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# ASSESSING EXCESS PROFITS FROM DIFFERENT ENTRY REGULATIONS

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XARXA DE REFERÈNCIA EN ECONOMIA APLICADA

# Assessing excess profits from different entry regulations

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**Abstract**

Entry regulations affecting professional services such as pharmacies are common practice in many European countries. We assess the impact of entry regulations on profits estimating a structural model of entry using the information provided by a policy experiment. We use the case of different regional policies governing the opening of new pharmacies in Spain to show that structural models of entry ought to be estimated with data from policy experiments to pin down how entry regulations change payoffs functions of the incumbents. Contrary to the public interest rationales, regulations are not boosting only small town pharmacies payoffs nor increasing all pharmacies payoffs alike. The gains from regulations are very unevenly distributed, suggesting that private interests are shaping the current mix of entry and markup regulations.

Keywords: entry, regulation, professional services.

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## 1. Introduction

While regulations that restrict the entry of new firms into a market by fixing the number of firms that can supply that particular market are common in industries such as finance (e.g., banking and insurance), transport (e.g., taxis and buses), retailing (e.g., supermarkets, alcohol and tobacco) and the professions (e.g., pharmacists and solicitors), in Europe there is an on-going discussion as to whether these entry restrictions serve public interests or whether they benefit private incumbents. At the same time a growing body of literature has begun to assess the impact of these restrictions and their appropriateness with regard to the aims they pursue.

In many European countries it is common practice that the entry regulations restricting the number of pharmacies in a given geographic area are particularly stringent. ÖBIG's report (2006) for the European Commission revealed that 17 out of 25 EU Member States operate entry restrictions[1], a situation that contrasts markedly with that in the US and Canada where no restrictions are operative. Furthermore, European entry restrictions are typically coupled with price or retail margin regulations.[2]

In the case of pharmacies, it might be argued that it is in the public interest to increase the profits of small-town pharmacies (marginal outlets), while attempts should be made to avoid the excessive entry of pharmacies downtown (infra-marginal outlets). In this case, regulations should seek only to raise the revenues of small-town pharmacies.

Alternatively, it might also be argued that it is in the public interest to raise the profits of all pharmacies. In this case, regulatory quasi-rents should be designed so as to pay pharmacists for public services produced jointly with private services. Pharmacists produce positive externalities when in the role of gatekeepers they curb the non-desired use of medicines in the sense described by Kraakman (1986) and Arruñada (2006). Here, regulation may serve as the policy instrument to increase profits like a tide that raises all boats.

Or, private interests might pursue competition restrictions that ensure phar-

[1] In most state members, the establishment of new pharmacies is restricted on geographic and demographic criteria. Only in the UK and the Netherlands entry is restricted by the contracts with the tax-funded health care organizations. Mossialos and Mrazek (2003) also report that entry is restricted in Norway.

[2] ÖBIG (2006) reported to the European Commission that 18 out of 25 Member States set the pharmacy markups by regulation and discounts are not allowed, while the other 7 set maximum markups or fees for servicies while allowing for free discounts to customers.

macists obtain excess profits or pure regulatory rents. However, the European Commission has initiated infringement proceedings against countries that operate overly tight entry and ownership regulations on the grounds that restricting freedom of establishment is neither the adequate nor the proportional policy for serving public interest.[3]

The aim of this paper is to examine the particular case of recent regional policy changes in regulations restricting the entry of pharmacies in Spain to assess their impact on the equilibrium number of pharmacies and payoffs. Static entry models such as that developed by Schaumans and Verboven (2008) can be estimated by taking into account the fact that entry is restricted by the government. However, structural estimates of payoffs and competitive interactions obtained exclusively from a regulated market are incapable of identifying structural changes in equilibrium behavior before and after deregulation.

Here, however, we show how policy experiments actually help bail out the structural approach and we demonstrate that estimating a structural model using data from regulated and deregulated markets is a suitable way to avoid bias in the counterfactuals. Specifically, we compare the case of a Spanish region (Navarra), which underwent a change of policy from restricted entry to free entry in 2000, with that of other regions in which severe entry restrictions continue to be applied.

We find that restrictions have reduced entry by as much as 71%. And that deregulation has markedly reduced the scale of the outlets so that as many as a third of the pharmacies would not have entered the market if the outlets had maintained the same scale as before deregulation.

Additionally, we find that geographic entry regulations cannot be compared to an incoming tide that raises all boats since entry restrictions increase the payoffs of the pharmacies in some municipalities, while reducing payoffs in others, especially in the least populated municipalities.

Therefore, attempts to reform entry regulations might prove difficult since the incumbents that occupy the upper tail of the distribution and who gain most from the restrictions will be willing to invest heavily in lobbying so as to avoid policy reforms. Any assessment of the impact of these regulations on welfare is beyond the scope of this current paper, although this question undoubtedly merits further research.

The paper is organized as follows. Section 2 provides a brief review of the

[3] The European Commission has initiated infringement proceedings against the legislation on ownership and establishment of pharmacies in Austria, Bulgaria, France, Germany, Italy, Portugal and Spain (European Commission 2008).

previous literature conducted in this field. Section 3 describes policy changes in the geographic areas of analysis, which enable us to assess the impact of regulations across different regional jurisdictions. Section 4 outlines the entry model that we use in our empirical analysis. Section 5 presents and discusses the results obtained from our estimation of the entry model. Section 6 simulates free-entry policy counterfactuals. Section 7 presents our concluding remarks.

## 2. Literature Review

There is a large body of empirical literature examining the effects of pricing, quality and entry regulations on the provision of services. In a seminal paper, Eckard Jr. (1985) showed that restricting entry into the car retailing business creates artificial scarcity rents for existing dealers, which are reflected in higher prices for new cars. Valletti et al. (2002) concluded that the regulatory tools of uniform pricing and coverage constraints as applied in the telecommunications market are not competitively neutral. They also showed that they may have far-reaching strategic effects and a varying impact on the achievement of public service aims. Further, Klapper et al. (2006) found that costly entry regulations can hamper the creation of new firms, especially in industries that should naturally have high entry. These regulations also force new entrants to be larger and cause incumbent firms in naturally high-entry industries to grow more slowly.

This paper is conducted in line with a tradition in the empirical literature that can be traced back to the entry models devised by Bresnahan and Reiss (1990 and 1991), and subsequent papers by Griffith and Harmgart (2006), Moreno, Puig and Borrell (2007), and Schaumans and Verboven (2008). In so doing we seek to demonstrate the importance of estimating the drivers of entry by taking into consideration entry regulations.

Entry models have been used to assess a closely related question: whether prices and entry are optimal in equilibrium in markets with product or location differentiation. The theory remains ambiguous as to whether there is scope for welfare enhancing pricing, quality and entry regulations. Chamberlain's (1933) excess entry theory, subsequently generalized by Suzuma and Kiyono (1986), shows that entry is excessive whenever transportation costs are high and economies of scale are large. Mankiw and Whinston (1986) set the conditions under which free entry is socially inefficient in oligopolistic markets. The key issue is to estimate whether new entrants to an industry add more to the consumer surplus entering the market than they reduce the profits to incumbents by taking their business from them.

