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Entry in German Pharmacy Market

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1. Introduction

Over the last few years there has been an increasing debate on supply security in the German healthcare system. In particular, concerns have been raised with respect to the shortage of pharmacies in rural regions.

While the low level of demand for pharmaceutical services and products in these in these areas dampens the profitability of pharmacies, regulations imposed on pharmacies with substantial implications for their cost structures affect the entry and exit decisions of pharmacies in rural district, and hence directly affecting the supply gap.

In this article we estimate a model of entry for pharmacies in Germany and identify the economic forces determining market entry. Our empirical model captures important features of the pharmacy market. First, the toughness of short-run competition reflect the idea that an increase in the number of pharmacies in a given market lowers the profits that can be earned by all participants. Second, potential entrants face an amount of fixed entry cost lowering the net profit level and affect firm's entry decision. Furthermore, we allow the magnitude of the fixed cost to differ across firms and allowing different firms to earn different levels of profit in a given market and therefore allow for markets with similar characteristics to support different numbers of pharmacies. This feature allows markets with similar structures to have different numbers of pharmacies. We estimate the model using a constructed dataset on the number of pharmacy stores operating in 4115 geographic markets in Germany. In addition to information on market characteristics such as population number and demographic structure, we also measure the number of branches a pharmacist operates. The number of branches captures information on possible scale effect affecting the level of firm's fixed cost. The model estimates describe the pharmacies' profitability and the longrun market structure. Furthermore, using the estimates we can also assess the effect different policy measure on market structure, for instance the effect of entry subsidy, the relaxation of operation requirements that have cost impacts, or indirect subsidy through altering market characteristics.

The next section provides information on the regulation of pharmacies in Germany and Europe and summarizes the observed market structure in the data. The third section describes the empirical model used for the analysis and outlines our estimation procedure. At this stage the model estimates on the competition effect and importance of firm heterogeneity and the entry fixed cost are still work in progress. The fourth section provides outlook on possible counterfactual exercises and conclude.

2. Overview of Pharmacy Regulation Europe

In most European countries, the pharmacy sector is highly regulated. Besides the qualification of pharmacists and a regulation of retail prices, the regulation usually determines the criteria for opening new pharmacies and the requirements for owning and operating one or more

possible branch stores. The main argument for these regulations on different levels is to ensure the consistent and high-quality supply of drugs in all regions of a country.

Entry restriction for new pharmacies

In many European countries, entry in the pharmacy market is restricted. Typical restrictions are based on demographic criteria (e.g. minimum number of inhabitants that will be supplied by one pharmacy) and/or geographic criteria (e.g. minimum distance to existing pharmacies). These entry restrictions for potential competitors should ensure a (required) minimum revenue for existing pharmacies in their local markets. Nevertheless, such regulation obviously limits entry into the market and creates local monopolies. In a market with regulated prices, possible negative effects of such local monopolies can be inefficient cost-structures and/or less service orientation of the existing pharmacies (e.g. opening hours, additional services such as delivery, see OFT 2003). In Spain, for example, national regulation requires a minimum distance of 250 meters to the next pharmacy and a minimum number of 2,800 supplied people. Similar restriction apply in Belgium, where the regulation requires a minimum of 2,000 people in small municipalities and 3,000 people in the larger municipalities.

In contrast, there are no establishment rules in countries like Germany, Iceland, Ireland, the Netherlands, Norway or Sweden. The situation in the UK is a bit different, as there is no entry restriction in general, but a restriction for the overall amount of pharmacies that are allowed to dispense prescriptions at the expense of the National Health Service. (OECD 2014)

Ownership restrictions

Ownership restriction can limit the maximum number of pharmacies that may be owned by a single person. Another example for ownership restrictions can be specific rules regarding the takeover of pharmacies. In regulated environments, such as Germany, only approbated pharmacists are allowed to own a strictly limited amount of pharmacies. One argument for a strict ownership restriction is the fear that separation of profession and ownership may lead to uncertainty with regard to liability in cases of misconduct in a pharmacy. The main idea of the regulation of an upper limit is to prevent the formation of pharmacy chains that could be dominated by external investors (for example form the pharmaceutical industry). However, limiting the formation of pharmacy chains may severely limit entry in the market, especially if the ownership restriction prevents the utilization of economies of scale in a larger network of pharmacies. Related savings could lower the minimum turnover of each pharmacy in the network and encourage the establishment of branches in less profitable areas (e.g. rural region with less customer potential).

