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MARKET STRUCTURE, ENTRY, AND COMPETITION IN TRANSITION ECONOMIES

Dissertation thesis

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Declaration of Honour

I hereby solemnly declare that this thesis represents my own work and all used sources are listed in Bibliography.

In Bratislava, 15. 5. 2020 ....

Peter Mandžák

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Abstract

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The central research topic of this thesis is market structure, entry, and competition in a transition economy. 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 as well as the nature of competition. Investigating this issue in transition economies is especially interesting. This research falls into the intersection between healthcare economics and Industrial Organization, which is currently a hot research area.

In this thesis, we study the relationship between market size and a number of firms in several healthcare professions in Slovakia. A special focus will be given on pharmacies and physicians because they represent a entry point for most patients into the healthcare system. We chose the healthcare sector for several reasons. Health is one of the most critical areas that influence the quality of life. Quality of healthcare has an important impact on every member of society. Despite the substantial growth of healthcare expenditure in developed countries, there are still many challenges concerning the efficiency of healthcare systems that need to be addressed. Inequality of access to healthcare is one of the challenges. Slovakia has the highest dispersion between small regions - almost three-fold differences in physician density.

While before 2010 pharmacies tend to enter mostly larger cities (Lábaj et al., 2018b), entry liberalization led to a diffusion of pharmacies to smaller markets. Results suggest that entry of the second healthcare provider of the same profession leads to tougher competition. However, third and fourth entrant does not change competitive behavior in the market. Nevertheless, in contrast to Lábaj et al. (2018b), the spatial demand effect continued to grow since 2010 and in 2017 outweighed the competition effect.

Competition and complementarity between firms can be observed at the same time. Pharmacies and general practitioners behave as a strategic complements in Slovakia. The presence of a physician in the market decreases entry thresholds for pharmacies by almost 70 %. Because of the mandatory referral scheme, general practitioners are strong complements for specialists. However, the effects are asymmetric in size. Results from a counterfactual analysis suggest, that better coverage of GPs in rural areas would result in the entry of new pharmacies.

Key words: entry models, strategic interactions, health economics, industrial economics.

Abstrakt

MANDŽÁK, Peter: Trhová štruktúra, vstup a konkurencia v tranzitívnych ekonomikách - Ekonomická univerzita v Bratislave. Národohospodárska fakulta; Katedra hospodárskej politiky. - Školiteľ dizertačnej práce: doc. Ing. Martin Lábaj, PhD. – Bratislava: NHF EU, 2020. Počet strán 156

Ústrednou témou tejto dizertačnej práce je vzťah medzi trhovou štruktúrou a veľkosťou trhu v tranzitívnej ekonomike. Analýzou správania firiem pri vstupe na trh a vzťahu medzi počtom firiem na trhu a veľkosťou trhu je možné získať náhľad na determinanty ziskovosti firiem, úlohu fixných a utopených nákladov, ako aj samotnú podstatu konkurencie. Obzvlášť zaujímavé je skúmanie týchto vzťahov v tranzitívnej ekonomike ako je Slovensko. Ako uviedol Estrin (2002), "tranzitívne ekonomiky sú výborným laboratóriom pre pochopenie dynamiky evolúcie trhov." Zatiaľ čo vstup a výstup firiem z trhu je základom trhovej ekonomiky, správanie firiem v rámci centrálne plánovanej ekonomiky je značne odlišné (Lábaj et al., 2018b).

Tento výskum spadá do prieniku medzi industriálnou ekonómiou (IE) a zdravotníckou ekonómiou, ktorá je podľa Snydera a Trembleya (2018) v súčasnosti populárnou oblasťou výskumu. Napriek tomu, že zdravotnícke trhy majú svoje špecifiká, nástroje využívané ekonómami na výskum v rámci IE je možné uplatniť aj v tejto oblasti. Konkurencia je v trhovej ekonomike nevyhnutná aj na regulovaných zdravodníckych trhoch.

Zdravotnícky sektor sme si pre výskum vybrali z viacerých dôvodov. Zdravie je jedna z najdôležitejších oblastí, ktorá ovplyvňuje kvalitu života (OECD, 2020). Od roku 1970 krajiny OECD zažili významný rast výdavkov na zdravotníctvo, keď výdavky rástli rýchlejšie ako HDP. Priemerný podiel zdravotníckych výdavkov na HDP vzrástol z 4.6 % na 9 %. Napriek významnému rastu výdavkov na zdravotníctvo rozvinuté krajiny stále čelia mnohým výzvam v oblasti efektívnosti vynakladania týchto výdavkov.

Zdravotníctvo bolo v posledných rokoch viackrát identifikované ako jedna z najväčších výziev slovenskej ekonomiky (Haluš (2015), Laffersová (2017)). Výrazné zvýšenie zdravotných výdavkov v minulosti neviedlo k zlepšeniu výsledkov. Jednou z

výziev je aj nerovnosť v priestorovej distribúcii lekárov, ktorá môže významne vplývať na zdravie obyvateľstva. Najvyššie rozdiely v hustote lekárov medzi mestami a vidiekom spomedzi krajín OECD sú práve na Slovensku. Zlý stav slovenského zdravotníctva a vysoký podiel na celkových výdavkoch bol hlavným dôvodom, prečo bolo zdravotníctvo prvou témou pri štarte revízií výdavkov projektu Hodnota za peniaze. Prvá revízia výdavkov na zdravotníctvo, vykonaná v roku 2016 identifikovala úspory vo výške 363 mil. eur. Najvýraznejšími oblasťami na zlepšenie boli lieky, zdravotnícke zariadenia a rádiologická medicína a laboratóriá.

"Ekonómia zdravotníctva je doslova záležitosť života a smrti" (Morris et al., 2012). Gay et al., 2011 zdôrazňuje, že hlavným cieľom zdravotného systému je zlepšovať zdravie obyvateľstva. Zároveň by však mala byť výkonnosť zdravotného systému pravidelne vyhodnocovaná. Prvú komplexnú analýzu efektívnosti zdravotníckeho systému na Slovensku poskytol Filko et al. (2012). Analýza poukázala na zlý a stále sa zhoršujúci stav slovenského zdravotníctva. Slovensko podľa výsledkov analýzy patrí medzi najhoršie krajiny OECD, aj po zohľadnení dôležitých faktorov ovplyvňujúcich zdravie (spotreba alkoholu, vzdelanie, post-socialistická minulosť, atď.).

Hlavnou oblasťou výskumu dizertačnej práce je vzťah medzi veľkosťou trhu a počtom firiem poskytovateľov zdravotnej starostlivosti. Špeciálna pozornosť je venovaná najmä lekárňam, všeobecným lekárom a ich vzájomnej interakcii. Lekárne a všeobecní lekári predstavujú vstupnú bránu do zdravotníctva pre väčšinu pacientov. Vzťah medzi veľkosťou trhu a počtom firiem na trhu môže poskytnúť náhľad na determinanty ziskovosti firmy, úlohu fixných a utopených nákladov, ako aj na samotnú podstatu konkurencie (Lábaj et al., 2018b).

Empirický rámec na skúmanie efektov vstupu na koncentrované trhy prostredníctvom vzťahu medzi veľkosťou trhu a počtom firiem predstavili Breshahan a Reiss v roku 1991. Tento prístup predpokladá, že ak populácia (na jednu firmu) potrebná na fungovanie určitého počtu firiem rastie so vstupom ďalších firiem, konkurencia sa zintenzívňuje. Konkurencia znižuje marže, a preto je potrebný väčší trh na vygenerovanie variabilného zisku na pokrytie vstupných nákladov firmy.

Prístup predstavený Breshahanom a Reissom bol neskôr rozšírený v rôznych smeroch. Berry (1992) ich prístup rozšíril o empirické modely oligopolu prostredníctvom dôrazu na rozdiel medzi firmami. Mazzeo (2002) navrhol empirický model na analýzu produktovej diferenciácie na trhu oligopolu. Výsledky naznačujú silnú motiváciu firiem k diferenciácii. Berry a Waldfogel (1996) rozšírili model využitím dát zohľadňujúcich trhové podiely a ceny, čo im umožnilo skúmať efektívnosť vstupu na trh rozhlasového vysielania.

Newhouse et al. (1982a) ako prví skúmali vzťah medzi veľkosťou trhu a počtom lekárov. Autori našli dôkaz o vplyve veľkosti mesta na pravdepodobnosť výskytu lekára. Ich štúdia potvrdila predpoklad, že nárast celkového počtu lekárov viedol k ich vstupu na predtým neobsadené, menšie trhy. Priestorovú nerovnosť v distribúcii lekárov v Portugalsku skúmali Isabel a Paula (2010), ktorí potvrdili hypotézu Newhouse et al. (1982a). Veľkosť trhu mala signifikantný vplyv na počet lekárov. Trhy s ich nižšou hustotou v minulosti zažili výraznejší vstup nových firiem na trh. Vstup lekárov na trh skúmali aj Newhouse et al. (1982c), Brown (1993), Dionne et al. (1987) či Rosenthal et al. (2005).

Štúdia od Rosenthal et al. (2005) overila výsledky analýzy od Newhouse et al. (1982b). Autori skúmali 23 štátov USA s nízkym podielov lekárov na populácii využitím dát v osemdesiatych a deväťdesiatych rokoch. Medzi rokmi 1980-1999 sa počet lekárov zdvojnásobil. Výsledky analýzy potvrdili, že zatiaľ čo všetky trhy zaznamenali nárast počtu lekárov, vplyv na malé trhy bol vyšší.

Komplexný prehľad literatúry venujúcej sa zdravotníckym trhom poskytli Gaynor a Town (2011). V analýze sa venovali najmä literatúre zameranej na determinanty trhovej štruktúry. V závere práce konštatovali, že kvalita zdravotníckej starostlivosti môže mať významné dopady na blahobyt obyvateľstva.

Abraham et al. (2007) rozšírili BR model o možnosť identifikácie zmien v konkurencii od zmien vo fixných nákladoch. Zistili, že na trhu s nemocnicami vstup vedie k rýchlej konvergencii ku konkurenčnému prostrediu. Vstup redukuje variabilný zisk a zvyšuje kvantitu výstupu.

Literatúra v oblasti Industriálnej ekonómie sa v minulosti zvykla venovať výhradne rozvinutým trhovým ekonomikám. Prvý empirický dôkaz o zmenách v bariérach vstupu, determinantov ziskovosti ako aj podstaty konkurencie v tranzitívnej ekonomike priniesol Lábaj et al. (2018b) and Lábaj et al. (2018a). Autori odhadovali hranice potrebné na vstup firiem na trh na Slovensku. V oboch štúdiách autori skúmali vzťah veľkosti trhu a počtu firiem v troch obdobiach prechodu na trhovú ekonomiku - 1995, 2001 a 2010. Novinkou bolo rozšírenie modelov o priestorovú interakciu medzi trhmi.

V prvom článku sa Lábaj et al. (2018a) venoval vzťahu medzi veľkosťou trhu a počtom firiem pri niekoľkých poskytovateľoch maloobchodných služieb (elektrikári, inštalatéri, reštaurácie a predajcovia automobilov). Dôvodom výberu bol ich špecifický charakter malých a nezávislých predajcov a podobnosť voči predchádzajúcim štúdiám. Výsledky priestorového modelu naznačujú, že bariéry vstupu na Slovensku významne poklesli (s výnimkou reštaurácií) a že intenzita konkurencie v priemere stúpla. Významným zistením bolo, že dopytový efekt prelievania (spill-over efekt) prevážil nad negatívnym efektom spôsobeným konkurenčnými silami medzi susednými trhmi (obcami). Dôležitosť priestorových efektov sa však líši medzi povolaniami.

V druhom článku (Lábaj et al., 2018b) poskytli autori prvý empirický dôkaz o vzťahu medzi veľkosťou trhu a počtom firiem na zdravotníckych trhoch na Slovensku počas obdobia tranzície na trhovú ekonomiku. Hranice pre vstup na trh boli odhadnuté pre tri povolania - lekárne, všeobecných lekárov a zubárov počas troch období - 1995, 2001 a 2010. Lekárne, ako jediný plne liberalizovaný trh v analýze, zažili najvýraznejšiu zmenu v konkurenčnom správaní počas procesu prechodu na trhovú ekonomiku.

Konkurenciu a komplementaritu je podľa Schaumans (2008) možné pozorovať súčasne. Schaumans a Verboven (2008) ako prví poskytli empirický dôkaz o vplyve interakcie medzi všeobecnými lekármi a lekárňami pri ich rozhodovaní o vstupe na trh. Všeobecní lekári a lekárne poskytujú komplementárne služby, preto obe profesie profitujú z prípadnej vzájomnej blízkosti. Výsledky potvrdzujú, že populácia (na jednu firmu) potrebná na udržanie určitého počtu lekárov (resp. lekární) klesá v prípade, že je na trhu prítomná lekáreň (resp. lekár).

Schaumans (2008) skúmala strategické interakcie medzi všeobecnými lekármi a inými špecialistami. Výsledky naznačujú, že na belgickom trhu poskytovateľov zdravotnej starostlivosti predstavujú dermatológovia a pediatri strategické substitúty pri rozhodovaní všeobecných lekárov o vstupe na trh. Na druhej strane, gynekológovia, oftalmológovia a krční lekári majú pozitívny vplyv na ziskovosť všeobecných lekárov.

Pre správnu interpretáciu výsledkov z modelov Industriálnej ekonómie sú nevyhnutné poznatky o správaní lekárov, ktoré poskytuje ekonómia zdravotníctva, najmä čo sa týka rozhodovania lekárov o umiestnení. Literatúra sa zhoduje, že lekári preferujú umiestnenie vo veľkých mestách. Štandardná ekonomická teória predpokladá, že krivky dopytu sú stabilné, prípadne môžu byť posunuté pomocou reklamy. Avšak podľa teórie Dopytu vyvolaného dodávateľom (supplier-induced demand), môžu v niektorých prípadoch dodávatelia indukovať dopyt a zvyšovať tak svoju ziskovosť. Tým môžu ostať pôsobiť aj na trhoch, z ktorých by inak museli odísť. Indukovaný dopyt je obzvlášť dôležitý pre medicínske profesie. Lekári vedia odporúčať pacientom vyšetrenia, ktoré v skutočnosti nie sú nevyhnutné, a tak zvyšovať dopyt po svojich službách. Je to možné v dôsledku asymetrie informácií medzi lekárom a pacientom, kedy je pre pacienta neefektívne vyhľadávať resp. potvrdzovať si informácie od lekára (McPake et al., 2013, Sloan and Hsieh, 2017; Feldman a Sloan, 1988 alebo Rice a Labelle, 1989).

Priestorové rozmiestnenie čiastočne obmedzuje minimálna sieť zdravotných poskytovateľov. Minimálna sieť je vypočítavaná vynásobením normatívu podielom poistených obyvateľov danej poisťovne na celkovom počte obyvateľov daného kraja. Minimálna sieť všeobecných lekárov v roku 2018 predstavovala 1733 lekárov na Slovensku. Vo všetkých krajoch je však skutočný počet všeobecných lekárov vyšší, než si žiada minimálna sieť. V súčasnosti neexistujú demografické alebo geografické reštrikcie pre vstup lekární na trh. V minulosti však existovala regulácia, ktorá vyžadovala minimálne 5000 obyvateľov na jednu lekáreň. Lekárne navyše nesmeli byť od seba vzdialené menej ako 500 metrov.

V práci sme si vytýčili niekoľko cieľov, prostredníctvom ktorých máme ambíciu rozšíriť existujúcu literatúru. Prvým a hlavným cieľom je preskúmať strategické interakcie pri rozhodovaní o vstupe na trh medzi poskytovateľmi zdravotnej starostlivosti. Špeciálny dôraz je kladený na vzťah lekární a všeobecných lekárov, keďže tieto profesie predstavujú vstupnú bránu do zdravotníctva pre väčšinu pacientov. Všeobecní lekári a lekárne poskytujú komplementárne služby. Nadviazaním na výskum predstavený v článku od Schaumans a Verboven (2008) sa pokúsime zistiť, či by lepšie pokrytie rurálnych oblastí viedlo k zníženiu hranice vstupu na trh, a tým k vstupu vyššieho počtu lekární.

V niektorých rozvinutých krajinách (ako napríklad Belgicko) si môže pacient voľne vyberať svojho lekára - špecialistu. Na druhej strane, na Slovensku existuje referenčný systém - pacient potrebuje výmenný lístok od všeobecného lekára, ak potrebuje návštevu u špecialistu. Očakávame preto, že všeobecný lekár bude mať významný vplyv na ziskovosť (a teda vstup na trh) špecialistov na Slovensku. Cieľom bude preskúmať, ako sa líši interakcia medzi všeobecnými lekármi a špecialistami, a medzi špecialistami navzájom.

Okrem hlavného cieľa práce sme si vytýčili niekoľko čiastkových cieľov. Výsledky zo štúdie Lábaj et al. (2018b) naznačovali, že liberalizácia lekárenského trhu viedla k nárastu celkového počtu lekární, tie však vstupovali najmä na väčšie (mestské) trhy. Koncentrácia iných poskytovateľov zdravotnej starostlivosti v mestách je už v literatúre potvrdená (Sloan a Hsieh, 2017; Folland et al., 2017; Isabel a Paula, 2010), konkrétne v prípade lekárov. Štúdie však zároveň konštatujú, že nárast celkového počtu lekárov nakoniec vedie aj k difúzii do menších trhov (Newhouse et al., 1982b,c; Rosenthal et al., 2005; Brown, 1993). Cieľom práce je preto preskúmať, či deregulácia lekárenského trhu po roku 2010 a následný vstup nových lekární na trh viedlo k zníženiu nerovností v priestorovom usporiadaní.

Optimálna dostupnosť zdravotnej starostlivosti pre všetkých obyvateľov vyžaduje nielen adekvátne množstvo lekárov, ale aj ich rovnomerné rozmiestnenie. Koncentrácia lekárov v jednej oblasti a nedostatok v inej vedie podľa OECD (2020) k nerovnosti v prístupe k zdravotnej starostlivosti. Navyše, ako ukázala Schaumans (2015), prílišná koncentrácia lekárov v jednej oblasti môže viesť k nadmernému predpisovaniu liekov kvôli väčšej konkurencii. Práve na Slovensku sú najvýraznejšie rozdiely v hustote lekárov medzi urbánnymi a rurálnymi oblasťami spomedzi krajín OECD (OECD, 2019). Ďalším cieľom práce je preskúmať, ako sa nerovnosti líšia medzi regiónmi Slovenska. Čo je ale dôležitejšie, po vzore práce Lábaj et al. (2018b) budeme odhadovať populáciu (veľkosť trhu) potrebnú, aby prvý poskytovateľ zdravotnej starostlivosti vstúpil na trh. Rovnako je cieľom preskúmať, ako sa bude meniť konkurencia pri vstupe ďalšej firmy rovnakého typu.

Na naplnenie cieľov práce budeme využívať niekoľko regresných modelov. Základným je ordered probit model, ktorý neskôr rozširujeme o priestorovú interakciu po vzore Lábaj et al. (2018b). Na skúmanie strategických interakcií medzi dvojicami poskytovateľov zdravotnej starostlivosti bol využitý bivariate ordered probit model. Ten spočíva v odhade dvoch rovníc súčasne (po vzore seemingly unrelated regressions). Multivariate modely berú do úvahy možnú koreláciu v náhodnej chybe. Rovnako prinášame prvé výsledky strategickej interakcie medzi troma lekármi súčasne, využitím trivariate ordered probit modelu.

Odhadnuté parametre z regresných modelov nám umožňujú vypočítať hranicu vstupu (entry threshold) a rovnako ich podiel (entry thresholds ratios). Hranica trhu vyjadruje populáciu na jednu firmu, nevyhnutnú na pôsobenie daného počtu firiem na trhu. Podielom hranice trhu pre 2 firmy hranicou pre 1 firmu vypočítame podiel hranice trhu (entry thresholds ratio, ETR). ETR vyjadruje zmenu konkurencie (ak predpokladáme, že fixné náklady sa nemenia) pri vstupe dodatočnej firmy na trh. Zvýšená konkurencia by mala znižovať marže. Je tak potrebná väčšia populácia na jednu firmu, aby firma pokryla náklady spojené so vstupom na trh. Zmena ETR nemeria úroveň konkurencie, ale jej zmenu. Pri multivariate modeloch je možné vyjadriť aj takzvané inter-format ETR. Ide o zmenu v hranici trhu, pri vstupe iného typu firmy.

Pre výpočet entry modelu sú nevyhnutné dáta o počte firiem (v našom prípade o počte lekárov a lekární) a veľkosti trhu z roku 2017. Dáta o počte lekárov a lekární pochádzajú z registra poskytovateľov zdravotnej starostlivosti. Dáta o vysvetľujúcich premenných - počte obyvateľov a ďalších trhových charakteristikách (priemerná mzda, nezamestnanosť, podiel starých a mladých obyvateľov a hustota obyvateľstva) pochádzajú zo štatistického úradu. V praktickej časti sa zameriame na trhy všeobecných lekárov a lekárne, ale aj na pediatrov, zubárov a oftalmológov.

Po vzore existujúcich štúdií definujeme trh ako obec. Aby sme sa vyhli prípadnému prekrývaniu trhov, vynechávame zo vzorky dát mestá (s populáciou vyššou ako 15 tisíc a hustotou vyššou ako 800 obyvateľov na km^2).

Všeobecní lekári sú medzi kraje a okresy rozdelení relatívne rovnomerne, problémom je ich koncentrácia do väčších miest. Nerovnosť v dostupnosti všeobecných lekárov a lekární rastie smerom na východ Slovenska. Najvyššie nerovnosti sme zistili v Prešovskom kraji, najnižšie v Nitre a Bratislave.

Vplyvy vysvetľujúcich premenných sú v súlade s našimi očakávaniami. Veľkosť populácie má významný vplyv na ziskovosť poskytovateľov zdravotnej starostlivosti. Na druhej strane, priemerná mzda a hustota obyvateľstva má signifikantný vplyv len na ziskovosť pediatrov. Najrobustnejší vplyv na ziskovosť špecialistov majú miera nezamestnanosti a podiel mladých obyvateľov v obci.

