online. Some are inherent to countries and geographies, such as van emissions in different countries. Others are directly driven by consumer behaviors, such as the number of items purchased per order and the number of items returned.

Transportation

Van emissions — variations between countries: As with car emissions, the average van emissions per item for each country are similar, ranging from 330 g CO_2e per km in France to 400 g CO_2e per km in Germany (for loaded vans in an urban environment). The gap is due to the difference in average fuel consumption per kilometer, reflecting different population densities.[84]

Van emissions — area density of deliveries: The higher the delivery density, the lower the marginal last-mile impact of each parcel.

National level compared with urban areas: In absolute terms, e-commerce has a lower impact in denser areas than in more sparsely populated places: In France, emissions per item are 350 g CO_2e for the Paris area and 400 g CO_2e at national level; in London, the figure is 580 g CO_2e, and at the UK national level 730 g CO_2e. One reason is denser deliveries: 180[85] parcels per van per day in the Paris area and London, compared with 115 at a national level[86] in France and 70 in the UK. The lower impact is in spite of higher return rates in big cities. However, the impact ratio of physical retail to e-commerce is roughly the same at both the national level and in urban areas: physical retail results in 1.5 times the emissions of e-commerce in both Paris and France as a whole, 1.9 times as much in London, and 2.0 times as much at the UK national level.

Differences between countries at the national level: The last-mile impact of delivery varies between countries, as they don't have the same densities of consumers to serve — mostly due to different rates of e-commerce penetration and geographical distributions. The average delivery density in France is 115 parcels per van daily, but that for Italy is 70.

Consumer behavior

Number of items bought per online order: The higher the number of items purchased per order, the lower their marginal last-mile impact. The share of e-commerce impact subject to variation in the number of items per parcel is limited to the very last mile of delivery (26 percent of total impact in the Average Case). The number of items per online order by category and geography is around three items per order: The minimum is 2.15 for fashion in the London area, and the maximum is 4.1, also for fashion, in the Paris area (see "Impact on jobs", the Passenger last mile, for details). Given the size of the items in the categories covered, it has been assumed[87] that when three items are ordered from the same category, they will be delivered in the same parcel, as in most cases they will be sent from the same vendor.

Returns: Returning products implies transporting them back to the warehouse.

Overall return rates: Considering all categories and geographies together, more than 80 percent of customers return less than 10 percent of their online orders, but a minority of heavy buyers drive the average online return rate to between 10 and 20 percent. Except in Germany, consumers return fewer fashion orders in rural areas (5 to 16 percent) than in large cities (15 to 22 percent).

The impact of a share of consumers using their cars to return online items to a collection point also has been factored in. For example, based on a consumer behavior survey, when returning a consumer electronics item bought online, consumers use their car in 15 to 20 percent of cases.

Return rates estimated at the item level: (This contrasts with estimating return rates at the level of parcel or shopping trip, and it was not factored into the Average Case.) The average return rates used are estimated at parcel level, which is equivalent to assuming that all products from the same parcel are returned when a return occurs.[88] A more granular estimate would have required direct access to a large sample of e-retailers' returns data. But if we consider an average basket size of three items, the real online return rate per item would lie between 5.3 and 14.7 percent. That could imply a decrease in e-commerce emissions of up to 9 percent, or 70 g CO_2e.[89] For physical retail, the correction would be smaller, as return rates would lie between 2.7 and 7.4 percent, potentially decreasing the impact by up to 1 percent, or 30 g CO_2e.[90]

Merchandise transport: sourcing from the vendor and shipment from the warehouse to the store (4 percent of the impact for physical retail and 18 percent for e-commerce)

Sourcing from vendor (no difference assumed between e-commerce and physical retail)

In the model, 90 percent of consumer electronics and fashion products are assumed to be sourced from Asia and 10 percent near-sourced; 100 percent of books are assumed to be near-sourced.

Fashion products might be near-sourced more than is assumed, and this was not factored into the Average Case. However, sourcing from Asia has a 55 g CO_2e impact, compared with a 15 g CO_2e impact for near-sourcing. As a result, near-sourcing 100 percent of fashion products would only decrease the impact by around 40 g CO_2e, representing 4 percent of the online impact and less than 1 percent of the offline impact.

Cross border e-commerce

Air-shipment effect: Direct shipment from an Asia-based e-commerce distribution center results in 25 times the CO_2e emissions as shipment from EU-based facilities — which first sources products by sea, before shipping them to end consumers by road.

In most cases, goods coming from Asia (country A) are shipped by container to the retailer warehouse (in country B). Only then are they separated into consumer units for delivery by road in a parcel to the final consumer (in country B).

The cross-border case considered here is when the retailer's warehouse and the consumer are in different countries, so an additional leg of travel is required by air or by road. In this case, a parcel delivered by air from Asia emits 25 times the amount of CO_2e as a parcel delivered from a local (European) warehouse by road. For instance, shipping a 250 g consumer electronics product from Hong Kong to Paris by air and on to a postal station will emit 1,600 g CO_2e, while shipping it by sea and then taking it by road to a postal station will emit 60 g CO_2e.[91] Because next-day shipping is only possible when the product is already located in EU-based facilities, buying such products will generate lower CO_2e emissions than buying products that are located overseas at the time of buying and that will be shipped by air.

Delivering a parcel by road from a warehouse serving Europe emits up to 30 g CO_2e more than a delivering it from a national warehouse by road: This extra 30 g represents less than 4 percent of the e-commerce impact. For instance, shipping a 400 g fashion product from Munich to a postal station in Paris by road (about 900 km) will emit 45 g CO_2e. But shipping a product from a French warehouse to a postal station somewhere else in France will on average cause 14 g CO_2e.[92]

Delivering a parcel by road from a warehouse serving Europe emits up to 30 g CO_2e more than a delivering it from a national warehouse by road: This extra 30 g represents less than 4 percent of the e-commerce impact.

Cross-border differences between product categories: In the European countries studied, 86 percent[93] of e-commerce products are stored in their destination country and 14 percent in warehouses in a different country from the consumer's. Of this 14 percent, 8 percent is intra-Europe e-commerce, and 6 percent is stored overseas (in Asia or America) at the time of the purchase and then shipped by air. In the model, average cross-border ratios are assumed for consumer electronics and fashion. Books are assumed to be stored locally in Europe or in the destination country. This explains the main e-commerce impact difference between books and consumer electronics: 6 percent[94] of consumer electronics parcels are shipped by air freight, which increases average e-commerce emissions by about 100 g CO_2e for that category. Recent trends show a higher annual growth rate (20 percent[95] over the period 2014-2019) for cross-border e-commerce (parcels not originating from the destination country) than for domestic e-commerce (11 percent[96] over 2014-2019). However, recent changes in regulation might slow growth in the near future.[97]

Replenishment of small and large stores

Two types of stores (large and small) could be considered, each with a different replenishment scheme, but the difference in emission impacts would be minor, only about 10 or 20 g CO_2e per item. Products in large stores are considered as traveling from national warehouses to regional ones (in 40-ton semi-trailers) and then to stores in straight trucks (7.5 tons). Products for small stores are supplied as replenishment flows and are considered as B2B parcels: They are first sent to a postal station from a national warehouse and then to a store in a delivery van (only a few boxes at a time). The number of units per parcel is adjusted to reflect differences with consumer unit parcels.

Energy consumption (IT and buildings — 66 percent of the impact for physical retail and 42 percent for e-commerce)

The main variations of emissions due to energy consumption are the energy mix of each country and store productivity — that is, the number of items sold per square meter of store.

Energy mix: This is discussed above in the sections on the Nominal and Average Cases (see "Nominal case: Driving to a store results in between 3 and 6 times the CO_2e as ordering a product online").

Store productivity: Fashion is the category with the highest emissions level for physical retail, almost three times that of other product categories. One reason is its relatively low in-store rotations — about 100 items sold per square meter of store space, compared to more than 200 items for the other categories.[98] Another is its higher energy consumption — 324 kWh per square meter, compared to around 250 kWh per square meter for book and consumer electronics stores[99] — because of greater lighting and heating needs.

Conclusion

The Average Case factors in the main drivers of emissions. As stated above, other factors have not been fully taken into account — in many cases because of a lack of data or the high level of effort required to get estimates that are marginally more precise. As a result, the Average Case might overestimate the emissions impact of both modes of shopping. The estimate could be 5 percent too high for physical retail and up to 13 percent too high for e-commerce. However, the conclusion on the emissions gap between the two sales channels remains valid.

Exhibit 45: Summary of the sensitivity analysis

Main non-factored drivers only	Impact difference (g CO2e and % of total)	
	E-commerce	Physical retail
Including some use of public transportation (rather than only foot and car)		+60 g CO2e (3%)
Combining non-food shopping and grocery shopping		-85 g CO2e (-4%)
Return rates estimated at product level instead of the level of parcel/shopping trip	-70 g CO2e (-9%)	-30 g CO2e (-1%)
More near-sourcing of fashion products	-40 g CO2e (-4%)	-40 g CO2e (-1%)

Note: By default, all other listed drivers have been included in the modeling.

Source: Oliver Wyman analysis

CONSUMER AND RETAILER ACTION

As seen previously, consumers' behavior can directly influence the emissions impact of their shopping, both online and offline. Compared to the Average Case, consumers of non-food products can reduce their CO_2e impact by up to 46 percent[100] when buying online, and by up to 30 percent[101] when buying offline in the following ways:

- Prioritizing walking to nearby physical stores or ordering online rather than driving to stores
- Grouping their purchases and returning fewer of them (both online and offline)
- When ordering online, favoring online retailers with national or European mass-storage facilities to avoid long-distance air freight

According to an Oliver Wyman consumer study carried out in France in 2019, less than 10 percent of online shoppers[102] show systematic interest in the environmental impact of their online orders, while a third may be sensitive to the topic. Consumers think first about the impacts of their product choices (about 65 percent) and packaging (40 to 50 percent) and last about delivery (about 40 percent). Emissions related to production are indeed higher than those for delivery: Production emissions are about 1 kg CO_2e for a 300 g book, 23 kg CO_2e for a pair of jeans, and 10 kg CO_2e for a Bluetooth speaker.[103] In each of these cases, delivery generates only 900 or 1,000 g CO_2e. However, as described above, packaging is on average a minor contributor of greenhouse gas emissions — 115 g CO_2e in the average case.

Instead, the major factors are the invisible drivers of transportation and energy consumption to heat and light buildings.

Only 20 to 25 percent of consumers show interest in low-impact delivery options. And less than 10 percent are willing to pay any extra price or tax to compensate for the negative environmental impact of delivery. In France for example, many consumers prefer to collect their parcels at dedicated depots (40 percent, according to one survey), roughly the same percentage as those who group their orders (35 to 45 percent). Only 25 to 30 percent are willing to wait for their products to be delivered.

CO_2e emissions also can be reduced through several mechanisms implemented by retailers, both online and physical. Some examples are:

- Designing buildings with energy-efficient lighting and heating systems and, when possible, using renewable energy in warehouses and stores. This energy consumption is the cause of 20 percent of the emissions from online sales and 60 percent from physical.
- Using clean modes of transportation that are adapted to the country's energy mix. Goods transportation accounts for 44 percent of the emissions impact of online shopping and 4 percent for physical shopping.
- Connecting large out-of-city stores to public transport or locating showrooms closer to city centers.
- Incentivizing customers to group their purchases, even if this means delaying delivery, and making return conditions more restrictive. Grouping purchases addresses 30 to 35 percent of the total emissions impact of both online and offline shopping.
- Optimizing the supply chain by storing products as close as possible to end consumers. Last-mile delivery for e-commerce accounts for 26 percent of the total emissions impact.
- Optimizing over-packaging, which accounts for 10 to 15 percent of the total e-commerce emissions impact.

OUTLOOK FOR REDUCING EMISSIONS IMPACT

Aligning with the European Union's climate ambition for 2020-2030 would imply a 30 percent reduction in the impacts of both e-commerce and physical shopping, while maintaining the current gap.

