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Click-and-collect Entry Regulation in the Grocery Retail Sector

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Contents

Abstract

Click-and-collect (C&C) services have rapidly expanded in the grocery retail sector, reflecting the growing adoption of omnichannel formats that integrate online and offline operations. In France, the proliferation of C&C points raised concerns among policymakers, prompting the introduction of a new entry regulation in 2014. This article examines the impact of this regulation and it unintended effects on local competition. Using a difference-in-differences approach, we find that the legislation significantly constrained warehouse openings for the two leading retail chains. While the regulation similarly reduced openings of both independent and adjacent warehouses, we show that independent warehouses are more likely to alleviate local market concentration than adjacent ones. As a result, the law may have inadvertently affected competition in digital and physical grocery markets.

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, reshaping both consumer behaviour and retailer strategies. 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 representing 7% of the market[1]. Despite this growth, online grocery penetration remains lower than in other product categories. In France, for ex- ample, online sales account for 26% of high-tech products, 20% of home appliances, and 14% of clothing.[2] This slower adoption is partly explained by the last-mile problem (Gielens et al., 2021), whereby consumers demand fast and free delivery despite the substantial costs it imposes on retailers (see also Chintagunta et al. (2012)).

In response, retailers have increasingly adopted omnichannel strategies that integrate online and offline operations. A central example is Click-and-Collect (C&C), a format combining digital ordering with physical pick-up points. This model reflects a broader trend of online–offline integration (often described as "bricks-and-clicks"), allowing retailers to leverage existing physical networks while expanding digital sales channels. In the United States, Walmart and Kroger have been competing to expand their C&C facilities, while Amazon has recently expanded its Amazon Fresh offerings, providing pick-up services and Same-Day Delivery of fresh groceries in over 1,000 U.S. cities and towns, with plans to extend the service to more than 2,300 areas by the end of 2025.[3]

In France, the C&C service is called "Drive" and has outperformed home delivery. In 2018, C&C accounted for 81% of online grocery sales compared to 19% for home delivery.[4] French retail groups have adopted different strategies: Auchan and Leclerc primarily rely on warehouses as pick-up points, either as independent entities or adjacent to existing brick-and-mortar (B&M) stores, whereas other retailers operate in-store C&C facilities, assembling orders directly from store shelves without dedicated warehouses.

Although the expansion of some C&C formats required the construction of dedicated warehouses, these were initially exempt from commercial planning regulations. National authorities began scrutinizing online shopping largely due to the perceived "anarchic" proliferation of warehouses. In March 2014, the *loi Accès au Logement et à un Urbanisme Rénové* (2014-366-03/24/2014), hereafter the ALUR law, introduced a requirement that C&C warehouse openings receive prior approval from regional zoning boards (*Commission départementale d'aménagement commercial* (CDAC)). These boards were created in the 1970s to control the spread of big-box retailers, which were viewed a threat to small independent stores. To this day, the establishment or extension of B&M stores exceeding 1,000m2 still requires CDAC approval.[5] Since retailers were already accustomed to managing such permissions for their B&M outlets, it is not immediately clear to what

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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 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 are estimated at 10.7% for an average online order with home delivery and 13.8% for an order with pickup services.

5 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)).

extent the extension of the law to warehouses affected entry, particularly during a period of rapid C&C growth.

While primarily motivated by urban planning and environmental concerns, the ALUR law also raises questions for digital markets and competition policy. By altering conditions of entry, it may influence the growth trajectory of online formats, local market concentration, and consumer welfare. This paper evaluates both the intended and unintended consequences of the regulation, focusing on its effects on C&C warehouse development, retailer performance, and local competition.

We adopt a two-step empirical strategy. First, we exploit heterogeneity in the regulation across formats and conduct a difference-in-differences (DID) analysis to estimate the law's effect on C&C warehouse openings. We use Nielsen's Panorama-TradeDimension dataset, which provides detailed information on store and warehouse openings in France from 2009 to 2017. We compare the expansion of Auchan and Leclerc, the two main adopters of warehouse-based C&C, to other retail chains and formats not subject to the ALUR law.[6] We also assess the impact on retailer performance using the Kantar World- panel dataset.

Second, we examine the law's implications for competition by analysing how the entry of C&C warehouses affects local market concentration. Using Nielsen data on store locations and surface areas, we delineate catchment areas around each warehouse and B&M store and compute changes in the Herfindahl-Hirschman Index (HHI). To do so, we follow the methodology proposed by the French Competition Authority for assessing market concentration in merger analyses. Since Kantar data are representative only at the regional level, we use surface area as a proxy for revenue. Kantar data are instead employed to evaluate how closely surface-based market shares approximate revenue-based market shares.

Our results show that the ALUR law substantially reduced C&C warehouse entry -by 90.6% for Auchan and 61.4% for Leclerc. When distinguishing between formats, ad- jacent 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, C&C revenue growth declined by approximately 5% for both chains.

Regarding competition, our findings suggest mixed effects of regulating C&C warehouse entry. On one hand, restricting adjacent warehouses may have limited market concentration, potentially preventing price increases. On the other hand, constraining the opening of independent warehouses may have blocked new entries that could have increased competition and lowered prices. Despite their differing competitive impacts, both formats were significantly affected by the ALUR law.

