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Market Structure and Competition in the Health-care Industry: Results from a Transition Economy*

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Abstract

The present paper provides first empirical evidence on the relationship between market size and the number of firms in the health-care industry for a transition economy. We estimate market size thresholds required to support different numbers of suppliers (firms) for three occupations in the health-care industry in a large number of distinct geographic markets in Slovakia, taking into account the spatial interaction between local markets. The empirical analysis is carried out for three time periods (1995, 2001 and 2010) characterizing different stages of the transition process. Our results suggest that the relationship between market size and the number of firms differs both across industries, and across periods. Furthermore, we find evidence for correlation in entry decisions across administrative borders.

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1 Introduction and Literature Review

Health systems in OECD countries have seen a steady increase in health spending over the last 50 years. Expenditure in this sector has tended to grow faster than Gross Domestic Product (GDP). While health spending accounted for under 4 % of GDP on average across OECD countries in 1960, this share has increased to 8.9 % in 2013 (OECD (2015)). The health spending share of GDP grew particularly rapidly in the United States, rising from about 5 % in 1960 to 16.4 % in 2013. A similar tendency can be seen in Central European countries, where health-care services today represent one of the most important sectors of a modern economy (with 11.0 % of GDP in Germany, 10.1 % in Austria, 7.6 % in the Slovak Republic and 7.1 % in the Czech Republic, for instance). The size of these industries and their long run trends suggest that understanding their structure, conduct and performance is not only important for the performance of the health-care industry, it is also important for understanding the economy as a whole.

Given the increasing significance of this sector, it is not surprising to find a large number of empirical studies analyzing the determinants of market structure (i.e. the location and the number of suppliers in a specific market) as well as the effects of market structure on competition and economic performance[1]. A substantial share of this literature focuses on the relationship between market size (population) and the number of suppliers (firms) in different local markets. As noted by Bresnahan and Reiss (1991), market structure is endogenous and the relationship between market structure (i.e., the number of firms) and market size (e.g. population) speaks to the nature of static price competition. This approach uses a simple, general entry condition to model market structure. The intuition is that if the population (per-firm) required to support a given number of firms in a market grows with the number of firms, then competition must be getting tougher. The intense competition shrinks profit margins and therefore requires a larger population to generate the variable profits necessary to cover entry costs[2] . Thus, the key data required for this method are both minimal and commonly available: market structure (i.e. the number of firms in a local market) and population.

The relationship between population and market structure (number of suppliers) for the market of physicians was first investigated empirically by Newhouse et al. (1982), who found that the size of a town affects the probability of having a physician located there. They also

[1] A comprehensive survey of this literature is available in Gaynor and Town (2011).

[2] For example, if the size of the market needs to triple in order to add an additional entrant, that suggests that the addition of that firm dramatically reduces firm profits.

make use of the fact that the number of specialists in the U.S. increased dramatically over the decade of the 1970s. Location theory further predicts that towns that did not previously have a specialist would gain them at a greater rate than those that did. Their empirical results seem to confirm this.

Rosenthal et al. (2005) revisit this hypothesis using data from the 1980s and 1990s. They examine 23 states with low physician to population ratios. The total number of physicians in these states doubled from 1970 to 1999. They find that communities of all sizes gained physicians over this period, but that the impact was larger for smaller communities, as predicted by the theory. A recent paper by Isabel and Paula (2010) examines some of these issues using data for Portugal from 1996 and 2007. The total number of physicians in Portugal grew by approximately 30 percent over that period and the number per capita grew by approximately 22 percent. They estimate a static model using 2007 data and find that population size has a large and significant impact on the number of physicians per capita located in an area. They also test a dynamic model and find that areas that had more physicians per capita in 1996 had lower growth in the number of physicians per capita. This is consistent with the hypothesis of Newhouse et al. (1982). Brown (1993) finds confirmation of the hypothesis for the Canadian province of Alberta, although the evidence is not overwhelming. A study by Dionne et al. (1987) also found this to be true for the province of Quebec, Canada. The results of these studies are consistent with competitive effects from entry.

A recent paper by Schaumans and Verboven (2008) examines the determinants of entry in physician services markets in Belgium. They consider the entry decisions of pharmacies as well. Pharmacies and physician practices provide complementary services. As a consequence, each type of firm benefits from the presence of the other. Both prescription drug prices and physician services prices are heavily regulated in Belgium. Therefore, both pharmacies and physician practices only in engage in non-price competition (convenience, quality of service, quality of care, etc.). The entry of physicians into local markets is free, but pharmacy entry is regulated: there is a maximum number of pharmacies allowed in an area based on the local population. Schaumans and Verboven adapt the models of Bresnahan and Reiss (1991) and Mazzeo (2002) to allow for entry restrictions for pharmacies and that products sold by the two types of firms (pharmacies and physicians) may be strategic complements. As in the Bresnahan and Reiss and Mazzeo framework, this is a static game and the outcomes in terms of market structure (numbers of firms of both types), as opposed to firm identities, is what is modeled. They find that the population necessary to support a given number of firms increases approximately proportionately with the number of firms. As in Bresnahan

and Reiss (1991), this implies that entry does not lead to tougher competition. These results suggest that they do not engage in more intense price competition as more firms of their own type enter a market. They also find that the population necessary to support another physician practice falls with the number of pharmacies, and vice versa. This supports the hypothesis of strategic complementarities. Schaumans and Verboven then use the parameter estimates from the model to simulate the impacts of policy reform toward pharmacies. They consider easing entry restrictions by increasing the maximum number of pharmacies allowed in an area, and reducing pharmacies' regulated markups. They find that simply allowing free entry (no change in markups) would increase the number of pharmacies by 173 percent. The complementarities between pharmacies and physician practices lead to a 7 percent increase in the number of physician practices as a result of the entry liberalization for pharmacies. If pharmacy markups are reduced to 50 percent of their original levels then with free entry the number of pharmacies increases by 44 percent and the number of physician practices increase by 6-10ths of 1 percent. Not surprisingly, a drop in markups decreases the magnitude of entry, but it is still extensive.

Abraham et al. (2007) specify a static entry model modified from Bresnahan and Reiss (1991) to better understand the nature of competition for hospitals. They augment the Bresnahan-Reiss approach by incorporating the use of quantity data. Their method allows the separate identification of changes in the fixed costs of entry and changes in the toughness of competition. Their estimates imply that the threshold per-firm population required to support one hospital is approximately 7,000, increases to 12,600 to support two hospitals, is approximately 19,000 for three hospitals, and just under 20,000 for four or more hospitals. They also find that increases in the number of hospitals in the market dramatically increases the number of patients up until there are three hospitals, by 23 % with the entry of the second hospital and 15 % with the entry of the third hospital. This implies substantial increases in the toughness of competition with the entry of a second or third firm, but not afterwards. These results point to substantial effects on competition even from having only a second firm in the market. However, the magnitude of the effects (23 % increase in quantity associated with moving from a monopoly to a duopoly) seems extremely large.