As part of the European Green Deal, the European Commission proposed in September 2020 to raise the target for reducing GHG emissions by 2030. The new goal is to reduce GHG emissions by at least 55 percent from their 1990 levels. The Green Deal also calls for the EU to be carbon neutral by 2050. Achieving this implies a 30 percent reduction in CO_2e by 2030, according to a high-level estimate, to be achieved through a combination of improvements to the energy residual mix, reductions in emissions from cars and vans, and more efficient buildings.

Actions aimed at aligning with these objectives should reduce the impacts of both e-commerce and physical retail by around 30 percent — assuming that the actions include continued efforts to optimize packaging and building efficiency (see Exhibit 46). These actions would maintain the CO_2e impact gap between the two types of shopping: Physical retail would result in average emissions of 1,400 g CO_2e per item, 2.4 times the level for e-commerce, which would be 600 g CO_2e per item.

Recent investments and announcements by leading delivery operators and retailers provide strong indications that the overall industry might reach the neutrality objective ahead of the EU target. Changes in consumer behavior and steady urbanization also could contribute to progress.

Exhibit 46: Summary of key assumptions on key drivers of CO_2e impact evolution by 2030

Drivers	Evolution vs 2020	Comments
Decrease in energy mix	-25%	Based on EU CO_2e reduction ambition by 2030 (-40% vs 1990) adapted based on 2020 with the ambition to reach neutrality by 2050.
Productivity of building energy for physical retail	-5%	Additional 0,5% of consumption reduction due to technology and process on top of energy residual mix optimisation.
Consumers' vehicles	-30%	Based on EU -38% ambition vs 2021 for new personal cars which translates into 25% by 2030 assuming 15-year lifetime of cars.
Merchandise transportation (vans)	-31%	Based on EU CO_2 -31% reduction ambition vs 2021 for new vans assuming average lifetime of <10years for vans.
Packaging	-30%	Based on observed improvements over last 5 years by leading operators.

Souce: Oliver Wyman Analysis

According to an Oliver Wyman consumer study carried out in France, less than 10 percent of online shoppers[102] show systematic interest in the environmental impact of their online orders, while a third may be sensitive to the topic.

TRAFFIC: E-COMMERCE DELIVERIES SAVE 4 TO 9 TIMES THE TRAFFIC THEY GENERATE

E-COMMERCE'S SHARE OF TRAFFIC

E-commerce deliveries to consumers in urban areas generate about 0.5 percent of total traffic (in vehicle-km) for those areas; physical retail generates 11 percent.

Methodology

The share of overall traffic generated by e-commerce deliveries to consumers is calculated using a comparison of total traffic (derived from public sources and sometimes split by vehicle type) and e-commerce deliveries.

The figures for e-commerce deliveries are based on the following:

- The number of parcels delivered over a year in an area. This is calculated from the total number of parcels in a country and the population of the area, adjusted to reflect the greater use of e-commerce by urban consumers.
- The estimated distance covered by van per parcel, factoring in delivery attempt failures and returns. All parcels are considered, even those delivered through existing daily runs by the postal service (this leads to an over-estimate of the actual flows).

Physical retail traffic was analyzed for the Paris, London, and Berlin areas. It consists of the following:

- Traffic flows to replenish stores. These are calculated from retail's share of total merchandise traffic (based on a sample).
- Consumers' car movements dedicated to shopping, including the distances traveled. These figures are based on an Oliver Wyman consumer survey done in December 2020.

Key results

Traffic and congestion are often considered as direct externalities of e-commerce deliveries. Branded vans of delivery operators may be increasingly visible, but they actually account for a small part of total traffic in an urban area. In the Paris area, for example, average daily traffic totals around 160[104] million vehicle-kilometers (vkm), the equivalent of 8 million vehicles driving 20 km each. Of this total, 13 percent[105] is related to merchandise transport; 66 percent is personal car traffic; and the rest is split between taxis, motorcycles, and service vehicles (such as ambulances, police vehicles, and waste-collection trucks).

Based on an evaluation factoring in the total volume of parcels delivered in the Paris area and standard van delivery, e-commerce deliveries account for 2.1 percent of merchandise traffic in the Paris area, or around 0.3 percent of total traffic.

Physical retail accounts for almost 11 percent of Paris area traffic: Consumers driving to stores represent some 12 percent of car traffic, or 8 percent of total traffic. Store replenishment accounts for about 22 percent of merchandise traffic, or 2.8 percent of total traffic.

Therefore, when factoring in consumer travel and merchandise delivery to stores, physical retail in the Paris area creates 4.7 times as much traffic to generate the same revenue as e-commerce: e-commerce accounts for 11 percent of retail sales and 0.3 percent of traffic, while physical stores account for 89 percent of retail sales and 10.8 percent of traffic.

Analysis of other major European cities leads to the same conclusion: e-commerce deliveries represent a small share of total traffic. In the London area, e-commerce deliveries represent 0.3 percent of the annual traffic of 36 billion vkm.[106] In Berlin, e-commerce deliveries account for 0.6 percent of the daily traffic of 27 million vkm.[107]

NET IMPACT ON TRAFFIC

E-commerce deliveries replace consumer car trips to stores, saving between 4 and 9 times the traffic they generate.

Methodology

To estimate the substitution effect of replacing shopping trips with e-commerce deliveries, the distance covered by van per parcel is compared to the distance driven by a shopper to buy a parcel-equivalent in a store. Consideration is taken of the fact that about 50 percent of shopping trips are made by car, and share has been adjusted by geography. Data on traffic for shopping trips come from a consumer survey covering multiple geographies. They factor in car use for shopping trips, distance covered, and the number of items purchased per online order and per offline trip.

Key results

By replacing some consumer car trips, e-commerce deliveries reduce overall traffic. In the Paris area, about 40 percent of shopping trips are made by car — looking only at the most representative e-commerce categories: fashion, books, and consumer electronics. One delivery van saves 50 car trips, which implies that 1 vkm of e-commerce deliveries removes 4 vkm of car trips to physical stores.

In the London area, car use for shopping trips is higher, at 54 percent, because distances to stores are longer. But last-mile delivery distances are lower. As a result, 1 vkm of e-commerce deliveries removes 9 vkm of car trips to physical stores. Berlin is in the middle: 1 vkm of e-commerce deliveries removes 6 vkm of car trips to physical stores.

Conclusion

Though the visibility of branded delivery vans gives the impression that e-commerce adds significantly to traffic, it is in fact a low contributor, and it has benefits when compared to shopping by personal car. As such, facilitating deliveries in urban areas is one way to reduce passenger traffic.

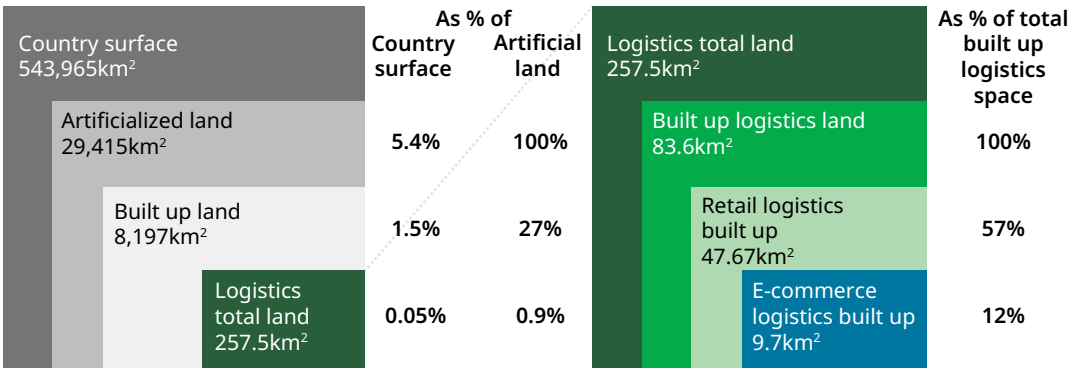
LAND OCCUPATION: E-COMMERCE OCCUPIES LESS THAN 0.3 PERCENT OF ARTIFICIALIZED LAND; OVERALL LAND USE IS HIGHER FOR PHYSICAL RETAIL THAN FOR E-COMMERCE WHEN FACTORING IN LOGISTICS, SELLING AND PARKING SPACE

OCCUPIED SPACE

The space used for logistics is a small share of each country's artificialized land (less than 1.5 percent). Logistics related to e-commerce accounts for less than 0.3 percent of artificialized land in France, Germany, and the UK.

Methodology: Land use is estimated from a combination of databases and use case analyses in France, Germany, and the UK. Only warehouses bigger than 5,000 m^2 are reported in the French database.[108] The German data source is less granular: It has been compiled at the regional level and consolidated by LAE and the Fraunhofer Center for Applied Research on Supply Chain Services.[109] Source data have been corrected using real estate reports to factor in the take-up of land.[110] The average area used for logistics per unit of revenue is based on a selection of cases. It has been adjusted by country and type of retail.

Exhibit 47: Land occupation scope, France, 2019



- Logistics total land includes all warehouse dedicated to logistics activities of more than 5000 sqm as well as their surrounding area (car park, access, manoeuvre zones, green area).

- Artificialization is an "actual change of state of an agricultural, forest or natural surface towards artificial surfaces, which in effect includes urban areas, industrial and commercial zones, areas of transport infrastructure such as roads and related infrastructure, open pit mines an quarries, landfills and construction sites, urban green spaces (green spaces included in the urban fabric), and sports and leisure facilities including golf courses.
- Built up logistics land only includes warehouses dedicated to logistics activities of more than 5000 sqm.
- Retail logistics built up is the land occupied by warehouses of more than 5000 sqm dedicated to retail logistics activities.
- E-commerce logistics built up is the land occupied by warehouses of more than 5000 sqm dedicated to e-commerce logistics activities.

Source: Oliver Wyman analysis

Exhibit 48: Logistics, a minor share of artificialized land

2019, unless specified

	France	Germany	United Kingdom
In km²			
Country surface	543,965	357,121	242,910
Artificialised land (2015)	29,415	26,404	16,003
Built-up area (2015)	8,197	8,811	5,798
Bulit-up/articificialized land	**5.4%**	**7.4%**	**6.6%**
Total logistics space (including access)	257.5	357.1	175.6
Logistics space (built only)[1]	83.6	115.9	57.0
Total logistics of artificialized land	**0.9%**	**1.4%**	**1.1%**
Retail logistics space built[2]	47.6	48.4	28.1
E-commerce space built	9.7	11.0	11.1
Retail as percentage of total logistics (built)	57%	41%	49%
E-commerce logistics as % of logistics	12%	9%	19%
E-commerce as % of retail logistics	20%	23%	39%
Total e-commerce of artificialized land	**0.10%**	**0.14%**	**0.22%**

Raw data Extrapolated data Raw and extrapolated data

1. Warehouses above 5000 sqm; 2. Includes wholesale.

Sources: Fraunhofer SCS, ministere de la transition ecologique, Oliver Wyman analysis

Artificialized land is natural land that has been converted into artificial land surfaces, ranging from urban green spaces to industrial zones. (See Exhibit 47 for complete definition.) Such land occupies 5 to 7 percent of the surface area of the countries analyzed.

Logistics occupies less than 1.5 percent of total artificialized land. Retail logistics (including wholesale facilities) accounts for 40 to 60 percent of total logistics. E-commerce represents 12 percent of the total land used for logistics in France, 9 percent in Germany, and about 19 percent in the UK, reflecting different stages of e-commerce penetration and the relative size of retail in the country's total logistics operations. Overall, the footprint of e-commerce ranges from 0.10 percent of total artificialized land in France to 0.22 percent in the UK.

Greater distances between fulfilment centers and consumptions areas are increasing the CO_2e impact of transportation.

E-COMMERCE LAND TAKE-UP

The land taken up by e-commerce is growing at 13 to 17 percent a year — in line with sales growth (12 to 14 percent a year). On average, about 60 percent of it is new build.

