Entry and price competition in the over-the-counter drug market after deregulation: evidence from Portugal

Ana Moura[a] and Pedro Pita Barros[b]

[a]Tilburg University
[b]Nova School of Business and Economics

Abstract

In the last two decades, many European countries allowed the sale of Over-the-Counter (OTC) drugs outside pharmacies. This was expected to lower retail prices through increased competition. However, evidence of price reductions is scarce.
We assess the impact of supermarket and outlet entry in the OTC drug market on OTC prices charged by incumbent pharmacies, using a difference-in-differences strategy.
We use price data on five popular OTC drugs for all retailers located in Lisbon for three distinct points in time (2006, 2010, and 2015).
Our results suggest that competitive pressure in the market is mainly exerted by supermarkets, which charge, on average, 20% lower prices than pharmacies. The entry of a supermarket among the main competitors of an incumbent pharmacy is associated with an average 3 to 9% decrease in prices compared to the control group. These price reductions are long-lasting, but fairly localized. We find no evidence of price reductions following outlet entry. Additional results from a reduced-form entry model and a propensity score matching difference-in-differences approach suggest that these effects are causal.

Keywords: over-the-counter drugs; pharmaceutical market; market liberalization; price competition.

JEL codes: I11, I18, L11.

1 Introduction

Over-the-counter (OTC) drugs are pharmaceuticals whose purchase does not require a prescription. They are usually not reimbursed and their pricing is free, in contrast with the highly regulated prices of reimbursed and/or prescription-only pharmaceuticals.

During the last two decades, European countries have extensively reformed their community pharmacy sectors. An important element of these reforms is the liberalization of OTC medicine distribution (OECD, 2014). OTC market liberalization implies a move from a traditional pharmacy-centered model to a multi-channel distribution model in which OTC drugs are sold outside pharmacies, namely in supermarkets, petrol stations, and other non-pharmacy outlets. Throughout this paper, we refer to these as non-pharmacy retailers.

The rationale for OTC market liberalization was that the entry of non-pharmacy retailers, combined with free OTC pricing, would lower OTC drug prices via increased competition among retailers (Lluch and Kanavos, 2010; Stargardt et al., 2007; Morgall and Almarsdóttir, 1999).Existing literature posits that pharmacies are not used to price competition and do not place competitive constraints on each other (Pilorge, 2016; Stargardt et al., 2007).[1] The fact that, at least in urban areas, non-pharmacy retailers charge lower prices than traditional pharmacies (Anell, 2005; OFT, 2003) might mechanically lead to lower average prices, but provides no evidence of competitive forces. We examine whether facing increased competitive pressure following the entry of a non-pharmacy competitor, who is able to charge lower prices, triggers price decreases by incumbent pharmacies.

This is an important question that, to the best of our knowledge, has not yet been fully addressed in the literature. OTC drugs are one of the few product segments for which pharmacies can make their own pricing decisions. Because they are frequently used, we expect consumers to be aware of price differences between retailers (Sorensen, 2000). By shedding light on how competition takes place in this market, we contribute to inform policy-makers on the market dynamics they might expect upon liberalizing OTC medicine distribution.

We first provide a theoretical framework for understanding non-pharmacy entry and its potentially ambiguous impact on the prices of incumbent pharmacies. The empirical analysis draws on the Portuguese experience. In Portugal, OTC market liberalization started in late 2005 and allowed OTC drugs to be sold outside pharmacies, namely in supermarkets and

[1]This inability may be associated with either the development of close professional relationships among pharmacists or to their use to the non-competitive environment in place prior to market liberalization. Alternatively, pharmacies may not compete in prices but rather in quality, range of services, location, or opening times (Martins and Queirós, 2015; Lluch and Kanavos, 2010; Anell, 2005; Rudholm, 2008; Stargardt et al., 2007; Schaumans and Verboven, 2008).

outlets.[2] OTC market liberalization reforms similar to the Portuguese one were implemented all over Europe during the last two decades: In 2000, Poland allowed for a limited range of OTC products to be sold outside pharmacies; Denmark, Norway, Italy, Hungary, Sweden, and France adopted similar policies in the following years; Germany and the United Kingdom had already done so during the 1990s.

We use price data for five popular OTC drugs across all retailer types (traditional pharmacies, supermarkets, and outlets) located in Lisbon. The dataset has a panel structure and each retailer is observed for at most three points in time, the years of 2006, 2010, and 2015. In our data, supermarkets and outlets charge, on average, 20% and 4% lower prices than traditional pharmacies, respectively.

Using a difference-in-differences (DID) strategy, we estimate the change in prices charged by incumbent pharmacies following the entry of a non-pharmacy among their main competitors. Identification comes from the different timing of exposure of incumbent pharmacies to different types of non-pharmacy competitors.

We find that incumbent pharmacies lower their prices by 3 to 9% after experiencing entry of a supermarket among their main competitors. These effects are long-lasting, but their magnitude and significance falls quickly as one enlarges the set of main competitors, suggesting competition is fairly localized. We do not find evidence that outlet entry leads to price reductions by incumbents. We find a decent degree of heterogeneity in price responses across pharmacies operating in areas with different degrees of market concentration, with our results being driven by the most isolated pharmacies, who likely enjoyed some degree of market power prior to experiencing entry.

Our results do not seem to be driven by existing pre-treatment trends, and survive alternative definitions of main competitors and a battery of robustness checks. Their causal interpretation, however, rests on the assumption that market structure is exogenous, so that exposure to non-pharmacy entry is random. We address this concern in two ways. First, we implement a propensity score matching DID approach, with propensity scores being a function of pre-entry levels of competitive pressure and demand faced by each pharmacy, and obtain results in line with our baseline estimation. Second, we estimate a reduced-form entry model in which the probability that a pharmacy faces non-pharmacy entry is a function of past prices. We find no evidence of an association between past prices and non-pharmacy entry.

Our findings contribute to the empirical literature on OTC drug pricing and the effects of OTC market liberalization in Europe. This literature is scarce, mostly descriptive, and often unable to confirm the expected downward trend in OTC prices (OECD, 2014; Vogler et al.,

[2] Patrício et al. (2005), CEGEA (2005), and Gomes (2007) used the classic frameworks of Hotelling (1929) and Waterson (1993) to make predictions of the expected price outcomes of the reform. These predictions pointed in very different directions and the real impact of the reform was never assessed.

2014). We show that OTC liberalization reforms can lower prices via increased competition, though this crucially depends on the ability of entrants to underprice incumbent pharmacies. Our study also contributes to a broader literature within industrial organization on the price effects following the entry of supermarkets and chain stores in general in a market previously composed of small, independent firms, as is the case of traditional pharmacies in Portugal.[3] Bennett and Yin (2019) study the entry of a retail pharmacy chain in India on the price of incumbent pharmacies. Basker (2005) studies the effect of Walmart entry on average city-level prices, and Basker and Noel (2009) estimate its effects on the competitor prices. We contribute to this literature by providing evidence for the OTC drug market.

The remainder of this paper is as follows. Section 2 provides institutional background on the Portuguese OTC market and the liberalization process. Section 3 provides a theoretical foundation for our empirical analyses. Section 4 describes our dataset and Section 5 presents our empirical strategy. Section 6 presents our results and Section 7 concludes.

2 The Portuguese OTC market

Traditionally, community pharmacies enjoyed a monopoly for selling both prescription and OTC drugs. In Portugal, their monopoly for selling OTC drugs ended with Decree-Law n. 134/2005 (August 16, 2005), which allowed the sale of OTC drugs outside pharmacies.[4] Prescription drugs remain available only at traditional pharmacies.

According to the National Authority of Medicines and Health Products (Infarmed), the first non-pharmacy retailers entered the OTC market in October 2005. Non-pharmacy retailers can be of two types: supermarkets and outlets (*parafarmácias*).

In supermarkets, by regulation, OTC drugs are not are freely accessible to customers. They are placed either in a closed shelf located behind the cashiers' check-out counter, or in a dedicated area together with other wellness products. Either way, customers wishing to purchase a given OTC drug must request it from the cashier or the employee attending to the dedicated area. Most supermarkets selling OTC drugs in Lisbon belong to either one of the two biggest supermarket chains in Portugal.

[3] Traditional pharmacies in Portugal are independently owned due to existing ownership restrictions which limit the number of pharmacies that an agent can own. Ownership restrictions are common and seek to ensure a certain degree of market competition. Recently, organized groups of independently-owned pharmacies were created, but our data are prior to that.

[4] The Portuguese government announced the intention to liberalize the OTC market a few months before Decree-Law 134/2005 was passed. We cannot completely rule out that pharmacies adopted strategies other than pricing to prevent non-pharmacy entry. Nevertheless, the fact that non-pharmacy entry took off quickly after liberalization, combined with pharmacies not being used to operate in a competitive environment, leaves less scope for such strategic behavior.

Non-pharmacy outlets are stores selling cosmetics, baby care products, vitamins and supplements, among others. OTC drugs represented a natural expansion of their product range. Outlets can be either independently owned or part of small chains of two or three stores.

Non-pharmacy retailers wishing to enter the Portuguese OTC market must apply for a license at Infarmed, and satisfy specific requirements related to drug storage, qualification of personnel, etc. Application by supermarket and outlet chains is done individually by each store belonging to the chain (as opposed to one license application for all stores belonging to the chain).

The entry of supermarkets and outlets in the OTC market took place quickly following market liberalization.[5] In the first quarter of 2009 there were over 800 non-pharmacies in Portugal, and by the end of 2017 there were about 1,200. The volume share of OTC drugs in the total outpatient pharmaceutical market was 16.5% by the end of 2017. The corresponding value share was 11.7%. The non-pharmacy volume share of the OTC sector in Portugal has risen continuously since market liberalization, plateauing at 20% in 2014 (Infarmed, 2018).

3 Theoretical framework

We highlight the economic effects associated with OTC liberalization using a stylized model. We consider a version of the Salop (1979) model with entry of competitors with marginal cost differences relative to incumbents. This reflects the possibility that different types of non-pharmacy entrants may have a cost-advantage or disadvantage relative to community pharmacies.

The equilibrium price effects of entry into the OTC market will result from extra competition due to more players in the market and from how hard marginal competition has become. In the Salop model, competition is localized, so entry by a low cost rival creates a downward pressure on prices from both a closer rival and a lower marginal cost, more aggressive, competitor. On the other hand, entry by a higher cost competitor brings a balance between a closer rival and a "softer" (higher marginal cost) competitor. The former drives down equilibrium prices while the latter exerts pressure for increasing equilibrium prices.

In our setting, entry by large supermarket chains is likely to be approximated by the low-cost entrant, reflecting their cost advantage in logistics, management and, eventually, bargaining power with wholesalers. In areas where supermarkets enter the OTC market, we expect prices to decrease in pharmacies. The entry of other small OTC retailers, outlets, on the other hand may induce a richer set of effects. If they have marginal costs lower than those of pharmacies,

[5] Throughout the paper, entry in the OTC market refers to the moment at which a retailer is granted a license to sell OTC drugs.

but higher than those of supermarkets, the same qualitative effects described for supermarkets apply, though with lower intensity. More interesting is that, in the presence of higher cost entrants, we cannot rule out that equilibrium prices increase. The competition effect works in the direction of lower prices but the strategic interaction effect due to localized competition works in the direction of higher prices whenever the entrant has higher marginal costs. Thus the empirical prediction on the effect of entry of small OTC retailers on equilibrium prices is ambiguous (in the absence of a strong presumption that such outlets have a marginal cost advantage relative to pharmacies).

The model uses the simplest layout to support the above claims. In the pre-entry equilibrium we consider two pharmacies symmetrically located on the Salop circumference of length one. Density of consumers (patients) is 1 and uniformly distributed along the circumference. Each consumer has a linear cost t of "travelling" to an OTC retailer. A distance x implies a total travel cost of tx. We use x to index a patient location on the circle relative to the nearest left-side OTC retailer. The distance to the nearest right-side retailer is denoted by $d - x$, and the associated travel cost is $t(d - x)$. The value of d is determined by the location of OTC retailers. With n sellers, $d = 1/n$. Consumers of OTC products are assumed to have no insurance coverage (either public or private) for this type of product.[6]

Traditional pharmacies are assumed to be profit maximizing in their decisions regarding the price of OTC products. Pharmacies have a constant marginal cost, c, of selling an OTC product. Supermarkets and outlets have constant marginal cost given by $c + \Delta^S$ and $c + \Delta^O$, respectively. We assume $\Delta^S < 0$, $\Delta^S < \Delta^O$, and Δ^O can be greater or smaller than 0.

To keep the model as tractable as possible without losing any essential element, we assume that entry occurs in pairs (either two supermarkets or two outlets) and that all locations are symmetrically placed on the Salop circumference. These assumptions can be easily relaxed without changing the qualitative nature of the result. Symmetry allows for far more tractable expressions, from which economic intuition can be obtained.

We first characterize the market equilibrium for two symmetrically located community pharmacies. Demand directed to each pharmacy results from patients located both to its left and right-hand sides. A pharmacy located at point i on the Salop circumference faces demand

$$D_i = \left(\frac{1}{2n} - \frac{p_i - p_{i-1}}{2t}\right) + \left(\frac{1}{2n} - \frac{p_i - p_{i+1}}{2t}\right), \tag{1}$$

where $i - 1$ and $i + 1$ denote the locations of rivals. Note that with two pharmacies only, $p_{i-1} = p_{i+1}$, as the other pharmacy is both the left-side and the right-side competitor.

[6] Although some OTC products are covered by the National Health Service in Portugal, most are not.

Profit of each pharmacy is

$$\Pi_i = (p_i - c)\left(\frac{1}{n} - \frac{p_i - p_{i-1}}{t}\right). \tag{2}$$

Maximizing each firms' profit with respect to price and solving for the symmetric price equilibrium, we obtain the standard result of $p^* = (t/2) + c$.

The next step is the characterization of the post-entry equilibrium. We assume that two non-pharmacy OTC retailers enter the market and locate symmetrically on the circle in relation to pharmacies' location. Moreover, pharmacies do not relocate in response to entry.[7] Our assumption of symmetric entrants also implies that entrants have the same marginal cost (different from pharmacies marginal cost).

Demand directed at retailer i now has to accommodate the existence of more competitors, $d = 1/4$. The profit of a retailer located at i is given by

$$\Pi_i = (p_i - c - \Delta)\left(\frac{1}{4} - \frac{p_i - p_{i-1}}{2t} - \frac{p_i - p_{i+1}}{2t}\right) \tag{3}$$

with $\Delta = 0$ for traditional pharmacies.

Pharmacies face a symmetric situation in their decisions and so do supermarkets (or outlets). Thus, we only need to characterize two equilibrium values of prices, one for each type of retailer. Each pharmacy faces competition by two supermarkets/outlets and each supermarket/outlet faces competition of two pharmacies. The resulting equilibrium prices for incumbent pharmacies (I) and non-pharmacy entrants (E) are:

$$p^I = c + \frac{t}{4} + \frac{\Delta^E}{3}, \qquad p^E = c + \frac{t}{4} + \frac{2\Delta^E}{3} \tag{4}$$

From these equilibrium prices it follows that for $\Delta^E < 0$ (more efficient entrants), $p^E < p^I < p^*$. The direct competition effect of more retailers is captured by the difference $(t - t/4)$ when comparing p^I and p^*. The strategic interaction effect from competition is associated with the term Δ^E. With $\Delta^E > 0$ different possibilities exist. Equilibrium price of pharmacies increases if $\Delta^E > 9/4t$ (and pharmacies have lower price than entrants in this case).