On the contrary, in a liberalized pharmacy sector any individual or legal entity may own pharmacies. Some countries, though liberalized, excluded specific stakeholders from ownership: in Iceland, Ireland, Norway and Sweden physicians are not allowed to own a pharmacy

due to a possible conflict of induced drug demand. In Iceland, Norway and Sweden, also stakeholders form the pharmaceutical industry are excluded from pharmacy ownership. (OECD 2014)

Sale of non-prescription OTC-drugs outside pharmacies

The permission of the sale of OTC medicines (over the counter) outside pharmacies allows, for example, supermarkets to sell non-prescription drugs. This permission could increase the amount of selling points in rural areas and reduce existing access routes for certain drugs. However, such a permission would not improve the accessibility of prescription drugs, where a contemporary access could be even more important. In addition, a permission of outside sales reduce the proportional profits of the OTC drug sales business of existing pharmacies. As a result, without counteractive measures, a permission of outside OTC drug sales would likely reduce the accessibility of prescription drugs.

At the moment, in 10 out of 28 European countries there is a pharmacy monopoly on the sale of OTC medicines, whereas in the other 18 countries OTC medicines can be sold outside pharmacies. However, the extent of OTC medicines which may be sold outside pharmacies varies among the countries. In Austria for example, only a very limited range of OTC medicines can be sold outside pharmacies (for example light analgesics such as Aspirin). As a result, the Austrian regulation is rather close to a pharmacy monopoly for OTC medicines. In countries where OTC sale is permitted outside pharmacies (for example Italy, Denmark, the Netherlands, Sweden or UK) this is either done by specific OTC dispensaries or in general stores such as supermarkets or petrol stations. (OECD 2014)

Regulation on retail prices and profit margins

Pharmacists usually receive a regulated fixed fee or a fixed percentage of the drug price related to the number of prescription drugs they dispense. This fixed fee is supposed to compensate pharmacists for their provision of pharmaceutical services. Regulation of OTC drug selling prices is unusual in Europe.

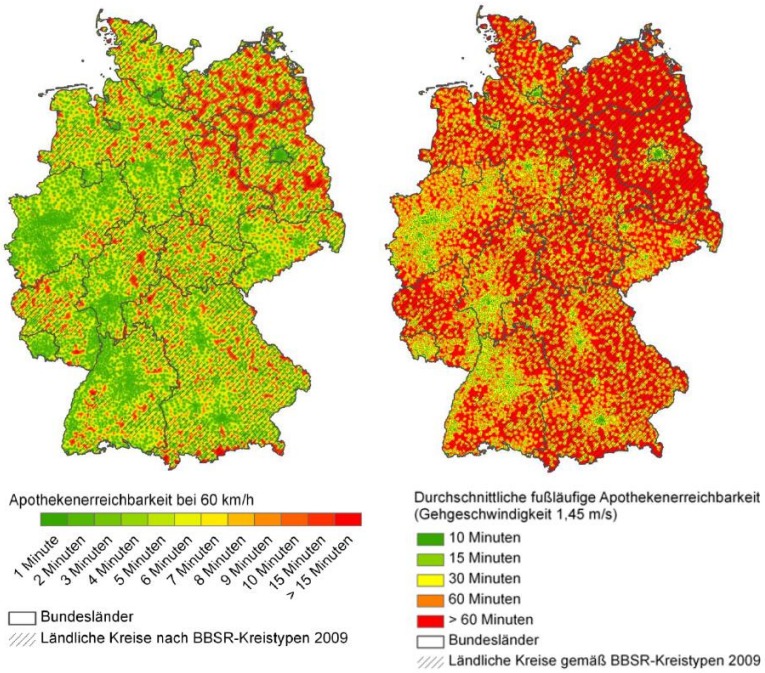
3. Supply Situation and specific Regulation in Germany

Across European countries, there is a huge variation when it comes to the share of pharmacies per capita. On European average, one pharmacy supplies 3,200 inhabitants). An above average concentration of pharmacies can be found in Greece (1,000 capita per pharmacy), Spain (2,200:1) or Belgium (2,100:1). The ratio in Germany (4000:1) in slightly below the European average. Countries that do not permit the sale of non-prescriptive OTC-drugs outside pharmacies have a significant lower concentration of pharmacies. Examples are Sweden (7,100:1), The Netherlands (8,300:1), or Denmark (16,700:1). (Data 2014 by ABDA)

