Retail Food Environment and Online Food Purchases: Evidence from France

by

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Abstract

Europe's online grocery market is experiencing strong growth, fueled by the convenience it offers in today's fast-paced society with high urbanization and higher than ever before labor market participation. Time-saving benefits, like avoiding store visits and product searches, are becoming increasingly attractive. Traditional food retailers are responding by adding online options, allowing customers to partially or completely bypass physical stores. This study explores whether the rise of online grocery shopping is influenced by the characteristics of the food retail environment itself. We will utilize primary data (Food Purchase Diary Surveys) on online and traditional grocery purchases (both at and away from home), along with demographic and geographic information about both the participants and the shopping venues. Our central finding reveals that online shopping is not associated with the general retail landscape in the shopper's local area. Rather, the decision to shop online, and the associated expenditure, is significantly influenced by the proximity of the shopper's preferred store, irrespective of the proximity of other large-format retailers. This suggests that accessibility to available retailers is not the primary driver of online shopping behavior; instead, preference for a specific venue is the key determinant.

1. Introduction and Background

The digital revolution has touched upon many aspects of the economy, including food retailing. In response, historically conventional food retail landscape evolved into something called cross-channel retailing in the last two decades in Europe (Rittinger and Zentes, 2011). The characteristics of the core process of food retailing, along with the accompanying pre- and after-sale services, within individual channels leaked and fused between multiple channels, giving the consumers an unprecedented level of flexibility in navigating food acquisition. The boundaries between offline and online services vanished as consumers can search, research and purchase online, and return or exchange in brick-and-mortar locations, rendering coexistence of these channels not only viable but also synergistic.

Off to a strong start, the online grocery market is poised to grow steadily in Europe. In today's highly urbanized society, with record labor force participation, the convenience of avoiding time-consuming grocery shopping—including travel, searching for items, navigating crowds, waiting in checkout lines, and carrying heavy bags—is increasingly appealing. Consequently, more and more traditional food retailers are offering online alternatives to physically patronizing a venue altogether or in part, such as offering the option of ordering groceries online from the retailers' websites, Amazon Pantry, restaurant food delivery, UberEats, Click & Collect, Shop & Go, etc.

While catering to the entire range of consumer needs for information, convenience, affordability and accessibility of foods clearly makes economic sense, this evolution spawned a slew of research regarding the motivation for or anticipation from shopping online, its repercussions and byproducts. Beauchamp and Ponder (2010) discuss the retail convenience regarding in-store and online shopping. They found that the perceptions of retail convenience – access, search, transaction, and possession, are more favorable in online shopping than in-store shopping. Zhu and Semeijn (2015) show that time savings is the most critical factor in online grocery shopping, followed by product quality and service quality. While Kang, Moon, Kim, and Choe (2016) found that the time requirement to access offline grocery markets had no effect on the adoption of online grocery shopping, however, it did affect the online grocery purchase amount.

While the research discussed above elaborates on the intentions or anticipations for online purchases, there is a body of research that focuses on the attributes, albeit post-purchase, of online grocery shopping. Ilyuk (2018) demonstrates that waste likelihood is higher when consumers purchase food items online as opposed to in-store purchase, attributed to lower perceptions of purchase effort, thereby reducing experiences of psychological ownership and, in turn, increasing consumers' intentions of discarding purchased food items. Quevedo-Silva *et al.* (2016) find that while novelty of a product is positively related to purchasing online, the perceived riskiness and freshness are negatively related. Mortimer *et al.* (2016) demonstrate that online shopping perceptions play an important role in perceived risk and trust. They find that this varies by online shopping experience. In a cross-cultural study, Goodrich and Mooij (2011),

demonstrate that similar differences in product acquisition via the Internet exist as via conventional shopping channels.

Research also explores the effects of the COVID-19 pandemic on various aspects of grocery shopping, including food demand, consumer preferences, shopping patterns, and the impact of the shopping environment. Chang and Meyerhoefer (2020) investigate how the pandemic affected shopping patterns, including online shopping. Their findings demonstrate that an increasing infection rate has a positive effect on both online sales and the number of customers. Ellison et al (2020) reveal decreased food away from home consumption and increase in online groceries as a direct result of the pandemic. Harris-Lagoudakis (2022) report positive influence of online shopping on the healthfulness of purchase baskets.