The aim of the present paper is to investigate (changes in) market structure and the intensity of competition in the health-care industry in Slovakia during the period of transition. The empirical approach to investigate market structure and competition in these markets extends the entry-threshold approach pioneered by Bresnahan and Reiss (1991) by explicitly focusing on the spatial dimension of competition.

The paper is organized as follows. Section 2 briefly highlights relevant changes in the economic environment in Slovakia during the transition period. Section 3 presents the data and the empirical framework. Section 4 discusses the empirical results and Section 5 summarizes and proposes possible extensions.

2 Transition of the Health Care System in Slovakia and Market Description

Slovakia[3] entered the transition from a centrally planned economy to a market economy as a part of Czechoslovakia. Until 1989, the communist regime did not allow independent decisions of firms on prices; free entry and exit was impossible, and the entire production process was governed by central and regional governmental units and state owned institutions. The state was responsible for health care coverage and took over full responsibility for financing (through general taxation), planning, management and provision of health care. Health care was granted free of charge to all citizens. The pre-1945 social insurance system was abolished. All health care providers were nationalized and incorporated into Regional and District Institutes of National Health. Regional Institutes consisted of regional health care centers (large hospitals). District Institutes of National Health consisted of small or medium-sized hospitals and polyclinics, along with pharmacies, centers of hygiene, emergency, first aid services and nurseries. The centrally planned economy and health care system led to inefficiencies and inaccurate resource allocation decisions. The system was not able to deal with the growing incidence of lifestyle diseases and hospitals were becoming equipped with outdated technology. The lack in improvements in technology was compensated by the increasing numbers of health workers and hospital beds which resulted in a health care system with a surplus of ambulatory physicians.

A social insurance system (based on the Bismarck system) was reintroduced after 1989. In 1993, Slovakia gained independence and the National Insurance Fund was established to fund health, social and pension insurance. Social health insurance was legally defined in 1994 by the Act on Health Insurance which enabled the establishment of other health insurance funds. The reintroduction of social health insurance suffered from problems created during the previous regime and the macroeconomic environment that went along with the transformation process. The Slovak economy was in a deep recession and public finances were seriously

[3]This section is based on the Health Systems in Transition report for Slovakia by Szalay et al. (2011) which provides a detailed description of the health system and of reforms in the Slovak Republic. It was prepared by country experts in collaboration with European Observatory on Health Systems and Policies.

constrained. This led to a situation in which the state did not have the capacity to pay health insurance contributions for the inactive population. The health system that was based on a new institutional and regulatory framework with privatized health care providers was marked by weak budget constraints and corruption which led to increasing debts and bankruptcies in the health insurance market. Hospitals remained technologically underdeveloped with oversupply of health personnel and ineffective management. Even though nearly all hospitals were owned by the state (they existed under the control of the Ministry of Health as state contributory organizations) during the 90s, most pharmacies and ambulatory physicians went into private practice. The hierarchical health care structure was broken down and the health care system became fragmented, with a high number of specialized health care providers. The functioning of the health care system became unsustainable and required another set of reforms.

The first set of institutional changes was introduced by the new government in the 1999 – 2002 period as part of a broader set of macroeconomic stabilization measures. Unfortunately, the major problems were tackled only partially and the structural deformation of the system's supply deepened. The state lost the control of 14 health care facilities that were privatized and transformed to non-profit organizations. The management was transferred to regional and local governments in most of the other state owned health care facilities (with the exception of the biggest hospitals and specialized institutions). This restructuring and the migration of doctors and nurses abroad led to a continuous fall in the number of physicians and nurses in relation to population after 2001.

Key reforms in health care system were introduced in the 2002 – 2006 period, with major legislative changes taking place in 2004. The health reform was based on a set of structural and functional changes which were supposed to transform the centralized system into a decentralized system; the state as a provider of health care services to the state as a supervisor setting the "rules of the game"; the hierarchical functional structure to a contractual structure; and the state as a risk bearer to a situation in which each player bears the risk (providers, patients, purchasers). The key objective of the reform was to increase the independence and financial responsibility of health care providers. During this period, hard budget constraints were introduced; health insurance companies were transformed into joint stock companies; the Health Care Surveillance Authority (HCSA) was established (in order to split the legislative and control function in the health care system); user fees were introduced; flexible prices, contractual relations with selective contracting and flexible basic benefit packages were decentralized to health insurance companies; a flexible health care

network (with the definition of minimum network) and drug policy measures accompanied with liberalization of ownership of pharmacies were implemented. The reform aimed to make the process of entry in the health care provision market more transparent and to remove barriers to entry.

After the 2006 elections, some of the pro-market reforms were discarded (selective contracting was restricted, health insurance companies were no longer allowed to make a profit, user fees were scaled down or completely abolished) but key reform acts remained unchanged. A new government in 2010 reversed the trajectory of reforms again and declared plans to continue to bring new market mechanisms into the health care system.

As of 2010, the social health insurance system was based on solidarity, provided universal coverage for a broad range of benefits and guaranteed an annual free choice of one of three nationally operating health insurance companies (one of which was state-owned and covered 66 % of the insured and two privately owned). Pharmacies, diagnostic laboratories and almost 90 % of outpatient facilities were in private hands. Ambulatory care was provided mostly by privately organized physicians and people were free to choose their general practitioner and specialist. The system was administered by the Ministry of Health, the HCSA and the self-governing regions which, besides other responsibilities, issued permits to health care providers. Chambers and professional associations kept registers of health professionals, issued opinions on ethical issues, issued or revoked licenses and monitored the management of health care facilities.

For providers to enter the Slovak health care provision market several criteria were supposed to be fulfilled. Health care professionals had to obtain a license from the Slovak Medical Chamber and a permit from the self-governing region or the Ministry of Health (depending on what type of provider it was). Then, providers were supposed to submit a request for a contract with a health insurance company although providers could provide services without a contract with a health insurance company as well. A minimum network of providers was determined by the government that defined the density and structure of health care providers across Slovakia. In primary care, general practitioners were entitled to a contract as soon as a patient registered with them. In ambulatory secondary care and in inpatient tertiary care, the minimum network was defined as a minimum number of specialists by type in a given region. Health insurance companies then had a choice to contract more providers if they had enough resources. Certain state-owned hospitals that were deemed crucial in guaranteeing geographical accessibility of specialized services were supposed to be contracted even if the quality and price did not match those of their competitors. Exit from the market was usu-

ally caused by the lack of contracts with health insurance companies and/or as a result of a negative financial situation.

As indicated above, dental care was provided either by contracted or non-contracted dentists. But direct payments from patients for dental procedures were necessary in most cases even to contracted dentists because social health insurance covered only basic dental costs (under the condition of regular preventive dental examination each calendar year).