Supply Situation in Germany

In Germany, there are 20,441 operating public pharmacies (Data 2014 by ABDA). 16,269 pharmacies are operating as main stores *(Hauptapotheken)*. Another 4,172 pharmacies are operating as branch stores *(Filialapotheken).* These branch stores are always owned by an owner of a nearby main store. More than 1,000 of the pharmacies have licensed an online store as a second mainstay. Via these online stores, the licensed pharmacies are allowed to sell both non-prescription as well as most prescription drugs (the patient needs to hand in its prescription via mail in advance). However, the market for online drugs in Germany in mainly dominated by the platforms of a few pharmacies. The utmost majority of pharmacies that have licensed an online store have to generate their main sales revenues with their physical stores. In the recent past, the amount of online licenses is continuously increasing, while the amount of physical pharmacies is slightly decreasing (21,602 pharmacies in year 2008). The overall supply situation in Germany is satisfying. Neumeier (2013) shows that in most urban areas the next pharmacy is accessible by foot (see figure 1, map on right). In the majority of the rural areas, the next pharmacy is accessible by car within 15 minutes. However, in parts of the northeast of Germany, the next pharmacy is not accessible within 15 minutes even by car (see figure 1, map on left). This regions are particularly affected by demographic change. As a result, the supply situation is bound to deteriorate further as the number of inhabitants in a local market seems to be a driving force when it comes to entry decisions of pharmacies (and physicians)

Figure 1: Accessibility of pharmacies in Germany



Source: Neumeier 2013, S. 39, based on a simulation by the Bundesforschungsinstitut für Ländliche Räume.

Specific regulation of establishment and ownership of pharmacies in Germany

The ownership of a pharmacy is limited to approbated pharmacists only. An approbation can be achieved after a degree in pharmacy and an additional state examination. In Germany there is no (geographic) entry restriction via instruments such as quotas. Therefore, market entry all over Germnay is possible at any time. Since the year 2004, besides one main store, every approbated pharmacist has been allowed to own up to three more branch stores. However, these branch stores must be located in the same or in a bordering administrative district (Landkreis).

Regulation of retail prices in Germany

Dispensing prescription drugs is the main business of the German pharmacies (83 percent of the sales revenues in 2014, ABDA). In this main business, a strict price regulation is applied. The pharmaceutical wholesalers supply the pharmacies with drugs. The wholesalers can charge up to 3.15 percent on the manufacturer price (Herstellerabgabepreis HAP) and an additional fixed fee of 0.70 Euros. The resulting purchasing price for pharmacies (Apothekeneinkaufspreis AEP) determines the selling price and the profit margin of the pharmacies. When dispensing a prescription drug, a pharmacy earns 3 percent of the purchasing price and an additional fixed fee of 8.35 Euros. However, a specific commitment between the pharmacies and the health insurers to reduce overall costs in the German healthcare system reduces the payout of the pharmacies by 1,77 Euro. Due to the strict price regulation, there is no way for pharmacies in less profitable (rural) areas to compensate for their locational disadvantage by higher selling prices.

Minimal equipment requirements of pharmacies in Germany

The minimal requirements regarding the equipment of a pharmacy are regulated by law in the "Apothekenordnung" (BApO) and the "Apothekenbetriebsordnung" (ApBetrO). Although discussed during the last reform of the "Apothekenbetriebsordnung" in the year 2012, there is no significant differentiation between equipment requirements for main pharmacy stores and branch stores. The store premises of every German pharmacy needs to be at least as big as 110 square meters. Furthermore, every Pharmacy needs a laboratory to control their purchased drugs on a random basis and to produce customer-specific ointments, tinctures, powders and tea mixtures in house. The average fixed costs of a whole laboratory equipment is around 50.000 to 60.000 Euros. Regarding the storage of drugs, every pharmacy needs a warehouse stock that last to supply the surrounding population for at least one week. The equivalent value of the fixed capital in the stock is around 100.000 Euros.

Nevertheless, pharmacy networks of a main store and up to three branch stores can benefit form better cost structures. These networks can apply a joint quality management that is required by law and make use of a joint purchasing structure. In addition, it is easier to have access to the inventory of another pharmacy within the network if there is a shortcoming in

one the pharmacies. Furthermore, there are some legal simplifications for pharmacy networks when it comes to night services.

