Click & Collect Entry Regulation in the Grocery Retail Sector

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Abstract

Click-and-collect (C&C) services have rapidly expanded in the grocery retail sector, with consumers and retailers increasingly preferring them over delivery services. In France, the rise of C&C points 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 opening of C&C warehouses. Using a difference-in-differences approach, we find that the legislation significantly hindered warehouse openings for the two leading retail chains. While the regulation similarly reduced the openings of both independent and adjacent warehouses, we show that independent warehouses are more likely to reduce local market concentration than adjacent ones. As a result, the law may have inadvertently harmed 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 making up 7% of the market[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] This is partly due to the last mile problem (Gielens et al., 2021), wherein consumers demand free and fast delivery despite the considerable expenses it represents for retailers (see also Chintagunta et al. (2012)).

In response, many retailers have introduced Click-and-collect (C&C) services, enabling customers to make online purchases and pick them up at designated locations and times. Various retailers are rapidly building new fulfillment points by either expanding their stores or by constructing stand-alone facilities. 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.[3]

In France, this C&C service is called "Drive," and it has shown more success than grocery delivery services. In 2018, C&C sales represented 81% of online grocery sales against 19% for home delivery.[4] French retail groups differ in their development strategies for

[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] As of November 2023, Amazon has expanded 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] Source: https://www.nielsen.com/fr/fr/insights/news/2018/grande-consommation-e-commerce-la-france-championne-europe.html (last retrieved in September 2018). 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 10.7% for an average online order with home delivery and 13.8% for an order with pickup services.

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

Although the expansion of certain C&C formats involved the construction of dedicated warehouses, it was initially exempt from existing commercial planning regulations. National authorities began scrutinizing online shopping largely due to the "anarchic" proliferation of warehouses. In March 2014, the *loi Accès au Logement et à un Urbanisme Rénové* (2014-366-03/24/2014), henceforth referred to as the ALUR law, introduced a requirement for C&C warehouse openings to be approved by regional zoning boards (*Commission départementale d'aménagement commercial* (CDAC)).[5] These boards were first created in the 1970s to control the spread of big-box retailers, which were considered a threat to mom-and-pop stores. To this day, the establishment or extension of B&M stores exceeding 1,000 m^2 in size still requires CDAC approval.[6]

The ALUR law was largely motivated by land use and sustainable concerns, but it also has economic implications for retailers and consumers. This paper aims to measure the effect of the law on the development of C&C warehouses and the performance of retailers that invested in this format. It also investigates its potential effect on local competition.

First, 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 de-

[5]The CDAC is composed of six permanent members, including experts in consumer protection and sustainable development, typically from fields such as sociology, economics, geography, and environmental protection. Local elected officials, such as mayors and representatives from inter-municipal public institutions, also participate. In addition to the six permanent members, five others are appointed on a case-by-case basis, depending on the project, with provisions for interdepartmental or cross-border initiatives.

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

creased 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 analyze how the ALUR law affected Auchan's and Leclerc's openings compared to other retail chains and formats not subject to the law.[7] Additionally, we analyze its effect on the evolution of these retailers' revenues by using information on households' purchases from the Kantar Worldpanel dataset.

Second, to better understand the potential law's impact on competition, we analyze how the entry of C&C warehouses affects local market concentration. For this, we again use the Nielsen dataset, which also provides information on location and facilities' size, to define catchment areas around each warehouse and B&M store. We then estimate changes in the Herfindahl-Hirschman Index (HHI) resulting from new entries, using surface areas as a proxy for sales.

Our results show that the ALUR law had a significant negative impact on the opening of C&C warehouses: a 90.6% reduction for Auchan and a 61.4% reduction for Leclerc. When distinguishing between formats, adjacent and independent warehouses for both Auchan and Leclerc together, we find a 65.3% decline for independent warehouses and a slightly larger reduction (72.7%) for those adjoining a B&M store. These effects remain robust even after accounting for the potential market maturity, which could also contribute to a slowdown in C&C warehouse expansion and bias our estimates. In terms of retailer performance, we find that the legislation also affected revenue growth, with C&C revenue declining by approximately 5% for both retail chains.

Regarding competition, our findings suggest mixed effects of regulating C&C warehouse entry. On one hand, restricting adjacent warehouses may have prevented further market concentration, potentially avoiding price increases. On the other hand, limiting the opening of independent warehouses may have blocked new entries that could have increased competition and lowered prices. Despite their differing competitive impacts,

[7] 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.

both formats were significantly 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.

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 has not been studied before. Our article contributes to this literature by examining the effects of entry regulation on the evolution of online formats and the interplay with traditional (offline) shopping.

Our study also contributes to the literature on online grocery shopping. Regarding C&C services, Gielens et al. (2021) study 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 harm 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 (near-store) warehouses affect local competition.

To assess the potential impact of C&C entry on local competition, we draw upon existing literature examining the relationship between supermarket entries or mergers and retail price changes. First, various studies have found that the entry of Wal-Mart stores generally leads to price reductions (Hausman and Leibtag, 2007; Basker, 2005; Basker and Noel, 2009). Second, research on supermarket mergers suggests that such consoli-

dations drive the local concentration index and prices upward (Hosken et al., 2018; Allain et al., 2017; Rickert et al., 2021; Smith, 2004). A study by Hosken et al. (2016) integrates these two strands of literature by comparing price variations resulting from new market entries with those caused by horizontal mergers in the supermarket sector. Their findings reveal that price changes in both cases are of similar magnitude.

Given the well-established link between changes in local concentration and retail prices, and the absence of retail price data, we focus our analysis on the impact of C&C warehouse and brick-and-mortar store entries on local concentration. Our contribution to this literature lies in offering a new perspective: we show that different store formats are likely to have distinct effects on local market concentration.

This article is organized as follows. Section 2 provides an overview of the French grocery retail sector and the ALUR law. Section 3 describes the data. Section 4 outlines our empirical strategy and presents the main results on the law's impact on C&C entry and retailer performance. Section 5 examines how C&C warehouse openings affect local market concentration. Finally, we conclude in Section 6.

