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Strategic interactions in regulated markets: spillover effects from a better regulation *

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Abstract

Usually, health policy makers face a trade-off between benefits and costs from healthcare markets regulation and deregulation. We argue that these markets and policy reforms should not be studied in isolation as the effects from regulation in one market spillover to other markets. In particular, we study entry decisions and strategic interactions between general practitioners, pediatricians, and pharmacies. We show that a better regulation and accessibility of one profession allow policy makers to relax spatial restrictions and regulations of other healthcare professionals. We document that these spillover effects could be sizeable as the entry thresholds for pharmacies to enter the market decrease by 70 % with the presence of a general practitioner. Our counterfactual analysis suggests that a better coverage of GPs would improve spatial accessibility of pharmaceutical services and lead to an entry of new pharmacies in currently unattractive markets, mostly in rural areas.

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1 Introduction

Pharmacy market belongs between sectors with wide regulations in most EU countries. Accessibility, efficiency and quality of healthcare services are among the prime reasons for a wide rage of regulations of their providers. The regulation can occur in various forms, especially concerning restrictions on entry. For example, the ownership is strictly controlled in most EU countries and in many countries the location or number is also regulated (Wisell et al., 2015). Similar regulation was in place in Slovakia before 2004, where the minimum distance between pharmacies was set to 500 m and the minimum population per pharmacy was regulated to 5000 inhabitants (Lábaj et al., 2018).

However, recently there is a trend towards deregulation in Europe. Improvements in efficiency and benefits of competition for patients call for a dismantling of unnecessary restrictions and regulations. Many European countries have introduced policies leading to liberalization of the sector, for example Slovakia (deregulation in 2004, partly reversed on 2011) Portugal (deregulation in 2004), Sweden (deregulation in 2009) or Italy (deregulation in 2017) complemented countries like United Kingdom, Ireland, Netherlands, Germany, Iceland or Norway have no regulations on ownership.

There is already a number of papers analyzing changes in competition in pharmaceutical industry. Most of the papers conclude, as Barbarisi et al. (2019) pointed out, that relaxation of entry restriction leads to an increase in number of pharmacies, but also to a negligible accessibility improvement for users living in

low densely populated area. Martins and Queirós (2015) analyzed the impact of individual and market characteristics on the typology of services delivered by a community pharmacy after a Portuguese pro-competitive regulatory change. They conclude, that access to additional pharmacy services may in some cases increase as market competition increases. Thus, pro-competitive regulatory measures may have led to asymmetric distribution of pharmacy services across the country, favouring more competitive urban marketplaces. Anell (2005) studied the cases of Iceland and Norway, where relaxed restrictions on ownership and competition were introduced in 1996 and 2001, respectively. Authors concluded significant increase in number of pharmacies,but it was restricted to the capital while most rural areas suffered a reduction in accessibility. Garattini et al. (2012) analyzed deregulation in Italy in 2012 and predicted that higher density f pharmacies would not prevent the problem of rural areas. Barbarisi et al. (2019) focused on evaluation of the impact of relaxation of demographic and geographic constraints to open new pharmacy. They conclude, that increasing number of competitors does not necessarily imply a more equitable distribution of market shares, thus putting at risk the desired effects in terms of cost reduction and quality improvement. Gallone et al. (2020) conclude, that removal of barriers to pharmacy ownership in Italy incentivize companies to invest in the sector, leading too the emergence of pharmacy chains.

Several studies have confirmed that larger cities have attracted more physicians. However, they also claim, that a subsequent increase in the total number of physicians led to diffusion into smaller cities (Newhouse et al., 1982a,b; Rosenthal et al., 2005; Brown, 1993). Newhouse et al. (1982a) claimed that the size of a town affected the probability of having a physician located there. Rosenthal et al. (2005) revisited the analysis provided by Newhouse et al. (1982a). 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.