3. Overview of the data

Our dataset contains information on 4115 markets in the year 2014, defined at the level of postal codes in (PLZ) in Germany. The market definition based on postal codes has two main advantages: First, in more urban areas, the subdivision of postal codes is way more small-partial. For example, the whole urban region of Cologne belongs to one administrative municipality area, but is subdivided into more than 50 postal code areas. Second, the definition of the markets on postal code level allows for precise matching with our data on German pharmacies and physicians via the postal codes in their store or practice addresses. To avoid potential problems with large markets that could actually be subdivided within one postal code area, and overlapping markets, we only consider market that are in rural areas and geographic isolated. Furthermore, we exclude markets with more than 15 pharmacies and only consider markets with a population of at least 500 inhabitants.

We have information on the number of active pharmacies and the number and specialization of physicians per market in the year 2014 (ArztData AG, Lagoon Media GmbH). We use the information of the specialization of the physicians to separate the group of general practitioners and physicians for internal medicine from other (highly) specialized physicians. The reason for this is that most drugs in Germany are prescribed by the first group of more generalized physicians (Häussler et. al 2012). Therefore it is reasonable that the profit function of pharmacies mainly depends on this first group when it comes to the effect of a possible complementary relationship between pharmacies and physicians. Schaumann and Verboven (2008) found that physician and pharmacies are strategic complements as the presence of one profession group can increase the profit of the other.

Additionally we have information on the ownership structure of the pharmacies. That means we can distinguish between stand-alone pharmacies and pharmacies that belong to a small chain of pharmacy stores. In the later analysis, we use this differentiation to capture information on firm heterogeneity in our model. Pharmacies provide their services in relatively small local markets and their product range is fairly standardized. Therefore, the market demand for these services and hence revenue for pharmacies is closely tied to population structure. This will lead to different entry decisions given different market characteristics. To capture the market conditions we employ structural information on the characteristics of each postal code market from a German market research institute (GFK SE Gesellschaft für Konsumforschung). We have information on the population and age structure as well as the income structure and buying power of each single market. These measures are collected in the year 2014.

Table 1 presents counts of the observed market configurations that will be included in our later econometric analysis (total amount of included markets is n=4115). For example, there

are 279 markets with no pharmacies or physicians, and 152 markets with one pharmacy and one physicians. There are also several market configurations that never occur, such as ten physicians and no pharmacy. In line with the finding of Schauman and Verboven (2008) for the Belgium pharmacy market, there is also quite a strong correlation between the number of pharmacies and physicians in Germany; the correlation coefficient is 0.87 (Belgium in year 2001: 0,85). We follow the hypothesis of Schauman and Verboven (2008) that the correlation may be, at least to a significant extend, due to the fact that physicians provide complementary services for pharmacies as dispensing prescription drugs is the main business of the German pharmacies (83 percent of the total turnover in 2014).

Table 1: Observed market configurations

		Number of pharmacies in a market																
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Total**
Number of physicians in a market	**0**	279	46	2	4	2		1										334
	1	177	152	13	4	1		1										348
	2	62	220	35	4	1	1											323
	3	25	167	71	10	1												274
	4	6	107	79	34	4	1	2										233
	5	2	54	82	41	2	2	1										184
	6	1	47	65	47	18	4	1	1									184
	7		16	61	59	29	4	1	1	1				1				173
	8	1	7	38	55	38	16	8		1					1			165
	9		4	20	67	35	26	9	3	1								165
	10		4	27	49	47	25	14	4	3								173
	11		2	11	33	54	26	12	4	2		2						146
	12		3	18	29	42	24	13	9	1								139
	13		1	6	21	32	30	14	6	1	1							112
	14		3	6	18	27	23	23	9	3	4	1	1					118
	15		1	2	12	25	21	10	8	4	2	2						87
	> 15		1	10	39	96	133	115	149	115	92	72	42	31	27	17	18	957
Total markets		553	835	546	526	454	336	225	194	132	99	77	43	32	28	17	18	4115
% of markets		13,4%	20,3%	13,3%	12,8%	11,0%	8,2%	5,5%	4,7%	3,2%	2,4%	1,9%	1,0%	0,8%	0,7%	0,4%	0,4%	