These results provide the conceptual background to guide the interpretation of our empirical findings.

[7]Given our assumption of two entrants, the forces for maximum product differentiation and symmetric locations is compatible with the assumption made. Moreover, it is unlikely that pharmacies will relocate geographically as OTC are a relevant but not the main source of their revenues (and relocation may take place in other dimensions relevant to patients other than geographic distance).

4 Data

Our data consists of the prices of five popular OTC drugs charged by all pharmacies, supermarkets, and outlets located in the Lisbon municipality for three different points in time, 2006, 2010, and 2015.

The five OTC drugs are Aspirina 500mg (20 pills, Bayer), Cêgripe (20 pills, Jassen-Cilag Ltd.), Trifene200 (20 pills, Medinfar), Mebocaína Forte (20 tablets, Novartis), and Tantum Verde (mouthwash, Angelini). These drugs tackle simple conditions such as fever and headaches (Aspirina), colds (Cêgripe), menstrual pain (Trifene200), sore throat (Mebocaína Forte), and toothache and gum swelling (Tantum Verde). They are some of the top-selling OTC drugs in Portugal. In 2009, these five drugs accounted for 10.8% of the volume sales of OTC drugs outside pharmacies. All of them featured in the top 15 best-selling drugs in volume, and 3 of them featured in the top 10 (Infarmed, IP, 2010).[8] They are well-known brands to consumers and often advertised in the media. More importantly, they are available at all retailers.[9]

Price data for 2006 were kindly provided by Simões et al. (2006), who collected them between March and April. We then carried out two additional rounds of data collection, in 2010 and 2015. Infarmed keeps an on-line, updated list of all active retailers that are licensed to sell OTC drugs. We examined these lists before each data collection round and identified the active retailers and their exact locations. We collected price data for 2010 and 2015 between December 2010 and February 2011 and between February and April 2015, respectively.

Though Simões et al. (2006) visited every OTC retailer in 2006, some retailers were not willing to disclose price information, resulting in some missing price data for that year. When we carried out the data collection in 2010 and 2015, we purchased the drugs at retailers whose staff refused to disclose prices. Therefore, in these two periods we observe prices for all retailers located in Lisbon.

We use latitude and longitude coordinates of each retailer to identify its main competitors at each time period. We also construct indicators for retailer type (traditional pharmacy, supermarket or outlet) and the parish where each retailer is located.[10] Finally, we have data from the 2001 Portuguese census on the population living in the census block where each retailer is located.

We follow retailers over the three time periods for which we have data. Our dataset is unbalanced because there are retailers entering and exiting the market between each data

[8]After 2009, Infarmed stopped releasing sales data by commercial designation, so we do not have more recent figures.

[9]Supermarkets and outlets typically carry a smaller selection of OTC drugs than pharmacies.

[10]Portuguese municipalities are composed of smaller areas called parishes. The number and geographic borders of the Lisbon parishes were revised in 2012. According to the revised version there are 24 parishes in Lisbon.

collection round. Figure A.1 in the online Appendix conveys the OTC market structure in Lisbon, for the years 2006, 2010, and 2015. The number of supermarkets in our dataset increased over time, from 1 in 2006 to 25 in 2015. The number of outlets raised from 8 in 2006 to 25 in 2010 and then slightly declined to 21 in 2015. The number of traditional pharmacies has been declining over time, from 301 in 2006 to 259 in 2015.

We now highlight a few patterns present in our data. The average prices of the drugs under analysis increased over time, as did their variance. All supermarkets in our data belong to supermarket chains and each chain adopts a common pricing strategy, rather than store-specific prices that reflect the competitive environment faced by each store belonging to the chain. On average, supermarkets charge about 20% lower prices than traditional pharmacies for the sample of OTC drugs we analyze. This might be due to economies of scale in the distribution chain of supermarkets, more efficient practices regarding stock management and logistics, and stronger bargaining position when engaging in price negotiations with suppliers due to larger quantities purchased. All of these result, cumulatively, in lower marginal costs, leading to lower equilibrium prices for supermarkets. Outlet prices are, on average, 4% lower than those of traditional pharmacies. Outlets are either independent stores or part of very small chains, which might imply that they face wholesale prices similar to those faced by traditional pharmacies.

5 Methodology

5.1 Empirical Strategy

We use a DID strategy to assess the price effects following the entry of non-pharmacy retailers. Since our main interest is on the effects on the pricing of incumbent pharmacies, we estimate our models among pharmacies only. In robustness checks we include all retailer types in the estimation sample.

Non-pharmacy entry started before our first round of data collection. However, non-pharmacy entry took place gradually, meaning that each pharmacy experiences entry of different types of non-pharmacies at different points in time. This is our source of identification.

We define treatment groups depending on the type of entrant and timing of entry. Experiencing the entry of a supermarket or an outlet are the two types of treatment, as supermarkets and outlets charge different prices and thus may exert different levels of competitive pressure on incumbent pharmacies.

An incumbent pharmacy is "treated" if it experiences the entry of either a supermarket or an outlet among its main competitors. Prior to treatment, its set of main competitors consists only of traditional pharmacies. Each of the two types of treatment can take place either before 2006, between 2006 and 2010 or between 2010 and 2015. This allows differentiating between early and late entry. In total there are six treatment groups. The control group is composed of pharmacies who never face non-pharmacies among their main competitors.

We compare the pre- and post-treatment price differences between each treatment group and the control group. The regression counterpart of these differences is as follows:

$$P_{ikt} = \beta_0 + \theta_{tg(i)} + \delta_t + \gamma_k + \varepsilon_{ikt}, \tag{5}$$

where the dependent variable is the natural logarithm of the price charged by pharmacy i, for drug k in year t. The main explanatory variables are contained in vector $\theta_{tg(i)}$ and correspond to interactions between each of the six treatment groups $g(i)$ and year fixed-effects. The estimates of $\theta_{tg(i)}$ inform about the price effects of non-pharmacy entry on incumbent pharmacies, and their dynamics over time. Additional regressors include year fixed-effects, δ_t, and drug fixed-effects, γ_k. ε_{ijkt} is an error term.

Our DID design is as flexible as possible, given that we only have data for three time periods. First, we do not restrict pre-treatment trends to be identical for the control and treatment groups. Instead, we allow for fully flexible pre-treatment trend differentials between treated and control groups, since $\theta_{tg(i)}$ includes interactions between the treatment groups treated after 2010 and the year fixed-effects (as for these treatment groups we observe two pre-treatment periods). The statistical significance of these coefficients informs about the plausibility of the parallel trend assumption. Second, we do not restrict the treatment effect to be permanent and equal to the change in price in the first post-treatment period. Instead, we allow for flexible dynamics of the treatment effect over time, since $\theta_{tg(i)}$ includes interaction terms between the groups treated between 2006 and 2010 and the year fixed-effects (as for these treatment groups we observe two post-treatment periods).

Equation (5) is estimated using fixed-effects at the pharmacy level, thus differencing out all time-invariant, pharmacy-specific characteristics. We cluster standard errors at the pharmacy level to account for serial correlation in pharmacy pricing decisions.[11]

In our baseline specification, we define the set of main competitors of pharmacy i as its N nearest neighbors in terms of walking distance, with $N = 1, ...5$.[12] Therefore, in the baseline

[11]This clustering option is common when defining markets around a focal retailer, see Hosken et al. (2008). We experimented with alternative ways of clustering the standard errors, namely two-way clustering by pharmacy and drug. This does not affect the significance of our results to a large extent (Table B.11 in the online Appendix).

[12]We use walking distances instead of straight-line distances to define the nearest competitors of each pharmacy. This accounts for physical barriers that might cause two nearby retailers not to be regarded as competitors by consumers, ie. a high-speed road. We measured walking distances between retailers after each data collection round because they can change over time due to urban development, ie. a new aerial bridge

case, treatments consist on the entry of a supermarket or outlet in the set of N nearest neighbors before 2006, between 2006 and 2010, or between 2010 and 2015. Alternatively, in online Appendix C, we define the set of main competitors of a pharmacy to include all retailers located within a radius of 400, 600, and 800 meters of its location.

Throughout most of our analysis, we focus on samples in which all treatment and control groups are mutually exclusive.[13] Thus, the number of observations in the treatment and control groups varies with the choice of N. Table 1 shows the composition of the treatment and control groups for different choices of N.[14] Each pharmacy belongs to the same group throughout all time periods in which it is observed. However, the number of pharmacies in each group varies over time due to market entry and exit. The increase in the number of pharmacies in the control group between 2006 and 2010 also reflects the missing price data for 2006, as discussed in Section 4.

One concern is that pharmacies in the control group and those that eventually face non-pharmacy entry are already somewhat different prior to treatment. In Table 2 we compare the pre-treatment means of our main variables for pharmacies in the control group, and those treated after 2006. We exclude pharmacies who experienced non-pharmacy entry before 2006, as for these we have no pre-treatment observations. There are some differences between the treated and control groups, namely in the population of the census block where they are located, which might be seen as a proxy for demand. This further motivates the estimation of equation (5) on a matched sample of pharmacies (see Section 4.2).[15]

Entry is expected to have stronger effects in areas where market structure is more concentrated, i.e. closer to a monopoly. We assess this hypothesis by estimating equation (5) among the most and the least spatially isolated pharmacies, alternatively.

Our control group may be contaminated by second-order effects related to the entry of non-pharmacies. That is, if pharmacy A experiences the entry of non-pharmacy B among its main competitors, A might lower its price (first-order effect). That may cause C, who is in the control group and has A but not B among its main competitors, to change its price as a response to the price change of A (second-order effect). We mitigate this concern by restricting the control group to pharmacies whose main competitors are in the control group

might be built allowing consumers to easily cross over a high-speed road.

[13]Pharmacies experiencing non-pharmacy entry at several points in time, or experiencing both supermarket and outlet entry are disregarded from most of our analysis. This avoids having many interaction terms in our model, whose identification relies solely on one or two specific pharmacies. In alternative specifications, we have relaxed the assumption of mutually exclusive treatments and included all the interaction terms. Our results are unchanged (see Table B.6 in the online Appendix).

[14]Table B.1 in the online Appendix shows the composition of control and treatment groups for radius-based definitions of main competitors.

[15]Table B.2 in the online Appendix replicates the same exercise for alternative treatment group definitions based on the radius around each pharmacy.

Table 1: Composition of control and treatment groups, across distinct definitions of main competitors

		Number of nearest neighbors (N)				
		1	2	3	4	5
Control group	2006	190	167	152	138	109
	2010	258	235	220	207	179
	2015	234	212	197	185	159
Treated with supermarket before 2006	2006	0	1	2	3	0
	2010	0	1	2	3	0
	2015	0	1	2	3	0
Treated with supermarket in 2006/10	2006	4	3	6	5	5
	2010	4	3	6	5	5
	2015	4	3	6	5	5
Treated with supermarket in 2010/15	2006	4	8	13	19	18
	2010	4	8	13	19	18
	2015	4	8	13	19	18
Treated with outlet before 2006	2006	8	9	8	13	10
	2010	8	9	8	12	8
	2006	8	9	8	12	7
Treated with outlet in 2006/10	2006	10	8	10	10	14
	2010	10	8	10	10	14
	2015	10	8	10	9	12
Treated with outlet in 2010/15	2006	15	9	11	18	18
	2010	15	9	11	18	18
	2015	15	9	11	18	18
Total	2006	231	205	202	206	174
	2010	299	273	270	274	242
	2015	275	250	247	251	219

NOTES: The table shows the number of pharmacies included in the estimation sample per treatment group and year, across different values of nearest neighbors. The lower number of pharmacies in the control group in 2006 is a consequence of missing price data for that year, as discussed in Section 4. In addition, the number of pharmacies used changes with the number of nearest neighbors because we are focusing on a sample of pharmacies for which each treatment is mutually exclusive. Thus, a more nearest neighbors means higher chances that a pharmacy falls into more than one treatment group and is excluded from the analysis.

Table 2: Testing for differences between groups at baseline (2006) across distinct definitions of main competitors

		Number of nearest neighbors (N)				
		1	2	3	4	5
Price *Aspirina 500mg* (€)	Control group	3.041	3.030	3.033	3.036	3.033
	Eventually treated	2.873	3.045	2.996	2.997	3.013
	Difference	0.167**	-0.015	0.026	0.040	0.020
	P-value	0.018	0.772	0.378	0.321	0.588
Price *Cêgripe* (€)	Control group	4.292	4.302	4.312	4.314	4.325
	Eventually treated	4.273	4.227	4.195	4.224	4.260
	Difference	0.019	0.074*	0.118***	0.089**	0.065*
	P-value	0.745	0.073	0.002	0.013	0.063
Price *Trifene200* (€)	Control group	3.326	3.336	3.348	3.415	3.340
	Eventually treated	3.271	3.268	3.255	3.307	3.326
	Difference	3.322*	0.069	0.093**	0.035	0.014
	P-value	0.055	0.167	0.041	0.411	0.732
Price *Mebocaína Forte* (€)	Control group	4.664	4.663	4.676	4.671	4.681
	Eventually treated	4.582	4.635	4.613	4.667	4.697
	Difference	0.082	0.028*	0.062	0.004	-0.015
	P-value	0.295	0.062	0.238	0.931	0.725
Price *Tantum Verde* (€)	Control group	4.970	4.972	4.987	4.979	4.993
	Eventually treated	4.864	4.899	4.848	4.918	4.940
	Difference	0.107	0.073	0.139**	0.061	0.053
	P-value	0.309	0.337	0.047	0.356	0.418
Distance to Nth nearest neighbor (km)	Control group	0.309	0.408	0.516	0.605	0.298
	Eventually treated	0.434	0.505	0.596	0.624	0.312
	Difference	-0.125*	-0.097*	-0.079	-0.018	-0.014
	P-value	0.059	0.060	0.197	0.769	0.702
Walking time to Nth nearest neighbor (min)	Control group	3.729	5.042	6.599	7.630	3.533
	Eventually treated	5.077	6.071	7.343	7.651	3.865
	Difference	-1.348	-1.030	-0.744	-0.021	-0.333
	P-value	0.120	0.140	0.369	0.980	0.491
Avg distance to N nearest neighbors (km)	Control group		0.154	0.241	0.311	0.510
	Eventually treated		0.188	0.275	0.323	0.512
	Difference		-0.034	-0.035	-0.012	-0.002
	P-value		0.142	0.241	0.717	0.966
Avg walking time to N nearest neighbors (min)	Control group		4.406	5.161	5.796	6.385
	Eventually treated		5.357	5.800	5.860	6.249
	Difference		-0.951	-0.639	-0.064	0.136
	P-value		0.128	0.323	0.920	0.836
Population in census block (as of 2001)	Control group	609.516	598.024	589.507	591.058	588.156
	Eventually treated	698.308	723.286	709.686	662.233	618.763
	Difference	-88.792	-125.262***	-120.507***	-71.175**	-30.608
	P-value	0.124	0.002	0.001	0.040	0.340

NOTES: The table conveys the 2006 mean of several variables of interest for two distinct groups, across different definitions of main competitors. For each panel, the figures in the first row correspond to pharmacies belonging to the control group. The figures in the second row correspond to pharmacies which were not yet treated in 2006, but will eventually face the entry of a non-pharmacy amongst their competitors, thus grouping together pharmacies facing the entry of a supermarket or an outlet either between 2006 and 2010, or between 2010 and 2015. Pharmacies already treated in 2006 are not accounted for in this table. The third row computes the difference of rows 1 and 2, and row 4 shows the corresponding two-sided p-value. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

themselves. This robustness check is informative about whether our choice for the set of main competitors, and our definitions of control and treatment groups are adequate.

