A new supermarket in the neighborhood: The price reaction of incumbent retailers*

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Abstract

This paper studies empirically the volatility of retail price indexes at the store level as a result of changes in the local market structure within an urban market. Using a reduced-form pricing equation, the standard approach bases the analysis of a potential competition effect on the number of firms in the market at a certain point in time. We decompose the competition effect in the effect of incumbent retailers and the effect of new grocery store openings. Considering the Spanish supermarket industry, which is strongly regulated, we make use of panel data and use a first-difference approach to estimate a distributed-lag model. The results suggest an instantaneous price reaction to entry which is smaller than the long-term competition effect of an incumbent firm. Possible explanations are constrained price-flexibility for incumbent firms in the short run or difficulties of the entrant in establishing themselves as coequal rivals. We find that this gradual price reaction is especially pronounced for supermarkets positioned in the middle price-segment, and the strongest price reaction has been found for high-price retailers.

Keywords: market entry, retail regulation, pricing, supermarkets, Spain.

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1 Introduction

Models of oligopolistic price competition in general suggest that an increase in the number of firms in the market decreases prices. However, little is known about the dynamics of price reactions when a new supermarket opens its doors. In this paper, we aim to analyze empirically whether market entry induces incumbent firms to adjust prices instantaneously, step-wise or with a delay. We analyze this question using the price indexes of a standard shopping basket and expect new insights into the general repositioning of stores. Currently, we observe in the British market that Tesco has decreased prices for several products of a standard shopping basket as a reaction to the competitive pressure of the new German retailers Aldi and Lidl. But can we generalize this observation for other markets and any type of new supermarket? Considering data for urban supermarkets in the City of Madrid, descriptive statistics show for stores that face entry into their neighborhood a significant price decrease with respect to supermarkets without entry in their trade area. But how quickly do incumbents react to new players? This paper analyses the competition effect on supermarket prices, differentiating the effect of incumbent stores and new entrants. This distinction allows us to distinguish between long-run competition effects and immediate competition effects when a new supermarket opens its doors.

To analyze this question, we use a new dataset of quarterly normalized price indexes for supermarket stores in the city of Madrid (Spain). To be precise, we use different types of data to build a panel dataset of relative price indexes at the store level and associated store location-specific characteristics. In particular, we use a quarterly price survey for a sample of supermarkets in Madrid containing the street address of each store and normalized price indexes of a standard shopping basket. Additionally, we use census data to identify all the supermarkets in the urban area and the distribution of economic and demographic characteristics within the city. Using the geographic information system ArcGIS, we construct a unique panel dataset with quarterly data from 2009-2011. While in a parallel work Asensio (2013) uses only one time period of this supermarket data to emphasize the price-flexing practice of Spanish supermarket chains, the present paper focuses on the dynamics of the price of a standard food basket, in particular the price reaction over time to a new store opening and the effect on the relative position of a store with respect to competitors.

The literature explaining the variation in supermarket prices can be classified in terms of price variations due to changes in the wholesale price or cost changes, on the one hand, and changes in the retail margins on the other hand. The latter can be differentiated into two approaches: behavior-based inter-temporal price discrimination ('sales approach') and competition-referenced pricing ('competitive outcome').

Considering the price evolution of a particular product, abstracting from competition, several papers have identified sales cycles in supermarket pricing. Examples are Hosken

and Reiffen (2004), who analyze the price variation of different supermarket products using monthly prices at the store level for different cities and find that there is typically a 'regular price', with most of the deviations identified as temporal sales. Explanations for this kind of observed temporal sale are proposed by Ariga et al. (2010) as an incentive of the supermarket to discriminate between consumers who buy for immediate consumption and those who buy for inventory, and by Dubé at al. (2008) as a result of the firm's incentive to achieve consumer loyalty. However, since promotions are in general product-specific and last from a few days to one month, these arguments cannot be used to explain the observed variation in the price index of a standard shopping basket. On the one hand, Kopalle et al. (2009) argue that in a fixed-weight price index the demand effect of the sales is not captured. On the other hand, it seems reasonable to assume that product-specific sales do not last more than one month and so they may not be considered when using quarterly evaluation.

Studying price changes as an outcome of imperfect competition, many of the existing empirical papers are cross-sectional, and focus implicitly on the long-run competition effect in a particular industry and market (Singh and Zhu (2008), Gullstrand and Jörgensen (2012), Asensio (2013)).

This paper in turn considers dynamics in the competition effects, differentiating between the immediate competition effect of a new entrant and the long-run competition effect of changes in the market structure.[1] Throughout the paper, we will use the terms 'incumbents' for firms that are established in the market at a certain point in time and 'new entrants' for firms entering the market in the respective period. It is important to notice that according to this definition, in the period after market entry has taken place, the old entrants are now established firms in the market and hence become incumbent firms. One of the closest analyses to our paper is that of Basker (2005, 2009), who analyzes empirically the effect of Wal-Mart's entry on the pricing of incumbent retailers. Using quarterly city-level prices for different products, he finds significant price decreases that are stronger in the long run than in the short run, larger in cities with less incumbent firms per capita, and smaller for the big three players than for other retailers. For the analysis, we set up a reduced-pricing equation that differentiates competition effects in the competition effect of incumbent stores and the entry effect of a new grocery retailer. Given that entry into the Spanish supermarket industry is strongly regulated, in the sense that firms have to apply for licences a long time in advance to entry, which produces a time lag between the entry decision and the realized entry, we argue that a potential simultaneity problem of entry and pricing is not an issue but that the required approval by the regional regulation authority induces a potential selection bias in the estimation. Under the assumption of selection on time-constant market characteristics, we make use

