Click & Collect Entry Regulation
in the Grocery Retail Sector

Preliminary draft - Please do not circulate

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This version: June 2024

Abstract

Click-and-collect (C&C) services have rapidly expanded in the grocery retail sector. In many countries, their adoption supersedes the use of delivery services. In France, the rise of C&C services prompted concerns among policymakers, leading to the implementation of a new entry regulation in 2014. This article examines the impact of this regulation on the openings of C&C warehouses in France. Using a difference-in-differences analysis, we find that the legislation significantly hindered C&C warehouse openings, particularly for the two leading retail chains, and negatively affected their C&C revenue growth. Our analysis also highlights the varying effects of C&C warehouse entries on local market concentration, providing a better understanding on the potential unintended effects of the law on competition.

JEL classifications: L13, L52, L81.

Keywords: Entry regulation, competition, e-commerce, grocery shopping, retailing.

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1   Introduction

Over the past decade, online grocery shopping has experienced a rapid expansion. In 2022, the leading European countries were the United Kingdom and France, where online grocery purchases accounted for 11% and 9% of total sales, respectively. The United States followed closely, with online grocery sales of 7% of total sales[1].

Despite its growth, online grocery sales still lag behind other product categories in terms of market penetration. For instance, in France, online sales reach a market share of 26% for high-tech products, 20% for home appliances and 14% for clothes.[2] As noted by Gielens et al. (2021), the challenges faced by online grocery shopping stem from the "last mile" problem, wherein consumers demand free and fast delivery despite the considerable expenses it represents for retailers (Chintagunta et al. (2012)). In response, many retailers have introduced Click-and-collect (C&C) services, enabling customers to make purchases online and retrieve them at designated locations and times. Various retailers are rapidly building new fulfillment points by either expanding their stores or by constructing stand-alone facilities.[3]

In France, this C&C service is called "Drive" and it has indeed shown more success than grocery delivery services. In 2018, C&C sales represented 81% of online grocery sales against 19% for home delivery (Nielsen Company (2018)).[4] French retail groups differ in their development strategies for C&C. Two major retail chains, Auchan and Leclerc, have primarily established warehouses as pick-up points, either as independent entities or adjacent to existing brick-and-mortar (B&M) stores. Conversely, other retailers have

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[1] https://www.mckinsey.com/industries/retail/our-insights/the-state-of-grocery-in-north-america-2023

[2] https//www.fevad.com/chiffre-daffaires-e-commerce

[3] In the United States, grocery retailers such as Walmart and Kroger are racing to expand their C&C facilities. Another example is Amazon's online grocery service, Prime, which began offering pick-up services just one year after Amazon acquired Whole Foods Market stores in 2017. As of November 2023, Amazon expands grocery delivery and pickup to all customers, not only to Prime members. (See: https://www.aboutamazon.com/news/retail/amazon-expands-grocery-delivery-and-pickup)

[4] According to McKinsey & Company (2013), C&C's economic model is attractive because it generates relatively higher margins than home delivery. Variable margins would be of 10.7% for an average online order with home delivery, and of 13.8% for an order with pickup services.

invested in in-store C&C facilities, where employees assemble purchased items directly from the shelves, eliminating the need for dedicated warehouses.

While the expansion of some C&C formats entailed the construction of dedicated warehouses, it was not initially subject to regulation on commercial planning. Online shopping started being scrutinized by national authorities mainly because of the "anarchic" implementation of warehouses. As of 2014, the *loi Accès au Logement et à un Urbanisme Rénové* (2014-366-03/24/2014), henceforth ALUR law, subjected the opening of C&C warehouses to the approval of regional zoning boards. These boards were first created in the 1970s to control the expansion of big-box retailers, which were considered a threat for mom-and-pop stores. The establishment or extension of B&M stores with a surface larger than 1,000 m^2 is still subject to the approval of these boards (*Commission départementale d'aménagement commercial* (CDAC)).[5]

The ALUR law was largely motivated by land use and sustainable concerns, but it also has economic implications for retailers, consumers, and employment. In this paper, we aim to assess the economic impact of the law on the development of C&C warehouses and the performance of retailers that invested in this format. We exploit the heterogeneity of the regulation across retail formats and conduct a difference-in-differences (DID) analysis to estimate the extent to which the law decreased the opening of C&C warehouses. For this, we use the Nielsen dataset (Panorama-TradeDimension), which provides information on the creation dates of C&C warehouses and B&M stores in France from 2009 to 2017. We first analyse whether and how the ALUR law affected Auchan's and Leclerc's openings compared to other retail chains and formats not subject to the law.[6] Additionally, we analyze its effect on the evolution of these retailers' revenues by using information on households' purchases from the Kantar Worldpanel dataset.

Our results show that the ALUR law had negative causal impact on the opening of

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[5]See Peiffer-Smadja and Torre (2018) for a review of the retail regulation in France. Besides France, entry regulation in the retail sector has been implemented in most European countries (e.g., UK, Sweden, and Italy) and, to a lower extent, in the U.S. (See (Boylaud and Nicoletti (2001)).

[6]Other retail chains had not established C&C warehouses and were therefore not subject to the ALUR law. Moreover, other B&M formats were not covered by this specific law but were already governed by previous regulations.

C&C warehouses: a 90.6% reduction for Auchan and a 61.4% reduction for Leclerc. When differentiating between adjacent and independent warehouses (for both Auchan and Leclerc together), the estimated negative effect is of 65.3% for independent warehouses and slightly larger (72.7%) for those adjoining a B&M store. These results remain robust even after accounting for the potential maturity of the format, which could also contribute to a lower creation rate of C&C warehouses and potentially bias our estimates. Regarding retailers' performance, we show that these two retail chains experienced a decline in revenue growth due to the legislation: their C&C revenue decreased by 5.3% and 4.3%, respectively.

To better understand the law's impact on competition, we analyze how the entry of C&C warehouses affects local market concentration. For this analysis, we define catchment areas around each warehouse and estimate the changes in the Herfindahl-Hirschman Index (HHI) caused by new entries. Our findings suggest that regulatory measures concerning the entry of C&C warehouses may have yielded mixed outcomes concerning competition. On one hand, restricting the establishment of adjacent warehouses might have deterred a consolidation of local market concentration, potentially preventing price increases. On the other hand, impeding the opening of independent warehouses may have hindered entries that could have reduced local concentration and prices. Despite the significant disparity in their impact on local competition across both types of formats, our results show that both independent and adjacent warehouses were markedly affected by the ALUR law.

Our paper contributes to the literature studying how regulation impacts firm entry, particularly focusing on commercial planning regulation's effect on retailers, as reviewed in Pozzi and Schivardi (2016). Bertrand and Kramarz (2002) were the first to investigate the effects of regional entry regulations implemented in 1973 in the French retail industry. Their findings indicate that entry regulation led to increased market concentration and a slowdown in employment growth.[7] Fisman and Allende (2010) assess the impact of such regulation across industries and countries. They find that zoning regulation has

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[7]See also Viviano (2008) for an analysis of retail regulation on labour market outcomes in the Italian market.

a greater effect on the number and average size of firms in industries with lower natural barriers to entry. Schivardi and Viviano (2010) leverage the decentralisation of entry regulation at regional level in Italy in 1998, showing that entry barriers are associated with significantly larger profit margins and lower productivity of incumbent retailers.

More broadly, the existing literature examines the influence of regulation on various aspects of market structure, including the number and type of firms, prices (Griffith and Harmgart, 2012), employment patterns (Schivardi and Viviano, 2010), location strategies, store format or variety (Cheshire et al., 2015; Sadun, 2015; Datta and Sudhir, 2013), and productivity (Schivardi and Viviano, 2010; Maican and Orth, 2015). However, to the best of our knowledge, the impact of commercial planning regulation on e-commerce and online shopping has not been studied before. Our article contributes to this literature by shedding light on the potential influence of entry regulation on the evolution of online retail.

Our study also contributes to the literature on online grocery shopping. Regarding C&C services, Gielens et al. (2021) analyze how different C&C formats appeal to households based on their shopping characteristics. They also focus on France, with their analysis stopping in 2014, and distinguish C&C formats differently: in-store, near store, and stand-alone facilities. They find that C&Cs boost online spending and, contrary to general concerns, do not have a negative effect on B&M stores. Additionally, they show that stand-alone facilities are the most profitable option for retailers compared to in-store and near-store formats. We complement their study by further exploring how independent (stand-alone) and adjacent warehouses affect local competition.

This article is organized as follows. Section 2 describes the French grocery retail sector and the ALUR law. Section 3 presents the data on C&C openings and revenues. Sections 4 and 5 outline our empirical strategy and main results on the effects of the law on C&C entry and performance, respectively. Section 6 analyzes the changes in local market concentration induced by the opening of a C&C warehouse. Finally, we conclude in Section 7.

2 The French grocery retail sector and its entry regulation

2.1 Industry background

Based on the typical classification of retail brick-and-mortar stores in the grocery industry, the French market primarily features four types of stores: hypermarkets, with a surface area larger than 2,500m^2; supermarkets, with surfaces ranging from 400 to 2,500m^2; convenience stores, below 400m^2; and discount stores, often compact supermarkets offering a restricted range of goods at more affordable prices. The French grocery retail sector is dominated by seven major retail chains: Auchan, Carrefour, Casino, Cora, Intermarché, Leclerc, and Système U. These "traditional" retail chains predominantly operate supermarkets and hypermarkets, with supermarkets outnumbering hypermarkets for all retailers except Leclerc, which owns more hypermarkets than other formats. The discount sector in France is primarily led by two German chains, Aldi and Lidl.[8]

Besides these seven traditional retailers and two German discounters, there are also smaller retailers owning a network of supermarkets and convenience stores, such as Diapar and Francap Distribution. Overall, the French B&M sector exhibits a considerable level of concentration at national level: the combined revenue market share of the top five chains (CR5) surpasses 75%.[9] The level of concentration is even higher at the local level, often characterized by the competition of just two or three chains within a given catchment area (see Allain et al. (2017)).