Berry and Waldfogel (1999) and Davis (2006a and 2006b) were the first to employ an entry model for assessing the efficiency of free entry, and reported excessive entry in the radio broadcasting and the motion picture exhibition industries, respectively. By contrast, Gowrisankaran and Krainer (2006) reported too little entry in the ATM industry, and a lack of geographical coverage or penetration. In the case of pharmacies, Watersson (1993) reporting in Melbourne and Janson (1999) in Spain showed empirically that free entry leads to excessive entry, and that price regulation might mitigate the problem.

When adding quality of service to the problem, Nuscheller (2003) showed, using a vertical and horizontal product differentiation model, that under linear price regulation there is excessive entry but optimum quality in equilibrium when governments cannot commit to a price prior to firms' entry decisions. In this instance, price regulation is required in order to ensure an optimal level of quality, and another regulation such as entry restrictions are required to attain the optimal level of entry.

However, it can prove especially difficult to set the right prices and entry restrictions when demand is heterogeneous. As Waterson (1993) pointed out an overly generous price regulation can lead to a larger number of pharmacies than the market would allow in a situation of free entry. And, furthermore, entry regulations can result in insufficient entry.

The question then as to whether regulations are getting the pricing and the amount of entry right needs to be assessed case by case. And in conducting this assessment it is essential to get the counterfactual right. As Pakes (2007) pointed out, the typical role of counterfactuals in industrial organization is to evaluate alternative policy scenarios, i.e., to answer the question as to what would happen if a regulation were changed. But today the emphasis lies more on estimating models that are able to approximate what might happen in an environment that has never actually been observed.

We are therefore interested in assessing whether experimental data can help us improve the counterfactuals from static entry models. Structural models allow us to pin down some of the primitives of the entry model, while the experimental data should allow us to determine whether the payoff functions change with regulation.

A large number of studies in economics have been conducted based on natural experiments or quasi-experiment designs to examine outcome measurements for observations in treatment groups and comparison groups. Meyer (1995) described the strengths and weaknesses of using quasi-experiments in economics, but among the good natural experiments he cites those induced by policy changes, as they allow a researcher to obtain exogenous variation in the main explanatory variables.

Besley and Case (2000) explored the use of different methods for estimating the incidence of policies in situations where there was a concern about policy endogeneity. Symeonidis (2000 and 2007) showed the utility of policy reforms for comparing outcomes before and after the introduction of laws, specifically the law prohibiting cartels in the UK in the late 1950s.

Regional changes in pharmacy entry regulations in Spain provide us with just such an experimental setting in which policy changes were both unexpected and unwanted, as we shall see in the section below.

## 3. Background on the policy change

Entry regulations for pharmacies in Spain date back to the early 20th century. In 1904, the government ruled that local governments should guarantee the existence of at least one pharmacy for every 2,000 inhabitants so as to attend to the needs of the poor. This was a typical public service obligation whereby local governments had to contract-out to one pharmacist certain specified retail pharmacy services for the poor.[4]

It was not until 1941 that the government restricted the number of pharmacies. The new law ruled that there should be no more than one pharmacy for every 5,000 inhabitants in each municipality.[5] It also laid down minimum distance requirements.[6] These entry restrictions were coupled with linear regulated mark-ups for pharmacies.[7] Entry restrictions have changed little since then. The current

[4] Pure licensing regulations and restrictions whereby only pharmacists can own pharmacies that open to the public and the one-pharmacy per pharmacist rule go back to 1860. In Spain chemists competed with pharmacists as outlets authorized to sell the new industrial medicines from the mid-19th century to 1931. See the detailed account of the confrontations between pharmacists and chemists in Rodríguez-Nozal and González-Bueno (2005). Pharmacists eventually won the exclusivity right for selling medicines with the support from the upstream industrial producers of medicines.

[5] One pharmacy for every 10,000 inhabitants in municipalities with a population greater than 50,000 inhabitants.

[6] New pharmacies could only open 250 meters away from existing ones in cities larger than 100,000 inhabitants, 200 meters away in cities with between 50,000 and 100,000 inhabitants and 150 meters away in cities with between 5,000 and 50,000 inhabitants.

[7] Retail price maintenance was imposed by the government in 1928 as retail and industrial pharmacists complained about the discounts offered in the chemists' outlets, while government regulations capping the markups on industrial medicines date back to 1945, fourteen years after

Spanish legislation regulating the establishment of new pharmacies, introduced in 1997, fixes a ratio of one pharmacy per 2,800 inhabitants in each health care zone.[8] A health care zone is a part of a municipality or group of municipalities in which there should be at least one public, National Health System (NHS), primary health care center.[9] The minimum distance between pharmacies is fixed at 250 meters, while the regulated mark-up was fixed at 27.9% of the retail price.

In 2000, the Parliament of the Foral Community of Navarra, a small region in the North of Spain, with just over 600,000 inhabitants, challenged these national entry restrictions. Navarra passed a law which reverted to a regulation of minima, i.e., the regional government allowed new pharmacies to be opened and sought to ensure that there was at least one pharmacy in each health care zone.

The policy shift in Navarra can be seen as a natural experiment, since it was unexpected and unwanted. In fact, the sponsor of the legislative proposal, the region's Health Minister, was a doctor whose original intention was to obtain discounts from pharmacies in the distribution of medicines prescribed by doctors working in the public sector. Paradoxically, pharmacy mark-ups are fixed by Spain's central government, while health care is fully managed by the regions.

The aim of Navarra's Health Minister was to license the new pharmacies under a new contract with the regional government, under whose terms they would have to give discounts to the NHS. During the attempts to introduce the bill, confrontations between the regional government and the pharmacists were frequent and acrimonious. The pharmacists even took strike action, and public health care centers were exceptionally given judicial permission to dispense medicines during the strike action. The new legislation was finally introduced by the regional parliament, coming into force late in the year 2000. Consequently, a considerable number of new pharmacies started trading in 2001.

The new regulation guarantees that there is at least one pharmacy per health care zone, a global maximum for the region so as to avoid region wide excessive entry (though this is still not binding), and a minimum distance of 150 meters

the retail pharmacists became the exclusive providers of industrial medicines.

[8] An additional pharmacy can be established whenever the population of the health zone is 2,000 people larger than the number resulting from multiplying the number of pharmacies already open to the public by 2,800. Therefore, a municipality needs a population of 2,800 inhabitants to obtain the permit for the first pharmacy, 4,800 for the second, 7,600 for the third, and 10,400 for the fourth and so on.

[9] Zones vary in population size. For instance, the median health care zone is around 6,100 inhabitants in one region of Spain (Navarra in 2000), while it is 24,000 in another (Andalusia in 2008).

between incumbent and new businesses. By contrast, the other regions of Spain have continued to adhere, more or less, to the national mandate, which prevails in those cases where the region has not specifically legislated.

The legal dispute eventually reached the Constitutional Court in 2004, where it was held that the regional government was respecting the provisions laid down by the constitution and Spain's pharmacies law regarding the duty of guaranteeing a fair geographic coverage of pharmaceutical services albeit by adopting a less interventionist approach. The situation was held to be consistent with EU policy of only maintaining trade and professional regulations that are necessary, adequate and proportional to the public aim they pursue.