Besides the described institutional changes, the pharmacy market in Slovakia was influenced by specific regulatory changes. Until 1998, it was regulated by the Act No. 13/1992 on the Slovak Medical Chamber, the Slovak Chamber of Dentists and the Slovak Chamber of Pharmacists. The entry of new pharmacies was not explicitly regulated by demographic or population criteria but the Slovak Chamber of Pharmacists had the right to comment on the request for establishment of a new pharmacy that had to be approved by the Ministry of Health of the Slovak Republic. A new Act No. 140/1998 from 1998 on drugs and medical facilities gave the Slovak Chamber of Pharmacists an explicit right to approve the request for establishment of new pharmacies in Slovakia. Without its approval, new pharmacies could not enter the market. Later on, the Slovak Chamber of Pharmacists approved the directive on Declaration of professional and ethical competences for the operation of pharmaceutical care in the public pharmacy (SLEK (2000)) that explicitly introduced demographic and population criteria for the establishment of new pharmacies. The minimum distance between pharmacies was set to 500 meters and the minimum population per one pharmacy was regulated to 5000 inhabitants. Based on several decisions of the Antimonopoly Office of the Slovak Republic against the Slovak Chamber of Pharmacists (PMU SR (2001), PMU SR (2002), PMU SR (2004)), these restrictions were abolished.The ownership regulation has changed in 2004. The revision of the Act on Drugs and medical facilities from 2004 (633/2004) allowed (after fulfilling some specific requirements) any individual or legal entity to own a pharmacy (only pharmacists could own a pharmacy before). The liberalization of pharmacy market in the period 2002 and 2004 led to an entry of new pharmacies afterwards.

3 Data and Empirical Framework

3.1 Data and Descriptive Evidence

The empirical analysis is based on data from 2,800 to 2,900 regional submarkets in Slovakia[4]. Data characterizing market conditions for pharmacies, physicians and dentists are collected on a local level for three time periods (1995, 2001, and 2010).

The number of firms for each occupation is obtained from the "Register of Economic Subjects" of the Slovak Republic which covers the whole population of firms in manufacturing and services. For each firm, information on its location and main economic activity (classified according to the NACE Rev. 1 classification of industries) is collected. From this we compute the number of firms in the different local markets. Following previous research, local submarkets are defined at the level of ZIP codes; this rougly corresponds to the definition of a city or village in Slovakia. The number of cities and villages (regional submarkets) identified in this way in 1995 (2001 and 2010) is 2,843 (2,858 and 2,926)[5]. Data on population as well as demographic characteristics of the regional markets are obtained from the "Urban and Municipal Statistics". The population of cities and villages is highly skewed, ranging from 12 to 111800, with an average of 1858 in 2010, for example. We control for several market characteristics such as wages, unemployment rates and the share of young and senior population. Data on wages and unemployment rates are taken from the "Regional Statistics Database". Unfortunately, we only observe these variables at the district level (for 79 districts). The share of population aged below 15 years and above 60 years for each market is obtained from the "Urban and Municipal Statistics". We supplement the dataset with information on the distances between cities and villages in order to capture the spatial distribution of occupations. Descriptive statistics for all variables are reported in the appendix.

Table 3 shows the number of regional markets with a given number of firms. Following previous research, we pool all markets with more than seven firms into one category since the number of observations for larger market sizes is insufficient to accurately identify entry effects for 8 or more competitors.

[4]The main results in this paper are based on the full sample of towns from "Urban and Municipal Statistics". The larger cities (such as Bratislava and Kosice) are divided into a number of regional submarkets. Unfortunately, the exact location of each individual firm within the market is not available. Our empirical model thus follows previous research and assumes that the location of a firm within a market does not have any implications on its profits or on the degree of competition with other firms.

[5]The different number of regional submarkets identified for the three time periods is due to "de-integration" of several municipalities into separate units over time. The village Žitavany, for instance, has been established in 2002 by splitting the town Zlaté Moravce into two separate units. Detailed description of these changes can be found in MISR (2013) and SOSR (2014).

3.2 Empirical analysis

The empirical framework is based on Schaumans and Verboven (2015) who elaborate a simplified version of the seminal work by Bresnahan and Reiss (1991). We assume that all health-care providers are identical. As such firms on a market with N competitors make per-firm per-capita variable profits equal to $v(N)$ from each of the S consumers on the market and face fixed costs of f, which are independent of the number of firms. Per-firm profits are given by $\pi(N) = v(N)S - f$.

While we would ideally like to observe $v(N)$ and f directly, we can only make inferences about the changes in costs and prices which occur on the market. In particular, we know that for a given cost structure and population size only a certain number of firms breaks even (N), which implies that the $N + 1^{st}$ potential entrant did not find it profit maximizing to join the market. Hence:

$$\pi_{N+1} = v(N+1)S - f < 0 < v(N)S - f = \pi_N$$

or equivalently:

$$ln\frac{v(N+1)}{f} + lnS < 0 < ln\frac{v(N)}{f} + lnS \tag{1}$$

In order to estimate $ln\frac{v(N)}{f}$, we collect data on market characteristics (summarized in the matrix X), include firm fixed effects (θ_N) and allow for random shocks in expected profitability vi an unobservable error term ε.

$$ln\frac{v(N)}{f} = X\beta + \theta_N + \varepsilon,\ \varepsilon \sim N(0, \sigma^2 I) \tag{2}$$

Integrating the above equality into (1) results in an ordered probit model of the entry decision:

$$y = N,\ if\ \theta_N \leq y^* < \theta_{N+1}$$

$$y^* = X\beta + lnS + \varepsilon$$

Of the estimated parameters, the values of θ_N and θ_{N+1} contain the most crucial information, as they measure the changes in the variable profits to fixed costs ratio which can be attributed to differences in market structure. If the two values are far apart, then the presence of N firms makes the entry of a next competitor significantly harder, or, in other words, markets with $N + 1$ firms are expected to generate more intense competition than

those with N players.

While the above consideration would be sufficient for the estimation of entry threshold values in a world with isolated markets, the results of a Moran's I analysis (see Table 1) point to the presence of strong autocorrelation both in the number of firms and in the market characteristics[6]. We therefore follow Labaj et al. (2015) by allowing for spatial autocorrelation across observations. In doing so, we break with the independence assumption which prevails in most of the literature on the subject, which in general invests in providing proof for the isolated markets assumption. As this assumption is unlikely to hold in the densely populated Central European area of interest, we instead explicitly model interactions across towns and hence implement a model which would also be applicable to urban markets in other countries.