Every traditional retail chain includes C&C services, with sales accounting for approximately 5.4% of total grocery sales. In 2018, Leclerc led the C&C market with a 48% share of total C&C revenues, followed by Auchan at 19%, Carrefour at 10%, Système U at 9%, and Intermarché at 8.5%.[10]

C&C fulfillment formats can be categorized into three main types. Firstly, there are independent warehouses that function as stand-alone C&C facilities. Secondly, there are C&C warehouses adjoining a B&M store, typically hypermarkets. Thirdly, there are

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[8]Casino and Intermarché also possess discount stores.

[9]Source: Kantar Worldpanel, 2021, https://www.kantarworldpanel.com/fr/grocery-market-share/france/

[10]Source: Kantar Worldpanel, 2017.

C&C points attached to a B&M store without a dedicated warehouse. In this case, items are collected directly from the store shelves, often featuring a drive-thru area (dedicated parking lot) where customers can drive up, communicate with store staff, and collect their purchases without leaving their vehicles (Gielens et al., 2021).[11]

In 2017, the majority of C&Cs adjacent to B&M stores operated without warehouses (75%), while 10% had adjacent warehouses. Independent warehouses accounted for 15% of total C&C facilities. Consequently, when considering both adjacent and independent warehouses together, they represent 25% of all C&Cs, as documented in Table 10 of the Appendix.

Retail chains have chosen different strategies to implement their C&C services. For instance, Leclerc and Auchan have predominantly opted for warehouses, collectively owning 93% of adjacent warehouses and 94% of independent warehouses. In contrast, other retail chains have focused on expanding their C&Cs without warehouses. Interestingly, although Auchan and Leclerc together account for only 26% of the total number of C&Cs, they dominate in terms of C&C revenues, holding a 68% market share.

Regarding fixed and variable costs, constructing a warehouse involves a fixed investment cost that increases with its size, ranging from 2 to 5 million euros for a 4,500m^2 surface area.[12] Conversely, C&Cs offering pick-up from store shelves require substantially lower investments. As previously mentioned, the space allocated to C&C services is typically designed so that customers can retrieve their online purchases without entering the store. B&M stores must invest in configuring physical spaces (e.g., parking lots, overhead roofing) and logistics to implement C&C services, with investments ranging between 20,000 and 200,000 euros depending on the store size.[13] In contrast, labor costs for order picking constitute a larger portion of the total order cost for C&Cs without dedicated warehouses, accounting for 12.5%, compared to 5% for those with warehouses.[14]

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[11]Some C&Cs without warehouses do not offer outdoor pickup services, requiring customers to exit their cars and enter the store to retrieve their orders.

[12]Source: "C&C: Les 7 questions que l'on me pose le plus souvent", *Les dossiers Grande Consommation*, 2013, Olivier Dauvers.

[13]https://www.olivierdauvers.fr/wp-content/uploads/2014/07/Dossier-Grande-Conso-C&C-Renta.pdf

[14]https://www.olivierdauvers.fr/wp-content/uploads/2013/06/Dossier-Grande-Conso-C&C1.pdf

Assessing the resulting profitability of C&C formats is challenging as it hinges on both the potential market expansion effect and the cannibalization effect between C&Cs and B&M purchases within a chain (Melis et al. (2016)).

2.2   The ALUR law

In France, regulations governing the establishment of B&M stores have been enforced since the Royer Law of 1973. These regulations have evolved over time, with the current legislation established by the "Loi de modernisation de l'économie" (LME) in 2008. According to this law, retailers must obtain administrative commercial approval from the "Commission départementale d'aménagement commercial" (CDAC) to open stores with surface areas exceeding 1,000m^2.[15]

The emergence of C&Cs began in the early 2000s.[16] Initially, retailers faced no regulation to open C&C facilities. However, their rapid proliferation raised policy concerns regarding the impact of warehouses on land use, sustainability, and competition with other retail formats. In response, the French government introduced the ALUR law in March 2014, mandating administrative authorization for the establishment of C&C warehouses larger than 20m^2. Importantly, this legislation did not modify the opening rules for C&Cs without warehouses.

Furthermore, under the ALUR law, opportunities for opening warehouses became confined to commercial zones. Independent warehouses were particularly affected, as they were often occupied non-commercial areas with lower land costs and convenient road access, potentially contributing to increased traffic and pollution. In contrast, warehouses adjacent to B&M stores were inherently located within the commercial zones of their respective stores. Moreover, the law aimed to address the imbalance favoring C&Cs

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[15]The Royer law (loi d'orientation du commerce et de l'artisanat) subjected any creation or extension of B&M stores with a surface larger than 1,000m^2 to the approval of commercial zoning boards. This regulation was later tightened to a threshold of 300m^2 by the Raffarin law in 1996. In 2008, the LME restored the threshold to 1,000m^2.

[16]Auchan launched its first C&C pickup point in 2000, followed by its second facility, ChronoDrive, in 2004 (Source: Nielsen TradeDimension).

over other retail formats, as the latter required administrative authorization to enter a local market.

Overall, by increasing the administrative costs[17] and extending the timeline for firms to establish warehouses, the law is expected to somewhat deter the establishment of new C&Cs warehouses. [18]

3 Data

3.1 Data on store openings

We use store-level data provided by Nielsen (Panorama - TradeDimension), a company specializing in retail data collection, for the year 2017. This dataset encompasses comprehensive information of all retail stores operating in France, including their format (supermarket, hypermarket, hard-discounter, C&C), location, and opening date. With these data, we compute the number of store openings per semester, spanning from January 2004 to July 2017. With the law taking effect in the first half of 2014, our dataset on store openings covers both periods before and after its enactment. Due to the scarcity of C&C openings before 2009, we narrow our analysis to the period from January 2009 to June 2017.

Regarding C&Cs, we observe whether they are independent or adjacent to hypermarkets and supermarkets.[19] We match C&Cs to B&M stores based on their location.

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[17]Retailers often hire consultants to conduct studies on the environmental impact of their proposed openings, thereby enhancing their chances of obtaining approval.

[18]Additionally, the legislation may indirectly impact employment, as new C&Cs create jobs depending on their type: opening a new independent warehouse might result in an average of 20 to 30 new jobs, while new adjoining warehouses might create a smaller number of positions (averaging 15). C&Cs offering pick-up services directly from the shelves generally generate fewer employment opportunities. The assessment of the law's impact on employment falls outside the scope of this study due to insufficient data availability.

[19]Our analysis excludes C&Cs adjacent to hard discounters because only a small fraction (4%) of discounters offer C&C services. Additionally, convenience stores are disregarded since they are never associated with the establishment of C&Cs. Both formats pursue significantly different strategies in terms of the assortment of products offered to consumers, with convenience stores typically offering a limited range

Figure 1: Evolution of C&Cs' openings per format (2004 - 2017-I)
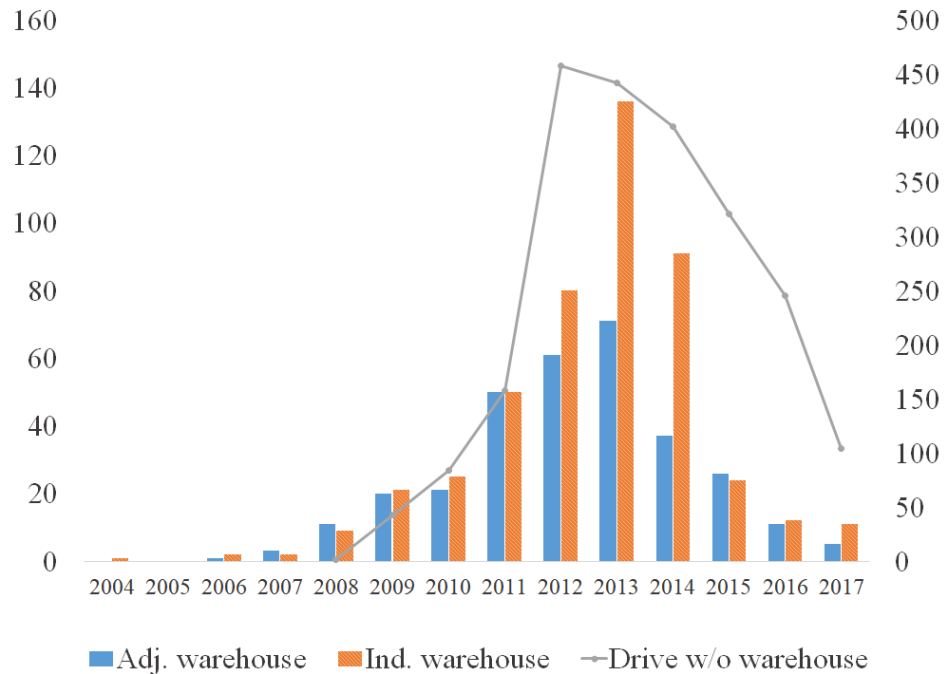
Notes: This figure shows the evolution of new C&Cs per type and per year. The number of warehouses (adjacent to a store and independent) is represented on the left axis, while the number of C&Cs without warehouses is depicted on the right axis. *Source:* Nielsen TradeDimension.

We also observe their type (with or without warehouse). Consequently, we classify C&Cs into three formats: those adjoining a store without a warehouse, those adjoining with a warehouse, and independent warehouses.

Figure 1 shows that the number of new C&C warehouses declined following the enactment of the law. However, the expansion of C&Cs that are not affected by the ALUR law, i.e., C&Cs without warehouses, also declined two years prior to the law's implementation. This decline could indicate that the expansion of C&Cs reached a certain level of maturity by this period, after experiencing a dynamic growth for several years. In addition, the evolution of C&Cs warehouses post-2014 could be attributed to their lower

of products, while discounters predominantly focus on private labels.

profitability. Our goal is to empirically evaluate the causal impact of the law on the decrease in the opening of C&C warehouses.