The higher the level of e-commerce penetration in a country, the more closely its growth in land take-up matches e-commerce sales growth. Land taken up by e-commerce has increased since 2010, in line with e-commerce sales growth. In France, the land take-up for new e-commerce construction grew by 17 percent a year between 2010 and 2018, while sales grew by 12 percent a year. In Germany, land take-up grew by 16 percent a year during the 2010-18 period, while sales grew by 14 percent a year. In the UK, land take-up grew by 13 percent a year during the same period, while sales grew by 12 percent a year.

Part of the land taken up by e-commerce logistics consists of the reallocation of existing logistics space. Of land-use expansion for all forms of logistics between 2010 and 2019, 56 percent was new build in France, 63 percent in Germany, and 66 percent in the UK. Reuse is expected to grow as logistics space becomes scarcer and e-commerce penetration grows, because buildings will be increasingly adapted to e-commerce.

For newly built logistics facilities, the ratio of greenfield (previous undeveloped sites) to brownfield (sites with previous commercial, industrial, or logistics activity) development is expected to vary greatly between countries and even regions. This would reflect land availability, land use policies, and the marketability of brownfield sites. For example, in Germany, the share of brownfield development for new logistics construction reached 28 percent in 2020, evolving from less than 15 percent a decade before. Looking forward, the share of brownfield development is expected to increase, as real estate becomes increasingly scarce.

FULL LAND OCCUPATION

Overall land use is higher for physical retail than for e-commerce when factoring in space for logistics, selling, and parking.

Caveat: The comparison of land-use productivity is complex due to a lack of official data and of a clear segmentation of activities between national and export volumes. The national figures used include all retail categories — notably grocery in physical retail. The ratios below are directional estimates to evaluate the size of the land-use productivity gap.

When considering fulfilment only, e-commerce requires two to three times as much fulfilment space as physical retail to generate the same revenue, as there is no storage space for the inventory downstream. In a properly managed physical retail supply chain, about 50 to 60 percent of inventory is in stores.

Exhibit 49: Full land use comparison between e-commerce and physical retail (2019 estimate)

	France	Germany	United Kingdom	Ratio
In €/m²				
Productivity physical retail fulfilment (built)	11,136	12,208	20,753	
Productivity e-commerce fulfilment (built)	4,789	5,484	7,230	
Productivity physical retail fulfilment (built + access area)	3,615	3,963	6,737	A
Productivity e-commerce fulfilment (built + access area)	1,555	1,780	2,347	B
Ratio productivity physical retail/e-commerce	2.3	2.2	2.9	A/B
Productivity physical retail logistics + store	1,815	1,710	2,323	C
Productivity e-commerce logistics + delivery	1,519	1,688	2,267	D
Gap in productivity physical retail/e-commerce	19%	1%	2%	C/D
Productivity physical retail end to end + parking space (1.5x selling surface)	11,22	1,004	1,282	E
Gap in productivity physical retail/e-commerce (including parking space)	-26%	-41%	-43%	E/D

Source: Oliver Wyman analysis

If the space used by fulfilment centers (both buildings and space for vehicles to access the facilities and park), delivery hubs, and physical retail selling areas is considered without taking into account parking space, the land utilized by the two retail models is comparable.

In Germany, the productivity of both e-commerce and physical retail is around €1,700 per square meter, while in the UK both models generate revenues equivalent to €2,300 per square meter. In France, physical retail earns about €1,800 per square meter, about 20 percent more than e-commerce, at €1,500. This partly can be explained by the higher productivity of France's hypermarket model and partly by the increase in productivity of e-commerce as it grows in scale.

When physical stores' access areas and car parks also are included, e-commerce land occupation clearly appears to be more efficient. A conservative simulation shows that total retail space is typically accompanied by 1.5 times as much additional space for car parking, with the result that physical retail land productivity falls well below that of e-commerce: It is 26 percent lower in France, 40 percent lower in Germany, and 43 percent lower in the UK.

Looking forward, the productivity of both e-commerce and physical retail logistics is expected to improve through automation, which will mean less circulation space will be required, and eventually through higher warehouses and multiple floors (for e-commerce notably). The optimization of selling space is likely to be slower, however (see "Economic Impact"). As a result, the land use productivity of e-commerce is likely to improve more quickly.

LOGISTICS SPRAWL

Greater distances between fulfilment centers and consumptions areas are increasing the CO_2e impact of transportation.

The development of European cities has gradually moved warehouses away from city centers because of real estate pressure, land-use policies, and job-density requirements. Moreover, the search for economies of scale has led to the building of ever larger regional, national and even European distribution centers. The result in many European cities — such as Paris, Berlin, and Brussels — has been a sprawl of cross-docking terminals and logistics centers. On average, logistics areas have been moving away from city centers by 1 km every two to three years over the past two decades or so.[111]

In theory, the impact of sprawl is relatively more important for e-commerce, as the last mile of delivery is more fragmented. An annual increase in distance away from a city center of 0.5 km would add 1 km each year (because of the return trip) to an 80 km delivery loop — a 1.25 percent annual rate of increase. Based on a last-mile impact for the Average Case of 215 g CO_2e for e-commerce, the annual increase would be 2.5 g CO_2e. For physical retail, the increase would be 1 g CO_2e.

In practice, the recent development of same-day e-commerce has led to a search for shorter lead times and distances traveled, which implies using warehouses that are closer to consumers. Since consumers are concentrated in cities, e-retailers and logistics companies are looking for e-commerce warehouses that are nearer to cities.[112] The expansion of online sales has boosted the development not only of large-scale distribution centers but also of smaller, modernized facilities with higher ceilings (10,000-30,000 square meters) that are closer to central urban areas.[113] Paradoxically, bringing logistics centers closer to city centers again seems to be a way to reduce the nuisance they cause.

CONCLUSION

Change has been a constant in retail for the past century, as technology simplifies tasks, and new lifestyles — such as the growth in car use — alter consumers' habits. Retailers have proved to be masters at adaptation and innovation, and the current digital transformation is no exception. While e-commerce looked at first as though it might be an alternative to traditional shopping, large banners and smaller physical stores are now adding online features that interact with and augment their existing offers and make them even more attractive. As a result, boundaries between e-commerce and physical retail are becoming blurred. While e-commerce is growing faster than the rest of the sector, jobs are growing throughout.

The diversity of the shopping situations studied highlights the complexity of comparing the pollution impacts of online and offline retail. The study demonstrates that comparisons need to be made on an end-to-end basis, including transportation, packaging, IT, and the energy consumed by buildings. It also highlights the potential to reduce environmental impacts — something particularly apparent when differences are examined across geographies. On average in Europe, when consumer car travel is factored in, non-food e-commerce appears to have a lower environmental impact than physical retail. This should be considered as good news for future generations, but more importantly as a call to do even more to prepare for the next evolution of retail: toward becoming a carbon-neutral industry.

APPENDIX A

GLOSSARY

ACEA	Association des Constructeurs Européens d'Automobiles (France: European Automobile Manufacturers' Association)
ACOSS	Agence Centrale des Organismes de Sécurité Sociale (Central Agency of Social Security Organisations)
ACSEL	Association de l'économie numérique (Association of the players of the digital economy)
ADEME	Agence de l'Environnement et de la Maîtrise de l'Energie (French Agency for Ecological Transition)
Artificialized land	Artificialized land is natural land that has been converted into artificial land surfaces, ranging from urban green spaces to industrial land. Examples include industrial and commercial zones, transport infrastructure such as roads, open pit mines and quarries, landfills, construction sites, and sports and leisure facilities
B&M	Bricks & Mortar refers to the 'physical store' or 'in-store' retail
BIEK	Bundesverband Internationaler Express- und Kurierdienste (German: Association of International Express and Courier Services)
CBRE	CB Richard Ellis (real-estate firm)
CEP	Courier, express and parcel
CIBSE	Chartered Institution of Building Services Engineers
CORINE	Coordination of Information on the Environment
COVID-19	Name given by WHO (World Health Organization) to the disease caused by the SARS-CoV-2 (2019-nCoV) virus
CAGR	Compound Annual Growth Rate
DC	Distribution Center
DVZ	Deutsche Verkehrszeitung (German: Traffic Newspaper)
E-commerce	E-commerce refers to the sale of products made via the online channel to individual consumers. Products can originate from either pure online retailers or physical retailers. E-commerce includes all products sold online, including groceries and items sold through click-and-collect. It excludes travel, ticket for events, and food services.
E-commerce frequency	Number of parcels ordered per household per year
EGT	Enquête Globale Transport (French: Comprehensive Transport Survey)
EU	European Union
FTE	Fulltime-equivalent employee
FEVAD	Fédération des Entreprises de Vente à Distance (Federation of e-commerce and distance selling)
GDP	Gross Domestic Product
Greenhouse gas (GHG) emissions	Greenhouse gases reported are CO_2, CH_4, N_2O, CF_4, CHF_3, and SF_6. They are measured in CO_2-equivalent, abbreviated as CO_2e

HDE	Hauptverband des Deutschen Einzelhandels (German: Central Association of Retail Trade)
ICCT	International Council on Clean Transportation.
INSEE	Institut National de la Statistique et des Études Économiques (French: National Institute of Statistics and Economic Studies)
IPC	International Post Corporation.
ISTAT	Istituto Centrale di Statistica (Italian: Italian National Statistics Institute)
IT	Information Technology
LCV	Light Commercial Vehicle
NACE	Nomenclature statistique des activités économiques dans la Communauté européenne (French: Statistical classification of economic activities in the European Community)
kWh	Kilowatt-hour is a unit of energy equal to 3600 kilojoules (3.6 megajoules)
NEDC	New European Driving Cycle (NEDC). It refers to exhaust emissions and fuel consumption measurements carried out on a test rig
OENAF	Observatoire des espaces naturels, agricoles et forestiers (Observatory of Natural, Agricultural and Forest Areas (OENAF), adapted from CORINE Land Cover statistical source — Eurostat)
Omnichannel retailers	Retailers who offer consumers the opportunity to shop and complete purchases both in stores and via online channels.
Organized retail	Organized retail includes any food or non-food chains with a national or at least a regional footprint and with sales above 0.01 percent of total national sales. That means revenues of over €50 million in Germany, €30 million in France, or €12 million in Spain. Organized retailers are characterized by grouped sourcing; standardized offers and marketing; and, very often, a centralized organization. These organizations' data include the revenues both of their own shops and of affiliated or franchised shops.
OW	Oliver Wyman
Physical retail	Physical retail, or offline sales, refers to retail sales made in a physical store (offline sales channel). Physical retailers are players originally limited to such sales, though today they also may sell online. This report clearly indicates the sales channel, by differentiating physical retailers' online and offline sales. The term omnichannel physical retailer is used for a physical retailer that sells both online and offline.
PLACI	Pre-Loading Advance Cargo Information
PUDO	A pick-up-drop-off (PUDO) point is a location, often a local shop or retail outlet, that offers a parcel pick up and drop off service
R2	In statistics, the coefficient of determination, denoted R2 or r2 and pronounced "R squared", is the proportion of the variance in the dependent variable that is predictable from the independent variable(s)
SCS	Supply Chain Services
STIF	Île-de-France Mobilités (ÎDF Mobilités), formerly STIF (Syndicat des Transports d'Île-de-France), is the organisation authority that controls and coordinates the different transport companies operating in the Paris-area public transport network and rest of Île-de-France region
UK	United Kingdom
UPU	Universal Postal Union is a specialized agency of the United Nations (UN) that coordinates postal policies among member nations, in addition to the worldwide postal system
VAT	Value Added Tax

vKm	Vehicle-kilometer (vKm) as a measure of traffic flow, determined by multiplying the number of vehicles on a given road or traffic network by the average length of their trips measured in kilometers
WLTP	Worldwide Harmonized Light Vehicles Test Procedure (vehicle emissions standard)
YOY	Year over year

APPENDIX B

METHODOLOGY

SECTION 1: METHODOLOGY AND DETAILED ASSUMPTIONS

The study on the economic impact was based on an analysis of official statistics and surveys conducted on independent retailers in 2020. Detailed assumptions are listed below, and further details of the methodology are described.

SECTION 1.1.