Our paper contributes to the literature on policy evaluation by examining how commercial planning regulation shapes firm entry and competition, extending prior work on traditional retailing (Pozzi and Schivardi (2016)) to the context of e-commerce. While earlier studies document the effects of entry restrictions on market concentration, prices, employment, location strategies, and productivity (Bertrand and Kramarz (2002); Griffith and Harmgart (2012); Schivardi and Viviano (2010); Cheshire et al. (2015); Sadun (2015); Datta and Sudhir (2013); Maican and Orth (2015)), little is known about

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

their impact on omnichannel retailers integrating online and offline operations. By focusing on C&C format, we provide new evidence on how entry regulation affects the evolution of digital channels and their interaction with brick-and-mortar formats, with implications for competition.

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 house- holds based on their shopping characteristics. They also focus on France, with their analysis stopping in 2014, and distinguish C&C formats slightly differently: in-store, near-store, and stand-alone facilities. They find that C&C services 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 on the existing literature examining the relationship between supermarket entries or mergers and retail price changes. First, several studies find that the entry of Walmart stores leads to price reductions (Hausman and Leibtag, 2007; Basker, 2005; Basker and Noel, 2009). Second, research on supermarket mergers suggests that such consolidations increase local market concentration and drive 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 changes resulting from new market entries with those caused by horizontal mergers in the supermarket sector, showing that the magnitude of price changes is similar in both cases.

Given the well-established link between local concentration and retail prices, and in the absence of granular price data, we focus our analysis on the impact of C&C warehouse and B&M 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 presents our empirical strategy and 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 2,500m2), supermarkets (400–2,500m2), convenience stores (under 400m2), 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 super- markets 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.[7]

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%.[8] 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)).

As part of broader omnichannel strategies that integrate online and offline operations every major retail chain has introduced C&C services, which accounted 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%.[9]

C&C fulfilment formats can be categorized into three types: (i) independent ware- houses functioning as stand-alone C&C facilities; (ii) warehouses adjoining a B&M store, typically hypermarkets; and (iii) pick-up points without warehouses, where items are collected directly from store shelves, often through drive-thru areas (dedicated parking lots) where customers retrieve purchases without leaving their vehicles (Gielens et al., 2021).[10] In 2017, most C&Cs adjacent to B&M stores operated without warehouses (75%), while 10% had adjoining warehouses. Independent warehouses accounted for 15% of C&C facilities. Consequently, when considering both adjacent and independent warehouses, these online-offline integration formats represent 25% of all C&Cs, as shown in Table 7 of the Appendix.

Retail chains have pursued different strategies in developing their omnichannel net- works. Leclerc and Auchan have predominantly invested in warehouses, collectively owning 93% of adjacent warehouses and 94% of independent warehouses. In contrast, other retail chains have focused on expanding pick-up points without warehouses. Despite representing only 26% of the total number of C&Cs, Leclerc and Auchan dominate revenues, accounting for 68% of C&C sales.

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 4,500m2 surface area.[11] Conversely,

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7 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.

8 Source: Kantar Worldpanel, 2021.

9 Source: Kantar Worldpanel, 2017.

10 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.

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

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.[12] 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.[13] Assessing the profitability of C&C formats is complex, as it depends on whether they generate market expansion or merely cannibalize B&M sales within a chain (Melis et al., 2016).

2.2. The ALUR law

In France, regulation of B&M store entry has existed since the Royer Law of 1973 and has evolved over time, with the current framework established by "Loi de modernisation de l'économie" (LME) in 2008. Under this regulation, retailers must obtain administrative approval from the CDAC to open stores with surface areas exceeding 1,000m2.[14] [15]

The emergence of C&C services in the early 2000s initially faced no regulatory barriers.[16] However, their rapid proliferation raised policy concerns related to 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 20m2. 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 constrained, as they often occupied non-commercial areas with lower land costs and convenient road access. In contrast, warehouses adjacent to B&M stores were inherently located within the commercial zones of their respective stores. The law thus altered the relative entry costs of competing formats and sought to address perceived regulatory imbalances between digital formats and traditional grocery stores, which had long been subject to entry restrictions.

Overall, by raising administrative costs[17] and lengthening approval timelines, the ALUR law introduced new barriers to entry in digital grocery markets. Whether this regulation had a measurable impact-and to what extent- is ultimately an empirical question, particularly since the same retailers were already accustomed to navigating similar requirements for their B&M stores. Finally, although

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

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

14 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 1,000m2 to the approval of commercial zoning boards. This regulation was later tightened to a threshold of 300m2 by the Raffarin law in 1996. In 2008, the LME restored the threshold to 1,000m2.

15 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.

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

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

the law was designed to promote sustainable urban development, it may have also reshaped market structure, altered local concentration dynamics by constraining the expansion of certain C&C formats and redefining their competitive interaction with traditional B&M rivals. This paper evaluates both the intended and unintended consequences of the Alur law on entry, market concentration, and omnichannel competition.[18]

[18] Employment effects also vary by format: independent warehouses may create 20–30 jobs, adjacent warehouses around 15, and shelf-pickup C&Cs even fewer. Insufficient data prevent a systematic analysis of these impacts here.