The regulation changes, however, should not be studied in isolation. Competitive interactions can take place not only within one profession, but also between professions. For example, pharmacies and general practitioner's services are potentially strong complements. While GPs are responsible for the prescription of drugs, pharmacies are responsible for selling the drugs. Therefore both professions can benefit from mutual proximity. Schaumans and Verboven (2008) consider the entry decisions of pharmacies simultaneously with those of general practitioners. They found that the population necessary to support another physician practice in the market decreases with the number of pharmacies and vice versa, which supports the hypothesis of strategic complements. Different approach to the estimation of strategic interaction in healthcare professions was proposed by Schaumans (2008). The author did not restrict the strategic interaction effects to be negative or positive a priori. Atella and Deb (2008) claim that general practitioners, public and private specialists, are found to be substitute sources of medical care, as long as common unobserved heterogeneity is adequately accounted for. On the other hand, the naive model suggests that they are complements.

In this paper, we employ a bivariate ordered probit model to examine strategic interactions between several pairs of healthcare providers in Slovakia. In particular, we study the interactions between pharmacies, GPs, and pediatricians. Our aim is to explore the potential to nudge the entry of new pharmacies into currently unprofitable and unattractive markets without further regulation utilizing positive spillover effects from better accessibility and market coverage by GPs and pediatricians.

2 Healthcare system and regulation in Slovakia

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. 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.

Almost all GPs and the vast majority of specialized physicians provide health care services in their private medical practices. The state owns the largest health care providers, including university hospitals, large regional hospitals, highly specialized institutions, and almost all psychiatric hospitals and sanatoria (Szalay et al., 2011).

In order to operate an outpatient practice, a physician must submit their license to the chief physician of the relevant self-governing region, together with an application for a permit to operate an outpatient practice. Upon fulfilling specific requirements for qualification and medical equipment (technical and personnel criteria established by law), a physician is authorized to run their practice. GPs who do not operate in any health care facility but function as entrepreneurs may provide health care services based only on their license to perform in independent medical

practice. Irrespective of their legal form, all providers need to compete for contracts with health insurance companies based on quality criteria and prices(Smatana et al., 2016). Furthermore, there is no mechanism for regulating the number of health workers in each category and specialization according to the population's needs.

Strategic interactions between pharmacies and GPs are the main subject of interest in this research. Both professions serve as a primary form of healthcare providers in Slovakia. As we already discussed, both professions usually represent the first contact with healthcare for most patients. Both are a part of primary care services, and represent the main entry point into health systems. Inter-format competition interaction between several firms was not studied in Slovakia yet. In this paper, we provide the first empirical results on strategic interaction between pharmacies and GPs in Slovakia.

Access to medical care requires an adequate number and equitable distribution of doctors in all parts of the country. The concentration of doctors in one region and shortages in others can lead to inequities in access, such as longer travel or waiting times (OECD Health at a Glance).

OECD also provides a list of policy levers that can be used to influence the choice of the practice location of physicians, for example, 1) the provision of financial incentives for doctors to work in rural areas; 2) increasing enrolments in medical education programs of students coming from specific social or geographic backgrounds; 3) regulating the choice of the practice location of doctors and 4) re-organizing service delivery to improve the working conditions of doctors in rural areas. In this research, we would like to examine whether strategic interactions between healthcare providers (especially in the case of complementarity) could provide another answer for increasing accessibility of healthcare. Would better coverage of pharmacies lead to the entry of additional physicians?

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).

3 Methodology and data

3.1 Methodology

In our research, we follow the entry models developed by Schaumans and Verboven (2008) and Schaumans (2008) with two types of firms that may provide complementary or substitution services. Entry decisions by firms of the same

type are strategic substitutes as firm´s marginal profits from entering decrease when another firm of the same type decides to enter. Firms of a different type are strategic complements if a firm´s payoffs are increasing in the number of firms of the other type.