[1]For a general discussion of the literature and further challenges analyzing the interaction between pricing and competition effects see, for example, Kopalle et al. (2009).

of the panel data and propose a first-difference approach.
The results suggest the immediate price adaptation of Spanish supermarkets upon the entry of a new supermarket store, which is lower than the competition effect of incumbent firms. To be precise, we find that, on average, the entry of a new supermarket in the neighborhood leads to an instantaneous price decrease by established stores of 1.26%, and the full (long-run) competition effect implies an average total price decrease of 2.11%. This implies a differentiation in short-run and long-run competition effects which may be explained by the constrained price flexibility of Spanish supermarkets in the short run, or that new stores need time to establish their business as a fully-fledged rival in the local market. Moreover, we find that the difference between the entry effect and the competition effect of incumbent firms is especially pronounced for supermarkets positioned in the middle price-segment, and that, high-price stores react the strongest to changes in the market structure.

The article proceeds as follows. First, we introduce the industry and the dataset with a special focus on how to deal with normalized price indexes. After providing some descriptive statistics that motivate the analysis, we provide an econometric approach and the results. Finally, we comment on pending work and future research.

2 The grocery retail industry in Spain

With a contribution of 7-8% to overall GDP, the food sector is one of the most important industry sectors in Spain. However, it is also a very dynamic sector, where changes in technological innovations and consumer behavior bring along challenges for traditional retailers such that administrative measures have been taken to protect small-scale firms.

A key feature of the supermarket industry in Spain is that the sector is highly regulated and that the regulation is decentralized. While there exist general guidelines at the national level, the autonomous regions have a large degree of leeway to decide the terms of opening hours and the dates of sales periods and entry conditions for certain formats of commercial establishments, while some decisions, for example Sunday or Holiday shopping days, are delegated to the municipalities. A good summary of the evolution of the legislative regulations at the national level and that of the autonomous regions can be found in Matea and Mora (2012). For our analysis, focusing on the city of Madrid and regulation at the national level, the autonomous region level and the municipality level are the same for all considered supermarket stores, so that there is no variation in the legal framework which may alter regional prices. Concentrating on the implementation of regulations in the Community of Madrid, the Competition Court of the Community of

Madrid has the main task of guaranteeing effective competition in line with the legislation of the Community of Madrid. This legal framework includes information about the opening of large-scale retail formats and discounters, although medium-sized retailers are also subject to approvals. While the Competition Court has a solely informative role, the authorization or modification of certain retail businesses is undertaken by the Regional Ministry of Economy and Finance of the Community of Madrid. In the following, we comment briefly on the types of businesses that are especially strongly regulated and which comprise a large proportion of all the establishments.[2] A large retailer needs a second special licence from the autonomous community in addition to the licence of the corresponding town hall to enter the market at a particular location. For the City of Madrid, this includes all retail establishments of at least 2.500 m^2. Discount retailers are likewise required to apply for a specific licence and this applies to all retailers with a minimum number of white-label products compared to branded products ($> 70\%$), an affiliation with a multi-store company or chain, a minimum sales area (> 500 m^2) and a minimum sales volume (> 3 billion Euros). Last, but not least, since 2001 medium-sized retailers with a floor space of at least 750 m^2 are also subject to the approval of a specific licence from the Regional Ministry of Economy and Finance. In 2012, the law 'Dynamization of the Commercial Activity in Madrid' relaxed the strong administrative and urban requirements for retail establishments although, given our data from 2009-2011, this period is out of sample.[3]

Considering the market structure, the supermarket industry in the City of Madrid is dominated by several large supermarket chains which are associated with a certain format, service and product quality. Table 1 provides an overview of the active stores in 2010.

As a pioneer project in Europe, the government decided to provide consumers with more transparency and information about prices across supermarkets and initiated the 'Observatorio de precios', a quarterly study of price indexes at the store level that was published on the Web. However, in 2011 the firms complained that the prices did not reflect the product quality and services provided, which could be misleading for consumers, and the government finally stopped this initiative and removed the comparison from the Web. However, some firms continued sharing their own monitoring of their rivals' prices with consumers, whenever convenient for them, as an advertisement strategy within the store.

[2]Ley 16/1999, de 29 de abril, de comercio interior de la Comunidad de Madrid, Capítulo II, §17., Capítulo III, §24.; Ley 14/2001, de 26 de diciembre, de Medidas Fiscales y Administrativas, §17.

[3]Ley 2/2012, de 12 de junio, de Dinamizacin de la Actividad Comercial en la Comunidad de Madrid.