3. Data

We use store-level data from Nielsen (Panorama - TradeDimension), a company specializing in retail data collection. The dataset provides comprehensive information on all retail stores operating in France in 2017, including their format (supermarket, hypermarket, hard discounter, C&C), location, opening date, and surface area (in m2). We use the opening dates to compute the number of store openings by semester (half-year) from January 2004 to July 2017. Since the ALUR law came into force in the first half of 2014, the data cover both the pre- and post-reform periods. Because of the limited number of C&C openings before 2009, we restrict 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 as- sess 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- 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.

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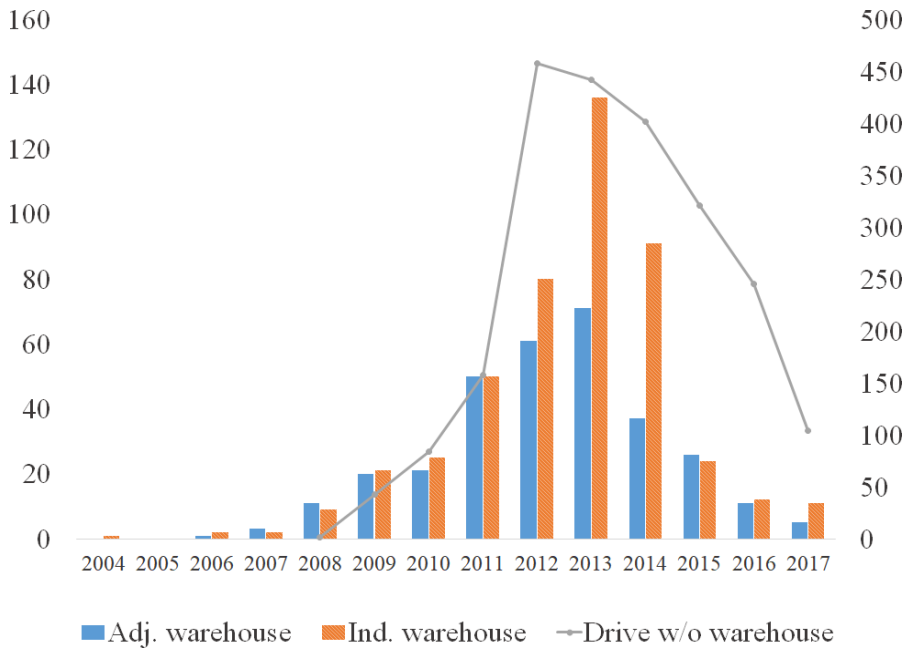
[19] Our analysis excludes C&Cs adjacent to hard discounters because only a small fraction (4%) of dis- counters offer C&C services. Additionally, convenience stores are disregarded since they are never associated with the establishment of C&Cs. Both formats pursue significantly different strategies 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)



Source: Nielsen TradeDimension data. Note: 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. The effect of the ALUR law on C&C's 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.

3.1. Identification strategy

3.1.1. 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 (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 (R=12).

We focus on 5 retail formats (I=5): two B&M store types (hypermarkets and super- 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 (R × T = 192), amounting to a total of 7,680 observations across all retailers and formats (R × T × C × 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.

Table 1. Creation of warehouses per retailer, pre and post the ALUR law

	Pre		**Post**	
	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
Systeme U	3	1	3	2
Others	0	0	0	0
Subtotal (B)	**13**	**16**	**28**	**10**
Total (A+B)	**223**	**312**	**79**	**138**

Source: Nielsen TradeDimension. Note: 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.

3.1.2. 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 ware- houses, 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.

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

	Treated Auchan + Leclerc		Potential control groups Other retail formats			
	adj.w.	ind. w	C&Cs w/o w.	super	hyper	total
Pre	210	296	1,185	610	155	2,456
Post	51	128	1,072	333	87	1,671
Total	685			3,442		4,127

Source: Nielsen TradeDimension. Note: 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.

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[21], PPML estimation naturally accommodates many zero values in the dependent variable. Additionally, it requires minimal assumptions about the data distribution.[22] The estimating equation is as follows:

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

where n_{icrt} denotes the number of store entries (i.e. new stores created) of format i ∈ {1, ...,I} and chain c ∈ {1, ...,C} in region r ∈ {1, ...,R} at semester t ∈ {1, ...T }. X represents the set of explanatory

[21] Log-linear models may yield biased results when applied to count data such as ours.

[22] The Stata command used for the estimation is ppmlhdfe. We have also estimated our model using negative binomial regressions, and the results remain robust. However, our preferred specification is the PPML method

variables, which includes our treatment variable, Tic, a dummy that equals one when format i and chain c are treated. βtTic represents the interaction between time fixed effects and our treatment variable. The estimated βt after the treatment event occurs captures 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 βt should not show a trend before the event time. In other words, it is essential that the estimated βt 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 (θt), format (θi), chain (αc), and regional fixed effects (nr). Finally, to address potential serial autocorrelation in entry decisions, we employ a cluster-robust inference procedure at the region-chain level.[23]

Figure 2 displays the event studies for the four distinct treatment groups. The vertical axis shows PPML estimates of βt, 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 sur- prising, as there could be substitution effects between different types of C&Cs. If such effects existed, the ALUR law could have also influenced our control groups by increasing openings of C&Cs without warehouses. However, the data suggest otherwise: Auchan opened only 4 such C&Cs before the law and 2 after, while Leclerc opened 42 before (compared to 383 warehouses) and 22 after (compared to 161 warehouses), indicating that their dominant strategy was to open warehouses. If anything, the number of C&Cs without warehouses declined following the law's implementation, suggesting that direct substitution effects did not occur.