2 The French grocery retail sector and its entry regulation

2.1 Industry background

The French B&M grocery market primarily consists of four store types: hypermarkets (over 2,500m^2), supermarkets (400–2,500m^2), convenience stores (under 400m^2), and discount stores, which are compact supermarkets offering limited goods at lower prices. The sector is dominated by seven major retail chains: Auchan, Carrefour, Casino, Cora, Intermarché, Leclerc, and Système U. These traditional chains mainly operate supermarkets and hypermarkets, with the former being more common for most, except for Leclerc, which has more hypermarkets. The discount segment is led by German chains Aldi and Lidl.[8]

[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 the 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 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 6 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.

[9] Source: Kantar Worldpanel, 2021

[10] Source: Kantar Worldpanel, 2017.

[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.

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] 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 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 regu-

[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

[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).

lation 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 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 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

We use store-level data from Nielsen (Panorama - TradeDimension), a company specializing in retail data collection, for the year 2017. This dataset encompasses comprehensive information on all retail stores operating in France, including their format (supermarket, hypermarket, hard discounter, C&C), location, opening date, and surface area

[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 adjacent 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.

(in m^2). We use these data to 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. We also observe their type (with or without a 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 not subject to the ALUR law, i.e., C&Cs without warehouses, also slowed down two years before the law came into force. This pattern suggests that C&C expansion may have reached a certain level of maturity after years of dynamic growth. Additionally, the post-2014 slowdown in C&C warehouse openings could be linked to their lower profitability. Our objective is to empirically assess the causal impact of the law on the decline in C&C warehouse openings.

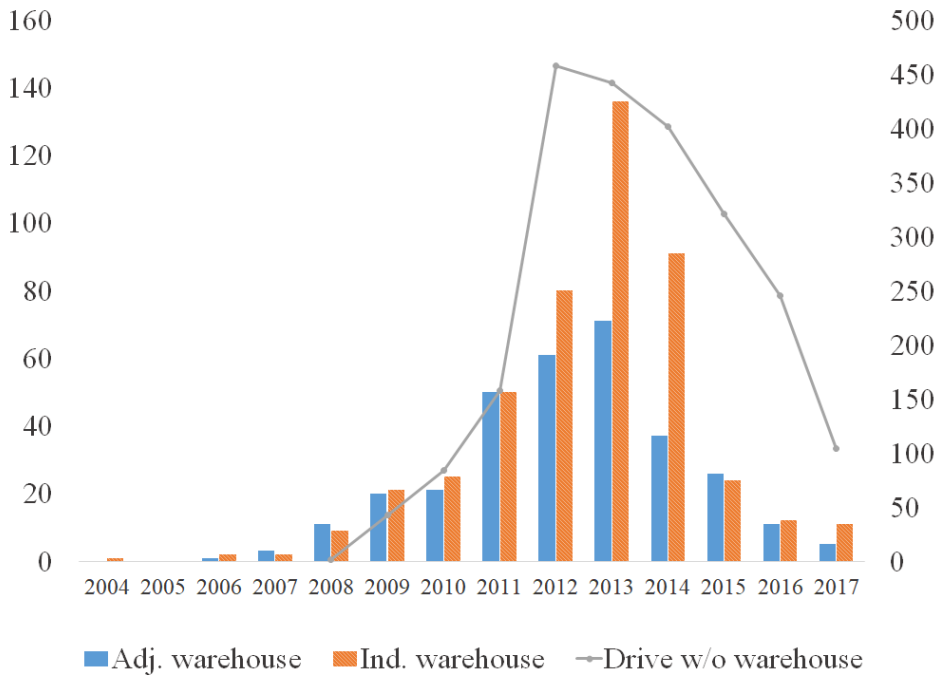
As previously mentioned, Leclerc and Auchan are particularly exposed to the effects of the law due to their focus on opening C&C warehouses. Given the differentiated strategy among retailers, we conduct our analysis at the chain level. Moreover, recognizing that chains may vary their entry strategies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

In addition to Nielsen TradeDimension, we use the Kantar Worldpanel database (2009-

[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 of products, while discounters primarily focus on private labels.

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

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 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.

2017), which provides regionally representative data on household food expenditures. This dataset allows us to estimate retailers' revenue by format, including supermarkets, hypermarkets, and online sales. Kantar data has lower granularity compared to Nielsen TradeDimension as it does not distinguish between C&C and delivery services for online purchases. However, given that 80% of online revenue during our study period came from C&C, we believe this information is a reasonable proxy for C&C revenue.

More specifically, we use Kantar data in two ways: (i) to construct control variables for our robustness checks (Section 4.3) and (ii) to complement our main analysis by estimating the effect of the ALUR law on the C&C revenue growth (Appendix D). A detailed description of the Kantar dataset and its main summary statistics is provided in Appendix B.

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. Our robustness checks are summarized in Section 4.3. Finally, Section 4.4 briefly presents the effects on retailers' performance.

4.1 Identification strategy

Sample selection. We use data on the number of new stores opened 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 throughout our study period, resulting in a final sample of 12 regions ($\mathcal{R}$=12).

We focus on 5 retail formats ($\mathcal{I}$=5): two B&M store types (hypermarkets and super-

Table 1: 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 in March 2014. *Source*: Nielsen TradeDimension.

markets) and three C&C formats (without warehouses, adjoining warehouses, and independent warehouses). Our dataset includes 8 retail chains (C=8), comprising the seven major retailers discussed in Section 2.1 -Auchan, Carrefour, Casino, Cora, Intermarché, Leclerc, and Système U- as well as smaller retailers that are grouped under "Others". We have 192 observations per retail chain and format ($\mathcal{R} \times \mathcal{T}$ = 192), amounting to a total of 7,680 observations across all retailers and formats ($\mathcal{R} \times \mathcal{T} \times C \times \mathcal{I}$ = 7,680). However, our final sample varies across regressions, reflecting differences in the composition of treatment and control groups. The selection process for both groups is detailed below.

Table 1 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 1 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 the causal effect of the law on Auchan and Leclerc only. In other words, Auchan's and Leclerc's warehouses constitute our treatment group.