Table 1: The grocery retail industry in the City of Madrid

Main Retail Groups[1]	Banners (number of stores, Alimarket census 2010)
Ahorramás (Spain) [2]	AhorraMas (82)
Auchan (France)	Alcampo (4), Aro Rojo (3),
	Simply City (10), Simply Market (5)
Carrefour (France)	Carrefour (5), Carrefour City (9),
	Carrefour Express (9), Carrefour Market (2)
Condis (Spain) [2]	Condis (25)
Dia (Spain)	Dia (110), Maxi Dia (11), Dia Market (88)
Dinosol (Spain, private equity owned)	Supersol (21), Cash Diplo (1)
El Corte Inglés (Spain)	Supermercado El Corte Inglés (7), Supercor (6),
	Opencor (28), Hipercor (4), Convenience Store (1)
Eroski (Spain)	Eroski (2), Eroski City (18), Eroski Center (14),
	Caprabo con Eroski (40)
Híper Usera (Spain) [2]	Híper Usera (16), Híper Aluche (1)
	Híper Villaverde (2), Cash IFA - Híper Usera (3)
Lidl (Germany)	Lidl (29)
Roig (Spain)	Mercadona (31)
Unide (Spain) [2]	Gama (18), Udaco (35), Maxcoop (17)

[1] Retail groups operating at least 20 stores in the City of Madrid. The non-listed stores belong to retail groups with a significantly smaller presence in this urban market (Aldi, C.C. Darbe, Covirán, Eco Mora, Ferjama, Franco-Mor, Miquel, Supermercado Sánchez Romero, Villa de Madrid) or else belong to small firms.
[2] Integrated in the IFA Retail group.

3 The data

(1) Price indexes at the store level

The main data for our analysis come from the aforementioned survey of the Spanish Ministry of Industry, Tourism and Commerce, which collected from 2008-2011 quarterly food price data for the main national and regional grocery chains in Spain. The data are provided as price indexes at the store level. In each period, the sample covers more than 4,000 stores in the 56 mayoral cities in Spain, whereby the stores are identified by their exact street address, format and chain affiliation. For each store, 187 products were tracked to construct individual price indexes for the stores which were then normalized within a city with respect to the cheapest basket. That is, considering a particular city, for a store i at period t, the normalized food price indexes can be expressed as follows,

$$FPI_{it} \equiv \frac{P_{it}}{min_j\{P_{jt}\}} \cdot 100$$

with P_{it} being a fixed-weight price index of a standard shopping basket.

The analysis in this paper is restricted to the panel data for the City of Madrid, whereby in each quarter between 209 and 212 hypermarkets, supermarkets and discount retailers are observed, of which 181 stores were continuously tracked through all the periods. [4]

Preparing the data for the analysis, we construct a panel dataset of price indexes at the store level. We assign an identification number to each store that has been tracked by the survey at some moment between the first quarter of 2009 and the second quarter of 2011. Each store is identified by the exact street address and the banner. Subsequently, the quarterly data are merged to a panel dataset. Finally, in order to analyze the data in its geographic context, we convert the street addresses of the observed stores to longitude and latitude coordinates using the geocoder of Google Maps.[5] Next, the geographic information system ArcGIS is used to map the geographic data and project them in an x-y coordinate system to be analyzed.[6]

(2) Census data

In order to identify changes in the market structure, we use the census data from the publisher Alimarket, which provides the exact street addresses of all grocery establishments within the City of Madrid (supermarkets, hypermarkets and discounters) and the

[4]Since the prices in each city have been normalized with respect to the cheapest store within the urban area we cannot exploit cross-city variations, but we may consider other urban areas for a sensitivity analysis of the results.

[5]With the aim of achieving a highly accurate match, when the house number was missing but the store belonged to a mall, we geocoded the mall site. Otherwise, we verified the exact position on the street using Google's street view.

[6]For the projection we use the cylindrical Universe Transverse Mercator (UTM) projection for the area of Spain, which corresponds to the UTM Zone 30.

associated opening dates.The census data contain the exact opening date of each store which is used to identify the entry decisions. The data do not directly provide the closing dates, but we infer the timing of the market-exit decision of a store from a comparison of the census data of different years. In order to merge the census data from 2008-2011 and to guarantee the consistency of the data, we match the data by the street address and the banner. The apparent independence of the data collection of different years requires a correction of different spellings of the street addresses. A few observations appear in the census only after the year of entry, so that we correct for this inconsistency taking the opening date as the true reference. Additionally, we account for 'banner changes' within a chain and transformations within a retail group which may be falsely considered as market entry but which do not constitute true entry decisions (which can in general be verified given the opening date). Since we are interested in the analysis of the urban grocery market, we exclude one store location from the data which is situated inside the 'Pardo' distrit, a forested area with only a tiny urban area next to the royal palace. Based on the merged census data, we identify all the stores for which prices have been tracked and assign the corresponding identification number.

(3) Demographic and economic data
Additional to the store datasets, we use information on the distribution of demographic and economic data within the considered market using data from the Statistic Institute of Madrid for the smallest available administrative unit. In particular, we use quarterly population data for each neighborhood district (128 'barrios') and housing prices at the superordinate district level (21 'distritos'). The Community of Madrid also provides shapefiles of territorial borders for districts and neighborhood units which we use for the spatial association of these variables.

4 Descriptive statistics

Table 2 indicates the changes in the market structure for the considered time periods.