Hranice trhov sa pre rôznych špecialistov na Slovensku líšia. Najnižšie hranice pre vstup na trh majú všeobecní lekári a lekárne. Naopak, najvyššiu populáciu potrebnú pre vstup prvého špecialistu majú oftalmológovia a chirurgovia. ETR pre všeobecných lekárov, lekárne, zubárov a pediatrov postupne klesajú k jednotke s rastom počtu firiem na trhu. Po vstupe štvrtého poskytovateľa na trh je ETR rovné jednej pre všetky spomínané typy poskytovateľov. Vstup ďalšej firmy tak nevplýva na zmenu v konkurencii. Populácia na jednu firmu sa musí zvýšiť o 30 percent pri vstupe druhej lekárne na trh. Pre všeobecných lekárov a zubárov je to o niečo menej (25 resp. 22 %). Naopak, pre pediatrov o niečo viac (37 %).

Vyše 70 % trhov na Slovensku je bez lekárne či všeobecného lekára. Napriek tomu obyvatelia týchto trhov predstavujú dopyt po zdravotnej starostlivosti. Susedné trhy preto môžu benefitovať z pozitívnych dopytových efektov prelievania (spill-overs).

Výsledky z priestorového ordered probit modelu nadväzujú na výsledky z Lábaj et al. (2018a), kde autori konštatovali negatívne, avšak klesajúce priestorové (konkurenčné) efekty medzi rokmi 1995-2010. Naše výsledky z roku 2017 naznačujú, že pokles konkurenčných efektov pokračoval, až prevládli dopytové efekty. Zakomponovanie priestorových efektov podľa očakávania zvyšuje hranice vstupu na trh. Rovnako sú vyššie aj výsledné ETR pre vstup druhej firmy na trh. Populácia na jednu firmu sa musí takmer zdvojnásobiť pri vstupe druhej lekárne, všeobecného lekára aj pediatra.

Medzi rokmi 2007 a 2018 vstúpilo na trhy na Slovensku vyše 500 lekární. Počas rokov 2010-2017 vzniklo vyše 50 monopolných a 25 duopolných trhov. Najviac vstupov na trhy sa udialo na trhoch s veľkosťou do 20 tisíc obyvateľov. Výsledky sú v kontraste so závermi Lábaj et al. (2018b), ktorí konštatovali, že do roku 2010 vstupovali lekárne najmä na veľké trhy. Vstup lekární na menšie trhy sa prejavil aj v nižších hraniciach pre vstup na trh v porovnaní s rokom 2007.

Pred využitím multivariate modelov sme skúmali interakciu medzi špecialistami zahrnutím počtu špecialistov medzi vysvetľujúce premenné. Hlavný dôraz bol opäť kladený na lekárne a všeobecných lekárov. Špecialisti zahrnutí medzi vysvetľujúce premenné mali signifikantný a pozitívny vplyv na ziskovosť lekární ako aj všeobecných lekárov. Ich efekt sa však zmenšil v prípade, že boli v modeli zahrnutí súčasne. Oftalmológovia mali dokonca pri využití priestorového modelu negatívny vplyv na všetkých skúmaných poskytovateľov zdravotnej starostlivosti.

Lekárne a všeobecní lekári sú silné strategické komplementy. Hranice vstupu pre lekárov aj lekárne signifikantne klesajú v prípade prítomnosti druhého typu poskytovateľa. Lekáreň potrebuje takmer 2000 obyvateľov v obci na vstup na trh, ak sa na trhu nenachádza všeobecný lekár. V prípade, že tam je aspoň jeden, sa hranica na vstup zníži na 635 obyvateľov, teda takmer o 70 %. Na druhej strane, v prípade absencie lekárne na trhu potrebuje všeobecný lekár aspoň 1300 obyvateľov na vstup. Ak sa na trhu nachádza aspoň jedna lekáreň, hranica sa zníži na 618 obyvateľov. Dochádza teda k zníženiu hranice o 50 %.

Všeobecní lekári majú najvyšší vplyv na ziskovosť iných profesií. V prípade ich prítomnosti (ak sa na trhu nachádza aspoň jeden) sa hranice vstupu na trh pre iné profesie znižujú o 70-80 %. V prípade iných špecialistov je efekt nižší. Navyše je možné pozorovať asymetriu v strategickej interakcii - vplyv všeobecného lekára je stále vyšší, ako vplyv špecialistu na všeobecného lekára.

Strategická interakcia medzi troma typmi firiem nebola dosiaľ v literatúre skúmaná. V dizertačnej práci prinášame prvé empirické odhady využitím trivariate ordered probit modelu. Výsledky sú čiastočne v protiklade s výsledkami z bivariate modelov. Pri využití triaviate modelu, kde berieme do úvahy súčasne rozhodovanie o vstupe lekární, všeobecných lekárov aj pediatrov, majú pediatri negatívny efekt na ziskovosť lekární aj všeobecných lekárov. Hoci je efekt relatívne malý (a v prípade vplyvu na všeobecných lekárov aj nevýznamný), je opačný ako v prípade využitia bivariate modelu. Prítomnosť pediatra na trhu zvyšuje hranicu pre vstup lekárne o takmer 20 %. Efekt je však kompenzovaný vplyvom všeobecných lekárov. Ak sa na trhu nachádzajú pediatri aj všeobecní lekári, hranica pre vstup lekárne sa znižuje o takmer polovicu. Rozdielne výsledky bivariate a trivariate modelov vysvetľujeme nízkym počtov trhov s prítomnosťou pediatrov bez všeobecných lekárov (prípadne bez lekární). Všeobecní lekári ako aj lekárne majú nižšie hranice pre vstup, preto sú na trhu zvyčajne skôr ako pediatri. Celý strategický efekt je tak vysvetlený prítomnosťou jedného z tejto dvojice poskytovateľov zdravotnej starostlivosti. Ďalší výskum by sa mal zamerať práve na vysvetlenie týchto súvislostí. Podobne negatívny efekt sme zaznamenali pri prítomnosti zubárov na lekárne. Hranica vstupu pre lekárne sa v prítomnosti zubára zvyšuje o 17 %. Efekt zubárov na všeobecných lekárov je minimálny.

Schaumans and Verboven (2008) vo svojom článku usúdili, že odstránenie reštrikcií vstupu lekární by priamo zvýšilo ich počet o 50 % a nepriamo zvýšili počet lekárov o 7 %. Inšpirovaní týmito výsledkami sme simulovali zmeny v trhovej štruktúre lekární a lekárov a skúmali priame aj nepriame efekty. V prvom scenári sme skúmali, aký efekt by malo lepšie pokrytie lekárov v rurálnych oblastiach na vstup lekární. Konkrétne sme simulovali vstup práve jedného všeobecného lekára na trhy, kde model predpovedal ich prítomnosť. Z predchádzajúcich výsledkov je zrejmé, že lepšie pokrytie všeobecnými lekármi znižuje hranice pre vstup lekárne. Simulovaný vstup 350 všeobecných lekárov by tak umožnil vstup ďalším 176 lekárňam.

Programové vyhlásenie vlády z roku 2020 uvádza, že vláda zavedie demografické a geografické kritériá na reguláciu lekární. V druhom scenári sme preto simulovali znovuzavedenie minimálneho počtu obyvateľov na jednu lekáreň v obci. Takmer 300 trhov by ostalo bez lekárne v prípade zavedenia takejto regulácie. Spolu by sa počet lekární znižoval na 415 trhov, pričom by z trhov muselo spolu odísť 589 lekární.

Key words: entry modely, strategická interakcia, ekonómia zdravotníctva, industriálna organizácia.

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Introduction

The central research of this thesis covers market structure, entry, and competition in a transition economy. 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 since 'transition economies make a particularly good laboratory for understanding the dynamics of market evolution (Estrin, 2002). While the entry of new firms and the exit of others is an essential element of competition in a market economy, the behavior of firms in a planned economy differs in many dimensions (Lábaj et al., 2018b).

In this thesis, we study the relationship between market size and a number of firms in several healthcare professions in Slovakia. A special focus will be given on pharmacies and physicians, because they represent entry point for most patients into healthcare system. Powerful tools to examine entry (and exit) decisions of firms (even healthcare providers) and determinants of their location decisions provide an Industrial Organization (IO). The intersection between healthcare economics and IO is currently a hot research area (Snyder and Tremblay, 2018). Even though healthcare professions have their specifics, they are not necessarily more distinctive than hundreds of other markets that IO economists have studied for decades. Competition is an essential element in a market economy, even in regulated healthcare markets.

There are several reasons, why we decided to focus entirely on healthcare markets in our research. Despite the substantial growth of healthcare expenditure in developed countries, there are still many challenges concerning the efficiency of healthcare systems that need to be addressed. According to OECD (2019), "Countries spend a lot on health, but they do not always spend it as well as they could." One of the critical policy issues in most OECD countries is spatial inequality of physician distribution and the difficulties of attracting doctors in certain regions. Barriers to healthcare access persist, particularly amongst the less well-off. The highest differences in the density of doctors between urban regions and rural regions are in Slovakia (OECD, 2019).

Healthcare expenditures in Slovakia have risen significantly in the last years, the same as in other OECD countries. However, the efficiency of healthcare compared to other countries is low. The sector also faces several structural problems and challenges that need to be solved. Shortages of doctors, unfavorable age structure, or over-consumption of antibiotics are just a few of them. Economic research in the sector is, therefore, essential and necessary.

This research extends the existing literature in several ways. (1) Existing literature in Slovakia focused on pharmacies, dentists and genral practitioners until now. We extend the existing research on entry thresholds of healthcare providers in Slovakia with other healthcare providers, such as pediatricians, ophthalmologists, cardiologists, or surgeons. Moreover, we provide with estimates for pharmacies, GPs and dentists for more recent period in Slovakia as well. (2) Strategic interactions between healthcare providers is the area which has not been examined very often until now (we are aware of the two papers by Schaumans and Verboven (2008) and Schaumans (2008)). We employ a bivariate ordered probit model, used by the former on pharmacies and GPs, to examine strategic interactions between several pairs of healthcare providers in Slovakia. Above the relationship between pharmacies and GPs, we also examine the effects of pediatricians and dentists. (3) As far as we are aware, the trivariate model has not been employed to study relationship between market structure and market size yet. We provide first empirical evidence on the strategic interactions between three professions using trivariate ordered probit model.

Competition can be observed even in regulated healthcare markets. Theory introduced by Bresnahan and Reiss (1991) assumes, that if the population per firm required to support a given number of firms grows with the number of firms, competition must getting more intense. In Slovakia, in line with theory, the population per firm has to more than double for second healthcare professional to enter. Population per firm in the market to support the second firm has to increase by 30 % for pharmacies, 25 %

for GPs, and almost 40 % for pediatricians. However, after the entry of a second firm, the intensity of competition does not change significantly. If taking spatial spillover to account, the demand effect (demand spill-overs from markets without healthcare provider) continued to grow since 2010 and in 2017 outweighed the competition effect (stealing costumers from neighbouring markets) suggested by Lábaj et al. (2018b).

Competition and complementarity between firms can be observed at the same time. Healthcare providers (e.g. pharmacies) can benefit from the presence of the other type (GPs). The critical market size should, therefore, decrease with the entry of new firms of the other type. According to Schaumans and Verboven (2008), regulation of pharmacies in Belgium indirectly decreased number of general practitioners by 7 %. Better coverage of physicians in rural areas can lead to the entry of additional pharmacies. Pharmacies and GPs are strong strategic complements in Slovak healthcare markets. Critical market size for pharmacies decreases by almost 70 %, if at least one GP is already in the market. Results suggest that GP is the strongest complement for all healthcare professions. However, strategic interaction seems to be asymmetric in size.

The first chapter contains a literature review on Industrial Organization, healthcare literature, and its intersection, with a special focus on entry models and spatial distribution of healthcare professions. Aims of this thesis are summarized in the second chapter. Entry models (including entry thresholds and entry threshold ratios) and several specifications of regression models (uni-, bi-, and trivariate ordered probit models) are discussed in chapter three, together with a description of data. Empirical results in chapter four are divided between six sub-chapters, based on different approaches to analysis. Conclusions are summarized in the last chapter.

1 Literature review

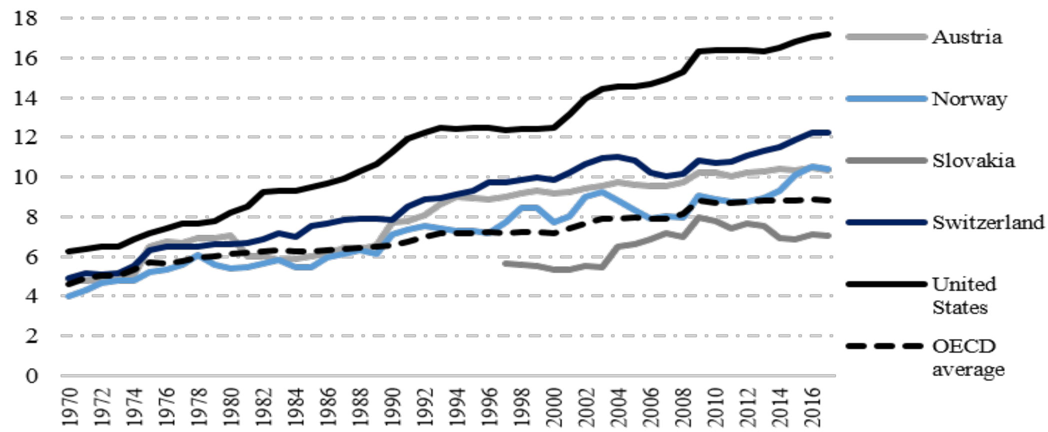
1.1 Importance of healthcare

”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. Similarly Sloan and Hsieh (2017) claim that health affects the enjoyment of life, the ability to contribute to family’s well-being and to be a productive member of the workforce, and, earlier in life, the ability to be productive in school. Most people receive at least one health care service annually. The importance of health economics primarily lies in fact, that it provides valuable insights into and empirical evidence on important health policy. Moreover, government intervention is more common in this sector than in most sectors.

”Health economics is literally a matter of life and death (Morris et al., 2012)”. Health care is one, though not the only way to modify the incidence and impact of ill health. The availability of healthcare can determine the quality of our lives and our prospects for survival. Zweifel et al. (2009) claim that ”health is priceless either in an ethical sense (invaluable) or in a more economic sense (very expensive).” Two dominant goals of health policies are distinguished - (1) improving the health status of the population and (2) fairness or equity (McPake et al., 2013). Health economics focus on assessing how to help the government and other agencies to maximize the impact on health and equity.

Since 1970, OECD countries experienced a significant increase in expenditure in the healthcare sector. Moreover, the expenditure growth was even faster than GDP growth. 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. 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 % (black line in Figure 1.1). 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.

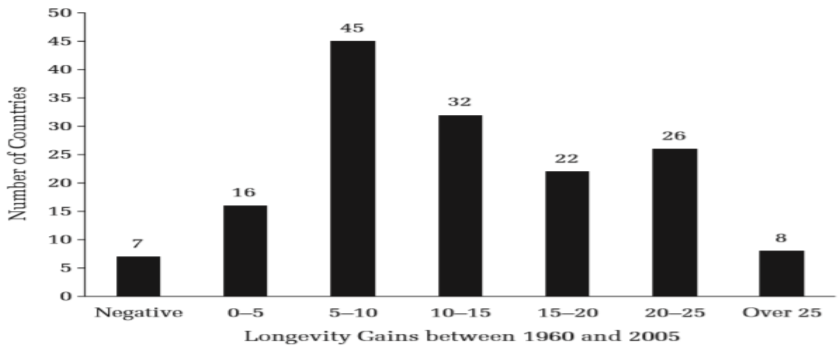
Figure 1.1: Healthcare expenditure in chosen OECD countries as a share of GDP, in %, 1970-2016



Source: authors compilation based on OECD database

Sloan and Hsieh (2017) considers two factors that account for the dramatic growth of health economics as a field. Except for the expansion of health sectors throughout the world (e.g. already mentioned share of health expenditures as a share of GDP), authors highlight global health and longevity gains. The improvements in health and longevity are closely related to overall improvements in well-being. Health and longevity have improved dramatically in most countries around the world, especially in the middle-income and most affluent countries. More specifically, 149 out of 156 countries worldwide experienced substantial longevity gains during 1960 – 2005 (Sloan and Hsieh, 2017). Improved health may have substantial benefits in improving productivity, as well as having value on its own.

Figure 1.2: Global distribution of longevity gains



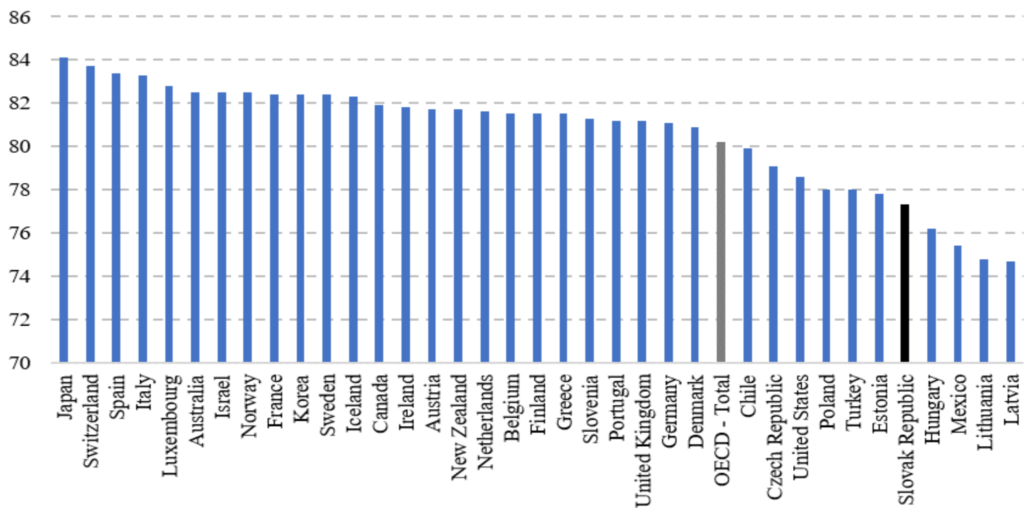
Source: Sloan and Hsieh (2017)

A person born today in OECD countries can expect to live almost 81 years on average (figure 1.3). Nevertheless, life expectancy gains have slowed recently across most OECD countries, especially in the United States, France, and the Netherlands (OECD, 2019). OECD also concluded that ”barriers to healthcare access persist, particularly amongst the less well-off people.” An estimated one in five adults who needed to see a doctor is not able to. The final remark is that countries spend a lot on health, but they do not always spend it as well as they could.

The uneven distribution of doctors in certain regions is an important policy issue in most OECD countries. The geographic distribution of doctors is one of the determinants of access to healthcare. Optimal access to medical care for all inhabitants requires an adequate number and equitable distribution of doctors in all parts of the country. Differences in the density of doctors between urban and rural regions are highest in the Slovak Republic, Hungary, and Portugal.

It is widely agreed that the primary goal of a health system is to improve population health and that health systems’ performance should be assessed (Gay et al., 2011). Folland et al. (2017) claim that while stressing the importance of inputs, the

Figure 1.3: Life expectancy in OECD countries, 2017



Source: authors compilation based on OECD database

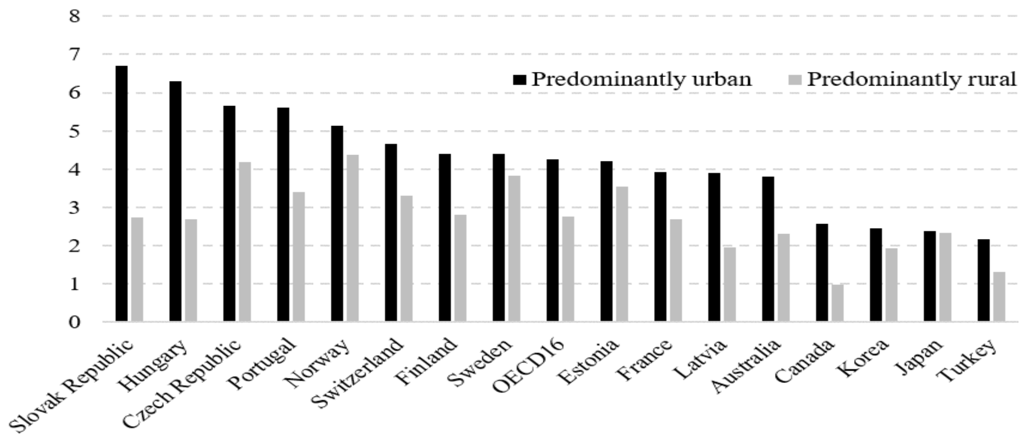
contribution of health resources to the economy is ultimately a measure of the value of the output - health itself. In the Slovak Republic, attention was focused on the efficiency of healthcare in recent years as well.

The first complex analysis of the efficiency of the healthcare system in Slovakia was provided by Filko et al. (2012). The authors pointed out the poor and even worsening state of the Slovak healthcare system. Authors concluded that Slovakia belongs between the worst-performing developed countries, even after controlling for several influential factors (alcohol consumption, education, post-socialistic past, etc.). Efficiency, which was around the OECD average for several years, started to decline. This decline was assigned to increase in healthcare expenditures without an increase in performance.

In 2015, the Ministry of Finance of the Slovak Republic identified healthcare (together with the labor market) as the greatest challenge for the Slovak economy (Haluš, 2015). Both sectors remain between the three greatest challenges also two years later, in updated manual in 2017 (Laffersová, 2017).