The transformation of retail was analyzed based on official data up to 2019 published during 2020 by Euromonitor and Eurostat. Segmentation by retail type was done at the banner level. Figures for retail sales exclude VAT.

Exhibit 50: Induction
2010-2019, growth of retail sales above population growth

	Inflation	Total retail sales		Physical retail sales		Population	Induction
	CAGR	CAGR	Deflated CAGR	CAGR	Deflated CAGR	CAGR	Growth of total deflated retail above population
France	1.2%	1.7%	0.5%	1.0%	-0.2%	0.4%	**0.1%**
Germany	1.4%	2.5%	1.0%	1.5%	0.1%	0.2%	**0.9%**
Italy	1.2%	0.4%	-0.8%	-0.2%	-1.5%	0.2%	**-1.1%**
Netherlands	1.6%	1.1%	0.4%	0.4%	-1.1%	0.5%	**-0.1%**
Poland	1.4%	4.2%	2.8%	3.5%	2.1%	0.0%	**2.8%**
Spain	1.1%	1.1%	0.0%	0.7%	-0.4%	0.1%	**-0.1%**
Sweden	1.2%	2.9%	1.8%	2.1%	0.9%	1.0%	**0.8%**
United Kingdom	2.1%	2.5%	0.4%	1.1%	-1.0%	0.7%	**-0.3%**
Total	**1.4%**	**2.0%**	**0.6%**	**1.0%**	**-0.4%**	**0.3%**	**0.3%**

Sources: Eurostat, Euromonitor, Oliver Wyman analysis

SECTION 1.2: DIRECT EMPLOYMENT

The evolution of direct employment in the retail sector (both e-commerce and physical) was analyzed based on official public data — that is, Eurostat. In addition, cross-checks were carried out against data from national trade associations and national statistics institutes. Direct employment in physical retail uses figures from 'Retail trade, except of motor vehicles and motorcycles' (G47 in NACE 2007), and it excludes employees of 'retail trade not in stores, via stalls and markets'. Direct e-commerce employment uses the data of companies officially listed as e-commerce retailers and excludes omnichannel retailers' online sales.

Self-employed jobs are not accounted for in these official data for subsections of economic activities (see Exhibit 51 for sensitivity analysis). Labor intensity is defined as revenue per direct full-time equivalent employee (FTE).

Exhibit 51: Evolution of self-employment across wholesale and retail[1]
2008-2019, Self-employed in 000's, share of self-employed over employees of wholesale and retail

	France	Germany	Italy	Netherlands	Poland	Spain	Sweden	United Kingdom	Total
2008	407/14%	580/13%	1202/59%	138/14%	493/28%	777/33%	66/14%	382/10%	4044/22%
2009	417/14%	577/13%	1180/59%	126/13%	474/26%	703/32%	66/14%	35/10%	3894/21%
2010	455/16%	555/12%	1158/59%	121/13%	476/27%	698/32%	67/14%	348/10%	3878/21%
2011	438/16%	545/12%	1150/60%	115/12%	480/28%	709/32%	66/14%	340/10%	3842/21%
2012	420/15%	537/12%	1145/57%	119/12%	463/27%	730/35%	64/14%	355/ 0%	3833/21%
2013	392/14%	534/11%	1134/58%	149/14%	454/26%	743/36%	63/13%	348/10%	3818/21%
2014	433/15%	508/10%	1105/57%	155/15%	456/26%	725/35%	60/12%	353/10%	3795/20%
2015	416/14%	484/10%	1090/57%	147/14%	423/23%	719/34%	59/12%	336/9%	3672/19%
2016	431/15%	486/9%	1086/56%	159/15%	408/22%	701/32%	56/11%	361/10%	3688/19%
2017	424/14%	462/9%	1053/52%	160/15%	390/21%	687/31%	56/11%	362/10%	3595/ 8%
2018	421/14%	438/8%	1035/50%	148/14%	370/ 0%	665/ 29%	55/11%	336/9%	3468/18%
2019	431/15%	435/8%	1006/48%	145/14%	386/21%	660/28%	49/10%	341/10%	3453/18%
CAGR self-employed	**+1%**	**-3%**	**-2%**	**0%**	**-2%**	**-1%**	**-3%**	**-1%**	**-1%**
Margin of error[2]	**0.1%**	**-0.2%**	**-0.8%**	**0.1%**	**-0.5%**	**-0.4%**	**-0.3%**	**-0.1%**	**-0.3%**

1. Wholesale and retail trade; repair of motor vehicles and motorcycles; 2. Based on CAGR of self-employed and share of self-employed over total employees.

Sources: Eurostat, Oliver Wyman analysis

Estimation of indirect employment, end-to-end sales per FTE, and end-to-end personnel costs

Official statistics only report direct jobs at companies registered as online retailers. Comparing labor intensity between physical retail and e-commerce requires integrating the share of outsourced fulfilment and transportation activities of both segments. In this evaluation, indirect jobs only include fulfilment and delivery activities. No distinction is made in these estimates between full-time, part-time, and temporary jobs.

For e-commerce, delivery jobs were estimated based on e-commerce parcel volume in 2018 and the average productivity of delivery operations (between 65 and 89 parcels delivered per day per employee and parcel market volume for 2018). Outsourced fulfilment jobs were estimated based on the typical outsourcing rate for the e-commerce industry for each country (see Exhibit 52).

Exhibit 52: E-commerce created indirect jobs in delivery and fulfilment

2018, Per country

	E-commerce jobs[1]	Fulfilment jobs of internal e-commerce jobs	Outsourcing rate of e-commerce fulfilment[2]	Total outsourced fulfilment jobs	Parcels delivered per FTE/day	Total delivery jobs
France	47,130	75%	20%-32%	9,000-17,000	70-115	23,000-42,000
Germany	204,317		30%-35%	66,000-83,000	68-100	87,000-128,000
Italy	13,683		20%-25%	2,500-4,000	60-70	22,000-26,000
Netherlands	25,293		40%-45%	13,000-16,000	68-100	15,000-22,000
Poland	28,718		30%-35%	9,000-12,000	68-100	13,000-19,000
Spain	13,301		18%-30%	2,000-4,000	60-75	19,000-23,000
Sweden	14,856		20%-25%	4,000-5,000	68-100	3,000-5,000
United Kingdom	136,082		40%-50%	68,000-102,000	69-75	102,000-111,000
Total	**483,380**			**175,000-238,000**		**286,000-376,000**
Jobs created for 1 e-commerce job				**0.4-0.5**		**0.6-0.8**

1 Employees includes full- and part-time; 2. Interpolated numbers with lower confidence in Italy.

Sources: EU Commission WIK report, CEP study, Hans-Böckler-Association, German Logistic Association, Euromonitor, Oliver Wyman analysis

For physical retail, indirect jobs in transportation were estimated based on the average cost of transportation (2 percent of revenue) and average number of drivers for this activity (costing between €30,000 and €40,000 per driver per year). Fulfilment jobs were evaluated based on the average surface area required for a standard retailer, the number of fulltime equivalent employees (FTE) required for that surface (15 employees for 1000 m2, including temporary), and the industry's outsourcing rate (25 to 50 percent) (see Exhibit 53).

Exhibit 53: Physical retail jobs direct and indirect transportation and fulfilment jobs
2018, Per country

	Physical retail jobs	Outsourcing rate of physical retail fulfilment	Total outsourced fulfilment job	Outsourcing rate of physical retail transportation	Total transportation jobs
France	1,613,665	50%	232,000	65%	135,000
Germany	3,080,468	35%	199,000	65%	209,000
Spain	1,289,462	25%	60,000	65%	95,000
Total	**5,983,595**		**491,000**		**440,000**
Jobs created for 1 physical retail job			**~0.1**		**~0.1**

Note: Scope of the analysis has been limited to countries with robust data available for the outsourcing rate.
Source: Contracts logistics outsourcing estimate: Oliver Wyman

Estimation of end-to-end sales per FTE

Detailed estimates were carried out only for France, Germany, and Spain, due to the limited robust data available for the other countries. First, sales per FTE were calculated for direct FTE employees. Second, sales were calculated for both direct and indirect full-time equivalent employees, including those working in outsourced delivery and fulfilment (see Exhibit 54). The sales per FTE for direct and indirect employees were calculated based on estimates of the number of indirect employees (see above). Due to the limited public available data on the outsourcing rate for e-commerce, both a lower-end and a higher-end case for the outsourcing rate were calculated. End-to-end sales per FTE were calculated as the average of the lower and higher cases (see Exhibit 55).

Exhibit 54: Sales per FTE comparison between physical retail and e-commerce for direct FTE and direct and indirect FTE
2018, In €

	E-commerce sales per FTE	Physical retail sales per FTE
Comparison for direct full time equivalent employee[1]		
France	535,000	329,000
Germany	423,000	235,000
Spain	442,000	209,000
Average	**467,000**	**258,000**
Comparison for direct and indirect (including outsourced delivery and fulfilment) full time equivalent employee[2]		
France	261,000	270,000
Germany	230,000	205,000
Spain	172,000	188,000
Average	**221,000**	**221,000**

Note: Scope of the analysis has been limited to countries with robust data available for the outsourcing rate, e.g., Italy has been excluded due to the large presence of temporary employment agencies; Average value of sales per FTE based on lower end and higher end assumptions for outsourcing rate (margin of error of ~10%) of e-commerce, due to the lack of official outsourcing data.
Sources: Eurostat; Oliver Wyman Analysis

Exhibit 55: Assumptions and sales/FTE for lower-and higher case
2018, Per country

	Assumptions				Turnover per FTE	
	Outsourcing rate of e-commerce fulfilment		Parcel delivered per FTE per day		Sales per FTE	
	Lower Case	Higher Case	Lower Case	Higher Case	Lower Case	Higher Case
France	32%	20%	70	115	**€225,000** (-17% vs. Physical retail sales/FTE)	**€296,000** (+10% vs. Physical retail sales/FTE)
Germany	35%	30%	68	100	**€213,000** (+4% vs. Physical retail sales/FTE)	**€247,000** (+20% vs. Physical retail sales/FTE)
Spain	30%	18%	60	75	**€157,000** (-16% vs. Physical retail sales/FTE)	**€187,000** (0% vs. Physical retail sales/FTE)
Average					**€198,000** (-10% vs. Physical retail sales/FTE)	**€243,000** (+10% vs. Physical retail sales/FTE)

Sources: EU Commission WIK report, CEP study, Hans-Böckler-Association, German Logistic Association, Euromonitor, Oliver Wyman analysis

Estimation of end-to-end personnel costs

End-to-end personnel costs for e-commerce were calculated based on the weighted averages of the costs of e-commerce and delivery personnel, which were used as proxies for the costs of fulfilment personnel. The weightings were based on the indirect e-commerce job ratio for each country. Personnel costs for physical retail were not adjusted.

Fulltime, part-time, and self-employed mix

The evolution of the full-time and part-time job mix was analyzed based on official public data (Eurostat). Self-employed jobs were not included in these official data for subsections of economic activities.

SECTION 1.3: CITY ANALYSIS

Cities were chosen for the availability of data, to be representative of their countries in scope, and to sample a variety of sizes and economic contexts. The neutral fact bases analyzed in this section mostly end in 2019, because official public sources only have data up to that year. In addition to the analysis of city cases, statistical analyses were performed on country samples for France and Italy.

French city analysis: Based on a sample of approximately 450 French cities of more than 20,000 inhabitants, Oliver Wyman tested whether one or a combination of factors could predict the evolution of jobs and outlets from 2007 to 2019. The following available quantitative data were used: population, population change from 2007 to 2019, disposable income, regional penetration of e-commerce from FEVAD (Fédération du e-commerce et de la vente à distance — a French business group), and e-commerce purchase frequency (average number of parcels ordered per household, based on an Oliver Wyman survey).

