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Entry and competition of healthcare providers in Slovakia: a spatial analysis *

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Abstract

We study the relationship between market size and a number of firms in several healthcare professions in Slovakia to provide a new evidence about their entry decisions and a toughness of competition in the market. The size of a local market to support the entry of the first general practitioner is estimated to 1400 inhabitants. It equals 1700 inhabitants for the first pharmacy to enter, and 2300 for pediatricians. The population has to more than double for the second professional to enter. To support the second firm, the population per firm in the market has to increase by 30 % for pharmacies, by 25 % for general practitioners, and by almost 40 % for pediatricians. However, after the entry of the second firm, the intensity of competition does not change, except for pediatricians. The results are robust to spatial interactions taken into account. However, our estimates of spatial interactions show negative (but decreasing) spatial spillover effects for pharmacies, general practitioners, and dentists between 1995 and 2010. In this period, competitive effects prevailed and outweighed demand spillovers. We document that demand effect continued to grow since 2010 and in 2017 outweighed the competition effect for pharmacies.

Key words: entry models, healthcare market, industrial organization
JEL-codes: D22, I11, L22, R12

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Introduction

"There is more to life than the cold numbers of GDP and economic statistics" (OECD, 2020). Health is one of the most important areas that influence the quality of life. Quality of healthcare has an important impact on every member of society, and good health is one of the most important things to people. It brings many benefits, including enhanced access to education and the job market, an increase in productivity and wealth, reduced health care costs, good social relations, and of course, a longer life. Most people receive at least one health care service annually. Moreover, government intervention is more common in this sector than in most sectors.

Since 1970, OECD countries experienced a significant increase in expenditure in the healthcare sector. Moreover, the expenditure growth was even faster than GDP growth. The average share of health expenditure on GDP in OECD countries rose from 4.6 % in 1970 to 8.9 % in 2017. The most rapid increase in the ratio recorded USA, from 6.2 % to 17.2 %. Slovakia during the transition, together with significant GDP growth (the real GDP more than doubled between 1995 and 2017) also experienced growing healthcare expenditure. Expenditure to GDP ratio increased from 5.7 % in 1997 to 8.0 % in 2009 (OECD). A similar trend should also continue in the future, because as stated in Kišš et al. (2018), the more wealthy country, the higher healthcare expenditure - not only in nominal terms but also as a share of GDP. Moreover, Slovakia is among the countries with the highest differences in the density of doctors between urban and rural regions (OECD, 2019).

Industrial Organization provides powerful tools to examine entry (and exit) decisions of firms (even healthcare providers) and determinants of their location decisions. By studying the entry behavior of firms and the relationship between market structure and market size for different regional markets, economists can gain insight into the determinants of firm profitability, the role of fixed and sunk costs, as well as the nature of competition. Investigating this issue in transition economies is especially interesting.

In this paper, we study the relationship between market size and a number of firms in several healthcare professions in Slovakia. The paper extends the literature in several dimensions.

First, we extend the research of the Slovak healthcare market to other healthcare providers, such as pediatricians, ophthalmologists, cardiologists, or surgeons. Moreover, we provide updated estimates for pharmacies, GPs, and dentists.

Second, we study spatial interactions of the healthcare providers after the market deregulation. Due to the significant liberalization of pharmacies, Slovakia provides a good case study to explore these interactions over time. Several studies conclude that healthcare providers first concentrate in urban areas, but a subsequent increase in the total number of healthcare providers leads to the diffusion of professionals into smaller cities (Newhouse et al., 1982b,c; Rosenthal et al., 2005; Brown, 1993). Lábaj et al. (2018b) studied relatively short period of time after the deregulation of pharmacies in Slovakia and found out concentration to urban areas. In this paper, we study the development since 2010. We document that the subsequent increase in the total number of pharmacies led to diffusion into smaller markets and the number of markets without pharmacy decreased by 68.

Slovakia has the highest differences in the density of doctors between urban and rural regions among OECD countries. The third goal of our research is to examine how the inequality differs across regions of Slovakia. The analysis suggests that inequalities in the spatial distribution of physicians are rising towards the east of Slovakia. The highest inequality is in Prešov county, the lowest in Nitra, Trenčín, Trnava, and Bratislava. Another finding is that GPs are relatively equally distributed between counties and districts.

1 Literature review

This research falls into the intersection between healthcare economics and Industrial Organization (IO), which is considered as a hot area of current research (Snyder and Tremblay, 2018). In 1991, there were only 23 papers on this intersection, which accounted for 2 % of total IO papers. In 2016 it was already 600 articles (6 % of total). Expenditure growth in healthcare can be the first reason for increasing interest. A growing share of research and development expenditure that is being poured into the healthcare sector and significant healthcare reforms enacted during the period is considered to be other reasons.

In some sense, healthcare markets are not necessarily more distinctive than hundreds of other markets that IO economists have studied for decades. The tools developed by IO economists for the analysis of other markets can also be applied to health markets (Snyder and Tremblay, 2018).

On the other side, Morris et al. (2012) summarize seminal paper written by Arrow (1963) about special characteristics that make health care different from other goods and services. He concluded that "the behaviors of consumers and providers of medical care are very different from the norm of a competitive market in standard economic theory." An unregulated private market for medical care is unlikely to produce socially optimal outcomes.

Early industrial economists have aimed to establish a link between market structure and conduct of firms in the market (Structure-Conduct-Performance - SCP - approach). In turn, that conduct would determine the outcome or performance of the market in terms of economic efficiency or welfare. While between 1945 and 1960, the dominance of the SCP approach grew, since the 1970s its impact faded. Academics started to reflect significant failings of SCP paradigm (Pepall et al., 2014). The relationship between market structure (competition) and market outcomes was vastly examined within the SCP paradigm. Analysis typically involved regression, where dependent variable represented market outcome (profit, markup or prices) and a measure of market concentration on (often HHI) as an independent variable, along with various control variables. Morris et al. (2012) also suggest structure-conduct-performance as a useful framework for the supply of health and healthcare analysis. Hospitals in a more competitive environment may behave more aggressively in terms of pricing and quality of care. Observing the number of firms in the healthcare market can indicate how competitive a market is. Abraham et al. (2007) argue, that while late SCP studies have proved valuable in uncovering patterns in the data, they are subject to the usual criticism that it is tough to know if SCP studies identify competitive effects.

Bresnahan (1989), Schmalensee (1989) or Berry et al. (2019) point out that the approach seems to have been readopted in recent years outside of the Industrial Organization. The authors summarized problems of this approach, which are often ignored by economists outside IO. The first problem is connected with measuring concentration, which is inherently difficult because of the definition of economic or geographic markets. Moreover, even if the structure and output variables were measured with precision, researchers often struggled with the problem of interpreting their regressions. As Bresnahan (1989) argued, clear interpretation of the impact of concentration is not possible without a clear focus on equilibrium oligopoly demand and supply, where supply includes the list of the marginal cost functions of the firms and the nature of oligopoly competition.

New empirical framework for measuring the effects of entry in concentrated markets was pioneered by Bresnahan and Reiss (1991). Authors present a method for examining the effect of market structure on competition that is not subject to the problems associated with the SCP approach (Abraham et al., 2007). Using data on geographically isolated monopolies, duopolies, and oligopolies, authors studied the relationship between the number of firms in a market, market size, and competition. This approach assumes 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 getting more intense. The competition shrinks profit margins, and therefore a firm needs a larger market to generate the variable profit necessary to cover entry costs. Empirical results suggest that competitive conduct changes quickly as the number of incumbents' increases. Their approach was later extended in various ways.

Berry (1992) extended the literature on empirical models of oligopoly entry proposed by Bresnahan and Reiss, mainly via a focus on the crucial role of differences between firms. The former approach used information on market size and the number of firms to make inferences about the nature of competition, frequently abstracting from differences among firms. In contrast, the Berry paper focuses on inferences about firm-specific sources of profit in the presence of a large number of heterogeneous potential entrants.

Mazzeo (2002) proposed an empirical model to analyze product differentiation and oligopoly market. The entry model was estimated using data from oligopoly motel markets along U.S. interstate highways; their quality choice characterizes motel establishments. The results demonstrate a strong incentive for firms to differentiate. The effects of demand characteristics on product choice are also significant.

Berry and Waldfogel (1996) extended the Bresnahan and Reiss entry model by including data on market shares and prices, which allows them to make inferences about the efficiency of entry in the radio broadcasting industry. Using data on advertising prices, the number of stations, and radio listening in 135 US metropolitan markets, authors estimated how listening, and revenue vary with the number of stations. Relative to the social optimum, the welfare loss of free entry is 40 percent of industry revenue.

Another papers supporting hypotheses from Newhouse et al. (1982a) and consistent with competitive effects from entry were provided by Brown (1993) and Dionne et al. (1987). The first article analyses how physicians choose locations of practice in response to spatial competition forces and considers the implications of such choices for public policy to alleviate shortages of practitioners in rural areas. The predicted geographic distribution of physicians, as determined through spatial competition modeling, was compared with the actual distribution of physicians in 1990 among Alberta's 19 census divisions. Physicians seem to respond to spatial competition forces in choosing where to practice. A policy to attract more physicians to rural areas through income subsidies is technically feasible but expensive. More empirical evidence on the geographical distribution of physicians provide Dionne et al. (1987) in the Province of Quebec. The results are consistent with the standard location theory. They also show that quality of leisure, distance to central city areas, average income and presence of a hospital are significant in explaining the probability that at least one physician (specialist or general practitioner) is present in a given town.

Rosenthal et al. (2005) revisit analysis provided by Newhouse. They found that communities of all sizes gained physicians over this period, but that the impact was larger for smaller communities, as predicted by the theory. Although most specialties experienced great diffusion everywhere, smaller specialties had not yet diffused to the smallest towns. They concluded that geographic access to physicians has continued to improve over the observed period, although some smaller specialties have not diffused to the most rural areas.

Gaynor and Town (2011) provide with comprehensive literature review devoted to studying markets for health care services and health insurance. They examined research on the determinants of market structure, considering both static and dynamic models. They conclude that variation in the quality of health care clearly can have substantial welfare consequences. Therefore authors also describe the theoretical and empirical literature on the impact of market structure on the quality of health care.