Between 2000 and 2006, the number of pharmacies in Navarra doubled. In this paper, we seek to infer the impact of entry regulations on payoffs and the service's geographic reach by comparing the establishment of new pharmacies in Navarra, where entry is was deregulated although location was not, and the opening of pharmacies in two other Spanish regions in which stringent entry regulations remained in force.[10]

Our control regions are Euskadi and Andalusia. Euskadi is in the north of Spain, and is officially named the Autonomous Community of the Basque Country. It has around 2 million inhabitants. Euskadi has one of the most restrictive policies regarding the opening of new pharmacies. The entry regulation in Euskadi allows at most one pharmacy per 3,200 inhabitants in large municipalities, one per 2,800 inhabitants in intermediate municipalities and one per 2,500 inhabitants in small municipalities. Further, pharmacies in municipalities with fewer than 800 inhabitants are not authorized at all.

The other control region, Autonomous Community of Andalusia, is in the south of Spain. It has around 8 million inhabitants. Since 2003, Andalusia has allowed the free opening of the first pharmacy in any town or suburb. But, the establishment of a second, and subsequent, pharmacies is restricted to comply with the regulation whereby the total number of pharmacies cannot be greater than one per 2,800 inhabitants. The law in Andalusia is as restrictive as that practiced in Euskadi, except in large tourist towns, since here it is not only the registered population that is taken into account, but also tourist accommodation and second homes.

[10] A new law restricting entry again in Navarra has just benn passed late 2008, although the new entry restriction is much *softer* than in other regions: the openning of the first pharmacy in any municipality is free, while the second and further pharmacies can only be opened if population per pharmacy reaches 700 inhabitants.

## 4. The entry model

To estimate the parameters underlying entry decisions, we use the entry model à la Bresnahan and Reiss (1990 and 1991) where entry decisions taken by potential entrants are strategic substitutes as proposed by Schaumans and Verboven (2008) for studying the markets for pharmacies subject to entry restrictions. This paper was the first to take into account geographic entry restrictions when estimating the parameters for an empirical entry model, and also the strategic complementarities between the entry of pharmacies and doctors.

In static models of this type, inferences are drawn about unobserved payoffs from the equilibrium relationship between the observed market structure and market characteristics such as market size and profitability.[11]

The literature here begins by considering that entry is primarily related to demand drivers, such as the size and profitability of different markets, to variable and fixed cost shifters, and to competition effects.[12]

In this present paper, we assume that there is only one type of firm (pharmacy) with a large pool of potential entrants for each local market.[13] Health care centers are public facilities set up by the regional government according to social needs. Thus, we consider them to be fixed when pharmacy entry decisions are taken in each local market.

Following Schaumans and Verboven (2008), we assume that the total number of firms entering each local market is a random variable $N$. Equilibrium realizations of this random variable are denoted by $n$. Firms are subject to an entry restriction in any local market when $N \leq \overline{n}$. This is the case when in any local market there cannot be more than $\overline{n}$ firms. If $N < \overline{n}$, the entry restriction is not binding in equilibrium; by contrast, when $N = \overline{n}$ the entry restriction is binding.

Firms are identical and have the same payoff functions. If a firm does not enter, it has zero payoffs. If a firm enters, its payoffs depend on the total number

[11] Reviews of the fundamentals of static models of this type can be found in Reiss and Wolak (2005) and in Berry and Reiss (2007). Dynamic entry models have been developed more recently and are reviewed by Pakes, Ostrovsky and Berry (2007).

[12] Different papers use different demand drivers and cost shifters: see Reiss and Spiller (1989), Morrison and Winston (1990), Bresnahan and Reiss (1990 and 1991), Berry (1992), Joskow et al. (1994) and Dresner et al. (2002).

[13] The ownership of any single pharmacy is restricted to licensed pharmacists. Each pharmacist can only own one pharmacy, so there is not chain effects. But licensing does not limit the number of potential entrants as only around a third of the members of the professional associations of licensed pharmacists currently own a pharmacy in Spain, and less than half of these owned a pharmacy in Navarra after deregulation.

of entering firms:

$$\pi^*(N) = \pi(N) - \varepsilon, \tag{4.1}$$

where $\pi(N)$ is the deterministic component of payoffs, and $\varepsilon$ is a random component, unobserved to the econometrician. The nature of the competitive interaction conditions the precise relationship between the deterministic component of payoffs and the number of firms. In entry models of this type, the main assumption is that entry decisions by firms are strategic substitutes: when one firm decides to enter, the payoffs from the entry of another firm decrease. That is, payoffs from entering the market decrease with a rise in the number of firms.

$$\pi(N+1) < \pi(N) \tag{4.2}$$

Payoffs decrease with respect to the number of simultaneous entrants. This assumption is plausible and consistent with this type of entry literature, and is key to characterizing the Nash equilibrium outcomes.

When entry restrictions are not binding, $N < \overline{n}$, each firm freely decides whether or not to enter, given the entry decisions of the other firms. There is a large number of pure-strategy Nash equilibria in this entry game. Bresnahan and Reiss (1990) resolved this problem by aggregating the non-unique Nash equilibrium outcomes into a Nash equilibrium in a simultaneous or sequential game.[14]

Any observed market configuration $n$ is a Nash equilibrium outcome if and only if the random component of payoffs, $\varepsilon$, satisfies the following condition:

$$\pi(N+1) < \varepsilon \leq \pi(N). \tag{4.3}$$

When this condition is satisfied, $n$ firms find profitable to enter the market, and no additional firm has an incentive to enter, therefore $N$ is shown to be a Nash equilibrium outcome. The assumption that the deterministic component of payoffs decreases with the number of firms guarantees that there are realizations of $\varepsilon$ for which this condition holds, so there is a positive probability for all outcomes in case the error term has full support.

[14] Alternatively, equilibrium selection mechanisms should be assumed to construct the likelihood function. Bajari et al. (2006) allowed the data to show which equilibrium is selected by the data. However, as stated by Draganska et al. (2008) counterfactuals nevertheless require the solution and selection of the model equilibrium. Aguirregabiria and Ho (2006) proposed a method to obtain a linear approximation of the counterfactual choice probabilities. Estimating such static game models with firm specific information is left for further research. See Berry and Reis' (2007) recent survey on the estimation of such models.

Assuming that $\varepsilon$ has a density function $f(\cdot)$, the probability that market configuration $n$ will be observed as the unique Nash equilibrium outcome when entry restrictions are not binding is the following:

$$\Pr(N = n) = \int_{\pi(n+1)}^{\pi(n)} f(u)du \equiv P(n). \tag{4.4}$$

We observe $i = 1, 2...I$ local markets in which a number of firms have decided simultaneously or sequentially to enter. The log likelihood function related to the probabilities of observing a particular market configuration ranging from no entry ($n = 0$) to entry by more than 4 firms ($n = 4+$), is just the following:[15]

$$l = P(n = 0) + P(n = 1) + P(n = 2) + P(n = 3) + P(n = 4+). \tag{4.5}$$

We specify the density $f(\cdot)$ as a normal density that leads us to estimate the entry model as an ordered probit model like those estimated by Bresnahan and Reiss (1990 and 1991) and many others. Following Genovese (2001) and Schaumans and Verboven (2008), we define a firm's payoffs as $\Pi_i^*(N) = V_i(N)\exp(-\nu_i) - F_i(N) \geq 0$ where $V_i(N)$ is variable profits, $F_i(N)$ is fixed costs, and $\nu_i$ is a multiplicative error term capturing unobserved market-specific variable profits. Firms enter if and only if $\Pi_i^*(N) \geq 0$, or equivalently if and only if

$$\pi_i^*(N) = \ln\left[V_i(N)/F_i(N)\right] - \nu_i \geq 0. \tag{4.6}$$

That is, a firm's payoffs $\pi_i^*(N)$ are the log of the variable profits over the fixed costs ratio. As stated by Schaumans and Verboven (2008), this interpretation differs from Bresnahan and Reiss' (1991) where payoffs are modeled directly as profits. The following linear specification allows us to explain the latent variable, firms payoffs, as a function of market variables that affect the log of the variable profit to the fixed costs ratio:

$$\pi_i^*(N) = \lambda \ln(S_i) + \sum_k \beta_k X_i^k - \alpha^j - \nu_i. \tag{4.7}$$