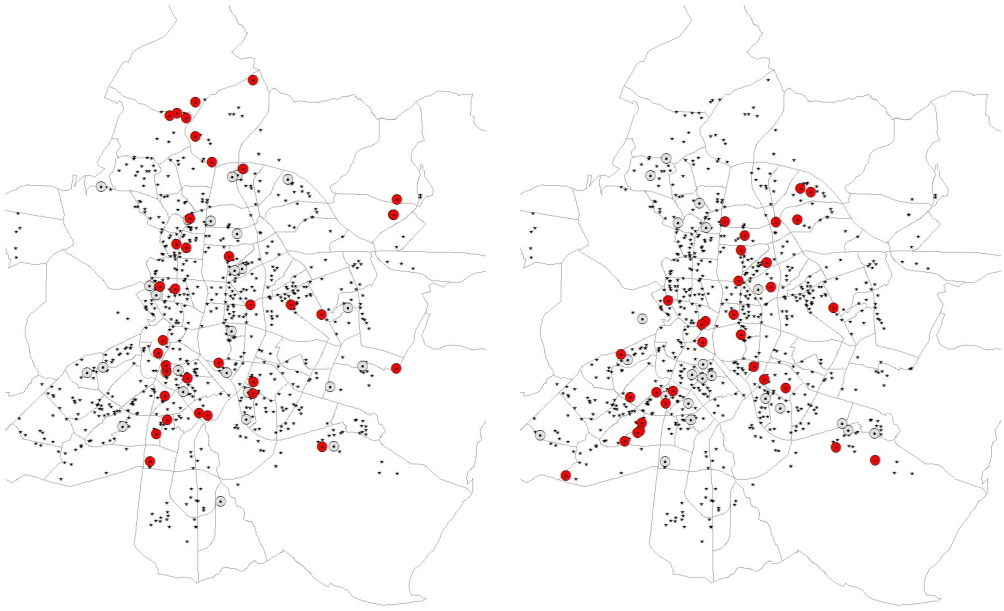
Table 2: Market entry within the considered time period.

	2009				2010				2011	
	t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8	t_9	t_{10}
Entry	7	11	9	9	4	7	11	10	3	5
Total number of stores	730	741	750	759	738	745	756	766	742	747

The observed entry events are accomodated, approved entry. The second row indicates the total number of stores within the market. Since we can only infer a market exit from the comparison of annual census data, we correct at the beginning of each year for the

stores which exit the market in that year. That is, we make the strong assumption that firms that exit the market are not profitable and that this is anticipated by all firms at the beginning of each year. Complementary to this, Figure 1 illustrates the geographic distribution of all the grocery stores in the City of Madrid and the market entry events for the years 2009 and 2011.

Figure 1: Changes in the market structure.

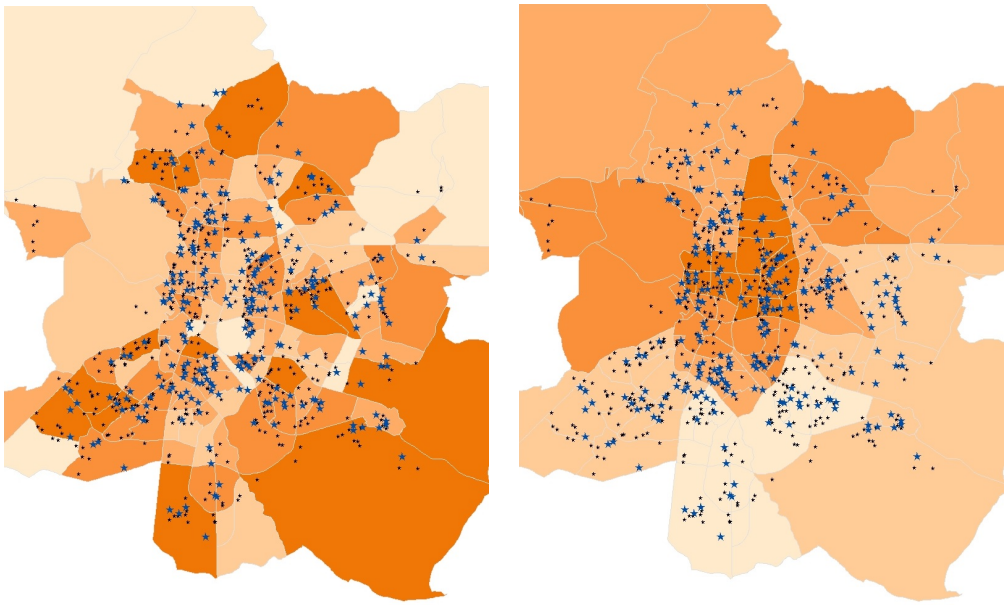


(a) Market entry and exit 2009.

(b) Market entry and exit in 2010.

Since the price survey has been realized for a random sample of all the stores, Figure 2 illustrates (with blue stars) those stores that have been tracked by the survey. Additionally, the figures present (with black stars) all the incumbent retail stores as well as the population distribution at the neighborhood level and the distribution of housing prices at the district level for the first quarter in 2009, with a darker shaded area being associated with a higher population density and higher house prices, respectively.

Figure 2: Tracked grocery stores.



(a) Population distribution

(b) House prices.