Abraham et al. (2007) extend the entry model developed by Bresnahan and Reiss to make use of quantitative information, and apply it to data on the U.S. hospital industry. Entry threshold ratios identify the product of changes in the toughness of competition and changes in fixed costs. By using quantity data, they were able to identify changes in the toughness of competition from changes in fixed costs separately. They conclude that in the hospital markets, entry leads to a quick convergence to competitive conduct. Entry reduces variable profits and increases quantity. Most of the effects of entry come from having a second and a third firm enter the market.

The first micro-level (indirect) empirical evidence on changes in entry barriers, the determinants of firm profitability as well as the nature of competition for a transition economy was provided by Lábaj et al. (2018b) and Lábaj et al. (2018a). The authors estimated thresholds required to support different numbers of firms for a large number of geographic markets in Slovakia. In both papers three-time period were analyzed to characterize different stages of the transition process (1995, 2001, 2010), taking spatial interaction between local markets into account.

Lábaj et al. (2018a) focused on several retail and professional service industries, in particular for automobile dealers, electricians, plumbers, and restaurants. The reasons to choose these occupations are their specific character of small and independent sellers and their similarity to those analyzed in previous empirical studies. Estimation results obtained from a spatial ordered probit model suggest that entry barriers have declined considerably in Slovakia (except for restaurants) and that the intensity of competition has increased on average. Authors further found that demand spillovers and/or the effects associated with a positive correlation in unobservable explanatory variables seem to outweigh negative spillover effects caused by competitive forces between neighboring cities and villages. The importance of these spatial spillover effects differs across industries.

The second paper provides first empirical evidence on the relationship between market size and the number of firms in the healthcare industry for a Slovak economy during the transition period. Market-size thresholds for three occupations were estimated – for pharmacies, physicians and dentists. Results suggest that the relationship between market size and the number of firms differs both across industries and across periods. Pharmacies, as the only wholly liberalized market in the data set, experience the most substantial change in competitive behavior during the transition process. Furthermore, correlation in entry decisions across administrative borders, suggesting that future market analysis should aim to capture these regional effects (Lábaj et al., 2018b).

In this way, it is important to study the interlinkages between business stealing effects and supplier induced demand effects. According to the Physician induced demand (PID) hypothesis (generally known as supply-induced demand), information between physicians and patients is so asymmetric that a physician can shift out the demand curve for his services. This shift involves recommending a service such as a revisit or a surgical procedure whether or not the recommended care is of potential benefit to the patient. The only reason a consumer (patient) would accept this situation is asymmetric information between doctors and their patients (Sloan and Hsieh, 2017). It is inefficient for a patient (as a consumer) to seek out all the relevant information regarding proper treatment. Instead, we can observe extensive use of agents such as doctors or pharmacist employed by a consumer (patient) to make a purchasing decision on her behalf (McPake et al., 2013).

Induced demand is especially important for the analysis of competition in the health care industry. Since doctors can induce demand for their services, they can enter a market with already sufficient number of doctors. This can lead to a lower density of doctors in rural areas because doctors usually prefer to live in a city (see the previous section). If doctors can generate demand for their services, they possess far more market power than is usually attributed to the monopolist, whose price-setting ability is constrained by a fixed demand curve. There are however ambiguous conclusions on the existence of induced demand in literature so far.

Rice and Labelle (1989) have argued, that more attention should be paid to the consequences of PID. If additional health services result in improved health status or better access to health care, then PID may be beneficial to society irrespective of physicians' motives for generating more services.

Several studies examined the determinants of physician locations. The relationship between physician supply at the regional level and demographic (population size, age structure, fertility, and migration) and geographic determinants were analyzed by Kuhn and Ochsen (2009). Results suggest a negative relationship to both the population share 60+ and the population share 20- in rural areas. While both population shares tend to have a less negative impact in urban areas, a pronounced positive effect arises only for the share 20- in regions with agglomeration character.

Newhouse (1990) claims that doctors, in general, prefer a location in cities. There can be several reasons why. One of the motives could be higher life-quality in the greater city. Literature suggests that physicians maximize overall utility, not only profit. It can include quality of life in a specific area, culture, sport, or recreational facilities. Several studies conclude that greater cities attract more physicians, but the subsequent increase in the total number of physicians will lead to diffusion into smaller cities (Newhouse et al., 1982b,c; Rosenthal et al., 2005; Brown, 1993).

Isabel and Paula (2010) analyzed the inequality in the geographic distribution of physicians and its evolution in Portugal. They also estimated the determinants of physician density and assessed the importance of competitive and agglomerative forces in location decisions. They measured inequality in spatial distribution using Gini indices, coefficients of variation, and physician-to-population ratios. The authors concluded that geographic disparities in physician density are still high and appear due to income inequality. The impact of the growing number of physicians, and therefore potential increased competition, on geographic distribution during the period studied was small.

2 Healthcare system and regulation in Slovakia

Since 1993, the healthcare sector in Slovakia experienced several reforms, mainly as a result of a government change. We summarize the most important regulatory changes in Table 1. Regulatory overview, as well as an overview of the healthcare system in Slovakia in this chapter, is based on Health system review, provided by Szalay et al. (2011) and Smatana et al. (2016), and healthcare spending review by Kišš et al. (2018).

The health care system in Slovakia is based on universal coverage, compulsory health insurance, a basic benefits package, and a competitive insurance model with selective contracting and flexible pricing. After fulfilling certain explicit criteria, there are no barriers to entry to the health care providers and health insurance markets. All health insurance companies (HIC, three in 2020 in Slovakia) must operate nationwide, although their market shares show significant regional variation. This results in regional differences between health insurance companies in negotiating positions vis-à-vis health care providers (Szalay et al., 2011).

Fundamental reforms to the healthcare system were introduced in 2004. The health reform was based on a set of structural and functional changes that were supposed to transform the centralized system into a decentralized system. The principal objective of the reform was to increase the independence and financial responsibility of healthcare providers. Since this year, flexible prices, contractual relations with selective contracting, and flexible basic benefit packages were decentralized to health insurance companies, a flexible healthcare network (with the definition of a minimum network), and drug policy measures accompanied by the liberalization of ownership of pharmacies were implemented. The reform aimed to make the process of entry into the healthcare provider market more transparent and to remove barriers to entry. However, after 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 wholly abolished), but critical reform acts remained unchanged.

General ambulatory care in Slovakia

One of the main goals of ambulatory care is to secure prevention. Ambulatory care in Slovakia consists of general care and specialized care. General care includes General Practitioners (GPs) for adults, pediatricians, gynecologists, and dentists. In Slovakia, almost half of all visitors to ambulatory care include visits to specialists. Kišš et al. (2018) concludes, that the healthcare system in Slovakia could save resources by shifting a part of care from specialized to general care.

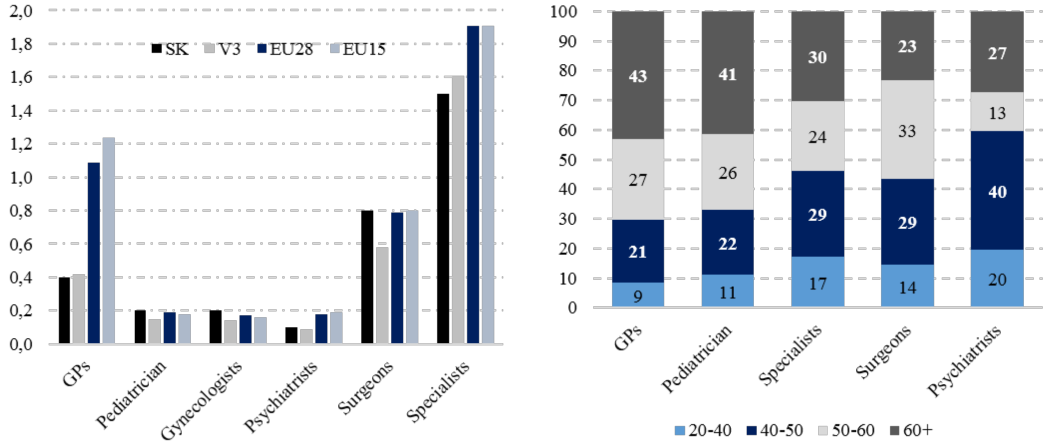
However, to be able to make this shift, there has to be a sufficient network of GPs in place. Szalay et al. (2011) states that after 2001, Slovakia witnessed a continuous fall in the number of physicians and nurses in relation to the population. These changes are closely linked with the migration of doctors and nurses abroad and the restructuring of health care facilities. According to Kišš et al. (2018), the total number of doctors in Slovakia is currently slightly below the EU28 average and above the V3 average. However, the specialization structure of doctors is different - Slovakia has significantly fewer GPs than the EU average. Paper also stresses that these problems will grow in the future because over 40 % of them are older than 60 years of age. On the other hand, the number of pediatricians is above the V3 average and relatively similar to the EU28 average. However, age structure is almost the same as for GPs.

Table 1: Overview of main regulatory changes in the Slovak Healthcare sector

Year	Subject of regulation	Regulation
1990		Re-introduction of market principles and fragmentation of the system
1995	Pharmacies and Physicians	Most pharmacies and ambulatory physicians went into private practice
1998	Pharmacies	Slovak Chamber of Pharmacists approves the establishment of new pharmacies.
	Pharmacies	Entry of pharmacies was not restricted by population or location explicitly.
	Pharmacies	Only a pharmacist can provide pharmaceutical care, limited to one pharmacy and one subsidiary of the pharmacy.
2000	Pharmacies	Demographic and location restrictions for pharmacies.
2001	Doctors	Decline in number of doctors due to restructuring of hospitals and migration abroad.
2004	Pharmacies	Reform aimed at transparent entry and decrease of entry barriers.
	Pharmacies	Legal persons can also receive permission to own and run a pharmacy.
2006	Doctors	User fees were largely abolished.
2009	Pharmacies	Price referencing of medicines to the average of the three lowest prices in the EU.
2011	Pharmacies	The new legislation does not limit the number of pharmacies that one person can own.
2013	Pharmacies	Liberal rules on ownership of pharmacies were reversed. Since 2011 one natural/legal person can own only one pharmacy and one subsidiary.
2014	GPs	Introduction of Residential programme.