In order to incorporate spatial autocorrelation in the latent profitability measure (y^*), we estimate a spatial autocorrelated ordered probit model, as outlined in LeSage and Pace (2009). This model implies that the entry/exit decision of each firm is not only determined by local market conditions (summarized in $X\beta$ and lnS) but might also be influenced by favourable or unfavourable conditions in neighbouring markets (represented by $\rho W y^*$):

$$y = N \ \textit{if}\ \theta_N < y^* < \theta_{N+1}$$

$$y^* = \rho W y^* + X\beta + lnS + \varepsilon, \ \textit{where}\ \varepsilon \sim N(0,1) \tag{3}$$

In the above equation W is a row-standardized spatial weights matrix with elements $w_{ij} = 1/dist_{ij}^2$, where $dist_{ij}$ is the distance between regions i and j. [7]

In the presence of spatial autocorrelation in the latent profitability measure, the data are assumed to follow a truncated multivariate normal distribution:

$$y^* \sim TMVN(\mu, \Omega)$$

$$\mu = (I - \rho W)^{-1}(X\beta + lnS)$$

[6]The Moran's I statistic is calculated as:

$$I = \frac{n}{S_0} \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

where w_{ij} is equal to the inverse distance between town i and town j squared if those are within 30 kilometers of each other and 0 otherwise. It measures the spatial correlation between the observations and compares that to a random distribution

[7]We set $w_{ij} = 0$ if the distance between regions exceeds 30 kilometers. In choosing a cut-off value of 30 kilometers, we follow Bresnahan and Reiss (1991) who argue that towns are isolated if there are no competitors with-in a 20 mile radius.

Table 1: Spatial autocorrelation in firm numbers and market characteristics

Year	1995		2001		2010	
Variable	Moran's I	p-value	Moran's I	p-value	Moran's I	p-value
Firm Numbers						
Pharmacies	0.005	0.514	0.054	0.000	0.092	0.000
Physicians	0.015	0.034	0.045	0.000	0.089	0.000
Dentists	0.011	0.138	0.056	0.000	0.080	0.000
Market Characteristics						
Population	0.004	0.501	0.086	0.000	0.100	0.000
Wage	0.817	0.000	0.703	0.000	0.759	0.000
Unemployment	0.913	0.000	0.915	0.000	0.908	0.000
% Young	0.290	0.000	0.313	0.000	0.230	0.000
% Senior	0.278	0.000	0.279	0.000	0.259	0.000

$$\Omega = [(I - \rho W)'(I - \rho W)]^{-1}$$

Note that the theoretical impact of spillover effects (measured by the parameter ρ) is ambiguous, since it measures the effect of a one unit change in the estimated average neighborhood profitability. This profitability (given by Wy^*) may rise due to two counteracting reasons: 1) if market characteristics improve (in other words μ grows) or 2) if more firms have entered the market (since $y_N^* < y_{N+1}^*$ by construction). Hence we would expect a positive value of ρ if practitioners cluster in certain areas (suggesting that demand effects are more important than competitive effects). If the observed values are negative, this would imply that the aim of the regulator is to offer a supply distribution which is uniform. In this scenario, the central planner will try to make sure that firms are not located too closely in order to increase efficiency and decrease transportation costs in remote areas. In this case whenever the neighborhood Wy^* grows due to entry, the likelihood of a firm establishing in the local market will decrease significantly, resulting in a negative sign of ρ.

The parameters are estimated using a Bayesian MCMC procedure from the R package `spatialprobit` provided by Wilhelm and de Matos (2013). The method relies on data augmentation. With-in the estimation process values are generated for the unobserved profitability (y^*) based on the observed number of firms (y) via Gibbs sampling. The remaining parameters are then calculated conditional on the predicted values of the latent variable[8].

[8]The prior for β is normal with mean 0 and variance $T = I_K 10^{12}$, where K is the number of regressors. For the thresholds, we impose that θ_N should lie between θ_{N-1} and θ_{N+1} in order to ensure ordering but remain agnostic about the actual relationship using a uniform prior $\theta_N \sim U(\theta_{N-1}, \theta_{N+1})$. For the spatial correlation parameter we again choose an uninformative prior, using a beta (1,1) distribution to assign equal probability to all values of ρ with-in the unit interval. For an outline of the procedure, please consult LeSage and Pace (2009), pp. 279-299.

The estimation of the model outlined in Equation (3) allows us to address the question whether entry barriers have decreased in the transition process. In particular, we are interested in the changes in the minimum market-size (population) necessary for the first firm to break-even (monopoly entry threshold S_1):

$$S_1 = exp(\hat{\theta}_1 - \bar{X}\hat{\beta} - \hat{\rho}Wy^*)$$

$\bar{X}$ represents the average of the variables in X. A significant decline in S_1 between two time periods is indicative of a decrease in entry barriers.

To investigate whether firm competitive behavior has changed during transition, we follow Bresnahan and Reiss (1991) and compute entry thresholds (s_N) and entry threshold ratios (ETR_N):

$$s_N = \frac{exp(\hat{\theta}_N - \bar{X}\hat{\beta} - \hat{\rho}Wy^*)}{N} \tag{4}$$

$$ETR_N = \frac{s_{N^m}}{s_N} = exp(\theta_{N^m} - \theta_N)\frac{N}{N^m} \tag{5}$$

where N^m represents the upper limit of the number of firms in a market.[9]

An increase of entry thresholds with the size of the market ($s_N < s_{N+1}$) is an indication of intensified competition. Entry threshold ratios (s_{N^m}/s_N) are scale-free measures of entry's effect on market conduct. If firms are identical and entry does not change competitive mark-ups, then $s_{N^m}/s_N = 1$. Departures of successive entry threshold ratios from one suggest that pricing strategies change as the number of firms increases. In other words, if a larger population is necessary for the next entrant and we assume that each representative consumer has the same level of per-capita demand, mark-ups decrease due to entry.

4 Results

Table 4 reports parameter estimates from a spatial ordered probit model. The results show that population, which is our proxy for market size S, positively affects the number of firms in all industries and periods. The parameter estimate for the log of population (α) is

[9]Ordered probit model restricts the number of categories. Here we use $n^m = 7$. A similar procedure is used in previous empirical studies. The loss of information is unlikely to be significant as the incremental change in the perceived competitive environment is likely to be small on a market with 7 vs. 8 firms and towns with more than 10 competitors are likely to consist of sub-markets.

significantly different from zero across all occupations[10].

Wages and unemployment rates as well as the demographic composition of the population in the market exert a significant impact in most equations. Because these variables summarize both demand and cost conditions, we do not attempt to draw structural inferences about the signs of their coefficients.

Changes in competitive pressure due to entry are measured by the ordered probit parameters θ_N. All values are significant, suggesting that market structure plays an important role in determining profitability.

Based on these estimates we calculate the entry threshold population (Table 5) and entry threshold ratios (s_7/s_N) for all occupations (Table 6).

4.1 Entry barriers

On the market for pharmaceutical services entry barriers appear to have fluctuated significantly. The estimated monopoly entry threshold (S_1) suggests that 3845 inhabitants were necessary for a single firm to break-even in 1995. This number jumped to 5921 in 2001, only to subsequently fall to the initial level of just above 3000.