The following specification of a model is estimated using bivariate ordered probit estimator:

$$\pi_i^*(N_1, N_2) = \lambda_i ln(S) + X\boldsymbol{\beta_i} - \theta_i^j + \frac{\gamma_i^k}{N_i} - \epsilon_i \tag{1}$$

where the variable S is market size, measured by total population of given market as a number of potential consumers, X is a vector of other observed market characteristics, such as average income, percentage of young and elderly and unemployment rate, and λ_i and β_i are the corresponding type-specific parameters. The parameters θ_i^j and γ_i^k are fixed effects for type i firm when there are, respectively, j firms of the own type and k firms of the other type present in the market.

Entry threshold calculation

Entry thresholds and entry threshold ratios are calculated from estimated parameters as follows:

Entry threshold for N firms in the market:

$$S_N = exp(\frac{\theta_i^j - \frac{\gamma_i^k}{N_i} - \bar{X}\beta_i}{\lambda_i}) \tag{2}$$

Entry threshold per firm:

$$s_N = \frac{exp(\frac{\theta_i^j - \frac{\gamma_i^k}{N_i} - \bar{X}\beta_i}{\lambda_i})}{N} \tag{3}$$

Entry threshold ratio:

$$ETR_N = \frac{s_{N+1}}{s_N} = exp(\theta_{N+1} - \theta_N)\frac{N}{N+1} \tag{4}$$

Entry threshold ratios (ETR) expressed in Equation 4 can be also denoted as intra-format threshold ratios, since they measure to what extent the market size per firm needs to increase to support an extra firm of the *same* format. Cleeren et al. (2010) also calculate an inter-format entry threshold ratios, defined as:

$$InterETR = \frac{s_i^{k+1}}{s_i^k} = exp(\frac{\gamma_i^{k+1} - \gamma_i^k}{\alpha_i}) \tag{5}$$

Inter-format threshold ratios (InterETR) measure the increase in the per firm market size needed to support a monopolist of first type firm when an additional firm of the other type enters. Again, please note that change in intra or inter format ETR does not measure the level of competition, but how the level changes with entry.

3.2 Data

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).

Table 1 contains descriptive statistics of the main variables. After restricting our sample with regards to the population and density, the sample has 2 852 observations (markets). 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. (2018) 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 (S) is the key explanatory variable in the model. It represents the market size. 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 is over 1.1 thousands. Lábaj et al. (2018) 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.

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.

Table 1: 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

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. The maximum share of the older population was 56 percent. 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.

4 Strategic interactions of healthcare providers

4.1 Strategic interaction between pharmacies and GPs

Results from bivariate ordered probit regression, where two dependent variables are pharmacies and GPs, are reported in table 2. The estimated parameters are consistent with the literature and our expectations. Effect of the market size (measured as the size of a population) on payoffs of pharmacies and physicians is significant and positive. The share of the young population also has a significant and robust negative effect on the profitability of both professions, compared to productive population. The number of pharmacies and physicians in the market declines with the share of the young population. On the other hand, the share of the old population in the market has a positive effect on profitability, as expected. The effect is larger for GPs.

The wage has a different effect on the professions. The higher average wage in the market is negatively correlated with the number of GPs, but positively with pharmacies. The results suggest that wealthier consumers visit GPs less often, but spend more money on drugs. The estimated parameters are, however, insignificant

and only with a small effect compared to the rest covariates. On the other hand, the unemployment rate has a significant and robust effect on the profitability of both firms. However, the effect is larger in the case of GPs.

Table 2: Results from bivariate ordered probit model for pharmacies and GPs

	Pharmacies		**GPs**	
lnpop	1.602***	(20.98)	1.678***	(24.45)
wage	0.000214	(0.54)	-0.000620	(-1.77)
unem_rate	3.915*	(2.48)	7.828***	(6.37)
density	0.00161***	(3.63)	0.000747	(1.77)
young_share	-6.651***	(-4.22)	-7.353***	(-5.72)
old_share	2.111	(1.07)	3.649*	(2.34)
γ	1.786***	(16.99)	1.257***	(12.80)
θ_1	12.41***	(15.06)	11.87***	(17.09)
θ_2	14.71***	(17.13)	13.93***	(19.29)
θ_3	15.30***	(17.62)	14.66***	(20.00)
θ_4	15.64***	(17.87)	15.20***	(20.42)
athrho	0.462***		(8.66)	
N	2852			

$^{*}\ p < 0.05,\ ^{**}\ p < 0.01,\ ^{***}\ p < 0.001$

The model is internally consistent. Changes in competitive pressure due to entry of additional firms are measured by the ordered probit parameters (cut values θ). Cut values (own-type fixed effect) are positive and increasing, which is consistent with our assumptions. It implies that firms of the same type are strategic substitutes because the entry of firms of the same type lowers payoffs. Significant values suggest that market structure plays an essential role in the profitability of firms.