Variable $S$ is market size, measured by the population of each market, $X^k$ are $k$ different other observed market characteristics that drive each market profitability, $\lambda$ and $\beta_k$ are the parameters that show the impact of observed market

[15] As the probability of observing five or more firms is very small, we aggregated them within the four or more category.

characteristics on the log of the variable profits over the fixed costs ratio, and the parameters $\alpha^j$ are fixed effects when there are $j$ firms in the market.

As we estimate the model including a constant term, these fixed effects are the "cut-off values" in this simple ordered probit where the cut-off value for the one entrant market structure is set at zero ($\alpha^1 = 0$). The fixed effects $\alpha^j$ measure the competition effect of $j$ firms on the average entrant's payoffs (simultaneous game) or last entrant's payoffs (sequential game).

As in Schaumans and Verboven (2008), we allow the competition fixed effects to be non-linear with respect to $N$ : given that competition is highly localized and that location is not free, we expect the first competitor to be affected by average payoffs more strongly than the second and third ones.

Also, as in Schaumans and Verboven (2008), to estimate the model we restrict the standard deviation of $\nu$ so that it is equal to one. As is common in discrete choice models, the scale of the payoffs is not identified. We are estimating a standard ordered probit model in which $\nu \backsim N(0,1)$. Subsequently, we will add an additional structure to the payoffs so as to identify the scale of these payoffs.

We can estimate the model separately for the restricted entry region-years (Navarra before deregulation, Euskadi and Andalusia), and also for Navarra after deregulation. We can also pool the data. By pooling we are able to identify whether there are any differences in the payoff function in the restricted region-years (control group) with respect to the free entry region (treatment region). Denoting $\phi$ the policy indicator where $\phi = f$ when entry is free and $\phi = r$ when entry is restricted, we allow the parameters of the payoff function to depend on the regulatory policy:

$$\pi_i^*(N) = \lambda^\phi \ln(S_i) + \sum_k \beta_k^\phi X_i^k - \alpha_\phi^j - \nu_i.$$

In the pooled estimation we are able to identify whether deregulation changes the primitives of the entry models: the parameters that show the impact of the demand drivers, the cost shifters, and the competition effects on payoffs, that is on the log ratio of variable profits over fixed costs.[16]

[16] All $\alpha_\phi^j$ should be positive and the model is internally consistent if $\alpha_\phi^{j+1} > \alpha_\phi^j$.As in Euskadi in 2006, entry restrictions are always binding in markets with more than 4 pharmacies, and as in the other region-years there are very few markets of 5 or more pharmacies, we follow Schaumans and Verboven (2008) and restrict $\alpha_\phi^j$ so that there is no further competitive entry effect for $j > 4 : \alpha_\phi^j = \alpha_\phi^{j-1} + \lambda^\phi \ln((N-1)/N)$.

From the estimates of the model, we can compute the implied population thresholds for different market structures: $S_{\phi}^{j} = \exp\left[\left(-\sum_k \beta_{\phi}^{k} X^k + \alpha_{\phi}^{j}\right)/\lambda^{\phi}\right]$ .The free-entry thresholds will differ from the entry-restricted thresholds if $\beta_{\phi}^{k}$, $\lambda^{\phi}$ or $\alpha_{\phi}^{j}$ differ for $\phi = f$ and $\phi = r$.

Using the estimates from the model, we can then also simulate policy counterfactuals. We can estimate what should be the reduction in regulated mark-ups in the free-entry counterfactual to keep the number and distribution of pharmacies equal to those in the restricted entry scenario. The difference in mark-ups is then our best estimate of the overcharges that patients and insurers (taxpayers) are paying for their current pharmaceutical coverage.

As in Schaumans and Verboven (2008), to account for the reduced regulated mark-ups, we adjust the estimated intercept $\beta_0$ downwards by an amount $\lambda \ln(\Delta)$, where $0 \leq \Delta \leq 1$ refers to a given reduction in the net mark-ups. As we only have information regarding gross mark-ups (here 27.9%), but we have no information about variable retail costs, we cannot compute the effect of an absolute reduction in regulated gross mark-ups.

Following Schaumans and Verboven (2008), we assume that variable profits are the following:

$$V(N) = \mu \cdot R(N) \cdot S, \tag{4.8}$$

where $R(N)$ are revenues per population head. That is, we make the following two assumptions that seem reasonable for pharmacies: net mark-ups $\mu$ are constant across markets, the variable profits per population head are independent of the number of consumers $S$, and any differences across markets are captured by differences in the log of the variable profits per head on fixed costs, $\ln(R(N)/F(N)) = \overline{\beta}_k^{\phi} X_i^k - \overline{\alpha}_{\phi}^{j} - \epsilon_i^{\phi}$. In this new specification we allow the error term $\epsilon$ to have a more general normal distribution with unknown standard deviation: $\epsilon^{\phi} \backsim N(0, \sigma^{\phi})$. So $\epsilon^{\phi} = \sigma^{\phi}\nu$. And substituting this into the payoffs, we obtain:

$$\overline{\pi}_i^*(N) = \ln(S_i) + \ln\mu + \overline{\beta}_k^{\phi} X_i^k - \overline{\alpha}_{\phi}^{j} - \epsilon_i^{\phi}, \tag{4.9}$$

and dividing by $\sigma^{\phi}$,

$$\pi_i^*(N) = \frac{\overline{\pi}_i^*(N)}{\sigma^{\phi}} = \frac{1}{\sigma^{\phi}} \ln(S_i) + \frac{\ln\mu}{\sigma^{\phi}} + \frac{\overline{\beta}_k^{\phi}}{\sigma^{\phi}} X_i^k - \frac{\overline{\alpha}_{\phi}^{j}}{\sigma^{\phi}} - \nu_i. \tag{4.10}$$

Comparing this expression of a firm's payoffs with the previous one, the additional structure links the coefficients of the two specifications so that $\lambda^{\phi} = 1/\sigma^{\phi}$ and that $\beta_0^{\phi} = (\overline{\beta}_0^{\phi} + \ln \mu)/\sigma^{\phi}$.The estimates of $\lambda^{\phi}$ identify the standard deviation of $\epsilon_i^{\phi} : \sigma^{\phi}$. And, the intercept $\beta_0^{\phi}$ contains the net mark-up $\mu$. For a different pharmacy mark-up such as $\Delta\mu$, the intercept in the first specification would be $\widetilde{\beta}_0^{\phi} = (\overline{\beta}_0^{\phi} + \ln \Delta\mu)/\sigma^{\phi}$.And then, adjusting the mark-up is equal to adjusting the intercept by $\widetilde{\beta}_0^{\phi} - \beta_0^{\phi} = \ln \Delta/\sigma^{\phi} = \lambda^{\phi} \ln \Delta$.