Finally, the maps of the market structure of the OTC market in Lisbon in online Appendix A show that some retailers exited the market during our study-period. Most of these were pharmacies. In our robustness checks, we address pharmacy exit in several ways. First, we estimate equation (5) on a balanced panel of pharmacies. Second, we estimate equation (5) among pharmacies whose main competitors do not exit the market. Third, we assess whether experiencing the entry of a non-pharmacy retailer makes pharmacies more likely to exit the market in the future. Specifically, we estimate a logit model whose dependent variable is a binary indicator taking value 1 in case pharmacy i exits the market before the next round of data collection, and value 0 otherwise. The independent variables are treatment group indicators, year fixed-effects, and parish fixed-effects. If the estimates corresponding to the treatment group indicators are not statistically different from zero, then experiencing entry of a supermarket or outlet does not systematically cause pharmacies to exit the market.

5.2 Endogeneity of market structure

Our estimates from equation (5) can only be interpreted as causal if entry and location decisions of non-pharmacies are exogenous. The decision to open a supermarket or outlet in a given location is plausibly unrelated to pharmacy market structure, as OTC drugs are a small subset of their product range.[16] However, it is more difficult to defend the exogeneity assumption when not all retailers belonging to a given chain apply for a license to sell OTC drugs.

One potential threat is the existence of *time-varying*, retailer-specific, unobservables that affect both prices charged by incumbent pharmacies and entry. This occurs, for example, if certain retailers experience demand shocks due to the natural course of urban development, gentrification of certain neighborhoods, etc. Previous literature instruments for entry using pre-existing market structure, though this is a rather weak instrument (Basker and Noel, 2009). Instead, we combine propensity score matching with our DID design (Heckman et al., 1997; Smith and Todd, 2005). The underlying idea is that by matching treated and untreated pharmacies on their propensity score, that is, on their probability of being treated, we make treated and control groups more similar in terms of the observables used in the estimation of the propensity score. Thus, treatment should be random, conditional on those observables.

[16] In the particular case of supermarket chains, OTC drugs seem to correspond to a small share of total sales. For example, in 2014 the supermarket chain with the largest OTC sales value was Pingo Doce with M€ 8.3 nationwide (Infarmed, IP, 2015). Its total sales value was M€ 3,234 (Jerónimo Martins SGPS SA, 2015). At the time OTC drugs were available at 74 of a total of 380 stores existing Pingo Doce in Portugal. Assuming stores are symmetric, on average, OTC drugs amount to 1.3% of total sales value per store.

We estimate the propensity score as a function of the levels of competitive pressure and demand faced by each pharmacy prior to experiencing their first non-pharmacy entrant.[17] We then use the estimated propensity scores to build two matched samples of pharmacies using, alternatively, single neighbor matching and local linear regression (see online Appendix E for additional technical details). Finally, we estimate equation (5) in this matched samples. Another potential threat is that, in addition to pharmacies adjusting their prices in the presence of a non-pharmacy, non-pharmacies make location decisions based on prices charged by existing pharmacies in the area. We address this concern by assuming a sequential game in which in year $t-1$ supermarkets and outlets make joint entry and location decisions for year t, taking into account (functions of) $t-1$ prices charged by the pharmacies they would be competing with. Then in year t entry is realized and observed, and all players make their pricing decisions for that year taking entry as given. We have no information on retailers that did not enter the market. Thus, we use the fact that we observe entry in certain locations, but not in others. For this analysis, retailers are the relevant unit of observation and the prices of each of the five OTC drugs are aggregated to generate an OTC bundle price which is retailer-year specific, $P_{it} = \sum_{k=1}^{5} P_{ikt}$. The equation taken to the data is as follows:

$$entry^*_{ijt} = \beta_0 + \beta_1 \zeta(P_{i,t-1}) + \delta_t + \lambda_j + \varepsilon_{ijt}, \qquad \varepsilon_{ijt} \sim iid\ logistic \tag{6}$$

$$entry_{ijt} = \begin{cases} 1 & \text{if } entry^*_{ijt} > 0, \\ 0 & \text{if } entry^*_{ijt} \leq 0 \end{cases}$$

where $entry^*_{ijt}$ is a latent variable representing the probability that pharmacy i, located in parish j, experiences the entry of a non-pharmacy among its competitors in year t. Although we do not observe this probability, we observe whether a pharmacy experienced non-pharmacy entry at a given point in time, $entry_{ijt}$. Thus, $entry_{ijt}$ is a binary indicator taking value 1 in case pharmacy i located in parish j experienced the entry of a supermarket or outlet among its main competitors in year t, and value 0 otherwise. $\zeta(P_{t-1})$ is a functional form through which past prices affect entry and location decisions by supermarkets or outlets. ζ is, alternatively, the $t-1$ price charged by pharmacy i located in parish j (P_{ijt-1}), and the ratio between P_{ijt-1} and the average $t-1$ price among all retailers operating in Lisbon. The remaining terms are time and parish fixed effects. ε_{ijt} is a logistically-distributed error term. Since we take lags of price, the model is estimated using the years 2010 and 2015 only and the lags

[17] Specifically, demand is measured as population living in the census block where the pharmacy is located, as of 2001 (Table 2 shows that treated and control groups are different in this dimension, further motivating the use of this variable in the matching process). Competitive pressure is measured by the average walking time, in minutes, to the N closest competitors as of 2006. We do not take into consideration the groups that were treated already in 2006, as for those we do not observe a pre-treatment period.

are taken with respect to the previous period for which we have data. We estimate separate models for the probability of experiencing entry of a supermarket or an outlet, and for all our alternative definitions of main competitors. If the estimates of β_1 are not statistically different from zero in these models, then entry and location decisions by supermarkets and outlets are not driven by past prices charged by pharmacies operating in that location.

6 Results

Table 3 shows the estimates of equation (5), each column corresponding to a distinct choice of N. Overall, the entry of a supermarket among the N nearest neighbors of a pharmacy is associated with long-lasting price decreases. In 2010, pharmacies who faced the entry of a supermarket amongst their $N = 1, ...4$ nearest neighbors between 2006 and 2010 charged 6-9% lower prices than those in the control group. In 2015, this very same group of pharmacies was still charging, on average, 5-9% lower prices than pharmacies in the control group.[18] The effects are of smaller magnitude and weaker significance for pharmacies experiencing entry of a supermarket between 2010 and 2015. These effects seem fairly localized, as for N=5 they are already fading out. While pharmacies experiencing supermarket entry before 2006 charge 2-3% lower prices than those in the control group both in 2010 and 2015, we do not know how their prices compared to the control group pre-entry and thus do not put too much emphasis on this result.

The entry of an outlet among the N-nearest neighbors of a pharmacy is not associated with price reductions. Recall from the theoretical framework in Section 3 that entry does not necessarily lead incumbents to reduce prices. Indeed, due to the localized nature of competition, entry can lead to higher prices if the entrant is less efficient, so that the incumbent faces a softer rival at the margin. Some of our results seem to reflect that.

In the last two rows of Table 3, we compare the prices charged in 2010 by pharmacies that are treated only after 2010 with those charged by pharmacies in the control group. The lack of statistical significance of these coefficients in all but one specification broadly supports the plausibility of the common trend assumption. Nevertheless, their magnitudes are sometimes not too different from our main effects. Figure D.3 in online Appendix D plots raw prices for the two groups of pharmacies treated after 2010 and the control group. These plots do not suggest different trends across groups, though we would need a longer panel to make a stronger claim regarding this matter.

[18] To put these effects into perspective, the entry of a pharmacy chain in India is associated with a 2% price decline among incumbents (Bennett and Yin, 2019), and the entry of Walmart, which charged on average 10% lower prices, is associated with a 1-1.2% price decrease by its competitors (Basker and Noel, 2009) and a short-run average city-level price decrease in the range of 1.5-3% (Basker, 2005).

Table 3: Estimates of θ, across different values of N

	Number of nearest neighbors (N)				
	1	2	3	4	5
DiD estimates:					
2010×Treated with supermarket before 2006		-0.038***	-0.027***	-0.037***	
		(0.005)	(0.008)	(0.006)	
2015×Treated with supermarket before 2006		-0.023***	-0.038***	-0.023***	
		(0.005)	(0.013)	(0.006)	
2010×Treated with supermarket in 2006/10	-0.063**	-0.094***	-0.064***	-0.082***	-0.049
	(0.027)	(0.016)	(0.019)	(0.023)	(0.031)
2015×Treated with supermarket in 2006/10	-0.062**	-0.095***	-0.064***	-0.050*	-0.044*
	(0.028)	(0.017)	(0.022)	(0.028)	(0.023)
2015×Treated with supermarket in 2010/15	-0.035*	-0.037***	-0.015	-0.029	-0.028**
	(0.020)	(0.012)	(0.016)	(0.018)	(0.015)
2010×Treated with outlet before 2006	0.007	-0.016	0.013	0.044**	0.046***
	(0.016)	(0.024)	(0.020)	(0.018)	(0.014)
2015×Treated with outlet before 2006	0.001	-0.025	-0.005	0.008	0.016
	(0.019)	(0.023)	(0.010)	(0.021)	(0.020)
2010×Treated with outlet in 2006/10	-0.017**	-0.034	0.009	-0.015	-0.005
	(0.007)	(0.023)	(0.023)	(0.029)	(0.025)
2015×Treated with outlet in 2006/10	0.031***	-0.027	0.015	-0.001	0.028
	(0.005)	(0.020)	(0.021)	(0.024)	(0.020)
2015×Treated with outlet in 2010/15	0.003	-0.014	-0.001	-0.018	-0.004
	(0.053)	(0.033)	(0.034)	(0.024)	(0.019)
Pre-treatment trends:					
2010×Treated with supermarket in 2010/15	-0.022	-0.026	-0.009	-0.027	-0.027
	(0.022)	(0.026)	(0.027)	(0.023)	(0.019)
2010×Treated with outlet in 2010/15	-0.053***	-0.017	-0.007	-0.003	-0.000
	(0.020)	(0.018)	(0.018)	(0.012)	(0.011)
Time FE	YES	YES	YES	YES	YES
Drug FE	YES	YES	YES	YES	YES
Pharmacy FE	YES	YES	YES	YES	YES
N	3,709	3,624	3,429	3,309	3,160
R^2	0.910	0.911	0.912	0.912	0.913

NOTES: Estimates based on equation (5) among traditional pharmacies. The columns take the main competitors of pharmacy i as its N nearest neighbors, with N=1,..5. Standard errors in parenthesis are clustered at the pharmacy level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Our results are driven by the most spatially isolated pharmacies as of 2006 (Table B.1 in the online Appendix). Estimating the model amongst the least isolated pharmacies as of 2006 yields few significant effects and of a very small magnitude, suggesting that price reductions mostly originate from pharmacies who enjoyed some degree of market power before experiencing entry (Table B.2 in the online Appendix).

Our baseline results remain are robust to estimating the model in a balanced panel of pharmacies, including all retailer types, including pharmacies that are in multiple treatment groups, and to restricting the sample to pharmacies whose main competitors are in the control group themselves (Tables B.5, B.3, B.6, and B.4 in the online Appendix, respectively). Estimating the model on propensity-score-matched samples of control and treated pharmacies yields results of similar magnitude, though in some cases significance is lost (Table B.8 in the online Appendix). Experiencing the entry of a non-pharmacy retailer does not seem to cause pharmacies to exit the market before the next round of data collection (Table B.10 in the online Appendix).[19]

The results of our reduced-form entry model do not support the claim that non-pharmacies make entry decisions based on the prices charged by pharmacies already operating in that area, since the estimate of β_1 in equation (6) is not statistically significant in most specifications (Table B.9 in the online Appendix). Because our reduced-form entry model has a very specific functional form, we create bar charts of the share of pharmacies in each of the deciles of current and past prices for the bundle of drugs we analyze. We do this separately by year and by type of non-pharmacy entrant. If entry is in any way related to current or past prices, then these plots should convey a non-random relationship. In particular, if entry occurred in locations which were more profitable because they had higher prices, then pharmacies in the highest price deciles would experience the largest shares of entry by non-pharmacies. We find no such pattern (Figure D.1 in the online Appendix). A similar analysis using deciles of resident population instead of price deciles yields again no clear pattern (Figure D.2 in the online Appendix).[20]

Finally, all these results and robustness checks are broadly robust to defining the treatments to facing the entry of a supermarket or outlet within a radius of 400 meters. Longer radius of 600 or 800 meters show very little price effects, supporting the finding that competition

[19] Exit of traditional pharmacies cannot be directly linked to the liberalization of the OTC market, as the share of OTC drugs on total pharmacy revenue is probably too small to produce such an impact. Instead, it is more likely a consequence of the overall economic environment and the squeezing of pharmacy margins on prescription drugs (Barros, 2012). In Table F.1 in the Online Appendix we provide a brief overview of the main regulations affecting pharmacy profitability that were passed between 2005 and 2015.

[20] The plots shown in the online appendix are for N=5. Plots for smaller values of N are available upon request. They convey a similar picture but are "emptier", since lower values of N mean less pharmacies experiencing non-pharmacy entry.

among pharmacies has a very local nature (online Appendix C).

7 Concluding remarks

In this study, we use unique OTC price data at the retailer level for the city of Lisbon to examine the effects of non-pharmacy entry on the prices of incumbent pharmacies. We show that non-pharmacy entry can be successful at fostering competition and lowering prices charged by traditional pharmacies. However, the extent to which this occurs depends crucially on the type non-pharmacy entrant and, particularly, on their ability to underprice incumbent pharmacies. Recall that supermarkets in our sample charge about 20% lower prices than incumbent pharmacies, whereas outlets charge 4% lower prices than pharmacies. This means that supermarkets have a greater ability to exert competitive pressure on incumbent pharmacies than outlets.

Our results reflect those differences: While incumbent pharmacies charge 3-9% lower prices (depending on the model specification) than the control group after experiencing the entry of a supermarket among their main competitors, they seem not to react to the entry of an outlet. Furthermore, while incumbent pharmacies lower their prices as a response to supermarket entry, they do not lower prices enough so as to match the prices charged by supermarkets. This findings are in line with predictions from a Salop model with non-pharmacy entrants differing from incumbents in their marginal cost.

Our results are specific to retailers operating in the Lisbon municipality and to the set of drugs and years we analyze. They might not apply generalize to other settings. In particular, price reductions may not occur in rural areas, where entry of supermarkets takes place on a smaller scale. Nevertheless, our study contributes to a deeper understanding of how competition takes place in retail pharmaceutical OTC markets.