Population > 500; Number of pharmacies < 15; thinly and moderate populated regions (BBSR regional planning type 3 and 4)

Table 2 provides summary statistics on the demographic and structural variables of our defined markets which may affect the profitability of pharmacies. We include information on population size, the share of different age groups (young, middle age and old inhabitants) and information on the purchasing power of the population. Furthermore, we include information on the number of physicians in each market. As most of the prescription in are prescribed by general physicians and internists in Germany, we include a variable of this subgroup (#general physicians)

Table 2: Summary statistics

Variable	Description	Mean	Standard diviation
# pharmacies	Number of pharmacies in a market	3,44	3,06
# general physiscians	Number of general physicians in a market	10,14	9,80
# all physicians	Numper of all physicians in a market including specialists	22,12	27,37
# population	Total population in a market	13251,77	9506,18
ln(population)	Logarithm of population in a market	3,97	0,41
% young	Fraction of population, younger than 18 years	16,61%	2,56%
% middelaged	Fraction of population, between 18 and 65 years	63,28%	3,75%
% old	Fraction of population, older than 65 years	20,10%	3,74%
purchasing power	total purchasing power in a market (in billion Euro)	285,98	209,28
purchasing index	GFK purchasing index in a market	104,31	16,67

Number of observations: n = 4115 markets

4. Empirical Entry Model and Estimation

Our model of entry relies on the framework of a two-stage game as considered for instance by Bresnahan and Reiss (1991), and Berry (1992). In this framework, P_m potential operating pharmacies make their decision to enter a market *m* in the first stage. In the second stage, given the entry decisions pharmacies compete to maximize their profit.

Similar to Berry (1992) we allow for pharmacies to differ in their characteristics, reflecting heterogeneity in factors affecting their fixed entry costs and hence profit levels. The differences in firm characteristics for different firm profit levels in the same market. We assume the variable profit is identical for all operating firm in a given market and only depends on market characteristics.

For further information on our empirical model see appendix A.

5. Counterfactuals and Policy implications

Draft version, this section will be updated after including our final estimation result

One observed policy to prevent the risk of closure of pharmacies in less attractive places or even support rural pharmacies in Europe is to provide financial incentives: In England, rural pharmacies are subsidized under the Essential Small Pharmacy Local Pharmaceutical Services scheme, and in Denmark a tax equalization scheme is in place to support pharmacies with lower turnover. In Norway, for several years an agreement between the state and pharmacy chains provided that in case of closure of a pharmacy in a rural area the pharmacy chain had to take over this pharmacy or establish a new one.

6. Conclusion

Draft version, this section will be updated after including our final estimation result

The shortage of pharmacies in rural areas in Germany resulted from market entry decisions that are driven by firm long-run profitability. In this article we study the determinants of pharmacy market structure by estimating a static entry model. In our model we allow for competition effect of rivals in the market and firm heterogeneity to impact the incentives driving firm entry decision. We estimate the model using a dataset containing information on German pharmacies in different geographic areas. The estimates obtained from the model provide insight on the importance of market and firm specific factors for the profitability. Using the estimates we can simulate the impact of a change in the economic environment on market structure. For instance, we can assess how changes financial incentives in terms of direct entry subsidy or favorable tax treatment can affect the entry rate through effectively raising the net profit level. Alternatively allowing pharmacies to operate more than 3 further branches can have a fixed cost reducing effect and encourages entry in less favorable markets.

7 Appendix A: Empirical Entry Model and Estimation

Our model of entry relies on the framework of a two-stage game as considered for instance by Bresnahan and Reiss (1991), and Berry (1992). In this framework, P_m potential operating pharmacies make their decision to enter a market m in the first stage. In the second stage, given the entry decisions pharmacies compete to maximize their profit.

Similar to Berry (1992) we allow for pharmacies to differ in their characteristics, reflecting heterogeneity in factors affecting their fixed entry costs and hence profit levels. The differences in firm characteristics for different firm profit levels in the same market. We assume the variable profit is identical for all operating firm in a given market and only depends on market characteristics.