Compared to Schaumans and Verboven (2008) results, other-type fixed effect (γ) is also positive, but more symmetric. Positive effect suggests, that pharmacies and GPs are strategic complements. However, physicians seem to have a larger impact on the profitability of pharmacies than vice versa. Like we mentioned earlier, almost every visit of GP results in a prescription and later visit the pharmacy. On the other hand, a patient (consumer) can also visit a pharmacy without a previous

visit to the GPs. Therefore a GP is less dependent on the presence of pharmacy.

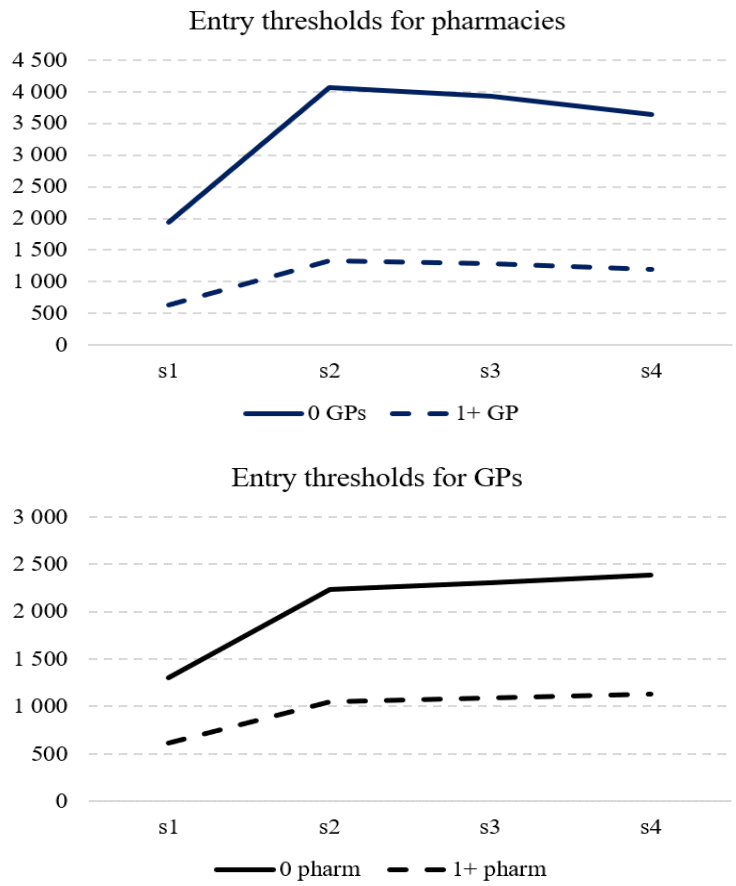
Figure 1 shows the entry thresholds for pharmacies (at the top) and physicians (at the bottom) in relation to the number of firms in the market. The solid lines represent entry thresholds for a firm (e.g. pharmacies) when there is zero firms of the other type (zero GPs). On the other hand, the dashed line represents the entry threshold for a firm (e.g. pharmacies) when there is at least one firm of the other type (e.g. at least one GP) in the market. From the figure, it is evident that entry of other type firms substantially decrease entry thresholds for both professions.

Pharmacies have significantly higher entry thresholds necessary to break even.The results suggest that a monopoly pharmacy requires almost 2000 people in the market to set up a business if there is no GP in a market. A general practitioner needs a smaller market to start as a monopoly, over 1300 inhabitants.