Healthcare was one of the most important sectors to focus on during the start

Figure 1.4: Physician density per 1000 inhabitants in OECD countries, 2016



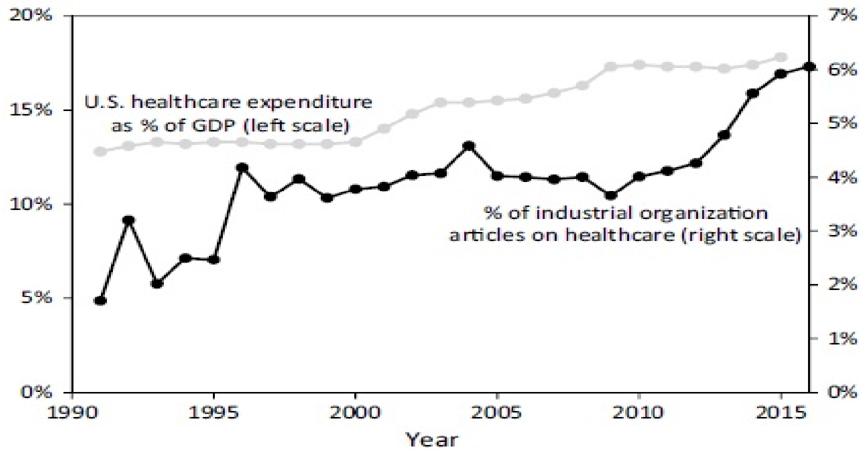
Source: authors compilation based on OECD database

of the Value for Money project in Slovakia. The first spending review on healthcare, conducted in 2016, identified saving in the amount of 363 mil. euro. The most significant areas for improvement were medicines, health institutions and Radiology medicine, and laboratories.

1.2 Healthcare and Industrial Organization

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, figure 1.5). 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 could be other reasons.

Figure 1.5: U.S. healthcare expenditures and number of IO articles on healthcare



Source: Snyder and Tremblay (2018)

The most important reason that is especially important for our research is that healthcare markets (unique as they are) are not necessarily more distinctive than hundreds of other markets that IO economists have studied for decades. The tools that have been honed by IO economists in the analysis of other markets can also be applied to health markets (Snyder and Tremblay, 2018).

The Industrial Organization approach examines how individuals and firms make decisions about whether to enter the market. It enables us to study how they try to differentiate their products to gain competitive advantage or how existing regulation (legislation) affects them.

Morris et al. (2012) summarize seminal paper written by Arrow (1963) about 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.

Progress in the field of IO has contributed to a more sophisticated analysis of markets under imperfect competition. According to Lábaj (2019), pharmacies, which operates on such markets, are more than an interesting field of study. Imperfect markets are already under some form of regulation (state or self-regulation). The relevant question arises - is there a better form of regulation with higher individual or social benefits?

1.2.1 Industrial Organization literature

From SCP paradigm to Industrial Organization

Early industrial economists have aimed to establish a link between market structure and conduct of firms in the market. In turn, that conduct would determine the outcome or performance of the market in terms of economic efficiency or welfare. This approach is named as Structure-Conduct-Performance (SCP) approach. 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.

Although the approach was discredited a long time ago, by Bresnahan (1989), Schmalensee (1989) or Berry et al. (2019) pointed 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.

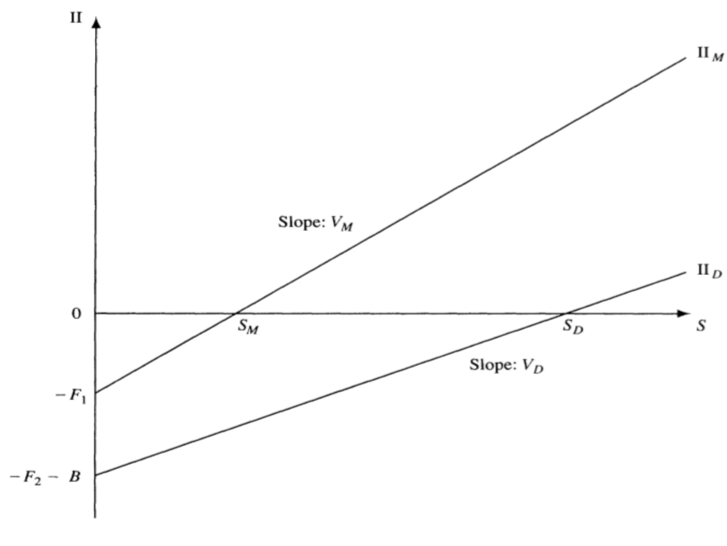
Industrial Organization (IO) is a study of the functioning of markets, which is the central concept in microeconomics (Tirole, 1988). IO investigates the behavior of firms in markets with imperfect competition.

The relationship between entry barriers, competition, and market structure, is the main focus of IO and empirical research in this field. The relationship between market structure (usually the number of firms in a market) and measures of the market size (population) for different regional markets can provide insight into the determinants of firm profitability, the role of fixed and sunk costs, as well as the nature of competition.

Estimating entry thresholds from the relationship between the number of firms and an exogenous profit shifter (such as population) provides evidence on the toughness of competition (defined as the rate at which the post-entry equilibrium markup falls with the addition of competitors) for a product or industry (Lábaj et al., 2018b).

An 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.

Figure 1.6: Profits as a function of market size when duopoly is threatened



Source: Bresnahan et al. (1987)

Bresnahan et al. (1987) explains the relationship between market size and the number of firms in figure 1.6. The figure plots profit function Π as a function of the market size, S. Line Π_M is the profit function of a monopolist. Line Π_D is the profit function of the second firm in the market. If Π_M <0, markets have insufficient demand to support at least one firm. With an increase in market size, there is eventually enough demand to cover fixed costs, and the first (monopoly) firm enters at S_M. If market size grows over S_D, it is profitable for the second firm to enter. In our analysis, as well as related empirical literature, we would like to estimate S_M and S_D, as well as the slopes of lines Π_M and Π_D.

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. The estimates obtained are consistent with the vast literature that indicates an essential role for airport presence in determining airline profitability. However, the preferred estimates also imply that profits decline reasonably rapidly in the number of entering firms.

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) extend 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.

1.2.2 The intersection of Industrial Organization and healthcare economics

The first empirical evidence on the number of physicians and the size of the market was provided by Newhouse et al. (1982b). While the U.S. was training too many physicians, they were geographically maldistributed, with too few in rural areas. The authors found that the size of a town affects the probability of having a physician located there. The number of specialists in the U.S. increased dramatically over the decade of the 1970s. The theory predicts that towns that did not previously have a specialist would gain them at a higher rate than those that did. They empirically confirmed that this is the case.

The geographic distribution of physicians in Portugal was examined by Isabel and Paula (2010). The paper confirmed the hypotheses suggested by Newhouse et al. (1982b). They analyzed the inequality in the geographic distribution of physicians and its evolution, estimated the determinants of physician density, and assessed the importance of competitive and agglomerative forces in location decisions. The total number of physicians in Portugal grew by approximately 30 percent between 1996 and 2007 (approximately 22 percent per capita). Using a static model on 2007 data, they found that population size has a large and significant impact on the number of physicians per capita located in an area. Furthermore, using a dynamic model, they found that areas that had more physicians per capita in 1996 had lower growth in the number of physicians per capita.

Another papers supporting hypotheses from Newhouse et al. (1982b) 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 examine 23 states with the low physician to population ratios using data from the 1980s and 1990s. Between 1979 and 1999, the number of physicians doubled in the sample states. 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. While substantial variation in the supply of physicians across communities remains, current measures of geographic access to physicians overstate the extent of maldistribution and yield an incorrect ranking of areas according to geographic accessibility of physicians.

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.

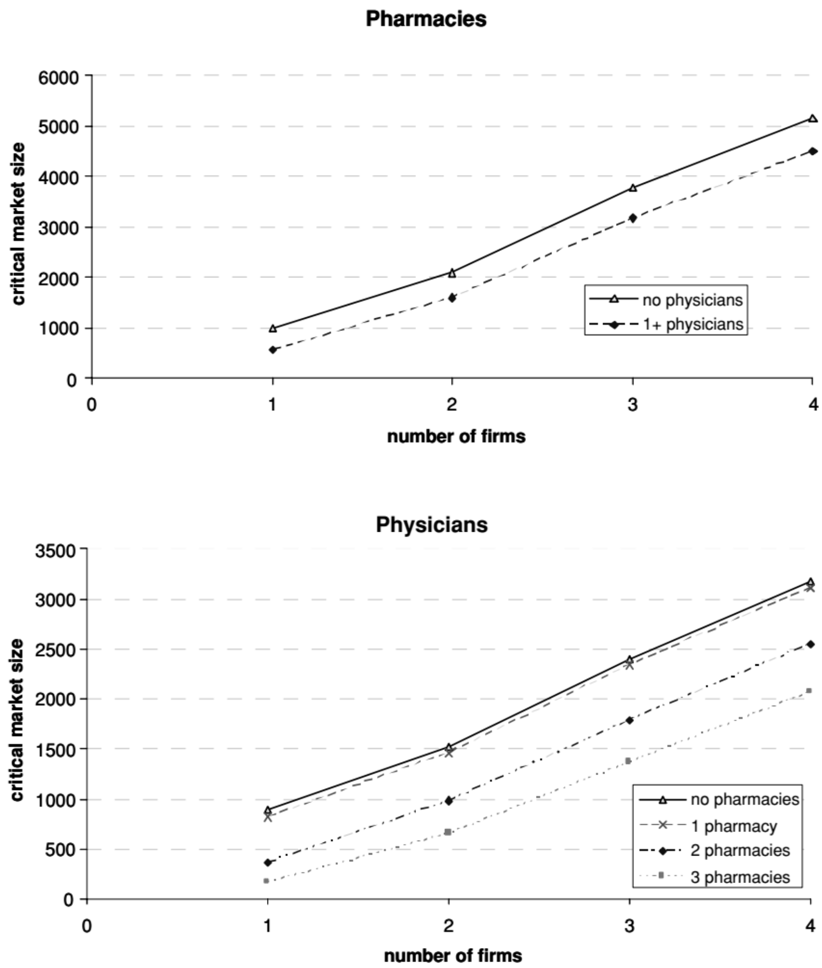
Abraham et al. (2007) extend the entry model developed by Bresnahan and Reiss to make use of quantitative information, and apply it to data on the U.S. hospital industry. Entry threshold ratios identify the product of changes in the toughness of competition and changes in fixed costs. By using quantity 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.

Strategic interactions between healthcare providers

Competition and complementarity between firms can be observed at the same time. A novel feature of paper by Schaumans and Verboven (2008) is that the authors consider the entry decisions of pharmacies simultaneously with those of general practitioners. Each type of profession benefits from the presence of the other. They found that the population necessary to support a given number of firms increases more or less proportionally with the number of firms. According to Bresnahan and Reiss, this implies that entry does not lead to tougher competition. The authors also find that the population necessary to support another physician practice decreases with the number of pharmacies and vice versa, which supports the hypothesis of strategic complements. Figure 1.7 shows the entry thresholds for pharmacies and physicians concerning the number of firms. The lines shift downward when there are additional firms of the other type. Hence, the critical market sizes drop as there are more firms of the other type, reflecting the extent of strategic complements between both professions.

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. Furthermore, she did not impose the interaction effects to be symmetric in sign. A sequential incomplete information entry game was used to identify the sign of the strategic interaction between general practitioners and specialists of a different type. The author concluded that for the Belgian physician market applies, the entry decisions of dermatologists and pediatricians are strategic substitutes in the entry decisions of GPs. On the other hand, the presence of gynecologists, ophthalmologists, and throat, nose, and ear-specialists has a positive impact on GPs payoffs of entry.

Figure 1.7: Entry thresholds of pharmacies and physicians in Belgium



Source: Schaumans and Verboven (2008)

Gächter et al. (2012) investigated how the densities of private and contract suppliers of outpatient health care (GPs and specialists) are related to each other. The authors did not confirm the competition effect between contract and private specialists. However, this might be due to the aggregation of specialists under one variable, so effects between different specialists canceled out each other. On the other hand, a significantly negative impact of contract GPs on private GPs can be observed. Moreover, the authors confirmed the negative effect of contract GPs density of non-contract surgeons and internists, despite the insignificant effects of neurologists and gynecologists.

Accounting for unobserved heterogeneity is necessary during the investigation of strategic interaction. 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.

Although General practitioners have limited tools for competition, a few papers provide with analysis of this type. Schaumans (2015) investigated whether GPs in Belgium prescribe more units if the competition is intense. The results suggest that a higher number of GPs per capita results in a higher number of prescribed units. Although there is no monetary benefit for the GPs in doing so, Schaumans claim it can be seen as quality signaling for patients. More prescriptions in case of GPs located in cities (therefore with more possible competitors) also reported Kališ (2019) for the Slovak healthcare market. Similar pattern concluded Gravelle et al. (2016) for GPs market in Australia. GPs with more distant competitors charge high prices and a smaller proportion of their patients make no out-of-pocket payments.

Strategic interactions between firms were also studied outside healthcare markets. Cleeren et al. (2010) studied Intra- and inter - format competition outside of healthcare markets. They examined interactions between discounters and supermarkets using an empirical entry model to the German grocery industry. Authors endogenized the retailers' entry decisions and allowed for asymmetric Intra- and inter- format competitive effects. Evidence of intense competition within both supermarkets and discounts can be found, although more severe between supermarkets. Authors also explain retailers rush to add a discount chain to a portfolio, since early entrants may benefit from the growth of the discount-prone segment without cannibalizing the profits of their more conventional supermarkets.

Industrial Organization literature in transition economies

From this literature review is notable that the existing empirical literature considers the market structure and competition in developed market economies only. There is a lack of similar micro-level studies for transition economies. While the entry of new firms and the exit of others is an essential element of competition in a market economy, the behavior of firms in a planned economy differs in many dimensions. The structure of the planned economy did not permit competition, entry, or exit. To ease the informational demands of planning, firms in the communist economies were often gigantic and vertically integrated into ways that would not have emerged in a market economy. Once markets were liberalized post-transition, their structures were therefore highly concentrated (Schaffer, 1998). Therefore, investigating this issue in transition economies is especially interesting since ”transition economies make a particularly good laboratory for understanding the dynamics of market evolution” (Estrin, 2002).

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).

1.2.3 Healthcare economics literature

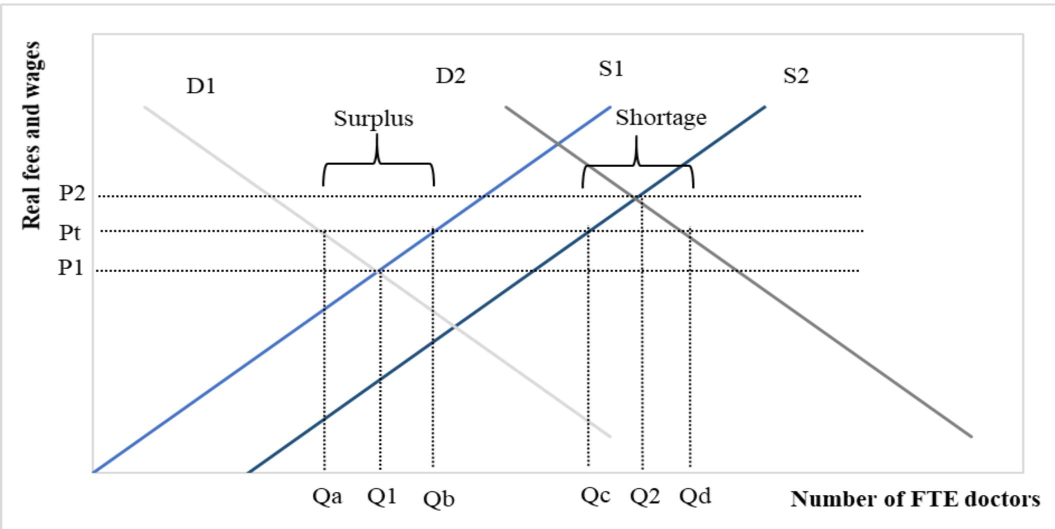
According to Morris et al. (2012), "health economics is the application of economic theory, models and empirical techniques to the analysis of decision making by people, health care providers and governments concerning health and health care." It is not only an application of economic theory to health problems, but it also comprises a body of theory developed specifically to understand the behavior of patients, doctors or hospitals.

The papers in the healthcare economics area focus mainly on the entry behavior of physicians (alternatively other professions in this market). In the subsequent chapter, we summarize the main findings from healthcare economics related to the decision making of healthcare professions on whether and where to enter a market. We will focus mainly on demand for, and supply of healthcare services and determinants of physician location, which are like was suggested by Sloan and Hsieh (2017), the captains of the health care team. We will also separately mention supplier-induced demand (SID), which could also cause spatial maldistribution of physicians. Lastly, we introduce some tools for regulation in case of market failure.

Equilibrium at healthcare market

While the market may not be the best way to allocate some health care resources, many of them reflect standard patterns of demand. People buy more at lower and buy less at higher prices (McPake, Normand and Smith, 2017). Like at any standard market, a number of doctors in a given market is affected by demand and supply. Blumenthal (2004) claims that demand for doctors is affected by the level of health insurance coverage, the proportion of gross domestic product spent on health or method of physician remuneration. Demand could also be affected by population characteristics, for example, by mortality and morbidity. Variations in the supply of physicians can be caused by differences in the availability of physician education and training, and terms and conditions of service. Shortages and surpluses of physicians can occur if wages or fees are set at a level which does not match supply with demand. Additionally, shortages and surpluses can arise due to lags in responses to changes in demand or supply (Simoens and Hurst, 2006) .

Figure 1.8: Equilibrium at doctors' market



Source: authors compilation based on Simoens and Hurst (2006)

Figure 1.8 shows a standard demand and supply model, where the demand for physicians declines with the real wage, and the supply increases. Two countries (or for our case, it could be municipalities) 1 and 2 can have different demand and supply schedules for physicians, such as D1 and D2, and S1 and S2, respectively. Equilibrium between demand and supply would be attained in each country if fees and wages were set at P1 and P2, resulting in levels of physician employment at Q1 and Q2, respectively. However, if real fees and wages in both countries had been set for many years at an intermediate wage (Pt) country, 1 is likely to have developed a surplus of physicians equal to Qb-Qa. At the same time, country 2 is likely to have developed a shortage equal to Qd-Qc (Simoens and Hurst, 2006).

Determinants of physician location and spatial maldistribution

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). Using regional data for Germany, the authors examined econometrically the determinants of regional physician supply. 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., 1982a,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.

In the 1990s, much government policy effort in Ontario (Canada) has been targeted toward the perceived "maldistribution" of resources between geographic regions. The authors of this paper apply the Gini index of resource concentration methodology to gauge the maldistribution of physician resources in Ontario during the 1990s. The novel feature of this study is that it also proposes an approach for quantifying physician shortages through a physician shortage intensity index. The results reveal that numerous government policies and programs aimed at the geographic maldistribution of doctors were unsuccessful (Kralj, 2001).

The Gini coefficient was also used by Horev et al. (2004), to measure variations in the distribution of physicians, but also hospital-beds (at the county level) during three decades. No association was found between equality in hospital-beds' distribution and rates of hospital-beds per capita. However, physician distribution has become less equitable, while hospital-beds' equity has increased.

The geographical distribution of general practitioners (GPs) was a persistent policy concern also in England and Wales since 1974. Results suggest that the maldistribution of GPs as measured by the Gini coefficient and Atkinson index increased from the mid-1980s to 2003. However, the decile ratio showed little change over the entire 1974–2003 period. Unrestricted GP principals and equivalents were more equitably distributed than other types of GP. The 20 percent increase in the number of unrestricted GPs between 1985 and 2003 did not lead to an equal distribution (Hann and Gravelle, 2004).

Given the wide popularity of the Gini index for evaluation of geographic maldistribution of health practitioners, Brown (1994) analyzed how Gini-style indices should be optimally used. The analysis establishes that Gini-style indices can be used, only if the ordering of geographic areas required to give Gini-coefficient values internal technical coherence also has meaning in terms of the conceptual predictions of the modeling. In practice, the analysis establishes that one particular geographic distribution of health practitioners is empirically dominant, and that is the distribution which involves the lowest practitioner/population ratio in rural areas, and the highest ratio in large urban areas, with the ratio for small urban areas in between.

International comparative evidence on the factors driving inequalities in the use of GP and specialist services in 12 EU member states was provided by Van Doorslaer et al. (2003). The authors found little or no evidence of income-related inequity in the probability of a GP visit. There is even evidence of a somewhat pro-poor distribution. By contrast, substantial pro-rich inequity emerges in virtually every country with respect to the probability of contacting a medical specialist. Despite their lower needs for such care, wealthier and higher educated individuals appear to be much more likely to see a specialist.

Instead of analyzing maldistribution, Bolduc et al. (1996) assessed the effect of various incentive measures introduced in Quebec (Canada) to influence the geographical distribution of physicians across 18 regions. Their dataset covers sub-periods before and after the introduction of these measures. Incentive policies are captured through price and income effects. Results provide evidence that these measures had a significant effect on location choices.

Supplier induced demand

In standard economic theory, demand curves are stable. In some cases, they can be shifted by advertising. However, shifting demand is costly. 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.

Feldman and Sloan (1988) concluded that there is little evidence to support the notion of supplier-induced demand or the contention that physicians generate demand to avoid the impact on their incomes of government price controls. Paper by Rice and Labelle (1989), however, criticized this conclusion. Authors argued that the evidence on supplier-induced demand and physician responses to price controls does not support the conclusions drawn by Feldman and Sloan.

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.

Carlsen and Grytten (2000) tried to throw light at the ongoing controversy about existence induced demand. Their results suggest that policy-makers can compute the socially optimal density of physicians without knowledge about whether supply-induced demand exists if one accepts the controversial assumption that consumer satisfaction is a valid proxy for patient utility.

The economics of healthcare regulation

In previous sections we showed that healthcare markets, in many ways, reflect standard patterns of demand and supply. The same applies to market failure and hence the economic rationale for regulation. McPake et al. (2013) suggests that the regulation aims to correct market failure on the understanding that if one market distortion exists, introducing another (regulation) can lead to efficient improvement (theory of second-best).

McPake et al. (2013) considers several areas of regulation in healthcare: entry, prices, quantity, quality, pharmaceuticals. The structure of the health care system determines the chosen regulatory mechanism. We will focus our attention on entry regulation.

The licensing of professionals before they are allowed to be employed in the sector restricts entry to the market. Since consumers are unable to judge the quality of the professionals for themselves, there is a rationale for collectively organized licensing system.