As previously mentioned, Leclerc and Auchan are particularly susceptible to the effects of the law due to their focus on opening C&C warehouses. Given the differentiated strategy among retailers, we conduct our analysis at the chain level. Moreover, recognizing that chains may vary their entry strategies across regions of the country, we aggregate our data at the regional level.[20]

3.2 Data on retailers' performance

To estimate the impact of the ALUR law on retailers' performance, we use the Kantar Worldpanel database. This database contains data on home-scan food purchases of a panel consisting of 13,000 households in France, and it includes information on their online purchases. Following each shopping trip, households record the quantity and expenditure of their purchases. The database also provides details on household locations, store types (e.g., supermarkets, hypermarkets and online), and the name of retail chains.

Compared to the store-level data, this database provides less granularity for online shopping, as it reports total online household expenditure without distinguishing between purchases made via C&Cs or home delivery services. Given that over 80% of online grocery shopping during our study period was attributed to the C&C service, we consider total online revenues a good proxy for C&C revenues. Unfortunately, we cannot further distinguish revenues for C&Cs by type (e.g. C&C with and without warehouses).

Table 1 shows the average revenues of retail chains (in million euros) by aggregating household expenditures per chain, region, semester and format (hypermarket, supermarket, and C&Cs) from 2009 to 2017. For confidentiality reasons, we label the retail chains from C1 to C7.

There is significant heterogeneity in revenues across retail chains and formats. For instance, average revenues from C&Cs range from 4.16 to 50.85 million euros. Notably,

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[20]Aggregating the number of C&C establishments at a lower geographical unit, such as departments or catchment areas, results in numerous instances of zero counts, which could potentially undermine our empirical analysis.

Table 1: Average revenue per retailer and retail format (2009 - 2017)

	C1	C2	C3	C4	C5	C6	C7
C&C	50.85	33.15	9.46	8.74	4.81	12.57	4.16
Hyper	571.93	276.00	428.56	130.04	85.88	176.88	122.13
Super	33.20	81.38	276.03	326.47	47.84	161.38	105.13

Notes: This table shows the average revenue for all regions and semesters per format (C&C, hypermarkets and supermarkets), and per retail chain (C1,..., C7) in million euros. *Source*: Kantar Worldpanel.

retail chain C1 generates 50% more revenues from C&Cs than its closest rival, C2. Together, these two retail chains contribute 68% of the total C&C revenues, primarily driven by their warehouses.

Although C&C revenues represent a relatively small portion of total revenues for retail chains, ranging from 1.7% (for C7) to 7.8% (for C1) of the total revenues, their expansion has been steady over time across almost all retail chains (see Figure 2). The most substantial revenue growth has been experienced by retailers C1 and C2. While their revenues continued to grow after the implementation of the ALUR law in 2014, there are signs of a slowdown, suggesting a potential change in growth rate.

In the subsequent sections, we empirically explore whether the ALUR law has indeed impacted the establishment of C&C warehouses and their revenue growth, as suggested by the raw data.

4 The effect of the ALUR law on C&Cs' entry

To estimate the average treatment effect (ATE) of the law on the opening of Auchan's and Leclerc's C&C warehouses, we use a difference-in-difference (DID) estimator. Section 4.1 explains our sample selection and the definition of control groups, based on an event study approach. Section 4.2 presents our DID model and the estimated results.

Figure 2: Evolution of C&C revenues per retailer
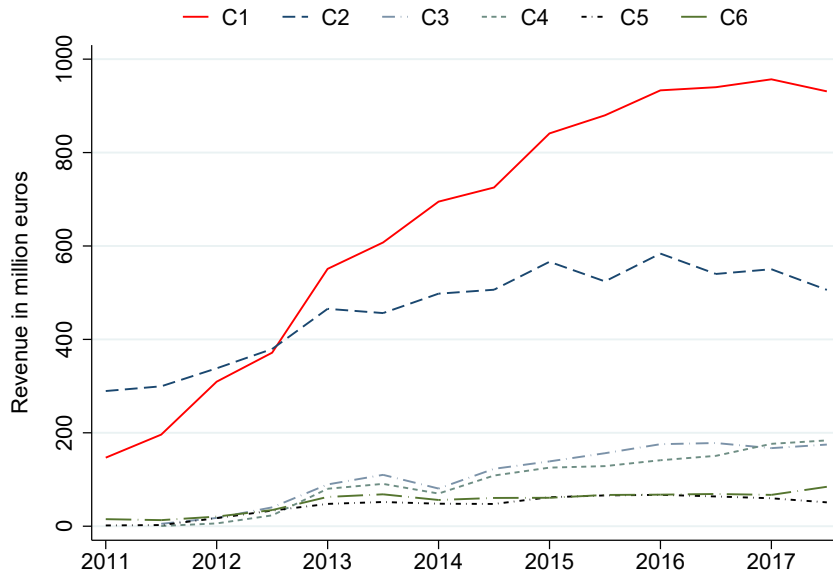
Notes: This figure shows the evolution of C&C revenues per chain from 2011 to 2017. *Source:* Nielsen TradeDimension.

4.1 Identification strategy

Sample selection. We use data on the number of new stores created by each retail chain at the regional-semester level. Our sample consists of 16 semesters, $\mathcal{T} = 16$, spanning from the first semester of 2009 to the first semester of 2017. We exclude the first semester of 2014 because the ALUR law was enacted in March 2014. Out of a total of 13 regions, we drop Corsica, where the development of C&Cs remained very limited over our study period. Therefore, we include $\mathcal{R} = 12$ regions in our sample. We focus on $\mathcal{I}=5$ retail formats: two B&M stores (hypermarkets and supermarkets) and the three formats of C&Cs. We include $\mathcal{C}=7$ traditional retail chains, as presented in Section 2.1.

Table 2 shows the number of new C&C warehouses (adjacent and independent) created before and after the implementation of the ALUR law for each retail chain. Auchan and Leclerc jointly accounted for 96% of new warehouses from 2009 to 2014. Additionally, Table 2 shows that some chains did not create any warehouse either before or after the implementation of the law. For this reason, we focus our analysis on estimating

Table 2: Creation of warehouses per retailer, pre and post the ALUR law

| | Pre | | Post | |
| | C&Cs | | C&Cs | |
	adj. w	ind. w	adj. w	ind. w
Auchan	52	71	5	13
Leclerc	158	225	46	115
Subtotal (A)	*210*	*296*	*51*	*128*
Carrefour	10	11	18	5
Casino	0	4	0	1
Cora	0	0	0	1
Intermarché	0	0	7	1
Système U	3	1	3	2
Others	0	0	0	0
Subtotal (B)	*13*	*16*	*28*	*10*
Total (A+B)	**223**	**312**	**79**	**138**

Notes: This table shows the total number of new adjacent and independent warehouses per retail chain. We split the sample period (2009 – 2017-I) into two: before and after the implementation of the ALUR law. *Source*: Nielsen TradeDimension.

the causal effect of the law on Auchan and Leclerc only. In other words, Auchan's and Leclerc's warehouses constitute our treatment group. We exclude the few warehouses opened by other retail chains from our sample, resulting in a final sample of 4,800 observations.[21]

Control groups and parallel trend tests.   As the ALUR law regulates the entry of C&Cs with warehouses, both independent and adjoining a B&M store, we analyse four cases.

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[21]There are thus 5 formats for Auchan and Leclerc and 3 formats for the 5 remaining chains. The total number of observations is thus (2 chains×5 formats+5 chains×3 formats)×$\mathcal{R}$×$\mathcal{T}$=4,800.

Table 3: Number of store openings

| | Treatment | | Control | | | |
| | Auchan + Leclerc | | Other retail chains | | | |
	adj.w.	ind. w	C&Cs w/o w.	super	hyper	total
Pre	223	312	1,185	610	155	2,485
Post	79	138	1,072	333	87	1,709
Total	752		3,442			4,194

Notes: This table shows summary statistics of the number of stores (C&Cs, supermarkets and hypermarkets) created from 2009 to 2017-I. We split the sample per treatment and (potential) control group, before and after the implementation of the ALUR law in the first semester of 2014. *Source*: Nielsen TradeDimension.

The first two cases focus on the effect at retailer level, where our treatment groups are C&C warehouses of 1) Auchan and 2) Leclerc. Our next two cases study the effect of the law at the format level, for both retailers together: 3) adjacent and 4) independent warehouses.

The remaining three formats (C&Cs without warehouses, hypermarkets, and supermarkets) and five retail chains (Casino, Carrefour, Cora, Intermarché, and Système U) were not subject to the ALUR law. Therefore, they are all possible candidates for inclusion in the control group.

Table 3 provides an overview of store openings per format before and after the law. Among the formats that may belong to the control group, there is a significant increase in the openings of C&Cs without warehouses, which typically have lower opening costs. Taking into account that the pre-treatment period includes 5 years, and the post-treatment period includes 3 years, we observe that the number of C&Cs without warehouses has increased by 50%, while hypermarkets and supermarkets have seen slight declines of approximately 6% and 9%, respectively. This trend suggests a shift towards the expansion of new C&C formats over conventional B&M formats. Overall, the total number of new stores increased by less than 3.6%.