Treatment and control groups: Parallel trend tests. Since the ALUR law regulates the entry of C&C warehouses, both independent and adjoining a B&M store, we analyze four cases. The first two examine the effect at the retailer level, where the treatment groups consist of C&C warehouses of 1) Auchan and 2) Leclerc. The next two cases assess the law's impact at the format level for both retailers combined: 3) adjacent warehouses and 4) independent warehouses. The remaining three formats (C&Cs without warehouses, hypermarkets, and supermarkets) were not subject to the ALUR law and are therefore potential candidates for the control groups.

Table 2 provides an overview of the total number of store openings per format, both before and after the law's implementation. Among the formats that could belong to the control group, there is a significant increase in the openings of C&Cs without warehouses, which typically have lower opening costs. Given that the pre-treatment period spans 5 years and the post-treatment period covers 3 years, we observe that the yearly average number of new C&Cs without warehouses increased by 50%, while the openings of hypermarkets and supermarkets saw slight declines of approximately 6% and 9%, respectively. This trend suggests a shift toward 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%.

To determine suitable control groups for each treatment, we evaluate various combinations of unaffected 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 a Poisson regression using pseudo maximum likelihood (PPML) with multiple high-dimensional fixed effects (Correia et al. (2020), Correia et al. (2021)). Unlike log-linear models, which are commonly used in empirical studies even for count data, PPML

Table 2: Number of store openings

	Treated		Potential control groups			
	Auchan + Leclerc		Other retail formats			
	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 treated and (potential) control groups, before and after the implementation of the ALUR law.*Source*: Nielsen TradeDimension.

estimation naturally accommodates many zero values in the dependent variable. Additionally, it requires minimal assumptions about the data distribution.[21] The estimating equation is as follows:

$$\mathbb{E}\left(n_{icrt}|\,\mathrm{X}\right) = \exp\left(\beta_t \mathrm{T}_{ic} + \theta_t + \theta_i + \alpha_c + \eta_r\right) \tag{1}$$

where n_{icrt} denotes the number of stores of format $i \in \{1, ...,\mathcal{I}\}$ and chain $c \in \{1, ...,C\}$ 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. $\beta_t \mathrm{T}_{ic}$ represents the interaction between time fixed effects and our treatment variable. The estimated β_t after the treatment event occurs capture the dynamic effects of the treatment as these effects unfold over time since the event. In the absence of anticipation effects, model misspecification, or omitted confounding variables, the pre-event β_t should not show a trend before the event time. In other words, it is essential that the estimated β_t are not significantly different from zero before the ALUR law.

To control for shocks that may similarly affect the creation of stores, X also includes time (θ_t), format (θ_i), chain (α_c), and regional fixed effects (η_r). Finally, to address po-

[21] The Stata command used for the estimation is `ppmlhdfe`.

tential serial autocorrelation in entry decisions, we employ a cluster-robust inference procedure at the region-chain level.[22]

Figure 2 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 warehouses. 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 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 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, suggesting 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, including a combination of C&C without warehouses and B&M stores in our control groups offers several advantages. First, incorporating C&Cs without warehouses helps control for demand shocks or overall demand trends (i.e., global maturity) in C&Cs that could otherwise bias the estimated causal effect of the law. For instance, as the

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

C&C format matures, there might be a natural slowdown in demand across all types of C&Cs. Thus, including C&Cs without warehouses in the control group helps mitigate any potential upward bias in the estimated causal effect of the law.[23]

Additionally, including B&M stores in our control group helps account for supply-side shocks affecting retailers' profits. For example, a rise in building costs could impact the profitability of both C&Cs with warehouses and B&M stores, while C&Cs without warehouses might remain unaffected. Hence, incorporating B&M stores mitigates potential upward bias in the estimated causal effect of the law. Finally, similar to C&Cs with warehouses, B&M store openings do not indicate that retailers substituted warehouses by opening new supermarkets or hypermarkets. On the contrary, these formats remained stable or experienced a slight decline after the law's implementation.[24]

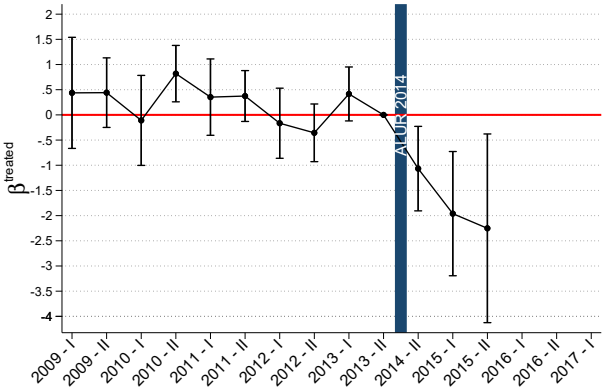
Key identifying assumptions. Our main identifying assumption is that, in the absence of the ALUR law, the openings of C&Cs would have evolved similarly between the treatment and control groups for each case – Leclerc, Auchan, adjacent warehouses, and independent warehouses. It is important to note that some shocks may have occurred at the same time as 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 buyer alliances were created between: (i) Carrefour and Cora, (ii) Système U and Auchan, and (iii) Intermarché and Casino. This is not a concern for our study because any effect of buyer alliances on retailers' supply costs would be independent of store formats.

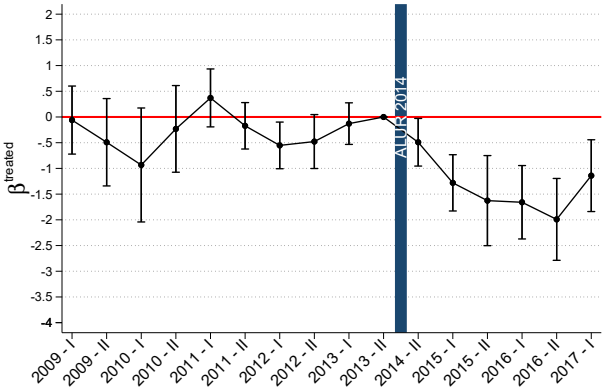
[23] In cases where C&Cs without warehouse are not included in the control group, part of the decline observed in C&Cs with warehouses -attributed to the ALUR law- may actually be driven by the maturity of the C&C format. This motivates the use of C&C revenue in our robustness checks.

[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.