Additionally, 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.

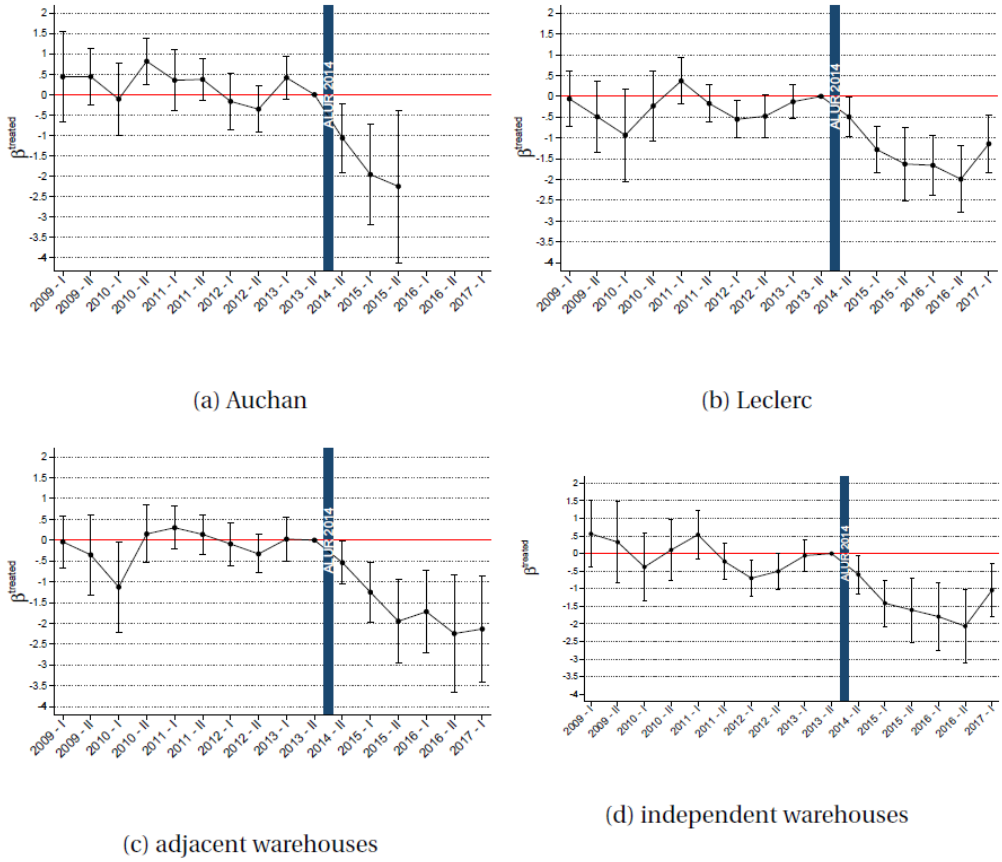
Lastly, including a combination of C&C without warehouses and B&M stores in our control groups offers several advantages. First, incorporating C&Cs without warehouses helps control for demand shocks or overall demand trends (i.e., global maturity) in C&Cs that could otherwise bias the estimated causal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

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

the control group helps mitigate any potential upward bias in the estimated causal effect of the law.[24]

Second, 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.[25]

Figure 2. Event Studies



Source: Authors' analysis. Note: This figure displays the results of our event studies based on Equation (1). The vertical axis shows PPML estimates of the βt. 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.

[24] 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.

[25] 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.

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) Systeme 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.

3.2. 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 regression. More precisely, we compare the average change in the number of C&Cs with ware- houses 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:

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

where, as before, n_{icrt} denotes the number of stores of format $i \in \{1, \ldots, I\}$ and chain $c \in \{1, \ldots, C\}$ created in region $r \in \{1, \ldots, R\}$ at semester $t \in \{1, \ldots, T\}$. 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 (n_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 8 in the Appendix A for supporting evidence).

Table 3: PPML DID analysis

Dependent variable: number of opening (nicrt)				
	(1)	(2)	(3)	(4)
PostALUR × Auchan w.	-2.37***			
	(0.38)			
PostALUR × Leclerc w.		-0.95***		
		(0.20)		
PostALUR × Adjoining w.			-1.29***	
			(0.17)	
PostALUR × Independent w.				-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

*Source: Authors' analysis. 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. Δ% = exp(β) − 1] × 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 ware- houses (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).*

3.3. 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.

3.4. 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.