Exhibit 56: Correlation between retail evolution and tested drivers

	R2 value (correlation with retail outlet[1] CAGR 2007-2019)			
	All cities	Small (20,000-50,000)	Medium (50,000-200,000)	Large/Metropole (200,000+)
Population level	0.00	0.00	0.06	0.24
Population change	0.09	0.10	0.07	0.16
Disposable income	0.02	0.02	0.02	0.42
Regional e-commerce penetration rate[2]	0.00	0.00	0.00	0.04
City size by region e-commerce frequency[3]	0.01	0.01	0.01	0.22

	R2 value (correlation with retail job[1] CAGR 2007-2019)			
	All cities	Small (20,000-50,000)	Medium (50,000-200,000)	Large/Metropole (200,000+)
Population level	0.00	0.02	0.04	0.27
Population change	0.04	0.04	0.05	0.15
Disposable income	0.01	0.02	0.01	0.25
Regional e-commerce penetration rate[2]	0.00	0.00	0.00	0.18
City size by region e-commerce frequency[3]	0.01	0.01	0.00	0.04

Note: Change in number of outlets is not correlated strongly with any one driver, including ecommerce rates, pointing to interlinking of drivers at city level

1. ACOSS, includes retail establishments declaring employees (no self-employed/single trader included). Includes cities upwards of 20,000 inhabitants; 2. Regional ecommerce penetration rate data available from FEVAD; 3. Based on average parcels received per person, at a city size level within each French metropolitan region — data collected via survey; based on OW-run survey with demographic weighting.

Sources: ACOSS, FEVAD, ISTAT, Oliver Wyman analysis

Italian city analysis: Based on a sample of 15 Italian cities with between 50,000 and 200,000 inhabitants. Cities were selected at random in a way that would yield a mix of geographic locations — a variety of regions, as well as both coastal and inland cities. Oliver Wyman tested whether one or a combination of factors could predict the evolution of jobs and outlets from 2012 to 2018, using the following available data: population level, population evolution (2007 to 2019), “nights spent” (in tourist accommodation), andregional e-commerce penetration (when available).

SECTION 1.4: INDEPENDENT RETAILER SURVEY

Independent store managers' vision of e-commerce benefits and limits were analyzed based on the results of an independent retailer survey conducted by Oliver Wyman during the fourth quarter of 2020. The survey was carried out among small physical retailers running independent stores — either without any banner or with a small banner (less than 15 stores). In France, 387 small physical retailers were surveyed, and in Germany 304.

SECTION 1.5.

The impact of COVID-19 on the retail sector was analyzed based on preliminary official data (from Euromonitor). Most of this was available up to the end of November 2020.

Consumer behavior changes in the light of COVID-19 were analyzed using a consumer survey performed by Oliver Wyman in France, Germany, Spain, Italy, the Netherlands, and the UK. Between 500 and 1,000 responses were collected for each country during the survey period in April 2020.

SECTION 2: METHODOLOGY AND DETAILED ASSUMPTIONS

The study captured the most important externalities of retail: greenhouse gas (GHG) emissions, traffic, and land use or occupation. The greenhouse gases reported are CO_2, CH_4, N_2O, CF_4, CHF_3, and SF_6. They are measured in CO_2-equivalent, or CO_2e.

Other pollution externalities such as noise and emissions of particulate matter were not studied. One reason was a lack of data sources. Another was the assumption that most conclusions would be similar to those related to CO_2e and traffic.

The study covered the most important (non-food) categories sold online: books and media, small consumer electronics, and apparel.

The study of environmental impact was based on a proprietary CO_2e impact model. Its detailed assumptions are described below.

SECTION 2.1

Methodology and detailed assumptions

The scope of the CO_2e impact model is end to end (factory to consumer) including primarily areas where e-commerce and physical retail differ (see Figure X). The following definitions of the transport steps for the end-to-end methodology were used:

- Sourcing between vendor and retailer warehouses: transporting products from vendors (in Europe or in Asia, with a split depending on the product category) by sea and road to the retailer warehouse where the goods will be stored. (No difference is assumed between physical retail and e-commerce).
- Physical retail:
  - Store replenishment for physical retail: from retailers' warehouse to stores by road, partly in full rigid truck and partly in vans.
  - Consumers' last mile to stores by car, public transportation or on foot.
- For e-commerce
  - Shipment by road of the parcel from the retail warehouse to the station or postal depot closest to the final destination — in full truck (nominal case) for shipments within Europe, by air if shipped from Asia.
  - Parcel last mile, by van from the station or postal depot to consumers' houses.

List of assumptions

The main drivers of CO_2e impact are transport, energy consumption by buildings, and packaging. Detailed assumptions are listed below.

Exhibit 57: Assumptions (vehicle pollution, 1/2)

Transport pollution per vehicle type (well to wheel), gCO2e/km

	Value	Unit	For a 350g item
Sea freight	6.3	gCO_2e/t.km	0.00
Air freight	548		0.29
Semi-trailer 40 tons (miscellaneous long distance)	65		0.03
Semi-trailer 40 tons (parcel)	96		0.04
Straight truck 7.5 tons	772		0.38
Van			
Personal car			
Public transportation (bus)	150	gCO_2e/km.passenger	150
Public transportation (Metro)	10		10

Sources: GHG information for transport services, 2019, Ministère de la Transition Ecologique et Solidaire, France; Environmental Impact Of Shopping Via The Internet, Germany, 2016; DHL

Exhibit 58: Assumptions (vehicle CO_2e emissions, 2/2)

Vehicle emissions in urban environment, gCO_2e/km

	Empty vans[1]	Loaded vans[2]	Cars[3]
France (National)	301g	330g	237g
France (Paris)	301g	348g	237g
Germany	367g	399g	281g
Italy	351g	373g	260g
Spain	338g	360g	268g
United Kingdom (National)	352g	374g	265g
United Kingdom (London)	352g	407g	265g

1. Empirical measure; 2. Oliver Wyman analysis; 3. Assumption based.

Sources: GHG information for transport services, 2019, Ministère de la Transition Ecologique et Solidaire, France; *Environmental Impact Of Shopping Via The Internet*, Germany, 2016; DHL, Oliver Wyman analysis.

Exhibit 59: Assumptions (vehicle CO_2e emissions)

Load factors and unladen journeys

	Leg concerned	Load factor (weight)	Share of unladen journey	Additional comments
Sea freight	Sourcing from vendor (when from Asia)	70%		Additional 40% speed reduction
Air freight	Parcel transit (Air from Asia)	70/81% (belly/freighter)		50%/50% belly vs. freighter
Semi-trailer 40 tons (miscellaneous long distance)	Sourcing from vendor (part on road) and store replenishment (physical retail retailer linehaul, between national and regional DC only)	63%	• 0% for the sourcing from vendor part • 20% for store replenishment	
Semi-trailer 40 tons (parcel)	Parcel transit (e-commerce retailer linehaul)	2,500-3,000 parcels	50% (all return are empty	
Straight truck 7.5 tons	Store replenishment (physical retail retailer linehaul, DC and store only)	38%	20%	

Source: Oliver Wyman analysis

Exhibit 60: Assumption on IT energy consumption

	E-commerce	Physical retail stores
IT energy comsumption (kWh/purchased parcel)[1]		
Data centres	0.32	0.27
Computer network	0.11	0
Annual warehouse energy consumption (kWh/sqm)		
Partially automated warehouse[2]	150 (24/7)	128 (7-day a week)

1. From The carbon footprint of retail: Ecommerce vs Physical retail, 2020, Generation Investment Management. 2. Partially automated ambient warehouse, Oliver Wyman analysis, 2020; 3. Environmental Analysis of US Online Shopping, MIT, 2016.

Source: Oliver Wyman analysis

Exhibit 61: Assumptions (product category specific, 2/2)

	Books	Consumer Electronics	Fashion
Store energy consumption[1] (kWh/sqm/year)	225	259	324
Physical retail store productivity[2] (annual sales per store sqm) (in €/sqm/year)			
France	3,569	2,180	3,375
Germany	2,305	2,759	1,743
Italy	2,892	3,040	2,001
Spain	927	2,700	1,678
United Kingdom	2,033	9,450	3,224
In-store rotation[3] (number of items annually sold per sqm) (in items/sqm/year)			
France	357	342	151
Germany	230	221	67
Italy	289	277	74
Spain	93	89	68
United Kingdom	203	195	129

1. From CIBSE database, UK; 2. From Euromonitor, 2019; 3. Using average selling price computed with Euromonitor data (2019).

Source: Oliver Wyman analysis

Exhibit 62: Assumptions (other, 2/2)

Energy residual mix factor[1] (gCO_2e/kWh)	
France	43g
Germany	609g
Italy	466g
Netherlands	555g
Poland	811g
Spain	343g
Sweden	50g
United Kingdom	348g

1. Association of Issuing Bodies European Residual Mixes 2019 — Residual Mixes 2018.

Source: Oliver Wyman analysis

Exhibit 63: Packaging assumption

	Value	Unit	For a 350g item 10% packaging weight
Packaging pollution per packaging type[1] (gCO_2e/parcel)			
Corrugated cardboard	1.45	gCO_2e/g	51
EPS	4		140
PVS	2.45		86
Paper	0.123		4

1. Partially automated ambient warehouse including transportation over 200 km 1.3 otherwise; 2. Environmental Analysis of US Online Shopping, MIT, 2016.

Source: Oliver Wyman analysis

2.1. RESULTS FOR THE NOMINAL CASE

Several configurations for the Nominal Case were considered to account for the diversity of distances for delivery and shopping trips by geography, population and delivery densities, and energy mix. The variations are between different countries, between large cities and national averages, and between average products and individual product categories (fashion, books, and consumer electronics).

Exhibit 64: Detailed online and offline emissions for the average product

In gCO_2e and % E-commerce / Physical Retail	France (Paris)	France (National)	Germany (National)	Italy (National)	Spain (National)	UK (London)	UK (National)
Transport	201 (57%) / 2056 (97%)	284 (64%) / 2375 (97%)	385 (39%) / 3047 (59%)	495 (49%) / 2049 (61%)	449 (52%) / 2234 (62%)	187 (34%) / 2730 (78%)	497 (55%) / 2813 (79%)
Last Mile (Delivery or Passenger)	162 (46%) / 1992 (94%)	246 (55%) / 2311 (95%)	336 (34%) / 2969 (58%)	448 (44%) / 1976 (59%)	405 (46%) / 2163 (60%)	140 (26%) / 2659 (76%)	450 (50%) / 2737 (76%)
Retailer linehaul	11 (3%) / 36 (2%)	11 (3%) / 36 (1%)	12 (1%) / 40 (1%)	11 (1%) / 39 (1%)	11 (1%) / 38 (1%)	12 (2%) / 34 (1%)	12 (1%) / 39 (1%)
Sourcing from vendor to retailer DC	28 (8%) / 28 (1%)	28 (6%) / 28 (1%)	38 (4%) / 38 (1%)	35 (3%) / 35 (1%)	33 (4%) / 33 (1%)	36 (7%) / 36 (1%)	36 (4%) / 36 (1%)
Building energy consumption	38 (11%) / 53 (3%)	49 (11%) / 53 (2%)	225 (23%) / 1913 (37%)	217 (21%) / 1162 (35%)	170 (20%) / 1258 (35%)	97 (18%) / 676 (19%)	139 (15%) / 676 (19%)
Store	n.a. / 48 (2%)	n.a. / 48 (2%)	n.a. / 1845 (36%)	n.a. / 1105 (33%)	n.a. / 1216 (34%)	n.a. / 653 (19%)	n.a. / 653 (18%)
Warehousing and delivery	38 (11%) / 5 (0%)	49 (11%) / 5 (0%)	225 (23%) / 68 (1%)	217 (21%) / 57 (2%)	170 (20%) / 42 (1%)	97 (18%) / 23 (1%)	139 (15%) / 23 (1%)
IT Energy consumption	18 (5%) / 12 (1%)	18 (4%) / 12 (0%)	256 (26%) / 166 (3%)	196 (19%) / 127 (4%)	144 (17%) / 94 (3%)	146 (27%) / 95 (3%)	146 (16%) / 95 (3%)
Packaging	94 (27%) / n.a.	94 (21%) / n.a.	121 (12%) / n.a.	112 (11%) / n.a.	108 (12%) / n.a.	118 (21%) / n.a.	118 (13%) / n.a.
Total	**350 / 2121: 6.1x**	**445 / 2441: 5.5x**	**987 / 5126: 5.2x**	**1020 / 3339: 3.3x**	**871 / 3586: 4.1x**	**548 / 3500: 6.4x**	**900 / 3584: 4.0x**