Here, we assume that variable retail costs are zero, and therefore that net mark-ups are equal to gross mark-ups. We do not have any information on the variable retail costs other than wholesale costs. Assuming that most retail costs are fixed seems plausible, as Schaumans and Verboven (2008) suggest, because retail costs are mostly labor costs, and time spent on servicing patients is essentially fixed during opening hours. Although, as these authors point out, it would not be difficult to consider net mark-ups ($\mu$) as being smaller than gross mark-ups ($\upsilon$), and to estimate the corresponding reduction in gross mark-ups of a drop in net mark-ups as it is equal to $[(1-\upsilon)/(1-\mu)]\, \mu(\Delta - 1)$.

## 5. Estimation and results

We examine the entry of pharmacies at the municipal level, which here we consider as constituting the local market for pharmaceutical services. Following Schaumans and Verboven (2008), we select municipalities with fewer than 15,000 inhabitants and those whose density of population is less than 800 inhabitants per square kilometer. By doing so, we focus our attention on what can be assumed to be relatively isolated markets since pharmaceutical services are overwhelmingly local by nature. We gathered data for Navarra before and after deregulation (2000 and 2006), and for the entry restricted regions of Euskadi in 2006 and Andalusia in 2008.[17]

For each municipality we gathered data regarding the number of pharmacies as well as for a set of drivers of entry including population headcounts, the number of public health centers, population density, the percentage of population under

[17] Our experimental setting enabled us to test as to whether the definition of the municipalities as the relevant markets was correct as we were able to check whether the free opening of pharmacies in Navarra had any significant effect on the payoff functions of the municipalities across the border in Euskadi. We did not find any cross border significant effect, and therefore municipality boundaries place an upper limit to the relevant markets.

the age of 14 and the percentage over the age of 75 (in order to be sure to include those with the greatest needs in terms of health-care assistance), educational attainment, and unemployment.[18]

< Insert table1 around here >

From the statistics in Table 1 we can observe that removing entry restrictions in Navarra doubled the mean number of pharmacies per municipality, but that the drivers of entry in the region remained largely constant before and after deregulation. On average, municipalities are larger in Andalusia than in Euskadi, while the municipalities of these two regions are in turn larger than those in Navarra. The mean number of pharmacies in Euskadi, where entry restrictions are operative, is similar to that in Navarra following entry deregulation. The mean number of pharmacies in Andalusia under market entry restrictions is, however, larger even than that in Navarra after deregulation.

Table 2 shows the market structures in the four region-year pair samples, in the combined sample containing the three regulated region-years, and in the pooled sample. The mass of the density distribution lies within the 0 and 1 pharmacies per municipality. This is particularly true for Navarra in 2000 when entry was first restricted. Deregulation caused a large proportion of the mass of the density function in Navarra to shift towards 2, 3 and 4 or more pharmacies per municipality. The regulatory policy of allowing the first pharmacy free entry in each town in Andalusia has achieved the aim of ensuring that virtually no municipality is without a pharmacy. Most municipalities have just one pharmacy.

<Insert table 2 around here>

Table 3 shows how tough regulations were in the three regions. Entry restrictions were almost always binding in Navarra in 2000. The 3% of municipalities with two pharmacies were all restricted to having at maximum those two pharmacies. By contrast, in Euskadi in 2006 we observe that there were a substantial number of markets in which the regulations allowed two or three pharmacies to operate but numbers were lower than this entry cap. In Euskadi in 2006, entry

[18] Data on the number of pharmacies are drawn from the regional governments, data on health care facilities, and data on demographics at the municipal level are from the Spanish Statistical Office. Using population under 16 and over 65 do not alter the results.

restrictions were always binding for municipalities with four or more pharmacies. In Andalusia in 2008, there were no constraints placed on opening the first pharmacy, and there were always some municipalities in which the maximum number of pharmacies was not binding. However, the one, two and three pharmacy entry restrictions were binding more often in Andalusia than in Euskadi. By contrast, the four or more pharmacy cap was found to be binding more often in Euskadi than it was in Andalusia.

<Insert table 3 around here>

It should not be forgotten that the location of new entrants was constrained before and after the entry decision was deregulated. In Navarra in 2000, Euskadi in 2006 and Andalusia in 2008, new pharmacies had to be located at a distance of 250 meters from incumbents in the market. In Navarra in 2006, new pharmacies had to be located 150 meters from existing businesses.

Table 4 shows the results when estimating the entry model using the entry restricted data and the free entry data separately. As outlined above, we use the log of population of each municipality as a measure of market size ($S$). Population was found to be a very good entry driver in the Spanish market where almost all medicine prices and mark-ups are set by the government.

To allow for differences in the pharmacies profitability per headcount, we added the extra market characteristics: the number of public health centers in each municipality, population density, the percentage of young people in the municipality, the percentage of old citizens, education and the unemployment rate. However, in both entry restricted and free entry scenarios, the drivers of profitability per head did not seem to have any statistically significant impact. This is probably due to the effect of the regulation of medicine price and public sector intervention, which means that any differences in profitability per head across markets are very small.

Table 4 shows that the constant term ($\beta_0$) and the population parameter ($\lambda$) appear to differ between the free-entry and entry-restricted samples suggesting that there are significant differences across regulation settings. Our data do not allow us to identify time fixed effects, but there have been no changes in mark-up regulations or in other payoff relevant observables to suggest the need to include any year specific impact.

<Insert table 4 around here>

Estimating the entry model for the pooled sample allows us to test whether deregulation changes the payoff function of the entry model. Table 5 shows the results of estimating the parameters of the payoff function combining the data from entry restricted and free entry region-years. The first panel shows the estimates using the data for entry-restricted Euskadi in 2006, and before and after data for Navarra in 2000 and 2006. The second panel shows the estimates using the data for entry-restricted Andalusia in 2008 and before and after data for Navarra in 2000 and 2006.

To keep the model parsimonious we did not include the payoff drivers that were found not to be statistically significant. We included a regional fixed effect to separate out the differences in the mean payoffs in Euskadi and Andalusia with respect to those in Navarra ($\beta_0^{Nav}$), and we also allowed regional differences in the coefficient measuring the impact of population on payoffs ($\lambda^{Nav}$) . We also allowed the competition effects ($\alpha_\phi^j$) to be different in the free entry and restricted entry region-years. By so doing, we allowed for differences in the competition effects after deregulation. These effects measure the change in competition when there is a new entry.

A likelihood ratio test showed that the unrestricted model allowing for differences in the competition effect is preferred to a model in which the competition effects are common in the case of free entry and restricted entry.