4. The competitive 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 noted earlier, the ALUR law imposes entry restrictions without explicitly addressing competitive outcomes. However, store openings directly shape local competition and, consequently, prices. The introduction of C&Cs facilities may enhance competition by providing consumers new shopping options, thereby intensifying rivalry and putting downward pressure on prices. In this context, restricting C&C entry and expansion could unintentionally dampen competitive forces. Conversely, if a new warehouse strengthens a retailer's local market position, it may increase concentration and lead to higher prices, in which case entry regulations could have pro-competitive effects.

A large body of literature has shown that increases in local concentration, such as those following retail mergers, are associated with higher retail prices (Hosken et al., 2016; Rickert et al., 2021; Smith, 2004). In particular, Hosken et al. (2016) demonstrates that changes in local concentration driven by either supermarket entry or mergers have similar effects in magnitude on prices. Based on this literature, and given that we lack data on retail prices, we analyze how the entry of C&C warehouses and B&M stores affects local market concentration, measured by the HHI index, with store surface area used as a proxy for sales (see discussion below). From this, we infer the potential and heterogeneous effects of different 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.

4.1. Catchment area definition and HHI computation

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

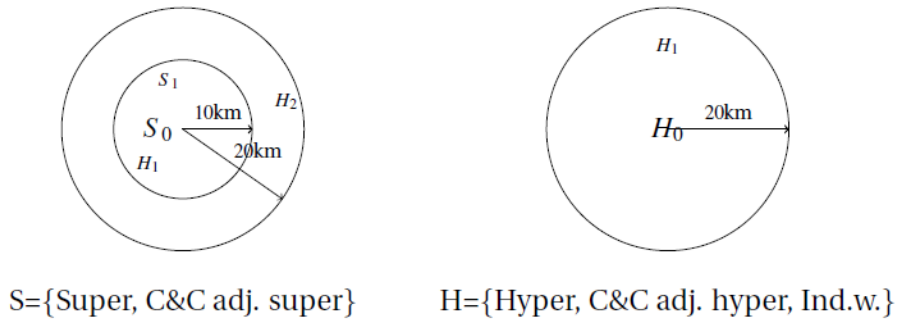
For B&M stores, we rely on the definition of catchment areas used by the French com- petition authority to analyze merger cases in the grocery retail sector. If the focal point is a supermarket, the relevant catchment area consists of two concentric circles around the store. The first circle, with a 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.[26]

[26] *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

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

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.

Figure 3: Catchment areas for rural markets



Source: Authors' illustration. 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.

Herfindhal Hirschmann Index. Once we define the catchment areas, the next 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 computed as the sum of the squared market shares of each retail chain, ranging from near zero (indicating nearly perfect competition) to 10,000 (indicating a pure monopoly).

Unfortunately, retail chain revenue market shares cannot be computed for catchment areas using Kantar data, as the household survey is not representative at this level. Although the survey is representative at the regional level, changes in market structure are most relevant locally. For instance,

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27 The French Competition Authority states in its guidelines (Annex D) that the competitive pressure of online sales on B&M stores should be treated as homogeneous across the national territory. While this assumption may be reasonable for pure online players, it is not appropriate for C&C formats, since consumers must still travel to collect their purchases. In this case, defining the relevant geographical market remains essential.

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

two chains may have similar market shares regionally, yet one could hold a monopoly in certain catchment areas. High local market concentration can have adverse effects on prices, as shown by Allain et al. (2017) for the French retail sector.

To overcome this limitation, we use store surface areas as a proxy for revenues to estimate each retailer's market share within a catchment area. This approach aligns with the French Competition Authority's merger guidelines, which recommend using surface areas when revenue or sales data are not available to assess competitive effects.[29]

The use of surface-based market shares may raise concerns, particularly for C&C warehouses, as their surface areas do not correspond to actual selling space accessed by consumers, unlike B&M stores. To assess whether surface-based market shares reliably approximate revenue shares, we regress each retailer's revenue share on its surface share at the regional–semester level using Kantar data. Separate regressions are estimated for hypermarkets, supermarkets, and C&Cs to evaluate the validity of this measure across formats. **Table 4** shows the results.

Ideally, coefficients should equal 1, indicating a proportional relationship between surface and revenue shares. Without fixed effects, estimates are not statistically different from 1 for hypermarkets (p = 0.20) and supermarkets (p = 0.81), suggesting that surface-based shares are good proxies for these formats. For C&Cs, the coefficient is slightly lower (around 0.8). Beyond format-specific characteristics, this discrepancy may also stem from data limitations, as Tradedimension reports surface areas only for ware- houses, excluding C&Cs without warehouses that still generate online revenues. All estimates are statistically significant at 1%, and the R-squared is close to 1, indicating that surface shares alone capture most of variation in revenue shares.

When controlling for retailer-, region-, and semester-specific fixed effects, the coefficient for hypermarkets remains close to 1, while for C&Cs it increases from around 0.8 to nearly 1[30]. For supermarkets, the coefficient decreases to 0.85. Adjusted R-squared values remain close to 1 for hypermarkets and supermarkets, whereas for C&Cs, it rises from 0.87 to 0.92, suggesting that some variation in revenue shares is not fully explained by surface areas alone.