Source: Oliver Wyman analysis

Exhibit 65: Detailed online and offline emissions per product type, Nominal Case (Fashion)

In gCO_2e and % E-commerce / Physical Retail	France (Paris)	France (National)	Germany (National)	Italy (National)	Spain (National)	UK (London)	UK (National)
Transport	228 (50%) / 2098 (95%)	311 (57%) / 2849 (96%)	401 (38%) / 4344 (58%)	514 (47%) / 1983 (47%)	470 (49%) / 2263 (56%)	205 (33%) / 3687 (79%)	515 (53%) / 3526 (78%)
Last Mile — Delivery or Passenger	162 (36%) / 2007 (91%)	246 (45%) / 2758 (93%)	336 (32%) / 4249 (56%)	448 (41%) / 1890 (45%)	405 (42%) / 2171 (54%)	140 (23%) / 3599 (77%)	450 (46%) / 3432 (76%)
Retailer linehaul	14 (3%) / 39 (2%)	14 (3%) / 39 (1%)	14 (1%) / 43 (1%)	14 (1%) / 42 (1%)	14 (1%) / 41 (1%)	14 (2%) / 37 (1%)	14 (1%) / 42 (1%)
Sourcing from vendor to retailer DC	52 (12%) / 52 (2%)	52 (10%) / 52 (2%)	52 (5%) / 52 (1%)	52 (5%) / 52 (1%)	52 (5%) / 52 (1%)	52 (8%) / 52 (1%)	52 (5%) / 52 (1%)
Building energy consumption	38 (8%) / 98 (4%)	49 (9%) / 98 (3%)	225 (21%) / 3016 (40%)	218 (20%) / 2086 (50%)	171 (18%) / 1679 (42%)	98 (16%) / 896 (19%)	139 (14%) / 896 (20%)
Store	n.a. / 93 (4%)	n.a. / 93 (3%)	n.a. / 2948 (39%)	n.a. / 2029 (48%)	n.a. / 1637 (41%)	n.a. / 874 (19%)	n.a. / 874 (19%)
Warehousing and delivery	38 (8%) / 5 (0%)	49 (9%) / 5 (0%)	225 (21%) / 68 (1%)	218 (20%) / 57 (1%)	171 (18%) / 42 (1%)	98 (16%) / 23 (0%)	139 (14%) / 23 (1%)
IT Energy consumption	18 (4%) / 12 (1%)	18 (3%) / 12 (0%)	256 (24%) / 166 (2%)	196 (18%) / 127 (3%)	144 (15%) / 94 (2%)	146 (24%) / 95 (2%)	146 (15%) / 95 (2%)
Packaging	168 (37%) / n.a.	168 (31%) / n.a.	168 (16%) / n.a.	168 (15%) / n.a.	168 (18%) / n.a.	168 (27%) / n.a.	168 (17%) / n.a.
Total	**452 / 2208: 4.9x**	**547 / 2959: 5.4x**	**1051 / 7526: 7.2x**	**1096 / 4197: 3.8x**	**953 / 4036: 4.2x**	**617 / 4678: 7.6x**	**969 / 4517: 4.7x**

Source: Oliver Wyman analysis

Exhibit 66: Detailed online and offline emissions per product type, Nominal Case (Books)

In gCO_2e and % E-commerce / Physical Retail	**France (Paris)**	**France (National)**	**Germany (National)**	**Italy (National)**	**Spain (National)**	**UK (London)**	**UK (National)**
Transport	185 (62%) / 1841 (98%)	268 (68%) / 2171 (98%)	359 (40%) / 1446 (61%)	471 (50%) / 1950 (77%)	427 (53%) / 2275 (68%)	162 (35%) / 1756 (76%)	472 (58%) / 2247 (80%)
Last Mile — Delivery or Passenger	162 (54%) / 1792 (95%)	246 (62%) / 2122 (96%)	336 (37%) / 1394 (59%)	448 (48%) / 1899 (75%)	405 (51%) / 2224 (66%)	140 (30%) / 1710 (74%)	450 (55%) / 2195 (78%)
Retailer linehaul	11 (4%) / 36 (2%)	11 (3%) / 36 (2%)	11 (1%) / 40 (2%)	11 (1%) / 39 (2%)	11 (1%) / 39 (1%)	11 (2%) / 34 (1%)	11 (1%) / 39 (1%)
Sourcing from vendor to retailer DC	12 (4%) / 12 (1%)	12 (3%) / 12 (1%)	12 (1%) / 12 (1%)	12 (1%) / 12 (0%)	12 (1%) / 12 (0%)	12 (3%) / 12 (1%)	12 (1%) / 12 (0%)
Building energy consumption	38 (13%) / 36 (2%)	49 (12%) / 36 (2%)	224 (25%) / 742 (32%)	217 (23%) / 468 (18%)	170 (21%) / 985 (29%)	97 (21%) / 459 (20%)	139 (17%) / 459 (16%)
Store	n.a. / 31 (2%)	n.a. / 31 (1%)	n.a. / 674 (29%)	n.a. / 411 (16%)	n.a. / 943 (28%)	n.a. / 436 (19%)	n.a. / 436 (16%)
Warehousing and delivery	38 (13%) / 5 (0%)	49 (12%) / 5 (0%)	224 (25%) / 68 (3%)	217 (23%) / 57 (2%)	170 (21%) / 42 (1%)	97 (21%) / 23 (1%)	139 (17%) / 23 (1%)
IT Energy consumption	18 (6%) / 12 (1%)	18 (5%) / 12 (1%)	256 (29%) / 166 (7%)	196 (21%) / 127 (5%)	144 (18%) / 94 (3%)	146 (31%) / 95 (4%)	146 (18%) / 95 (3%)
Packaging	59 (20%) / n.a.	59 (15%) / n.a.	59 (7%) / n.a.	59 (6%) / n.a.	59 (7%) / n.a.	59 (13%) / n.a.	59 (7%) / n.a.
Total	**299 / 1888: 6.3x**	**394 / 2219: 5.6x**	**898 / 2355: 2.6x**	**943 / 2545: 2.7x**	**801 / 3353: 4.2x**	**464 / 2309: 5.0x**	**816 / 2800: 3.4x**

Source: Oliver Wyman analysis

Exhibit 67: Detailed online and offline emissions per product type, Nominal Case (Consumer Electronics)

In gCO_2e and % E-commerce / Physical Retail	**France (Paris)**	**France (National)**	**Germany (National)**	**Italy (National)**	**Spain (National)**	**UK (London)**	**UK (National)**
Transport	203 (60%) / 2481 (98%)	286 (66%) / 2236 (98%)	376 (40%) / 1867 (67%)	489 (50%) / 2239 (79%)	445 (53%) / 2146 (67%)	180 (36%) / 1830 (77%)	490 (57%) / 1937 (78%)
Last Mile — Delivery or Passenger	162 (48%) / 2418 (96%)	246 (57%) / 2172 (95%)	336 (36%) / 1800 (65%)	448 (46%) / 2172 (77%)	405 (48%) / 2081 (65%)	140 (28%) / 1769 (74%)	450 (53%) / 1871 (75%)
Retailer linehaul	8 (2%) / 31 (1%)	8 (2%) / 31 (1%)	8 (1%) / 35 (1%)	8 (1%) / 34 (1%)	8 (1%) / 33 (1%)	8 (2%) / 28 (1%)	8 (1%) / 34 (1%)
Sourcing from vendor to retailer DC	32 (9%) / 32 (1%)	32 (7%) / 32 (1%)	32 (3%) / 32 (1%)	32 (3%) / 32 (1%)	32 (4%) / 32 (1%)	32 (6%) / 32 (1%)	32 (4%) / 32 (1%)
Building energy consumption	37 (11%) / 36 (1%)	48 (11%) / 36 (2%)	224 (24%) / 742 (27%)	217 (22%) / 468 (17%)	170 (20%) / 985 (31%)	97 (19%) / 459 (19%)	138 (16%) / 459 (18%)
Store	n.a. / 31 (1%)	n.a. / 31 (1%)	n.a. / 674 (24%)	n.a. / 411 (15%)	n.a. / 943 (29%)	n.a. / 436 (18%)	n.a. / 436 (18%)
Warehousing and delivery	37 (11%) / 5 (0%)	48 (11%) / 5 (0%)	224 (24%) / 68 (2%)	217 (22%) / 57 (2%)	170 (20%) / 42 (1%)	97 (19%) / 23 (1%)	138 (16%) / 23 (1%)
IT Energy consumption	18 (5%) / 12 (0%)	18 (4%) / 12 (1%)	256 (27%) / 166 (6%)	196 (20%) / 127 (4%)	144 (17%) / 94 (3%)	146 (29%) / 95 (4%)	146 (17%) / 95 (4%)
Packaging	80 (24%) / n.a.	80 (19%) / n.a.	80 (9%) / n.a.	80 (8%) / n.a.	80 (10%) / n.a.	80 (16%) / n.a.	80 (9%) / n.a.
Total	**337 / 2529: 7.5x**	**432 / 2283: 5.3x**	**936 / 2775: 3.0x**	**981 / 2834: 2.9x**	**839 / 3225: 3.8x**	**502 / 2383: 4.7x**	**854 / 2490: 2.9x**

Source: Oliver Wyman analysis

SECTION 2.2.: METHODOLOGY AND DETAILED ASSUMPTIONS

The Average Case factors in average consumer behavior and different supply chain configurations on top of the Nominal Case described above. Data on consumer behavior were collected for different geographies and product categories through surveys carried out in December 2020.

Exhibit 68: Consumer survey (overview)

Countries	Fashion Survey	Media/Books/Consumer electronics survey
France	1,000	1,000
Germany	1,000	1,000
Italy	1,000	1,000
Spain	1,000	1,000
United Kingdom	1,000	1,000

Methodology

- Data on online and offline consumer behavior used in the CO_2e impact model have been collected during consumer surveys to more than 1,000 consumers for:
  - covered geographies (France, Germany, United Kingdom, Spain, Italy).
  - product categories through targeted surveys for fashion and media/books/consumer electronics.
- Surveyed topics for online and offline behavior cover:
  - Return rates (online and offline) and ways to return (online).
  - Car usage for shopping (use rate and distance travelled).
  - Frequency of purchase (online and offline).
  - Number of items per purchase (online and offline).

Source: Consumer survey conducted by Oliver Wyman during December 2020

2.2. RESULTS FOR THE AVERAGE CASE

Several configurations for the Average Case were considered to account for the diversity of distances for delivery and shopping trips by geography, population and delivery densities, and energy mix. The variations are between different countries, between large cities and national averages, and between average products and individual product categories (fashion, books, and consumer electronics).