Although extensive research has explored online food purchasing, especially its time-saving benefits and other conveniences, the interaction between online shopping and the food retail landscape remains understudied. Given the significant interest in this landscape within academic and policy circles—driven by its role in food access disparities and food deserts—investigating the relationship between online shopping, the food retail landscape, and ultimately, food access is both timely and important. The present study seeks to fill this gap.

2. Survey and Methods

This study utilizes primary survey data collected from a sample of individuals with prior online shopping experience (defined as at least one online order within the preceding twelve months). Data collection was conducted using the online platform of the Food Purchase Diary Surveys. The initial sample consisted of over 180 participants residing in metropolitan France, who provided detailed purchase records over an average period of four weeks. The primary objective of the survey was to gather comprehensive food purchase data to assess the nutritional quality of food baskets in relation to varying degrees of online purchasing. To ensure data accuracy and completeness, rigorous measures were implemented. Participants were required to report all food purchases, encompassing both at-home and away-from-home consumption, and to provide supporting documentation. This documentation consisted of purchase receipts for in-person transactions and invoices for online purchases, where available. In instances where such documentation was not available, detailed food purchase logs were required to ensure complete capture of food acquisition during the survey period. Consequently, the compiled data contains a complete record of purchased food products, including detailed descriptions; purchase variables such as quantities purchased and associated expenditures; the names and street addresses of retail outlets; and a set of demographic characteristics of the respondents. The resulting dataset contains 106 participants with 1218 shopping trips made over the four-week survey period in 2021-2022.

To achieve the research objective of investigating the relationship between online shopping and the food retail landscape, we defined three dependent variables. The first is a binary indicator variable, coded as one if the shopping trip was conducted online. Recognizing that this binary measure does not account for the magnitude of the purchase, we also constructed a second variable representing the total expenditure associated with each online shopping trip. Furthermore, drawing on existing literature on food deserts, which posits a correlation between limited access and reduced consumption of fruits and vegetables, we developed a third dependent variable representing online expenditures specifically on these food groups.

In assessing food access within the reference areas, we adopted a more precise methodology than the conventional approach of simply enumerating supermarkets and hypermarkets. Leveraging the detailed location data gathered during the survey—specifically, respondents' home addresses and the addresses of their shopping venues (derived from proof of purchase)—we were able to calculate direct distances between these locations. This approach allowed us to use precise distance measures, rather than relying on aggregated store distribution data as has been the practice in previous research. Distances were calculated using Google Maps.

The primary explanatory variable for the choice between online and in-person shopping is the walking distance between the respondent's residence and the chosen shopping venue (Store). Furthermore, to represent the food retail landscape of participants' residential areas, we also included walking distances to the nearest supermarket and hypermarket. Given that the survey did not collect information on transportation modes, we explored alternative measures based on travel time. Google Maps provided estimates for walking, driving, and public transportation times. Initially, we considered the minimum of these three travel times as a proxy for accessibility. However, recognizing that driving is frequently the fastest mode and that we lacked information on car ownership, we constructed a second alternative measure: the average of the two shortest travel times. We determined that an indicator variable for whether the chosen shopping venue was also the nearest supermarket or hypermarket was unnecessary, as this was true for only seven supermarkets and no hypermarkets in our sample.

In constructing the food environment measures, we implemented two corrections. First, to prevent unrealistic inflation of travel time estimates, we addressed instances where the second shortest travel time was walking and exceeded two hours. In these cases, we reverted to using the minimum travel time (typically driving), consistent with our first measure. Second, we addressed cases where it was evident that a respondent was traveling during a shopping trip. Since their actual location during travel was unknown, we imputed their residential address using the centroid of the store's city and postal code area, based on the assumption that travelers tend to shop locally. These imputed data points were flagged and included as a control in subsequent estimations. Finally, a weekend indicator variable was included to control for potential differences in travel times due to weekend traffic patterns and public transportation schedules.