We favour the specification without fixed effects because our goal is to evaluate the proportionality between surface and revenue shares. In our analysis, surface areas are used directly as proxies for revenues rather than predicting revenue shares from estimated parameters. This approach avoids interpolation errors that could arise from applying model-based predictions to catchment-area data.[31]

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29 *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

30 Neither coefficient is statistically different from 1 (p = 0.31 for hypermarkets; p = 0.26 for C&Cs).

31 We also examined the potential for a nonlinear relationship by including the quadratic value of the surface share in the regression. The results confirm that a linear specification is appropriate: the coefficient on the linear term remains close to 1, while the quadratic term is statistically insignificant for super- markets and C&Cs, and only weakly significant for hypermarkets (at 10%), with a confidence interval that includes zero.

Table 4: Regression of revenue shares on surface-based market shares

	Without Fixed Effects			With Fixed Effects		
	Hyper	Super	C&C	Hyper	Super	C&C
	(1)	(2)	(3)	(4)	(5)	(6)
surface-based market share	1.047***	0.991***	0.791***	0.956***	0.853***	0.952***
	(0.037)	(0.036)	(0.010)	(0.044)	(0.067)	(0.043)
fixed effects				Yes	Yes	Yes
Observations	1,497	1,389	1,126	1,497	1,389	1,126
R-squared	0.947	0.945	0.870	0.951	0.933	0.926
Adj. R-squared	0.947	0.945	0.870	0.950	0.931	0.924

*Source: Authors' analysis. Note: This table reports the estimates from regressions of revenue market shares on surface-based market shares for each retail format at the regional–semester level. Columns 1–3 present estimates without additional controls, while Columns 4–6 include retailer, region, and semester fixed effects. *, **, *** indicate significance at the 10%, 5% and 1% levels, respectively. Standard errors, shown in parentheses, are clustered by region- retailer level.*

To complement this analysis, we compare national ratios between revenue-based and surface-based market shares for each format. Ratios are close to 1 for B&M stores (1.04 for hypermarkets and 0.99 for supermarkets) but lower for C&Cs (0.68).

Overall, evidence from both regional regressions and national ratios supports using surface-based market shares as reasonable proxies for revenue shares in B&M stores. However, for C&C warehouses, this measure tends to overestimate revenue shares. To correct for this bias, we apply a 0.7 weight (w) to C&C surface areas when computing HHIs, adopting a conservative approach to their local impact.

While surface-based measures only approximate actual competitive dynamics, and potential errors may be amplified when estimating local HHIs, the direction of concentration changes is expected to remain reliable, as it is largely driven by retailers' location choices within catchment areas. As a robustness check, we re-estimate concentration changes using alternative weights for C&C surface areas (w = 0.8, 0.9, 1), and the results presented in the next section remain consistent.

4.2. The impact of Click-and-Collect entry on local 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 on the assessment of mergers and consider that an entry is triggering a significant decrease (increase) in concentration when the post-entry HHI is lies between 1,000 and 2,000 with ΔHHI < −250 (ΔHHI > 250), or when the post-entry HHI exceeds 2,000 with ΔHHI < −150 (ΔHHI > 150).[32] We focus our analysis on cases where concentration could potentially pose competition issues, particularly when post-entry HHI levels exceed 2,000. This choice is not restrictive as local markets with post-entry HHI larger than 2,000 represent 97% of the total number of markets.[33]

Table 5 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.

Table 5: 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	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

Source: Authors' analysis. 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 2,000. Surface areas for warehouses are weighted by a factor of w = 0.7.

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

[32] In its guidelines for evaluating both horizontal and non-horizontal mergers, the EC considers that a level of concentration lower than 1,000 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 1,000. For the remaining 3%, the post-entry HHI lies within the interval of [1,000, 2,000].

C&C warehouse leading to a significant increase in concentration in more cases than for B&M (12% of C&C cases vs 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 ware- house 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 urban 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 Île-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_{ict}, 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 de- pendent variable Y_{ict} is a dummy equal to 1 if the entry of format i, chain c at time t produced a ΔHHI < −150 (ΔHHI > 150), and 0 otherwise.

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

Table 6 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 weakly 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 5, 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.

[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.

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).

Table 6: Results probit models

	Pr ΔHHI < −150		Pr ΔHHI > 150		Pr ΔHHI < 0 | |ΔHHI| > 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	-1510.0	-1438.6	-725.8	-702.9	-550.9	-518.7

*Source: Authors' analysis. Notes: This table reports the results of the Probit estimations (Equation 3). Columns (1) and (2) show the probability of observing a large decrease and a large increase, respectively, in local market concentration following a store entry. Column (3) shows the probability that an entry reduces concentration (ΔHHI < 0), conditional on generating a big change upon entry (|ΔHHI| > 150). All specifications include chain and time fixed effects, as well as controls for urban density. The sample is restricted to markets with post-entry concentration levels above 2,000. Surface areas for warehouses are weighted by a factor w = 0.7. *, **, *** indicate significance at the 10%, 5% and 1% levels, respectively. Standard errors are shown in parentheses.*

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 given that C&C openings generally reduce local concentration less than new B&M stores, it appears reasonable to align the entry regulations for C&C stores with those applied to B&M stores. However, the effect of such regulations on local competition on the specific C&C format. Our findings suggest that restricting the establishment of adjacent warehouses may have prevented an increase in local concentration. In contrast, limiting the opening of independent warehouses could have discouraged entries that would have otherwise reduced local concentration and enhanced competition. Despite the different potential effects on competition, both warehouse types were significantly impacted by the ALUR law, as shown in Section 4.