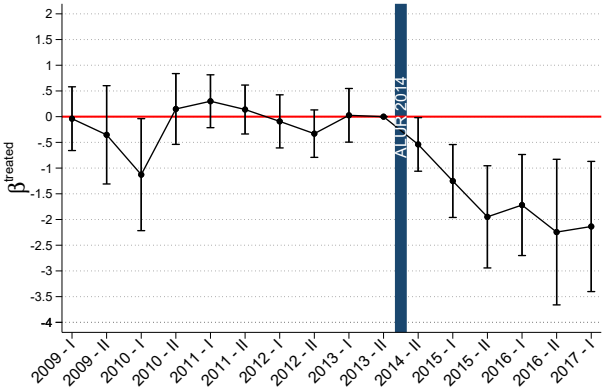
Figure 2: Event studies



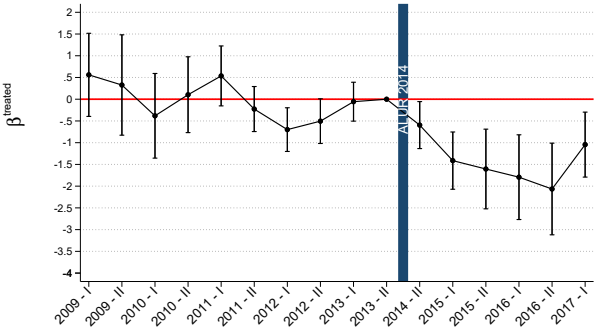
(a) Auchan



(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 warehouses. 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.

4.2 Average treatment effect

We now estimate the average causal effect of the ALUR law on the opening of C&C warehouses for each treatment group using a PPML difference-in-differences regres-

sion. 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:

$$\mathbb{E}\left(n_{icrt}|\,\mathrm{X}\right) = \exp\left(\beta\,\mathrm{T}_{ic} \times \mathrm{Post}_t + \delta\,\mathrm{T}_{ic} + \gamma\,\mathrm{Post}_t + +\theta_t + \theta_i + \alpha_c + \eta_r + Z_{crt}\right) \tag{2}$$

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

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 (θ_i), chain (α_c), region (η_r) and time (θ_t) fixed effects. 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.

Our parameter of interest, denoted by β, represents the average effect of the treatment. The results of the DID estimation at the chain level are presented in columns (1) and (2) of Table 3. 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 by 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 warehouses. 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 suggest a significant decrease in warehouse openings for both types of warehouses (independent and adjacent) following the introduction of the law. The estimated magnitudes align with the trends observed in the raw data (refer to Table 7 in the Appendix A for supporting evidence).

Table 3: 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	4,992	3,456	4,992	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 of B&M stores and C&Cs without warehouses, as indicated in Figure 2. We also control for chain, format, region, and time-fixed effects. Standard errors are clustered by region and chain. *** indicates significance at the 1% level. $\Delta\% = \exp(\beta) - 1] \times 100$. The number of observations varies for each regression because they correspond to the treated and control groups. As mentioned, each retail chain has 192 observations per format (12 regions×16 semesters). In the first column, for example, the treated group consists of Auchan's independent and adjacent warehouses (192×2 = 384), and the control group includes hypermarkets, supermarkets, and C&Cs without warehouses (3 formats×8 chains×192 observations = 4,608). The total number of observations used in this regression equals 4,992. Finally, the last regression, column (4), drops 192 additional observations to correct for the issue of separation in Poisson models (see Correia et al. (2021) for more information).

4.3 Robustness checks

We extend our analysis by introducing several controls, denoted Z_{crt} in Equation 2, to account for possible confounding factors influencing the growth of C&Cs. A detailed description of the construction of these control variables and their impact on the results is provided in Appendix C.

Maturity effect. A slowdown in C&C entry could indicate that the service has reached maturity, making further expansion less profitable for retailers. To assess the evolving importance of C&C services in retailers' revenues, we use Kantar Worldpanel data to compute the C&C revenue share relative to total revenues at the chain, region, and semester levels. To mitigate endogeneity concerns —where demand shocks influence both entry and revenues— we use the average C&C revenue share across all regions where the retailer operates, excluding the region under study, as a control. This approach helps capture variations in profitability across regions and over time. Our results remain robust even after incorporating this additional control, confirming the validity of our findings.

Saturation ratio. The expansion of C&Cs adjoining a store, with or without warehouses, depends on the existing stock of hypermarkets and supermarkets within each retail chain. While the availability of B&M stores may facilitate or constrain C&C entry, independent warehouses are not subject to the same limitations.

To account for the capacity of firms to establish new C&Cs near existing stores, we construct variables that measure the available retail capacity at the chain (c), region (r), and time (t) levels. The inclusion of these controls does not alter our main results.

4.4 Effects on C&C revenue

According to Gielens et al. (2021), C&C services enhance consumers' shopping convenience compared to B&M stores by facilitating search (online search), providing pick-up services, and improving accessibility. This ease of access is particularly important for

independent warehouses due to their strategic locations. The added convenience reduces both fixed and variable shopping costs for consumers, leading to higher household adoption of this format, increased spending, and more frequent visits to retailers (Bronnenberg (2018); Bell et al. (1998)). As a result, the expansion of C&Cs is likely to improve firms' performance, and the law may have influenced the rate of revenue growth generated by this format.

Using a DID approach, we indeed find that C&C revenue growth declined by approximately 5.3% for one retailer (either Auchan or Leclerc), and 4.3% for the other. Due to data confidentiality, we are unable to disclose the specific identities of the affected retailers. A detailed discussion of our methodology is provided in Appendix D.

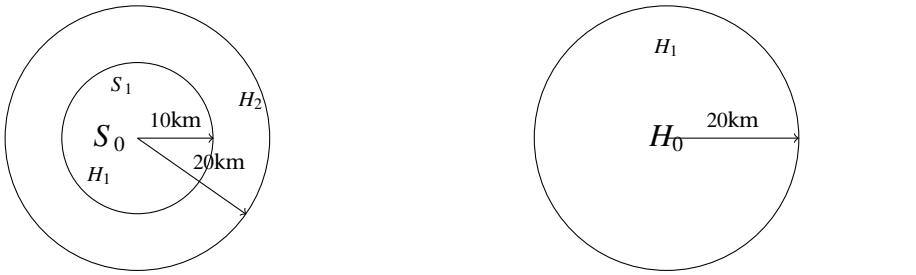
5 The competition effect of warehouses' entry

Our previous analyses have demonstrated the ALUR law's significant impact, notably in decreasing the entry of both independent and adjacent warehouses. We now turn to exploring the potential unintended effects of the law on competition.