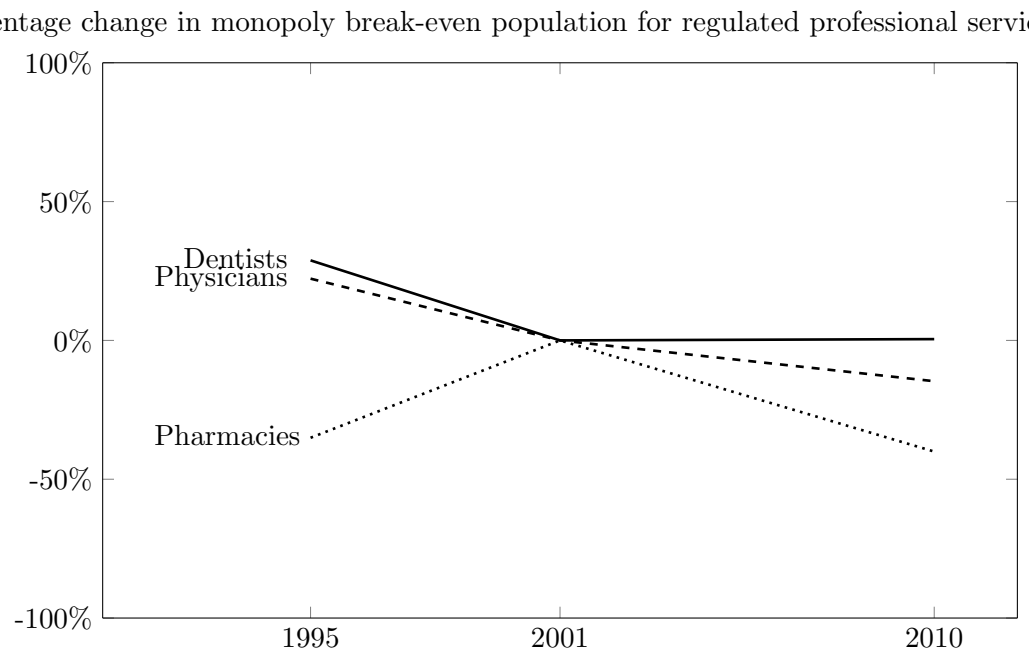
When analyzing this development, it is important to note that the privatization process for pharmacies was concluded in 1994, meaning that this outcome is to a large extent influenced by pre-liberalization dynamics and reflects the goal of the government to ensure market coverage by setting extremely low entry barriers for the first potential entrant.

Once the privatization process was complete, the role of regulator was taken up by the Slovak Chamber of Pharmacists, which sought to introduce explicit demographic and population criteria for establishment in order to ensure higher profitability for its members. The estimated entry threshold of 5921 individuals fits well with the legal limit set by the Chamber, which required that at least 5000 inhabitants should be served by each pharmacy seeking to enter the market. The rise in entry barriers may also be fueled by the loss of economies of scale which are sometimes present in systems under government control.

The subsequent sharp decrease in entry barriers between 2001 and 2010 is most likely attributable to a large extent to the decisions of the Antimonopoly Office of the Slovak Republic against the Slovak Chamber of Pharmacists (PMU SR (2001), PMU SR (2002), PMU SR (2004)) which removed entry restrictions and liberalized ownership. Furthermore, the income level in the country rose, which naturally depresses the estimates of S_1.

[10] As economic theory constrains the parameter of lnS to 1, we normalize the other parameters when calculating the thresholds (i.e. $S_N = exp\frac{\theta - \bar{X}\beta}{\alpha}$).

Figure 1: Changes in the break-even population (baseline: 2001)

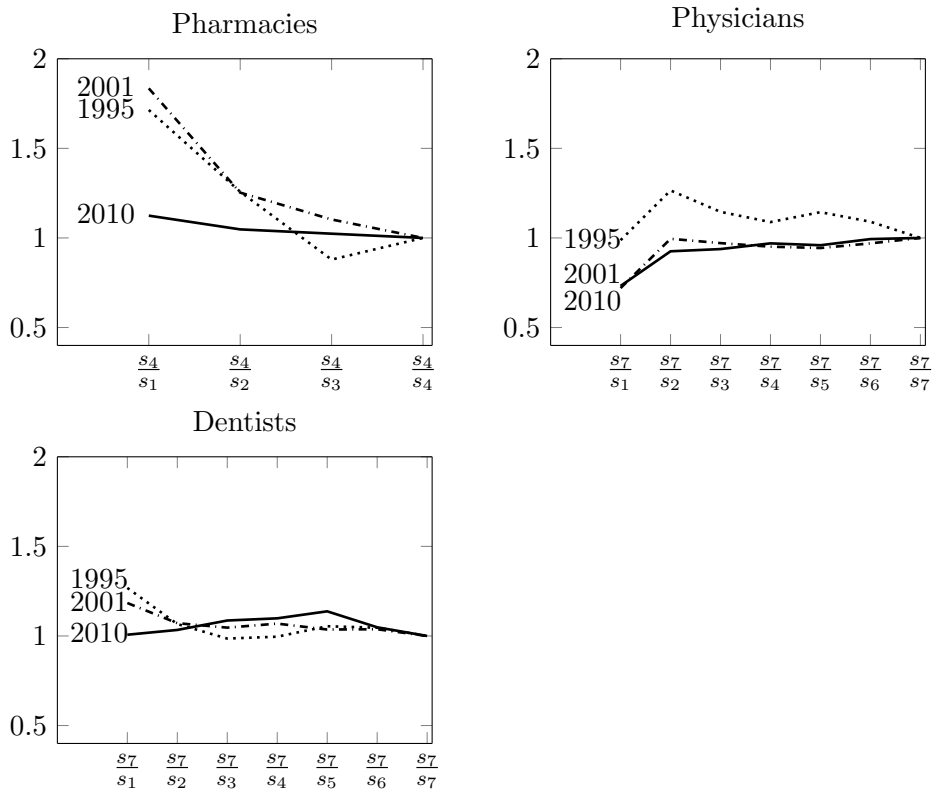


In comparison, the monopoly entry threshold value for physicians and dentists remained stable between 1995 and 2010, a clear indication of the role of administrative decision-making in these industries. In contrast to the other occupations, entry into these markets is strongly regulated and the supply of services was reasonably good during the communist regime, leading to very little change during our observation period.

However, it should be pointed out that previous research in Labaj et al. (2015) has shown that in competitive industries the increase in income levels between 1995 and 2010 led to substantial decreases in entry barriers in other sectors, suggesting that the health-care industry grew slower than its more competitive retail counterparts. The inability of the industry to generate higher levels of entry may be due to government intervention seeking to sanitize the finances of the health-care system. In 2004 a "reform package of laws" was adopted in order to reduce financial inefficiency by limiting consumption (EC (2013)). As such the lack of change may be perceived as an attempt to compensate for excessive growth previously.

The changes in entry barriers were also accompanied by changes in the relationship between market structure (the number of firms) and per-capita profitability or mark-ups.