A preliminary check of the spatial distribution of the observed store locations and the corresponding prices suggests that most of the tracked stores are located in very densely populated urban neighborhoods of Madrid. Complementary to the graphical illustration, Table 3 provides some summary statistics of store-location variables for the whole period of analysis, from the first quarter of 2009 to the second quarter of 2011.

Table 3: Summary statistics.

	Mean	Sd.dev.	Min	Max
sales area of the store (in m^2)	1262.95	(2307.73)	50	13000
incumbent stores	19.19	(9.62)	1	41
population within the trade area (in 100)	671.02	(270.07)	36.73	1222.62
house price at the store location (in €/m^2)	3659.86	(907.62)	2041	5406

Considering the normalized prices across stores reveals the price flexing policy of Spanish supermarkets, i.e. the supermarket chains set different prices for their stores within the same geographic market. However, the paper focuses on the price variation which requires, first of all, the redefining of the price data. Recall that the price indexes are normalized in each period with respect to the cheapest store in their respective periods that can differ over time. Hence, to make the data comparable over time, we define a reference store r, that will be the same throughout the analysis, and consider the evolution of the prices of

each store with respect to the reference store. That is, we change the normalization such that the price ratio, which we use for the analysis, is calculated as follows:

$$p_{it} = \frac{FPI_{it}}{FPI_{rt}} = \frac{P_{it}/min_j\{P_{jt}\})}{P_{rt}/min_j\{P_{jt}\})} = \frac{P_{it}}{P_{rt}}$$

As an interesting fact, comparing the average volatility of the prices (within variation) and the average price flexing among the stores (between variation) for each chain, the data show a significant correlation between the volatility and the price flexing practice. This suggests that those firms practising a high degree of price flexing are also likely to employ considerable price changes over time.
Table 4 reports the average price changes of stores that face a new entrant in period t within a radius of 1 km and those stores that are further away from the new establishment.

Table 4: Price changes associated with market entry in period t

price lags	average price change		$H_0 : \mu_1 \neq \mu_2$
	$(entry \leq 1km)$	$(entry > 1km)$	p-value
$p_t - p_{t-1}$	-1.37 % (3.70)	-0.41 % (3.54)	0.0001
$p_{t+1} - p_t$	-1.11 % (3.31)	-0.45 % (3.67)	0.0090
$p_{t+2} - p_{t-1}$	-0.29% (3.45)	0.16 % (3.23)	0.5934

The first row compares the average price changes with respect to the pre-entry period. The data suggest a significant difference between the price adjustment of the two groups. The supermarkets that face a new entrant in their trade area seem to instantaneously decrease their prices. The second row compares the price changes in the period after entry, and likewise shows a significant decrease for the stores that face new rivals. This may suggest a delayed price adjustment after entry has taken place. However, the last row shows no significant difference between the price adaptation in subsequent periods. We will investigate whether this pattern can indeed be interpreted as a gradual two-period price adjustment due to the market entry of a new supermarket in the neighborhood. [7]
In our data, 73% of all the tracked stores experience entry at some point of time within the considered time horizon. The reference store is chosen at random from the subsample of 11 stores for which we observe prices for the standard shopping basket and which experience neither entry nor exit within at least 1 km distance from the store location during the whole observation period. Since four of the stores belong to the retail chain Ahorramas, we choose one of the Ahorramas stores as our reference for the analysis and use the others for a robustness check of the results.

[7]Since we are interested in an econometric analysis of the price dynamics, we run a panel data unit-root test on the price ratios. The HarrisTzavalis unit-root test rejects the unit-root hypothesis so that we can rely on the usual econometric procedures.

5 Estimation approach

Since we are interested in estimating the causal effect of entry on market prices, let us briefly consider the process behind the observed market entry. Given the market structure and the distribution of local characteristics within the urban market, firms decide whether it is profitable to enter the market and, if so, which location to choose in order to maximize their profits. Assuming rational firms, the optimal location is the best response to the behaviour of incumbent firms in terms of prices and locations, as well as the distribution of relevant market characteristics. In turn, the prices of incumbent firms are the optimal response to the market entry decision, which implies that, in equilibrium, market entry and prices depend upon each other. Hence, setting up an econometric model that explains prices as a function of market entry, we face a simultaneity problem. However, dealing with a regulated market, let us assume a time lag between the entry decision and the entry realization, which comes from the necessary application and approval by the regulation authority. Next, following the assumptions of Basker (2005) that firms cannot accurately forecast prices, entry will affect the price setting in the entry period but not the other way around. In other words, in a regulated market that causes delays between the entry decision and the realization, any endogeneity bias of the entry coefficient due to simultaneity is not an issue. However, the necessary approval of entry by an external party introduces a potential problem of selection bias when evaluating the entry effect. The Ministry of Economy and Finance is assumed to pursue certain objectives when deciding on the approval or rejection of an entry application, such that entry approval is not a random assignment. However, note that if the decision of the ministry depends upon some unobservable market characteristics which are also price determinants, this produces a kind of omitted variable bias in the entry coefficient that we aim to estimate. Under the strong assumption that entry approval is merely based on time-invariant store-location characteristics, we can write observed market entry as follows,

$$E_{it} = f[g(p_{i,t-k}, X^{all}_{i,t-k}, Z^{all}_{i}), Z^{all}_{i}]$$

where $g(\cdot)$ defines the optimal decision of a firm at time $t-k$ with $k \geq 1$ to enter the market in the neighborhood of store i, and $f(\cdot)$ defines the decision made by the regulation authority based on the received application. Z^{all} accounts for observable and unobservable time-invariant characteristics and X^{all} accounts for observable and unobservable location-specific and store-specific differences that vary over time.