As previously mentioned, the ALUR law imposes entry restrictions without explicitly addressing competition. However, store openings impact local competition and, in turn, prices. The introduction of C&Cs could enhance competition by offering consumers new shopping alternatives, intensifying rivalry, and lowering prices. In this case, restricting C&C entry and expansion might unintentionally hinder competition. Conversely, if a new warehouse strengthens a retail chain's local market share, it could increase concentration and drive prices up, making entry regulations beneficial.

Many articles have demonstrated the link between an increase in local concentration index, after a retail merger, for instance, and retail prices rise (Hosken et al., 2016; Rickert et al., 2021; Smith, 2004). Hosken et al. (2016) has shown that variation in local concentration triggered by supermarket entry or merger would have similar effects in terms of magnitude on retail prices. Based on this literature and given that we lack data on retail prices, we proceed to analyze how C&C warehouses and B&M store entries impact the local HHI index (using the surface of warehouses/ stores as a proxy for sales). We then

Figure 3: Catchment areas for rural markets



S={Super, C&C adj. super} H={Hyper, C&C adj. hyper, ind.w.}

Notes: This figure illustrates how catchment areas are formed in rural markets. Depending on the format of the focal point, concentric circles are drawn to calculate changes in concentration. For example, if the focal point is a C&C adjacent to a supermarket, two concentric circles are drawn. The first circle includes all competing formats within a 10km radius. The second circle includes only larger formats as potential competitors, such as hypermarkets, C&C warehouses adjacent to hypermarkets, and independent warehouses, within a 20km radius.

infer the potential and heterogeneous effects of all the store formats on local prices.

Section 5.1 outlines our methodology for calculating the influence of entries on the Herfindahl-Hirschman Index (HHI) at the local level. Section 5.2 discusses the potential side effects of the regulation on competition.

5.1 Catchment area definition and HHI computation

To compute changes in local market concentration triggered by an entry, our first step is to determine the relevant catchment area for each retail format. This involves identifying the set of stores that compete 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 analyze merger cases in the grocery retail sector. If the focal point is a supermarket, the relevant catchment area consists of two concentric circles around 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.[25]

In the absence of any specific references regarding C&C warehouses, we follow the same definition as that for B&M stores, depending on the characteristics of the warehouse.[26] 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.[27]

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.[28] For a 30-minute drive, this corresponds to a radius of 5km, 10km, and 20km for urban, semi-urban and rural areas, respectively. For a 15-minute drive, we define a radius of 3km, 5km, and 10km for urban, semi-urban, and rural areas. Figure 3 illustrates the case for rural catchment 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. 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

[25] *Lignes directrices de l'Autorité de la concurrence relatives au contrôle des concentrations*, 2020, p.141,https://www.autoritedelaconcurrence.fr/sites/default/files/Lignesdirectricesconcentrations2020.pdf.

[26] The French competition authority stipulates in its guidelines (Annex D) that the competitive pressure exerted by online sales on B&M stores should be considered homogeneous across the entire national territory. However, if this definition makes sense for pure online players, this is not appropriate for C&Cs because consumers still have to collect their baskets. The geographical market definition thus remains relevant.

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

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

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.[29] 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[30], 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.[31] 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, 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 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.

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

[30] Lignes directrices de l'Autorité de la concurrence relatives au contrôle des concentrations, p.64, 226 https://www.autoritedelaconcurrence.fr/sites/default/files/Lignesdirectricesconcentrations2020.pdf

[31] 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.

5.2 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 $\Delta\text{HHI} < -250$ ($\Delta\text{HHI} > 250$), or when the post-entry HHI is larger than 2000 with $\Delta\text{HHI} < -150$ ($\Delta\text{HHI} > 150$).[32]

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.[33]

Table 4 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 local level (in 75% of cases, with 49% having large effects) rather than dampen competition (in 25% of cases, with only 9% showing a large impact). In contrast, the entry of a C&C warehouse 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

[32] 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.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52004XC0205(02)`.

[33] 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 4: Changes in concentration induced by entry (2004-2017)

	ΔHHI < -150	$-150 \leq \Delta$HHI ≤ 150		ΔHHI > 150	Total # cases
		≤ 0	> 0		
	(1)	(2)	(3)	(4)	
B&M	870	465	275	154	1,764
super	625	442	258	78	1,403
hyper	245	23	17	76	361
C&C	166	238	220	88	712
adj. w.	16	105	106	48	275
ind. w.	150	133	114	40	437

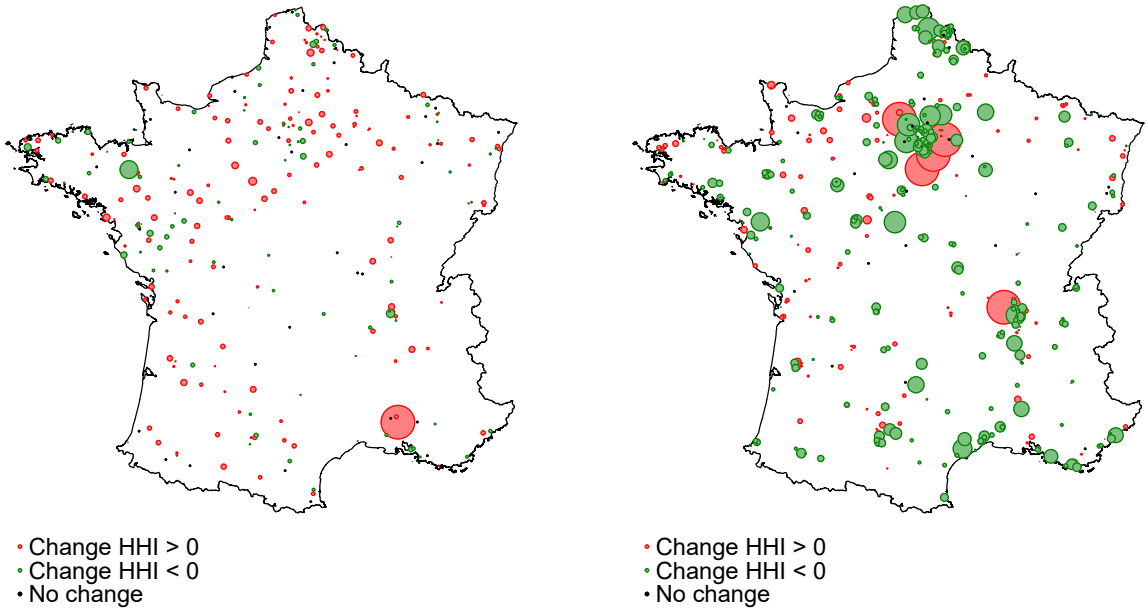
Note: This table shows the distribution of changes in the HHI level resulting from the entry of B&M stores and C&C warehouses. Our analysis focuses on markets with a post-entry HHI exceeding 2000. Surface areas for warehouses are weighted by a factor of w=0.7.