5. Conclusions

Given the rapid expansion of online grocery shopping and C&C services, which currently operate under lighter regulation than traditional grocery formats, national authorities are increasingly scrutinizing omnichannel retail models. In France, the ALUR law represents a pioneering attempt to regulate online shopping by overseeing the establishment of C&C warehouses, aiming to foster sustainable development in the sector.

Our study provides an empirical evaluation of the ALUR law's economic impact on the industry, taking competition effects into account. To the best of our knowledge, it is also the first attempt to examine how offline entry regulation affects the entry and growth of online formats. Using detailed data on retail entries and household expenditures, we show that the law substantially reduced warehouse expansion by the leading adopters of the C&C format, by roughly 60% and 90%, respectively. This contraction applied to both independent and adjacent warehouses and was accompanied by a deceleration in C&C revenue growth, likely due to the reduced establishment of new warehouses. Specifically, we estimate a revenue loss of about 5% of C&C sales.

Beyond firm growth, our analysis shows that the regulation had differentiated implications for local market competition. Adjacent warehouses appeared to reinforce incumbents' positions and thus risk increasing concentration, while independent warehouses tended to intensify competition by introducing additional entry. These findings underscore that regulatory policy in omnichannel retail formats requires careful attention to the heterogeneity of business models and their effects on market structure. This research underscores the evolving regulatory landscape of digital markets and calls for further investigation into their broader implications for consumer welfare.

Finally, we acknowledge that our analysis abstracts from dimensions beyond competition, such as land use, congestion, or employment. Recent policy debates in France—for example, proposals to tax deliveries or set prices to internalize environmental costs— illustrate the growing relevance of sustainability in regulating digital commerce.[35] Extending research to incorporate these dimensions would enrich our understanding of how regulation shapes the evolution of omnichannel markets and their consequences for firms and consumers.

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

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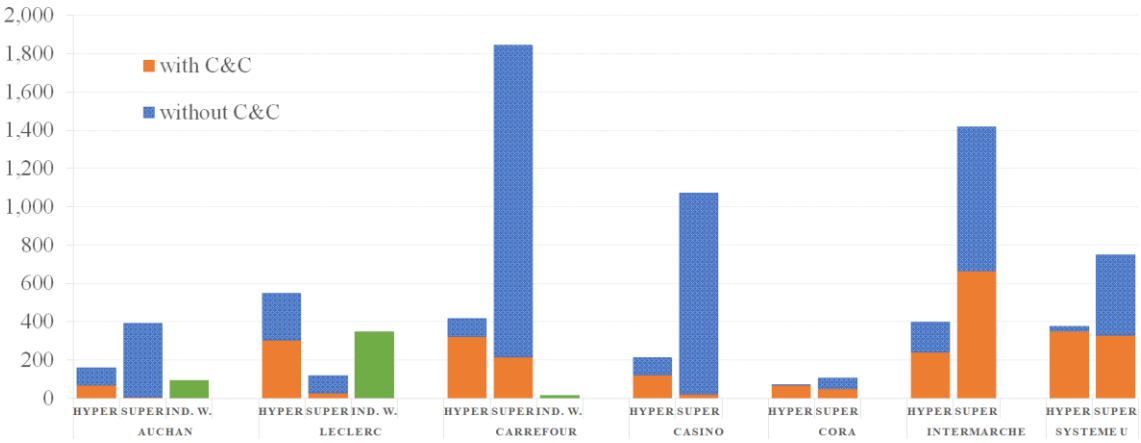
Annexes

Annex 1. Additional figures and tables

Figure 4: Number of stores per chain and format (2017)



Source: Nielsen TradeDimension data. 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.

Table 7: 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	

Source: Nielsen TradeDimension. 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 dis- counters).

Table 8: 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%

Source: Nielsen TradeDimension. 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.

Annex 2. Kantar Worldpanel dataset

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. How- ever, 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 9: Average revenue per retailer and retail format (2009 - 2017)