A license can provide two types of information about quality (McPake et al., 2013). Firstly, it can certify a sufficient level of knowledge of the healthcare provider. Secondly, it can provide information about the performance of individuals. In reality, however, the first type of information is much more common.

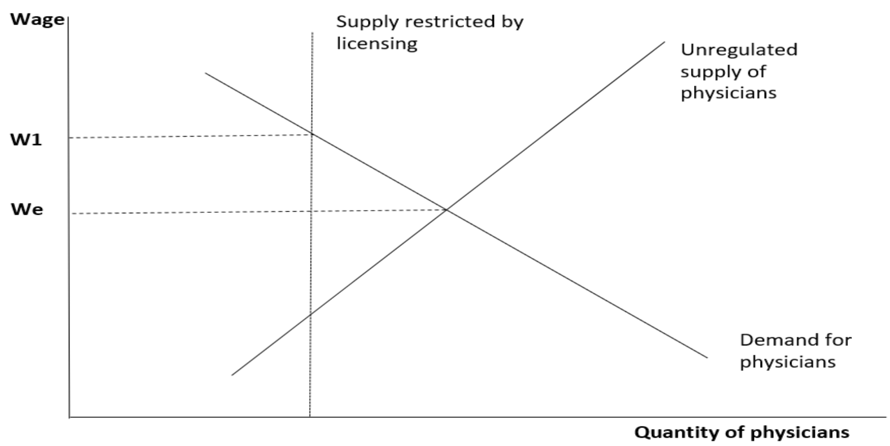
However, like McPake et al. (2013) state, ”organized professional groups may use licensing to promote their interests by limiting entry and reducing competition (e.g., raising licensing standards for potential entry). This will allow them to earn economic rent.”

Figure 1.9 shows the situation when the entry into the market is restricted (e.g. by introducing licensing). Restriction of entry will cause insufficient supply, and so the wage that physicians will earn is higher than if there were no supply restriction.

1.3 Regulation and the healthcare in Slovakia

For international efficiency benchmarking of Slovak healthcare, there were identified two leading indicators of healthcare quality. Slovakia has significant gaps compared to developed countries in both. Treatable mortality was chosen as a primary indicator of Slovak healthcare performance. This indicator expresses the number of

Figure 1.9: Potential impact of licensing requirements on healthcare professionals incomes



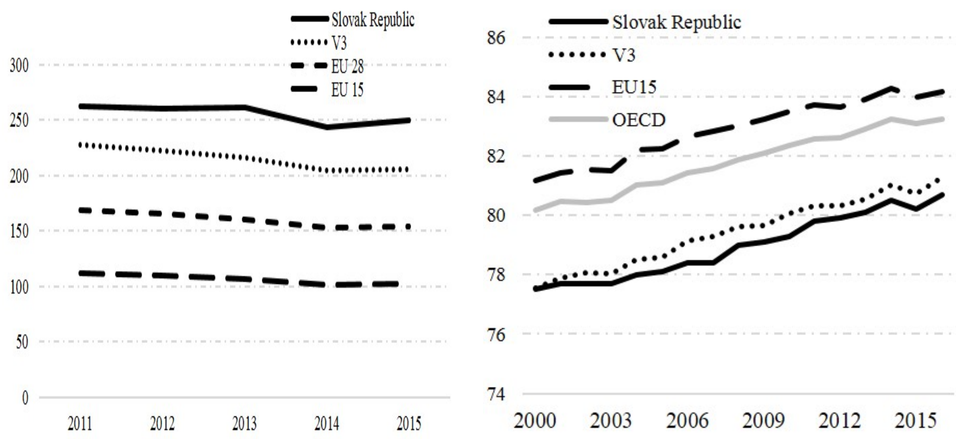
Source: authors compilation based on McPake et al. (2013)

avoidable deaths per 100 000 inhabitants. Deaths that could have been prevented by timely and effective treatment are considered treatable (avoidable). The most common treatable causes of death in EU countries are ischemic heart disease, vascular brain disease, and some forms of cancer (Eurostat, 2019). Slovak treatable mortality rate (168 deaths per 100,000 inhabitants) it is more than twice the EU15 average (76 deaths) and higher than the V3 average (145 deaths). If Slovakia were at the level of the V3 countries in 2016, the deaths of approximately 1,300 people would be avoided. Reaching the EU15 level would mean about 5 000 avoidable deaths a year less (Kišš et al. 2019).

The complementary indicator is the life expectancy of women at birth. Even in this indicator, Slovakia lags behind the reference countries (figure 1.10). The advantage of this indicator is its long-term reporting and relatively established methodology. The disadvantage is that the causes of death include those that are not influenced by health care.

The efficiency of health expenditures in EU countries was analyzed by Meaney et al. (2018) using Data Envelopment Analysis (DEA). The efficiency of health spending was determined by utilizing healthy life years at birth as a proxy of the health systems. Healthy Life Years is a widely used indicator to determine the efficiency of public

Figure 1.10: Amenable mortality (left) and Life expectancy at birth of females in Slovakia, V3 and EU countries, in thousands

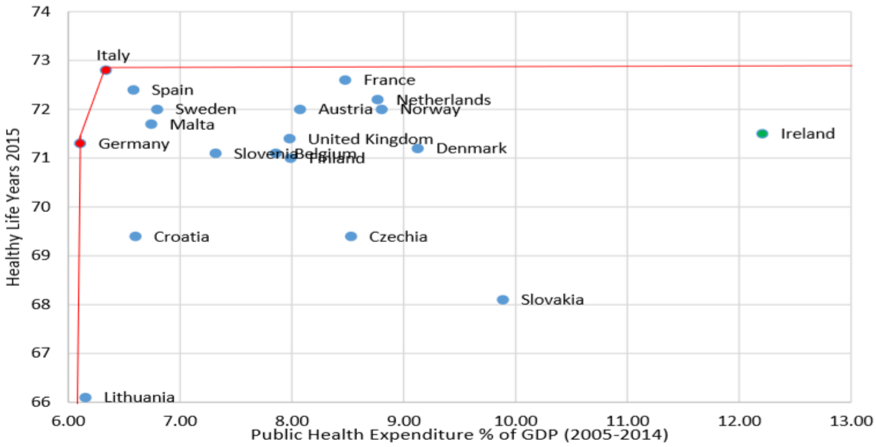


Source: authors compilation based on data from Kišš et al. (2018)

spending on health. Healthy life years has the benefit of being an extensive measure of population health and correlates with other indicators of health. Concerning age-adjusted health expenditure, Slovakia recorded the worst efficiency. With healthcare-related expenditures amounting to almost 10 percent of GDP.

Space for improvement of efficiency of Slovak healthcare confirmed paper by Jankovič and Mandžák (2019). The authors have estimated the efficiency of public healthcare expenditure in Slovakia using Data envelopment analysis. The authors proposed two equivalents of DEA models. The first is based on per capita style of variables (health expenditures per capita, healthy years of life, and preventable deaths per million people), and the second equivalent counts all the expenditures, healthy years, and preventable deaths per the whole population of a country. Slovakia has one of the least efficient healthcare systems among EU countries, while Cyprus and Bulgaria, seems to be efficient under all specifications of models. The results from DEA analysis (figure 1.12) suggest considerable space for improving for Slovakia. Slovakia needs to reduce health expenditure per capita and a number of preventable deaths by more than half while keeping the same level of healthy life years per capita to become efficient.

Figure 1.11: Plot of Age Adjusted Health Expenditure (PHE) as a % of GDP and Health Life Years 2015



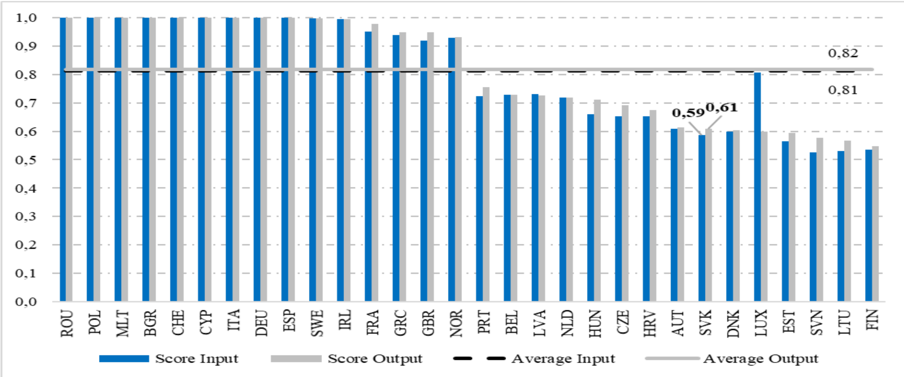
Source: Meaney et al. (2018)

1.3.1 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 1.1. We focused mainly on reforms concerning doctors (especially GPs) and pharmacies. 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).

Figure 1.12: Efficiency scores from DEA models – BCC input and output oriented



Source: Jankovič and Mandžák, 2019

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

Table 1.1: Overview of main regulatory changes in the Slovak Healthcare sector

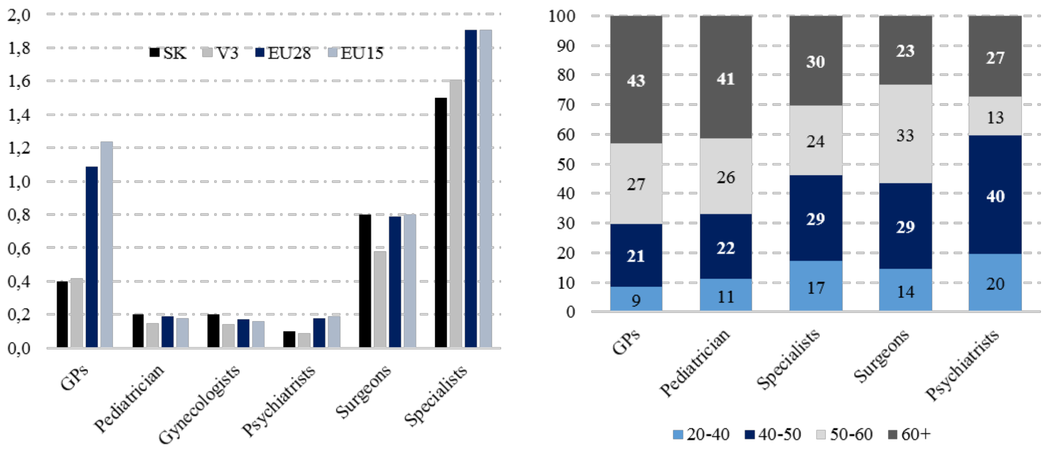
Year	**Subject of regulation**	**Regulation**
1990		Re-introduction of market principles and fragmentation of the system
1995	Pharmacies and Physicians	Most pharmacies and ambulatory physicians went into private practice
1998	Pharmacies	Slovak Chamber of Pharmacists approves the establishment of new 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)

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.

Figure 1.13: 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)

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).

Hospitals with attached polyclinics represent a significant market share of specialized ambulatory care. Since patients (except for soldiers, police officers, prisoners, and migrants seeking asylum) are free to choose their health care providers for both general and specialized care, doctors can engage in non-price competition.

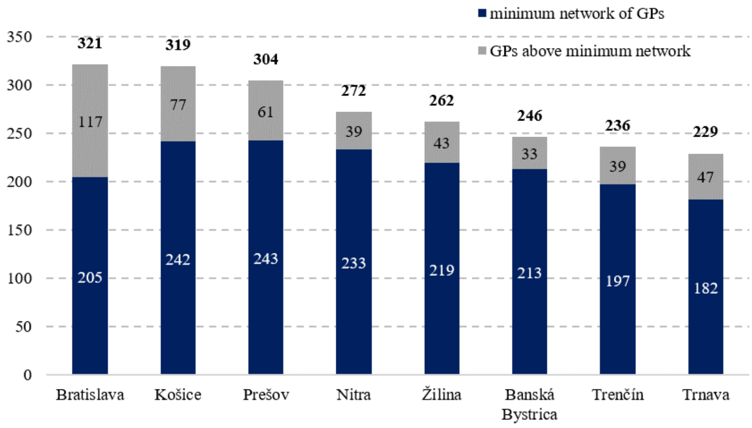
Minimum network of healthcare providers

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 1.14. Health insurance companies had to contract at least 1733 GPs in 2018.

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

Figure 1.14: Minimum network of GPs in Slovakia, 2017



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

and specialization according to the population's needs.

A GP is required to register each insured individual. For each patient, the GP receives a fixed capitation from the patient's Healthcare Insurance Company (HIC). Patients choose their primary care providers and can change GPs every six months.

A lack of regulation is evident in long-term human resource planning. Decisions concerning the numbers of students and graduates at medical faculties are made by the university, funded by the educational sector, and are not linked to health sector needs. The EU accession has strengthened the mobility of health professionals and has resulted in shortages in specialists in certain areas. The rigid territorial planning of GPs until 2004, which made the profession unattractive for new entrants, combined with the aging of the workforce, has led to significant shortages in the sector.

Residency programme

To reduce the high average age of the GPs Residency program was established in 2013. This program aims to (1) reduce the average age of general practitioners and pediatricians, (2) improve education in general medicine for adults, children and adolescents, and (3) improve the quality and accessibility of health care in primary care (Smatana et al., 2016). Residency program also aims to reduce visits to specialists. Until the end of 2018, 80 GPs for adults and 9 pediatricians finished the Residency program. Regarding the fact, that there is currently over 1500 GPs missing (for adults and children combined), the Residency program has only minimal contribution to strengthening personal capacities(Kišš et al., 2018). The residency program is the post-gradual study (or specialization study) for medical students. It lasts three years, and its graduates are obliged to stay in Slovakia for the next five years after completing the programme. This program is financed by the Ministry of Health of the Slovak Republic. Before the program, Hospitals were unwilling to accept students for general specialization study, because after completing the study (after attestation), GP would leave the hospital and start a private ambulatory practice.

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 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). Lábaj (2019) summarize general information about the pharmacy market and its regulation in Slovakia. In 2017, over 2.3 thousand subjects received at least one receipt from a doctor (of which 1956 were pharmacies). Except for pharmacies, there were over 200 dispensers of medical devices and approximately 160 opticians. Pharmacy in Slovakia could exist as a separate entity (1736), branch of existing pharmacy (386), or established by an entity that provides a different kind of healthcare (23). Another 50 pharmacies were owned by hospital.

There are several networks (branches) of pharmacies in Slovakia. The largest network is Dr.Max, with over 300 pharmacies. There are also virtual networks of pharmacies, where PLUS pharmacy is the largest with over 500 pharmacies.

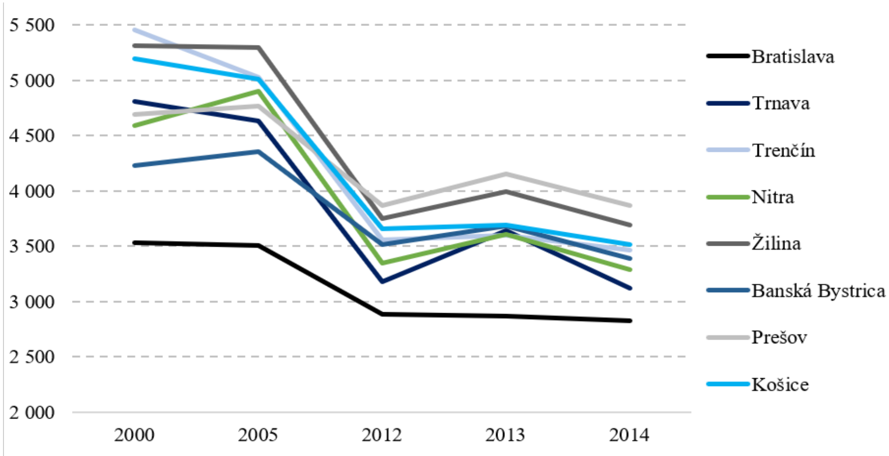
Regulation of pharmacies

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).

Figure 1.15: Evolution of inhabitants per pharmacy counties in Slovakia



Source: authors compilation based on 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.

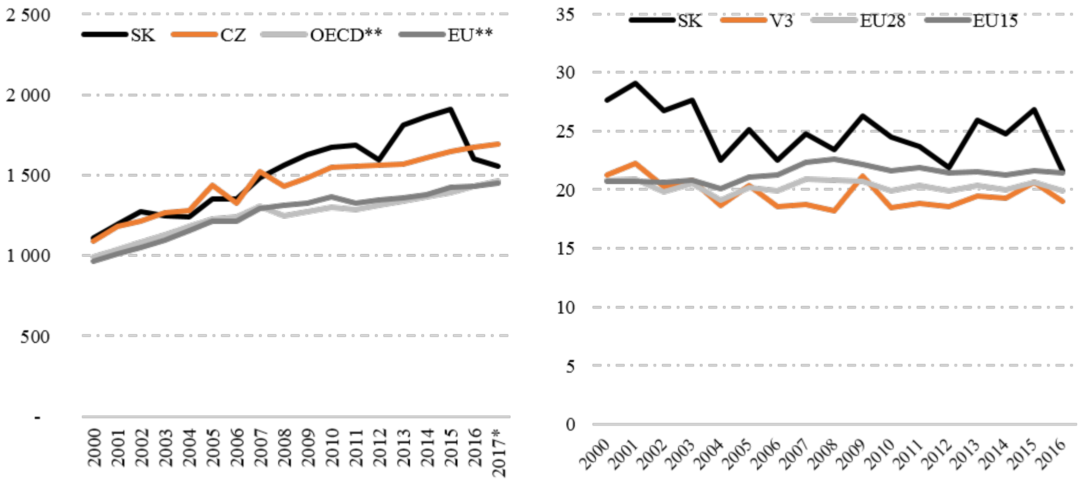
Prescribing and consumption of drugs

After the regulation change in 2011, doctors can prescribe effective substance of medicine, instead of the name of the drug. Furthermore, a pharmacists are obliged to inform a patients about cheaper alternatives (generics) when filling a prescription.

Thanks to a reference pricing system for pharmaceuticals, Slovakia belongs between countries with the lowest drug prices. The ex-factory price of the drug may not exceed the average of the three lowest prices of the same pharmaceutical sold in all 28 EU countries. However, Slovakia still spends more on drugs than countries with better results in healthcare. Czech Republic, Denmark, and Slovenia have lower expenditures, but also fewer amenable deaths. Based on this, Kišš et al. (2018) conclude, that money spend on drugs could be used better, to achieve higher value for money.

Kišš et al. (2018) also claims that the total consumption of drugs is higher than the EU and OECD average. Over-consumption of antibiotics is also a long-term problem in Slovakia. Over the last 16 years, consumption in Slovakia is above the V3 average, as well as the EU28 average (see figure 1.16). Authors warn, that excessive consumption of antibiotics signals the waste of resources, and also leads to bacteria resistance against drugs.

Figure 1.16: Total drug (on the left) and antibiotics (on the right) consumption (per 1000 inhabit., in daily doses)



Source: authors compilation based on Kišš et al. (2018)

Kišš et al. (2018) provides several steps to reduce the number of prescriptions (by doctors with the highest volume of prescriptions) and save around 30 mil. euro. This could be achieved thanks to electronic prescriptions and by behavioral effects. Spending review suggests that there is high variability between doctors in the prescription of drugs (within specialization). The review suggests publishing a ranking of doctors based on the numbers of their prescriptions.

Schaumans (2015) investigated whether GPs prescribe more units when confronted with more competition. As there is no monetary benefit in doing so, this type of (perceived) quality competition originates from GPs satisfying patients' expectations. The idea is that patient perceives that he received better treatment when he receives a prescription for drugs (or simply that his illness is taken seriously). The analysis indicates that a higher number of GPs per capita results in a higher number of units prescribed by GPs, both per capita and per contact. The author concluded that GPs prescribe more units when there is more competition to satisfy patients'expectations. The paper thus presents empirical evidence of (perceived) quality competition. A similar analysis of GPs behavior in Slovakia could provide another way of thinking about lowering prescriptions in Slovakia.

2 Aims of the dissertation thesis

Healthcare expenditures in Slovakia have risen significantly in the last years, the same as in other OECD countries. However, the efficiency of healthcare in Slovakia is low (Kišš et al. (2018), Haluš (2015), Filko et al. (2012)). Shortages of physicians, unfavorable age structure, over-consumption of antibiotics or unequal distribution of physicians across regions are just a few of them. Economic research in the sector is, therefore, essential and necessary. We aim to examine several policy problems using tools from the Industrial Organization literature.

The main purpose of this dissertation thesis is to examine the relationship between market structure (number of firms) and market size (population) for several healthcare professions in Slovakia. The special focus will be given to general practitioners and pharmacies. These professions represent first entry point for the most patients to the healthcare system. The empirical analysis will focus not only on the competition within professions, but also between them.

The market liberalization in Slovakia led to a strong increase in a number of new pharmacies in the past (Smatana et al., 2016), but pharmacies entered mainly larger, densely populated markets (Lábaj et al., 2018b). The concentration of healthcare providers in urban areas is well documented in the international literature (Sloan and Hsieh (2017), Folland et al. (2017), Isabel and Paula (2010)) . However, several studies also conclude that 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). First research aim of the thesis is **to examine, whether deregulation after 2010 (after horizon covered in Lábaj et al. (2018b)) have led to the entry of pharmacies into larger cities, or whether they already started to diffuse into smaller markets as well.** We hypothesize that due to the increase of number of pharmacies in larger market in the first years following deregulation, pharmacies were diffused into smaller markets in recent years.

Optimal access to medical care for all inhabitants requires an adequate number and equitable distribution of doctors in all parts of the country. Over-concentration of doctors in one region and shortages in others can lead to inequities in access (OECD, 2020). Moreover, Schaumans (2015) found over-prescription of drugs in markets with higher density of physicians due to more intense competition. The highest differences in the density of doctors between urban and rural regions in OECD are in the Slovakia. We aim to examine how the inequities differ across regions of Slovakia. However, more importantly, we will build on paper by Lábaj et al. (2018b) and estimate entry thresholds for different healthcare professions. The research aims to answer, **what population is necessary for the first healthcare provider to enter the market in Slovakia, and how the competition changes with the entry of another provider of the same type?**

Competition and complementarity between firms can be observed at the same time. Schaumans and Verboven (2008) consider the entry decisions of pharmacies simultaneously with those of GPs. Each type of profession benefits from the presence of the other. The critical market size should, therefore, decrease with the entry of additional firms of the other type. Better coverage of physicians in rural areas can lead to the entry of additional pharmacies. We aim to answer question: **what effect would have an increase in GPs supply in rural regions on supply of pharmacies and other healthcare professions?** Our hypothesis is, that pharmacies and GPs are strong complements in Slovakia as well, and that a better coverage of a GPs in a rural areas would result into entry of new pharmacies int these markets.