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 the large increase in market concentration is primarily driven by the entry of adjacent C&C warehouses. Specifically, 17% of the total number of adjacent warehouses that entered the market caused a large positive change in the HHI, compared to only 6% which produced a large negative decrease. In contrast, among independent warehouses, 34% of entries led to large decreases in concentration, while only 9% resulted in substantial increases.

Figure 4 illustrates the distribution of changes in concentration resulting from warehouse entries across the French territory. The red circles represent cases where entry caused an increase in concentration, while the green circles indicate instances where entry led to a decrease in concentration. The size of the circles is proportional to the magnitude of changes in the HHI. As we can observe, green circles are more prevalent and larger for independent warehouses. Furthermore, the most affected markets are ur-

Figure 4: Distribution of changes in concentration induced by warehouses' entry



adjacent warehouse

independent warehouse

Notes: This figure shows the distribution of changes in HHI for adjacent warehouses (left-hand side) and independent warehouses (right-hand side) between 2004 and 2017. The color of the circles depends on whether the changes in HHI are positive (red) or negative (green). The size of the circles is proportional to the level of the HHI changes. For example, a large green circle represents a large decrease in concentration following entry.

ban and semi-urban, due to retailers' choice location.[34] Adjacent warehouses tend to increase concentration primarily in semi-urban areas, while independent warehouses mostly decrease concentration in urban areas. Lastly, large changes are concentrated around major cities, such as Ile-de-France, Lille, Marseille, and Nice.

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 (region), d_{r_i}, 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_{ict} is a dummy equal to 1 if the entry of format i, chain c at time t produced a $\Delta\text{HHI} < -150$ ($\Delta\text{HHI} > 150$), and zero otherwise.

$$\Pr(Y_{ict} = 1) = \Phi(\text{Format}_i + \beta_c + \theta_t + \mathrm{d}_{r_i}) \tag{3}$$

Table 5 shows the results of three Probit models. Regarding the likelihood of producing a large decrease in the HHI, column (1a) shows 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 and significant at 10%. 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, while the entry of supermarkets is not. Additionally, as hinted by the results presented in Table 4, 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

[34] 62% of adjoined warehouses are located in semi-urban areas, followed by urban (26%) and rural locations (12%). For independent warehouses, 48% are located in semi-urban areas, 38% in urban areas, and 14% in rural areas.

Table 5: Results probit models

	$Pr(\Delta HHI < -150)$		$Pr(\Delta HHI > 150)$		$Pr(\Delta HHI < 0 \mid \lvert\Delta HHI\rvert > 150)$	
	(1)		(2)		(3)	
	(a)	(b)	(a)	(b)	(a)	(b)
B&M	0.292*		-1.978***		1.873***	
	(0.176)		(0.299)		(0.337)	
C&C	-0.605***		-1.914***		1.190***	
	(0.178)		(0.303)		(0.344)	
super		0.127		-2.215***		1.968***
		(0.180)		(0.309)		(0.347)
hyper		0.634***		-1.560***		1.531***
		(0.189)		(0.311)		(0.347)
adj. w.		-1.446***		-1.589***		0.0005
		(0.215)		(0.314)		(0.387)
ind. w.		-0.169		-1.937***		1.421***
		(0.185)		(0.313)		(0.354)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,476	2,476	2,265	2,265	1,149	1,149
Log likelihood	-1510.00	-1438.59	-725.80	-702.96	-550.96	-518.71

Notes: This table shows the results of the Probit models (Equation 3). Columns 1 and 2 show the probability of observing 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.

(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 most concerning due to their potential to either benefit or harm consumers, we focus on these cases and regress the likelihood of a decrease in concentration, conditional on

having produced a large change in HHI. Column 3 presents the results. By focusing on this sub-sample, it becomes clearer that supermarkets, hypermarkets, and independent C&C warehouses are more likely to generate pro-competitive outcomes. This is not the case for adjacent C&C warehouses, where the estimate is close to zero and not significant.

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 effects 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.

6 Conclusion

In light of the rapid expansion of online grocery shopping and C&C services[35], 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 expan-

[35]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)

sion 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.

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.[36] Our study refrains from exploring retail chains' strategies regarding B&M stores, emphasizing the need for future research to analyze 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

[36] 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.

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.[37] Including these dimensions poses a challenge for future research.