Figure 2: Break-even population and ETRs in transition



4.2 Competitive effects

The estimated entry threshold ratios shown in Figure 2 point to heterogeneity in the influence of market structure on prices across heath-care markets.

Deregulation on the market for pharmaceutical services had a substantial effect on the relationship between the number of firms and expected profitability. Before the removal of entry barriers, a duopolist needed 1.46 times the per-firm population that a monopolist would to break-even. This suggests that regulators were reluctant to introduce new firms into areas where an incumbent was present. The position of monopolists appears to have been most profitable during the brief period of strict self-regulation. The policy measures introduced in 2004 resulted in a very different relationship between markets in 2010, when a firm in a duopoly only needed 7% more consumers than its monopolistic counterparts in order to break-even. This suggests that the abolition of entry restrictions made concentrated markets contestable and led to a decrease in mark-ups (this effect is likely to occur due to an increased investment in quality and hence higher costs, rather than differences in prices).

Changes in regulatory policy also influenced the entry threshold ratios in other health-care industries. While the profitability on monopoly markets appears to have remained constant

for physicians and dentists, the profits on competitive markets grew. This process may explain the fact that ETRs are falling with time, even to the extreme case where firms on competitive markets appear to be more profitable than monopolists (as in the medical industry). Furthermore, it cannot be ruled out that entry in these markets does not necessarily lead to more competition for a given number of potential customers. As argued in Bresnahan and Reiss (1991) and shown in more detail in Schaumans and Verboven (2015), entry might also increase product variety and thereby have a positive effect on consumers' willingness to pay. This countervailing effect of entry reduces entry threshold ratios and can explain ratios smaller than one.

While the increased ease of entry on competitive markets may be a positive sign, increased entry in markets where other sellers are already present may not be optimal from a social perspective if it leads to extremely high transportation costs for consumers in rural areas. An analysis of spatial relationships can shed light on this matter.

4.3 Spatial spill-overs

Spatial spill-over effects are captured by the parameter ρ which measures the influence of the spatially weighted (unobserved) measure of neighborhood profitability (Wy^*) on the (unobserved) measure of profitability in the local market (y^*).

Table 4 reports significant and negative spatial correlation effects for all periods and occupations. This suggests that spatial spill-over effects are important and that the effect of competitive linkages seems to outweigh the demand spill-over effects associated with high regional profitability in all periods. The presence of a competitor in the neighborhood (and hence a higher sampled Wy^*) results in a lower probability of entry. In other words, having a highly profitable market in the neighborhood results in firm clustering in that area and decreases entry in the own market.

Interestingly, this effect wanes over our observation period, with the absolute value of ρ decreasing with time. This result is especially strong on the pharmacy market. One could interpret the estimates as an indication that with improved infrastructure and increased agglomeration, firms now expect to be patronized by more consumers from neighboring markets and demand spill-overs are starting to outweigh competitive effects. The result of decreasing negative effects of competition is also in concordance with new economic geography models, which predict that spatial development will become centralized and locational patterns persistent with time (Krugman (1990)). While there are no positive externalities for incumbents

when new pharmacies enter in the same area, if other industries also cluster in the same administrative unit and attract commuters from the region, it may make sense for pharmacies to co-locate. This, coupled with the fact that location decisions are no longer regulated can lead to a tendency to locate in large towns.

In order to determine whether there is indeed a tendency for firms to co-locate with their competitors we calculate transition matrices. Table 7 shows the transition probabilities across market structures. While most markets with a high number of sellers managed to retain them over the 15 years of observation, 43% of the monopoly markets lost their only provider of services over the same period, suggesting that once entry was deregulated certain areas did not benefit from more entry but rather were exposed to a re-location of existing sellers elsewhere. As such it seems that while deregulation of the sector had an overall positive effect on entry, the majority of the benefits were reaped by towns and villages where supply levels were already high.

This result is present also on the market for dental (medical) services with 28% (21%) of monopoly markets in 1995 loosing their access to a local provider of services.

5 Summary and Extensions

The present paper provides empirical evidence on the effects of entry on market conduct for a transition economy. We use the framework pioneered by Bresnahan and Reiss (1991) and estimate size thresholds required to support different numbers of firms for three professional service industries. The three time periods analyzed (1995, 2001 and 2010) characterize the different stages of the Slovakian transformation process. In 1995, the Slovak economy was in the early phases of a turbulent transition process with an unclear trajectory of its future route. Half a decade later, in 2001, the economy was in the process of relieving itself of post-socialist deformations and preparing for European integration. After being a member of the European Union for six years, the relevant institutions as well as the functioning of the Slovak economy in 2010 have already converged significantly towards Western European standards.

For professions related to health care, monopoly thresholds are substantially higher than those estimated in previous research for competitive retail service industries (Labaj et al. (2015)). By 2010 approximately 1,500 inhabitants were required for the first physician to enter a market and around 2,500 (3,300) inhabitants were necessary in a local market for the first dentist (pharmacist) to break even. The extremely large values (compared to those

for competitive industries) may reflect the government's policy of providing medical services in regional centers where they are accessible to the largest possible number of customers, which biases entry behavior towards very large towns. The skewness of the distribution of the number of firms (the large number of 0 observations) also results in large standard errors for our estimates.

Consistent with these observations, our results indicate that the effect of entry on market conduct has changed over time. While entry threshold ratios tend to be larger than one and decline with the number of firms in most professions in 1995, the estimation results obtained for 2010 suggest entry threshold ratios which are close and even below one. There does not seem to be a large premium on having a monopoly position in the modern Slovakian economy.

Future research could provide additional insights into the importance of sunk costs and entry barriers for entry thresholds and firm conduct by supplementing the present approach with an analysis of prices and costs (Einav and Levin (2010)).

A difference in difference approach using cross-border data from multiple regulatory frameworks could shed light on the causal links between policy decisions and market outcomes.

And finally, following the approach suggested in Abbring and Campbell (2010) would allow us to extend the static Bresnahan and Reiss framework to a dynamic setting. Explicitly modelling the dynamics of structural change is particularly important to further improve our understanding of the relationship between entry and competition in a transition economy.