Source: authors compilation based on Smatana et al. (2016), Lábaj et al. (2018b) and Kišš et al. (2018)

Figure 1: Numbers (on the left) and age structure (on the right) of doctors by specialization (per 1000 inhabit.) in 2016



Source: authors compilation based on Kišš (2018)

Minimum network of healthcare providers

The minimum network of physicians was set to guarantee the accessibility of physicians for patients. This network is based on calculations of the minimum number of physicians for each of the eight self-governing regions. Minimum capacities are calculated per capita, but they currently do not consider the specific health care needs of the population, like age or income structure or inhabitants. Health insurance companies then have the option to contract more providers if they had enough resources (Smatana et al., 2016).

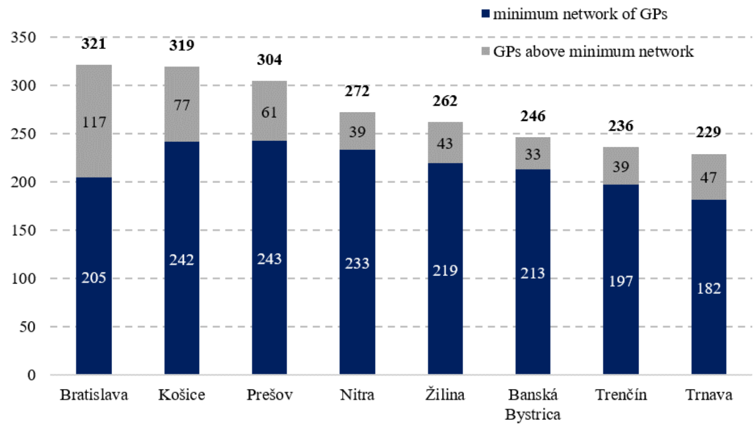
The minimum network is calculated by multiplication of normative by share of insured inhabitants of a given insurance company per total number of inhabitants of a given county. The minimum network of General practitioners in Slovak counties in 2018 is shown in figure 2. Health insurance companies had to contract at least 1733 GPs in 2018.

Pharmaceutical market

Pharmacy services represent the inseparable part of healthcare. Non-functioning pharmaceutical market or lower accessibility of drugs could lead to worse health of inhabitants (Mandžák and Hronček, 2019).

Pharmacy traditionally belongs between strictly regulated sectors to secure quality and broad accessibility of medication. Typical regulation covers the establishing of new

Figure 2: Minimum network of GPs in Slovakia, 2017



Source: authors compilation based on data from Government resolution 59/2019 Z. z. and RHP

pharmacies, restriction of ownership (e.g., the only pharmacist can be the owner) or demanded level of quality of education of pharmacists Vogler et al. (2006).

The Slovak pharmaceutical sector has undergone several reforms in the last few years. Until 1998, the entry of new pharmacies was not explicitly regulated by demographic or population criteria. However, the Ministry of Health of the Slovak Republic had to approve an establishment of a new pharmacy. A new Act from 1998 gave the Slovak Chamber of Pharmacists an explicit right to approve the request for the establishment of new pharmacies in Slovakia. Later, the Slovak Chamber of Pharmacists approved demographic and population criteria for the establishment of new pharmacies. The minimum distance between pharmacies was set to 500 m and the minimum population per pharmacy 5 000 inhabitants.

One of the effects of market liberalization could be the concentration of firms in attractive areas (Lábaj, 2019). This development in spatial location of pharmacies was confirmed by several partial analyses of the evolution after 2004, for example by Smatana et al. (2016).

Market liberalization led to a substantial increase in the number of new pharmacies. Together with abolishing distance and population criteria, non-pharmacists were allowed to own a pharmacy but must guarantee a trained pharmacist at the premises. In 2005 Slovakia had 1152 pharmacies (1 pharmacy per 4678 people), but by 2014 there were 1931 pharmacies (1 pharmacy per 2805 people). The increase in the number of pharmacies contributed to reductions in regional disparities compared to 2005 (Smatana et al., 2016).

On the other hand, after 2004, pharmacies tend to enter mainly city markets, with higher density. Despite good accessibility of pharmacies on average, Lábaj (2019) states that question of stricter regulation arise.

3 Methodology and data

3.1 Methodology

The entry model framework will follow Lábaj et al. (2018b), Assume market with N competitors with a per firm per-capita variable profit $v(N)$ generated by each of the S consumers on the market. Fixed costs of f are independent of the number of firms. Therefore, per firm profits are given as: $\pi(N) = v(N)S - f$.

Ideally, we would like to observe $v(N)$ and f directly. Unfortunately, we are not able to observe them, so it is not possible to examine the effect of a number of competitors on variable profits directly. However, from observing a specific number of firms in a market of size S, we can infer that the N incumbents break even, whereas the $N+1$ potential entrant does not:

$$\pi_{N1+1} = v(N+1)S - f < 0 < v(N)S - f = \pi_N \tag{1}$$

or equivalently:

$$ln\frac{v(N+1)}{f} + lnS < 0 < ln\frac{v(N)}{f} + lnS \tag{2}$$

To be able to estimate $ln\frac{v(N)}{f}$ we need to include data on market characteristic (matrix X), firm fixed effect θ_N, and unobservable error term ϵ:

$$ln\frac{v(N)}{f} = X\beta + \theta_N + \epsilon \tag{3}$$

After plugging equation 3 into 1 we obtain following entry rule:

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

The values of θ_N and θ_{N+1}measure the changes in the variable profits to fixed costs ratio which can be attributed to market structure. If the two parameters are significantly different from each other, one would conclude that market profitability changes substantially with the entry of the N + 1 st competitor.

After estimating parameters from equation 3.3, we are able to formulate entry thresholds, i.e., the number of inhabitants necessary for the first firm to break-even (monopoly entry threshold $S1$):

$$S_1 = exp(\theta_1 - \bar{X}\beta) \tag{4}$$

where $\bar{X}$ represents the average of the variables in vector X. Entry thresholds are affected by a combination of the change in the toughness of competition due to entry, and by the change in fixed costs due to entry (Abraham et al., 2007).

Aside from evaluating the ease of entry for the first firm to break-even (a monopoly position), we would also like to assess how the competitive pressure exerted by each successive entrant. We quantify competitive effects by comparing the per firm break-even population for each market structure:

$$s_1 = \frac{exp(\theta_1 - \bar{X}\beta)}{N} \tag{5}$$

$$ETR_N = \frac{s_{N+1}}{s_N} \tag{6}$$

If entry of additional firm does not change competitive conduct, then $s_{N+1}/s_N = 1$. Bresnahan and Reiss (1991) remind, that departures of successive entry threshold ratios from one measure whether competitive conduct changes as the number of firms increases. However, this statistic *does not measure the level of competition.* Instead, it measures *how the level changes with the number of firms.* Bresnahan and Reiss (1991) claim, that the ETR measures the fall in variable profits per customer between a monopoly and competitive market and is bounded below by unity.

Standard errors and significance levels for estimated entry thresholds and entry threshold ratios were calculated using *nlcom* command in Stata, that is based on the ”delta method.

Lábaj et al. (2018b) and Lábaj et al. (2018a) claimed that ”model which ignores the presence of spatial correlation in market structure and market characteristics is likely to provide biased estimates for entry barriers and competitive effects.” Therefore in the next stage of the analysis, we build on their approach and extend our analysis with a spatial ordered probit model. This model suggests that the entry of a firm is not only dependent on local market characteristics but can also be an influence of conditions (or market size) of neighboring markets:

$$y = N, if \theta_N \leq y^* < \theta_{N+1} \tag{7}$$

$$y^* = \rho W y^* + X\beta + lnS + \theta_N + \epsilon, where \epsilon\ N(0,1) \tag{8}$$

where W is a row-standardized spatial weight matrix, the parameter ρ captures the effect of competition, demand spill-overs, or unobserved differences in entry barriers across regions. We discuss these effects in more detail in subsection 4.4.

The profitability measure is assumed to follow a truncated multivariate normal distribution:

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

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

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

A Bayesian MCMC procedure from R package spatial probit, provided by Wilhelm and de Matos (2013), was used for estimation of the spatial ordered probit model. Spatial weight matrix W were created using K nearest neighbours for each municipality. This is because we expect, that willingness of consumers (inhabitants) to travel is not unlimited. Average number of municipalities per district in Slovakia is 40, so we set $K = 40$. The restriction of the spatial effect to 40 nearest municipalities also makes the estimation of the parameter easier, since the full sample contains data on 2928 municipalities. Without such restriction, the spatial weight matrix would contain 2928x2928 weights, one for each pair of municipalities.

Each firm – pharmacy and physician decide whether to or not to enter the market. Entry decisions can be viewed as a number of firms of each type i entering the market, denoted as N_i. Firms of the same type are assumed to be homogeneous; therefore, they have the same payoff functions. If a firm of type i enters, its payoffs depend on the total number of entering firms of both types, as given by

3.2 Data

The empirical analysis will focus on different occupations in the healthcare market in Slovakia, mainly with emphasis on complementary effects between these occupations in almost 2900 regional sub-markets in Slovakia. The units of analysis are markets for physician and pharmaceutical services.

For the entry analysis, information about the number of firms in the market is essential. There are several data sources about this information in Slovakia. In this paper, we used data obtained from **RHP** (Register of healthcare providers) is a list of all health-care providers and the main source of the data for our analysis. The National center manages this register for healthcare information. Unfortunately, the list of providers of healthcare is publicly available only for the current year. However, the data can only be obtained after a formal request. Moreover, information about the location is provided directly by providers. Therefore the quality of the data is varying. The problem is primarily with the quality of data about providers in the large cities, where providers filled in information only about the district, not municipality.

3.3 Market definition

We follow existing empirical studies (mainly Schaumans and Verboven (2008)) and define the relevant market at the municipality level. We also restrict our sample with municipalities with a population over 15 thousand or population density over 800 inhabitants per km^2, to avoid a problem with overlapping markets in line with Schaumans and Verboven (2008) (see next subsection for more details).