In determining suitable control groups for each treatment, we evaluate various com-

binations among candidate unaffected chains and formats. We assess the validity of the parallel trend assumption using an event study approach. Due to the nature of our data (count data), we estimate the following Poisson regression using pseudo maximum likelihood (PPML):

$$\mathbb{E}\left(n_{icrt}|\mathrm{X}\right) = \exp\left(\beta_t \mathrm{T}_{ic} + \delta \mathrm{T}_{ic} + \theta_t + \mathrm{FE}_{icr}\right) \tag{1}$$

where n_{icrt} denotes the number of stores of format $i \in \{1, ..., \mathcal{I}\}$ and chain $c \in \{1, ..., \mathcal{C}\}$ created in region $r \in \{1, ..., \mathcal{R}\}$ at semester $t \in \{1, ... \mathcal{T}\}$. X represents the set of explanatory variables, which includes our treatment variable, T_{ic}, a dummy that equals one when format i and chain c are treated. θ_t denotes time fixed effects, and $\beta_t \mathrm{T}_{ic}$ represents the interaction between time fixed effects and our treatment variable.

To control for shocks that may similarly affect the creation of all types of stores during the pre- and post-ALUR periods, X also includes format, chain, and regional fixed effects, denoted as FE_{icr}. Finally, to address potential serial autocorrelation in entry decisions, we employ a cluster-robust inference procedure at the region-chain level.[22]

Our parameters of interest are β_t, which reflect the effect of the treatment for each period t (with the second semester of 2013 as the reference point). To validate the parallel trend assumption, it is essential that β_t are not significantly different from zero before the ALUR law.

Figure 3 displays the event studies for the four distinct treatment groups. The vertical axis shows PPML estimates of β_t, and the vertical bars represent 95% confidence bands. For (1) Auchan, the control group includes hypermarkets, supermarkets and C&Cs without warehouse. For (2) Leclerc, the control group comprises hypermarkets and C&Cs without warehouses. For (3) adjacent warehouses, the control group is similar to that of Auchan. For (4) independent warehouses, the control group consists solely of C&Cs without warehouses. All selected combinations of formats and retail chains to form control groups are unaffected by the law.

The inclusion of C&Cs without warehouses in certain control groups may seem surprising, as there could be substitution effects between different types of C&Cs. If such

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[22]Serial autocorrelation may lead to an over-rejection of the null hypothesis of no effect.

effects were present, the ALUR law might have also influenced our control groups by increasing the openings of C&Cs without warehouses. However, upon examining our data, we find that both Auchan and Leclerc experienced a decrease in the number of C&Cs without warehouses after the implementation of the law. This suggests that direct substitution effects did not occur.

Nevertheless, there may have been an indirect effect on the opening of rival C&Cs without warehouses in response to the constraints faced by Auchan and Leclerc. We observe that the total number of rival C&Cs increased by an average of 20%, primarily driven by Intermarché, which entered the market later than other chains and was still catching up in the post-ALUR period. Conversely, excluding Intermarché, rivals decreased the opening of C&Cs without warehouses by an average of 18% after the ALUR law. Therefore, we are confident that such indirect substitution effects are limited, and if they exist, they may only slightly bias our results.

Lastly, the inclusion of a combination of B&M stores and C&Cs in our control groups offers several advantages. Firstly, incorporating C&Cs without warehouses allows us to control for demand shocks or the overall demand trend (i.e., global maturity) that could potentially bias the causal effect of the law. For instance, as the C&C format matures, there might be a natural slowdown in demand across all types of C&Cs. Including C&Cs without warehouses in the control group helps mitigate any upward bias in the estimated causal effect of the law.[23]

Additionally, including B&M stores as part of our control group allows us to control for any supply-side shock affecting retailers' profits. For example, a shock in building costs could affect similarly impact the profitability of both C&Cs with warehouses and B&M stores, while C&Cs without warehouses might remain unaffected. Thus, having B&M stores in the control group enables us to limit an upward bias in the estimated causal effect of the law.[24]

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[23]In the cases where we do not include C&Cs without warehouse in the control group, part of the decline in C&Cs with warehouses attributed to the ALUR law would in fact be driven by the maturity of C&C formats. This motivates the use of revenues in our robustness checks.

[24]Unfortunately, we cannot include B&M stores as part of the control group for independent warehouses because the parallel trend test does not hold in this case.
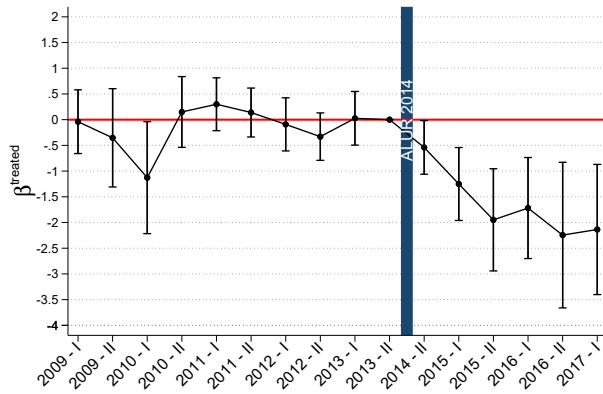
Figure 3: Event studies
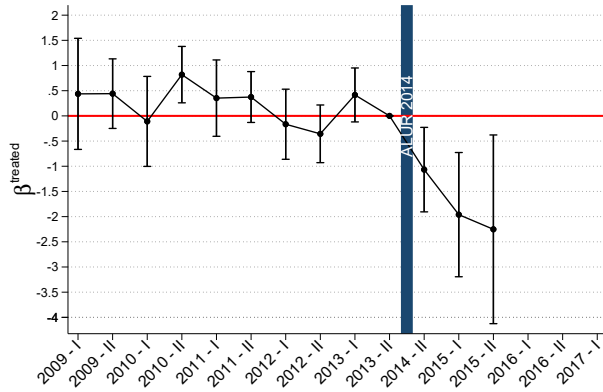
(a) Auchan
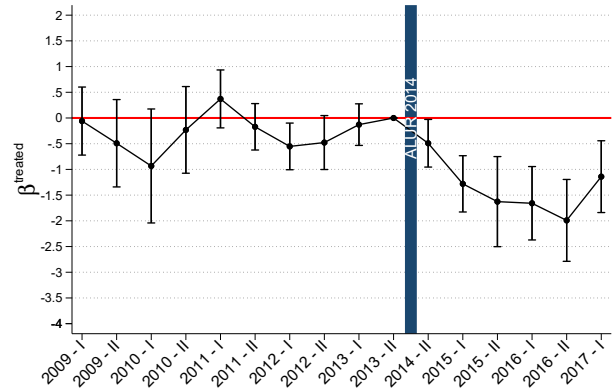
(b) Leclerc

(c) adjacent warehouses
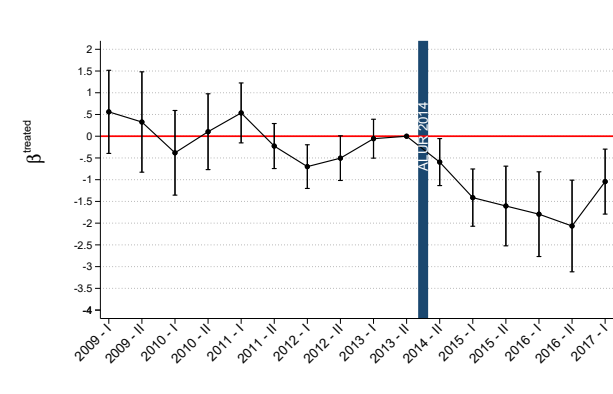
(d) independent warehouses

Notes: This figure displays the results of our event studies based on Equation (1). The vertical axis shows PPML estimates of the β_t. Vertical bars indicate 95% confidence bands. The control group for (1) Auchan includes hypermarkets, supermarkets and C&Cs without warehouse. Regarding (2) Leclerc, the control group comprises hypermarkets and C&Cs without warehouses. For (3) adjacent warehouses, the control group is similar to that of Auchan. For (4) independent warehouses, the control group consists of C&Cs without warehouses.

Key identifying assumptions. Our main identifying assumption is that, in the absence of the ALUR law, the openings of C&Cs would have evolved similarly between the treatment and control groups for each case – Leclerc, Auchan, adjacent warehouses and in-

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dependent warehouses. It is important to note that some shocks may have occurred at the same time than the ALUR law. The fixed effects and other variables used in our robustness check analyses (Section 4.3) control for observed shocks that could affect the number of openings differently among groups. We assume that unobserved shocks affect the outcome equally in both the treated and control groups.

During our period of study, for instance, another significant event that may have affected retailers' profits and subsequent entry decisions was the formation of buyer alliances. In 2014, three buying alliances were established between: (i) Carrefour and Cora, (ii) Système U and Auchan, and (iii) Intermarché and Casino. This is not a concern for the purpose of our study because if buyer alliances affected retailers' supply costs towards manufacturers, this effect is independent of the stores' formats.

4.2 Average treatment effect

We now estimate the average causal effect of the ALUR law on the opening of C&Cs with warehouses for each treatment group using a Poisson difference-in-differences regression. More precisely, we compare the average change in the number of C&Cs with warehouses between the pre- and post-ALUR periods to the average change in the number of stores of our control group. The equation is as follows:

$$\mathbb{E}(n_{icrt}|X) = \exp(\beta \, T_{ic} \times \text{Post}_t + \delta \, T_{ic} + \gamma \, \text{Post}_t + \text{FE}_{icr} + Z_{crt}) \tag{2}$$

where, as before, n_{icrt} denotes the number of stores of format $i \in \{1, \dots, \mathcal{I}\}$ and chain $c \in \{1, \dots, \mathcal{C}\}$ created in region $r \in \{1, \dots, \mathcal{R}\}$ at semester $t \in \{1, \dots, \mathcal{T}\}$.

The opening of stores depends on a set of explanatory variables, X, which includes our treatment variable, T_{ic}, a dummy that equals one when a specific format and chain are treated. Post_t is a dummy variable that equals one for periods after the first semester of 2014. We also control for format and chain fixed effects, as well as regional fixed effects, FE_{icr}. Finally, Z_{crt} is a set of controls used for robustness checks (see Section 4.3 for more details). Similar to our event studies, we employ a cluster-robust inference procedure, clustering at the chain and region levels.