Keeping this in mind, let us consider the following reduced-form price equation which has been used in several papers to analyze competition effects,

$$ln(p_{it}) = \alpha_0 + \alpha Z_i + \beta X_{it} + \gamma rivals_{it} + \epsilon_{it}$$

where Z_i are the observable time-invariant characteristics (like the size of the stores and the chain affiliation) and $X_{it} = (W_{it}, rivals_{it})$ are observable store- and location-specific variables, where W_{it} captures location-specific and store-specific differences like the population mass living within a 1 km radius of the stores or the difference in housing prices at the store location, and $rivals_{it}$ indicates the number of rival stores at a certain point in time. [8] In this model, γ is usually the parameter of interest to be estimated that captures the competition effect. Note that this specification implicitly assumes that all stores exercise the same competition effect, independently of whether they are incumbent stores or whether they have just entered the market, and this could be estimated using cross-sectional data.

In this paper, we are interested as to whether there is an entry effect on supermarket prices and, if so, whether the price adaptation takes place instantaneously or gradually, as well as how to identify the long-run competition effect. In order to address these issues in a reduced price regression, we disclose the number of supermarkets in the trade area of a store in incumbents and entrants in the following way,

$$ln(p_{it}) = \alpha_0 + \alpha Z_i + \beta X_{it} + \gamma Incumbents_{it} + \phi(L) Entry_{it} + \epsilon_{it} \quad \text{with} \quad \epsilon_{it} = w_i + u_{it} \quad (1)$$

where $Incumbents_{it}$ controls for the existing number of established stores within the trade area and $Entry_{it}$ captures the number of entrants in the respective periods. In order to allow for delayed price adaptations, we will also include the lagged values of entry, but for the moment let us focus on this specification.

Given our reasoning about the process behind the observed market entry, note that if $Cov(p_{it}, Z_{it}^{all} \setminus \{Z_i\}) \neq 0$ and $Cov(Entry_{it}, Z_{it}^{all} \setminus \{Z_i\}) \neq 0$, then our parameter of interest ϕ will suffer omitted variable bias. Hence, for the estimation I propose the use of first-differencing, which results in the following first-difference distributed-lag (FDDL) model:

$$\Delta p_{it} = \beta \Delta X_{it} + \pi_0 Entry_{it} + \pi_1 Entry_{i,t-1} + \Delta u_{it} \quad (2)$$

Controlling for the number of incumbent stores and entry, note that the number of incumbent stores of the next period is the number of the current stores plus entry ($N_{it} = N_{i,t-1} + Entry_{i,t-1}$). This implies that, when taking the first-difference of equation (1), the number of incumbent firms vanishes from the regression specification. The competition effects that we estimate under this specification are $\pi_1 = (\gamma - \phi_0)$ and $(\pi_0 = \phi_0)$, such that we estimate the competition effect of a new entrant (ϕ_0) directly and recover the effect of incumbent stores (γ). Note that both the number of incumbent stores and

[8] Similar specifications have been used by Singh and Zhu (2008), Basker (2009) and Asensio (2013). An alternative approach to model price variations, is to base the estimation on the price reaction function of the firm using a spatial autoregressive model. For applications of the latter see for example Pennerstorfer et al. (2012) and Gullstrand and Jörgensen (2012). It depends on the purpose of the analysis which model-type is preferred.

any observed and unobserved time-invariant determinants (e.g., product quality, services, location inside a shopping mall, etc.) may also be determinants of the entry approval by the ministry and they vanish, which prevents potential omitted variable bias from time-constant variables.[9]

In this specification, we expect to find a temporary entry effect on the price reaction of the stores, such that the coefficients of the entry variables are expected to decline over time. If this is the case, then we can interpret the coefficients of the FDDL model as $\hat{\pi_0}$, being the "short run effect" of market entry, while the sum over all the lagged coefficients of entry $\sum_{s=0}^{q} \hat{\pi_s}$ is the "long-run effect", which corresponds to the effect of incumbent stores. Table 5, panel A, columns (1) and (2), present the estimated coefficients of interest of the FDDL model without and with covariates for the full sample, and Table 6 provides the corresponding competition effects of interest.

Table 5: FDDL regression on the price of a standard food basket.