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

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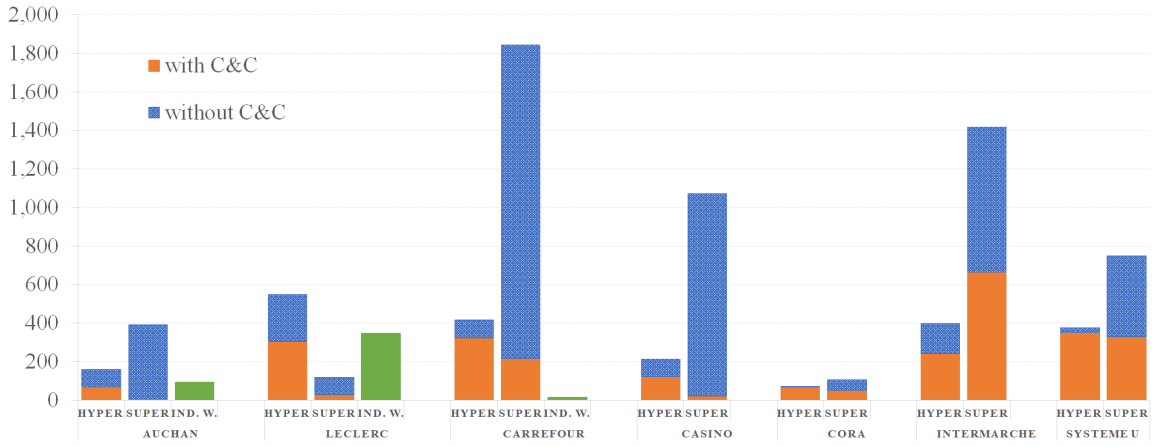
Appendix

A Additional figures and tables

Figure 5: Number of stores per chain and format (2017)



Notes: This figure shows the number of stores per chain and format. The green bars represent independent warehouses, the blue bars represent B&M stores without C&C, and the orange bars represent B&M stores with C&C. We exclude the few C&Cs adjacent to hard discounters. *Source:* Nielsen TradeDimension.

Table 6: 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 includes those that are adjacent to supermarkets and hypermarkets (we exclude the few C&Cs that are adjacent to hard discounters). *Source*: Nielsen TradeDimension.

Table 7: 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 in 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.

B Kantar Worldpanel database

To estimate the impact of the ALUR law on retailers' performance, we use the Kantar Worldpanel database (2009 - 2017). 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 retail chains. The panel is designed to be representative at the regional level for each semester.

One drawback of the Kantar database, compared to the store-level data provided by Nielsen, is its lower granularity for online shopping. It reports total household online expenditure without distinguishing between C&C purchases and home deliveries. However, since over 80% of online grocery shopping during our study period was through C&C, we consider total online revenues a reasonable proxy for C&C revenues. Unfortunately, we cannot further differentiate C&C revenues by type (e.g., with or without warehouses).

Table 8: Average revenue per retailer and retail format (2009 - 2017)

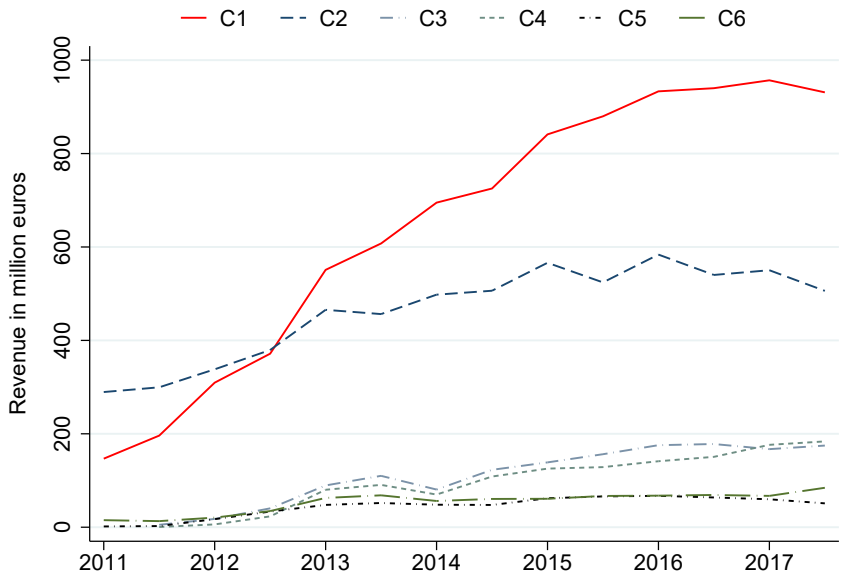
	C1	C2	C3	C4	C5	C6	C7
C&C	50.85	33.15	9.46	8.74	4.81	12.57	4.16
Hyper	571.93	276.00	428.56	130.04	85.88	176.88	122.13
Super	33.20	81.38	276.03	326.47	47.84	161.38	105.13

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

Table 8 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

Figure 6: Evolution of C&C revenues per retailer



Notes: This figure shows the evolution of C&C revenues for food products per chain from 2011 to 2017. *Source:* Nielsen TradeDimension.

instance, average revenues from C&Cs range from 4.16 to 50.85 million euros. Notably, retail chain C1 generates 50% more revenue 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 6). 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.

C 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:

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

where C is the total number of retail chains, and J is the total number of formats for which we have revenue data ($J = 3$, $j \in \{\text{C\&C, Super, Hyper}\}$). 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 establishment of C&Cs adjacent to a store, with or without warehouses, is shaped by the existing network of hypermarkets and supermarkets within each retail chain. 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 warehouses within a hyper and a super, respectively. Similarly, we define $2h$ and $2s$ for warehouses adjoining a hypermarket and a supermarket. Using these format classifications, we construct the variable $stock^i_{crt}$, which counts the number of stores of each format for each chain and region over time. Based on this, we compute the following saturation ratios:

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

Based on the premise that the saturation effect only plays a role when capacity is constrained, we construct a variable that assigns the value of zero when $\text{Sat}^{h}_{crt} \leq 0.75$ (resp. when $\text{Sat}^{s}_{crt} \leq 0.50$), and retains the actual value otherwise.[38] We interact this variable with a dummy equal to one for C&Cs adjoining a hypermarket (resp. supermarkets), as 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's gap realistically represents the delay between firms' decision to open a store and its actual opening. In doing so, we also avoid reverse causality problems between the number of openings at date t and the variable $stock^{i}_{crt}$ in the same period. Finally, we control for non-linear effects of the saturation ratios by using their squared values.

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 9. For ease of comparison, we present our baseline results in column (B). Column (B+ShareC&C) presents the 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.

The 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 the format level, the impacts of the ALUR law on adjacent and independent warehouses are more similar in magnitude (around 70%) when both controls are added.

[38] The threshold set for supermarkets is lower than the one used for hypermarkets because the maximum saturation level reached at the regional level for supermarkets equals 0.58. In contrast, we observe full saturation ($\text{Sat}^{h}_{crt} = 1$) for hypermarkets in some regions.