The population per firm required to support a given number of firms in a market grows with the entry of a second firm of the own type for both professions. This suggests that the competition is getting more intense. We assume that more intense competition reduce profit margins (and that fixed costs do not change). Therefore a firm needs a broader market to generate the variable profit necessary to cover entry costs. For both professions, the critical market size required to support a certain number of firms increases only with the entry of the second firm. After entry, the second firm, market size (population) per firm, remains relatively stable.

The results are in contrast with Schaumans and Verboven (2008), where the critical market size to support a certain number of firms increases roughly proportionally with the number of firms. Therefore, the additional entry does not lead to intensified competition in Belgium. On the other hand, Bresnahan and Reiss (1991) reported similar results, wherein markets with five or fewer incumbents (which is also the case for our markets), almost all variation in competitive conduct occurs with the entry of the second or third firm. Once the market has between three and

Figure 1: Entry thresholds for pharmacies and physicians



Source: authors compilation

five firms, the next entrant has little effect on the competitive conduct.

Effects of intra-format competition

Change in the competitive conduct after entry of the same type firm can be measured by intra-format entry threshold ratios (ETR). Significant deviations of ETR suggest the change in pricing strategies as the number of same type firms increases because a larger population is necessary for the next entrant to break even.

We show entry thresholds and also intra-format entry threshold ratios with standard errors in table 3. All estimated entry thresholds and entry thresholds

ratios are significant at 1 % level. The entry of the first pharmacy has a stronger competitive effect on the same type firms. Market size has to increase 2.1 times with entry of second pharmacy. Entry of the second GP in the market requires market population per firm to increase by 70 %. An increase of entry threshold with the size of the market for oligopoly is an indication of intensified competition ($s_1 < s_2$).

Decline in ETR stops at N=2, while s_3 approximately equals s_2. If s_2 is equal to s_3 (and also to s_4). The reason is, that if consumers have the same level of demand for healthcare services per capita across all markets, the number of providers grow proportionally to market size. However, entry of the second firm do not change competition in both cases. Note, however, that ETR measure change in competition, not the level of competition.

Table 3: Per firm entry thresholds for pharmacies and GPs

	Pharmacies		**GPs**	
Entry thresholds	0 GPs	1+ GP	0 pharm	1+ pharm
s1	1 936 (117)	635 (42)	1 308 (59)	618 (39)
s2	4 073 (423)	1 336 (76)	2 232 (176)	1 055 (55)
s3	3 925 (439)	1 288 (89)	2 301 (200)	1 088 (69)
s4	3 639 (429)	1 194 (94)	2 385 (227)	1 128 (85)
Intra-format ETR				
s2/s1	2.1 (0.15)		1.7 (0.1)	
s3/s2	1.0 (0.04)		1.0 (0.05)	
s4/s3	0.9 (0.04)		1.0 (0.06)	
Inter-format ETR				
1/0	0.33 (0.03)		0.47 (0.03)	

Source: authors compilation, standard errors in parentheses
all estimates significant at 1% level

Effects of inter-format competition

Inter-format ETR measures change in competitive conduct after entry of the other-type firm. Inter-format ETR larger than 1 suggests that the population in the market for a firm of the first type (e.g. pharmacies) has to increase after

entry of other type firms (e.g. GPs). This would imply that firms are strategic substitutes. However, if the ETR is significantly lower than 1, then it would imply that the population required to support the firm of the first type (pharmacies) declines after the entry of other type firms (GPs). This would imply that firms strategic complements.

Based on the results, we can also conclude the existence of significant complementarity between pharmacies and physicians. Our results suggest a significant drop in entry thresholds for a given profession once there is at least one firm of another type present in the local market. For example, the entry threshold for pharmacy drops from almost 2000 to 635 when there is at least 1 GP in the market. The same is true for GPs, where the presence of pharmacy in the market decrease threshold from 1.3 thousand to six hundred.