In some developed countries, like Belgium, patient is free to choose healthcare provider (self-referring). "The complementarity or substitutability of GP and specialist services is primarily driven by patients choice behavior in their decision to contact a GP or a specialist" (Schaumans, 2008). In Slovakia, mandatory referral schemes is implemented, where a GPs decide on the access of patients to specialist care. A patient is not allowed to visit most of specialists without such referral. We will examine, **how**

the interactions between a GPs and specialists (e.g. GPs vs pediatricians) and within specialists (e.g. pediatricians vs dentists) differ. We hypothesize, that GPs will have substantial impact on a profitability of specialists in Slovakia, and that the strategic interactions will be asymmetric in size.

3 Methodology and data

3.1 Methodology

Several models will be estimated to provide with answers on research questions of this thesis. We will start by adoption of entry model introduced by Bresnahan and Reiss (1991), which has been already used in Slovakia by Lábaj et al. (2018b) or Lábaj et al. (2018a). However, our analysis is based on more precise data on a number of healthcare providers in Slovakia. We will estimate the univariate ordered probit model. Based on the estimated parameters from the model, we will be able to calculate entry thresholds and entry thresholds ratios.

In the next step, we will focus on strategic interactions between healthcare professions. We will extend the previous univariate ordered probit model with a number of other healthcare profession as an explanatory variable. We will build on paper by Gächter et al. (2012), that used this approach.

We will also focus exclusively on strategic interactions between several pairs of healthcare providers. Special attention will be paid to the relationship between pharmacies and GPs. We will build on paper by Schaumans and Verboven (2008) and estimate the bivariate ordered probit model. The model allows us to calculate entry thresholds for pharmacies and GPs, affected by the presence of the other firm already in the market. Last but not least, we will provide with first empirical results on interactions between the trinity of healthcare providers using trivariate ordered probit model.

General (univariate) model (without complementarity)

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:

$$\pi_{N1+1} = v(N+1)S - f < 0 < v(N)S - f = \pi_N \tag{3.1}$$

or equivalently:

$$ln\frac{v(N+1)}{f} + lnS < 0 < ln\frac{v(N)}{f} + lnS \tag{3.2}$$

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:

$$ln\frac{v(N)}{f} = X\beta + \theta_N + \epsilon \tag{3.3}$$

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 $S1$):

$$S_1 = exp(\theta_1 - \bar{X}\beta) \tag{3.4}$$

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:

$$s_1 = \frac{exp(\theta_1 - \bar{X}\beta)}{N} \tag{3.5}$$

$$ETR_N = \frac{s_{N+1}}{s_N} \tag{3.6}$$

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.

3.1.1 Modelling spatial interactions between markets

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:

$$y = N, if \theta_N \leq y^* < \theta_{N+1} \tag{3.7}$$

$$y^* = \rho W y^* + X\beta + lnS + \theta_N + \epsilon, where \epsilon\ N(0,1) \tag{3.8}$$

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 4.2.2.

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.

3.1.2 Modelling interactions between healthcare professions (extended univariate model)

In the next step, we will extend the model with another type of effect. This represents N in equation 7. While θ represents its own type effect, γ represents another type of firm effect.

$$\pi_i^*(N_t) = X\beta + \lambda_i lnS + \theta_t + \sum_{j=1,j\neq t}^{T} \gamma n_j + \epsilon \tag{3.9}$$

The specification of the model is similar to the approach in Gächter et al. (2012). However, instead of fixed-effect panel regressions where densities of physicians are explained, we will estimate ordered probit model.

3.1.3 Strategic interactions between two healthcare professions (bivariate model)

In our research, we also follow the entry model developed by Schaumans and Verboven (2008) with two types of firms – pharmacies (1) and physicians (2). Pharmacies and physicians provide largely complementary services, so that entry in one profession may have a positive net impact on the profitability of entry in the other profession. Despite their paper, we allow for free entry of pharmacies.

Schaumans and Verboven (2008) argue that the two professions' core services are potentially strong complements: physicians provide medical consultations and prescribe drugs, whereas pharmacies are responsible for selling the drugs. The degree of complementarity is, however, not perfect, and it may be asymmetric: not all consultations end with a prescription, and pharmacies can sell several drugs without a prescription. Although the professions' core services are complementary, they regularly operate on each other's domain, so that they may also be viewed as providing substitute services.

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

$$\pi_i^*(N_1, N_2) = \pi_i(N_1, N_2) - \epsilon_i \tag{3.10}$$

where $\pi_i(N_1, N_2)$ is the deterministic component of payoffs, and ϵ_i is a random component, unobserved to the econometrician.

Our **first assumption** is that entry decisions by firms of the same type are strategic substitutes, therefore firm's marginal profits from entering decreases when another firm of the same type decides to enter:

$$\pi_1(N_1 + 1, N_2) < \pi_1(N_1, N_2) \tag{3.11}$$

$$\pi_2(N_1, N_2 + 1) < \pi_2(N_1, N_2) \tag{3.12}$$

In our case, if a pharmacy (firm type 1) decides to enter, it will decrease the profit of other pharmacies in the market. Same applies for physicians.

Second assumption is that firms of different type are strategic complements, or independent. We assume that a firm's payoffs are increasing in the number of firms of the other type:

$$\pi_1(N_1, N_2) \leq \pi_1(N_1, N_2 + 1) \tag{3.13}$$
$$\pi_2(N_1, N_2) \leq \pi_2(N_1 + 1, N_2) \tag{3.14}$$

$$\pi_1(N_1 + 1, N_2 + 1) < \pi_1(N_1, N_2) \tag{3.15}$$
$$\pi_2(N_1 + 1, N_2 + 1) < \pi_2(N_1, N_2) \tag{3.16}$$

There are two possible effects of complementarity. The assumption in equations 3.13 and 3.14 states that payoffs of entering firm are either increasing in or independent of the number of firms of the other type. Hence, the marginal profits from entering increase weakly when a firm of the other type decides to enter so that their entry decisions are (weak) strategic complements. 3.15 and 3.16 says that the extent of strategic complementarity between firms of different types is weaker than the extent of strategic substitutability between firms of the same type. Hence, payoffs decrease when there is an additional firm of both the own type and the other type (Schaumans and Verboven, 2008).

As suggested in Schaumans and Verboven (2008) or Mazzeo (2002), it is also possible to reverse Assumption 2, that is, assume that entry decisions by firms of different types are strategic substitutes. We will use this assumption on later research, to test the possible substitute effect of certain types of doctors.

The complementarity between pharmacies and doctors will be examined by using bivariate ordered probit model, as proposed by Schaumans and Verboven (2008). Bivariate probit models are interesting on its own for modeling the joint determination of two variables, in our case mainly pharmacies and doctors(Greene, 2012).

We will estimate the following specification of a model:

$$\pi_i^*(N_1, N_2) = \lambda_i ln(S) + X\boldsymbol{\beta_i} - \theta_i^j + \frac{\gamma_i^k}{N_i} - \epsilon_i \tag{3.17}$$

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.

Bivariate ordered probit regressions were estimated using Stata command *bioprobit*, that computes full/information maximum likelihood estimates of the model. A detailed description and discussion on the command can be found in Sajaia (2008).

The model is internally consistent if the estimated fixed effects θ_i^j and γ_i^k entering equation 3.24 satisfy the following conditions for all i , j , and k:

$$\theta_i^{j+1} > \theta_i^j$$
$$\gamma_i^{k+1} \geq \gamma_i^k$$
$$\theta_i^{j+1} - \frac{\gamma_i^{k+1}}{(N+1)} > \theta_i^j - \frac{\gamma_i^k}{N}$$

The first condition assumes that an additional firm of the own type decreases the payoffs. The second condition says that an additional firm of the other type increases the payoffs. Finally, the third row states that an additional firm of both types reduces the payoffs. Even after restricting our sample, there still may be up to 15 physicians and 12 pharmacies in a market, implying a large number of fixed effects. Following Schaumans and Verboven (2008), we will pool all markets with more than four firms into one category.

Entry threshold calculation

Entry thresholds and entry threshold ratios are calculated in a similar way as in the general model. However, in this case, inter-format competitors are present:

$$S_1 = exp(\frac{\theta_i^j - \frac{\gamma_i^k}{N_i} - \bar{X}\beta_i}{\lambda_i}) \qquad (3.18)$$

$$s_1 = \frac{exp(\frac{\theta_i^j - \frac{\gamma_i^k}{N_i} - \bar{X}\beta_i}{\lambda_i})}{N} \tag{3.19}$$

$$ETR_N = \frac{s_{N+1}}{s_N} = exp(\theta_{N+1} - \theta_N)\frac{N}{N+1} \tag{3.20}$$

Entry threshold ratios (ETR) expressed in equation 3.20 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:

$$InterETR = \frac{s_i^{k+1}}{s_i^k} = exp(\frac{\gamma_i^{k+1} - \gamma_i^k}{\alpha_i}) \tag{3.21}$$

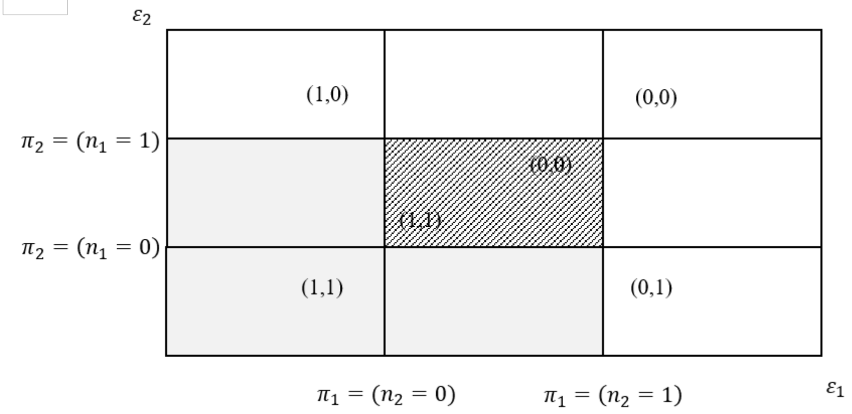
Inter-format threshold ratios (InterETR) measure the increase in the per firm market size needed to support a monopolist of first type firm when an additional firm of the other type enters. Again, please note that change in intra or inter format ETR does not measure the level of competition, but how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

Multiple equilibria problem

In entry games, where each firm decides whether or not to entry based on entry decisions of the other firms, problem regarding multiple Nash-euqilibria arise. Figure 3.1 shows the problem in entry game with one potential entrant for each type firm. For low values of both ϵ_1 and ϵ_2 both firms enter and the unique Nash equilubrium is (1,1). Similarly, for large values of ϵ_1 and ϵ_2 the Nash equilibrium is (0,0). However, for intermediate values of error terms both market configurations (1,0) and (0,1) are asch equilibria.

The multiplicity of equilibria can becomes complicated in the case with more than one potential entrant of each type firm (Cleeren et al., 2010). According Schaumans and Verboven (2008), the market configuration (n_1, n_2) is a Nash equilibrium if and only if the random component ($\epsilon = (\epsilon_1, \epsilon_2)$) satisfies the conditions:

Figure 3.1: Simple game with one entrant for each firm type as strategic complements



Source: authors compilation based on Schaumans (2008)

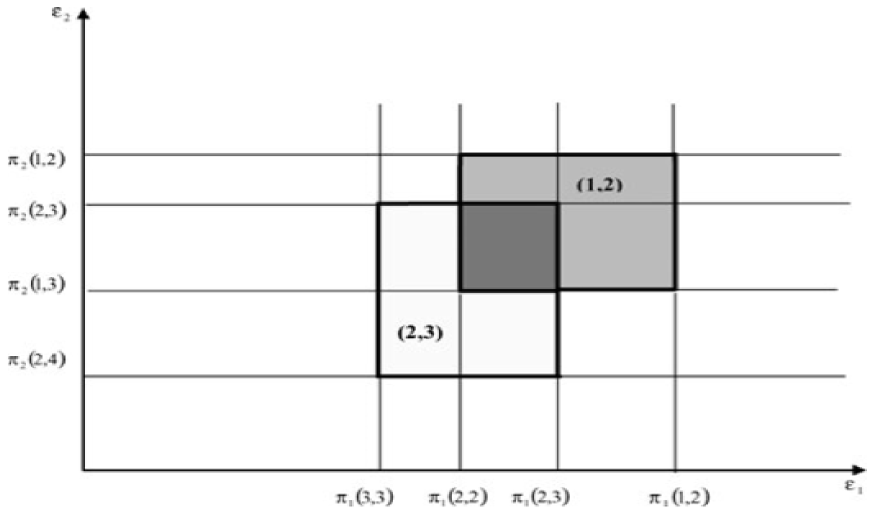
$$\pi_1(n_1+1, n_2) < \epsilon_1 <= \pi_1(n_1, n_2) \tag{3.22}$$

$$\pi_2(n_1, n_2+1) < \epsilon_2 <= \pi_2(n_1, n_2) \tag{3.23}$$

Schaumans and Verboven (2008) argue, that the multiplicity showed in 3.2 stems from coordination problems. The shaded rectangle area shows overlap in Nash equilibrium outcomes. As the extent of complemetarity increases, the shaded area (representing multiple equilibria) increases.

To deal with multiple equilibria, Schaumans and Verboven (2008) impose perfect Nash equilibrium sub-game in the spirit of Mazzeo (2002). However, they assume that firms choose their type firs, and each type entrant subsequently make their entry decision without being able to change their type. Alternative approaches to the multiplicity of equilibria can be found in Mazzeo (2002), Cleeren et al. (2010), Schaumans (2008), Ciliberto and Tamer (2004) or Seim (2006).

Figure 3.2: Nash equilibria for more entrants with strategic complements



Source: Schaumans and Verboven, 2008

3.1.4 Strategic interactions between three healthcare professions (trivariate model)

Multivariate models (systems or equation) are especially desirable in situations where the dependent variables are generated by processes that are independent except for correlated errors, or in the broader simultaneous equations framework, in which endogenous variables influence one another (Roodman, 2011). Like showed in the paper by Schaumans and Verboven (2008), the nearby presence of one profession (e.g. pharmacy) could strongly benefit the other profession (GP), and another way around.

Schaumans and Verboven (2008) also briefly discussed that competitive interaction might also stem from supply-side factors. For example, pharmacies and physicians may generate knowledge spillovers and learning effects, which can affect both their variable and fixed costs. The same could be true for other professions as well. Moreover, these effects should be more substantial if more professionals are present at the market.

We will estimate following specification of a model:

$$\pi_i^*(N_1, N_2, N_3) = \lambda_i ln(S) + X\boldsymbol{\beta_i} - \theta_i^j + \frac{\gamma_i^k}{N_i} + \frac{\gamma_i^{k+1}}{N_i} - \epsilon_i \tag{3.24}$$

The parameters θ_i^j and γ_i^k are fixed effects for type i when there are, respectively, j firms of the own type and k firms of the other type present in the market.

Parameters were estimated using the conditional mixed-process (CMP) framework implemented by David Roodman's cmp command in Stata. The CMP modeling framework is very similar to seemingly unrelated regressions. The individual equations need not be classical regressions with a continuous dependent variable. They may be, as in our case, ordered probit regressions. A more detailed discussion can be found in Roodman (2011).

Entry thresholds

Entry thresholds and entry threshold ratios are calculated in a similar way as in the general model. However, in this case, inter-format competitors are present:

$$S_1 = exp(\frac{\theta_i^j - \frac{\gamma_i^k}{N_i} - \frac{\gamma_i^{k+1}}{N_i} - \bar{X}\beta_i}{\lambda_i}) \tag{3.25}$$

$$s_1 = \frac{exp(\frac{\theta_i^j - \frac{\gamma_i^k}{N_i} - \frac{\gamma_i^{k+1}}{N_i} - \bar{X}\beta_i}{\lambda_i})}{N} \tag{3.26}$$

$$ETR_N = \frac{s_{N+1}}{s_N} = exp(\theta_{N+1} - \theta_N)\frac{N}{N+1} \tag{3.27}$$

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.

Data sources

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. However, each data source provides a slightly different point of view and has its limit. Moreover, the number of providers differs across databases. Table 3.1 summarizes information that can be obtained from available sources.

Every database includes information at the level of the individual healthcare provider with information about a spatial location. This will allow us to calculate the number of firms at the municipality level. For all calculations, data from Register of healthcare providers were used. However, we discuss also other possible sources of data below.

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.

EHealth is a database of documentation shared between healthcare providers. Every transaction within public health insurance is recorded in the system. Therefore one can obtain coded information about physical examinations, prescriptions of drugs, and also about pharmacies, where the patient collected a prescribed drug. This database, if available, can provide a large set of data for a researcher. Careful manipulation of data is necessary. However, the database is not publicly available. Restricted and anonymized data for the year 2017 were made publicly available at the webpage of Ministry of Health of the Slovak Republic.

The less reliable sources are **Finstat** and **eVUC** websites. Finstat is unique since it includes closing accounts of pharmacies. The information could serve as an example for the financial analysis of the economic performance of pharmacies, or market concentration based on revenues. However, the number of pharmacies is significantly lower than in the other three sources. Moreover, in this database, it is not possible to separate GPs from other specialists. The ultimate source is the web pages eVUC that publishes information about pharmacy locations and opening hours. This is not database per se; however, the data can be created based on the information provided by webpage.

Table 3.1: Description of data sources on healthcare providers

	eHealth	**RHP**	**Finstat**	**eVUC**
Number of pharmacies (most recent)	2321	2104	1687	2270
Number of GPs (most recent)	2189	2353	x	2392
Period of time	2017	2007-2018	2016	2016
Spatial location	yes	yes	yes	yes
Availability of data	yes, without location	yes, upon request	yes	no
Main issues	short period, data management		database accuracy	database accuracy

Source: authors compilation

3.2.1 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).

Table 3.2: Number of markets by healthcare professional and number of incumbents

	Number of firms							
Industry	**N=0**	**N=1**	**N=2**	**N=3**	**N=4**	**N=5**	**N=6**	**N>=7**
Pharmacies	2328	402	63	22	15	13	7	78
GPs	2216	479	84	34	14	12	12	77
Dentists	2411	332	51	26	15	11	8	74
Pediatrician	2473	301	57	16	14	17	12	38
Surgeons	2804	44	19	13	8	14	6	20
Cardiologists	2837	33	22	13	6	5	2	10
Ophthalmologists	2809	45	23	16	5	4	3	23

Source: authors compilation based on RHP, full sample

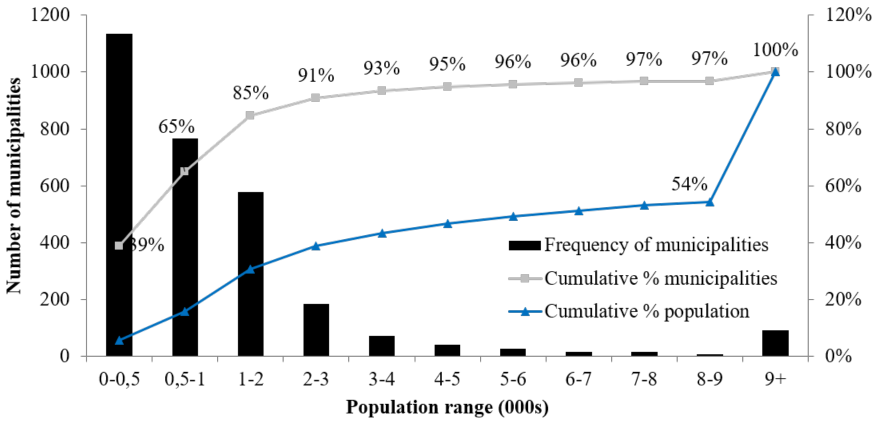
Schaumans (2008) claims that the town is a good approximation of the relevant market for GPs. Since GPs do not engage in advertising or other promotional selling activities, patients are guided mainly by the local information. However, it is generally believed that patients are willing to travel further for specialists. Therefore the relevant market for specialists should be broader.

A suggestion for a different market definition for healthcare specialists is supported by observed market configuration in Slovakia. Figure 3.2 shows the number of markets according to the number of specialists in the market. The number of monopoly markets for the pharmacies and GPs is significantly higher than for surgeons, cardiologists, or ophthalmologists. However, the observed market configuration is relatively similar for dentists and pediatricians.

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.

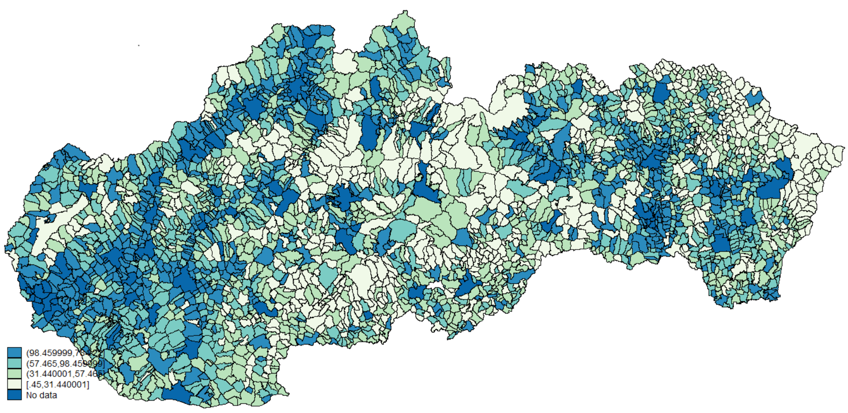
Figure 3.3 plots the distribution of the markets (municipalities in Slovakia) by ranges of their population. Approximately 2/3 of the markets have less than one thousand inhabitants. These two-thirds of the Slovak markets contains only 10 % of the total population. On the other hand, only less than 3 % of markets have nine thousand inhabitants or more. These larger markets contain almost half (46 %) of the total population.