Assuming the payoff of a pharmacy i that enters market m is given by:

$$\begin{aligned} \pi_{mi}(N_m) &= \alpha b(N_m) + X_m\beta + \gamma Z_{mi} - \epsilon_{mi}, \\ &= V_{mi}(N_m) - \epsilon_{mi} \end{aligned} \tag{1}$$

where the observed components of the profit function $V_{mi}(.)$ is described by a vector of market characteristic X_m, firm characteristic Z_{mi}, and the number of pharmacies operating the market N_m translated into profit through function $b(.)$ and parameter α. The firm profit level is assumed to be strictly decreasing in the number of firms in the market. In the empirical implementation we are going to specify the function $b(.)$ to be decreasing in N.

The unobserved component of firm's profit ϵ_{mi}

$$\epsilon_{mi} = \rho u_{m0} + \sqrt{1-\rho^2}u_{mi}. \tag{2}$$

contains unobserved market specific u_{m0} and firm specific factors u_{mi}. We assume that u_{m0} and u_{mi} are standard normal and iid across firms and markets. Thus, ϵ_m follow a multivariate distribution $\epsilon_m \sim N(0, \Sigma)$ where the parameter ρ denotes the correlation of ϵ across firms in a given market.

We assume firm can be ranked according to their profitability and this ranking does not depend on the set of entering firms. Given these assumption we know according to Berry (1992) the equilibrium number of entering firm is unique. In equilibrium, all firms that enter

are profitable, i.e. their payoff net the entry cost is non-negative, and all not entering firms expect zero profit.

Each firm's entry decision in market m depends on the firm and market characteristics but also on the realization of the unobserved component of all K_m potential entrants $\epsilon_m = (\epsilon_{m1}, .., \epsilon_{mK})$. In equilibrium there will be N pharmacies entering market m if for a given set of parameters $\theta = \alpha, \beta, \gamma, \rho)$, and the observed data, the unobserved component ϵ falls into a region that would support N profitable firms in the market. Therefore, the probability of observing $n^* = N$ pharmacies in equilibrium can be written as

$$\begin{aligned} Pr(n^* = N) &= Pr\Big((\epsilon_{m1}, .., \epsilon_{mK}) | \sum_{i=1}^{K_m} I(V_{mi}(N) > (\epsilon_{m1}, .., \epsilon_{mK})) = N\Big) \\ &= \int .. \int \big[\sum_{i=1}^{K_m} I(V_{mi}(N) > (\epsilon_{m1}, .., \epsilon_{mK}) = N\big] dF(\epsilon_{m1}, .., \epsilon_{mK}|\theta) \end{aligned} \tag{3}$$

Our goal is to estimate the parameters of the profit function α, β, γ and the correlation parameter ρ relying on the expression for probability distribution in equation (3). However,this expression is difficult to estimate as the number of potential entrant is increasing and the firm's decision to enter depends on the entire vector $\epsilon_m = (\epsilon_{m1}, .., \epsilon_{mK})$. Following Berry (1992) we estimate the model using simulation method. For this we define a prediction error

$$\nu_m(N_m, X_m, Z_{im}, \theta) = N_m - E(N_m|X, Z\theta) \tag{4}$$

which is mean independent when evaluated at true parameter values θ^*, $E(\nu_m(n^*, X, Z, \theta)|X, Z\theta = \theta^*) = 0$. The expected value of the equilibrium number of firms in the market will be simulated. In particular, for a given set of parameters θ^0, in the s-th simulation we fix a vector of random draws $u_m^s = (u_{m0}, u_{m1}, .., u_{mK_m})$ and calculate the simulated profit for firm i as

$$\pi_{mi}^s(N_m) = \alpha^0 b(N_m) + X_m\beta^0 + \gamma^0 Z_{mi} - \rho^0 u_{m0}^s - \sqrt{1-\rho^0} u_{mi}^s, \tag{5}$$

Given we get the simulated profit the estimated expected number of firms in the market $\hat{n^s}$ by adding one more firm to the market until it yields negative profit

$$n_m^s(X_m, Z_{mi}, \theta^0, u_m^s) = \max_{n \in [0, K_m]} \big(n : |\{i : \pi_{mi}^s(n, u_m^s) \geq 0\}| \geq n\big) \tag{6}$$

The expected number of firms in the market is estimated by averaging across all simulations

$$\hat{n}(X, Z, \theta^0, \hat{u}) = \frac{1}{S} \sum_{s=1}^{S} n^s(X, \theta^0, u_m^s) \tag{7}$$

Finally, the parameters θ can be estimatated using methods of moments employing the mean independence of the prediction error as moment condition.

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