We also estimated a model in which we allowed the constant ($\beta_0^\phi$) and the coefficient of population ($\lambda^\phi$) to be also different in the free entry region-year ($\phi = f$ : Navarra 2006) with respect to the restricted entry region-years ($\phi = r$ : Navarra 2000, Euskadi 2006 and Andalusia 2008). However, we show the estimates of a constrained model in which we did not include these parameters because the log likelihood ratio test allowed us to keep to the more parsimonious specification.

<Insert table 5 around here>

The regional effects are not statistically significant, although they are important in avoiding any bias in assessing the effect of deregulation. Navarra has a positive fixed effect but a negative interaction term with population with respect to Euskadi. Navarra has a negative effect and a negative interaction term with population with respect to Andalusia. Given the magnitude of the regional effects, this means that the threshold for the first entrant is smaller in Navarra than it is in Euskadi, but larger in Navarra than in Andalusia.[19]

[19] Solving for $S_\phi^1$ such that $(\lambda^\phi + \lambda^{Nav}) \ln S + \beta_\phi^0 + \beta^{Nav} > 0$ shows that the first pharmacy population threshold for Navarra is $S_\phi^{1,Nav} = \exp(\frac{-\beta_\phi^0 - \beta^{Nav}}{\lambda^\phi + \lambda^{Nav}})$, while for the other regions is $S_\phi^1 = \exp(\frac{-\beta_\phi^0}{\lambda^\phi})$.

The competition effects are slightly stronger in the restricted entry case, than in the free entry case as $\alpha_r^2 > \alpha_f^2$, $\alpha_r^3 > \alpha_f^3$ and $\alpha_r^4 > \alpha_f^4$. The second pharmacy steals much more business from the incumbent when entry is restricted than when it is free ($\alpha_r^2 > \alpha_f^2$). This is an unexpected result, as we expected to have smaller business-stealing effects when distance regulations imposed larger distances: 250 meters in entry restricted region-years rather than 150 meters in the free entry case. However, anecdotal evidence shows that the distance between the pharmacies that are closer to a health center is quite similar across regions and across regulation scenarios. Thus, if distance is not significantly different, the conduct appears to be more competitive in the case of entry restricted settings.

By contrast, the business stealing effect of the third and fourth pharmacies is smaller when entry is restricted than when it is free as $\alpha_r^3 - \alpha_r^2 < \alpha_f^3 - \alpha_f^2$, and $\alpha_r^4 - \alpha_r^3 < \alpha_f^4 - \alpha_f^3$. This result was expected as mean distance between pharmacies might be smaller in the free entry case. If distance is not significantly different across regions nor across regulation settings, conduct proves to be more competitive in the free entry scenario for the third and further pharmacies.

## 6. Policy counterfactuals

Once we have the estimates of the entry models, we can then use them to simulate policy counterfactuals regarding the reform of entry restrictions, the mark-up regulations or both. Furthermore, these counterfactuals will reveal the distribution of the the regulatory rents and this should shed light on the rationale guiding the regulatory policy.

Table 6 shows the different nature of the deregulation predictions for Euskadi and Andalusia in the different estimated entry models. If we follow Schaumans and Verboven (2008) and compute the number of pharmacies by removing the entry restrictions from those estimates that do not take into account the change in the business stealing effects in the payoff function due to deregulation, we see that regulation restricted entry by 26% in Euskadi in 2006 and by 47% in Andalusia in 2008. In this counterfactual, the parameters of the payoff function are kept constant before and after the entry restrictions have been lifted. This then constitutes our best prediction when exclusively using the structural entry model approach without data from the policy experiment. The estimate for Andalusia in 2008 is quite similar to the 50% reduction in the number of pharmacies caused by regulation obtained by Schaumans and Verboven (2008) for Belgium. The estimate for Euskadi, however, is roughly half that.

These estimates prove to be downward biased. If we allow the parameters of the payoff function to change in the free entry counterfactual, the impact of entry restrictions increase almost by half. Regulation restricted entry by 36% in Euskadi in 2006 and by 71% in Andalusia in 2008.

Table 7 shows, by contrast, that counterfactuals about the number of markets that remain without a pharmacy before and after deregulation are almost identical both when using the exclusively structural model and when combining it with the experimental data. This is because we only allow the differences in payoffs to be driven by differences in the competition effects. Small differences would appear if we had used a model including not only differential competition effects, but also differences in the constant term (regulation fixed effect) and in the market size effects.

<Insert tables 6 & 7 around here>

Table 8 shows that markets with a larger population are able to support more pharmacies. However, what is striking is the extent to which market thresholds differ in the restricted-entry and free-entry counterfactuals. In the case of Euskadi in 2006, the second and third thresholds are smaller in the free-entry counterfactual than in the restricted entry setting. By contrast, the first and the fourth thresholds do not differ in the entry restricted setting and the free-entry counterfactual. This is because the effect of having one competitor on the incumbent monopolist payoffs is greater in case of restricted entry than it is in that of free entry.

In the case of Andalusia in 2008, table 9 shows that all thresholds but the first are much smaller in the free-entry counterfactual. The effect of having one competitor on the incumbent monopolist payoffs is much larger when entry is restricted than when entry is free. Such differences reflect a change in the payoffs function and the equilibrium outcome of the model. Regulation does not only restrict entry, but it also changes the nature of the strategic interaction between competitors.

<Insert tables 8 & 9 around here>

The estimated thresholds are also informative about the change in competition in response to entry. In the free-entry counterfactuals, the estimates suggest a pattern of increasing competition in response to entry. The market threshold to support any given number of pharmacies increases more than proportionally:

the mean per-firm threshold always increases with the number of pharmacies. Similarly, the last firm threshold increases with the number of pharmacies.

This suggests that pharmacies do use costly non-price instruments such as quality of service (more counseling, longing opening hours, etc.) in response to additional entry, and in order to support such competition efforts larger per firm markets are required to survive.[20]

By contrast, the market threshold for supporting any given number of pharmacies increases more than proportionally from a monopolistic to a duopolistic situation, but less than proportionally from a duopoly upwards. This suggests that incumbents also use costly non-price instruments, such as quality of service, in response to the entry of a second competitor. Many incumbent pharmacies located near the main health centers in downtowns are the ones that tend to be larger and open 24 hours. However, duopolists may even reduce the use of such competitive reactions to the threat of entry from a third pharmacy, thereby decreasing the per firm threshold.

Finally, we can estimate how much the regulated mark-up needs to be reduced by in order to fit the counterfactual payoffs to the current payoffs, and consequently to fit the current distribution of pharmacies in the free entry counterfactual. Table 10 shows that the mean reduction in the net mark-up would have to be a factor of 0.86 in Euskadi and 0.29 in Andalusia in order that all municipalities keep the number of pharmacies at the current restricted entry number. This is a reduction of 3.9% in Euskadi and 19.8% in Andalusia on the current gross mark-up of 27.9%, assuming that net mark-ups equal gross mark-ups, and of 2.2% in Euskadi and 11.2% in Andalusia assuming that net mark-ups equal gross mark-ups minus 10% variable costs.

<Insert table 10 around here>

This is also a measure of regulatory rents and their distribution. The distribution of these rents is highly skewed in Euskadi. The 90th percentile records a 24.8% excess mark-up and the 75th percentile a 4.5% excess mark-up, while the rest do not record any excess. Excess mark-ups are large in municipalities with one, three and four or more pharmacies (7.8%, 8.8% and 14.2% respectively). By contrast, competitive interaction makes the duopolist worse off under regulated

[20] This result differs from Schaumans and Verboven's (2008) findings for Belgium where there are no location constraints, and market thresholds roughly increase in proportion with the number of pharmacies.

entry, they record mark-ups that are 8.2% smaller than they would be under free entry.