Table 4: Inter-format ETR for pharmacies and GPs

	Pharmacies	GPs
Pharmacies		0.47 (0.03)
GPs	0.33 (0.03)	

both ETRs are significant at 1 % level

Inter-format ETR are summarized in Table 4. The number in the cell expresses the effect of the provider in a row on the provider in the column. Inter-format ETR for both professions is significantly lower than 1. Strategic interaction is, however, asymmetric. GPs have a significantly larger effect on the profitability of pharmacies than vice versa. We already discussed this effect in the previous section with the interpretation of γ. The entry of additional GP will decrease the market threshold almost by 70 %. On the other hand, entry of additional pharmacies will decrease the entry threshold for GPs only by 50 %.

Strategic interaction between healthcare providers

We utilize the approach proposed by Schaumans and Verboven (2008) to study

entry decisions of pharmacies, GPs, and pediatricians. In each model, we examine strategic interaction between two professions, using a bivariate ordered probit model.

Every chart in Figure 2 shows the market for different healthcare provider - pharmacies, GPs, and pediatricians. For each occupation, the effect of the entry of the other two specialists was calculated. The solid lines represent a situation where there is no other-firm type present in the market. Dotted lines represent entry at least one specialist of another type.

Two common findings can be observed in the figure. The entry of the other-type firm substantially decreases entry thresholds for all occupations. However, this complementary effect is not equally strong for every profession (effect of the GPs on pharmacies is more robust compared to the pediatrician's effect). Furthermore, effects are also asymmetric within the pair - for example, the effect of GPs on pharmacies is stronger than vice versa.

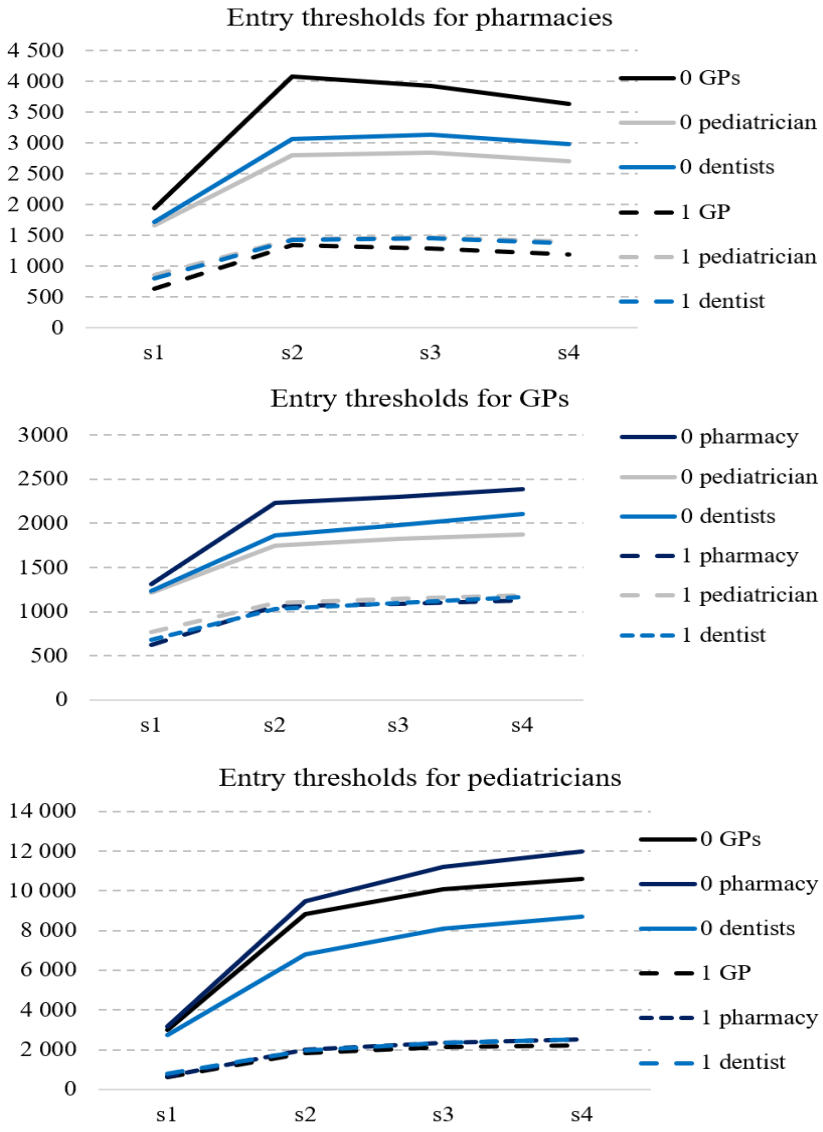
The results of strategic interaction between chosen healthcare providers are summarized in table 5, where we report inter-format ETR. Inter-format ETR measures change in competitive conduct after entry of the other-type firm - for example, how entry thresholds for pharmacies change if additional physician enters a market. Each column gives the calculated effect of the entry of the firm of the different types (rows). The results can be interpreted as follows - entry of additional GP into the local market will decrease the entry threshold for pharmacies by 70 % and by 80 % for pediatricians.