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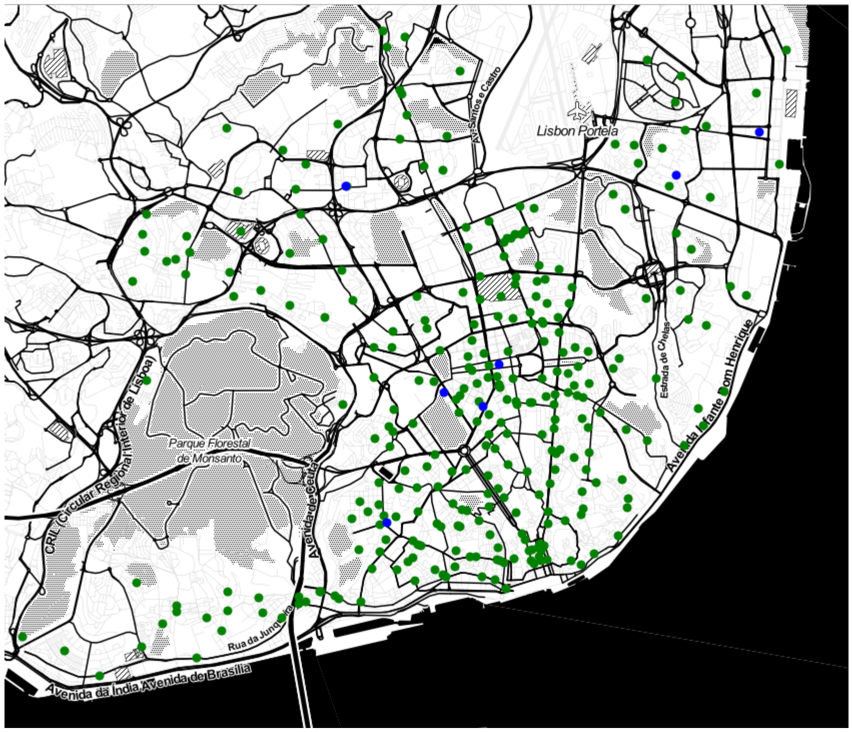
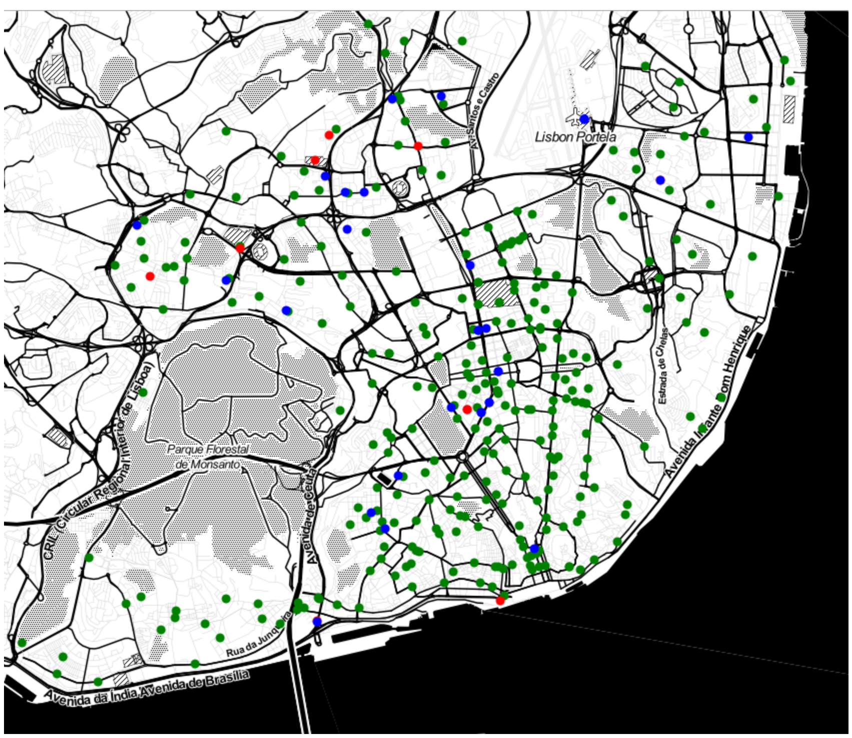
Online Appendix

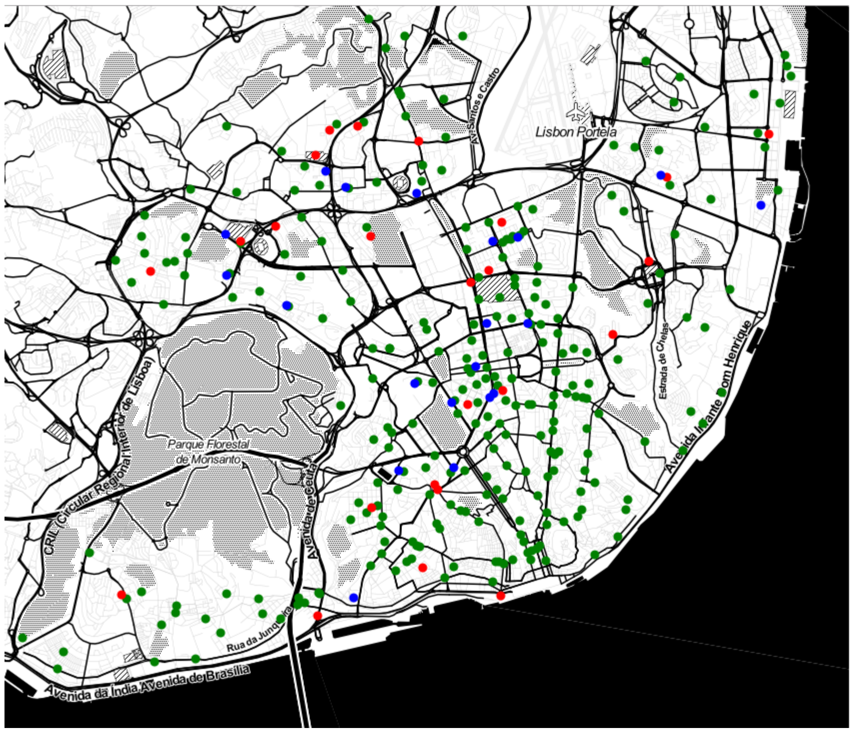
A OTC Market Structure in Lisbon



(a) 2006



(b) 2010



(c) 2015

Figure A.1: Evolution of OTC market structure in Lisbon

NOTES: Panels (a), (b) and (c) convey the location and type of each OTC retailer active in the Lisbon market as of 2006, 2010, and 2015, respectively. Traditional pharmacies are marker in green, supermarkets are marked in red and outlets are marked in blue. Because some retailers are located very nearby each other, the markers might overlap. In total, there were 301 pharmacies, 1 supermarket, and 8 outlets in 2006; 283 pharmacies, 10 supermarkets, and 25 outlets in 2010; and 259 pharmacies, 25 supermarkets, and 21 outlets in 2015.

B Additional Tables of Results

Table B.1: Results from estimating equation (5) among the most spatially isolated pharmacies in 2006

	Number of nearest neighbors (N)				
	1	2	3	4	5
DID estimates:					
2010×Treated with supermarket before 2006		-0.032***	-0.026**	-0.034***	
		(0.008)	(0.010)	(0.009)	
2015×Treated with supermarket before 2006		-0.025***	-0.033**	-0.020*	
		(0.008)	(0.015)	(0.010)	
2010×Treated with supermarket in 2006/10	-0.058**	-0.070***	-0.071***	-0.102***	-0.055*
	(0.028)	(0.009)	(0.022)	(0.020)	(0.032)
2015×Treated with supermarket in 2006/10	-0.061**	-0.116***	-0.078***	-0.077***	-0.056**
	(0.029)	(0.010)	(0.018)	(0.021)	(0.025)
2015×Treated with supermarket in 2010/15	-0.029	-0.045***	-0.033**	-0.029*	-0.055**
	(0.027)	(0.016)	(0.016)	(0.016)	(0.025)
2010×Treated with outlet before 2006	0.037**	0.035***	0.008	0.028**	0.031**
	(0.016)	(0.013)	(0.025)	(0.014)	(0.013)
2015×Treated with outlet before 2006	0.032	0.019	-0.003	-0.012	-0.035**
	(0.040)	(0.031)	(0.013)	(0.016)	(0.013)
2010×Treated with outlet in 2006/10	-0.012	-0.025	-0.014	-0.023	-0.005
	(0.009)	(0.026)	(0.026)	(0.028)	(0.034)
2015×Treated with outlet in 2006/10	0.031***	-0.015	0.006	-0.006	0.023
	(0.009)	(0.024)	(0.025)	(0.027)	(0.031)
2015×Treated with outlet in 2010/15	0.131***	0.059	0.067	-0.093***	-0.067*
	(0.009)	(0.052)	(0.052)	(0.026)	(0.035)
Pre-treatment trends:					
2010×Treated with supermarket in 2010/15	-0.040***	-0.035	-0.041	-0.040	-0.050
	(0.012)	(0.037)	(0.032)	(0.028)	(0.047)
2010×Treated with outlet in 2010/15	-0.091***	-0.014	-0.016	-0.010	-0.032
	(0.008)	(0.037)	(0.037)	(0.009)	(0.021)
Time FE	YES	YES	YES	YES	YES
Drug FE	YES	YES	YES	YES	YES
Pharmacy FE	YES	YES	YES	YES	YES
N	1288	1292	1257	1137	903
R^2	0.916	0.919	0.921	0.921	0.921

NOTES: Estimates based on the fixed effects estimation of equation (5) among pharmacies located in areas where market structure is the most concentrated. The columns take the main competitors of pharmacy i as its N nearest neighbors, with N=1,..5. The sample was restricted to pharmacies whose walking time (in minutes) to their Nth competitor is above the sample median in 2006. Standard errors shown in parenthesis are clustered at the pharmacy level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table B.2: Results from estimating equation (5) among the least spatially isolated pharmacies in 2006

	Number of nearest neighbors (N)				
	1	2	3	4	5
DID estimates:					
2010×Treated with supermarket before 2006					
2015×Treated with supermarket before 2006					
2010×Treated with supermarket in 2006/10			-0.058*	-0.086**	
			(0.030)	(0.034)	
2015×Treated with supermarket in 2006/10			-0.036*	-0.028	
			(0.019)	(0.025)	
2015×Treated with supermarket in 2010/15	-0.048***	-0.031	-0.007	-0.032	-0.019
	(0.009)	(0.023)	(0.025)	(0.022)	(0.022)
2010×Treated with outlet before 2006	-0.036*	-0.041	0.013	0.047**	0.065***
	(0.018)	(0.032)	(0.021)	(0.020)	(0.021)
2015×Treated with outlet before 2006	-0.004	-0.053**	-0.010	0.013	0.050*
	(0.009)	(0.021)	(0.010)	(0.023)	(0.026)
2010×Treated with outlet in 2006/10		-0.057	0.030	-0.011	0.018
		(0.036)	(0.030)	(0.042)	(0.031)
2015×Treated with outlet in 2006/10		-0.078***	0.003	-0.018	0.043*
		(0.019)	(0.033)	(0.035)	(0.024)
2015×Treated with outlet in 2010/15	-0.072***	-0.054	-0.005	-0.023	0.001
	(0.009)	(0.034)	(0.034)	(0.024)	(0.023)
Pre-treatment trends:					
2010×Treated with supermarket in 2010/15	0.053***	0.026*	0.017	-0.021	0.018
	(0.009)	(0.013)	(0.025)	(0.021)	(0.025)
2010×Treated with outlet in 2010/15	-0.013	-0.018	-0.007	-0.005	0.006
	(0.009)	(0.020)	(0.019)	(0.012)	(0.015)
Time FE	YES	YES	YES	YES	YES
Drug FE	YES	YES	YES	YES	YES
Pharmacy FE	YES	YES	YES	YES	YES
N	1102	1497	1752	1856	1099
R^2	0.908	0.915	0.918	0.919	0.919

NOTES: Estimates based on the fixed effects estimation of equation (5) among pharmacies located in areas where market structure is the least concentrated. The columns take the main competitors of pharmacy i as its N nearest neighbors, with N=1,..5. The sample was restricted to pharmacies whose walking time (in minutes) to their Nth competitor is below the sample median in 2006. Standard errors shown in parenthesis are clustered at the pharmacy level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table B.3: Results from estimating equation (5) among all retailer types

	Number of nearest neighbors (N)				
	1	2	3	4	5
DID estimates:					
2010×Treated with supermarket before 2006		-0.039***	-0.029***	-0.041***	
		(0.006)	(0.008)	(0.006)	
2015×Treated with supermarket before 2006		-0.020***	-0.034**	-0.022***	
		(0.006)	(0.013)	(0.006)	
2010×Treated with supermarket in 2006/10	-0.064**	-0.096***	-0.066***	-0.123***	-0.053*
	(0.027)	(0.016)	(0.019)	(0.037)	(0.031)
2015×Treated with supermarket in 2006/10	-0.058**	-0.092***	-0.060***	-0.107*	-0.042*
	(0.028)	(0.017)	(0.022)	(0.056)	(0.023)
2015×Treated with supermarket in 2010/15	-0.032	-0.034***	-0.011	-0.027	-0.026*
	(0.021)	(0.012)	(0.016)	(0.018)	(0.015)
2010×Treated with outlet before 2006	0.006	-0.025	-0.008	0.012	0.043***
	(0.016)	(0.024)	(0.027)	(0.030)	(0.014)
2015×Treated with outlet before 2006	0.004	-0.018	0.000	-0.004	0.018
	(0.019)	(0.023)	(0.019)	(0.024)	(0.020)
2010×Treated with outlet in 2006/10	-0.003	-0.029	0.008	-0.019	-0.004
	(0.014)	(0.021)	(0.023)	(0.029)	(0.024)
2015×Treated with outlet in 2006/10	0.041***	-0.020	0.019	0.001	0.032*
	(0.009)	(0.020)	(0.021)	(0.024)	(0.019)
2015×Treated with outlet in 2010/15	0.006	-0.010	0.003	-0.016	-0.002
	(0.053)	(0.033)	(0.034)	(0.024)	(0.020)
Pre-treatment trends:					
2010×Treated with supermarket in 2010/15	-0.023	-0.027	-0.011	-0.031	-0.030
	(0.022)	(0.026)	(0.027)	(0.023)	(0.019)
2010×Treated with outlet in 2010/15	-0.054***	-0.018	-0.008	-0.006	-0.004
	(0.020)	(0.018)	(0.018)	(0.012)	(0.012)
Time FE	YES	YES	YES	YES	
Drug FE	YES	YES	YES	YES	
Retailer FE	YES	YES	YES	YES	
N	4,141	4,056	3,851	3,716	3,542
R^2	0.904	0.904	0.905	0.905	0.906

NOTES: Estimates based on the fixed effects estimation of equation (5) among all retailer types: traditional pharmacies, supermarkets and outlets. The columns take the main competitors of retailer i as its N nearest neighbors, with N=1,..5. Standard errors shown in parenthesis are clustered at the retailer level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table B.4: Results from estimating equation (5) among pharmacies whose competitors are all in the control group