In Andalusia, all pharmacies record large excess mark-ups (median is 24.8%), with the 10th percentile recording none and the better off monopolies obtaining excess mark-ups of 21.3%.

# 7. Conclusions

Entry regulations have a strong impact both on the payoffs of incumbent pharmacies and on the actual number of new pharmacies across municipalities. The policy experiment of freeing entry in certain regions of Spain, including Navarra, has presented us with a laboratory in which we have been able to design a structural model of entry with experimental data. By comparing the impact of the free entry policy adopted in Navarra with the results obtained in other parts of Spain where entry is severely restricted, namely neighboring Euskadi and the highly-populated Andalusia, we have been able to predict a "but-for" scenario in the event of the liberalization of entry and when adjusting regulated mark-ups.

Here, when computing the counterfactuals it became apparent just how important it is to allow for a changing payoff function since regulation does not only restrict entry, but it also changes the conduct of pharmacies in the market place dramatically. Regulation means that pharmacies grow to much larger dimensions, allowing them to serve more inhabitants per outlet, and to react more aggressively through the use of non-price instruments, particularly when the incumbent's monopoly is threatened by a second entrant.

Further, it is apparent that the specific nature of the entry restrictions and the distribution of population in the territory can shape the distribution of regulatory rents. In Euskadi, where entry restrictions apply even to small towns and population is sparsely located in a continuum of small settlements, payoffs are boosted for what is a rather small number of incumbents, which are typically not those located in the region's smallest towns.

Contrary to the argument that the policy aims to serve public interests, regulation does not boost the payoffs of the pharmacies in the smallest towns. Nor does it increase the payoffs of all pharmacies at the same rate. The gains from these regulations are very unevenly distributed, suggesting that there are private interests involved in the shaping of the current mix of entry and mark-up regulations. The rising tide of regulation does not lift all boats.

Moreover, entry and mark-up regulations do not serve the public interest of promoting better access to retail pharmacy services. In the case of Euskadi, where entry is restricted even in small towns, the regulation leaves almost 40% of all municipalities without pharmacies. By contrast, the free entry counterfactual leaves only 30% without a pharmacy.

In Andalusia, where entry regulations do not restrict the entry of the first pharmacy and the region's population tends to be located to a greater extent in larger towns, payoffs are boosted more evenly. In closer keeping with public interest rationales, monopolist payoffs are those that tend to obtain most support, while most incumbents, with a few exceptions, obtain excess mark-ups. However, the costs of these entry restrictions for the taxpayer are higher in Andalusia than comparable rates in Euskadi.

Finally, the policy experiment illustrates that the key instrument for improving pharmaceutical service coverage across municipalities and for securing quasi-rents for public services jointly delivered with private services is neither entry regulations nor fixed percentage mark-ups.

Increasing access to retail pharmacy services across municipalities and securing uniform quasi-rents requires a program that raises profits in a non linear manner, offering larger mark-ups to those pharmacies operating in less populated municipalities, while capping the mark-ups of pharmacies in more populated municipalities. But non-uniform mark-ups, such as those paid by the NHS in the UK, are proving very difficult to design in countries with stringent regulations in their retail pharmaceutical services.

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Table 1. Summary Statistics

| Variable | Description | Entry-restricted | | | | | | Free-entry | |
|---|---|---|---|---|---|---|---|---|---|
| | | Navarra 2000 (#markets=263) | | Euskadi 2006 (#markets=207) | | Andalusia 2008 (#markets=654) | | Navarra 2006 (#markets=258) | |
| | | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. |
| # pharmacies | Number of pharmacies | 0.56 | 0.63 | 0.96 | 1.14 | 1.56 | 1.12 | 1.03 | 1.50 |
| population | Number of inhabitants | 951.86 | 1,385.25 | 2,325.19 | 3,100.00 | 3,256.01 | 3,250.62 | 1,033.31 | 1,556.10 |
| # health centers | Number of health centers | 1.13 | 1.04 | 0.94 | 0.61 | 1.51 | 1.13 | 1.14 | 1.04 |
| density | Inhabitants per square kilometers | 36.45 | 71.45 | 125.74 | 165.15 | 64.92 | 102.27 | 37.68 | 67.74 |
| %young | Fraction of population, 14 years and younger | 0.10 | 0.04 | 0.12 | 0.03 | 0.14 | 0.04 | 0.10 | 0.05 |
| %old | Fraction of population, 75 years and older | 0.13 | 0.05 | 0.10 | 0.03 | 0.10 | 0.04 | 0.14 | 0.06 |
| education | Educational attainment | 2.81 | 0.17 | 2.92 | 0.15 | 1.80 | 0.16 | 2.80 | 0.17 |
| %unemployment | Unemployment rate | 0.08 | 0.05 | 0.08 | 0.03 | 0.30 | 0.15 | 0.08 | 0.05 |

Table 2.- Market structures

| | Entry-restricted | | | | Free-entry | Entry-restricted and free-entry |
|---|---|---|---|---|---|---|
| | A | B | C | A & B & C | D | A, B, C & D |
| #pharmacies | Navarra 2000 | Euskadi 2006 | Andalusia 2008 | All restricted | Navarra 2006 | All |
| 0 | 49% | 38% | 1% | 44% | 47% | 24% |
| 1 | 48% | 46% | 70% | 47% | 31% | 55% |
| 2 | 3% | 8% | 15% | 5% | 10% | 11% |
| 3 | - | 3% | 7% | 2% | 7% | 5% |
| 4+ | - | 5% | 7% | 3% | 5% | 5% |

Table 3.- Binding entry restrictions

| | Entry-restricted | | | | Entry-restricted and free-entry |
|---|---|---|---|---|---|
| | A | B | C | A, B & C | A, B, C & D |
| # pharmacies | Navarra 2000 | Euskadi 2006 | Andalusia 2008 | All restricted | All |
| 0 | 99% | 89% | 0% | 92% | 59% |
| 1 | 99% | 92% | 96% | 96% | 86% |
| 2 | 100% | 81% | 88% | 88% | 72% |
| 3 | - | 86% | 91% | 90% | 66% |
| 4+ | - | 100% | 84% | 87% | 71% |