Panel A		Full sample			
		(1), None	(2), ΔX	(3), None	(4), ΔX
π_0	$entry_t$	-.011942***	-.0121336***	-.0073437***	-.0088779***
		(.0023682)	(.0024289)	(.0022614)	(.0022774)
π_1	$entry_{t-1}$	-.0084087***	-.0093975***		
		(.0020829)	(.0020653)		
$\tilde{\pi_1}$				-.0066492***	-.0067946***
				(.0022304)	(.0022176)
π_2	$entry_{t-2}$			-.0009511	-.0025532
				(.0022762)	(.0022661)
Panel B		Differentiation by price segment.			
		low price segment	middle price segment	high price segment	
		(5),ΔX	(6),ΔX	(7),ΔX	
π_0	$entry_t$	-.0162649*	-.0091188***	-.0311733**	
		(.0085604)	(.0020936)	(.0129666)	
π_1	$entry_{t-1}$	-.0051867	-.0100581***	-.0108938	
		(.0070136)	(.0020736)	(.0089116)	

The price index for a standard shopping basket has been normalized with respect to a reference store r. Hence, for ease of interpretation we define all the covariates as the difference with respect to the reference store. That is, we use $\Delta\tilde{X}_{it} = \Delta(X_{it} - X_{rt})$, and the competition effect of incumbent firms refers to a change in $\tilde{Incumbents}_{it} = (Incumbents_{it} - Incumbents_r)$, which corresponds to a change in $Incumbents_{it}$ since the reference store does not experience any change in the number of stores during the period of analysis.
Significance level: * 0.1, ** 0.05, *** 0.01. Robust standard errors in brackets.

The estimates of the entry effect in columns (1) and (2) suggest an instantaneous, sig-

[9]Recall that we analyze the effect of accomodated, approved market entry. Note that we do not observe when entry is blocked, deterred or denied by the regulation authority. In this paper we discuss potential endogeneity of entry but do not explain entry behavior but the reaction of incumbent stores to a new store opening.

Table 6: Summary of estimated competition effects.

	Full sample	low price segment	middle price segment	high price segment
	(a)	(b)	(c)	(d)
incumbent stores ($\hat{\gamma}$)	-.02153112***	-.02145158**	-.01917686***	-.04206712***
	(.00289845)	(.00982516)	(.00273631)	(.01381646)
new entrants ($\hat{\phi_0}$)	-.0121336***	-.0162649*	-.0091188***	-.0311733**
	(.0024289)	(.0085604)	(.0020936)	(.0129666)

nificant price decrease in the entry period, which is robust controlling for population and cost effects. In order to verify whether the entry effect is different from the competitive pressure that is exercised by an incumbent store, note that this is equivalent to test the hypothesis $H_0 : \pi_1 = 0$. Panel A suggests that the coefficient of the lagged entry variable in the FDDL model is significantly different from zero, which implies that the competition effect of a new entrant is different to the effect of an incumbent store. To be precise, the result suggest that entry leads to an instantaneous price decrease of 1.2%, but implies a total price decrease of 2.2%. This can be either interpreted as constrained price flexibility in the short run, or we can argue that supermarkets entering an urban market need one period to position their store as a fully-fledged rival in the market, which may be an alternative explanation for the partial competition effect in the entry period. Considering the price indexes of a standard food basket, it may be the case that firms adjust prices instantaneously for some products but, depending upon the contract with the providers, it may take time to adjust the prices of other goods. In order to get an idea about the magnitude of the competition effects, we find that an increase of one standard deviation in the probability of entry implies a decrease of 4.7% of the standard deviation of the normalized price index. This is a moderate effect, and we interpret this as the supermarket industry in Madrid being quite competitive.

Given the difference in the competition effect of new and incumbent firms, we consider potential delayed-entry effects accounting for lagged entry in the price equation. This introduces a sequence of potentially relevant lags in the FDDL model. Table 5, columns (3) and (4) present the results for two lags. Estimating the effect of lagged entry in the differentiated equation, we estimate $\pi_1 = \phi_0$, $\tilde{\pi_1} = (\gamma + \phi_1 - \phi_0)$ and $\pi_2 = -\phi_1$. Considering the entry coefficients, this confirms our expectations of a declining lag effect on the price change. However, testing the hypothesis of delayed-entry reaction implies testing the null hypothesis $H_0 : \pi_2 = 0$, which we cannot reject. Hence, the data suggest that there is an instantaneous price reaction to entry which is not as strong as the full competition effect by the incumbent store. Nonetheless, and already in the next period (three months later), the competition effect of the new entrant has been fully realized and there is no persistent effect on the price adaptation.

Panel B differentiates the analysis by price segments and Table 6, columns (b)-(d) provide

the associated competition effects.
Considering the low price-segment, the competition effects are similar to those estimated for the full sample. The entry effect increases slightly so that short-term and long-term competition effects are no longer statistically significantly different. A possible explanation is that low-cost retailers may be more efficient in the sense of being flexible and fast in reacting to changes in the market structure, thereby minimizing the time gaps of price adaptations.
For the middle price segment, the competition effect of an incumbent store is only a little smaller than for the low-price segment. However, it is interesting that the competition effect of a new entrant is only half as large. This implies that these stores are either less flexible in their pricing policy or else new retailers have some work to do in order to settle down in the market on a par with long-established grocery businesses. It has to be mentioned that the standard food price index for each store has been constructed with comparable products such that we do not measure differences in the composition of private labels and branded products, which may explain these time lags in the price adaptation. Hence, this delayed price adaptation may reveal difference in the flexibility of these firms in some senses, starting from the management to binding contracts with upstream firms. In this paper, we will not be able to explore the reason for this pattern further.
Last, but not least, considering supermarket stores that belong to chains in the high price segment, we find a significant negative competition effect for entrants as well as for incumbent stores that is much stronger than that identified for the full sample. The entry of a new supermarket (of the low or high price segment) leads to a price decrease of 3.1%, and the full effect is even 4.2%. In other words, we find that stores in the high price segment react with a relatively strong price decrease to any rival in their trade area, no matter if they have just entered the market. This stronger price reaction is surprising, since we expected them to be sufficiently differentiated from the rest of the stores, and hence to be less sensitive to market entry by other stores. However, the results may be interpreted as evidence of the high price-cost margin of these firms (opposed to low-price stores which don't have much room to adjust prices downwards) and the competitive threat of other supermarkets. Since almost all the entrant events in the analyzed time period are from the low and middle price segments, it remains open as to whether this holds for entrants of the high price segment.