The variables used in our estimations, along with their descriptions and summary statistics, are detailed in Table 1. The dataset comprises 1,181 shopping trips, of which approximately 9% were made online, with an average expenditure of €4.53. The average walking/driving distance to the shopping venue is 5.78 km, while the nearest supermarket and hypermarket are located an average of 1.63 km and 5.83 km away, respectively. The average travel time to the shopping venue is 10.34 minutes, compared to 3.95 minutes for the nearest supermarket and 13.49 minutes for the nearest hypermarket. When using the second measure of access – the average of the two shortest travel times, the travel times to the shopping venue, nearest supermarket, and nearest hypermarket are 19.72, 11.30, and 25.08 minutes, respectively. Approximately 9% of shopping trips occurred while respondents were traveling, and 26.6% took place on weekends. Respondents were predominantly female (77%), with an average age of 41, a household size of 2.5 persons, and a monthly family income of €2,845.57.

3. Empirical Model

The general form of the models used to estimate impact of the food retail layout in the reference area on the decision to shop online is represented by:

$$Y = \alpha + \beta_{Store} Access_{Store} + \beta_{Area} Retail\_Area_{Sup,Hyp} + \gamma D + \delta Other + \varepsilon \qquad (1)$$

where Y is the response variable captured by the Online, Exp_Online and Exp_FV_Online; $Access_{Store}$ is the distance or time to reach the purchase venue corresponding a particular shopping trip (captured by Dist_Store, Time_Store, and Avg_Time_Store); $Retail\_Area_{Sup,Hyp}$ is the distance or time to reach the closest supermarket and hypermarket (captured by Dist_Sup, Time_Sup, Avg_Time_Sup, etc.); the array D captures the demographic information of the respondents; $Other$ is an array of other variables we included to improve the precision that have not direct baring or interest for our dependent variables; and ε is the error term.

We estimated the models in (1) by OLS and by Random Effects method to account for individual effects.

Table 1. Names, Description and the Summary Statistics of Variables

Variable Names	Variable Descriptions	Obs	Mean	Std. dev.
Dependent Variables				
Online	Online: = 1 if Online Shopping; = 0 if in Person	1,184	0.0938	0.2916
Exp_Online	Online Food Expenditures	1,184	4.5314	18.2037
Exp_FV_Online	Online Fruit and Vegetable Expenditures	1,184	5.3474	8.1934
Distance Measures				
Dist_Store	Walking distance (km) to the store/shopping venue	1,184	5.7846	8.4355
Dist_Super	Walking distance (km) to the closest supermarket	1,184	1.6329	2.5488
Dist_Hyper	Walking distance (km) to the closest hypermarket	1,184	5.8362	6.4463
Time_Store	Minimum time (minutes) to reach the store/shopping venue by (i) walking, (ii) public transportation, or (iii) by car	1,184	10.3376	10.4493
Time_Super	Minimum time (minutes) to reach the closest supermarket by (i) walking, (ii) public transportation, or (iii) by car	1,184	3.9510	3.7780
Time_Hyper	Minimum time (minutes) to reach the closest hypermarket by (i) walking, (ii) public transportation, or (iii) by car	1,184	13.4932	35.2639
Avg_Time_Store	Average time (minutes) of the two shortest times to reach the store/shopping venue by (i) walking, (ii) public transportation, or (iii) by car	1,184	19.7229	19.6467
Avg_Time_Super	Average time (minutes) of the two shortest times to reach the closest supermarket by (i) walking, (ii) public transportation, or (iii) by car	1,184	11.2998	17.2579
Avg_Time_Hyper	Average time (minutes) of the two shortest times to reach the closest hypermarket by (i) walking, (ii) public transportation, or (iii) by car	1,184	25.0781	38.0850
Code Postale Imputed	For participants on vacation the center of the postal code was substituted for the residential code	1,184	0.0904	0.2868
Demographic				
Gender	Gender: = 1 if Female	1,184	0.7694	0.4214
Age	Age in Years	1,171	41.4219	9.5842
Household Size	Household Size	1,184	2.5296	1.2475
Income	Income: midpoints of €0-€1500; €1501-€2000; €2001-€3000; €3001-€4000; and €4001 et plus	1,151	2845.57	1167.96
Weekend	Weekend: = 1 if Weekend	1,184	0.2660	0.4421