	Number of nearest neighbors (N)				
	1	2	3	4	5
DID estimates:					
2010×Treated with supermarket before 2006		-0.036***	-0.026***	-0.054***	
		(0.006)	(0.009)	(0.019)	
2015×Treated with supermarket before 2006		-0.022***	-0.038***	-0.033*	
		(0.006)	(0.014)	(0.018)	
2010×Treated with supermarket in 2006/10	-0.064**	-0.093***	-0.049**	-0.059***	-0.048
	(0.027)	(0.017)	(0.020)	(0.022)	(0.032)
2015×Treated with supermarket in 2006/10	-0.063**	-0.094***	-0.058***	-0.057**	-0.048**
	(0.028)	(0.018)	(0.020)	(0.025)	(0.024)
2015×Treated with supermarket in 2010/15	-0.037*	-0.036***	-0.015	-0.005	-0.031**
	(0.021)	(0.013)	(0.017)	(0.020)	(0.016)
2010×Treated with outlet before 2006	0.006	-0.015	-0.006	0.024	0.047***
	(0.016)	(0.024)	(0.025)	(0.021)	(0.016)
2015×Treated with outlet before 2006	-0.001	-0.024	0.000	0.010	0.013
	(0.019)	(0.023)	(0.022)	(0.021)	(0.021)
2010×Treated with outlet in 2006/10	-0.018**	-0.033	0.011	-0.012	-0.004
	0.018**	(0.023)	(0.023)	(0.030)	(0.025)
2015×Treated with outlet in 2006/10	0.029***	-0.025	0.015	0.003	0.024
	(0.006)	(0.021)	(0.021)	(0.024)	(0.025)
2015×Treated with outlet in 2010/15	0.001	-0.013	-0.001	0.001	-0.008
	(0.053)	(0.034)	(0.028)	(0.022)	(0.020)
Pre-treatment trends:					
2010×Treated with supermarket in 2010/15	-0.023	-0.025	-0.022	-0.034*	-0.025
	(0.022)	(0.026)	(0.023)	(0.019)	(0.015)
2010×Treated with outlet in 2010/15	-0.053***	-0.015	-0.000	0.005	0.001
	(0.020)	(0.018)	(0.017)	(0.013)	(0.013)
Time FE	YES	YES	YES	YES	YES
Drug FE	YES	YES	YES	YES	YES
Pharmacy FE	YES	YES	YES	YES	YES
N	3,246	2,849	2,455	1,858	1,712
R^2	0.911	0.910	0.915	0.912	0.918

NOTES: Estimates based on the fixed effects estimation of equation (5) among pharmacies whose competitors are all in the control group. The columns take the main competitors of pharmacy i as its N nearest neighbors, with N=1,..5. Standard errors shown in parenthesis are clustered at the pharmacy level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table B.5: Results from estimating equation (5) in a balanced panel of pharmacies

	Number of nearest neighbors (N)				
	1	2	3	4	5
DID estimates:					
2010×Treated with supermarket before 2006		-0.034***	-0.022***	-0.052***	
		(0.005)	(0.008)	(0.019)	
2015×Treated with supermarket before 2006		-0.023***	-0.037***	0.033*	
		(0.006)	(0.013)	(0.018)	
2010×Treated with supermarket in 2006/10	-0.060**	-0.090***	-0.046**	-0.057***	-0.041
	(0.027)	(0.016)	(0.020)	(0.021)	(0.012)
2015×Treated with supermarket in 2006/10	-0.060**	-0.095***	-0.057***	-0.057**	-0.041*
	(0.028)	(0.018)	(0.020)	(0.024)	(0.024)
2015×Treated with supermarket in 2010/15	-0.034*	-0.034***	-0.011	-0.004	-0.023
	(0.021)	(0.012)	(0.017)	(0.019)	(0.015)
2010×Treated with outlet before 2006	0.010	-0.013	-0.005	0.025	0.054***
	(0.016)	(0.024)	(0.025)	(0.021)	(0.016)
2015×Treated with outlet before 2006	0.002	-0.024	0.000	0.008	0.019
	(0.019)	(0.023)	(0.021)	(0.021)	(0.021)
2010×Treated with outlet in 2006/10	-0.014*	-0.031	0.014	0.010	0.027
	(0.007)	(0.023)	(0.023)	(0.025)	(0.021)
2015×Treated with outlet in 2006/10	0.032***	-0.026	0.016	0.013	0.043**
	(0.006)	(0.021)	(0.021)	(0.023)	(0.019)
2015×Treated with outlet in 2010/15	0.005	-0.013	-0.000	0.001	-0.001
	(0.053)	(0.033)	(0.028)	(0.022)	(0.020)
Pre-treatment trends:					
2010×Treated with supermarket in 2010/15	-0.019	-0.018	-0.016	-0.030	-0.017
	(0.022)	(0.026)	(0.023)	(0.019)	(0.020)
2010×Treated with outlet in 2010/15	-0.049**	-0.013	0.002	0.007	0.009
	(0.020)	(0.018)	(0.017)	(0.012)	(0.012)
Time FE	YES	YES	YES	YES	YES
Drug FE	YES	YES	YES	YES	YES
Pharmacy FE	YES	YES	YES	YES	YES
N	2,460	2,385	2,265	2,235	1,923
R^2	0.912	0.920	0.923	0.921	0.924

NOTES: Estimates based on the fixed effects estimation of equation (5) among pharmacies who are observed throughout the entire period of analysis, 2006-2015. The columns take the main competitors of pharmacy i as its N nearest neighbors, with N=1,..5. Standard errors shown in parenthesis are clustered at the pharmacy level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table B.6: Results from estimating equation (5) with non-mutually exclusive treatments

	Number of nearest neighbors (N)				
	1	2	3	4	5
DID estimates:					
2010×Treated with supermarket before 2006		-0.038***	-0.027***	-0.036***	-0.032
		(0.005)	(0.008)	(0.006)	(0.024)
2015×Treated with supermarket before 2006		-0.023***	-0.038***	-0.021***	-0.049***
		(0.005)	(0.013)	(0.006)	(0.019)
2010×Treated with supermarket in 2006/10	-0.063**	-0.094***	-0.064***	-0.081***	-0.048
	(0.027)	(0.016)	(0.019)	(0.023)	(0.031)
2015×Treated with supermarket in 2006/10	-0.062**	-0.095***	-0.064***	-0.048*	-0.041*
	(0.028)	(0.017)	(0.022)	(0.028)	(0.023)
2015×Treated with supermarket in 2010/15	-0.035*	-0.037***	-0.018	-0.008	0.010
	(0.020)	(0.012)	(0.015)	(0.020)	(0.015)
2010×Treated with outlet before 2006	0.007	-0.016	0.013	0.044**	0.048***
	(0.016)	(0.024)	(0.020)	(0.018)	(0.014)
2015×Treated with outlet before 2006	0.001	-0.025	-0.005	0.010	0.019
	(0.019)	(0.023)	(0.010)	(0.021)	(0.020)
2010×Treated with outlet in 2006/10	-0.017**	-0.034	0.009	-0.015	-0.004
	(0.007)	(0.023)	(0.023)	(0.029)	(0.025)
2015×Treated with outlet in 2006/10	0.031***	-0.027	0.015	0.001	0.031
	(0.005)	(0.020)	(0.021)	(0.024)	(0.020)
2015×Treated with outlet in 2010/15	0.003	-0.014	-0.004	0.001	0.014
	(0.053)	(0.033)	(0.031)	(0.023)	(0.018)
Pre-treatment trends:					
2010×Treated with supermarket in 2010/15	-0.022	-0.026	-0.012	-0.027	-0.022
	(0.022)	(0.026)	(0.024)	(0.020)	(0.017)
2010×Treated with outlet in 2010/15	-0.053***	-0.017	-0.010	-0.003	0.004
	(0.020)	(0.018)	(0.017)	(0.012)	(0.012)
Time FE	YES	YES	YES	YES	YES
Drug FE	YES	YES	YES	YES	YES
Pharmacy FE	YES	YES	YES	YES	YES
Treatment group interactions × Time FE	YES	YES	YES	YES	YES
N	3,769	3,769	3,769	3,769	3,769
R^2	0.908	0.909	0.909	0.909	0.909

NOTES: Estimates based on the fixed effects estimation of equation (5) among traditional pharmacies, without imposing mutually exclusivity of treatments. The estimates corresponding to the interactions treatment group interactions and time fixed-effects are typically insignificant, and are available upon request from the authors. The columns take the main competitors of pharmacy i as its N nearest neighbors, with N=1,..5. Standard errors shown in parenthesis are clustered at the pharmacy level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table B.7: Results from estimating equation (5) among pharmacies whose main competitors did not exit

	Number of nearest neighbors (N)				
	1	2	3	4	5
DID estimates:					
2010×Treated with supermarket before 2006		-0.038***	-0.028***	-0.049***	
		(0.006)	(0.008)	(0.010)	
2015×Treated with supermarket before 2006		-0.022***	-0.037***	-0.027***	
		(0.006)	(0.013)	(0.007)	
2010×Treated with supermarket in 2006/10	-0.065**	-0.095***	-0.059***	-0.062***	-0.050
	(0.027)	(0.016)	(0.022)	(0.022)	(0.031)
2015×Treated with supermarket in 2006/10	-0.062**	-0.094***	-0.058**	-0.057**	-0.043*
	(0.028)	(0.018)	(0.024)	(0.024)	(0.023)
2015×Treated with supermarket in 2010/15	-0.054**	-0.032**	-0.016	-0.006	-0.027
	(0.026)	(0.013)	(0.015)	(0.020)	(0.015)
2010×Treated with outlet before 2006	0.045***	0.029**	0.050***	0.037***	0.048***
	(0.007)	(0.013)	(0.006)	(0.010)	(0.007)
2015×Treated with outlet before 2006	-0.040*	-0.052***	-0.011*	-0.018**	-0.011
	(0.022)	(0.017)	(0.006)	(0.007)	(0.007)
2010×Treated with outlet in 2006/10	-0.020***	-0.059*	-0.026	-0.027	0.001
	(0.007)	(0.031)	(0.036)	(0.036)	(0.033)
2015×Treated with outlet in 2006/10	0.030***	-0.007	0.016	0.016	0.030
	(0.006)	(0.029)	(0.029)	(0.029)	(0.026)
2015×Treated with outlet in 2010/15	0.002	-0.012	0.009	0.001	-0.003
	(0.053)	(0.033)	(0.028)	(0.022)	(0.020)
Pre-treatment trends:					
2010×Treated with supermarket in 2010/15	-0.042***	-0.036	-0.013	-0.029	-0.027
	(0.012)	(0.027)	(0.024)	(0.020)	(0.019)
2010×Treated with outlet in 2010/15	-0.055***	-0.017	-0.003	0.000	-0.001
	(0.020)	(0.018)	(0.017)	(0.012)	(0.012)
Time FE	YES	YES	YES	YES	YES
Drug FE	YES	YES	YES	YES	YES
Pharmacy FE	YES	YES	YES	YES	YES
N	2,897	2,867	2,837	2,837	2,673
R^2	0.913	0.913	0.913	0.913	0.914

NOTES: Estimates based on the fixed effects estimation of equation (5) among pharmacies whose main competitors do not exit the market during the time horizon under analysis. The columns take the main competitors of pharmacy i as its N nearest neighbors, with N=1,..5. Standard errors shown in parenthesis are clustered at the pharmacy level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table B.8: Results from estimating equation (5) in matched samples of pharmacies (PSM-DID)

Matching algorithm			Single Neighbor Matching					Local Linear Regression		
Number of nearest neighbors (N)	1	2	3	4	5	1	2	3	4	5
DID estimates:										
2010×Treated with supermarket in 2006/10	-0.060***	-0.079***	-0.055*	-0.037*	-0.048	-0.060	-0.074**	-0.055	-0.039	-0.034
	(0.022)	(0.025)	(0.033)	(0.020)	(0.041)	(0.056)	(0.037)	(0.056)	(0.034)	(0.041)
2015×Treated with supermarket in 2006/10	-0.055***	-0.094***	-0.080**	-0.038	-0.048***	-0.055	-0.092	-0.080*	-0.032	-0.040**
	(0.020)	(0.027)	(0.035)	(0.025)	(0.018)	(0.067)	(0.057)	(0.048)	(0.037)	(0.019)
2015×Treated with supermarket in 2010/15	-0.029*	-0.036***	-0.030	-0.017	-0.032	-0.029	-0.034	-0.030	0.004	-0.024
	(0.015)	(0.008)	(0.027)	(0.015)	(0.020)	(0.065)	(0.043)	(0.044)	(0.033)	(0.018)
2010×Treated with outlet in 2006/10	-0.015**	-0.020	0.019	0.029	-0.004	-0.015	-0.014	0.019	0.015	0.003
	(0.007)	(0.021)	(0.022)	(0.021)	(0.027)	(0.050)	(0.053)	(0.028)	(0.058)	(0.026)
2015×Treated with outlet in 2006/10	0.037**	-0.025	-0.001	0.011	0.025	0.037	-0.024	-0.001	0.012	0.034
	(0.018)	(0.020)	(0.025)	(0.020)	(0.022)	(0.051)	(0.041)	(0.050)	(0.039)	(0.021)
2015×Treated with outlet in 2010/15	0.009	-0.012	-0.016	-0.012	-0.005	0.009	-0.010	-0.016	-0.017	0.002
	(0.062)	(0.025)	(0.035)	(0.022)	(0.021)	(0.062)	(0.051)	(0.066)	(0.027)	(0.021)
Pre-treatment trends:										
2010×Treated with supermarket in 2010/15	-0.020	-0.011	0.000	0.017	-0.025	-0.020	-0.006	0.000	0.026	-0.011
	(0.018)	(0.025)	(0.024)	(0.020)	(0.023)	(0.052)	(0.046)	(0.045)	(0.037)	(0.024)
2010×Treated with outlet in 2010/15	-0.050**	-0.002	0.003	0.039***	0.001	-0.050	0.003	0.002	0.033	0.015
	(0.023)	(0.014)	(0.023)	(0.007)	(0.021)	(0.052)	(0.044)	(0.065)	(0.029)	(0.021)
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Drug FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	390	830	970	1,090	1,600	390	830	970	1,030	1,560
R^2	0.916	0.905	0.913	0.903	0.913	0.916	0.905	0.913	0.904	0.915

NOTES: Estimates based on the fixed effects estimation of equation (5) on a matched sample of pharmacies using two distinct matching algorithms: nearest-neighbor matching and local linear regression. For each of the algorithms, the five columns take the main competitors of pharmacy i as its N nearest neighbors, with N=1,..5. Standard errors shown in parenthesis are bootstrapped using 30 repetitions, drawn cross-sectionally at the pharmacy level in the original sample. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table B.9: Results from the estimation of the reduced-form entry model

Main Competitors	$\zeta(P_{t-1})$ specification	Supermarket	Outlet
1 Nearest neighbor	P_{it-1}	-0.716	-1.937*
		(1.647)	(1.033)
	P_{it-1} relatively to average market price	-0.744	-2.075**
		(1.525)	(1.042)
2 Nearest neighbors	P_{it-1}	-0.885	-0.154
		(5.882)	(0.649)
	P_{it-1} relatively to average market price	-0.802	-0.307
		(3.204)	(0.720)
3 Nearest neighbors	P_{it-1}	-0.771	-1.079
		(1.533)	(1.027)
	P_{it-1} relatively to average market price	-0.999	-1.289
		(4.293)	(1.262)
4 Nearest neighbors	P_{it-1}	-0.912**	-0.593
		(0.448)	(0.917)
	P_{it-1} relatively to average market price	-1.200***	-0.793
		(0.421)	(1.537)
5 Nearest neighbors	P_{it-1}	-0.724	-0.082
		(0.615)	(0.681)
	P_{it-1} relatively to average market price	-0.903	-0.194
		(0.579)	(0.686)

NOTES: Marginal effects of β_1 from RE logit estimation of equation (6), with dependent variable being an indicator for facing the entry of a supermarket (column 1) and an outlet (column 2). There are five panels, taking the main competitors of pharmacy i as its N nearest neighbors, with N=1,..5. In each of the panels, the first row tests whether pharmacy i facing the entry of a supermarket/outlet among its main competitors depends on the prices it charged in the previous period, $\zeta(P_{t-1}) = P_{it-1}$. The corresponding figures can be interpreted as the percentage-point change in the probability of facing entry associated with a 1% higher OTC bundle price in the previous period. The second row tests whether it depends on the lagged prices of pharmacy i relatively to the average bundle price in the city of Lisbon. The corresponding figures can be interpreted as the percentage-point change associated with a 1-unit increase in the independent variable. Recall that our estimation sample differs according to how we define the set of main competitors of pharmacy i, so that a different number of observations is used to obtain each estimate shown on the table. Standard errors shown in parenthesis are clustered at the pharmacy level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table B.10: Does experiencing non-pharmacy entry make pharmacies more likely to exit next period?