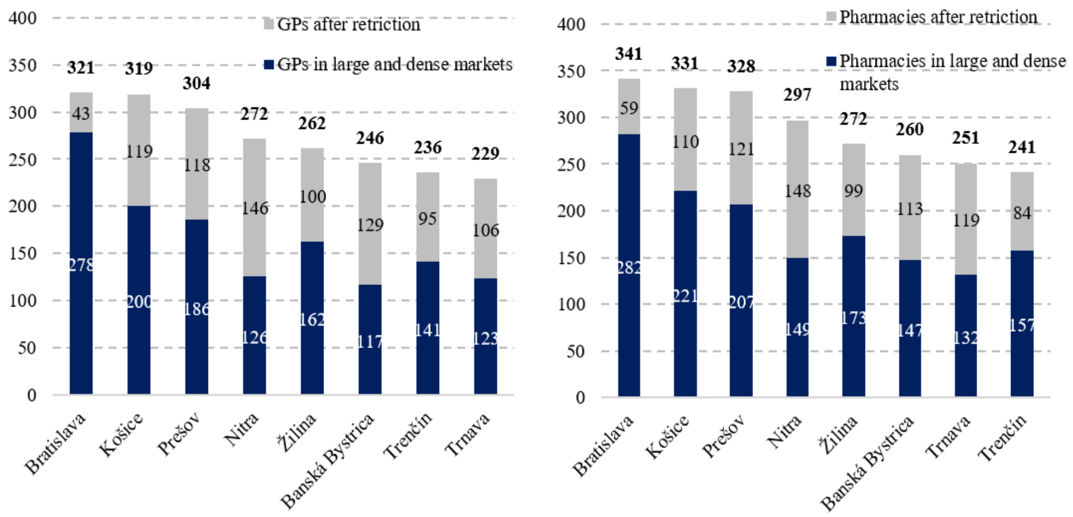
Different approach was proposed by Abraham et al. (2007) or Bresnahan and Reiss (1991), who focused on geographically isolated markets. Abraham et al. (2007) designated all cities with a population at least five thousand as potential markets. Bresnahan and Reiss eliminated towns or small cities that were near large metropolitan areas or were part of a cluster of towns.

The population in Slovakia is geographically dispersed, with higher density in the western and north-western Slovakia. The major part of the population (around 57%) lives in cities and urban areas. The lowest population density have the regions of Banská Bystrica (69.9) and Prešov (88), the highest region of Bratislava (291,8).

As we already mentioned above, our definition of the market on the municipality level leaves most markets without a healthcare professional. However, people living in these municipalities also demand pharmaceutical or physician services. Therefore they need to travel outside a municipality. On the other hand, even more, severe problems with the defined market can be considered overlapping markets at large, urban municipalities. Literature suggests that these urban markets, due to their characteristics, can attract more patients from outside markets. Schaumans and Verboven (2008) define urban markets as a municipality with a population over 15 thousand or population density over 800 inhabitants per km^2.

The restriction reduced the number of observations by 76 largest markets (less than 3 % of the markets), mainly city districts of Bratislava and Košice. Therefore the reductions have a greater impact on markets, with at least four doctors and pharmacies, and only limited impact on other market structures. The average market population in the sample was above 1,1 thousand. However, the average population for markets with 1 GP or pharmacy was above 2 thousand.

Figure 3: Number of GPs and pharmacies in Slovak counties, 2017



Source: authors compilation

3.4 Description of explanatory variables

Table 2 contains descriptive statistics of the main variables that we used in our models. After restricting our sample with regards to the population and density (as described above), the sample has 2 852 observations. As markets with more than four firms are seldom observed, we pool them to increase the precision of the estimates. We do this to have sufficient observations to identify each threshold. This is in line with previous literature, e.g. Lábaj et al. (2018b) or Schaumans and Verboven (2008). There is approximately 0.3 pharmacy and GP per municipality on average. Before the pooling of firms, we could observe even markets with 12 pharmacies and 15 GPs in regional markets in Slovakia.

The population is the key explanatory variable in the model. It represents the market size, S. Data on the population as well as demographic characteristics of the regional markets are obtained from the 'Urban and Municipal Statistics'. The average population per market in our restricted sample is over 1.1 thousands. A relatively low population per market is due to the fragmentation of municipalities in Slovakia. As stated by IFP (2017), the average number of inhabitants of a municipality in Slovakia is 3-times lower than the EU28 average and 5-times lower than the OECD average. However, Lábaj et al. (2018b) postulates that ”this definition of the administrative units allows to measure variations in local characteristics extremely precisely”.

Density in Slovakia is relatively heterogeneous. The average population density in 2017 was 79 inhabitants per km^2, with the same standard deviation. Population density ranges between 0.5 to 784 inhabitants per km^2.

In our model, we also control for several market characteristics. As noted by Lábaj et al. (2018b), ”it is necessary to build a model which reflects the fact that consumers differ in their per-capita level of demand, to assess the level of market barriers and competitive effects more precisely. Demand for medical services is determined by exogenous demand shifters, such as demographic factors and income”.

High variability in unemployment rate across municipalities can be observed. Average unemployment rate was around 5 %, with almost the same standard deviation. The highest unemployment rate (31 %) was recorded in Gemerska Ves in Revuca district.

The main demographic factor is age. We expect that the proportion of the population 65 years of age and older in a particular market will be positively correlated with the demand for medical services. In other words, we expect that older people visit GPs and pharmacies more often. In Slovakia, the average share of the older population per municipality is 16 percent. However, there are also some regions with higher shares of the older population. The maximum share of the older population was 56 percent. On the other hand, we also include a share of the young population in the model. Share of young and old population are almost the same on average.

We also include income as a factor affecting demand. The measure of income we use is average per capita income at the district level. The average wage in our sample was 855 EUR, varying between 660 EUR and 1450 EUR. Abraham et al. (2007) speculate, that this may capture both the direct effect of income on demand, but also the extent of health insurance coverage in the population.

Table 2: Descriptive statistics

Variable	**Obs**	**Mean**	**Std.Dev**	**Min**	**Max**
pharmacies	2852	0.30	0.92	0	12
pharm4	2852	0.27	0.68	0	4
GPs	2852	0.36	0.95	0	15
GP4	2852	0.33	0.74	0	4
pop	2852	1112	1504	7	14914
lnpop	2852	6.45	1.07	1.95	9.61
wage	2852	855	108	658	1450
unem_rate	2852	0.05	0.04	0.002	0.31
density	2852	79	79	0.46	784
old_share	2852	0.16	0.05	0.01	0.56
young_share	2852	0.15	0.05	0	0.45

Source: authors compilation based on restricted sample

4 Empirical results

4.1 Market structure of healthcare providers

”GPs are the captains of the healthcare providers (McPake et al., 2013).” GPs are the most common healthcare providers in Slovakia. In 2017, 2 353 GPs operated in Slovakia. Within other healthcare providers, pharmacies are right behind them (over 2.3 thousand), followed by dentists (2.1 thousand). The fourth most common healthcare providers are pediatricians, with only half the number of GPs. Description of basic characteristics of chosen healthcare providers provides table 3.

Table 3: Chosen healthcare providers in Slovakia, 2017

Physician	**Total**	**Max**	**Inhabitants per physician**	**Number of markets**
GPs	2 353	77	2 312	712
Pharmacies	2 321	66	2 343	600
Dentists	2 130	69	2 554	517
Pediatricians	1 159	31	4 693	455
Ophthalmologists	482	27	11 285	119
Surgeons	453	14	12 007	124
Cardiologists	277	16	19 636	91

Source: authors compilation based on RHP, full sample

The theory we follow assumes that market size predicts the number of active firms. We show number of markets by number of firms in tables 4 (for GPs) and 5 (for pharmacies), for both full and restricted sample. Restricted sample contains only markets under 15 thousand inhabitants and with density under 800 inhabitants per km^2. Moreover, we aggregated firms with more than 4 specialists.

The literature suggests that the population per firm should be increasing with a number of firms because more intense competition would decrease mark-ups. Therefore a higher population is necessary to cover entry fixed costs and lower margin. Instead, this simple GP to population ratio suggests that it is decreasing. However, we claim that the market population alone only imperfectly predicts the number of professionals. Other factors, such as age structure or income, also affect firms location decisions. The simple population-to-firm ratio does not take market characteristics into account.

There are over 2.2 thousand markets without GPs in Slovakia. Around 480 monopoly markets for both restricted and full sample of markets. Number of duopoly and markets with three GPs are significantly lower.

Table 4: Number of markets by number of GPs

	Total GPs		Average population		Population per firm	
	full sample	restricted	full sample	restricted	full sample	restricted
0 firms	2216	2213	641	639		
1 firm	479	477	1978	1878	1978	1878
2 firms	84	82	3945	3439	1973	1720
3 firms	34	31	5539	5054	1846	1685
4+ firms	116	49	22156	8639	1583	2160
Total	2929	2852	1856	1112	2310	3410

Source: authors compilation based on RHP

In contrast to GP markets, there are more markets without pharmacy (both in full and restricted sample). A similar pattern can be observed in pharmacy markets. The population per pharmacy is relatively stable until four firms in the market. In markets with four firms, the population per pharmacy increases significantly. However, for the market with five firms decreases again.