Figure 3.3: Number of municipalities by town population



Source: authors compilation based on data from RHP

Figure 3.4: Population density in Slovakia, 2017



Source: authors compilation based on data from RHP

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).

3.2.2 Ensuring the relevance of the market

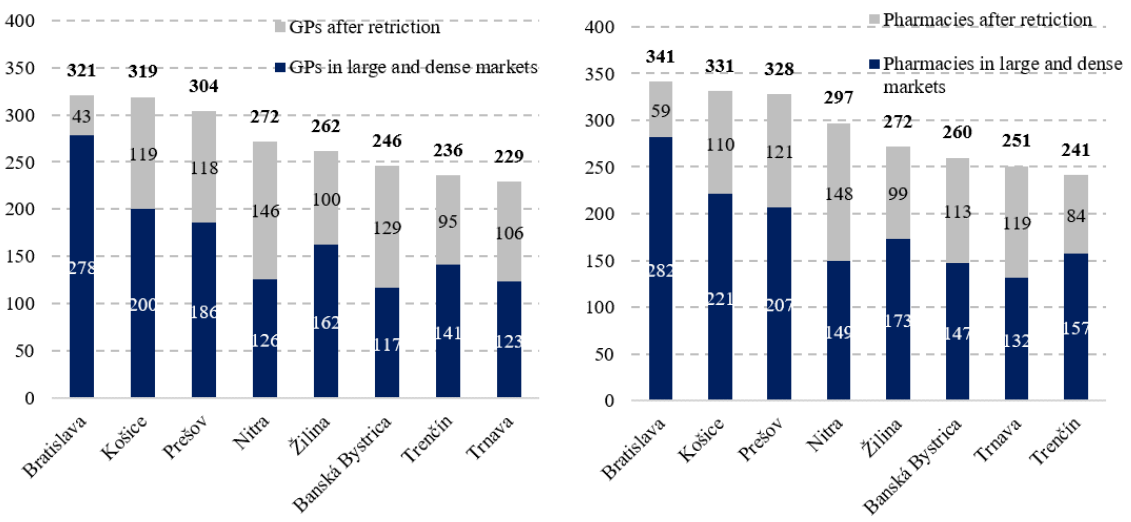
As we already mentioned above, our definition of the market on the municipality level leaves most markets without a healthcare professional. However, people living in these municipalities also demand pharmaceutical or physician services. Therefore they need to travel outside a municipality. On the other 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.

Total numbers of GPs and pharmacies - before and after the restriction

There were almost 2.2 thousand GPs and over 2.3 thousand pharmacies in Slovakia. Over 1.3 thousands of GPs (61 %) and 1.4 thousand pharmacies (63 %) were operating on 17 large and dense markets (markets with a population over 15 thousand or population density over 800 inhabitants per km^2). After the reduction of these markets from our dataset, there are 856 GPs and 853 pharmacies. Figures 3.5 presents numbers of GPs and pharmacies in Slovak counties, based on whether they were included in the analysis.

Figure 3.5: Number of GPs and pharmacies in Slovak counties, 2017



Source: authors compilation

3.2.3 Description of explanatory variables

Table 3.3 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 3.3: 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

Berry et al. (2019) suggest that a descriptive baseline for analysis should be a starting point to identify patterns in a market structure. Answers to simple questions about market structure, concentration markups, or even correlation between these variables can often point to fruitful areas for detailed study. Therefore in the first section of this chapter, we try to provide a baseline analysis of the current situation on the markets of healthcare providers in Slovakia.

4.1 Market structure of healthcare providers

4.1.1 Baseline analysis

"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 4.1.

The empirical analysis in this section will focus mainly on General practitioners and pharmacies, which are the most common providers of healthcare in Slovakia. They both represent entry point to the healthcare system. However, in some specific topics (e.g. strategic interactions), we will analyze other professions as well, mainly other professions included in primary care - dentists and pediatricians.

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 4.2 (for GPs) and 4.3

Table 4.1: 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

(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.

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 4.2: 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

Table 4.3: Number of markets by number of pharmacies

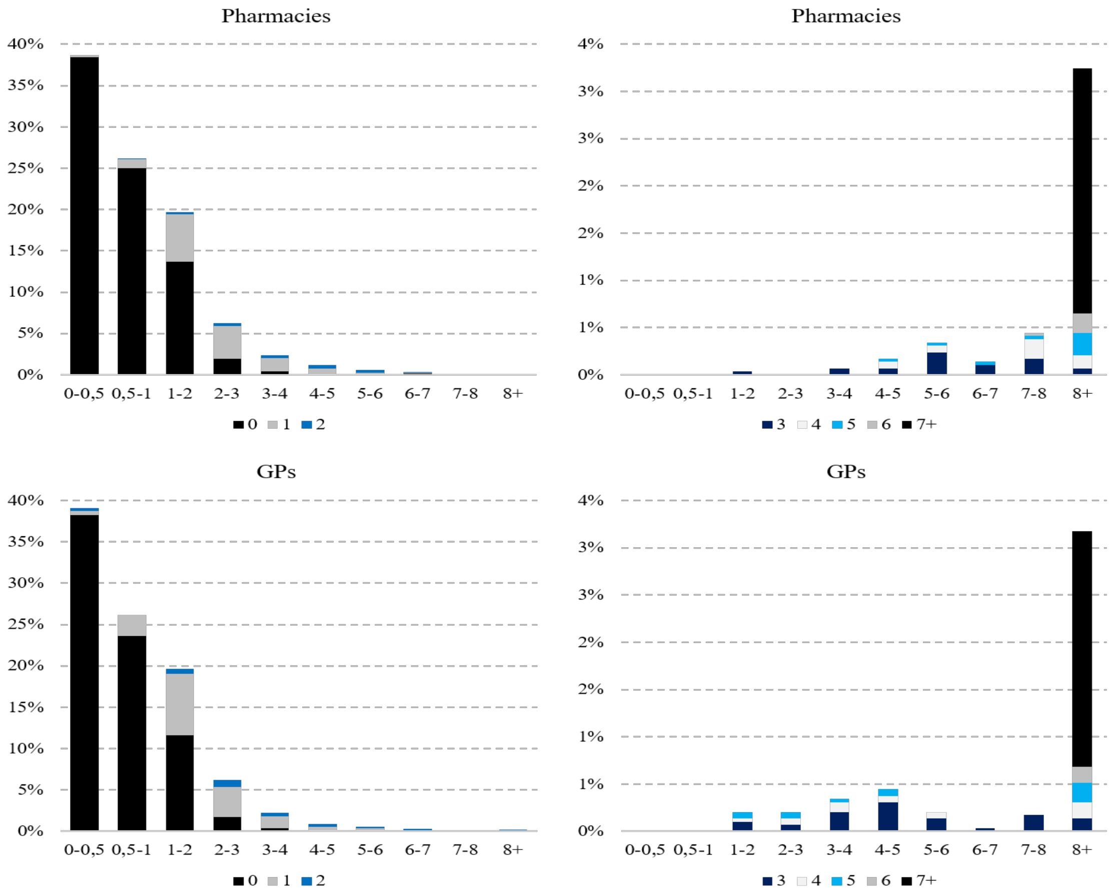
	Total Pharmacies		Average population		Population per firm	
	full sample	restricted	full sample	restricted	full sample	restricted
0 firms	2327	2326	669	667		
1 firm	402	400	2149	2153	2149	2153
2 firms	63	62	4290	3935	2145	1968
3 firms	22	20	6040	5896	2013	1965
4+ firms	114	44	22903	9021	1527	2255
Total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

Source: authors compilation based on RHP

The charts in the figure 4.1 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 4.1: 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

Table 4.4: 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

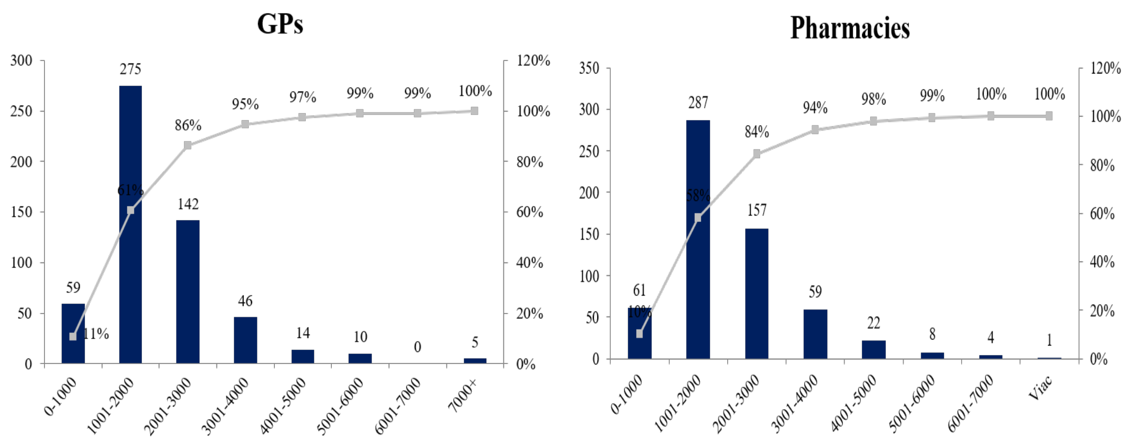
physician and pharmacy at the same time (more than two thousand). There are 43 markets with pharmacy and without a doctor at the same time. On the other hand, there are almost 160 markets with one GP, but without any pharmacy. There are also several markets with two or three pharmacies while there is 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.

4.1.2 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 4.2, 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.

Figure 4.2: Distribution of markets (municipalities) according to number of inhabitants per 1 firm, 2017

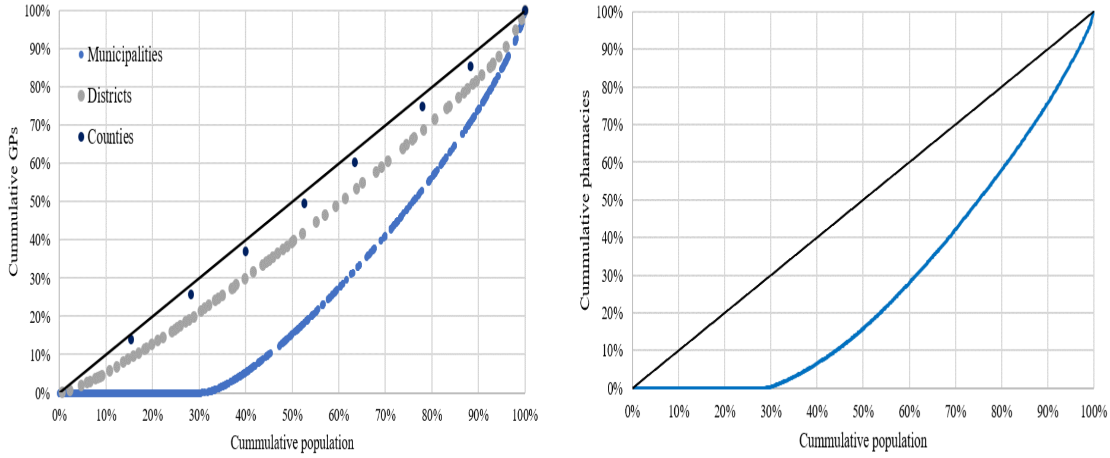


Source: authors compilation

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 4.3. 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 4.4. Figure 4.4 presents Gini coefficients for GPs in municipalities within the 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.

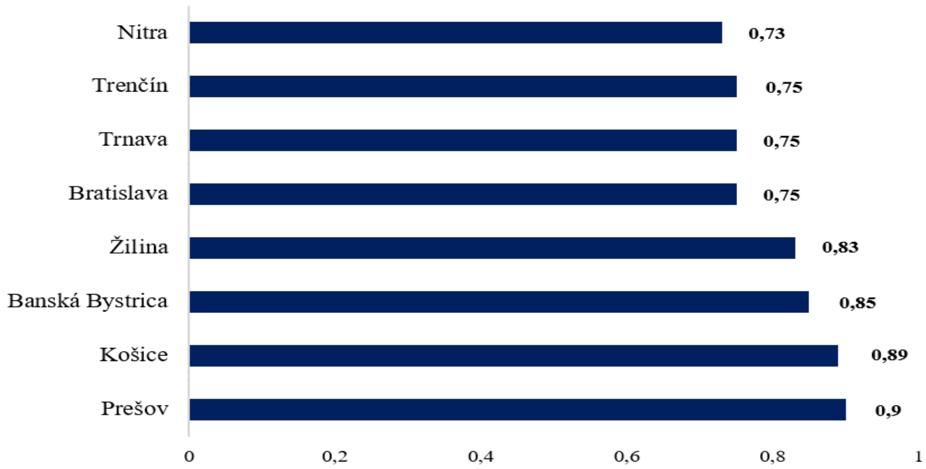
Figure 4.3: Lorenz curve for GPs (left) and pharmacies (right) distribution, 2017



Source: authors compilation

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 4.4: Gini coefficients for GPs in municipalities by county, 2017



Source: authors compilation

4.2 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.

We begin our analysis with the estimation of simple (univariate) models, where we will predict the number of firms in the market using market size and other market characteristics. Based on estimated parameters, we will also be able to calculate entry thresholds for different occupations. We will also build on Lábaj et al. (2018b) and extend the models with spatial spill-overs.

Instead of digging deeper into the analysis of the simple models, we will move to the next topic - interactions between healthcare providers. Competition and complementarities between firms can coincide. Firstly we will consider an approach suggested by Gächter et al. (2012). With this, we will extend our models in the first section.

In the next part of our analysis we will build on previous results.The main focus will be given on pharmacies and GPs, which are the two most common providers in the Slovak republic. We will build on model which was introduced by Schaumans and Verboven (2008), and we will estimate the bivariate ordered probit model, which allows us to take the entry decision of two healthcare providers into account simultaneously. Moreover, we will be able to calculate entry thresholds, which will be affected by the presence of the other type of firm. Based on the estimated thresholds, we will also simulate counterfactual scenarios by using this model. In the end, we also provide first empirical evidence on strategic interaction between three healthcare providers at the same time using trivariate ordered probit model.

4.2.1 General entry models for healthcare providers

The results from univariate ordered probit models (we will refer to as simple model) are shown in the table 4.5. We will explain the profitability of several healthcare providers (dependent variable, measured as their number in the market) with observed market characteristics - logarithm of population, average wage, market density, unemployment rate, and share of young and old population in the market. Changes in competitive pressure from the entry of new firms are measured by the ordered probit parameters (θ, cut parameters). All cut values are significant and increasing, which suggests that market structure plays an important role in determining profitability.

The coefficients estimated are consistent with our expectations. Market size (measured by logarithm of the population) has a significant impact on the number of specialists per market. The profitability of healthcare providers grows with the market size. On the other hand, wage and density have only a minimal and insignificant effect. The coefficients are significant only for the number of pediatricians.

The unemployment rate and share of the young population have the most robust effects on a number of providers, although in a different direction. The unemployment rate has a positive effect on the number of healthcare providers. GPs and ophthalmologists seem to benefit from higher levels of unemployment rates the most, together with surgeons. On the other hand, the unemployment rate has an insignificant effect on the profitability of cardiologists and ophthalmologists.

Younger people need to go to the doctor less often. The share of the young population in the market (compared to productive population) reduces the profitability of all healthcare providers. It is especially true for surgeons, cardiologists, and ophthalmologists - professions whose presence is generally associated with the older population.

Entry threshold, i.e. population necessary for a first, second, third, and fourth provider to enter the market in 2017, are plotted in figure 4.5. From the figure, it is evident that healthcare professions have different market size thresholds for entry. The

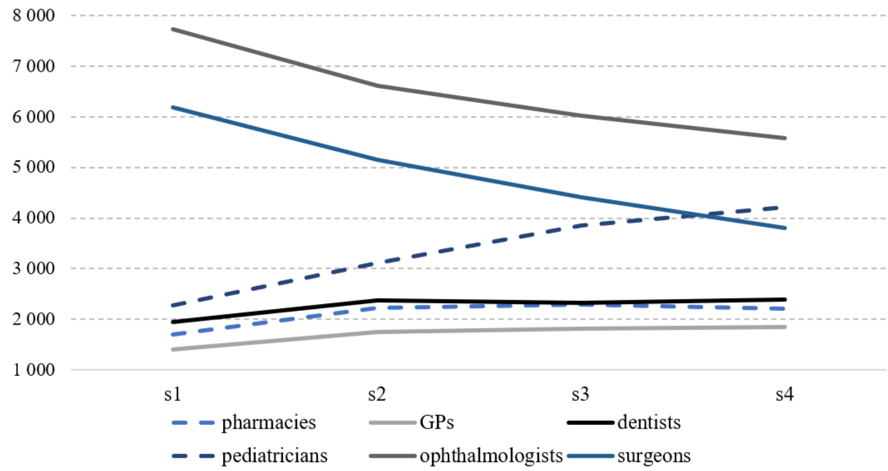
Table 4.5: Univariate ordered probit model results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	pharm4	GP4	ped4	dent4	surgeon4	cardio4	ophth4
lnpop	1.856***	1.931***	1.722***	1.782***	2.164***	1.494***	1.980***
wage	-0.0001	-0.0006	-0.0001*	-0.0002	0.0002	-0.0002	0.002
density	0.0006	-0.0002	0.0015***	0.0008	-0.0005	0.0008	0.0005
unem_rate	4.423***	7.117***	3.178*	4.194**	12.77**	4.696	6.176
young_share	-6.448***	-7.222***	-5.509***	-5.006***	-12.59*	-13.60*	-12.80*
old_share	2.462	3.754*	0.409	4.714**	1.047	-5.089	-2.098
θ_1	13.42***	13.29***	11.95***	13.56***	17.89***	11.29***	17.24***
θ_2	15.20***	15.05***	13.69***	15.16***	19.00***	12.15***	18.31***
θ_3	16.02***	15.89***	14.75***	15.84***	19.54***		18.92***
θ_4	16.48***	16.50***	15.40***	16.40***	19.84***		19.34***
N	2852	2852	2852	2852	2852	2852	2852

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

highest entry thresholds have ophthalmologists and surgeons. On the other hand, the lowest thresholds have (and therefore is it easier for them to enter) GPs and pharmacies. Entry thresholds per firm are surprisingly decreasing with the number of the firms for ophthalmologists and surgeons (possible explanations are discussed below). We show entry thresholds per firm with standard errors for chosen specialists also in table 4.6. All calculated thresholds are significant at 1 % level.

Figure 4.5: Entry thresholds for different specialists in Slovakia, 2017



Source: authors compilation

Table 4.6: Entry thresholds for different specialists, 2017

	pharm	**GPs**	**dentists**	**peds**	**ophth**	**surg**
s1	1 705	1 408	1 940	2 270	7 730	6 193
	(45)	*(30)*	*(58)*	*(81)*	*(890)*	*(541)*
s2	2 222	1 754	2 375	3 118	6 618	5 154
	(109)	*(71)*	*(130)*	*(207)*	*(976)*	*(605)*
s3	2 300	1 809	2 324	3 850	6 019	4 415
	(149)	*(100)*	*(160)*	*(373)*	*(1071)*	*(624)*
s4	2 210	1 858	2 390	4 215	5 577	3 803
	(167)	*(126)*	*(196)*	*(512)*	*(1151)*	*(604)*

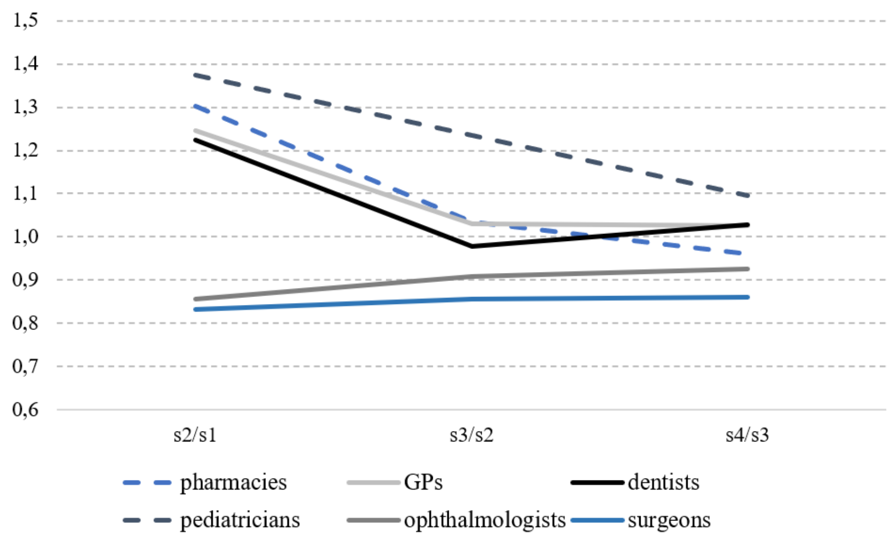
Source: authors compilation, standard errors in parentheses

all estimates significant at 1% level

Entry thresholds ratios (ETR) measures the change in population per firm with the entry of additional firms. The theory proposed by Bresnahan and Reiss (1991) suggests 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. Estimated entry threshold ratios for healthcare providers are reported in table 4.7 together with standard errors and also shown in figure 4.6. For pharmacies, GPs, dentists and pediatricians ETR gradually declines toward one with succession entry of additional firms. After the entry of the fourth firm is ETR close to 1 for each profession, with the highest ratio for pediatricians (1.09). ETR equal one means that for entry of additional provider market size grows proportionally. This can be either because of no change in toughness of competition or no change in fixed costs because of entry. Note that entry threshold ratios measure a change of competition rather than its level. Therefore, with the entry of the fourth entrant, competitive conduct (if we assume that fixed costs does not change with entry) changes only marginally for all firms but pediatricians. All estimates for entry thresholds ratios are significant at 1 % level.