6 Limitations, robustness checks and further research

So far, we have assumed that the approval for entry by the Ministry is based on time-invariant market characteristics. If we relax this assumption, allowing approval for entry

to depend upon observed time-variant variables or any type of observed and unobserved variables, our estimates will still be biased. We are currently working on this issue to verify the consistency of the results.[10]

Second, we are implicitly assuming that all the entry observations have been subject to the same approval process. However, for small grocery retailers in terms of the sales area of the store, entry barriers are relaxed. We will investigate how to account for this differentiation in our model.

In this version of the paper, we restrict the robustness analysis of the results to the analysis with respect to the definition of the variables, that is the chosen reference store. Table 7 reports the competition estimates for the full sample for different reference stores.

Table 7: Competition estimates for different reference stores.

ϕ_0	γ	Reference store
-.0121336***	-.02153112***	Ahorramas,
(.0024289)	(.00289845)	Avda. Daroca 300 (Vicalvaro), 28032 Madrid
-.0135573***	-.02230238***	Ahorramas
(.002395)	(.00286516)	C/Sofia 117, C/V P de Ginebra, 28022 Madrid
-.0125363***	-.018398***	Ahorramas
(.0023915)	(.00295826)	C/Maqueda 117 (Galeria Copasa), 28040 Madrid
-.0123088***	-.02175579***	Ahorramas
(.0024199)	(.00284723)	C/Villajoyosa 96, 28041 Madrid

Note that the competition estimates are very stable with respect to the reference store r that we have chosen in order to make the data comparable over time. On average, the entry of a new supermarket in the neighborhood leads to an instantaneous price decrease by established stores of 1.26%, and the full competition effect implies an average total price decrease of 2.11%. In other words, approximately 60% of the total impact on prices takes place instantaneously in the entry period.

Once we have addressed the concerns above, we plan to consider several extensions of this analysis.

First, we may ask whether the entry of a small store is negligible. Hence, it would be interesting to differentiate the competition effects by the size of the entrant in terms of the sales area, which allows to draw comparisons with the literature on Wal-Mart entry.

Second, since the time horizon of our analysis is from 2009-2011, just after the financial

[10]Remark: We have started with the robustness analysis under the null hypothesis $\gamma = \phi_0$. Allowing for selection on observables, we use a difference-in-difference methodology based on propensity score matching, as applied in Girma et al. (2003). Allowing additional for selection on unobservables, we use Altonji et al. (2005). Comparing this different approaches, the results will be provided in the next version of the paper when hopefully this issue can also be addressed under the alternative hypothesis, $\gamma \neq \phi_0$, which is suggested by the data.

crisis, the financial structure of a firm may effect its entry behavior. Firms that have a good access to credits, may enter the market with a low price and recover possible losses later. However, financially distressed firms don't have this option. Since in the considered time period, stores of Spanish chains as well as stores of International chains enter the market, where the latter are expected to have easier access to credit, it may be interesting to differentiate the entry effect by the financial distress of the firm which is comparable to Chevalier (1995), who provides evidence of price changes due to changes in the financial structure of a firm in terms of leveraged buyouts.

Last, but not least, we plan to analyze whether we can identify additionally the pricing pattern at the chain level. Descriptive statistics cause us to suspect that some retail chains of the same price segment monitor their own position and the positions of their rivals. Since firms have access to the published price indexes in the same way as consumers do, keeping track of their own market position may lead to tacit collusion, and it would be interesting to analyze this hypothesis.

Moreover, we may ask whether the entry of a small store is negligible. Hence, it would be interesting to differentiate the competition effects by the size of the entrant in terms of the sales area.

7 Conclusion

The motivation of this paper has been to analyze whether we can explain part of the observed volatility of supermarket price indexes as a result of changes in the market structure. The key idea for the econometric analysis has been to decompose the effect of rival stores into the number of incumbent firms and entrants and to use the panel data to estimate a first difference model with distributed lags. The results suggest that grocery retailers in the City of Madrid react to market entry with a gradual price decrease, which begins with an instantaneous reaction in the period of entry and reaches the long-term competition effect in the next quarter. For retailers of the middle price segment, the results suggest that they delay more than half of the price adaptation to the next quarter.

As noted in the last section, when considering the price volatility at the store level for grocery establishments with an affiliation with a retail chain, we have focused on the neighborhood of a store, although the whole store network within and across markets may explain part of the price variations, which would be interesting to analyze with the data used in this paper.

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