Table 5: Number of markets by number of pharmacies

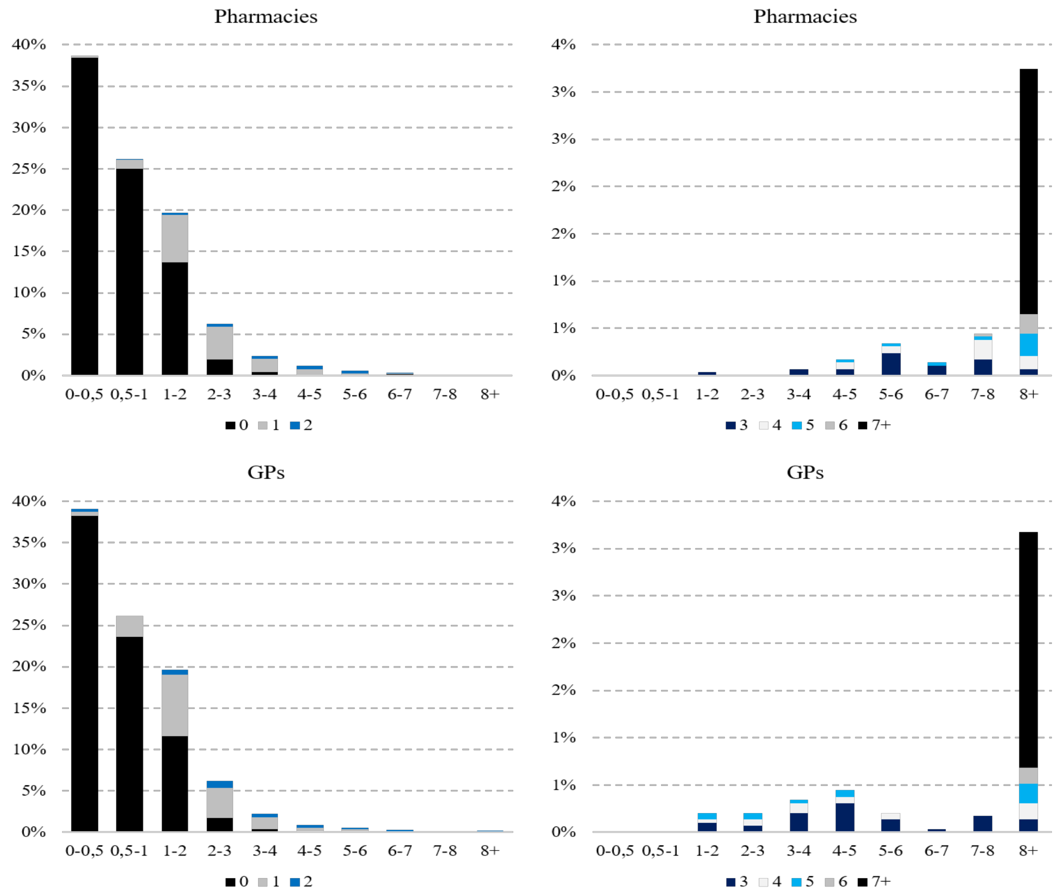
	Total Pharmacies		Average population		Population per firm	
	full sample	restricted	full sample	restricted	full sample	restricted
0 firms	2327	2326	669	667		
1 firm	402	400	2149	2153	2149	2153
2 firms	63	62	4290	3935	2145	1968
3 firms	22	20	6040	5896	2013	1965
4+ firms	114	44	22903	9021	1527	2255
Total	2928	2852	1856	1112	2362	4173

Source: authors compilation based on RHP

The charts in the figure 4 describe the relationship between market size (population) and number of Pharmacies (above) and GPs (bottom). The two charts on the left show distribution of markets that have zero, one or two healthcare providers for a given population range. In the markets with a population lower than 500, there are almost exclusively markets without healthcare providers. Charts suggest that the monopoly entry threshold for both professions is somewhere above 500 inhabitants. Duopoly entry threshold lies between 1 and 2 thousand inhabitants. Interesting is that these results are comparable to Bresnahan and Reiss (1991), who studied entry in US markets. Authors suggested that if population alone measures market size, entry threshold ratio, S2/S1 is larger then two. This suggests that entry of the second firm reduces margins.

The two charts on the right show distribution of markets that have more than two firms for a given population range (note that the axis on these charts is different). Differences between pharmacies and GPs can be observed when looking at more than two firms in the market. Three, four, and even five GPs can be observed in the markets with a population between 1-2 thousand. On the other hand, markets with four and more pharmacies usually have a population between 4-5 thousand.

Figure 4: Pharmacies and GPs by town population, 2017



Source: authors compilation, full sample

Although the total numbers of GPs and pharmacies are very similar, their market configurations slightly differ. Most of the markets in Slovakia are without any physician and pharmacy at the same time (more than two thousand). There are 43 markets with pharmacy and without a doctor at the same time. On the other hand, there are almost 160 markets with one GP, but without any pharmacy. There are also several markets with two or three pharmacies while there is no doctor present. On the other hand, if there is GP on the market, there is an increased number of markets with at least one pharmacy.

Table 6: Observed market configuration for pharmacies and physicians, 2017

	Number of pharmacies					
Number of GPs	0	1	2	3	4+	Total
0	2165	43	3	2	0	2213
1	158	300	17	1	1	477
2	3	48	25	4	2	82
3	0	8	13	5	5	31
4+	0	1	4	8	36	49
Total	2326	400	62	20	44	2852

Source: authors compilation, restricted sample

4.2 Spatial distribution

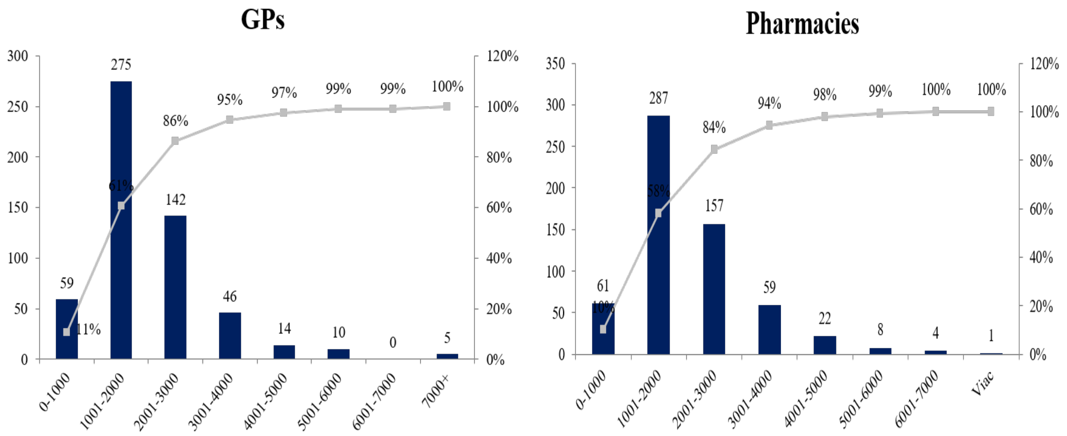
The spatial distribution of firms in Slovakia is affected by the fragmentation of municipalities. This issue was addressed in the paper by IFP (2017). According to this study, the average number of inhabitants of a municipality in Slovakia is 3-times lower than EU28 average, and 5-times lower than OECD average.

There are approximately the same numbers of GPs and pharmacies in total. Similarity can also be observed in spatial distribution. In figure 5, we show the distribution of markets by the number of inhabitants per 1 firm - pharmacy on the left figure, GP on the right. The density of both types of firms is very similar. Almost 60 percent of markets have relatively dense coverage of pharmacies and doctors since there are less than 2 thousand inhabitants per 1 firm.

General practitioners are slightly more spatially accessible than pharmacies. However, the difference in inequality in spatial distribution between GPs and pharmacies at the municipality level is small. We plot Lorenz curves for GPs and pharmacies in figure 6. However, inequality is somewhat higher in pharmacies, even though there are more pharmacies than GPs in total. Gini coefficient for the spatial distribution of GPs is 0.75, while for pharmacies, it is 0,85. Over one-third of the population is without direct access to pharmacy or GP within their municipality.

Lorenz curve for GPs' spatial distribution at district and county levels is shown in Figure 7. Figure 7 presents Gini coefficients for GPs in municipalities within the

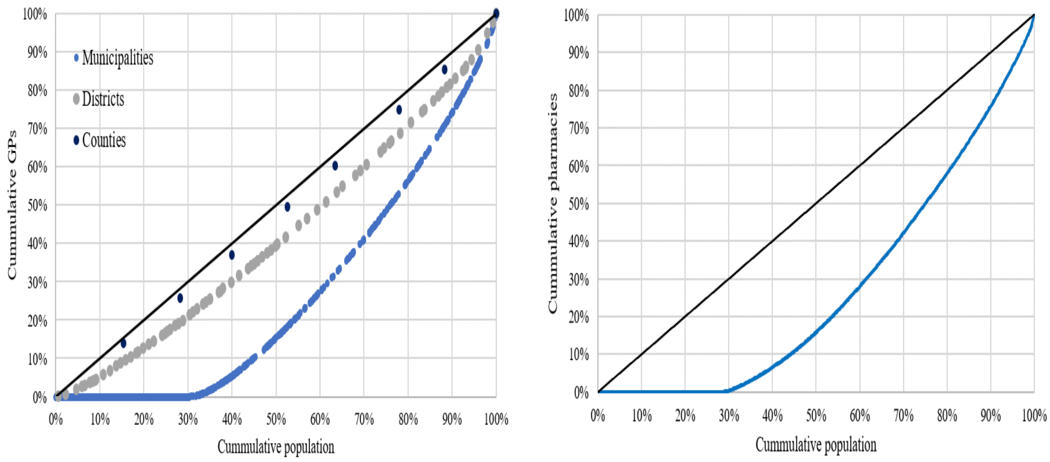
Figure 5: Distribution of markets (municipalities) according to number of inhabitants per 1 firm, 2017



Source: authors compilation

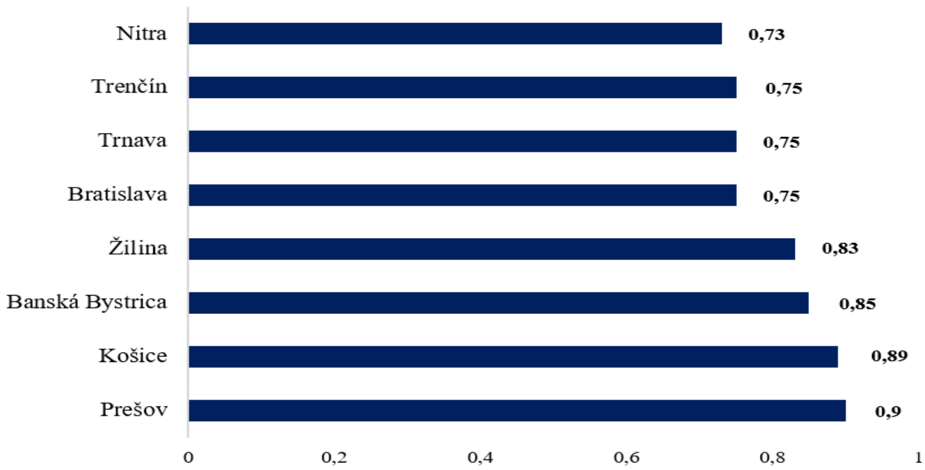
respective county. Results suggest that inequalities are rising towards the east of Slovakia. The highest inequality is in Prešov county, the lowest in Nitra, Trenčín and Trnava and Bratislava. Another interesting finding is that GPs are relatively equally distributed between counties and districts. However, inequality between municipalities could be an issue. Although the literature suggests that the concentration of medical experts under one roof could increase efficiency, the GPs could represent an exception. As Sloan and Hsieh (2017) states, physicians are the captains of the health care team. They usually have the first contact with the patient. They provide advice to patients about prevention diagnosis and treatment. They provide referrals to other sources of health care. Therefore their accessibility is especially essential.