4. Results

Our parameter estimates consistently indicate that the accessibility of the chosen shopping venue is the primary determinant of whether consumers choose to shop online or in person. Contrary to expectations, the surrounding retail landscape, as proxied by proximity to other large-format stores, does not significantly influence either the online/in-person choice or the amount spent online (Kyureghian *et al* (2013)). This finding has important implications for addressing food access disparities: it suggests that increasing online shopping availability alone may not be a sufficient strategy for improving food access in disproportionately disadvantaged communities, such as those designated as food deserts. These results appear in Tables 2 and 3.

Consistent with the results for general online shopping and total online expenditure, online spending on fruits and vegetables is significantly affected by travel time to the store. However, it is not affected by travel distance. This suggests a key distinction: while distance is not a determining factor in fruit and vegetable purchasing decisions (whether online or in-person), the time required for in-person shopping does influence the likelihood of online ordering. This may be related to the perishable nature of these products, making timely delivery a more salient concern. These results appear in Table 4.

Our analysis reveals no significant gender differences in the decision to purchase food online or in person. Although OLS estimates suggest a potential preference for online shopping among younger participants, the more robust RE estimates consistently show no significant effect of age. Income is also consistently insignificant across all estimations. This finding is somewhat unexpected, considering the previous findings in the literature emphasized the appeal of online shopping's convenience and time savings (Beauchamp and Ponder (2010) Zhu and Semeijn (2015)), all of which would be appealing to respondents with higher opportunity cost of time, of which income is repeatedly identified with in the literature.

Our estimations consistently reveal a positive relationship between household size and online shopping, with larger households showing a clear preference for online grocery purchases. Conversely, weekend shopping is consistently negatively correlated with online shopping, indicating that, when time permits, respondents do love doing their groceries in person.

Table 2. Effects of Store Proximity on Online Shopping - Parameter Estimates (Standard Errors)

	OLS	RE	OLS	RE	OLS	RE
	I	II	III	IV	V	VI
Distance to the Store	0.0024**	0.0024**				
	(0.0011)	(0.0011)				
Distance to the Closest Supermarket	-0.0010	-0.0040				
	(0.0046)	(0.0114)				
Distance to the Closest Hypermarket	-0.0022	-0.0009				
	(0.0017)	(0.0041)				
Shortest Time to the Store			0.0272***	0.0367***		
			(0.0078)	(0.0100)		
Shortest Time to the Closest Supermarket			0.0271*	0.0196		
			(0.0153)	(0.0336)		
Shortest Time to the Closest Hypermarket			-0.0340***	-0.0269		
			(0.0119)	(0.0295)		
Avg. Shortest Time to the Store					0.0352***	0.0480***
					(0.0085)	(0.0100)
Avg. Shortest Time to the Closest Supermarket					-0.0009	-0.0092
					(0.0122)	(0.0244)
Avg. Shortest Time to the Closest Hypermarket					-0.0183	0.0051
					(0.0122)	(0.0291)
Gender	0.0006	0.0070	-0.0102	0.0013	-0.0088	-0.0018
	(0.0195)	(0.0475)	(0.0199)	(0.0472)	(0.0205)	(0.0478)
Age	-0.0017**	-0.0025	-0.0023***	-0.0029	-0.0020**	-0.0026
	(0.0008)	(0.0021)	(0.0008)	(0.0020)	(0.0008)	(0.0021)
Household Size	0.0321***	0.0398**	0.0297***	0.0358**	0.0305***	0.0377**
	(0.0086)	(0.0161)	(0.0084)	(0.0160)	(0.0084)	(0.0160)
Income	0.0109	0.0091	0.0143	0.0118	0.0138	0.0083
	(0.0231)	(0.0395)	(0.0232)	(0.0394)	(0.0233)	(0.0395)
Weekend	-0.0440**	-0.0516***	-0.0466***	-0.0522***	-0.0442**	-0.0505***
	(0.0174)	(0.0183)	(0.0172)	(0.0182)	(0.0172)	(0.0182)
Code Postale Imputed	0.0789**	0.0696**	0.0675*	0.0671**	0.0671*	0.0586**
	(0.0369)	(0.0304)	(0.0367)	(0.0301)	(0.0367)	(0.0299)
Constant	-0.0055	0.0212	-0.0180	-0.0244	-0.0541	-0.1075
	(0.1809)	(0.3189)	(0.1753)	(0.3200)	(0.1775)	(0.3235)
Number of Observations	1,151	1,151	1,151	1,151	1,151	1,151
R-sq	0.0366	0.0353	0.0449	0.0436	0.0445	0.0413