	Number of nearest neighbors (N)	
	4	5
Treated with supermarket before 2006		
Treated with supermarket in 2006/10		
Treated with outlet before 2006	-0.137	0.071
	(0.135)	(0.130)
Treated with outlet in 2006/10	-0.143	-0.109
	(0.111)	(0.091)
Time FE	YES	YES
Parish FE	YES	YES
N	380	356

NOTES: Marginal effects from a logit regression of a binary variable equaling 1 for pharmacies that exited before the next round of data collection and 0 otherwise, on treatment group indicators, parish fixed-effects, and year fixed-effects. Columns 1 and 2 take the main competitors of pharmacy i as its N nearest neighbors, with N=4 and N=5, respectively. For N=1,2,3 there is not enough variation to estimate the model: none of pharmacies experiencing entry exits the market. The same occurs for pharmacies experiencing supermarket entry when using N=4 or N=5. Standard errors shown in parenthesis are clustered at the pharmacy level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table B.11: Results from estimating equation (5) with 2-way clustering of the SE by drug and pharmacy

	Number of nearest neighbors (N)				
	1	2	3	4	5
DiD estimates:					
2010×Treated with supermarket before 2006		-0.038**	-0.027	-0.037**	
		(0.010)	(0.023)	(0.011)	
2015×Treated with supermarket before 2006		-0.023	-0.038**	-0.023	
		(0.027)	(0.015)	(0.028)	
2010×Treated with supermarket in 2006/10	-0.063**	-0.094***	-0.064***	-0.082***	-0.049
	(0.017)	(0.015)	(0.012)	(0.018)	(0.027)
2015×Treated with supermarket in 2006/10	-0.062**	-0.095***	-0.064***	-0.050	-0.044**
	(0.016)	(0.007)	(0.012)	(0.024)	(0.011)
2015×Treated with supermarket in 2010/15	-0.035	-0.037***	-0.015	-0.029**	-0.028*
	(0.040)	(0.008)	(0.010)	(0.009)	(0.010)
2010×Treated with outlet before 2006	0.007	-0.016	0.013	0.044**	0.046**
	(0.012)	(0.021)	(0.009)	(0.011)	(0.016)
2015×Treated with outlet before 2006	0.001	-0.025	-0.005	0.008	0.016
	(0.011)	(0.018)	(0.005)	(0.012)	(0.015)
2010×Treated with outlet in 2006/10	-0.017**	-0.034	0.009	-0.015	-0.005
	(0.009)	(0.022)	(0.022)	(0.029)	(0.028)
2015×Treated with outlet in 2006/10	0.031*	-0.027**	0.015	-0.001	0.028
	(0.014)	(0.009)	(0.015)	(0.020)	(0.017)
2015×Treated with outlet in 2010/15	0.003	-0.014	-0.001	-0.018	-0.004
	(0.054)	(0.031)	(0.030)	(0.022)	(0.017)
Pre-treatment trends:					
2010×Treated with supermarket in 2010/15	-0.022	-0.026	-0.009	-0.027	-0.027
	(0.020)	(0.022)	(0.024)	(0.020)	(0.017)
2010×Treated with outlet in 2010/15	-0.053*	-0.017	-0.007	-0.003	-0.000
	(0.024)	(0.021)	(0.021)	(0.009)	(0.008)
Time FE	YES	YES	YES	YES	YES
Drug FE	YES	YES	YES	YES	YES
Pharmacy FE	YES	YES	YES	YES	YES
N	3,709	3,624	3,429	3,309	3,160
R^2	0.910	0.911	0.912	0.912	0.913

NOTES: Estimates based on the fixed effects estimation of equation (5) among pharmacies whose main competitors do not exit the market during the time horizon under analysis. The columns take the main competitors of pharmacy i as its N nearest neighbors, with N=1,..5. Standard errors shown in parenthesis are clustered at the pharmacy level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

C Results from radius-based specifications

Table C.1: Composition of control and treatment groups in radius-based specifications

Radius	Group	2006	2010	2015
400 m	Control Group	136	206	186
	Treated with supermarket before 2006	0	0	0
	Treated with supermarket in 2006/10	5	5	5
	Treated with supermarket in 2010/15	6	6	6
	Treated with outlet before 2006	9	7	6
	Treated with outlet in 2006/10	14	14	12
	Treated with outlet in 2010/15	12	12	12
	Total	182	250	227
600 m	Control Group	94	166	150
	Treated with supermarket before 2006	1	1	1
	Treated with supermarket in 2006/10	9	9	8
	Treated with supermarket in 2010/15	12	12	12
	Treated with outlet before 2006	13	9	7
	Treated with outlet in 2006/10	17	17	14
	Treated with outlet in 2010/15	12	12	12
	Total	158	226	204
800 m	Control Group	68	141	129
	Treated with supermarket before 2006	0	0	0
	Treated with supermarket in 2006/10	9	9	7
	Treated with supermarket in 2010/15	8	8	8
	Treated with outlet before 2006	12	7	6
	Treated with outlet in 2006/10	21	21	18
	Treated with outlet in 2010/15	10	10	10
	Total	128	196	178

NOTES: The table shows the number of pharmacies included in the estimation sample, for each of the radius used to define its set of main competitors. The lower number of pharmacies in the control group in 2006 is a consequence of missing price data for that year, as discussed in Section 4. In addition, the number of pharmacies used changes with the length of the radius because we are focusing on a sample of pharmacies for which each treatment is mutually exclusive. Thus, a longer radius means higher chances that a pharmacy falls into more than one treatment gorup and is excluded from the analysis.

Table C.2: Testing for differences at baseline in radius-based specifications

Variable	Control Group	Eventually Treated	Difference	P-value
Radius: 400m				
Price *Aspirina 500mg* (€)	3.026	3.004	0.022	0.554
Price *Cêgripe* (€)	4.323	4.240	0.065**	0.027
Price *Trifene200* (€)	3.340	3.285	0.055	0.149
Price *Mebocaína Forte* (€)	4.675	4.688	-0.013	0.213
Price *Tantum Verde* (€)	4.995	4.913	0.082	0.418
Number of retailers within radius	4.940	4.838	0.102	0.864
Population in Census section (as of 2001)	590.694	646.255	-55.561	0.104
Number of retailers	108	47		
Radius: 600m				
Price *Aspirina 500mg* (€)	3.022	3.019	0.002	0.958
Price *Cêgripe* (€)	4.321	4.238	0.084*	0.052
Price *Trifene200* (€)	3.337	3.299	0.039	0.382
Price *Mebocaína Forte* (€)	4.666	4.678	-0.012	0.811
Price *Tantum Verde* (€)	4.987	4.915	0.072	0.308
Number of retailers within radius	10.376	7.108	3.268***	0.002
Population in Census section (as of 2001)	594.101	651.243	-57.142	0.142
Number of retailers	99	37		
Radius: 800m				
Price *Aspirina 500mg* (€)	3.008	3.027	0.019	0.688
Price *Cêgripe* (€)	4.310	4.253	0.057	0.224
Price *Trifene200* (€)	3.324	3.306	0.018	0.697
Price *Mebocaína Forte* (€)	4.657	4.673	-0.016	0.761
Price *Tantum Verde* (€)	4.977	4.884	0.093	0.244
Number of retailers within radius	14.153	10.448	3.705**	0.010
Population in Census section (as of 2001)	588.329	653.103	-64.774	0.151
Number of pharmacies	85	29		

NOTES: For the year 2006, the table conveys the mean of several variables of interest for two distinct groups. In the first column the figures correspond to pharmacies in belonging to the control group. In the second column the figures correspond to pharmacies which were not yet treated in 2006, but will eventually face the entry of a non-pharmacy amongst their competitors (as defined by retailers within a 400, 600, or 800 meter radius). The group of pharmacies already treated in 2006 is not accounted for in this table. Column 3 computes the difference of columns 1 and 2, and column 4 shows the corresponding two-sided p-value.

Table C.3: Results from estimating equation (5) among the most spatially isolated pharmacies in 2006

	400m Radius	600m Radius	800m Radius
DID estimates:			
2010×Treated with supermarket before 2006		-0.042***	
		(0.009)	
2015×Treated with supermarket before 2006		-0.027**	
		(0.011)	
2010×Treated with supermarket in 2006/10	-0.099***	-0.059**	-0.058**
	(0.018)	(0.027)	(0.027)
2015×Treated with supermarket in 2006/10	-0.074***	-0.049**	-0.043**
	(0.024)	(0.022)	(0.019)
2015×Treated with supermarket in 2010/15	-0.047	-0.038	-0.040*
	(0.036)	(0.034)	(0.023)
2010×Treated with outlet before 2006	-0.026	-0.006	0.030*
	(0.021)	(0.030)	(0.018)
2015×Treated with outlet before 2006	-0.015	-0.027**	0.096
	(0.015)	(0.013)	(0.062)
2010×Treated with outlet in 2006/10	-0.054***	-0.050**	0.001
	(0.017)	(0.023)	(0.028)
2015×Treated with outlet in 2006/10	-0.018	-0.017	0.028
	(0.031)	(0.025)	(0.022)
2015×Treated with outlet in 2010/15	0.076*	0.020	-0.070
	(0.039)	(0.077)	(0.047)
Pre-treatment trends:			
2010×Treated with supermarket in 2010/15	-0.008	-0.050	-0.033
	(0.020)	(0.064)	(0.042)
2010×Treated with outlet in 2010/15	-0.005	-0.034	-0.035***
	(0.039)	(0.056)	(0.012)
Time FE	YES	YES	YES
Drug FE	YES	YES	YES
Pharmacy FE	YES	YES	YES
N	924	933	733
R^2	0.922	0.914	0.922

NOTES: Estimates based on the fixed effects estimation of equation (5) among pharmacies located in areas where market structure is the most concentrated (ie. closest to a monopoly). Columns 1,2, and 3 take the main competitors of pharmacy i as being all pharmacies located within a radius of 400, 600, and 800 meters, respectively. The samples were restricted to pharmacies whose number of competitors within the relevant radius in 2006 is below the sample median for the relevant radius distance. Standard errors shown in parenthesis are clustered at the pharmacy level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table C.4: Results from DID and PSM-DID estimations using radius-based measures of competition

	Simple DID			Single neighbour			Local Linear Regression		
	400m radius	600m radius	800m radius	400m radius	600m radius	800m radius	400m radius	600m radius	800m radius
DiD estimates:									
2010×Treated with supermarket before 2006		-0.036***							
		(0.007)							
2015×Treated with supermarket before 2006		-0.020***							
		(0.008)							
2010×Treated with supermarket in 2006/10	-0.076***	-0.022	-0.037	-0.053**	-0.007	-0.045	-0.053**	-0.014	-0.047
	(0.015)	(0.026)	(0.032)	(0.026)	(0.029)	(0.030)	(0.026)	(0.030)	(0.031)
2015×Treated with supermarket in 2006/10	-0.038*	-0.038*	-0.030	-0.010	-0.027	-0.036	-0.010	-0.027	-0.044*
	(0.023)	(0.020)	(0.023)	(0.031)	(0.024)	(0.024)	(0.031)	(0.025)	(0.026)
2015×Treated with supermarket in 2010/15	-0.025	-0.010	-0.045*	0.009	-0.001	-0.039	0.008	-0.001	-0.047*
	(0.017)	(0.021)	(0.023)	(0.025)	(0.029)	(0.028)	(0.030)	(0.026)	(0.028)
2010×Treated with outlet before 2006	0.031	0.014	-0.024						
	(0.022)	(0.021)	(0.022)						
2015×Treated with outlet before 2006	0.033*	0.030	0.029						
	(0.019)	(0.021)	(0.036)						
2010×Treated with outlet in 2006/10	-0.006	-0.002	0.007	0.010	0.017	-0.003	0.011	0.026	-0.006
	(0.017)	(0.018)	(0.016)	(0.023)	(0.023)	(0.022)	(0.024)	(0.024)	(0.023)
2015×Treated with outlet in 2006/10	0.015	0.012	0.009	-0.024	0.025	0.016	0.024	0.030	0.009
	(0.020)	(0.018)	(0.015)	(0.026)	(0.022)	(0.024)	(0.027)	(0.022)	(0.024)
2015×Treated with outlet in 2010/15	0.035*	0.005	-0.007	0.060**	0.004	-0.015	0.060**	0.004	-0.022
	(0.021)	(0.022)	(0.022)	(0.025)	(0.025)	(0.025)	(0.024)	(0.025)	(0.025)
Pre-treatment trends:									
2010×Treated with supermarket in 2010/15	-0.040	0.002	-0.038	0.020	0.013	-0.051*	0.021	0.013	-0.054*
	(0.033)	(0.029)	(0.033)	(0.024)	(0.030)	(0.028)	(0.025)	(0.030)	(0.028)
2010×Treated with outlet in 2010/15	0.011	-0.000	-0.012	0.040*	0.012	-0.029	0.040*	-0.012	-0.032
	(0.015)	(0.017)	(0.016)	(0.022)	(0.027)	(0.021)	(0.021)	(0.028)	(0.022)
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Drug FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Pharmacy FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
N	3,280	2,925	2,497	960	1,400	1,310	1,180	1,390	1,580
R^2	0.913	0.911	0.914	0.903	0.905	0.933	0.904	0.905	0.930

NOTES: Estimates based on the fixed effects estimation of equation (5). There are three vertical blocks in the table, corresponding to a simple DID estimation, a PSM-DID estimation using single neighbour matching, and a PSM-DID estimation using local linear regression. In each of the three vertical blocks, the first column shows the price effects of the entry of supermarkets and outlets within 400m, whereas the second and third columns use radii of 600 and 800m. Standard errors are clustered at the pharmacy level in the simple DID estimation. For single neighbour matching and local linear regression, standard errors shown in parenthesis are bootstrapped using 30 repetitions, drawn cross-sectionally at the pharmacy level in the original sample. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table C.5: Results from estimating equation (5) among the least spatially isolated pharmacies in 2006

	400m Radius	600m Radius	800m Radius
DID estimates:			
2010×Treated with supermarket before 2006			
2015×Treated with supermarket before 2006			
2010×Treated with supermarket in 2006/10	-0.030***	0.040	0.008
	(0.010)	(0.036)	(0.074)
2015×Treated with supermarket in 2006/10	-0.013	-0.044	0.015
	(0.009)	(0.038)	(0.038)
2015×Treated with supermarket in 2010/15	-0.010	-0.025	-0.056
	(0.019)	(0.031)	(0.050)
2010×Treated with outlet before 2006	0.076***	0.025	-0.023
	(0.019)	(0.033)	(0.023)
2015×Treated with outlet before 2006	0.067***	0.062***	0.019
	(0.021)	(0.019)	(0.038)
2010×Treated with outlet in 2006/10	0.032	0.042*	0.009
	(0.021)	(0.024)	(0.021)
2015×Treated with outlet in 2006/10	0.045**	0.037	-0.014
	(0.021)	(0.026)	(0.022)
2015×Treated with outlet in 2010/15	0.026	0.001	0.008
	(0.023)	(0.024)	(0.024)
Pre-treatment trends:			
2010×Treated with supermarket in 2010/15	-0.053	0.003	-0.042
	(0.256)	(0.040)	(0.055)
2010×Treated with outlet in 2010/15	0.020	0.008	0.012
	(0.015)	(0.020)	(0.020)
Time FE	YES	YES	YES
Drug FE	YES	YES	YES
Pharmacy FE	YES	YES	YES
N	1,287	924	760
R^2	0.919	0.925	0.926