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Table 2: Descriptive statistics ($N_{1995} = 2843$, $N_{2001} = 2858$, $N_{2010} = 2926$)

Variable	Mean	Std. Dev.	Min	Max
Number of pharmacies in 1995	0.30	1.97	0	77
Number of pharmacies in 2001	0.26	1.35	0	35
Number of pharmacies in 2010	0.51	3.14	0	81
Number of physicians in 1995	0.96	6.46	0	245
Number of physicians in 2001	1.89	9.52	0	159
Number of physicians in 2010	2.69	14.54	0	216
Number of dentists in 1995	0.59	4.41	0	169
Number of dentists in 2001	0.75	3.96	0	65
Number of dentists in 2010	0.87	4.81	0	85
Population in 1993	1878.77	10964.59	13	452253
Population in 2001	1790.00	6051.69	7	117000
Population in 2010	1858.00	5973.80	12	111800
Average nominal wage 1995	215.27	13.51	193	302
Average nominal wage 2001	363.10	42.08	294	657
Average nominal wage 2010	680.70	97.10	492	1327
Average unemployment rate in 1995	0.15	0.05	0.05	0.26
Average unemployment rate in 2001	0.23	0.07	0.04	0.35
Average unemployment rate in 2010	0.16	0.07	0.03	0.34
Share of population aged below 14 in 1993	0.21	0.05	0	0.51
Share of population aged below 14 in 2001	0.19	0.05	0	0.53
Share of population aged below 14 in 2010	0.16	0.05	0	0.69
Share of population aged above 60 in 1993	0.24	0.08	0.01	0.92
Share of population aged above 60 in 2001	0.23	0.07	0.02	0.89
Share of population aged above 60 in 2010	0.23	0.06	0.03	0.67

Table 3: Summary statistics for the number of firms in markets for professional services in 1995, 2001, 2010

Number of	Pharmacies			Physicians			Dentists		
firms	1995	2001	2010	1995	2001	2010	1995	2001	2010
	Number of local markets								
0	2469	2536	2555	2277	2171	2223	2391	2290	2410
1	258	219	214	237	233	315	296	361	290
2	60	38	54	154	184	171	55	71	69
3	6	19	23	52	82	56	20	25	31
4	18	10	10	17	39	28	10	19	16
5	6	12	9	18	18	15	10	11	19
6	4	4	10	15	11	12	9	10	12
≥ 7	22	20	51	73	120	106	52	71	79
Total	2843	2858	2926	2843	2858	2926	2843	2858	2926
	Share of local markets with a particular number of firms in %								
0	86.84	86.67	89.40	80.09	74.20	77.78	84.10	78.26	84.32
1	9.03	7.70	7.31	8.29	8.20	10.77	10.36	12.7	9.91
2	2.05	1.33	1.90	5.26	6.44	6.01	1.88	2.48	2.43
3	0.21	0.65	0.80	1.83	2.80	1.96	0.70	0.85	1.08
4	0.63	0.35	0.34	0.59	1.37	0.96	0.35	0.67	0.55
5	0.21	0.42	0.32	0.62	0.63	0.53	0.34	0.38	0.67
6	0.14	0.14	0.35	0.53	0.38	0.42	0.32	0.34	0.42
≥ 7	0.77	0.70	1.74	2.55	4.22	3.62	1.82	2.50	2.70

Table 4: Parameter estimates obtained from a spatial ordered probit model for Slovakia in 1995, 2001 and 2010

Number of	Pharmacies			Physicians			Dentists		
firms	1995	2001	2010	1995	2001	2010	1995	2001	2010
Population (log) (α)	1.581***	1.3052***	1.4862***	1.6798***	1.9006***	1.6971***	1.6628***	2.1129***	1.7436***
	(0.0615)	(0.0583)	(0.0569)	(0.0541)	(0.0492)	(0.0459)	(0.059)	(0.0725)	(0.0528)
Wages	-0.0108**	0.0011	0.0007	-0.0028	0.0008	0.0011***	-0.0026	0.0027**	0.0012**
	(0.0045)	(0.0012)	(0.0005)	(0.0037)	(0.0011)	(0.0004)	(0.004)	(0.0012)	(0.0005)
Unemployment (%)	0.3269	-0.9764	1.0785	0.2123	0.8543	1.0886	0.4579	-0.0152	1.7417**
	(1.3849)	(0.8456)	(0.8725)	(1.1329)	(0.6907)	(0.6789)	(1.244)	(0.7731)	(0.8293)
Young (%)	-2.9066*	-6.1194***	-4.9087***	-2.2861	-6.3426***	-4.7339***	-5.6278***	-6.7725***	-5.2827***
	(1.7566)	(1.697)	(1.4813)	(1.4038)	(1.1905)	(0.9195)	(1.653)	(1.3664)	(1.2721)
Elderly (%)	-1.7934	-2.5499	2.5611*	-0.5873	-2.1831*	1.1708	-3.2238**	-2.7957**	-0.0058
	(1.6082)	(1.6148)	(1.3706)	(1.2565)	(1.1375)	(0.9842)	(1.4919)	(1.3926)	(1.3056)
θ_1	9.7296***	9.7601***	12.5321***	11.8553***	13.1686***	12.887***	10.8794***	15.4345***	13.9254***
	(1.3969)	(0.9927)	(0.7946)	(1.1638)	(0.7917)	(0.5902)	(1.2966)	(0.9554)	(0.735)
θ_2	11.3149***	11.1627***	13.6673***	12.6037***	13.8707***	13.6654***	12.3197***	17.1103***	15.0883***
	(1.4001)	(1.0045)	(0.802)	(1.1645)	(0.7956)	(0.5969)	(1.2994)	(0.9734)	(0.741)
θ_3	12.522***	11.8583***	14.3044***	13.4512***	14.6879***	14.3308***	13.1256***	18.0167***	15.7086***
	(1.4065)	(1.0099)	(0.8101)	(1.1665)	(0.8009)	(0.6044)	(1.3023)	(0.9812)	(0.7511)
θ_4	12.7734***	12.3619***	14.7668***	14.0205***	15.274***	14.7624***	13.5864***	18.5797***	16.1909***
	(1.4076)	(1.0128)	(0.8208)	(1.1698)	(0.803)	(0.6138)	(1.3019)	(0.9907)	(0.7587)
θ_5	13.537***		15.0626***	14.3118***	15.7131***	15.1595***	13.8629***	19.1173***	16.5189***
	(1.4102)		(0.83)	(1.1726)	(0.806)	(0.6222)	(1.3048)	(1.0076)	(0.7661)
θ_6	13.8898***		15.3487***	14.6986***	16.0081***	15.4091***	14.1789***	19.4995***	16.9791***
	(1.412)		(0.8369)	(1.1757)	(0.8092)	(0.6279)	(1.3092)	(1.0153)	(0.7756)
θ_7			15.6829***	15.103***	16.2426***	15.6599***	14.5101***	19.9028***	17.3302***
			(0.8464)	(1.1804)	(0.8138)	(0.6322)	(1.3113)	(1.0241)	(0.7857)
ρ	-0.3573***	-0.332***	-0.161**	-0.4082***	-0.4618***	-0.2827***	-0.3623***	-0.4201***	-0.2747***
	(0.0631)	(0.071)	(0.0625)	(0.0571)	(0.0428)	(0.0439)	(0.0612)	(0.0459)	(0.0501)
Observations	2843	2858	2926	2843	2858	2926	2843	2858	2926

Note: All markets with more than seven firms are pooled in one category. Standard errors are in parenthesis.
***,**, and * indicates that parameters are significantly different from zero at the 1%, 5%, and 10% level, respectively.