Notes: The dependent variable is a binary variable equal to one if shopping is done online.

Table 3 Effects of Store Proximity on the Food Expenditures Online - Parameter Estimates (Standard Errors)

	OLS	RE	OLS	RE	OLS	RE
	I	II	III	IV	V	VI
Distance to the Store	0.0090**	0.0099**				
	(0.0044)	(0.0046)				
Distance to the Closest Supermarket	-0.0043	-0.0117				
	(0.0182)	(0.0500)				
Distance to the Closest Hypermarket	-0.0099	-0.0064				
	(0.0068)	(0.0181)				
Shortest Time to the Store			0.1124***	0.1593***		
			(0.0315)	(0.0435)		
Shortest Time to the Closest Supermarket			0.1104*	0.0974		
			(0.0662)	(0.1468)		
Shortest Time to the Closest Hypermarket			-0.1533***	-0.1388		
			(0.0528)	(0.1286)		
Avg. Shortest Time to the Store					0.1542***	0.2141***
					(0.0349)	(0.0435)
Avg. Shortest Time to the Closest Supermarket					-0.0015	-0.0237
					(0.0523)	(0.1070)
Avg. Shortest Time to the Closest Hypermarket					-0.0928*	-0.0080
					(0.0541)	(0.1274)
Gender	0.0248	0.0451	-0.0209	0.0162	-0.0171	0.0015
	(0.0835)	(0.2079)	(0.0851)	(0.2061)	(0.0875)	(0.2094)
Age	-0.0080**	-0.0115	-0.0105***	-0.0137	-0.0094***	-0.0125
	(0.0033)	(0.0090)	(0.0032)	(0.0089)	(0.0033)	(0.0091)
Household Size	0.1400***	0.1700**	0.1294***	0.1522**	0.1327***	0.1599**
	(0.0378)	(0.0705)	(0.0372)	(0.0698)	(0.0372)	(0.0701)
Income	0.0665	0.0657	0.0828	0.0782	0.0807	0.0640
	(0.0938)	(0.1732)	(0.0943)	(0.1721)	(0.0950)	(0.1730)
Weekend	-0.1846**	-0.2124***	-0.1955***	-0.2145***	-0.1859**	-0.2071***
	(0.0750)	(0.0798)	(0.0744)	(0.0794)	(0.0743)	(0.0790)
Code Postale Imputed	0.2856*	0.2475*	0.2412	0.2386*	0.2372	0.2009
	(0.1488)	(0.1321)	(0.1474)	(0.1308)	(0.1477)	(0.1301)
Constant	-0.1805	-0.1021	-0.2116	-0.2555	-0.3695	-0.6097
	(0.7399)	(1.3967)	(0.7100)	(1.3969)	(0.7194)	(1.4161)
Number of Observations	1,151	1,151	1,151	1,151	1,151	1,151
R-sq	0.0363	0.0355	0.0446	0.0437	0.0458	0.0430

Notes: The dependent variable is the online food expenditure.