Table 9: 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 3), 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$_{rt}^2$ to our baseline. Model (B+Sat) adds variables related to the saturation effect (Sat_{crt-2}^h, Sat_{crt-2}^s, $(\text{Sat}_{crt-2}^h)^2$, $(\text{Sat}_{crt-2}^s)^2$). 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.

D Effect of the ALUR law on retailers' performance

This section studies the impact of the ALUR law on the revenues generated by C&Cs for the two leading retailers. We cannot directly observe retailers' profitability but we can use revenues as a measure of performance. We follow a similar approach and estimate the ATE of the ALUR law on the retailers' C&C revenues using a DID approach.

D.1 Identification strategy for the DID analysis on revenues

Sample selection To analyze 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 Section 4.1. We have the same number of regions, $\mathcal{R}$=12, 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 which corresponds to the semester of the introduction of the law. We also remove smaller retailers, that were grouped under "Others", from the control group.

Regarding stores' format, we have a total of $\mathcal{J}$=3 formats, where $j \in$ {C&C (online), super, hyper}.

C&C format includes independent warehouses, warehouses adjoining supermarkets and hypermarkets, and C&Cs without warehouses. Given the confidentiality of data, we cannot provide the names of retail chains.

To reflect the changes in revenue growth of C&Cs, we compute the difference in online revenues from one semester to another for all retail chains, $c = 1, ..., C$, across regions, $r = 1, ..., \mathcal{R}$, and periods $t = 5, ..., \mathcal{T}$. This change is denoted ΔC&C Rev$_{crt}$ = C&C Rev$_{crt}$ − C&C Rev$_{crt-1}$.

Test of parallel trend assumption C1 and C2 constitute the treated groups since their C&C strategies rely on warehouses, making them subject to the ALUR law. In contrast, other retail chains, which primarily expand C&C without warehouses, serve as suitable candidates for 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 8, it is challenging to compare revenues across store formats since C&Cs represent only a small fraction of the total retail chains' revenues.[39]

We test for the parallel trend assumption using an event study approach, similar to our DID analysis on entry. 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:

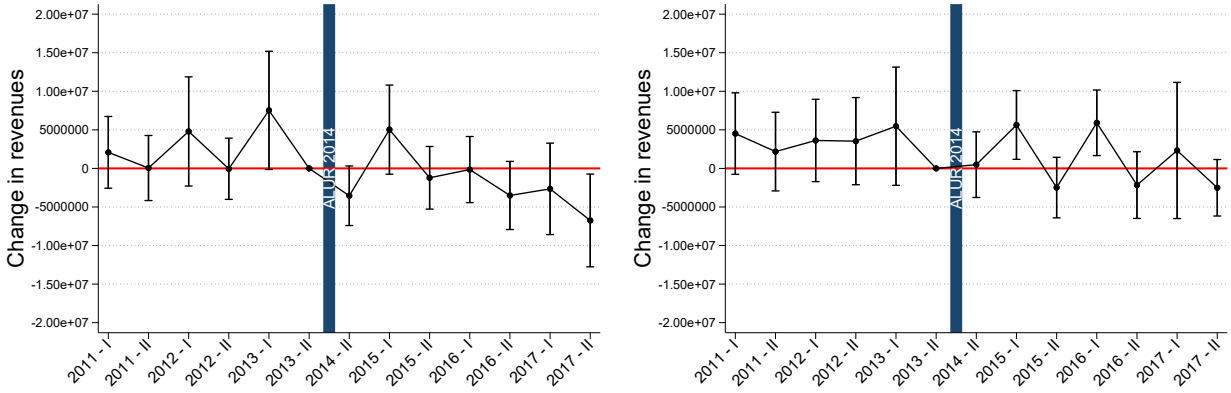
$$\Delta\text{C\&C Rev}_{crt} = \alpha + \gamma_t \text{T}_c + \mu_c + \theta_t + \mu_r + \varepsilon_{crt} \quad (4)$$

where ΔC&C Rev$_{crt}$ denotes the change in C&C revenues per chain c, region r and semester t. T_c is our treatment variable for C1 or C2. $\gamma_t \text{T}_c$ are the interactions between time-fixed effects and the treatment variable. We add a constant, α, and control for chain μ_c, and region μ_r fixed effects; ε_{crt} is the error term.

Results in Figure 7 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.

[39]When we tried to include B&M stores in our control group, the parallel trend requirement was not fulfilled.

Figure 7: Event studies for revenue analysis



(a) C1 (b) C2

Note: This figure shows the results of our event studies based on Equation 4. The control groups for C1 and C2 are composed of retailers who predominantly own C&Cs without a warehouse.

D.2 Average treatment effect

To analyze the impact of the ALUR law on performance, we estimate the average treatment effect of the law on the change in online revenues for retailers C1 and C2 separately, using the following equation[40]:

$$\Delta\text{C\&C Rev}_{crt} = \alpha + \beta \times \text{T}_c \times \text{Post}_t + \delta \text{T}_c + \gamma \text{Post}_t + \mu_c + \mu_r + \varepsilon_{crt}, \quad (5)$$

where ΔC&C Rev$_{crt}$ denotes the change in C&C revenues per chain c, region r and semester t. As before, T$_c$ is our treatment variable, a dummy that equals one if the retail chain $c = \{\text{C1, C2}\}$ is treated, and 0 otherwise. Post$_t$ is a dummy variable equal to 1 for semesters following the introduction of the ALUR law and 0 otherwise. 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 10 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

[40]We assess whether the law has impacted the change in C&C 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 10: DID analysis on the ALUR law

Dependent variable: revenue change (ΔC&C Rev$_{crt}$) (euros)		
	(1)	(2)
Post × C1	-3,730,879***	
	(929,231.1)	
Post × C2		-1,849,535**
		(722,072.4)
% C&C Revenues	-5.3%	-4.3%
% Total Revenues	-0.51%	-0.46%
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 of 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..

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 magnitude of the effects on revenues, we calculate the fraction that this change represents for 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, 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. Section 4.2 demonstrated that the ALUR law impacted the number of new C&C warehouse openings. We further show that it also affected the performance of retail chains in the C&C sector.