Table 5: Inter-format entry threshold ratios

	Market of the healthcare provider		
Effect of healthcare provider	GPs	Pharmacies	Pediatricians
GPs	x	0,3	0,2
Pharmacies	0,5	x	0,2
Pediatricians	0,6	0,5	x

Source: authors calculations

Figure 2: Entry thresholds for pairs of healthcare providers



All chosen professions seem to be strategic complements. The entry of a firm of the one type decreases entry thresholds for other type firms. However, GPs have the most substantial impact on the profitability of other healthcare providers. Pharmacy seems to have a similar impact on the profitability of pediatricians, but a smaller impact on GPs. Entry thresholds for GPs will decrease by 50 % after the entry of additional pharmacy.

Entry barriers of the GPs decrease only by 40-50 percent after entry of other healthcare professions, while pediatricians benefit the most. The reason can be, that pediatricians have the highest entry thresholds (since their customers are exclusively children), entry of other professionals can motivate parents to prioritize pediatrician, which is close to his GP, to avoid long travels.

Note that entry thresholds, shown in Figure 2, differ for situations when there are zero specialists of other types. Entry thresholds for pharmacies are substantially larger if there is no GP compared to the situation when there is no pediatrician. On the other hand, entry thresholds with at least one specialist of the other type are almost identical for each profession.

5 Counterfactual analysis

In the first step, we predict the expected number of firms in each market based on our estimated model. A comparison with the observed number of firms enables us to identify markets with a higher number (too concentrated) or a lower number of firms (insufficient coverage).

Nowadays, to guarantee the accessibility of physicians for patients, a minimum network is set by a government. 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 do not consider the specific health

care needs of the population, like age or income structure or inhabitants. On the other hand, our approach enables us to take complementarity with pharmacies into account. We also estimate the optimal number of physicians (and pharmacies) at the municipality level, not at the county level (self-governing region). We estimate the expected number of firms on each market as:

$$E(y_i) = \sum Pr(y_i = N|S_{gp}, S_{pharm})N. \tag{6}$$

Tables 6 and 7 show the results of the estimation, where the predicted number of pharmacies and physicians is compared to the actual observed number of firms. The observations on the diagonal of the matrix represent number of a markets where the actual number of firms equals prediction based on our model. Observations below the diagonal indicate that more firms entered the market than is predicted by our model. Conversely, observations above the diagonal suggest that there are fewer firms on the market than expected.

Table 6: Prediction of number of pharmacies

	Prediction of pharmacies					
pharm4	0	1	2	3	4+	Total
0	2131	184	9	2	0	2326
1	36	266	67	20	11	400
2	2	18	9	13	20	62
3	1	1	1	2	15	20
4+	0	0	0	2	42	44
Total	2170	469	86	39	88	2852

Results suggest that pharmacies behave more in line with our predictions from the entry model, compared to GPs. Only sixty markets have in reality more pharmacies, than predicted. On the other hand, 341 markets in Slovakia have fewer pharmacies than market size and other market characteristics suggest. More than a half of these markets (184) would became monopoly after the entry of a first

Table 7: Prediction of number of GPs

	Prediction of GPs					
doctor4	0	1	2	3	4+	Total
0	1969	228	12	4	0	2213
1	91	253	85	35	13	477
2	2	17	24	21	18	82
3	0	2	5	9	15	31
4+	0	0	0	4	45	49
Total	2062	500	126	73	91	2852

pharmacy.