Population per firm has to grow by 30 percent (1.3 times) for the second pharmacy to enter the market. However, for the third and the fourth pharmacy, the population per firm will only double (proportional increase). The intensity of competition, therefore, does not change after the entry of the third pharmacy. GPs and dentists have a very similar evolution of entry threshold ratios. The entry of the third firm does not change entry thresholds. The most significant change in the competition can be observed for pediatricians. Only after entry of the fourth pediatrician competition stops to intensify.

Figure 4.6: Entry threshold ratios for different specialists in Slovakia, 2017



Source: authors compilation

Table 4.7: Entry threshold ratios for different specialists in Slovakia, 2017

	pharm	**GPs**	**dentists**	**peds**	**ophth**	**surg**
s2/s1	1.30	1.25	1.22	1.37	0.86	0.83
	(0.06)	*(0.05)*	*(0.06)*	*(0.08)*	*(0.07)*	*(0.06)*
s3/s2	1.04	1.03	0.98	1.23	0.91	0.86
	(0.05)	*(0.04)*	*(0.05)*	*(0.09)*	*(0.08)*	*(0.06)*
s4/s3	0.96	1.03	1.03	1.09	0.93	0.86
	(0.05)	*(0.05)*	*(0.06)*	*(0.1)*	*(0.09)*	*(0.06)*

Source: authors calculation, standard errors in parentheses

all estimates significant at 1% level

On the other hand, ETRs are below 1 for ophthalmologists and surgeons. It means that the population per pharmacy declines with an increasing number of firms in the market. The decline can occur due to incorrect market specification, or the fact that the own type firm provides complementary services, and are not substitutes. The ETR remains similar even at markets defined at the district level. A similar pattern of decreasing of entry threshold also reported Lábaj et al. (2018b) for several healthcare professions. ETR significantly lower then 1 indicates that more competitive markets (with a higher number of firms) earn higher profits then monopolists. It can affect mainly professions, which concentrate in large hospitals or clinics, that are often located in densely populated municipalities. The clustering of professionals in these hospitals may attract more consumers than otherwise.

4.2.2 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 4.8 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 4.8: 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***

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

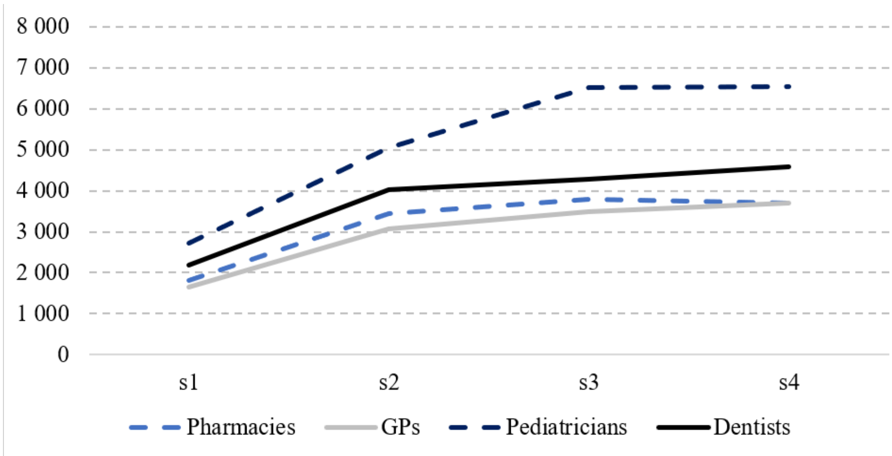
Parameter ρ in table 4.8 shows positive and significant spatial correlation for all occupations but surgeons, which indicates that spatial interactions are essential for profitability and the number of firms in the markets. The positive signs of the effect suggest that the effect of demand linkages (or 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 4.8 we calculate entry threshold population (table 4.9 and figure 4.7). Entry threshold ratios are reported in table 4.10 and figure 4.8.

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 4.7: Entry thresholds with spatial interactions, 2017



Source: authors compilation

Table 4.9: Entry thresholds with spatial interaction, 2017

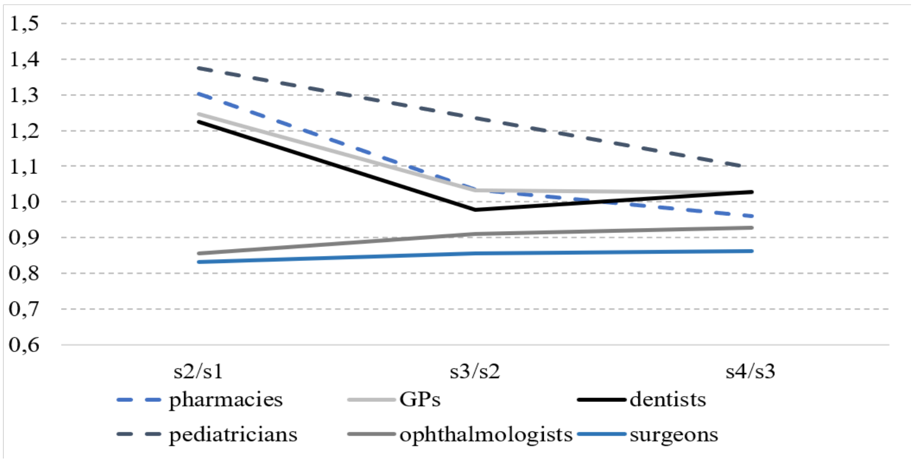
	pharm	**GPs**	**peds**	**dentists**	**surg**	**ophth**
s1	1 805	1 657	2 717	2 188	13 567	10 095
s2	3 455	3 060	5 047	4 034	14 463	11 138
s3	3 800	3 479	6 517	4 288	15 067	13 984
s4	3 706	3 691	6 535	4 594	17 252	19 505

Source: authors calculations

Evolution of the entry thresholds and also the ETR is very similar as in simple 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 4.8). 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.

Figure 4.8: Entry threshold ratios with spatial interactions, 2017



Source: authors compilation

Table 4.10: ETR with spatial interactions, 2017

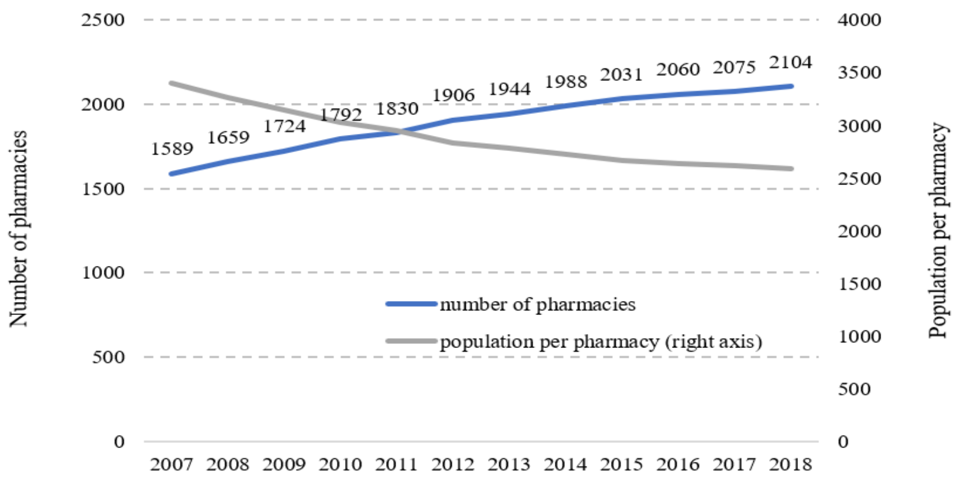
	pharm	GPs	peds	dentists	surg	ophth
s2/s1	1.91	1.85	1.86	1.84	1.07	1.10
s3/s2	1.10	1.14	1.29	1.06	1.04	1.26
s4/s3	0.98	1.06	1.00	1.07	1.15	1.39

Source: authors calculations

4.2.3 Entry of healthcare providers in 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 4.9). 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 4.9: 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 4.11. 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.

Table 4.11: 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

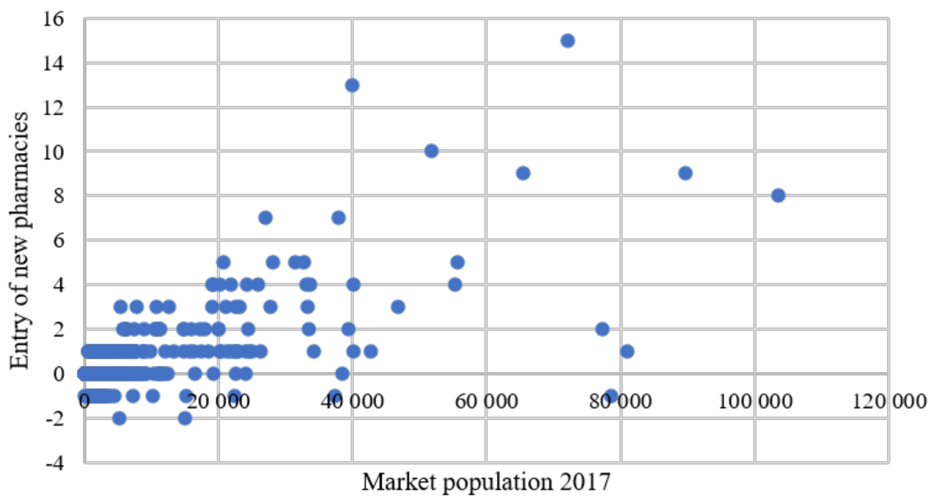
Market structures of pharmacies in 2010 and 2017 are also summarized in table 4.12. In total, the number of markets without pharmacy decreased by 32. The number of monopoly and duopoly markets has been increased by 22 during the period. On the other hand, only 13 markets with 4 or more firm in the market experienced an incrase in number of incumbents.

Table 4.12: 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

Figure 4.10: Entry of pharmacies since 2010, by market population



Source: authors compilation

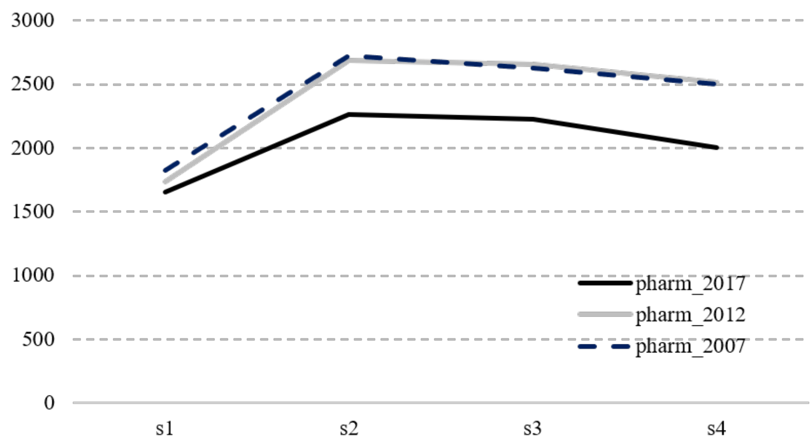
We show entry of new pharmacies into markets by market population in the figure 4.10. Most pharmacies entered into markets up to twenty thousand inhabitants. However, in most cases, only few pharmacy entered these markets. The entry of more firms (above four new pharmacies) can be observed mainly in 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 4.11 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.

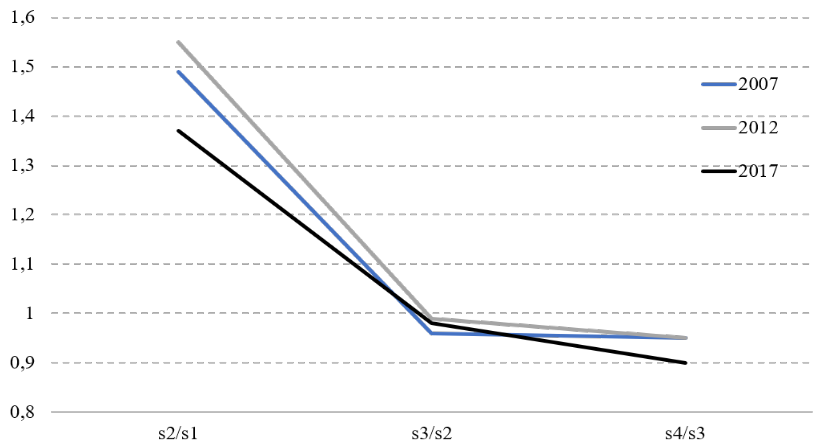
Figure 4.11: Change in entry thresholds of pharmacies in time



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



Source: authors compilation

Table 4.13: 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

4.2.4 Experimenting with market definition

We already discussed the importance of the definition of the right relevant market in previous sections. To avoid the problem with overlapping markets, we restrict our sample with municipalities with a population over 15 thousand or population density over 800 inhabitants per km^2. The restriction reduced the number of GPs and pharmacies by more than 60 %.

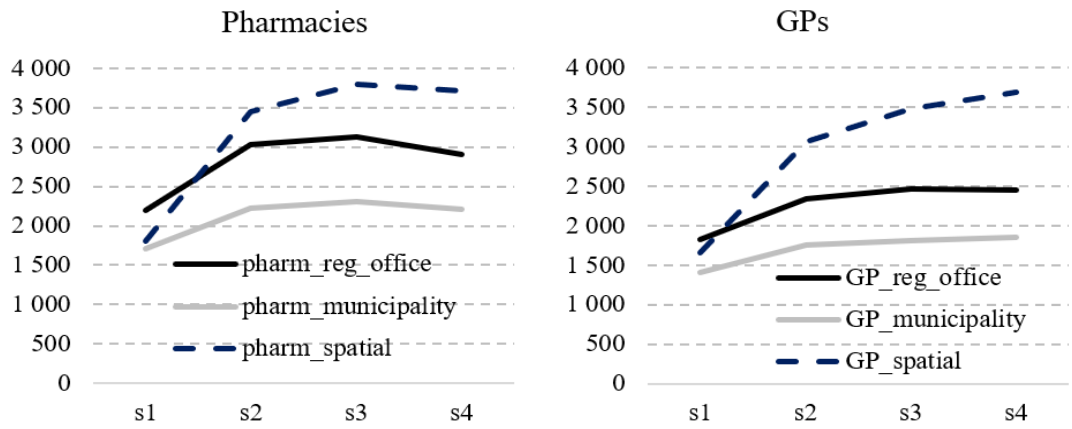
Results from ordered probit models with spatial interactions support the assumption that if other small markets surround the small market (unprofitable on its own) without healthcare providers, it will be easier for a first firm to enter. Municipalities with a small population will be, therefore, able to attract an incumbent due to these demand spill-overs. Since a simple ordered probit model can not take this effect into account, it will lead to lower entry thresholds. Indeed, the spatial models give higher entry thresholds, compared to simple model.

The substantial deviations from both models suggest (mainly for surgeons and ophthalmologists) that the market defined at the municipality level could be inaccurate. Therefore we tried different specification of the relevant market.

According to IFP (2017), Slovakia has high fragmentation of municipalities compared to other countries. Authors provided with several proposals for municipality mergers. One of them is merging small municipalities based on the mutual registry office. The merging would reduce the number of markets to 970 (the total number of municipalities is 2928). After the same restriction (total population above 15 thousand and density above 800 inhabitants per km^2) we will get 895 markets (previously 2852 markets for municipalities).

Figure 4.13 shows entry thresholds for pharmacies and GPs with market defined at the municipality level, registry office, and also model with spatial interactions. The entry threshold for monopoly is relatively similar for all models. However, entry thresholds at the municipality market are the lowest. On the other hand, the spatial model suggests the highest. Merging municipalities based on registry office moves thresholds closer to the spatial model, but not entirely. However, entry thresholds are not the most important for our research.

Figure 4.13: Entry thresholds for pharmacies and GPs for different market specification



Source: authors compilation

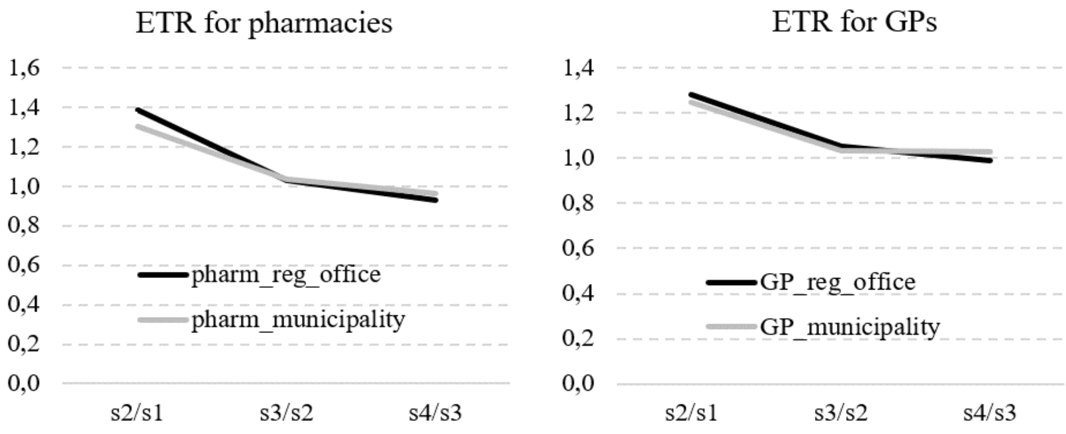
Entry threshold ratios that we use as a measure of the change in competition conduct are identical both for market defined at municipal or regional office level (figure 4.14). Different market specification, therefore, does not affect results of the change of competitive conduct with the entry of additional firms. We will use this fact for the estimation of the trivariate ordered probit model with observation defined at the regional office level.

4.3 Effects of entry between healthcare providers

4.3.1 General entry models extended by a number of other type firms

One of the main aims of this thesis is to extend existing research by the nature of the effects on profitability between Slovak GPs, pharmacies, and different healthcare specialists. We will focus mainly on investigation whether GPs and pharmacies, as the most frequent healthcare providers, benefit or are harmed by the presence of other

Figure 4.14: ETR for markets defined at municipality and regional office level, simple ordered probit model



Source: authors compilation

specialists in the market. We will also examine the size of the effect.

In this section, we will start the discussion on the effects of etnry between chosen healthcare professions. We will estimate the univariate effects of healthcare providers on the profitability of other healthcare providers. That means that the profitability of entry for GPs will be estimated independently from the profitability of pharmacies. Therefore we will not refer to these effects as strategic interaction - this will be closely examined in section 4.4.

The assumptions behind strategic interactions between healthcare providers are discussed in more detail in section 4.4. However, we would like to point out some most important assumptions also here. Patients' choice behavior drives the complementarity or substitutability of physician services in their decision to contact a GP or a specialist (Schaumans, 2008). In Slovak conditions, where referral system is in place (patient needs a referral from GP to visit a specialist), we expect a strong effect of the presence of GPs on the profitability of other specialists.

The effects between pharmacies and GPs (or other specialists) could be trickier. Schaumans and Verboven (2008) claim that the two professions' core services are potentially strong complements: physicians provide medical consultations and prescribe drugs, whereas pharmacies are responsible for selling the drugs. However, they can also operate on each other's domain - pharmacists can provide consultations to patients, and doctors can sometimes sell drugs directly from their office. Therefore they may also be viewed as providing substitute services.

Table 4.14 presents the effects of different specialists (and pharmacies) on the profitability of a GPs. Since we already discussed the estimates of the parameters in the previous section and the results extended models are consistent, we will focus on interaction effects. If we look at the effects of different specialists individually (if there is only one specialist of the other type incorporated between explanatory variables), we can observe relatively strong effects on the profitability of GPs. The effect of the presence of pharmacies is the strongest, while the effect of ophthalmologists is the smallest. However, we get slightly different (mainly smallest) results, if we include all specialists in one model. The effect of a pediatricians decline by a half. If controlling for the effects of other specialists, ophthalmologists seem to have a negative, but minimal and insignificant impact on GPs' profitability. This supports the conclusion by Atella and Deb (2008), that unobserved heterogeneity should be properly accounted for, to obtain consistent results. Pharmacies have the strongest impact on GPs profitability, followed by dentists.

A similar pattern, like for GPs, can be observed in determinants of pharmacy profitability (table 4.15). The effects of all specialists on pharmacy profitability decrease, if they all are incorporated into the model. The Effects of GPs on pharmacies are larger than vice versa. The presence of the GP in the market is therefore more important for the decision of pharmacy, then the presence of the pharmacy for GP. Moreover, the effect of GPs is significantly larger than the effects of other professions. The effect is almost two times larger than the effect of pediatricians and three times larger than the effect of the dentists. Effect of ophthalmology is again small and insignificant.

We also looked at the strategic effects of other specialists on pediatricians, dentists, and ophthalmologists. Results are reported in table 4.16. Only ophthalmologists seem to be a strategic substitute for one of the professions - specifically for

Table 4.14: Results from univariate ordered probit models for GPs, extended with number of specialists

	GP4	**GP4**	**GP4**	**GP4**	**GP4**
lnpop	1.264***	1.539***	1.410***	1.859***	1.044***
wage	-0.000541	-0.0000648	-0.000413	-0.000645	-0.000252
density	-0.000813	-0.00149**	-0.00108*	-0.000430	-0.00162**
unem_rate	5.767***	6.291***	5.703***	6.614***	5.277***
young_share	-5.048***	-5.793***	-5.750***	-6.768***	-4.619***
old_share	2.121	3.654*	1.801	3.384*	1.466
θ_1	9.022***	11.28***	9.875***	12.74***	7.760***
θ_2	11.21***	13.37***	12.01***	14.51***	10.24***
θ_3	12.49***	14.47***	13.36***	15.44***	11.90***
θ_4	13.74***	15.30***	14.77***	16.26***	13.76***
pharm4	1.192***				0.836***
ped4		1.090***			0.507***
dentist4			1.119***		0.707***
ophtalmo4				0.861***	-0.0367
N	2852	2852	2852	2852	2852

Source: authors calculation

pediatricians. Strategic interaction between ophthalmologists and pediatricians seems to be asymmetric because the latter does not affect the profitability of the former (the effect is small and insignificant). GP is the strongest complement for pharmacies, pediatricians, and dentists. However, the effect of GPs on ophthalmologists is insignificant. Ophthalmologist's profitability is influenced mostly by dentists and pharmacies (almost equal effect).