Figure 6: Lorenz curve for GPs (left) and pharmacies (right) distribution, 2017



Source: authors compilation

Figure 7: Gini coefficients for GPs in municipalities by county, 2017



Source: authors compilation

4.3 Entry and competition of healthcare providers

Entry models, formulated by Bresnahan and Reiss (1991) or Lábaj et al. (2018b), are relatively simple to estimate. As stated by Lábaj et al. (2018b), ”the attractiveness of this approach lies in the fact, that it can be applied with modest data requirement”. If the number of firms (or in our case, the number of healthcare professionals) is available, the relative degree of competition is easy to estimate. It is also true for the entry threshold calculation.

4.4 Modelling spatial interactions

Lábaj et al. (2018b) claim that since the costs of traveling between regions are relatively small compared to the value of healthcare services, consumers might be able to travel larger distances for a specific provider. Therefore we will extend the previous analysis with spatial spillover effects between markets and spatial dimension of competition in line with Lábaj et al. (2018b) and Lábaj et al. (2018a) in the next step. While the entry threshold approach assumes local markets to be isolated, spatial interactions might be especially important in healthcare services. In contrast to analysis in previous section, we will not restrict our sample of municipalities to obtain only rural areas. We include all markets, in line with empirical analysis in Lábaj et al. (2018b).

Lábaj et al. (2018a) summarizes three different effects of these spill-overs on the number of firms. Over 70 % of markets are without a physician or pharmacy in Slovakia. However, inhabitants of these markets also have demand for healthcare services. The neighbouring markets therefore benefit from **positive demand spill-overs** .

The other, countervailing effect can be assigned to competitive pressure from firms in neighboring markets. Firms in the local market are exposed to competitive pressure from the firm in other nearby markets. Prevailing of these **competition spill-overs** would imply a negative parameter for ρ.

The last effect of spatial interaction could be the result of **differences in entry barriers across markets**. Unobserved differences in the economic environment would imply a spatial correlation of the error term and, therefore, would lead to a positive parameter estimate for ρ (Lábaj et al., 2018a).

Table 7 reports the results from spatial ordered probit model. The parameter ρ measures the impact of spatially weighted neighborhood profitability and unobserved measure of profitability in the local market.

All cut values (θ) are significant (same as in model without spatial interactions), which suggests that even after taking spatial interactions into account, market structure plays an essential role in determining profitability.

The results are relatively consistent with models without spatial interactions. However, taking spatial interactions into account increased the significance of the parameter estimates. The effects of population density remain small and insignificant. However, the share of the older population has, after controlling for spatial interactions, adverse effects on a number of healthcare providers. This negative effect of the older population can also be seen in Lábaj et al. (2018b).

Table 7: Results from spatial ordered probit models, 2017

	pharm4	GP4	ped4	dent4	surgeon4	ophth4
lnpop	0.9447***	0.9423***	0.9196***	0.8807***	0.865***	0.8494***
density	0.00005	-0.000001	0.0001	0.0001	0.000002	-0.00002
wage	-0.002***	-0.003***	-0.002***	-0.002***	-0.002***	-0.002**
unem	0.0008***	0.0008***	0.001***	0.001***	0.002***	0.002***
young_share	-16.77***	-15.57***	-16.31***	-16.24***	-26.24***	-27***
old_share	-16.38***	-14.33***	-17.33***	-15.07***	-15.47***	-15.33***
ρ	0.3272***	0.2384***	0.2338***	0.2923***	0.1825.	0.2941**
θ_1	0	0	0	0	0	0
θ_2	1.268***	1.231***	1.207***	1.149***	0.6549***	0.6723***
θ_3	1.741***	1.734***	1.815***	1.56***	1.041***	1.21***
θ_4	1.989***	2.061***	2.082***	1.874***	1.407***	1.737***

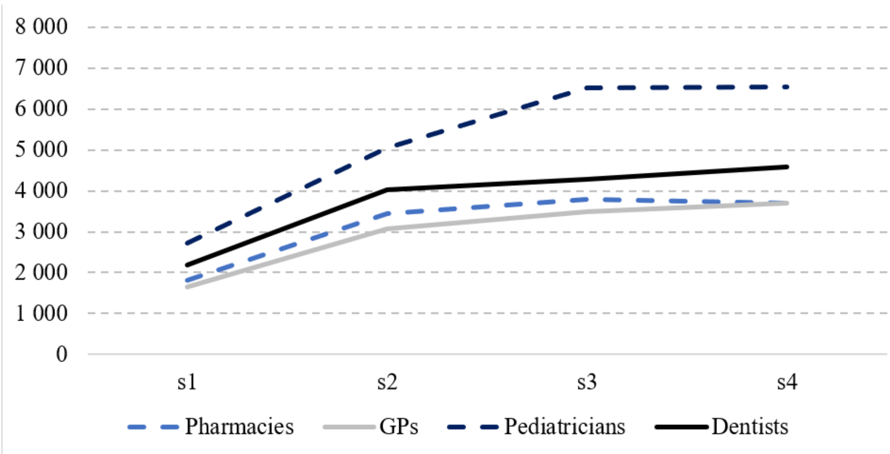
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Parameter ρ in table 7 shows positive and significant spatial correlation for all occupations but surgeons, which indicates that spatial interactions are essential for profitability and the number of firms in the markets. The positive signs of the effect suggest that the effect of demand linkages (or maybe positive correlation in regional characteristics) seems to prevail over negative effects associated with competition between neighboring regions. The effect seems to be more significant for pharmacies than for GPs.

Our estimates of spatial interactions complement results from Lábaj et al. (2018b), where authors concluded negative (but decreasing) spatial spillover effects for pharmacies, GPs, and dentists in three time periods (1995, 2001 and 2010). In these periods, the authors suggest that competitive effects outweigh demand spill-overs. Our results suggest, that demand effect continued to grow since 2010 and in 2017 outweighed the competition effect.

Based on estimates from table 7 we calculate entry threshold population (table 8 and figure 8). Entry threshold ratios are reported in table 9 and figure 9. The extension of the entry model with spatial interaction increased the entry threshold, as expected. If other small markets surround a small market (unprofitable on its own) without healthcare providers, it will be easier for a first firm to enter. Municipalities with a small population will be, therefore, able to attract an incumbent due to these demand spill-overs. Since simple ordered probit model can not take this effect into account, it will lead to lower entry thresholds.

Figure 8: Entry thresholds with spatial interactions, 2017



Source: authors compilation

Evolution of the entry thresholds and also the ETR is very similar as in simple

Table 8: Entry thresholds with spatial interaction, 2017

	pharm	**GPs**	**peds**	**dentists**	**surg**	**ophth**
s1	1 805	1 657	2 717	2 188	13 567	10 095
s2	3 455	3 060	5 047	4 034	14 463	11 138
s3	3 800	3 479	6 517	4 288	15 067	13 984
s4	3 706	3 691	6 535	4 594	17 252	19 505

Source: authors calculations

model (without spatial interactions). The results are, therefore, robust regardless of the estimation strategy. With the entry of the second firm entry thresholds increase significantly. The population required to support one firm in duopoly has to increase almost twice compared to monopoly (90 % for pharmacies, and 84-86 % for other three professions shown in figure 9). However, except for pediatricians (both for spatial and ordinary models), the population per firm remains relatively stable. For pediatricians, the population needs to increase by 30 % for a third firm to enter.

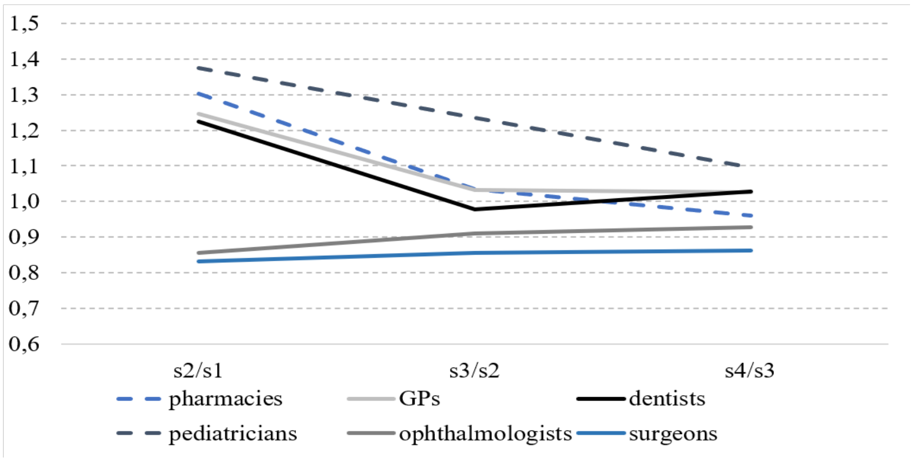
We do not show entry thresholds and ETR of surgeons and ophthalmologists in figures since entry thresholds are much larger than for other professions. Capturing spatial spillovers, however, changes ETR substantially for these professions. While ETR declined in ordinary models, ETR for surgeons is relatively stable (changes between 4-15 %) and grows for ophthalmologists. The different trends for entry thresholds after taking spatial spillovers into account suggest that a municipality is not optimal approximation for the market for those professions.