Table 4. Estimation results

| | | Entry restricted: Navarra 2000, Euskadi 2006 & Andalusia 2008* | | | Free entry: Navarra 2006** | | |
|---|---|---|---|---|---|---|---|
| | | Coeff. | (Std. Err.) | *t-stat* | Coeff. | (Std. Err.) | *t-stat* |
| constant | $\beta_0$ | -5.48 | (1.52) | *3.60* | -9.55 | (1.02) | 9.33 |
| ln (population) | $\lambda$ | 1.44 | (0.23) | *6.31* | 1.67 | (0.17) | 9.77 |
| # health centers | $\beta_1$ | 0.09 | (0.83) | *0.11* | 0.08 | (0.63) | 0.13 |
| density | $\beta_2$ | -0.0003 | (0.01) | *0.03* | 0.004 | (0.01) | 0.39 |
| %young | $\beta_3$ | -6.12 | (11.54) | *0.53* | -3.66 | (8.73) | 0.42 |
| %old | $\beta_4$ | -2.081 | (12.27) | *0.17* | 2.29 | (7.39) | 0.31 |
| education | $\beta_5$ | -0.67 | (0.65) | *1.03* | -0.16 | (0.36) | 0.43 |
| %unemployment | $\beta_6$ | 0.71 | (5.84) | *0.12* | 1.96 | (13.07) | 0.15 |
| | $a^2$ | 4.27 | (1.68) | *2.54* | 2.46 | (1.28) | 1.92 |
| | $a^3$ | 4.62 | (1.61) | *2.87* | 3.60 | (1.78) | 2.02 |
| | $a^4$ | 4.83 | (2.12) | *2.28* | 4.63 | (2.24) | 2.06 |
| Log likelihood | | -410.94 | | | -210.44 | | |
| # markets | | 1124 | | | 258 | | |

* Censored ordered probit model to account for entry restrictions

** Uncensored ordered probit model as entry is free

The other estimates $\alpha^j$, j = 5, …, 12 are not shown. Constrains on those estimates are discussed in the text.

Table 5. Estimation results

| | | Censored ordered probit models to account for entry restrictions | | | | | |
|---|---|---|---|---|---|---|---|
| | | Navarra 2000 & 2006, Euskadi 2006 | | | Navarra 2000 & 2006, Andalusia 2008 | | |
| | | Coeff. | (St. Er.) | *t-stat* | Coeff. | (St. Er.) | *t-stat* |
| constant | $\beta_0$ | -9.11 | (1.15) | *7.94* | -6.43 | (1.25) | *5.14* |
| ln (population) | $\lambda$ | 1.49 | (0.21) | *7.26* | 1.33 | (0.22) | *6.18* |
| navarra | $\beta_0^{Nav}$ | 0.57 | (1.32) | *0.43* | -0.73 | (1.66) | *0.44* |
| navarra * ln(population) | $\lambda^{Nav}$ | -0.01 | (0.21) | *0.05* | -0.05 | (0.26) | *0.20* |
| | $a_f^2$ | 2.24 | (2.04) | *1.10* | 2.18 | (2.53) | *0.86* |
| | $a_f^3$ | 3.21 | (2.71) | *1.19* | 3.09 | (3.36) | *0.92* |
| | $a_f^4$ | 4.12 | (3.62) | *1.14* | 4.08 | (4.62) | *0.88* |
| | $a_r^2$ | 3.64 | (2.56) | *1.42* | 4.45 | (1.71) | *2.61* |
| | $a_r^3$ | 3.95 | (2.53) | *1.56* | 4.74 | (1.43) | *3.32* |
| | $a_r^4$ | 4.12 | (3.18) | *1.29* | 4.89 | (1.77) | *2.76* |
| Log likelihood | | -387.95 | | | -513.14 | | |
| # markets | | 728 | | | 1175 | | |

The other estimates $a_f^j$, j = 5, …, 12 and $\alpha_r^j$, j = 5, …, 8 are not shown. Constrains on those estimates are discussed in the text.

Table 6. Entry restriction impact on the number of pharmacies: counterfactuals

| | Euskadi | Andalusia |
|---|---|---|
| A.- # pharmacies: entry restricted best prediction | 210 | 969 |
| B.- # pharmacies: free entry and constant payoffs counterfactual | 282 | 1817 |
| C.- # pharmacies: free entry & changing payoffs counterfactual | 327 | 3305 |
| (A-B)/B: entry restriction relative impact | -26% | -47% |
| (A-C)/C: entry restriction relative impact | -36% | -71% |

Table 7. Entry restriction impact on the number of markets with no pharmacies

| | Euskadi | Andalusia |
|---|---|---|
| A.- # markets: entry restricted best prediction | 76 | 2 |
| B.- # markets: free entry and constant payoffs counterfactual | 56 | 2 |
| C.- # markets free entry & changing payoffs counterfactual | 56 | 1 |
| (A-B)/B: entry restriction relative impact | 36% | 0% |
| (A-C)/C: entry restriction relative impact | 36% | 100% |

Table 8.- Entry Thresholds in Euskadi 2006

Entry-restricted

| N | Market Threshold | Per-firm Threshold | Last firm Threshold |
|---|---|---|---|
| 1 | 566 | 566 | 566 |
| 2 | 6513 | 3257 | 5947 |
| 3 | 8020 | 2673 | 1506 |
| 4 | 8989 | 2247 | 969 |

Free-entry counterfactual

| N | Market Threshold | Per-firm Threshold | Last firm Threshold |
|---|---|---|---|
| 1 | 566 | 566 | 566 |
| 2 | 2545 | 1273 | 1979 |
| 3 | 4880 | 1627 | 2335 |
| 4 | 8989 | 2247 | 4108 |

Table 9.- Entry Thresholds in Andalusia 2008

Entry-restricted

| N | Market Threshold | Per-firm Threshold | Last firm Threshold |
|---|---|---|---|
| 1 | 167 | 167 | 167 |
| 2 | 4732 | 2366 | 4566 |
| 3 | 5885 | 1962 | 1153 |
| 4 | 6588 | 1647 | 703 |

Free-entry counterfactual

| N | Market Threshold | Per-firm Threshold | Last firm Threshold |
|---|---|---|---|
| 1 | 167 | 218 | 167 |
| 2 | 859 | 429 | 692 |
| 3 | 1702 | 567 | 843 |
| 4 | 3583 | 896 | 1881 |

Table 10.- Policy reform: change in markups to make restricted entry payoffs equal to free-entry payoffs

| | Mean net markup drop by factor Δ | | Absolute gross markup drop | | | |
|---|---|---|---|---|---|---|
| | | | net markups == gross markups | | net markups= gross markups -10% | |
| | Euskadi | Andalusia | Euskadi | Andalusia | Euzkadi | Andalusia |
| mean | 0.86 | 0.29 | -3.9% | -19.8% | -2.2% | -11.2% |
| 90th percentile | 0.11 | 0.01 | -24.8% | -27.6% | -14.0% | -15.6% |
| 75th percentile | 0.84 | 0.02 | -4.5% | -27.3% | -2.5% | -15.4% |
| median | 1.00 | 0.11 | 0.0% | -24.8% | 0.0% | -14.0% |
| 25th percentile | 1.00 | 0.39 | 0.0% | -17.0% | 0.0% | -9.6% |
| 10th percentile | 1.00 | 1.00 | 0.0% | 0.0% | 0.0% | 0.0% |
| mean if #pharmacies==0 | 1.00 | 1.00 | 0.0% | 0.0% | 0.0% | 0.0% |
| mean if #pharmacies==1 | 0.72 | 0.24 | -7.8% | -21.3% | -4.4% | -12.0% |
| mean if #pharmacies==2 | 1.30 | 0.47 | 8.2% | -14.9% | 4.6% | -8.4% |
| mean if #pharmacies==3 | 0.69 | 0.40 | -8.8% | -16.7% | -4.9% | -9.4% |
| mean if #pharmacies==4+ | 0.49 | 0.52 | -14.2% | -13.4% | -8.0% | -7.5% |

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