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Our parameter of interest, denoted by β, represents the average effect of the treatment. The results of the DID estimation at chain level are presented in column (1) and (2) of Table 4. We find that the ALUR law in 2014 caused a significant reduction in the opening of C&C warehouses, decreasing by about 90% for Auchan and by 61% for Leclerc.

In columns (3) and (4), we divide our treated group by format rather than chain. Surprisingly, we observe a similar effect of the ALUR law on C&C warehouses, whether they are adjacent or independent. Specifically, the law resulted in a 72% decrease for adjacent warehouses and a 65% decrease for independent ones. This finding is unexpected given that the primary objective of the law was to regulate the "chaotic" opening of independent warehouses.

In general, the results indicate a substantial reduction in warehouse openings due to the law. The magnitude of this decrease may raise questions for the reader. However, Table 11 in the Appendix supports these findings by demonstrating consistent changes in the raw data.

4.3 Robustness checks

This section extends our analysis by introducing several controls, denoted Z_{crt} in Equation 2, aimed at capturing the potential maturity effect of the C&C service. Additionally, we control for the existing capacity that retailers have to offer C&C services.

Share of C&C's revenue. To reflect the increasing/decreasing profitability of C&Cs across different regions and time periods, we compute the share of C&C revenues over total retailers' revenues. To avoid endogeneity problems, we define our variable ShareC&C$_{rt}$ as the average share of C&C revenues across all regions excluding the specific region r. Formally, this control variable is defined as:

$$\text{ShareC\&C}_{rt} = \frac{\sum_{c=1}^{C} \sum_{s=1,s\neq r}^{R} \text{Rev}_{1cst}}{\sum_{c=1}^{C} \sum_{s=1,s\neq r}^{R} \sum_{j=1}^{J} \text{Rev}_{jcst}},$$

where C is the total number of retail chains, and J is the total number of formats for

Table 4: PPML DID analysis

Dependent variable: number of opening (n_{icrt})				
	(1)	(2)	(3)	(4)
PostALUR × Auchan w.	-2.37***			
	(0.38)			
PostALUR × Leclerc w.		-0.95***		
		(0.20)		
PostALUR × adj.warehouses			-1.29***	
			(0.17)	
PostALUR × ind. warehouses				-1.06***
				(0.26)
% change	-90.6%	-61.4%	-72.7%	-65.3%
Fixed effects	Yes	Yes	Yes	Yes
Observations	4,800	3,264	4,800	1,728

Notes: This table presents the estimated ATE effect of the ALUR law per retail chain ((1) Auchan and (2) Leclerc) and per format (adjacent (3) and independent warehouses (4) for both retailers together). The control groups are composed by B&M stores and C&Cs without warehouses, as indicated in Figure 3. We also control for chain, format, region and chain-format fixed effects. Standard errors are clustered by region and chain. *** indicates significance at the 1% level. $\Delta\% = \exp(\beta) - 1] \times 100$.

which we have revenue data ($J = 3$, $j \in \{$C&C^{25}, Super, Hyper$\}$). We also control for non-linear effects of the evolution of C&C revenues by including the squared value of this variable, ShareC&C$^2_{rt}$.

Saturation ratio. The creation of C&Cs adjoining a store, with or without warehouses, is influenced by the existing stock of hypermarkets and supermarkets for each retail chain. Retailers' B&M store capacity can either facilitate or limit the entry of these C&Cs, whereas independent warehouses are not constrained by the existing stock of B&M stores. Figure 5 in the Appendix shows the proportion of supermarkets and hypermarkets with and without C&C services by 2017.

To control for the ability of firms to open C&Cs adjacent to a store, we build a set

of variables that account for the available capacity for each retail chain c, region r and period t. First, we extend the set of formats by defining $1h$ and $1s$ for C&Cs without warehouse within a hyper and a super, respectively. Similarly, we define $2h$ and $2s$ for warehouses adjoining a hypermarket and a supermarket. Using these new formats, we then construct a variable $stock_{crt}^{i}$ that counts the number of stores of a specific format for each chain and region over time. Subsequently, we calculate the following saturation ratios:

$$\text{Sat}_{crt}^{h} = \frac{\text{stock}_{crt}^{1h} + \text{stock}_{crt}^{2h}}{\text{stock}_{crt}^{hyper}}$$

$$\text{Sat}_{crt}^{s} = \frac{\text{stock}_{crt}^{1s} + \text{stock}_{crt}^{2s}}{\text{stock}_{crt}^{super}}$$

Based on the premise that the saturation effect only plays a role when capacity is constrained, we construct a variable assigns the value of zero when $\text{Sat}_{crt}^{h} \leq 0.75$ (resp. when $\text{Sat}_{crt}^{s} \leq 0.50$), and retains the actual value otherwise.[26] We interact this variable with a dummy equal to one for C&Cs adjoining a hypermarket (resp. supermarkets) since these are the only formats affected by retailers' B&M capacity.

Moreover, we control for the saturation ratios at $t-2$ to explain the opening of adjoining C&Cs in semester t. This year gap realistically represents the delay between firms' decision to open a store and its actual opening. By doing so, we also avoid reverse causality problems between the number of openings at date t and the variable $stock_{crt}^{i}$ in the same period. Finally, we control for nonlinear effects of the saturation ratios by using their square value.

Results. These two control variables, the saturation effect and the share of C&Cs' revenue, are likely to affect both the treated and control groups. The results of the average treatment effect with the control variables are displayed in Table 5. For ease of comparison, we present our baseline results in column (B). Column (B+ShareC&C) presents the

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[26]The threshold set for supermarkets is lower than the one used for hypermarkets because the maximum saturation level reached for supermarkets equals 0.58. In contrast, hypermarkets can reach full saturation ($\text{Sat}_{crt}^{h} = 1$).

Table 5: DID analysis on the ALUR law: robustness checks

Dependent variable: number of opening (n_{icrt})				
Variable	Baseline (B)	B + ShareC&C	B + Sat	All
PostALUR × Auchan w.	-90.6%	-90.9%	-90.9%	-91.1%
PostALUR × Leclerc w.	-61.4%	-62.9%	-63.2%	-65%
PostALUR × adj.warehouses	-72.7%	-73.2%	-73.0%	-73.5%
PostALUR × ind. warehouses	-65.3%	-67.0%	-68.0%	-70.0%
Fixed effects	Yes	Yes	Yes	Yes

Notes: This table shows the estimated ATE with additional control variables for robustness checks. For simplicity, we directly present the estimated percentage change $\Delta\% = [\exp(\beta) - 1] \times 100$. Model (B) shows the results of our baseline model (Table 4), where we control for chain, format, region and chain-format fixed effects. Model (B+ShareC&C) adds the variables ShareC&C$_{rt}$ and ShareC&C$^2_{rt}$ to our baseline. Model (B+Sat) adds variables related to the saturation effect (Sat$^h_{crt-2}$, Sat$^s_{crt-2}$, (Sat$^h_{crt-2}$)^2, (Sat$^s_{crt-2}$)^2). Model (All) includes all of the above. Standard errors are clustered by region and chain level. The corresponding β parameters are significant at the 5% level.

results when incorporating the share of C&C revenues as controls. Column (B+Sat) introduces the saturation ratios to our baseline. Finally, column (All) displays the results with both sets of control variables.

Results are similar in all cases for Auchan. The effect increases by 4 percentage points for Leclerc when adding all control variables. Regarding the effect of the law at format level, the impact of the ALUR law on adjacent and independent warehouses are more similar in magnitude (around 70%) when adding both controls.

5 Effect of the ALUR law on retailers' performance

In this section, we focus on the impact of the ALUR law on the revenues generated by C&Cs for the different retailers. We cannot directly observe the profitability of retailers but we use revenues as a measure of performance. We then estimate the ATE of the ALUR law on the retailers' C&C revenues. As in the previous section, we first present our sample selection and control groups (Section 5.1) and then, we present our regression specification and the estimation results (Section 5.2).

5.1 Identification strategy

Sample selection To make the analysis on the effect of the ALUR law on retailers' performance as comparable as possible with the analysis of C&Cs' entry, we build our sample similarly to the one used in our previous analysis. We have the same number of regions, $\mathcal{R} = \infty \in$ but the number of years and retailers vary due to the existence of missing data. More precisely, we remove the first 4 semesters (2009-2010), in addition to the first semester of 2014 that corresponds to the semester of the introduction of the law. We also remove one retailer from the control group, resulting in $C = $ retailers.

Regarding stores' format, we have a total of $\mathcal{J} = \ni$ formats, where $j \in \{$C&C, super, hyper$\}$. C&C includes all types of formats: independent warehouses, warehouses adjoining supermarkets and hypermarkets, and C&Cs without warehouses. Given the confidentiality of data, we cannot provide the name of retail chains in this section.

To reflect the changes in revenue growth of C&Cs, we compute the difference in revenues from one semester to another for all retail chains, $c = 1, ..., C$, in all regions, $r = 1, ..., \mathcal{R}$, and periods $t = 5, ..., \mathcal{T}$: $\Delta\text{Rev}_{crt} = \text{Rev}_{crt} - \text{Rev}_{crt-1}$.[27]

According to Gielens et al. (2021), C&C services enhance consumers' shopping convenience compared to B&M stores by facilitating search (online search), by providing a pick-up service and by offering an easier access to consumers. The ease of access is especially important for independent warehouses due to their strategic location. This additional convenience decreases the (fixed and variable) costs of shopping for consumers, therefore generating an increase in the number of households using this format, as well as an increase in their online spending and frequency of visits to retailers (Bronnenberg, 2018; Bell et al., 1998). Therefore, the creation of C&Cs is thus likely to increase firms' performance.