Table 4 Effects of Store Proximity on the Fruit and Vegetable Expenditures Online - Parameter Estimates (Standard Errors)

	OLS	RE	OLS	RE	OLS	RE
	I	II	III	IV	V	VI
Distance to the Store	0.0023	0.0028				
	(0.0022)	(0.0027)				
Distance to the Closest Supermarket	0.0017	0.0039				
	(0.0072)	(0.0226)				
Distance to the Closest Hypermarket	-0.0099***	-0.0090				
	(0.0033)	(0.0083)				
Shortest Time to the Store			0.0331**	0.0546**		
			(0.0161)	(0.0253)		
Shortest Time to the Closest Supermarket			0.0660*	0.0724		
			(0.0352)	(0.0664)		
Shortest Time to the Closest Hypermarket			-0.1148***	-0.1055*		
			(0.0315)	(0.0590)		
Avg. Shortest Time to the Store					0.0664***	0.0953***
					(0.0185)	(0.0252)
Avg. Shortest Time to the Closest Supermarket					-0.0022	0.0026
					(0.0270)	(0.0492)
Avg. Shortest Time to the Closest Hypermarket					-0.0802**	-0.0594
					(0.0332)	(0.0590)
Gender	0.0498	0.0425	0.0189	0.0185	0.0269	0.0175
	(0.0491)	(0.0951)	(0.0495)	(0.0934)	(0.0511)	(0.0963)
Age	-0.0033*	-0.0037	-0.0049***	-0.0053	-0.0044**	-0.0049
	(0.0019)	(0.0041)	(0.0018)	(0.0041)	(0.0019)	(0.0042)
Household Size	0.0542**	0.0627*	0.0484**	0.0547*	0.0526**	0.0587*
	(0.0220)	(0.0324)	(0.0218)	(0.0318)	(0.0217)	(0.0324)
Income	0.0484	0.0312	0.0596	0.0381	0.0576	0.0345
	(0.0532)	(0.0797)	(0.0532)	(0.0785)	(0.0540)	(0.0800)
Weekend	-0.1263***	-0.1280**	-0.1287***	-0.1280***	-0.1251***	-0.1246***
	(0.0408)	(0.0469)	(0.0406)	(0.0467)	(0.0405)	(0.0466)
Code Postale Imputed	0.0208	0.0036	0.0022	0.0012	0.0049	-0.0111
	(0.0759)	(0.0771)	(0.0748)	(0.0765)	(0.0754)	(0.0762)
Constant	-0.1996	-0.0595	-0.1032	-0.0174	-0.1766	-0.1516
	(0.4255)	(0.6436)	(0.3995)	(0.6390)	(0.3971)	(0.6568)
Number of Observations	1,151	1,151	1,151	1,151	1,151	1,151
R-sq	0.0273	0.0267	0.0318	0.0306	0.0327	0.0307

Notes: The dependent variable is the online expenditure on fruits and vegetables.

1. Concluding Remarks

In recent years, historically conventional food retail landscape evolved to embrace the digital revolution, effectively blurring the division between the retail channels and introducing hybrids and, notably, online shopping. This evolution has impacted both shopping behaviors and food preferences. While a substantial body of research has examined the antecedents of online shopping, resulting shopping patterns, food choices, and nutritional implications, this study investigates the potential link between online shopping and the food retail landscape, with the goal of exploring how online shopping can be used to address food access disparities.

Our central finding reveals that online shopping is not associated with the general retail landscape in the shopper's local area. Rather, the decision to shop online, and the associated expenditure, is significantly influenced by the proximity of the shopper's preferred store, irrespective of the proximity of other large-format retailers. This suggests that accessibility to available retailers is not the primary driver of online shopping behavior; instead, preference for a specific venue is the key determinant. This is further supported by the observation that only seven online shopping trips involved the nearest supermarket, and none involved the nearest hypermarket.

Our findings suggest that online shopping may not be a panacea for addressing food desert and food access challenges. However, two important limitations should be acknowledged. First, the statistical power of our analysis could be improved with a larger sample size, which would allow for more robust conclusions. Second, our analysis focused solely on the residence address as a point of origin. Future research should consider incorporating other relevant activity hubs, such as work or school locations, as these may influence shopping behavior and store preferences, even in the presence of closer alternatives.

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