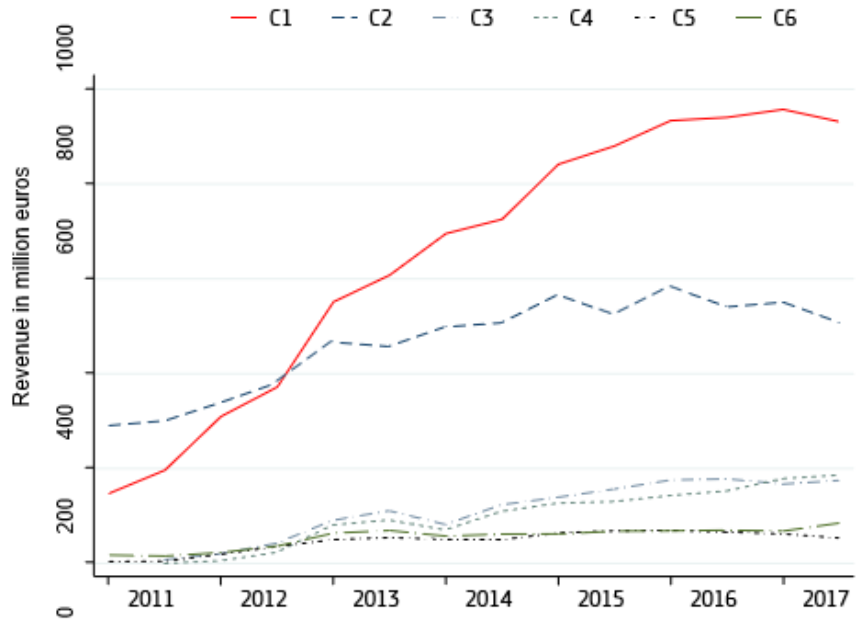
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
C&C	50.85	33.15	9.46	8.74	4.81	12.57	4.16
Hyper	571.93	276.00	428.56	130.04	85.88	176.88	122.13
Super	33.20	81.38	276.03	326.47	47.84	161.38	105.13

Source: Kantar Worldpanel. Note: 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.

Table 9 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, 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.

Figure 6: Evolution of C&C revenues per retailer



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

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. 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.

Annex 3. Robustness checks

This section extends our analysis by introducing several controls, denoted Zcrt 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&Crt 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 ∈ {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.

Saturation ratio. The establishment of C&Cs adjacent to a store, with or without ware- houses, is shaped by the existing network of hypermarkets and supermarkets within each retail chain. Figure 4 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, 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 $\text{Sat}_{crt}^{h} \leq 0.75$ (resp. when $\text{Sat}_{crt}^{s} \leq 0.50$), and retains the actual value otherwise.[36] 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 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 10. For ease of com- parison, we present our baseline

[36] The threshold set for supermarkets is lower than the one used for hypermarkets because the maxi- mum saturation level reached at the regional level for supermarkets equals 0.58. In contrast, we observe full saturation (Sath = 1) for hypermarkets in some regions.

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.

Table 10: DID analysis on the ALUR law: robustness checks

Dependent variable: number of opening (nicrt)				
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

Source: Authors' analysis. Notes: This table shows the estimated ATE with additional control variables for robustness checks. For simplicity, we directly present the estimated percentage change Δ% = [exp(β) − 1] × 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 and ShareC&C^2 to our baseline. Model (B+Sat) adds variables related to the saturation effect. 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.

Annex 4. 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.

A4.1. Identification strategy for the DID analysis on revenues

Sample selection. To analyse 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, 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 J=3 formats, where j ∈ {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, ..., R}, and periods t = {5, ..., 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 9, it is challenging to compare revenues across store formats since C&Cs represent only a small fraction of the total retail chains' revenues.[37]

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:

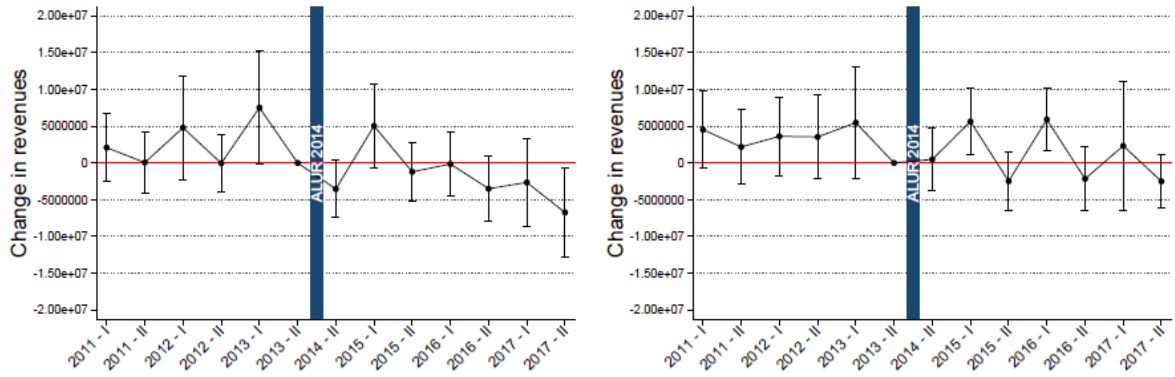
$$\Delta \text{C\&C Rev}_{crt} = \alpha + \gamma_t \text{T}_c + \mu_c + \theta_t + \mu_r + \varepsilon_{crt} \qquad (4)$$

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

Results in Figure 6 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.

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

Figure 6: Event studies for revenue analysis



(a) C1 (b) C2

Source: Authors' analysis. 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.

A4.2. 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.[38]

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

where ΔC&C Rev_{crt} denotes the change in C&C revenues per chain c, region r and semester t. As before, Tc is our treatment variable, a dummy that equals one if the retail chain c = {C1, C2} is treated, and 0 otherwise. Post 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 11 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.

[38] 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 11: 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

*Source: Authors' analysis. 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 (in parenthesis) are clustered by region and chain. *, **, *** indicate significance at the 10%, 5% and 1% level, respectively.*

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.

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