NOTES: Estimates based on the fixed effects estimation of equation (5) among pharmacies located in areas where market structure is the least concentrated (ie. the furthest from a monopoly). Columns 1 to 3 take the main competitors of pharmacy i as being all pharmacies located within a radius of 400, 600, and 800 meters, respectively. The samples were restricted to pharmacies whose number of competitors within the relevant radius in 2006 is above the sample median for the relevant radius distance. Standard errors shown in parenthesis are clustered at the pharmacy level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table C.6: Results from estimating equation (5) among all retailer types

	400m Radius	600m Radius	800m Radius
DID estimates:			
2010×Treated with supermarket before 2006		-0.036***	
		(0.007)	
2015×Treated with supermarket before 2006		-0.020***	
		(0.008)	
2010×Treated with supermarket in 2006/10	-0.076***	-0.022	-0.037
	(0.015)	(0.026)	(0.032)
2015×Treated with supermarket in 2006/10	-0.038*	-0.038*	-0.030
	(0.023)	(0.020)	(0.023)
2015×Treated with supermarket in 2010/15	-0.025	-0.010	-0.045*
	(0.017)	(0.021)	(0.023)
2010×Treated with outlet before 2006	0.031	0.014	-0.024
	(0.022)	(0.021)	(0.022)
2015×Treated with outlet before 2006	0.033*	0.030	0.029
	(0.019)	(0.021)	(0.036)
2010×Treated with outlet in 2006/10	-0.006	-0.002	0.007
	(0.017)	(0.018)	(0.016)
2015×Treated with outlet in 2006/10	0.015	0.012	0.009
	(0.020)	(0.018)	(0.015)
2015×Treated with outlet in 2010/15	0.035*	0.005	-0.007
	(0.021)	(0.022)	(0.022)
Pre-treatment trends:			
2010×Treated with supermarket in 2010/15	-0.040	-0.000	-0.038
	(0.033)	(0.017)	(0.033)
2010×Treated with outlet in 2010/15	0.011	0.008	-0.012
	(0.015)	(0.020)	(0.016)
Time FE	YES	YES	YES
Drug FE	YES	YES	YES
Retailer FE	YES	YES	YES
N	3,280	2,925	2,497
R^2	0.913	0.911	0.914

NOTES: Estimates based on the fixed effects estimation of equation (5) among all retailer types: traditional pharmacies, supermarkets and outlets. Columns 1 to 3 take the main competitors of retailer i as being all retailers located within a radius of 400, 600, and 800 meters, respectively. Standard errors shown in parenthesis are clustered at the retailer level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table C.7: Results from estimating equation (5) among pharmacies whose competitors are all in the control group

	400m radius	600m radius	800m radius
DID estimates:			
2010×Treated with supermarket before 2006		-0.030***	
		(0.009)	
2015×Treated with supermarket before 2006		-0.022**	
		(0.010)	
2010×Treated with supermarket in 2006/10	-0.073***	-0.017	-0.038
	(0.015)	(0.026)	(0.034)
2015×Treated with supermarket in 2006/10	-0.037	-0.040*	-0.034
	(0.023)	(0.021)	(0.026)
2015×Treated with supermarket in 2010/15	-0.024	-0.012	-0.049*
	(0.018)	(0.022)	(0.026)
2010×Treated with outlet before 2006	0.034	0.020	-0.025
	(0.022)	(0.021)	(0.024)
2015×Treated with outlet before 2006	0.034*	0.028	0.025
	(0.019)	(0.022)	(0.038)
2010×Treated with outlet in 2006/10	-0.003	0.004	0.006
	(0.017)	(0.019)	(0.020)
2015×Treated with outlet in 2006/10	0.017	0.010	0.005
	(0.020)	(0.018)	(0.020)
2015×Treated with outlet in 2010/15	0.037*	0.003	-0.013
	(0.021)	(0.022)	(0.020)
Pre-treatment trends:			
2010×Treated with supermarket in 2010/15	0.014	0.008	-0.039
	(0.015)	(0.029)	(0.035)
2010×Treated with outlet in 2010/15	0.010	0.006	0.005
	(0.015)	(0.018)	(0.020)
Time FE	YES	YES	YES
Drug FE	YES	YES	YES
Pharmacy FE	YES	YES	YES
N	2,764	1,875	1,486
R^2	0.915	0.913	0.909

NOTES: Estimates based on the fixed effects estimation of equation (5) among pharmacies whose competitors are all in the control group. Columns 1 to 4 take the main competitors of pharmacy i as being all pharmacies located within a radius of 400, 600, and 800 meters, respectively. Standard errors shown in parenthesis are clustered at the pharmacy level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table C.8: Results from estimating equation (5) in a balanced panel of pharmacies

	400m radius	600m radius	800m radius
DID estimates:			
2010×Treated with supermarket before 2006		-0.031***	
		(0.007)	
2015×Treated with supermarket before 2006		-0.019**	
		(0.009)	
2010×Treated with supermarket in 2006/10	-0.071***	-0.035	-0.033
	(0.015)	(0.022)	(0.029)
2015×Treated with supermarket in 2006/10	-0.035	-0.045**	-0.029
	(0.023)	(0.018)	(0.021)
2015×Treated with supermarket in 2010/15	-0.021	-0.017	-0.044*
	(0.019)	(0.021)	(0.023)
2010×Treated with outlet before 2006	0.039	0.032	-0.008
	(0.025)	(0.022)	(0.023)
2015×Treated with outlet before 2006	0.038*	0.037*	0.035
	(0.021)	(0.021)	(0.037)
2010×Treated with outlet in 2006/10	-0.011	-0.012	-0.000
	(0.018)	(0.019)	(0.016)
2015×Treated with outlet in 2006/10	0.014	0.006	0.003
	(0.020)	(0.018)	(0.015)
2015×Treated with outlet in 2010/15	0.038*	0.006	-0.006
	(0.021)	(0.022)	(0.022)
Pre-treatment trends:			
2010×Treated with supermarket in 2010/15	-0.037	0.000	-0.031
	(0.034)	(0.028)	(0.034)
2010×Treated with outlet in 2010/15	0.015	0.005	-0.005
	(0.015)	(0.017)	(0.016)
Time FE	YES	YES	YES
Drug FE	YES	YES	YES
Pharmacy FE	YES	YES	YES
N	2,043	1,698	1,314
R^2	0.923	0.922	0.928

NOTES: Estimates based on the fixed effects estimation of equation (5) among pharmacies who are observed throughout the entire period of analysis, 2006-2015. Columns 1 to 3 take the main competitors of pharmacy i as being all pharmacies located within a radius of 400, 600, and 800 meters, respectively. Standard errors shown in parenthesis are clustered at the pharmacy level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table C.9: Results from estimating equation (5) with non-mutually exclusive treatments

	400m Radius	600m Radius	800m Radius
DID estimates:			
2010×Treated with supermarket before 2006		-0.037***	-0.052***
		(0.007)	(0.014)
2015×Treated with supermarket before 2006		-0.021***	-0.038***
		(0.008)	(0.013)
2010×Treated with supermarket in 2006/10	-0.077***	-0.023	-0.037
	(0.015)	(0.026)	(0.032)
2015×Treated with supermarket in 2006/10	-0.040*	-0.038*	-0.029
	(0.023)	(0.020)	(0.023)
2015×Treated with supermarket in 2010/15	-0.061***	-0.013	-0.040*
	(0.021)	(0.018)	(0.022)
2010×Treated with outlet before 2006	0.030	0.013	-0.023
	(0.022)	(0.021)	(0.022)
2015×Treated with outlet before 2006	0.031	0.029	0.030
	(0.019)	(0.021)	(0.036)
2010×Treated with outlet in 2006/10	-0.007	-0.003	0.007
	(0.017)	(0.018)	(0.016)
2015×Treated with outlet in 2006/10	0.014	0.012	0.010
	(0.020)	(0.017)	(0.015)
2015×Treated with outlet in 2010/15	0.017	0.002	-0.003
	(0.019)	(0.019)	(0.020)
Pre-treatment trends:			
2010×Treated with supermarket in 2010/15	-0.053**	-0.007	-0.034
	(0.021)	(0.021)	(0.023)
2010×Treated with outlet in 2010/15	0.004	-0.009	-0.008
	(0.014)	(0.016)	(0.017)
Time FE	YES	YES	YES
Drug FE	YES	YES	YES
Pharmacy FE	YES	YES	YES
Treatment group interactions × Time FE	YES	YES	YES
N	3,769	3,769	3,769
R^2	0.909	0.909	0.909

NOTES: Estimates based on the fixed effects estimation of equation (5) among traditional pharmacies, without imposing mutually exclusivity of treatments. The estimates corresponding to the interactions treatment group interactions and time fixed-effects are typically statistically insignificant, and are available upon request from the authors. Columns 1 to 3 take the main competitors of pharmacy i as being all pharmacies located within a radius of 400, 600, and 800 meters, respectively. Standard errors shown in parenthesis are clustered at the pharmacy level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table C.10: Results from the estimation of the reduced-form entry model

Main Competitors	$\zeta(P_{t-1})$ specification	Supermarket	Outlet
400m radius	P_{it-1}	-0.865	0.665
		(2.226)	(0.836)
400m radius	P_{it-1} relatively to average market price	-1.432	0.548
		(7.868)	(0.820)
600m radius	P_{it-1}	0.027	0.214
		(0.912)	(0.749)
600m radius	P_{it-1} relatively to average market price	-0.511	0.140
		(0.803)	(0.736)
800m radius	P_{it-1}	-0.490	-1.167
		(1.178)	(1.057)
800m radius	P_{it-1} relatively to average market price	-0.626	-1.242
		(1.068)	(1.034)

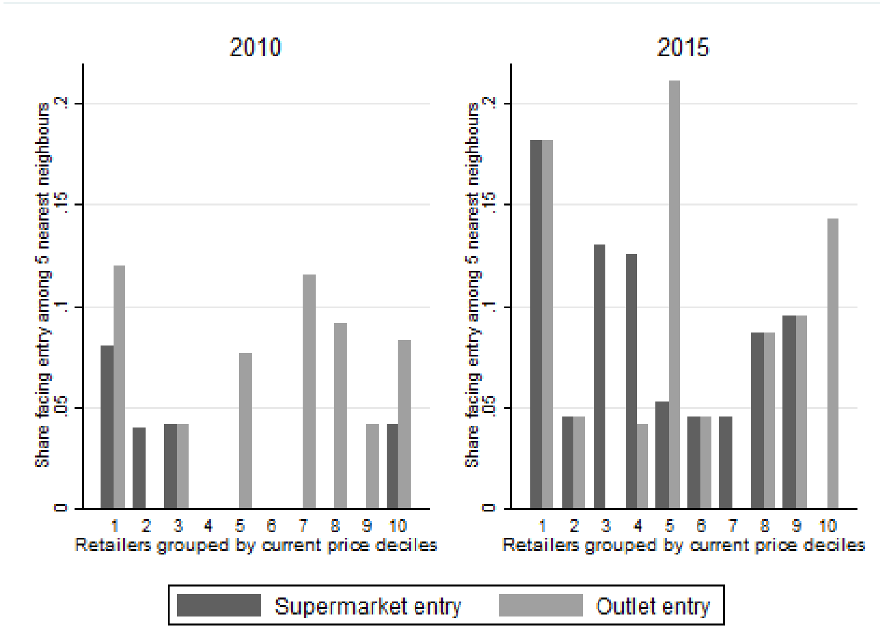
NOTES: Marginal effects of β_1 from RE logit estimation of equation (6), with dependent variable being an indicator for facing the entry of a supermarket (column 1) and an outlet (column 2). There are three panels, each corresponding to an alternative definition of main competitors of pharmacy i. Competitors of a pharmacy are the retailers located within a 400, 600, and 800-meter radius, respectively, for the first, second, and third panels. In each of the panels, the first row tests whether pharmacy i facing the entry of a supermarket/outlet among its main competitors depends on the prices it charged in the previous period, $\zeta(P_{t-1}) = P_{it-1}$. The corresponding figures can be interpreted as the percentage-point change in the probability of facing entry associated with a 1% higher OTC bundle price in the previous period. The second row tests whether it depends on the lagged prices of pharmacy i relatively to the average bundle price in the city of Lisbon. The corresponding figures can be interpreted as the percentage-point change associated with a 1-unit increase in the independent variable. Recall that our estimation sample differs according to how we define the set of main competitors of pharmacy i, so that a different number of observations is used to obtain each marginal effect shown on the table. Standard errors shown in parenthesis are clustered at the pharmacy level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table C.11: Does experiencing non-pharmacy entry make pharmacies more likely to exit next period?

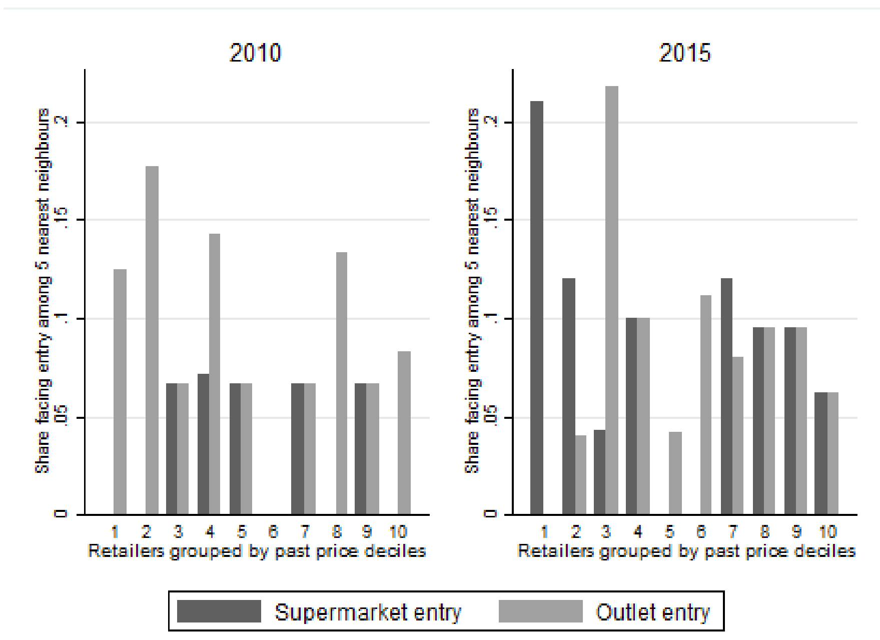
	400m radius	600m radius	800m radius
Treated with supermarket before 2006			
Treated with supermarket in 2006/10		-0.132	-0.033
		(0.123)	(0.101)
Treated with outlet before 2006	0.006	0.095	0.042
	(0.099)	(0.073)	(0.096)
Treated with outlet in 2006/10	-0.128	-0.121	-0.145*
	(0.086)	(0.085)	(0.086)
Time FE	YES	YES	YES
Parish FE	YES	YES	YES
N	368	328	265

NOTES: Marginal effects from a logit regression of a binary variable equaling 1 for pharmacies that exited before the next round of data collection and 0 otherwise, on treatment group indicators, parish fixed-effects, and year fixed-effects. Columns 1 to 3 take the main competitors of pharmacy i as being all retailers located within a radius of 400, 600, and 800 meters, respectively. Blank cells correspond to cases in which there is not enough variation: for example, none of the pharmacies experiencing entry of a supermarket before 2006 exits the market. Standard errors shown in parenthesis are clustered at the pharmacy level. $*p < 0.10, **p < 0.05, ***p < 0.01$.