Exhibit 69: Detailed online and offline emissions for the average product, Average Case (Average product)

In gCO_2e and % E-commerce / Physical Retail	**France (Paris)**	**France (National)**	**Germany (National)**	**Italy (National)**	**Spain (National)**	**UK (London)**	**UK (National)**
Transport	213 (60%) / 448 (87%)	251 (63%) / 514 (89%)	379 (38%) / 774 (27%)	385 (43%) / 475 (27%)	493 (55%) / 564 (29%)	220 (38%) / 356 (32%)	349 (48%) / 673 (47%)
Last Mile — Delivery or Passenger	100 (28%) / 384 (75%)	138 (35%) / 451 (78%)	221 (22%) / 696 (24%)	213 (24%) / 401 (23%)	210 (23%) / 493 (26%)	114 (20%) / 286 (25%)	244 (33%) / 598 (41%)
Retailer linehaul	88 (25%) / 36 (7%)	87 (22%) / 36 (6%)	123 (12%) / 40 (1%)	143 (16%) / 39 (2%)	258 (29%) / 38 (2%)	71 (12%) / 34 (3%)	71 (10%) / 39 (3%)
Sourcing from vendor to retailer DC	25 (7%) / 28 (5%)	25 (6%) / 28 (5%)	34 (3%) / 38 (1%)	29 (3%) / 35 (2%)	26 (3%) / 33 (2%)	34 (6%) / 36 (3%)	34 (5%) / 36 (3%)
Building energy consumption	29 (8%) / 53 (10%)	34 (9%) / 53 (9%)	233 (24%) / 1913 (67%)	205 (23%) / 1162 (66%)	152 (17%) / 1258 (66%)	100 (17%) / 676 (60%)	116 (16%) / 676 (47%)
Store	n.a. / 48 (9%)	n.a. / 48 (8%)	n.a. / 1845 (65%)	n.a. / 1105 (63%)	n.a. / 1216 (63%)	n.a. / 653 (58%)	n.a. / 653 (45%)
Warehousing and delivery	29 (8%) / 5 (1%)	34 (9%) / 5 (1%)	233 (24%) / 68 (2%)	205 (23%) / 57 (3%)	152 (17%) / 42 (2%)	100 (17%) / 23 (2%)	116 (16%) / 23 (2%)
IT Energy consumption	18 (5%) / 12 (2%)	18 (5%) / 12 (2%)	256 (26%) / 166 (6%)	196 (22%) / 127 (7%)	144 (16%) / 94 (5%)	146 (25%) / 95 (8%)	146 (20%) / 95 (7%)
Packaging	94 (27%) / n.a.	94 (24%) / n.a.	121 (12%) / n.a.	112 (12%) / n.a.	108 (12%) / n.a.	118 (20%) / n.a.	118 (16%) / n.a.
Returns impact (already included)	41 (12%) / 31 (6%)	40 (10%) / 32 (6%)	165 (17%) / 69 (2%)	100 (11%) / 31 (2%)	101 (11%) / 34 (2%)	80 (14%) / 13 (1%)	75 (10%) / 28 (2%)
TOTAL	**354 / 513: 1.5x**	**397 / 580: 1.5x**	**988 / 2853: 2.9x**	**898 / 1764: 2.0x**	**897 / 1916: 2.1x**	**584 / 1126: 1.9x**	**729 / 1444: 2.0x**

Source: Oliver Wyman analysis

Exhibit 70: Detailed online and offline emissions per product type, Average Case (Fashion)

In gCO_2e and % E-commerce / Physical Retail	**France (Paris)**	**France (National)**	**Germany (National)**	**Italy (National)**	**Spain (National)**	**UK (London)**	**UK (National)**
Transport	345 (61%) / 906 (89%)	373 (63%) / 862 (89%)	438 (40%) / 1109 (26%)	478 (46%) / 549 (20%)	701 (60%) / 538 (23%)	284 (41%) / 431 (30%)	420 (49%) / 980 (50%)
Last Mile — Delivery or Passenger	104 (19%) / 815 (80%)	133 (22%) / 771 (79%)	211 (19%) / 1014 (24%)	207 (20%) / 456 (17%)	213 (18%) / 445 (19%)	127 (18%) / 343 (24%)	264 (31%) / 887 (45%)
Retailer linehaul	196 (35%) / 39 (4%)	194 (33%) / 39 (4%)	180 (16%) / 43 (1%)	229 (22%) / 42 (2%)	450 (39%) / 41 (2%)	108 (15%) / 37 (3%)	107 (13%) / 42 (2%)
Sourcing from vendor to retailer DC	45 (8%) / 52 (5%)	45 (8%) / 52 (5%)	47 (4%) / 52 (1%)	42 (4%) / 52 (2%)	38 (3%) / 52 (2%)	49 (7%) / 52 (4%)	49 (6%) / 52 (3%)
Building energy consumption	29 (5%) / 98 (10%)	34 (6%) / 98 (10%)	234 (21%) / 3016 (70%)	205 (20%) / 2086 (75%)	153 (13%) / 1679 (73%)	102 (15%) / 896 (63%)	119 (14%) / 896 (45%)
Store	n.a. / 93 (9%)	n.a. / 93 (10%)	n.a. / 2948 (69%)	n.a. / 2029 (73%)	n.a. / 1637 (71%)	n.a. / 874 (61%)	n.a. / 874 (44%)
Warehousing and delivery	29 (5%) / 5 (0%)	34 (6%) / 5 (1%)	234 (21%) / 68 (2%)	205 (20%) / 57 (2%)	153 (13%) / 42 (2%)	102 (15%) / 23 (2%)	119 (14%) / 23 (1%)
IT Energy consumption	18 (3%) / 12 (1%)	18 (3%) / 12 (1%)	256 (23%) / 166 (4%)	196 (19%) / 127 (5%)	144 (12%) / 94 (4%)	146 (21%) / 95 (7%)	146 (17%) / 95 (5%)
Packaging	168 (30%) / n.a.	168 (28%) / n.a.	168 (15%) / n.a.	168 (16%) / n.a.	168 (14%) / n.a.	168 (24%) / n.a.	168 (20%) / n.a.
Returns impact (already included)	60 (11%) / 85 (8%)	40 (7%) / 74 (8%)	176 (16%) / 117 (3%)	100 (10%) / 49 (2%)	101 (9%) / 48 (2%)	88 (13%) / 16 (1%)	79 (9%) / 42 (2%)
TOTAL	**561 / 1016: 1.8x**	**593 / 972: 1.6x**	**1096 / 4291: 3.9x**	**1047 / 2763: 2.6x**	**1166 / 2311: 2.0x**	**700 / 1422: 2.0x**	**854 / 1972: 2.3x**

Source: Oliver Wyman analysis

Exhibit 71: Detailed online and offline emissions per product type, Average Case (Books)

In gCO_2e and % E-commerce / Physical Retail	**France (Paris)**	**France (National)**	**Germany (National)**	**Italy (National)**	**Spain (National)**	**UK (London)**	**UK (National)**
Transport	122 (54%) / 176 (79%)	162 (59%) / 379 (89%)	280 (34%) / 347 (28%)	238 (34%) / 477 (44%)	251 (41%) / 521 (33%)	125 (29%) / 251 (31%)	264 (45%) / 420 (43%)
Last Mile — Delivery or Passenger	95 (42%) / 128 (57%)	135 (49%) / 331 (78%)	253 (31%) / 295 (23%)	208 (30%) / 425 (40%)	219 (36%) / 471 (29%)	100 (24%) / 205 (25%)	239 (41%) / 369 (38%)
Retailer linehaul	15 (7%) / 36 (16%)	15 (5%) / 36 (8%)	15 (2%) / 40 (3%)	18 (3%) / 39 (4%)	20 (3%) / 39 (2%)	13 (3%) / 34 (4%)	13 (2%) / 39 (4%)
Sourcing from vendor to retailer DC	12 (5%) / 12 (5%)	12 (4%) / 12 (3%)	12 (1%) / 12 (1%)	12 (2%) / 12 (1%)	12 (2%) / 12 (1%)	12 (3%) / 12 (1%)	12 (2%) / 12 (1%)
Building energy consumption	28 (12%) / 36 (16%)	33 (12%) / 36 (8%)	234 (28%) / 742 (59%)	203 (29%) / 468 (44%)	151 (25%) / 985 (62%)	94 (22%) / 459 (57%)	114 (20%) / 459 (47%)
Store	n.a. / 31 (14%)	n.a. / 31 (7%)	n.a. / 674 (54%)	n.a. / 411 (38%)	n.a. / 943 (59%)	n.a. / 436 (54%)	n.a. / 436 (45%)
Warehousing and delivery	28 (12%) / 5 (2%)	33 (12%) / 5 (1%)	234 (28%) / 68 (5%)	203 (29%) / 57 (5%)	151 (25%) / 42 (3%)	94 (22%) / 23 (3%)	114 (20%) / 23 (2%)
IT Energy consumption	18 (8%) / 12 (5%)	18 (7%) / 12 (3%)	256 (31%) / 166 (13%)	196 (28%) / 127 (12%)	144 (24%) / 94 (6%)	146 (34%) / 95 (12%)	146 (25%) / 95 (10%)
Packaging	59 (26%) / n.a.	59 (22%) / n.a.	59 (7%) / n.a.	59 (8%) / n.a.	59 (10%) / n.a.	59 (14%) / n.a.	59 (10%) / n.a.
Returns impact (already included)	28 (12%) / 6 (3%)	32 (12%) / 16 (4%)	164 (20%) / 14 (1%)	89 (13%) / 20 (2%)	111 (18%) / 22 (1%)	53 (12%) / 10 (1%)	67 (11%) / 18 (2%)
TOTAL	**227 / 224: 1.0x**	**273 / 427: 1.6x**	**829 / 1256: 1.5x**	**696 / 1072: 1.5x**	**605 / 1599: 2.6x**	**425 / 804: 1.9x**	**583 / 974: 1.7x**

Source: Oliver Wyman analysis

Exhibit 72: Detailed online and offline emissions per product type, Average Case (Consumer Electronics)

In gCO_2e and % E-commerce / Physical Retail	**France (Paris)**	**France (National)**	**Germany (National)**	**Italy (National)**	**Spain (National)**	**UK (London)**	**UK (National)**
Transport	248 (66%) / 477 (91%)	295 (69%) / 379 (89%)	348 (38%) / 481 (35%)	387 (44%) / 365 (38%)	484 (56%) / 653 (38%)	200 (38%) / 322 (37%)	300 (47%) / 306 (36%)
Last Mile — Delivery or Passenger	105 (28%) / 414 (79%)	151 (35%) / 316 (74%)	212 (23%) / 414 (30%)	226 (26%) / 299 (31%)	194 (23%) / 588 (34%)	105 (20%) / 262 (30%)	206 (32%) / 240 (28%)
Retailer linehaul	115 (31%) / 31 (6%)	115 (27%) / 31 (7%)	106 (12%) / 35 (3%)	135 (16%) / 34 (4%)	266 (31%) / 33 (2%)	64 (12%) / 28 (3%)	64 (10%) / 34 (4%)
Sourcing from vendor to retailer DC	28 (7%) / 32 (6%)	28 (7%) / 32 (7%)	29 (3%) / 32 (2%)	26 (3%) / 32 (3%)	24 (3%) / 32 (2%)	31 (6%) / 32 (4%)	31 (5%) / 32 (4%)
Building energy consumption	29 (8%) / 36 (7%)	36 (8%) / 36 (8%)	230 (25%) / 742 (53%)	208 (24%) / 468 (49%)	153 (18%) / 985 (57%)	102 (19%) / 459 (52%)	113 (18%) / 459 (53%)
Store	n.a. / 31 (6%)	n.a. / 31 (7%)	n.a. / 674 (48%)	n.a. / 411 (43%)	n.a. / 943 (54%)	n.a. / 436 (50%)	n.a. / 436 (51%)
Warehousing and delivery	29 (8%) / 5 (1%)	36 (8%) / 5 (1%)	230 (25%) / 68 (5%)	208 (24%) / 57 (6%)	153 (18%) / 42 (2%)	102 (19%) / 23 (3%)	113 (18%) / 23 (3%)
IT Energy consumption	18 (5%) / 12 (2%)	18 (4%) / 12 (3%)	256 (28%) / 166 (12%)	196 (23%) / 127 (13%)	144 (17%) / 94 (5%)	146 (28%) / 95 (11%)	146 (23%) / 95 (11%)
Packaging	80 (21%) / n.a.	80 (19%) / n.a.	80 (9%) / n.a.	80 (9%) / n.a.	80 (9%) / n.a.	80 (15%) / n.a.	80 (13%) / n.a.
Returns impact (already included)	46 (12%) / 20 (4%)	57 (13%) / 15 (4%)	143 (16%) / 20 (1%)	111 (13%) / 14 (1%)	90 (10%) / 28 (2%)	99 (19%) / 12 (1%)	78 (12%) / 11 (1%)
TOTAL	**375 / 525: 1.4x**	**428 / 427: 1.0x**	**914 / 1390: 1.5x**	**870 / 960: 1.1x**	**860 / 1732: 2.0x**	**528 / 876: 1.7x**	**638 / 860: 1.3x**

Source: Oliver Wyman analysis

SECTION 2.3 METHODOLOGY

The share of overall traffic contributed by e-commerce deliveries to consumers was calculated from a comparison of total traffic (derived from public sources and sometimes split by vehicle type) and e-commerce deliveries.