Table 9: ETR with spatial interactions, 2017

	pharm	**GPs**	**peds**	**dentists**	**surg**	**ophth**
s2/s1	1.91	1.85	1.86	1.84	1.07	1.10
s3/s2	1.10	1.14	1.29	1.06	1.04	1.26
s4/s3	0.98	1.06	1.00	1.07	1.15	1.39

Source: authors calculations

Figure 9: Entry threshold ratios with spatial interactions, 2017

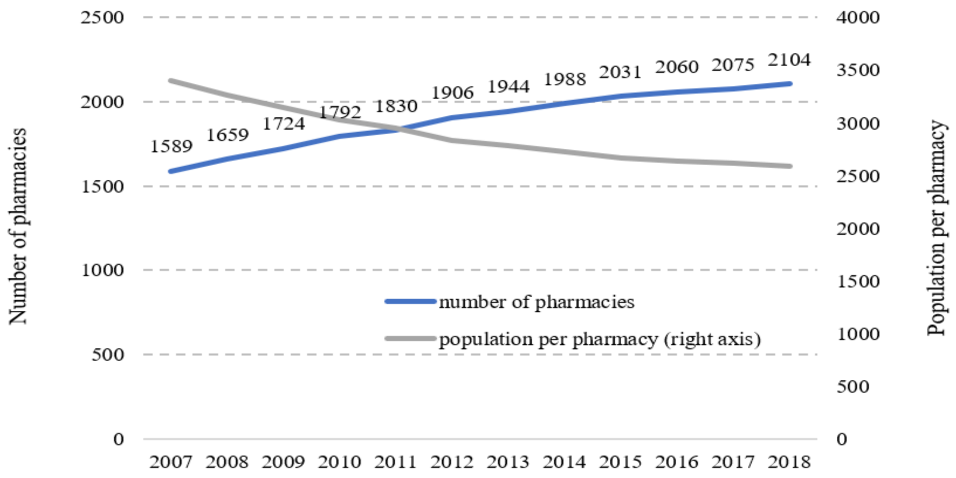


Source: authors compilation

4.5 Entry of healthcare providers over time

Between 2007 and 2018 increase in a number of pharmacies can be observed when over 500 pharmacies entered into regional markets in Slovakia. According to data from the register of healthcare providers, the total number of pharmacies increase from 1589 in 2007 to 2104 in 2018 (figure 10). With this entry of new pharmacies, the population-to-pharmacy ratio declined. The entry of the new pharmacies was possible mainly due to gradual easing of entry restrictions in this profession (see table for detail on change in regulation in time). Reform in 2004 aimed at transparent entry and decrease of entry barriers in the pharmacy market. For example, legal persons were allowed to own and run a pharmacy. Demographic and location restrictions for pharmacies were also abolished shortly before the period.

Figure 10: Evolution of number of pharmacies since 2007



Source: authors compilation

To secure comparability with paper by Lábaj et al. (2018b) and entry threshold calculation in this research, we show the observed market configuration for pharmacies in 2010 (rows) and 2017 (columns) in table 10. However, we did not exclude markets with a population above 15000 or a density above 800 inhabitants per km^2. The numbers on the main diagonal (from top left corner to bottom right corner) contains the number of markets with the same number of pharmacies in both years. The numbers above the diagonal represent the number of markets entered by pharmacy during the period. The numbers below the diagonal represent the number of markets with a pharmacy that exited from the markets.

During the examined period, 53 new monopoly markets emerged from markets that were originally without pharmacy. Moreover, 25 new duopoly markets were created from monopoly markets. On the other hand, another 22 monopoly and 4 duopoly markets were abolished.

Market structures of pharmacies in 2010 and 2017 are also summarized in table 11. In total, the number of markets without pharmacy decreased by 32. The number of monopoly and duopoly markets has been increased by 22 during the period. On the other hand, only 13 markets with 4 or more firm in the market experienced an incrase in

Table 10: Observed market configuration of pharmacies in 2010 and 2017

	Pharmacies_2017					
Pharmacies_2010	**0**	**1**	**2**	**3**	**4+**	**Total**
0	**2278**	53	1	0	0	2332
1	22	**370**	25	1	0	418
2	0	4	**31**	8	4	47
3	0	1	2	**11**	9	23
4+	0	0	0	0	**108**	108
Total	2300	428	59	20	121	2928

Source: authors calculations based on RHP, full sample

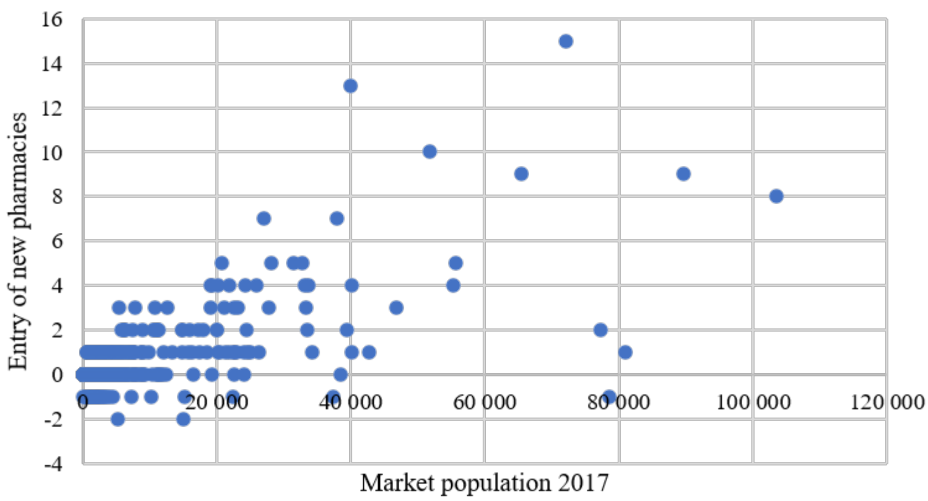
Table 11: Change in number of markets per number of firms between 2010 and 2017

	2010	**2017**	**Difference**
0	2332	2300	-32
1	418	428	10
2	47	59	12
3	23	20	-3
4+	108	121	13
Total	**2928**	**2928**	

Source: authors calculation

number of incumbents.

Figure 11: Entry of pharmacies since 2010, by market population



Source: authors compilation

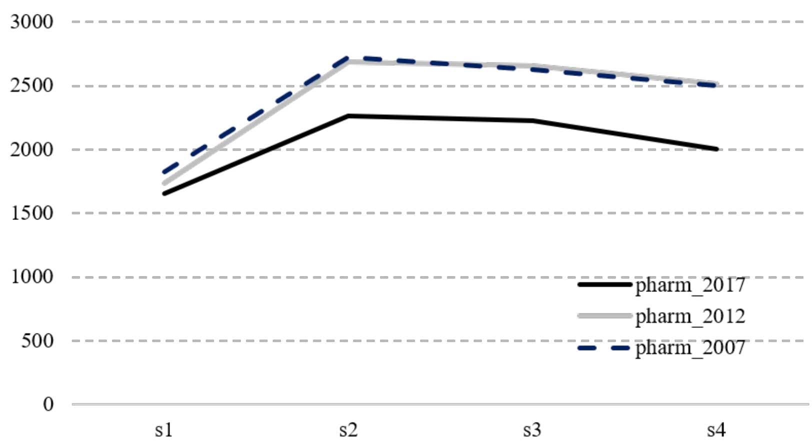
We show entry of new pharmacies into markets by market population in the figure 11. Most pharmacies entered into markets up to twenty thousand inhabitants. However, in most cases, only few pharmacy entered these markets. The entry of more firms (above four new pharmacies) can be observed mainly in larger markets, but less frequently.

These findings are in contrast to evolution in the pharmacy market between 1995-2010, described in Lábaj et al. (2018b). Authors in their paper conclude, that smaller villages did not benefit from the entry of new pharmacies, but rather lost services to larger neighboring markets. While most markets with a higher number of firms managed to keep or increase the number of firms, almost half of monopoly markets lost their only provider. Evolution between 2010 up to 2018 seems to go in another direction, with more pharmacies entering vacant markets.

With the entry of over 500 new pharmacies into the healthcare market in Slovakia since 2010, the pharmacy market change considerably. Since population does not change considerably, we can anticipate a decline in the entry thresholds.

The entry thresholds changed significantly over time. Figure 12 shows entry thresholds (required population) for 1, 2, 3, and 4 pharmacies in the market in three time periods - 2007, 2012, and 2017. The three periods allow us to study the evolution of entry and competition in 5 year periods.

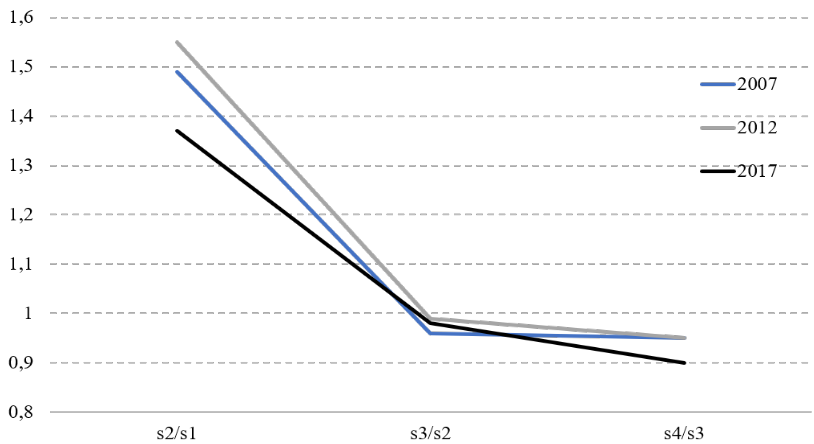
Figure 12: Change in entry thresholds of pharmacies in time



Source: authors compilation

The evolution of entry thresholds ratios is especially interesting to study because we can link our results to paper by Lábaj et al. (2018b). Competition with the entry of the second pharmacy increased in 2012 compared to 2007. However, in 2017 the entry of the second firm lead to less intense competition. The entry threshold ratio for entry of the second firm increased in 2012 but declined under the initial level in 2017. In other words - the population per firm had to increase more significantly for the second pharmacy to enter a market in 2012 than in 2007. However, in 2017 it was easier for a second pharmacy to enter since the population had to increase only 1.4 times compared to 1.6 times in 2012. After the entry of the third firm onward, competition conduct remains the same.

Figure 13: Change in entry threshold ratios of pharmacies between 2007 and 2017



Source: authors compilation

Table 12: ETRs in three time periods

	pharm_2007	**pharm_2012**	**pharm_2017**
s2/s1	1.5 (0.08)	1.54 (0.09)	1.30 (0.06)
s3/s2	0.96 (0.05)	0.99 (0.05)	1.04 (0.05)
s4/s3	0.95 (0.05)	0.95 (0.05)	0.96 (0.05)

Source: authors calculation, standard errors in parentheses

Summary and conclusions

Inequality of access to healthcare is still one of the challenges, even in developed, OECD countries. OECD in their report Healthcare at a Glance (2020) actually pointed Slovakia as an example of higher dispersion between small regions - almost three-fold differences in physician density for the Slovak Republic. This study aims to provide a new and fresh approach to determinants of entry of healthcare providers into local markets in Slovakia.

Entry model pioneered by Bresnahan and Reiss (1991) enables us to estimate entry thresholds for chosen healthcare providers. Entry thresholds represent the population per firm required to support a given number of firms in a market. If the entry threshold grows with a number of firms, then competition must be getting more intense. Change in intensity of competition with the entry of an additional firm of the same type is measured by (intra-format) entry threshold ratios (ETR).