To examine whether the creation of C&Cs generates revenues, we first regress the change in revenues ΔRev_{crt} on the creation of C&Cs for each chain in the previous pe-

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[27]We assess whether the law has impacted the change in revenues rather than the revenue levels themselves. This approach aligns our analysis with the one on C&Cs' entry, where we focus on changes in the opening of new C&Cs rather than changes in the stock of C&Cs.

Table 6: The marginal effect of the creation of C&Cs on ΔRev_{crt}

|	Coefficient	Standard error
Entry C&Cs$_{t-1}$	-116,198.8	(142,667.9)
C1 ×Entry C&Cs$_{t-1}$	757,017.7***	(178,293.1)
C2 ×Entry C&Cs$_{t-1}$	1,288,804***	(309,086.6)
C3 ×Entry C&Cs$_{t-1}$	345,168.6*	(183,331.6)
C4 ×Entry C&Cs$_{t-1}$	138,020.8	(156,300.4)
C5 ×Entry C&Cs$_{t-1}$	367,802.7	(261,985.1)
C6 ×Entry C&Cs$_{t-1}$	306,945.2	(234,944)
Constant	7,795,038***	(1,342,170)
Observations	1,048	
R^2	0.27	

Notes : *, **, *** indicate significance at the 10%, 5% and 1% level, respectively. Standard errors are clustered by region and period. We control for regional fixed effects. C7 is the reference group.

riod.[28] Table 6 shows that the creation of C&Cs significantly and positively affects the change in revenues for retailers C1 and C2. In contrast, this correlation is not observed for other chains. Given that C1 and C2 are the two retail chains that have opened warehouses, this suggests that the creation of C&C warehouses has a positive impact on retailers' performance. Conversely, the creation of C&Cs without a warehouse shows no significant effect.

Next, we analyse the impact of the ALUR law on revenue change, considering we have already identified a negative effect on entry.

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[28]To avoid endogeneity issues, we also regress the change in revenues on the number of C&Cs opened at period $t - 2$. This is because a shock in demand may simultaneously affect revenues and firms' entry decisions. We run the regression over the entire period from 2011 to 2017. Results remain consistent under this specification.

Figure 4: Event studies for revenue analysis

(a) C1   (b) C2
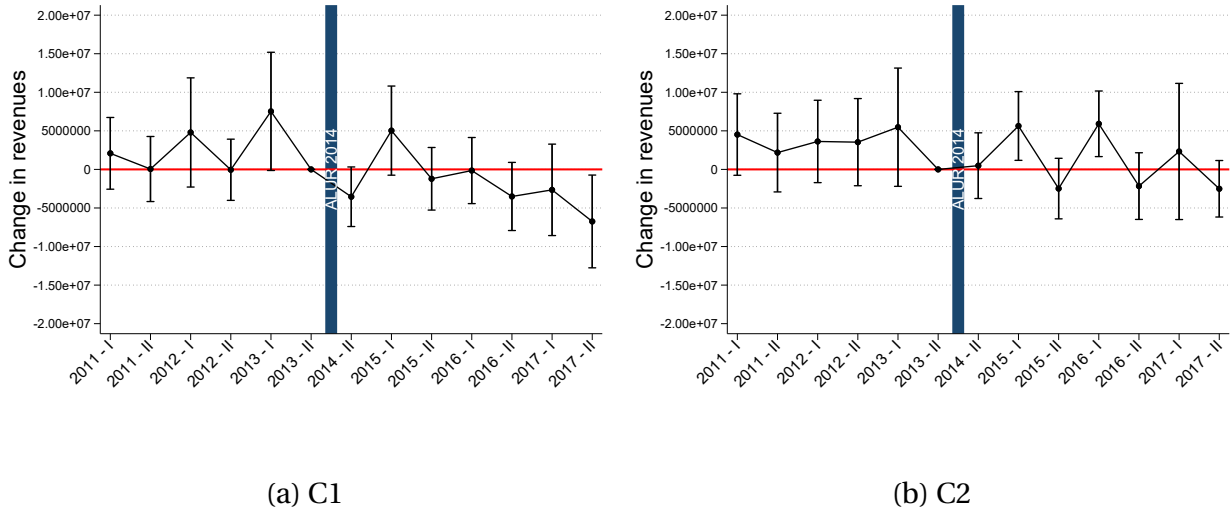
Note: This figure shows the results of our event studies based on Equation 3. The control groups for C1 and C2 are composed by C&Cs without warehouse.

Test of parallel trend assumption   We consider the C&Cs of C1 and C2 as the treated groups, and the C&Cs of other retail chains as the control group. Unlike the analysis of the ALUR law's effect on entry, we do not include hypermarkets and supermarkets in our control group. The main reason is that, as shown in Table 1, it is challenging to compare revenues across store formats since C&Cs represent only a small fraction of the total retail chains' revenues.[29] Furthermore, only retail chains C1 and C2 focus their C&C strategy on warehouses and are therefore subject to the ALUR law. Thus, the C&Cs of other chains are suitable candidates for the control group.

We test for the parallel trend assumption using an event study approach, similar to Section 4.1. We estimate the following regression to examine whether the change in revenues for C1 (C2) follows the same trend as the control group before the introduction of the ALUR law:

$$\Delta \text{Rev}_{crt} \;=\; \alpha + \gamma_t \text{T}_c + \mu_c + \theta_t + \mu_r + \varepsilon_{crt} \tag{3}$$

where ΔRev_{crt} denotes the change in revenues per chain c, region r and semester t.

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[29]We also analyse whether including B&M stores in our control group would meet the parallel trend requirement, but find that it does not

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T_c is our treatment variable, a dummy that equals one if the retail chain $c = \{C1, C2\}$ is treated, and 0 otherwise. $\gamma_t T_c$ are the interactions between time fixed effects and the treatment variable. We also control for chain μ_c, region μ_r and time α_t fixed effects; ε_{crt} is an error term.

Results in Figure 4 show the coefficients γ_t and their confidence intervals at 95%. We observe that the parallel trend assumption pre-ALUR law holds for C1 and for C2 since γ_t are not significantly different from zero.

5.2   Average treatment effect

We estimate the average treatment effect of the ALUR law on the change in C&C revenues for retailers C1 and C2 separately, using the following equation:

$$\Delta \text{Rev}_{crt} \quad = \quad \alpha + \beta \times T_c \times \text{Post}_t + \delta T_c + \gamma \text{Post}_t + \mu_c + \mu_r + \varepsilon_{crt}, \tag{4}$$

where Post_t is a dummy variable equal to 1 for semesters following the introduction of the ALUR law and 0 otherwise. T_c is our treatment variable for C1 or C2. The coefficient β captures the average effect of the ALUR law on the C&C revenues for C1 and C2. We include regional (μ_r) and chain (μ_c) fixed effects in the model.

Table 7 shows the DID estimation results, with column (1) presenting the estimated β for C1 and column (2) for C2. We find a negative and significant effect, with revenues for C1 decreasing by 3.7 million euros and for C2 by 1.8 million euros. This indicates that C&C revenue growth for both retailers would have been higher without the ALUR law.

To assess the impact on revenues for each retailer, we calculate the fraction that this change in revenue represents with respect to each retailer's C&C revenues and their total revenues from all formats. We find that the revenue change for C1 (respectively C2) implies a 5.3% (respectively 4.3%) lower C&C revenue compared to a scenario without the ALUR law. Since C&C revenues constitute a small share of the total revenues for retail chains (see Table 1), the overall effect of the ALUR law on total revenues is small: -0.51% for C1 and -0.46% for C2.

These results suggest that C&C warehouses are used by these two retail chains as a means of boosting their C&C revenue, effectively acting as an expansion effect. The

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Table 7: DID analysis on the ALUR law

Dependent variable: revenue change (ΔRev_{crt}) (euros)		
	(1)	(2)
Post $\times$ C1	-3,730,879***	
	(929,231.1)	
Post $\times$ C2		-1,849,535**
		(722,072.4)
Fixed effects	Yes	Yes
Observations	658	658

Notes: This table presents the estimated effect of the ALUR law per retail chain ((1) C1 and (2) C2). Both control groups are composed by C&Cs without warehouse. We control for chain and region fixed effects. Standard errors are clustered by region and chain. *, **, *** indicate significance at the 10%, 5% and 1% level, respectively..

previous section demonstrated that the ALUR law impacted the number of new C&C warehouse openings. We further show that it also affected the expansion of retail chains in the C&C sector.

6   The competition effect of warehouses' entry

As previously explained, the local authorities responsible for granting permits for the establishment of new B&M stores or C&C warehouses do not explicitly consider local competition. Nevertheless, the establishment of a new warehouse is likely to influence local competition and, consequently, prices.

The introduction of C&Cs could potentially enhance local competition by providing consumers with new shopping alternatives, leading to fiercer competition and lower prices. In this optimistic scenario, a law that limits the entry and expansion of C&Cs might inadvertently hinder competition. Conversely, the entry of a new warehouse might instead reinforce local market concentration, potentially resulting in higher prices. In such a scenario, regulations restricting C&C entries would be considered beneficial.

Given that our previous analyses have demonstrated the ALUR law's significant impact –primarily affecting Auchan and Leclerc by decreasing warehouse entries and corresponding revenue growth–, we now explore the unintended effects of the law on competition by examining the changes in local market concentration upon warehouse entries.

Section 6.1 provides a review of the existing literature on the relationship between local concentration and supermarket prices. Section 6.2 outlines our methodology for calculating the influence of warehouse entries on the Herfindahl-Hirschman Index (HHI) at the local level. Section 6.3 discusses the potential side effects of the regulation on competition.

6.1 Local concentration and supermarket prices

To better understand the relationship between local market concentration and prices, we briefly review articles analysing the effect of supermarket entries on prices, and then articles dealing with supermarket mergers and prices.