E-commerce deliveries were calculated as follows:

- The number of parcels delivered over a year in an area: calculated from the total number of parcels in a country and the population of the area, adjusted to reflect the greater use of e-commerce by urban consumers.
- The estimated distance covered by van per parcel, factoring in failed delivery attempts and returns. All parcels were considered, even those delivered through existing daily runs by the postal service. (This leads to an over-estimate of the amount of vehicle traffic created).

Physical retail traffic consists of the following:

- Traffic flows to replenish stores. These are calculated from a retail's share of total merchandise traffic (based on a sample).
- Consumers' car movements dedicated to shopping, including the distances traveled. These figures are based on the Oliver Wyman consumer survey done in December 2020.
- The analysis was done for the Paris, London, and Berlin areas.

SECTION 2.4 METHODOLOGY

Land use was estimated from a combination of databases and use cases analysis in France, Germany, and the UK. Only warehouses bigger than 5,000 m2 were reported in the French database.[114] The German data source was less granular: It was compiled at the regional level and consolidated by LAE and the Fraunhofer Center for Applied Research on Supply Chain Services.[115] Source data were corrected using real estate reports to factor in the take-up of land.[116] The average use of the logistics surface area per unit of revenue was based on a selection of cases. It was adjusted by country and type of retail.

ENDNOTES

1 More details about the methodology can be found in Appendix 2.

2 GBP, SEK, and PLN converted into euros, using constant currency conversion of 2019 average exchange rates. This does apply for the rest of the document.

3 Inflation of 1.4 percent p.a. on average since 2010 across the eight countries, Eurostat.

4 In the eight countries.

5 Across France, Germany, Italy, Spain and the UK.

6 In this analysis, the revenue of third-party merchants on marketplaces is isolated from the direct revenue of online retailers.

7 In this section, e-commerce employment data refers to the data of companies officially listed as e-commerce retailers, excluding omnichannel retailers' online sales.

8 Source: Eurostat, 'Retail trade, except of motor vehicles and motorcycles' (G47 in NACE 2007), excluding retail sales via stalls and markets. The number of employees is defined by Eurostat as persons who work for an employer and have a contract. It includes full- and part-time employees and excludes the self-employed and temporary employees, numbers of whom have remained flat over the same period across wholesale and retail, according to Eurostat.

9 Excluding automotive sales and repair.

10 France, Germany, Italy, the Netherlands, Poland, Spain, Sweden, UK.

11 Active population grew average by 0.5 percent CAGR 2008-18 across the eight countries.

12 CEP study 2020, German parcel and logistics association (BIEK); contracts logistics outsourcing estimate Oliver Wyman.

13 Average value based on analysis of France, Germany, and Spain.

14 Based on official public data from Eurostat.

15 Average value based on analysis of France, Germany, and Spain.

16 Based on official public data: Eurostat.

17 This would have required a comparison at the level of job description.

18 Calculated based on the weighted average of e-commerce personnel costs and delivery personnel costs and the indirect e-commerce job ratio in each country (See Exhibit 3).

19 Based on official public data: Eurostat.

20 Based on official public data: Eurostat.

21 Based on official public data: Eurostat.

22 Based on official data for wholesale and retail trade; including repair of motor vehicles and motorcycles, Eurostat.

23 Excludes Poland due to limited data availability.

24 E-commerce frequency of 14 parcels based on an Oliver Wyman survey.

25 INSEE population data for 2017.

26 Excluding the metropolitan area.

27 E-commerce frequency (number of parcels ordered per household) at a city size level vs. average e-commerce frequency at national level; Oliver Wyman survey with demographic weighting.

28 London's gross disposable income was 39 percent higher than the UK average in 2018, ONS.

29 In 2019, London accounted for 55 percent of all inbound visitor spend.

30 In 2019; CAGR 2015-19 of 1.1 percent, Eurostat.

31 Regional e-commerce penetration (share of online shoppers) for 2018, HDE, trade association Germany.

32 E-commerce frequency (number of parcels ordered per household) at a city size vs. average e-commerce frequency at a national level; Oliver Wyman survey with demographic weighting.

33 Includes restaurants, hotels, and services (including body care, medical premises, cultural services).

34 CAGR: Average retail rent in Paris grew from ~ 990 € at 5.0 percent CAGR to ~1390 €/sqm/year, excluding taxes and charges, between 2008 and 2015.

35 E-commerce frequency at a city size level vs. average e-commerce frequency; Oliver Wyman survey with demographic weighting.

36 Statistical significance (R2 = 0.02).

37 Average household disposable income in the city of €22,930 vs. average disposable income of €20,887; yearly disposable income per consumption unit (i.e., per tax household) in 2017, INSEE.

38 Available data on Germany (land level) does not provide enough evidence on this matter.

39 E-commerce frequency at a city size level within each metropolitan region vs. average e-commerce frequency; Oliver Wyman survey with demographic weighting.

40 Based on European ICT (Information and Communication Technologies) usage survey (n=160000) of retailers, Eurostat; online penetration based on assumption that all retail enterprises with more than 50 employees are active in e-commerce.

41 Independent retailers running an independent store (no banner) or from a small banner (less than 15 stores).

42 Germany n=304, Oliver Wyman survey Q4 2020.

43 France n=387, Oliver Wyman survey Q4 2020.

44 Source ACSEL (Association de l'économie numérique).

45 Multiple answers possible, France n=193, Germany n= 136, Oliver Wyman survey, Q4 2020.

46 Multiple answers possible, France n=193, Germany n= 136, Oliver Wyman survey, Q4 2020.

47 Multiple answers possible, France n=193, Germany n= 136, Oliver Wyman survey, Q4 2020.

48 Multiple answers possible, France n=194, Germany n= 168, Oliver Wyman survey, Q4 2020.

49 Multiple answers possible, France n=194, Germany n= 168, Oliver Wyman survey, Q4 2020.

50 Multiple answers possible, France n=194, Germany n= 168, Oliver Wyman survey, Q4 2020.

51 GDP in nominal terms increased by -10.6 percent during 2020 in Spain, Eurostat.

52 GDP in nominal terms increased by -3.5 percent during 2020 in Germany, Eurostat.

53 Year-on-year change in nominal terms of retail sales via mail order houses or via Internet, Eurostat.

54 Year-on-year change in nominal terms of retail sales via mail order houses or via Internet, Eurostat.

55 Collected responses between 500 and 1000 responses per country, survey period April 2020, Oliver Wyman survey.

56 Preliminary data on year-over-year growth for January to November 2019 vs. January to November 2020.

57 Preliminary data on year-over-year growth for January to November 2019 vs. January to November 2020.

58 On average across France, Germany, Italy, the Netherlands, Spain, and UK.

59 Collected responses between 500 and 1000 responses per country, survey period April 2020, Oliver Wyman survey.

60 Les Echos, Face à la crise les commerces contraints de se numériser à marche forcée November, 2020.

61 CAGR of 15 percent based on projection of historic evolution of e-commerce across EU-8 between 2010 and 2019.

62 Pet products, toys, media, etc.

63 Social commerce includes products or services ordered directly on a marketplace put in place by a social network.

64 Simplified example for a medium-sized city.

65 See Vehicle emissions in Appendix for details.

66 Oliver Sievering, 2020, The Environmental Impact of Shopping Via The Internet.

67 Oliver Wyman, based on main operator's pick-up and delivery figures, 2018.

68 Oliver Wyman consumer survey, December 2020.

69 Consumer survey by Oliver Wyman, December 2020; sampling and empirical measurement of deliveries; Oliver Wyman, based on main operator's pick-up and delivery figures, 2018; vehicle emissions, see Appendix B for details.

70 Based on sampling and empirical measurement of deliveries.

71 Consumer survey by Oliver Wyman, December 2020.

72 Ile-de-France.

73 See Energy consumption details in Appendix B.

74 Association of Issuing Bodies, Residual factor mixes, 2019.

75 See Building productivity details in Appendix B.

76 E-commerce mix per country calculated using IPC cross-border 2020 study (September 2019 data providing the split of cross-border by country) and Euromonitor e-commerce sales (2019 — domestic vs. cross border).

77 Oliver Wyman survey, December 2020, N=10,000, France, Germany, Italy, Spain, UK.

78 See Consumer survey results details in Appendix B.

79 EGT, Motorisation et usage de la voiture en Ile-de-France, 2010, STIF, encompasses all types or purchases.

80 ADEME, 2020.

81 See Consumer survey results details in Appendix B.

82 ADEME, 2020.

83 INSEE, April 2020, *Les hypermarchés n° 1 des ventes de produits alimentaires*.

84 Report Vehicles in use, Europe 2019, ACEA. 2. European vehicle market statistics 2019/2020, ICCT. 3. From NEDC to WLTP: effect on the type-approval CO2 emissions of light-duty vehicles, 2017, Joint Research Centre, European Commission.

85 Based on sampling and empirical measurement of deliveries.

86 Oliver Wyman, based on main operators' pick-up and delivery figures, 2018.

87 This assumption has been verified through interviews.

88 Survey question "How often do you return at least one product from an online purchase (respectively shopping trip)?"

89 E-commerce returns are considered to increase every impact along the supply chain except the transport from vendor to warehouse and packaging.

90 Physical retail store returns are considered to increase every impact along the supply chain except the transport from vendor to warehouse.

91 See Vehicle emissions and Distances per leg details in Appendix B.

92 See Vehicle emissions and Distances per leg details in Appendix B.

93 Euromonitor (2019) and IPC cross border (2020 — 2019 data).

94 Euromonitor (2019) and IPC cross border (2020 — 2019 data).

95 Euromonitor (2019), average year on year growth rate for Foreign e-commerce for the studied countries.

96 Euromonitor (2019), average year on year growth rate for Domestic e-commerce for the studied countries.

97 New EU rule on VAT 07/21, new UPU regulation on customs (PLACI), evolution of the UPU postal subsidized system.

98 Computed based on average sales per square meter and average item selling price. (see details in Appendix B).

99 CIBSE.

100 With 0% return rate, grouping more of their purchases, and only ordering products stored locally.

101 With 0% return rate and walking to store.

102 Oliver Wyman consumer study, Summer 2019, France.

103 ADEME carbon base, France.

104 Oliver Wyman bottom-up computation leveraging multiple sources: *EGT, Motorisation et usage de la voiture en Ile-de-France*, 2010 and 2018, STIF, *Enquête Transport De Marchandises En Ville*, 2014, *Région Ile-de- France; Le Bilan des Déplacements en 2016 à Paris*, 2016, L'Observatoire des déplacements à Paris (Mairie de Paris).

105 Oliver Wyman analysis combining the above and *Les véhicules utilitaires légers: une bonne complémentarité avec les poids lourds*, 2014, Service de l'observation et des statistiques to split the LCV traffic between merchandise traffic and services.

106 UK Department of Transport, *Road traffic statistics*, 2019.

107 *Traffic Volumes*, 2017 (2014 data), Berlin Senate Department for Urban Development and the Environment.

108 Enquête sur l'activité des entrepôts et des établissements logistiques ministère de la transition écologique (2016), published in 2018.

109 Fraunhofer Center for Applied Research on Supply Chain Services SCS (2021). L.Immo online.

110 Mostly CBRE, DVZ.de.

111 Paris (Dablanc & Andriankaja, 2011), Berlin (Hesse, 2004), Brussels (Strale, 2019) and Gothenburg (Heitz et al., 2018), Zurich (Todesco).

112 Bonney, 2017.

113 Mongelluzzo, 2019.

114 Enquête sur l'activité des entrepôts et des établissements logistiques (2016)- published in 2018.

115 Fraunhofer Center for Applied Research on Supply Chain Services SCS (2021). L.Immo online.

116 Mostly CBRE, DVZ.de.

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