D Additional Plots



(a) By current price deciles



(b) By past price deciles

Figure D.1: Share of pharmacies facing non-pharmacy entry among their 5 nearest neighbors, by price deciles

NOTES: In the top panel, pharmacies are grouped into deciles of their current price for the bundle of five OTC drugs considered in our analysis. In the bottom panel, pharmacies are grouped into deciles of their past price for the bundle of five OTC drugs considered in our analysis. In all the four plots the vertical axis indicates the share of pharmacies in each decile who faced the entry of a supermarket or outlet among their five nearest neighbors. We see that entry of supermarkets and outlets took place along all current and past price deciles in both 2010 and 2015, with no clear pattern.

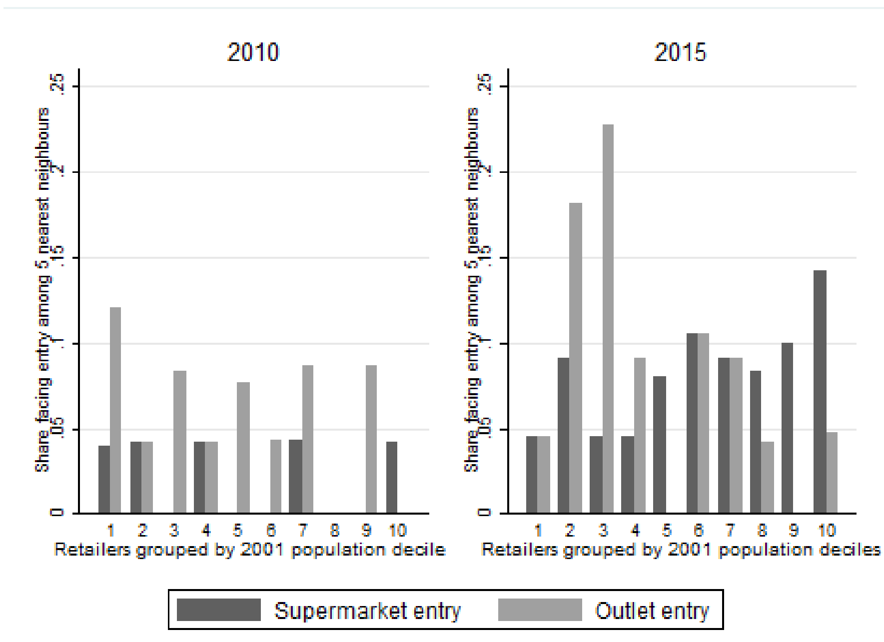
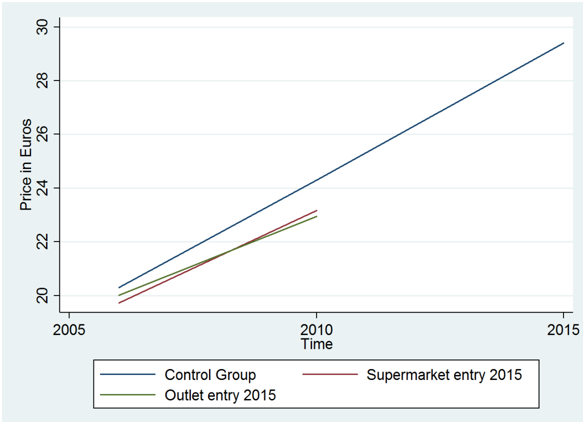
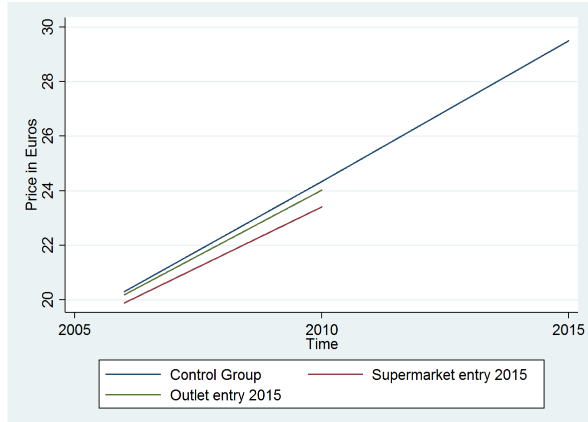


Figure D.2: Share of pharmacies facing entry of non-pharmacies among the 5 nearest neighbors, by population deciles

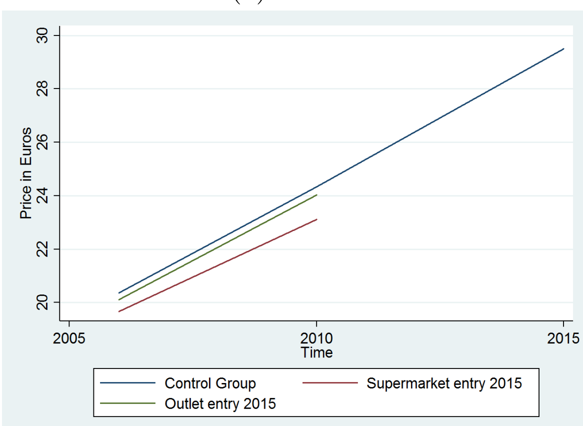
NOTES: In order to create this figure, pharmacies are grouped into deciles of their 2001 level of demand, as measured by the resident population in the Census tract where they are located. In all the four plots the vertical axis indicates the share of pharmacies in each decile who faced the entry of a supermarket or outlet among their five nearest neighbours. We again see that entry of supermarkets and outlets took place along all population deciles in both 2010 and 2015, with no clear pattern.



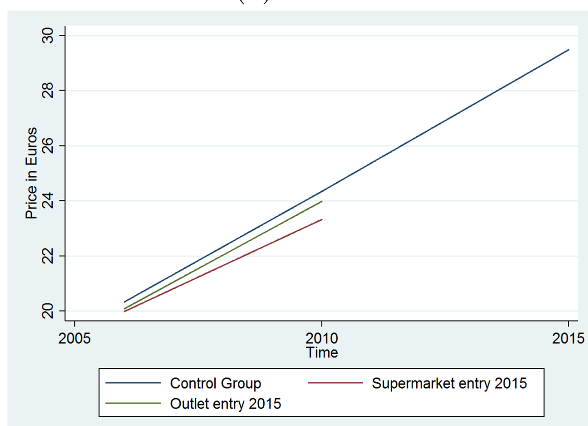
(a) $N = 1$



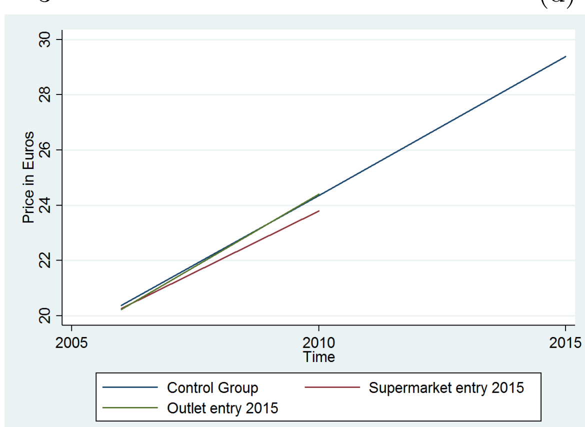
(b) $N = 2$



(c) $N = 3$



(d) $N = 4$



(e) $N = 5$

Figure D.3: Plots assessing the plausibility of the common trend assumption, N=1,...5

NOTES: The figures compare the evolution of the price of the bundle of 5 drugs in our analysis for three distinct groups: the control group and the two groups of pharmacies who experienced entry of a supermarket or outlet among their N nearest neighbors after 2010. For these groups we do observe prices for two pre-treatment periods and can compare their evolution with the control group. Overall, the plots do not suggest distinct price trends across the three groups between 2006 and 2010.

E Details on the PSM-DID procedure

We use a propensity score matching difference-in-differences approach to address the possible endogeneity of market structure (Heckman et al., 1997; Smith and Todd, 2005). The underlying intuition for this approach is that by matching treated and untreated pharmacies on their propensity score, that is, their probability of being treated, we make the groups more similar in terms of the observables used in the estimation of the propensity score. Thus, treatment should be random, conditional on the observables used to estimate the propensity score. The crucial assumption we are making with the use of PSM-DID is that, by achieving balancing on observables between the treated and control groups in the matched sample, it makes it more likely that such balancing also extends to unobservables, particularly time-variant unobservables (as time-invariant ones are in any case differenced out by the DID).

Below, we detail the more technical aspects regarding our implementation of PSM-DID.

Just like simple DID, PSM-DID yields estimates of the average treatment effect on the treated. PSM is, however, a data-demanding method. Typical applications of PSM control for a large set of observables in the estimation of the propensity score. While Heckman et al. (1997) shows that models using a richer set of covariates to estimate the propensity scores tend to be less biased, including more covariates also makes is more difficult to define the region of common support (Gibson-Davis and Foster, 2006). There is little guidance on how to balance this trade-off. As noted by Lechner (2010), one should include neither pre-treatment values of the outcome variable nor post-treatment values of independent variables in the estimation of the propensity score. With this in mind, and given that we do not have many variables available to estimate propensity scores, we opted for matching on few variables.

Specifically, we match pharmacies on two measures. These measures are the level of competitive pressure and the level of demand faced prior to experiencing non-pharmacy entry. Pre-entry levels of competitive pressure are measured as of 2006, our first data period. In the specifications using the N nearest neighbors as main competitors, pre-entry levels of competitive pressure are captured by the average walking time (in minutes) to the N nearest retailers in 2006. In the specifications using a radius distance to define the set of main competitors of a pharmacy, the pre-entry level of competitive pressure is given by the number of retailers within that radius in 2006. As for information of pre-entry levels of demand faced by each pharmacy, we complement our dataset with information from Statistics Portugal on the resident population in the Census tract where each pharmacy is located. This information was collected in the 2001 Census of the population.

We categorize the two variables used to estimate the propensity score into quintiles and we used the categorized variables for the matching. Given our unusual setting, featuring multiple time periods and multiple treatments, we proceed as follows. Using a logit model, we estimate the propensity scores separately for each of the four treatment groups and for each year of our data. Therefore, for each model specification, a total of 12(=4 treatments $\times 3$ time periods) PSM procedures were carried out in order to obtain the matched sample of pharmacies. Given the estimated propensity scores, we match each treated pharmacy to its closest untreated PSM-neighbor at each time period (thus allowing us to easily accommodate some exit that we see in the data). We use two alternative methods for matching treated and untreated pharmacies. The first method is single nearest-neighbor within caliper matching with replacement, setting the caliper at 0.02.[21] The second method consists of non-parametric local linear matching, with a bandwidth of 0.8.[22] Finally, we run our model specifications in this matched sample.

While asymptotically the estimates obtained should be independent of the matching method, this is not the case in small samples. In particular, nearest neighbor estimates may be the least biased, but are also less precise. Non-parametric methods, such as local linear regression, in turn, may be more biased, but have higher precision (Gibson-Davis and Foster, 2006). Therefore, if these two matched samples lead to similar price effects following the entry of supermarkets and outlets in the OTC market, then we have more confidence that these effects do not depend on the matching estimators used.

The standard errors of the estimates need to account for the propensity score estimation, the imputation of the common support, the fact that we are matching with replacement, and possibly also the order in which treated pharmacies are matched. A popular approach in this setting is to use bootstrapping methods. We bootstrap the entire procedure, meaning that we bootstrap pharmacies in the original sample, then carry out the estimation of the propensity scores and the matching procedure for each treatment and for each year, and finally estimate equation (5) in the matched sample for each of our bootstrapped samples.

We check covariate balancing between treatment and control groups in the original and matched samples. For the sake of brevity, and since 12 PSM procedures are carried out for each of the models we estimate, we do not show the results of covariate balancing tests or graphs of the common support condition. These are available upon request from the authors. In many, but nor all, of our PSM estimations we are able to achieve a decently balanced sample in terms of the covariates, and we thus assume that balance was achieved also in terms of unobservables.

Overall, the results of the PSM-DID are in line with those from the simple DID, though several effects lose statistical significance. The loss of statistical significance may be a result of

[21]Different choices of caliper and of the number of neighbors matched did not change our results.

[22]Different choices of bandwidth did not alter our results.

the smaller estimation samples used, as for each treated pharmacy we select only one matched untreated pharmacy. Alternatively, it may be due to the larger standard errors obtained with bootstrapping.

F Overview of pharmacy regulations during 2005-2015

Table F.1: Overview of pharmacy regulations during the period 2005-2015

Month & year	Legislation	Measures
August 2005	Decree-Law 134/2005	OTC drugs become available outside pharmacies.
February 2007	Ordinance 30B/2007	6% administrative price reduction for Government reimbursed drugs; Reduces margins for wholesalers and pharmacies.
March 2007	Decree-Law 60/2007	Introduces new rules for international price referencing to focus on low-price countries; Regulated drug prices become maximum prices and not fixed prices; Allows discounts at points of the value chain of pharmaceuticals in the ambulatory market (wholesale and retail), and sets a margin at each point.
June 2007	Decree-Law 238/2007	Enlarges the set of OTC drugs available outside pharmacies to include those subject to Government reimbursement; Reimbursement conditional on buying the drugs at a pharmacy.
August 2007	Decree-Law 307/2007	Liberalization of pharmacy ownership rules, with restrictions on the maximum number of pharmacies that can be owned by a single entity and on the professional categories that can own a pharmacy (ie. doctors, pharmaceutical companies, among others, cannot); Introduces exit restrictions (pharmacy opening restrictions were already in place).
November 2007	Ordinance 1430/2007	Changes the geographic criteria for the opening of new pharmacies by lowering number of inhabitants per pharmacy and the minimum distance between pharmacies.
October 2010	Ordinance 104-A/2010	6% administrative price reduction for Government reimbursed drugs.
January 2012	Decree-Law 112/2011	Introduces a new margin scheme for prescription drugs: there were changes in levels as well as the structure of the margins, with the introduction of a regressive margin. Also sets the price cap for the first generic entering the market to 50% of the price of the original drug.
May 2012	Ordinance 137-A/2012	Patients can substitute branded drugs for generics at the pharmacy; Pharmacies which must carry the 5 products with the lowest price in each reference group.
January 2013	Ordinance nº 14/2013	Introduces some flexibility in terms of the opening times of pharmacies
February 2013	Decree-Law 34/2013	Demands an annual revision of the set of countries use for reference pricing, in order to ensure downward trend in prices.
February 2014	Decree-Law 19/2014	Further revises the margin scheme for pharmaceuticals by increasing the fixed component and decreasing the proportional component.

NOTES: This table features the most important regulations affecting the profitability of pharmacies during the period 2005-2015 and it is not exhaustive.