The predicted number of GPs is less accurate compared to observed market configuration. Over 430 markets have higher predicted than actual number of GPs. On the other hand, 121 markets have more GPs than we predicted by the model. Most deviations occur in monopoly markets. The model predicts 228 monopoly markets that are currently vacant.

In the next step, we simulate an entry of new physicians into markets, where the predicted number of physicians is higher than the observed number of physicians by one (one physician will enter the market where the model predicts a shortage of one physician). This corresponds to the first off-diagonal on the right side in Table 7. In this way, the number of physicians is exogenously increased by 349. According to Kišš et al. (2018), there is a shortage of approximately 1500 GPs in Slovakia. Our simulation corresponds to a bit more than one fifth this perceived gap in optimal network of GPs.

The presence of new GPs decrease entry thresholds for pharmacies, as we showed in section 4.4. The entry of additional physicians in the market would lead to new pharmacies entering the market.

The effect of entry new pharmacies due to better coverage of GPs is shown in the table 9. There would be the additional entry of 176 pharmacies following the new entry of physicians. Most pharmacies (164) would enter currently unserved

Table 8: Entry of new physicians (actual observation plus one)

	Entry of new doctors					
doctor4	0	1	2	3	4+	Total
0	1985	228	0	0	0	2213
1	0	392	85	0	0	477
2	0	0	61	21	0	82
3	0	0	0	16	15	31
4+	0	0	0	0	49	49
Total	1985	620	146	37	64	2852

markets. Another 12 pharmacies would enter current monopoly markets.

Table 9: Entry of new pharmacies following entry of GPs

	Entry of new pharmacies					
Prediction	0	1	2	3	4+	Total
0	2006	**164**	0	0	0	2170
1	0	456	**12**	1	0	469
2	0	0	86	**0**	0	86
3	0	0	0	39	**0**	39
4+	0	0	0	0	88	88
Total	2006	620	98	40	88	2852

Moreover, we can identify specific markets with a new entry of firms. However, since we restricted our sample to avoid overlapping markets, the presented results of empirical analysis focus mainly on smaller (often rural) areas.

6 Summary and conclusions

In this paper, we studied strategic interactions between pharmacies, GPs, and pediatricians in Slovakia. We document that GPs are very important complement for pharamcies to enter the market. Entry thresholds tend to decrease by 70-80 % with the presence of the GP. Effects of pharmacies and pediatricians on profitability of GPs are smaller. Except for GPs, pharmacies are also strong complements compared to the effects of other specialists. Results from the bivariate model

suggest that GPs, pharmacies, and pediatricians provide mutually complementary services. Nevertheless, the effects are asymmetric in size.

Based on our estimation of entry thresholds, we are able to estimate the expected number of firms (pharmacies and physicians) on each market. We also implemented a simple counterfactual scenario to estimate additional entry of pharmacies due to the presence of new physicians. A better coverage of GPs in the market would lead to sizeable entry of new pharmacies. Specifically, there would be additional entry of 176 pharmacies following the simulated new entry of 349 physicians.

Related to regulation and policies, our results indicate that improvements in regulation, coverage and accessibility in physicians services would have sizeable positive feedback effects on the entry of new pharmacies in rural areas. Thus the merits of liberalized entry decisions of pharmacies and their entry to currently unprofitable markets could be materialized simultaneously. Trade-offs between regulated and unregulated entry decisions perceived by policymakers when they analyse the markets in isolation are turned to win-win policy options once positive spillover effects are taken into account. From this perspective, the need to reform and to improve the network of GPs in Slovakia becomes even more urgent need in the presence of these indirect positive effects.

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