Regarding the effect of entry on prices, Hausman and Leibtag (2007) shows that the entry of non-traditional outlets, such as Wal-Mart's supercenters, into the traditional U.S. grocery sector benefited consumers by reducing prices. The entry of supercenters had both direct and indirect negative effects on prices: Wal-Mart set lower prices than traditional supermarkets, and increased competition between Wal-Mart and incumbent retailers further drove prices down. Using a discrete choice model for household shopping choices, the study finds that consumer welfare increases, with low-income households benefiting the most.

These findings align with results by Basker (2005), which show that Wal-Mart's entry into the U.S. market decreased average retail prices by 1.5% to 3% in the short run, and up to four times as much in the long run. Basker and Noel (2009) find that price decreases varied depending on the retail chain, with prices dropping by 1.2% for chains differentiated from Wal-Mart and up to 1.8% for supermarket chains that were direct competitors.

Regarding the effect of horizontal mergers on prices, Hosken et al. (2018) shows that increased concentration resulting from horizontal mergers in the highly concentrated U.S. grocery retailing industry led to higher prices. Similar price increases in local markets have been observed in specific cases of mergers between supermarket chains in France (Allain et al. (2017)), and Germany (Rickert et al. (2021)). Using estimates from a structural (pre-merger) model of demand and supply in the UK supermarket industry, Smith (2004) simulates different mergers between two of the largest retail firms and also finds price increases.

An interesting paper by Hosken et al. (2016) links these literature streams by comparing the price changes produced by entry with those produced by a horizontal merger in the supermarket industry. Their results show that price changes are very similar in magnitude, highlighting the importance of analysing the effects of entry on local market competition.

Based on these studies, we proceed to analyze how market concentration is influenced by the introduction of a C&C warehouse in a local retail market.[30] To establish a benchmark for comparison, we also calculate the changes in concentration induced by the entry of traditional B&M stores. We conclude by discussing whether the regulation on C&C entry is likely to have had a negative or positive effect on local concentration, and consequently, potentially benefit or harm consumers.

6.2 Catchment area definition and HHI computation

To compute changes in local market concentration, our first step is to determine the relevant catchment area for each retail format. This involves identifying the set of stores that are in competition with the new entrant, whether it is a C&C warehouse or a B&M store.

For B&M stores, we rely on the definition of catchment areas used by the French competition authority to analyse merger cases in the grocery retail sector. If the focal point is a supermarket, the relevant catchment area consists of two concentric circles around

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[30]Please note that our available data do not enable a direct assessment of the impact of these entries on prices.

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the store. The first circle, with a 15-minute drive radius, includes competitors of all possible formats (hypermarkets, supermarkets, and discounters). The second circle, of a 30-minute drive radius, includes only hypermarkets as competitors. This means that supermarkets located 20 minutes away by car are not considered within the catchment area of the focal supermarket. In contrast, if the focal point is a hypermarket, the relevant catchment area is defined by a single circle with a 30-minute drive radius, which includes only hypermarkets.[31]

The French competition authority stipulates in its guidelines that the competitive pressure exerted by online sales on B&M stores should be considered homogeneous across the entire national territory.[32] In the absence of specific references regarding C&C warehouses, we adopt for them the same definition as that for B&M stores, depending on the characteristics of the warehouse. Specifically, if a C&C warehouse adjoins a supermarket, we define its catchment area as that of supermarkets. For C&C warehouses adjoining hypermarkets or independent warehouses, we apply the same catchment area definition used for hypermarkets.[33]

To address variations in travel times across differently populated areas, we categorize geographic regions into three types: urban, semi-urban, and rural, following INSEE's classification criteria.[34] For a 30-minute drive, this corresponds to a radius of 5km, 10km, and 20km for urban, semi-urban and rural areas, respectively. For 15-minute drive, we define radius of 3km, 5km, and 10km radius for urban, semi-urban and urban areas.

Herfindhal Hirschmann Index. Once we define the catchment areas, the second step to calculate changes in local market concentration is to estimate the Herfindhal Hirschmann Index (HHI) before and after the entry of C&Cs and B&M stores between 2004 and 2017.

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[31] *Lignes directrices de l'Autorité de la concurrence relatives au contrôle des concentrations*, 2020, p.141,ht tps://www.autoritedelaconcurrence.fr/sites/default/files/Lignesdirectricesconcentrations 2020.pdf.

[32] See Annex D of the guidelines.

[33] For independent C&C warehouses, we consider the same definition as for hypermarkets due to their large average surface area.

[34] INSEE's classification of communes depends on population density and road structure. See https: //insee.fr/fr/statistiques/3564100?sommaire=3561107.

The HHI is defined as the sum of the squared values of the individual market shares of each retail chain, ranging from close to zero (indicating nearly perfect competition), to 10,000 (pure monopoly).

Unfortunately, market shares of retail chains cannot be computed at the local level using the revenue data provided by Kantar, as the household survey data is not representative at the catchment area level.[35] Another limitation of Kantar data is the inability to distinguish retail revenues for different C&C formats (independent or adjacent). Therefore, we use stores' surface areas at the retail group level to estimate retailers' market shares. Our approach follows the French competition authority's merger guidelines[36], as well as previous literature (Allain et al. (2017)).

The use of market shares based on surface areas may cast some doubts for C&C warehouses because their surface areas are not actual selling areas used by consumers, unlike in the case of B&M stores.[37] To check whether surface areas are good proxies of revenues, we use aggregated information on retail revenues at the national level and compare retailers' market shares to their corresponding national market shares using surface areas. Specifically, we compute a ratio between the market share in revenue and the market share in surface area for each format and retailer, i.e., for hypermarkets, supermarkets and C&Cs.

We find a ratio very close to 1 for B&M stores (1.04 for hypermarkets and 0.99 for supermarkets). However, the ratio is lower for C&Cs, with a value equal to 0.68. This can be explained by the fact that Tradedimension data only report surface areas for C&C warehouses, whereas C&C without warehouses do not add surface areas to their corresponding B&M stores, despite generating online revenues. From these national level ratios, we conclude that surface areas appear to be a good proxy for revenues for B&M

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[35]The data are representative at a regional level.

[36]Lignes directrices de l'Autorité de la concurrence relatives au contrôle des concentrations, p64, §226 `https://www.autoritedelaconcurrence.fr/sites/default/files/Lignesdirectricesconcentratio ns2020.pdf`.

[37]Contrary to B&M stores, there is a lack of evidence supporting the reliability of this measure for the C&C service. This stems from the absence of prior investigations conducted by competition authorities into the C&C format.

stores. However, for C&C warehouses, surface areas may overestimate the market shares in revenues. To correct for this bias in our analysis, we apply a 0.7 weight to C&C surface areas when estimating the HHIs.

6.3 The impact of Click-and-Collect entry on local market concentration

As previously mentioned, entry, similar to a horizontal merger, can induce a local change in the HHI (denoted by ΔHHI). On the one hand, a decrease in the HHI is expected when a retail chain opens a new store in a catchment area where it was either not present or had a small market share, thereby creating a more competitive market. On the other hand, entry is likely to increase the HHI when the new store belongs to a chain already established in the area with a substantial market share.

We follow the EU guidelines for the assessment of mergers and consider that an entry will trigger a significant decrease (increase) in concentration when the post-entry HHI is within the interval $[1000, 2000]$ and ΔHHI < -250 (ΔHHI > 250), or when the post-entry HHI is larger than 2000 with ΔHHI < -150 (ΔHHI > 150).[38]

We focus our analysis on cases where concentration could potentially pose competition issues, particularly when post-entry HHI levels exceed 2000. This choice is not restrictive as local markets with post-entry HHI larger than 2000 represent 97% of the total number of markets.[39]

Table 8 provides the distribution of entries depending on whether they trigger a large decrease (column 1), a moderate decrease (column 2), a moderate increase (column 3), or a large increase (column 4) in HHI, categorized by retail formats, namely hypermarkets, supermarkets, C&C independent warehouses, and C&C adjacent warehouses.

The entry of a B&M store appears to be more inclined to enhance competition at the

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[38]In its guidelines for evaluating both horizontal and non-horizontal mergers, the EC considers that a level of concentration lower than 1000 does not raise competition concerns. See `https://eur-lex.euro pa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52004XC0205(02)`.

[39]There are no markets where the post-entry level HHI falls below 1000. For the remaining 3%, the post-entry HHIs range within the interval of $[1000, 2000]$.

Table 8: Changes in concentration induced by entry (2004-2017)

| | ΔHHI < −150 | −150 ≤ ΔHHI ≤ 150 | | ΔHHI > 150 | Total # cases |
| | | ≤ 0 | > 0 | | |
	(1)	(2)	(3)	(4)	
B&M	871	465	275	154	1,765
super	626	441	258	78	1,403
hyper	245	24	17	76	362
C&C	166	234	222	88	710
adj. w.	16	104	107	48	275
ind. w.	150	130	115	40	435

Note: This table shows the distribution of changes in the HHI level resulting from the entry of B&M stores and C&C warehouses. Our analysis focuses on markets with a post-entry HHI exceeding 2000. Surface areas for warehouses are weighted by a factor of w=0.7.

local level (in 75% of cases, with 49% having large effects), rather than dampen competition (in 25% of cases, with only 9% showing large impact). In contrast, the entry of a C&C warehouse typically results in a moderate change in HHI in most cases (64% of C&C cases compared to 42% for B&M), with the entry of a C&C warehouse leading to a significant increase in concentration in more cases than for B&M (12% of C&C cases versus 9%). Conversely, it leads to a substantial decrease in concentration in fewer cases (23% of C&C cases versus 49%).

However, when disentangling the entry effect by type of C&C format, we find that a large increase in concentration is mostly driven by the entry of adjacent C&C warehouses. Adjacent C&C warehouses tend to generate a significant positive change in HHI in more cases (17%) than they produce a large negative effect (6%). In contrast, independent warehouses generate large decreases in concentration in most cases (35%), compared to the fewer cases where large increases in the HHI are induced upon entry (9%).