Table 5: Per-firm entry thresholds for Slovakia in 2010, 2001, and 1995 for pharmacies, doctors and dentists (spatial model)

	Pharmacies			Physicians			Dentists		
	1995	2001	2010	1995	2001	2010	1995	2001	2010
	Total threshold population								
S_1	3845	5921	3335	2360	1931	1532	3007	2334	2529
S_2	10479	17343	7159	3685	2793	2424	7150	5159	4928
S_3	22487	29550	10990	6103	4294	3587	11609	7923	7033
S_4	26362	43462	15002	8564	5845	4626	15316	10343	9274
S_5	42731		18306	10187	7364	5845	18087	13339	11194
S_6	53412		22191	12824	8601	6772	21872	15984	14575
S_7			27786	16314	9730	7850	26694	19346	17826
	Threshold population per firm								
s_1	3845	5921	3335	2360	1931	1532	3007	2334	2529
	(292)	(634)	(243)	(114)	(70)	(49)	(178)	(92)	(115)
s_2	5240	8671	3580	1842	1397	1212	3575	2580	2464
	(282)	(635)	(166)	(51)	(26)	(21)	(147)	(70)	(71)
s_3	7496	9850	3663	2034	1431	1196	3870	2641	2344
	(349)	(551)	(130)	(47)	(22)	(16)	(130)	(59)	(52)
s_4	6591	10865	3750	2141	1461	1156	3829	2586	2319
	(238)	(493)	(107)	(44)	(19)	(14)	(105)	(49)	(43)
s_5	8546		3661	2037	1473	1169	3617	2668	2239
	(272)		(88)	(35)	(18)	(12)	(83)	(44)	(35)
s_6	8902		3698	2137	1434	1129	3645	2664	2429
	(246)		(77)	(34)	(16)	(11)	(74)	(39)	(34)
s_7			3969	2331	1390	1121	3813	2764	2547
			(74)	(34)	(14)	(10)	(70)	(36)	(33)

Standard errors are in parenthesis.

Table 6: Entry threshold ratios for Slovakia in 2010, 2001, and 1995 for pharmacies, doctors and dentists (spatial model)

	Pharmacies			Physicians			Dentists		
	1995	2001	2010	1995	2001	2010	1995	2001	2010
	Per-firm entry threshold ratios (s_7/s_N)								
s_7/s_1	2.32	1.83	1.19	0.99	0.72	0.73	1.27	1.18	1.01
	(0.19)	(0.21)	(0.09)	(0.05)	(0.03)	(0.02)	(0.08)	(0.05)	(0.05)
s_7/s_2	1.70	1.25	1.11	1.27	1.00	0.93	1.07	1.07	1.03
	(0.1)	(0.11)	(0.06)	(0.04)	(0.02)	(0.02)	(0.05)	(0.03)	(0.03)
s_7/s_3	1.19	1.10	1.08	1.15	0.97	0.94	0.99	1.05	1.09
	(0.06)	(0.08)	(0.04)	(0.03)	(0.02)	(0.02)	(0.04)	(0.03)	(0.03)
s_7/s_4	1.35		1.06	1.09	0.95	0.97	1.00	1.07	1.10
	(0.06)		(0.04)	(0.03)	(0.02)	(0.01)	(0.03)	(0.02)	(0.02)
s_7/s_5	1.04		1.08	1.14	0.94	0.96	1.05	1.04	1.14
	(0.04)		(0.03)	(0.03)	(0.01)	(0.01)	(0.03)	(0.02)	(0.02)
s_7/s_6			1.07	1.09	0.97	0.99	1.05	1.04	1.05
			(0.03)	(0.2)	(0.01)	(0.01)	(0.03)	(0.02)	(0.02)
	Test ratio = 1								
$s_7/s_1 = 1$	***	***	**		***	***	***	***	
Chi-sq.	49.42	15.32	4.53	0.06	106.86	121.78	11.6	13.99	0.02
$s_7/s_2 = 1$	***	**	*	***		***		**	
Chi-sq.	46.32	5.49	3.86	44.33	0.05	17.31	1.93	4.86	1.06
$s_7/s_3 = 1$	***		*	***		***		*	***
Chi-sq.	8.51	1.68	3.7	21.64	2.69	17.05	0.15	2.92	9.51
$s_7/s_4 = 1$	***			***	***	**		***	***
Chi-sq.	32.55		2.60	10.52	9.66	4.50	0.02	7.89	15.89
$s_7/s_5 = 1$			**	***	***	***	*		***
Chi-sq.	0.90		6.47	30.60	14.70	9.73	3.07	2.67	35.48
$s_7/s_6 = 1$			**	***	**			*	**
Chi-sq.			5.93	14.84	4.55	0.24	2.60	3.37	5.81

Standard errors are in parenthesis.

***,**, and * indicates that ETRs are significantly different from one at the 1%, 5%, and 10% level, respectively.

Table 7: Transition matrix: pharmacies

		Number of firms in 2010							
		0	1	2	3	4	5	6	7
1995	0	**0.97**	0.03	0	0	0	0	0	0
	1	0.43	**0.4**	0.14	0.03	0	0	0	0
	2	0.15	0.33	**0.13**	0.15	0.08	0.05	0.03	0.07
	3	0	0	0.33	**0**	0.17	0	0.17	0.33
	4	0	0.06	0.11	0	**0**	0.11	0.22	0.5
	5	0	0	0	0.17	0.17	**0.5**	0	0.17
	6	0	0	0	0	0	0	**0.25**	0.75
	7	0	0	0	0	0	0	0	**1**

Table 8: Transition matrix: dentists

		Number of firms in 2010							
		0	1	2	3	4	5	6	7
1995	0	**0.95**	0.04	0.01	0	0	0	0	0
	1	0.28	**0.56**	0.12	0.03	0.01	0	0	0
	2	0.02	0.27	**0.29**	0.2	0.09	0.11	0	0.02
	3	0	0.05	0.05	**0.3**	0.2	0.1	0.1	0.2
	4	0	0	0	0.1	**0.2**	0.5	0.2	0
	5	0	0	0	0	0.1	**0.1**	0.4	0.4
	6	0	0	0	0.11	0	0.22	**0.11**	0.56
	7	0	0	0	0	0	0	0.04	**0.96**

Table 9: Transition matrix: physicians

		Number of firms in 2010							
		0	1	2	3	4	5	6	7
1995	0	**0.89**	0.08	0.03	0	0	0	0	0
	1	0.21	**0.41**	0.19	0.08	0.04	0.03	0	0.03
	2	0.05	0.22	**0.36**	0.17	0.09	0.05	0.04	0.02
	3	0.02	0.08	0.23	**0.15**	0.27	0.08	0.04	0.13
	4	0	0	0	0.24	**0.24**	0.06	0.24	0.24
	5	0	0	0	0	0.06	**0.06**	0.06	0.83
	6	0	0	0	0	0.07	0	**0.07**	0.87
	7	0	0	0	0	0	0	0	**1**