This paper extends the existing literature in several ways. Until now, only competitive conduct within pharmacies, physicians, and dentists was studied in Slovak healthcare markets (Lábaj et al., 2018b). We extend the research to other healthcare providers, such as pediatricians, ophthalmologists, cardiologists, or surgeons. Moreover, we provide updated estimates for pharmacies, GPs, and dentists.

Several studies conclude that healthcare providers concentrate in urban areas, however a subsequent increase in the total number of physicians will lead to the diffusion of professionals into smaller cities (Newhouse et al., 1982b,c; Rosenthal et al., 2005; Brown, 1993). Lábaj et al. (2018b) studied healthcare markets in 1995, 2000 and 2010 and concluded that after market liberalization, pharmacies entered mainly city markets with higher population density. Our research aimed to answer, whether deregulation after 2010 have led to the entry of pharmacies into larger cities, or whether they already started to diffuse into smaller markets as literature expects. Results of our research suggest, that subsequent increase in a total number of pharmacies after 2010 lead to diffusion into smaller markets. During the period, the number of markets without pharmacy decreased by 68. An increase in the number of pharmacies affected mainly monopoly markets (+34) and duopoly markets (+17), mostly at markets up to four thousand inhabitants.

Slovakia has the highest differences in the density of doctors between urban and rural regions among OECD countries. One of the goals of our research was to examine how the inequality differs across regions of Slovakia. Results from our analysis suggest that inequalities in the spatial distribution of physicians are rising towards the east of Slovakia. The highest inequality is in Prešov county, the lowest in Nitra, Trenčín, Trnava, and Bratislava. Another interesting finding is that GPs are relatively equally distributed between counties and districts.

Our research also aimed to estimate the population necessary for the first pharmacy (and other healthcare providers) to enter the market in Slovakia, together with the competition changes with the entry of another provider of the same type. Pharmacies and GPs are the most frequent healthcare providers in Slovakia. This is also projected into our estimates of entry thresholds - for the two professions are the lowest. Local market, in our case municipality, has to have at least 1400 inhabitants for first GPs to enter and establish a monopoly. For pharmacy it is 1700 inhabitants and almost 2300 inhabitants for pediatrician. However, in line with theory, the population has to more than double for the second professional to enter. To support the second firm, the population per firm in the market has to increase by 30 % for pharmacies, 25 % for GPs, and almost 40 % for pediatricians. However, after the entry of the second firm, the intensity of competition does not change, except for pediatricians. The results are similar even after taking spatial interactions into account. However, our estimates of spatial interactions complement results from Lábaj et al. (2018b), where authors concluded negative (but decreasing) spatial spillover effects for pharmacies, GPs, and dentists between 1995 and 2010. In these periods, the authors suggest that competitive effects outweigh demand spillovers. Our results suggest, that demand effect continued to grow since 2010 and in 2017 outweighed the competition effect.

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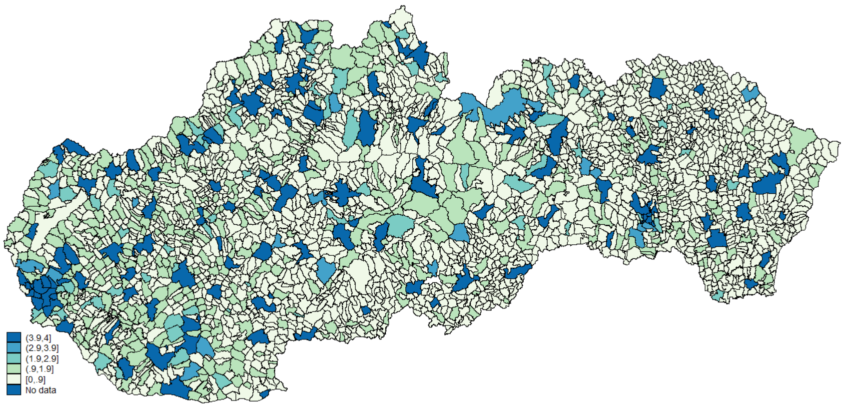
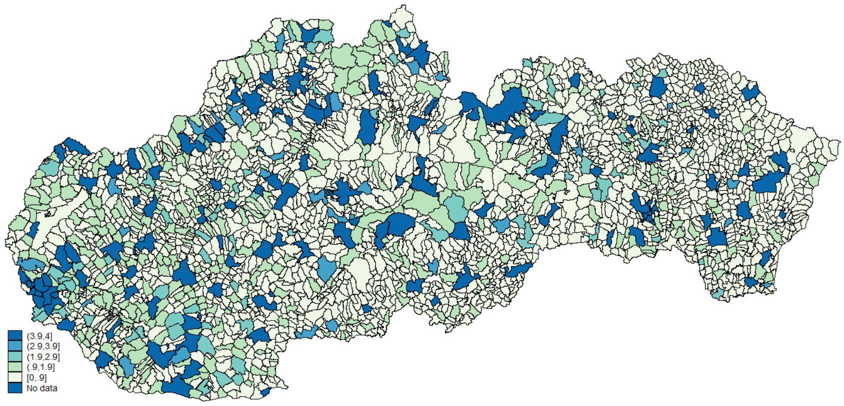
Appendix 1: Density of pharmacies and GPs in Slovak municipalities in 2017

Figure 14: Density of pharmacies in Slovakia



Source: authors compilation

Figure 15: Density of physicians in Slovakia



Source: authors compilation

Appendix 2: Results from trivariate ordered probit model

Table 13: Trivariate ordered probit model for pharmacies, GPs and dentists

	pharm4	**GP4**	**dentist4**
gamma_pharm4_GP1	1.486***		
gamma_pharm4_dent1	-0.29**		
gamma_GP4_pharm1		0.628***	
gamma_GP4_dent1		0.055	
gamma_dent4_GP1			1.327**
gamma_dent4_pharm1			0.167
/atanhrho_12		0.528***	
/atanhrho_13		0.632***	
/atanhrho_23		0.577***	
N		895	

Table 14: Trivariate ordered probit model for GPs, pediatricians and dentists

	GP4	**ped4**	**dent4**
gamma_B4_dentist1	0.312***		
gamma_B4_pediatrician1	0.164		
gamma_ped4_GP1		2.055***	
gamma_ped4_dent1		-0.170	
gamma_dent4_ped1			-0.220
gamma_dent4_GP1			1.635***
/atanhrho_12		0.293***	
/atanhrho_13		0.690***	
/atanhrho_23		0.500***	
N		895	

Figure 16: Entry thresholds from trivariate model

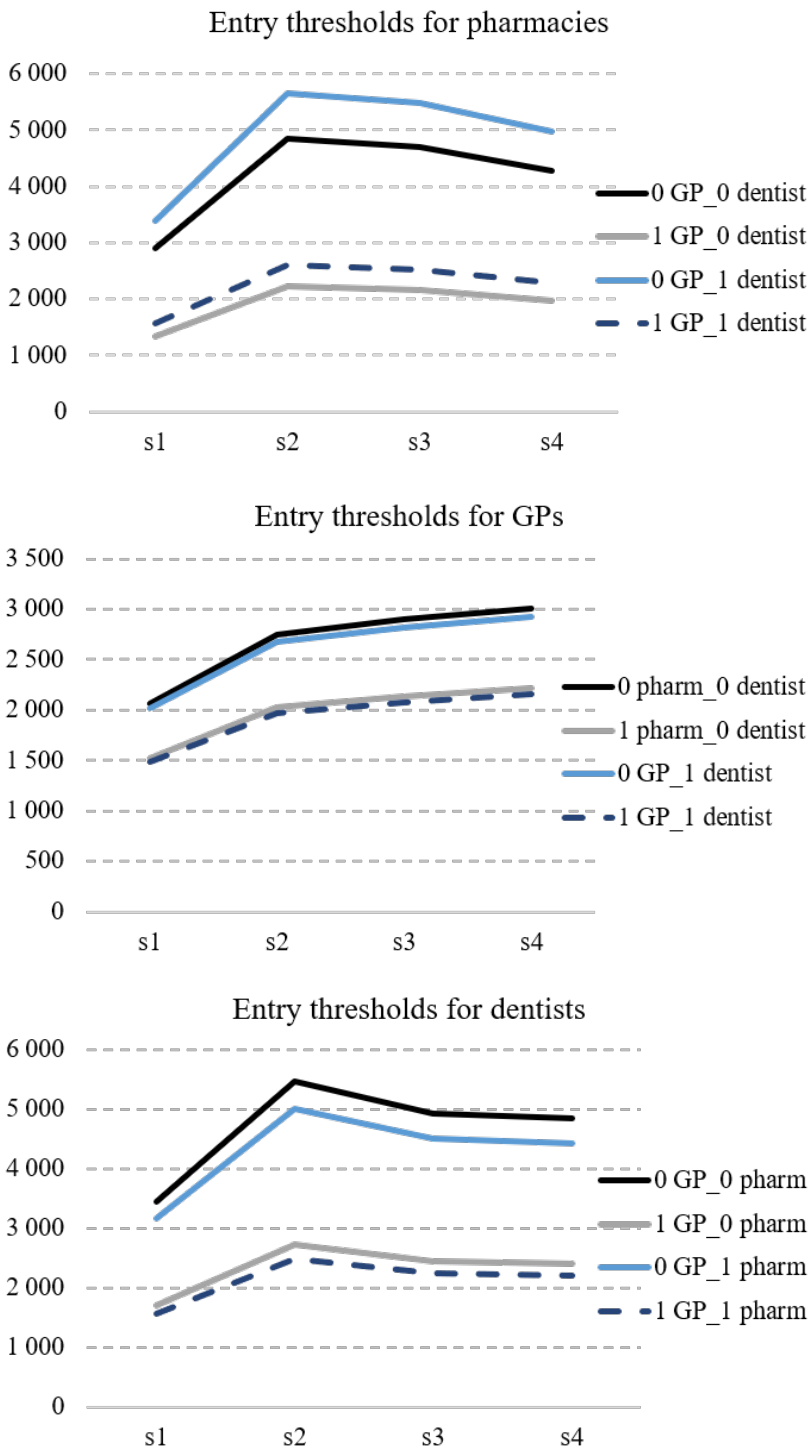


Figure 17: Entry thresholds from trivariate model