To better understand the relationship between entry and changes in market concentration, we regress the probability of an entry leading to a large decrease (or increase) in

the HHI on the stores' format, controlling for chain (β_c) and time (θ_t) fixed effects. We also control for the degree of population density of the focal point of entry, a count variable that ranges from 1 (very urban) to 7 (very rural), as defined by the French statistical bureau as a measure of urbanity. The likelihood of observing a large decrease (respectively increase) in concentration is estimated using a Probit model where the dependent variable Y is a dummy equal to 1 if ΔHHI < -150 (ΔHHI > 150), and zero otherwise.

$$\Pr(Y = 1) = \Phi(\text{Format}_i + \beta_c + \theta_t + \text{degree of density}) \tag{5}$$

Table 9 shows the results of three Probit models. Regarding the likelihood of producing a large decrease in the HHI, column (1a) show different patterns between B&M and C&C entries. The entry of a C&C warehouse is negatively correlated with a reduction in concentration (the estimated parameter is negative and significant). The estimate for B&M stores is positive but not significant. However, when looking at formats in a more granular manner, results in column (1b) show that the entry of hypermarkets within the B&M category is positively and significantly correlated with large decreases in concentration. Additionally, as hinted by the results presented in Table 8, the negative correlation for C&C formats is mainly driven by the entry of adjacent C&Cs. The coefficient is negative but not significant for independent warehouses.

Concerning a large increase in concentration, results show that both types of entry (B&M and C&C) are negatively correlated with large increases in the HHI (column 2a). This result holds across all retail formats, as evidenced by the negative and significant parameter estimates (column 2b).

Given that cases where entry produces large changes in concentration are the ones most concerning for their potential to either benefit or harm consumers, we zoom into those cases and analyze the correlation between formats and large decreases in HHI. In other words, column 3 regresses the likelihood to produce a decrease in concentration, conditional on having produced a large change. By focusing in this subsample, it is clearer that supermarkets, hypermarkets and independent C&C warehouses are more likely to generate a pro-competitive results. This is not the case for adjacent C&C warehouses, where the estimate is close to zero and not significant.

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Table 9: Results probit models

	Pr(ΔHHI < −150) (1)		Pr (ΔHHI > 150) (2)		Pr(ΔHHI < 0 │ |ΔHHI| > 150) (3)	
	(a)	(b)	(a)	(b)	(a)	(b)
B&M	0.285		-1.982***		1.873***	
	(0.176)		(0.299)		(0.337)	
C&C	-0.603***		-1.911***		1.189***	
	(0.178)		(0.303)		(0.344)	
super		0.120		-2.219***		1.968***
		(0.185)		(0.309)		(0.347)
hyper		0.619***		-1.566***		1.530***
		(0.190)		(0.311)		(0.347)
adj. w.		-1.448***		-1.587***		-0.0002
		(0.215)		(0.314)		(0.388)
ind. w.		-0.165		-1.931***		1.420***
		(0.185)		(0.313)		(0.355)
Observations	2,475	2,475	2,264	2,264	1,150	1,150
Log likelihood	-1510.20	-1438.93	-725.66	-703.05	-551.06	-518.78

Notes: This table shows the results of the Probit models (Equation 5). Columns 1 and 2 show the probability to observe a large decrease (increase) in local market concentration upon the entry of a store. Column 3 shows the probability that an entry generates an increase in concentration, conditionally on producing a big change upon entry. We control for chain and time fixed effects, as well as for the degree of urban density. In all cases, we only keep markets that have a concentration level higher than 2000 after entry. Surface areas for warehouses are weighted by a factor w=0.7.

Based on these results, and considering that C&C openings generally do not decrease local concentration as much as new B&M stores do, it seems justified to align the entry regulations for C&C stores with those already imposed on B&M stores. However, the impact of these regulations on local competition varies due to the different entry ef-

fects caused by various C&C formats. Specifically, our findings indicate that restricting the establishment of adjacent warehouses may have prevented an increase in local concentration. In contrast, hindering the opening of independent warehouses might have discouraged entries that could have otherwise reduced local concentration, potentially enhancing competition. Nevertheless, our results in Section 4 illustrate that both types of warehouses were significantly affected by the ALUR law.

7 Conclusion

In light of the rapid expansion of online grocery shopping and C&C services[40], which currently operate with minimal regulation compared to traditional retail grocery formats, national authorities are increasingly scrutinizing these emerging formats. In France, the ALUR law represents the pioneering effort to regulate grocery e-commerce by overseeing the establishment of C&C warehouses, aiming to foster sustainable development in the sector.

Our study provides a comprehensive empirical evaluation of the ALUR law's economic impact on the industry, and it is, to the best of our knowledge, the first attempt to analyze regulatory effects on C&C services. Using data on retail store entries and French households' food expenditures, we assessed how the ALUR law influenced the expansion of C&C warehouses and the growth of C&C revenues, focusing particularly on the leading retail chains in the C&C format.

Our findings indicate a substantial reduction in warehouse openings by these key retailers following the implementation of the ALUR law, with decreases of approximately 60% and 90%, respectively. This decline encompasses all warehouse formats, whether independent or adjacent to a retail store. Moreover, our analysis suggests that the ALUR law contributed to a notable deceleration in C&C revenue growth for these retailers, likely due to the reduced establishment of new warehouses. Specifically, we observed a significant revenue loss amounting to approximately 5% of C&C revenues.

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[40]For instance, in 2021, C&C services accounts for 39% of online grocery shopping in Germany (see https://www.statista.com/statistics/1288788/sustainable-e-commerce-packaging-germany)

Furthermore, our study highlights the regulatory impact on local market competition. We found that while the ALUR law constrained the expansion of C&C services overall, the entry of adjacent C&C warehouses appeared to potentially threaten local competition, whereas independent C&C warehouses tended to stimulate competition. This nuanced effect underscores the importance of differentiating between these types of warehouse entries when formulating regulatory policies.

Additionally, the regulatory landscape may have broader implications for the retail sector's market structure, particularly affecting traditional B&M stores. Retail chains stand to benefit from offering online grocery services if the expansion of their market share outweighs any potential cannibalization effects on their B&M operations.[41] Our study refrains from exploring retail chains' strategies regarding B&M stores, emphasizing the need for future research to delve deeper into the competitive dynamics generated by e-shopping in retail and its implications for consumer welfare.

In conclusion, our empirical analysis of the ALUR law sheds light on its significant impact on the C&C sector in France, offering valuable insights into how regulatory measures influence market competition and economic outcomes. This research underscores the evolving regulatory landscape of online grocery services and calls for continued investigation into their broader implications for retail markets and consumer behavior.

Our article does not address several dimensions of the regulation on online grocery services, such as land use, traffic or employment. For instance, in 2020, members of the Senate proposed implementing taxes or fixing prices for deliveries to internalize the environmental impact of delivery services and their effects on convenience stores.[42] Including these dimensions poses a challenge for future research.

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[41]Gielens et al. (2021) suggest minimal cannibalization effects within retail chains, but market expansion may impact competition among retailers and the performance of rival B&M stores.

[42]see https://www.strategie.gouv.fr/publications/un-developpement-durable-commerce-ligne

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8 Appendix

Figure 5: Number of stores per chain and format (2017)
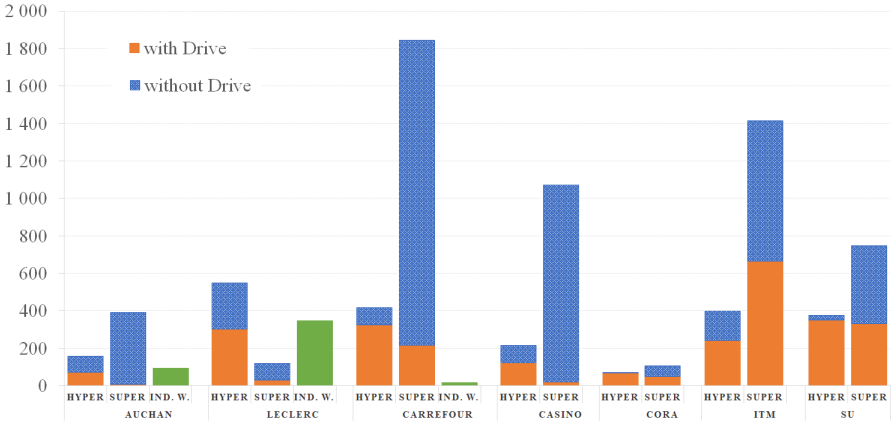
Notes: This figure shows the number of stores per chain and format. We exclude the few C&Cs that are adjacent to hard-discounters.*Source:* Nielsen TradeDimension.

Table 10: C&Cs per format in 2017

	# of C&Cs	%
Adjacent without warehouse	2,257	75%
Adjacent with warehouse	302	10%
Independent warehouse	450	15%
Total C&C	3,009	

Notes: This table shows the total number of C&Cs per format. The number of adjacent C&Cs only include those that are adjacent to supermarkets and hypermarkets (we exclude the few C&Cs that are adjacent to hard-discounters). *Source*: Nielsen TradeDimension.

Table 11: Evolution of C&C openings: raw data

	# pre	# post	# pre/sem.	# post/sem.	%Δ
Auchan ind. w.	71	4	7.1	0.66	-90%
Leclerc ind. w.	224	69	22.4	11.5	-49%
Auchan adj. w.	52	3	5.2	0.5	-90%
Leclerc adj. w.	155	31	15.5	5.16	-50%

Notes: This table shows the percentage change on the number of new C&C warehouses created before and after the law. The pre-period includes 10 semesters, from 2009-I to 2013-II, and the post-period includes 6 semesters, between 2014-II to 2017-I. We exclude the first semester of 2014 since the ALUR law was introduced in March of 2014. *Source*: Nielsen TradeDimension.