Parameter estimates for strategic interactions between specialists differ both in size and significance. This supports the hypothesis suggested by Schaumans (2008), that the strategic interaction effect could be asymmetric in the size of the effect.

Effects represented by estimated parameters in tables 4.14-4.16 were not adjusted

Table 4.15: Results from univariate ordered probit models for pharmacies, extended with number of specialists

	pharm4	**pharm4**	**pharm4**	**pharm4**	**pharm4**
lnpop	1.032***	1.419***	1.344***	1.774***	0.888***
wage	0.000568	0.000624	0.000227	-0.000135	0.000855*
density	0.000277	-0.000548	-0.000104	0.000436	-0.000402
unem_rate	-0.499	3.089*	2.409	3.767**	-0.434
young_share	-2.295	-4.408**	-4.756***	-5.832***	-1.956
old_share	0.807	3.038	0.606	2.341	0.991
θ_1	8.898***	11.40***	10.14***	12.82***	8.213***
θ_2	11.25***	13.54***	12.28***	14.61***	10.74***
θ_3	12.64***	14.59***	13.56***	15.58***	12.34***
θ_4	13.48***	15.23***	14.30***	16.23***	13.33***
GP4	1.217***				0.923***
ped4		1.079***			0.547***
dentist4			0.913***		0.293***
ophthalmo4				0.868***	0.0422
N	2852	2852	2852	2852	2852

Source: authors calculation

by the number of the own-type firm. The effect of an other-type entrant on the aggregate own-type profits would increase with the number of own-type firms. In other words - we assume that one GP would have the same effect on all pharmacies, regardless of the number of pharmacies. Regardless of whether there is one, two, or four pharmacies - the size of the GPs effect would be the same on each pharmacy. On the other hand, Schaumans and Verboven (2008) suggested dividing the effect of other type firms by the number of own types of firms in the market. This ensured that the effect of an other-type entrant on the aggregate profits of all own-type firms is independent of the number of own-type firms. If we restrict the effects of other-type entrants in the univariate model, results are different. Estimated parameters are reported in table 4.17. The effects of pediatricians are, in this specification of the models, small and

Table 4.16: Results from univariate ordered probit models for different specialists, extended with number of other specialists

	pharm4	**GP4**	**ped4**	**dentist4**	**oftalmo4**
pharm4		0.836***	0.471***	0.351***	0.560***
GP4	0.923***		0.497***	0.811***	0.221
ped4	0.547***	0.507***		0.513***	0.151
dentist4	0.293***	0.707***	0.381***		0.582***
ophth4	0.0422	-0.0367	-0.403**	0.324*	

Source: authors calculation

insignificant. GPs still have the largest effects on the profitability of other healthcare providers.

4.3.2 Spatial models

To test the robustness of interactions between healthcare professionals, we also estimated an ordered probit model with spatial spill-overs. The results are reported in table 4.18. We again show only estimated parameters for a number of other specialists. Parameter ρ is again significant. Therefore spatial spillovers are still meaningful to incorporate into the model.

The results again suggest asymmetric interactions between healthcare providers. Our main subject of interest, pharmacies, and GPs as well - the models with spatial spillovers confirm the more robust effect of GPs on the profitability of pharmacies, compared to the effect of pharmacies on the GPs. Therefore the presence of GP in the market has a greater impact on the profitability (or entry) of pharmacy.

The direction of the effects of other physicians also remains consistent with simple ordered probit models. However, the parameter estimates are more significant in models with spatial interactions. We can confirm the positive effect of pediatricians and dentists on the profitability (measured as a number of firms) of pharmacies and GPs. On the other hand, the ophthalmologist has again negative, but this time also a

Table 4.17: Results from univariate models with restricting of other type effect

	pharm4	**GP4**	**ped4**	**dentist4**
gamma_pharm_gp	1.847***			
gamma_pharm_ped	-0.0223			
gamma_pharm_dent	0.264*			
gamma_GP_pharm		1.096***		
gamma_GP_ped		0.110		
gamma_GP_dent		0.606***		
gamma_ped_pharm			0.742***	
gamma_ped_GP			1.544***	
gamma_ped_dent			0.406*	
gamma_dent_pharm				0.600***
gamma_dent_gp				1.543***
gamma_dent_ped				0.130
N	2852	2852	2852	2852

Source: authors calculation

significant effect.

Table 4.18: Results from univariate spatial ordered probit models for different specialists, extended with number of other specialists

	pharm4	**GP4**	**ped4**	**dent4**	**ophth4**
lnpop	0.3102***	0.4245***	0.285***	0.2512***	-0.141
density	-0.000	-0.000**	0.0000	-0.000	-0.000
wage	-0.000***	-0.001***	-0.001***	-0.000***	0.0007
unem	-0.000	-0.000	0.0002	-0.000	0.0012***
young_share	-6.932***	-7.477***	-6.091***	-6.356***	-12.97***
old_share	-8.497***	-8.032***	-9.734***	-7.612***	-5.056*
GP4	0.8891***		0.5176***	0.7374***	0.3722*
pharm4		0.6822***	0.418***	0.3386***	0.3263*
ped4	0.2665***	0.1546*		0.2526***	0.2152
dent4	0.1889**	0.4102***	0.2319**		0.4647**
ophth4	-0.431***	-0.470***	-0.284***	-0.320***	
rho	0.4032***	0.2131***	0.2461***	0.326***	0.3038**
θ_2	1.652***	1.447***	1.613***	1.514***	1.21***
θ_3	2.309***	2.215***	2.463***	2.216***	1.803***
θ_4	2.62***	2.669***	2.722***	2.63***	2.28***

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

4.4 Strategic interactions of healthcare providers

In the previous section, we focused mainly on competitive interaction within each of the healthcare providers. The competitive conduct does not change after the entry of the third firm (for all studied providers). Also, the correlation between healthcare providers was estimated by incorporating a number of other healthcare providers as explanatory variables. This approach allowed to identify univariate effects between healthcare providers. Results suggest that the strongest correlation is between GPs and pharmacies.

However, strategic competitive interactions can also take place between healthcare providers. According to Schaumans and Verboven (2008), the 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.

The same could also be true for other healthcare professions. In Slovakia, a referral system is in a place where a patient needs a referral from a general practitioner, in case if he needs special medical treatment from a specialist. A patient can not visit specialist without this referral. We, therefore, expect that specialists are motivated to locate near GPs to attract new patients. To save travel time, the patient could prefer to have all physicians close to each other. The providers are therefore motivated to locate near existing professional. Please note, that we are talking about proximity at the municipality level. We expect, that specialist would prefer market with a GP in it rather than without.

The degree of interaction can be asymmetric either in a volume or in direction. Schaumans and Verboven (2008) gives an example for pharmacies and GPs: "not all consultations end with a prescription, and pharmacies can sell some drugs without a prescription." We expect a similar effect between professionals - effect of the GP on a profit of specialist can be greater (or lower) than vice versa.

Schaumans and Verboven (2008) also pointed out that ”although the pharmacies and GPs core services are complementary, they regularly operate on each other domain.” A physician can, in some countries, sell drugs, and pharmacy can provide medical consultations. Sometimes maybe, therefore, viewed as providing substitute services. Schaumans and Verboven (2008) analyzed these so called inter-format interactions between pairs of professions in case of pharmacies and GPs. Cleeren et al. (2010), on the other hand, examined competition among discounters and supermarkets. The previous paper concluded that the entry threshold for both professions shifted downwards when there are additional firms of the other type reflecting strategic complementarity between both professions. The latter found that, in contrast to intuition, entry of the two first discounters have no significant effect on the performance of supermarkets in the area. Authors suggest that this is because supermarkets can focus on the more profitable price-insensitive segment when a discounter is present. Things start to change only after entry of several discounters.

Inter-format competition interaction between several firms was not studied in Slovakia yet. In the next section, we provide the first empirical results on strategic interaction between pharmacies and GPs in Slovakia. Furthermore, in another section we extend research by Schaumans and Verboven (2008) with the interaction of several pairs of healthcare providers in Slovakia.

Compared to the previous section, where we estimated the effects of healthcare providers on other providers, here, we will analyze their strategic interaction. It means that we will estimate profit functions for two providers simultaneously. For this, we will use the bivariate ordered probit model. Compared to the univariate model, the bivariate (or multivariate) model allows capturing linkages among their error processes. There may or may not be relationships among their dependent variables. If there, in fact, are correlations between the error processes, estimates, taking account of those correlations, will be more efficient than those derived from single-equation regressions.

4.4.1 Strategic interaction between pharmacies and General practitioners

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.

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?

Results from bivariate ordered probit regression, where two dependent variables are pharmacies and GPs, are reported in table 4.19. 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 4.19: 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.

Thanks to the regression estimates, we can calculate the entry threshold population and entry threshold ratios for pharmacies and physicians for both inter- and intra-format competition.

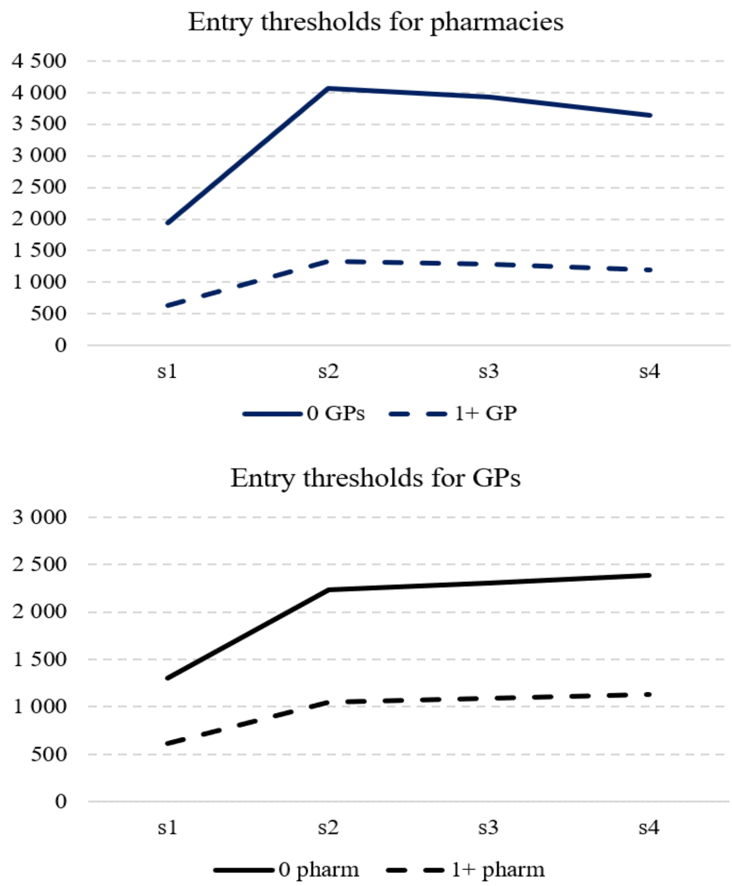
Entry barriers

Figure 4.15 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.

Figure 4.15: Entry thresholds for pharmacies and physicians



Source: authors compilation

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 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 4.20. 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.

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 comple-

Table 4.20: 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

mentarity 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 4.21: 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 summarizes in table 4.21. 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 %.

4.4.2 Strategic interaction between healthcare providers

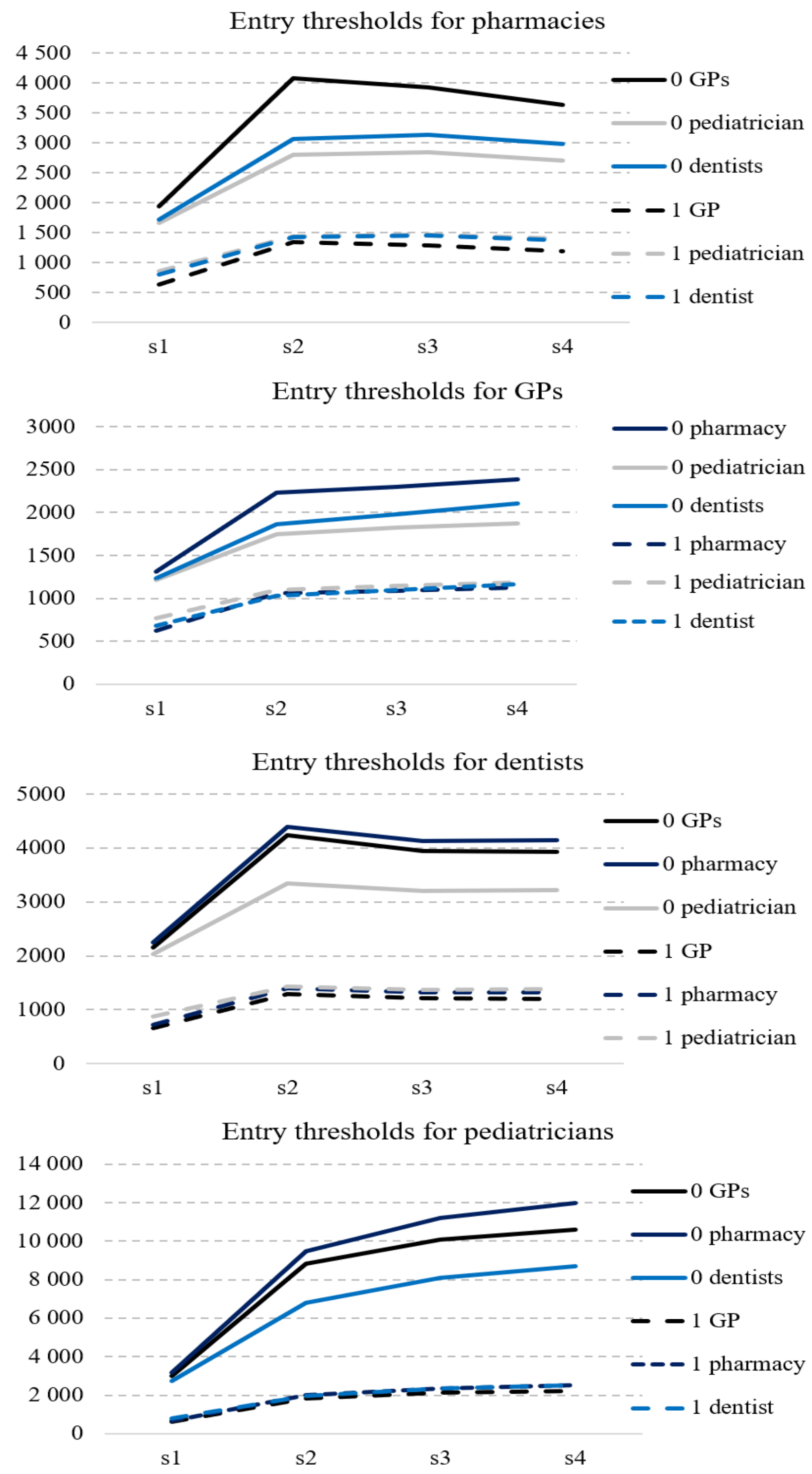
We extend the approach proposed by Schaumans and Verboven (2008) also for other healthcare providers, namely dentists and pediatricians. Both professions, together with GPs, represent primary healthcare. In each model, we examine strategic interaction between two professions, using a bivariate ordered probit model. This gives us markets for four providers with strategic interaction of other three providers in each of them.

Since the estimated parameters from the models are consistent with the parameters from table 4.19 for pharmacies and GPs, and differs only in the volume, we do not report them. Instead, we focus on estimated entry thresholds and later on inter-format ETR.

Every chart in figure 4.16 shows the market for different healthcare provider - pharmacies, GPs, dentists, and pediatricians. For each occupation, the effect of the entry of the other three 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. Please note, that although every chart shows interactions with 3 professionals, every pair was estimated separately.

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

Figure 4.16: Entry thresholds for pairs of healthcare providers



stronger than vice versa.

The results of strategic interaction between chosen healthcare providers are summarized in table 4.22, 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 and dentists by 70 % and by 80 % for pediatricians.

Table 4.22: Inter-format entry threshold ratios

	Market of the healthcare provider			
Effect of healthcare provider	GPs	Pharmacies	Pediatricians	Dentists
GPs	x	0,3	0,2	0,3
Pharmacies	0,5	x	0,2	0,3
Pediatricians	0,6	0,5	x	0,4
Dentists	0,6	0,5	0,3	x

Source: authors calculations

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 and dentists, but a smaller impact on GPs. Entry thresholds for GPs will decrease ”only” by 50 % after the entry of additional pharmacy.

On the other hand, the GPs benefit from the entry of other professions the least, followed by pharmacies. 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 or dentist, to avoid long travels.

Note that entry thresholds, shown in figure 4.16, 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 dentist or pediatrician. On the other hand, entry thresholds with at least one specialist of the other type are almost identical for each profession.

4.5 Strategic interactions between three professions

Strategic interaction between firms (especially in healthcare) is still relatively little covered in Industrial Organization empirical literature, even though it has important implications for firm entry and competition behavior. Existing literature conclude substantial impact on regulation outcomes of these effects.

Schaumans and Verboven (2008) focused exclusively on the relationship between pharmacies and GPs, while Schaumans (2008) analyzed strategic interactions between several pairs of professionals. The previous paper concludes the decrease in entry barriers if another profession is present in the market. Regulation in one profession can also affect the other, which affects the availability of healthcare services for patients. Authors found that the entry restrictions have directly reduced the number of pharmacies by more than 50 %, and also indirectly reduced the number of physicians by about 7 %. Removal of the entry restrictions, combined with a reduction in the regulated markups, would generate a substantial shift in rents to consumers, without reducing the availability of pharmacies.

Paper by Schaumans (2008) concluded important implications for gate-keeping by GPs. In Belgium, in contrast to Slovakia, there is no referral system. Its introduction can have an important impact on interaction again. The author suggests that some healthcare specialists are strategic complements (gynecologists, TNE-specialists), and some are strategic substitutes in the entry decision of GPs (dermatologists, ophthalmologists, psychiatrists). Policy implication from the paper is, that although introducing mandatory referral schemes would improve inefficiency, it would generate sustainability problems for the current body of specialists.

Significant strategic interactions (mainly complementary) also suggest the first empirical results for Slovakia (see previous sections). The strong effect can be observed between pharmacies and GPs. However, also a number of pediatricians or dentists have a positive effect on GPs and pharmacy's payoffs. On the other hand, the effect of ophthalmologists seems to be ambiguous.

While bivariate ordered models were used by Schaumans and Verboven (2008) and Kleese (2010), trivariate ordered models are not that common in Industrial Organization literature yet. We extend existing literature with interactions between the trinity of healthcare providers.

Results from univariate ordered probit models, extended with a number of other type firms, showed that the size (and sometimes also direction) of the effect of specialist changed if several providers were included at the same time. Moreover, the multivariate approach also allows capture correlation between error terms.

4.5.1 Market definition and descriptive statistics

The spatial distribution of firms in Slovakia is affected by the fragmentation of municipalities. Approximately one-third of a population lives in a municipality without GP or pharmacy. Despite previous studies in Slovakia, where the market was defined at a municipality level, we will try a different approach. We will aggregate municipalities based on the residency of a regional office. This simplification affects mainly small villages. The number of markets declined from 2928 municipalities to 895 markets. The lower number of observation also makes estimation of the trivariate ordered probit model easier.

The merger of small municipalities significantly reduced share of markets without healthcare providers (for all examined professions). While for the market defined as a municipality, over 82 % were without pharmacy, now it is only 46 % (total numbers decline from 2328 to 415). On the other hand, total numbers for markets with more than one provider changed only marginally (as expected, because the merger affected almost entirely only small municipalities). See section x for a more detailed discussion on the effects of the different market specifications. Outcomes of competitive conduct do not change with the different market specification, which is essential for our analysis.

Table 4.23: Number of markets by healthcare professional

	N=0	N=1	N=2	N=3	N=4+
GP4	336	385	94	32	48
pharm4	415	362	62	18	38
dentist4	488	298	49	25	35
pediatrician4	537	281	49	17	11

Source: authors calculation based on data from RHP, aggregated at regional office level

Table 4.24: Descriptive statistics at regional office level

Variable	**Obs**	**Mean**	**Std.Dev.**	**Min**	**Max**
lnpop	895	7.8	0.76	3.6	9.6
wage	895	881	112.65	658.0	1450
unem_rate	895	0.04	0.03	0.0	0.2
density	895	83.5	66.58	0.5	737
young_share	895	0.2	0.04	0.05	0.4
old_share	895	0.2	0.03	0.04	0.4

Source: authors calculation based on data from RHP, aggregated at regional office level

4.5.2 Empirical results

Results from trivariate ordered probit

In the previous analysis, we focused mainly on pharmacies and GPs, which are the most prevalent healthcare providers in Slovakia. They also represent the first contact for a patient in need. Pharmacies and GPs are strong complements, one benefit from the presence of the other. Compared to the two professions, strategic interactions with other professionals are weaker. What is more important, however, is that pharmacies, GPs, pediatricians and dentists are all strategic complements, if we looked at each pair. We will extend the analysis by looking at the trinities of providers. Preliminary results suggest that strategic effects are asymmetric not only in size but also in sign.

We discuss results for the trivariate model for pharmacies, GPs, and pediatricians in more detail. For other models (pharmacies, GPs and dentists and GPs, pediatricians, and dentists), we show only inter-format ETR. Results from regressions and figures are reported in annex.

Pharmacies, GPs, and pediatricians

The estimated parameter, which represents strategic interaction effects from trivariate ordered probit for pharmacies, GPs, and pediatricians are reported in table 4.25. Significant parameters for rho confirms the importance of the usage of the trivariate specification. Highest ρ can be observed between pharmacies and pediatricians, the lowest between GPs and pediatricians.

From the other-type fixed effects can be observed asymmetry only in volume but also in sign. Trivariate model confirms strategic complementarity between GPs and pharmacies. Effect of a GPs on pharmacies is again two times larger than vice versa.

Pharmacies have a positive effect on pediatrician profitability. A pediatrician can benefit from the presence of the pharmacy because his patients can go from his office straight to pharmacy. However, the effect is not symmetric - the effect of pediatricians on pharmacy is significant and negative. However, both effects are relatively small compared to the effects of pharmacies and GPs. The substitution can also be observed in the market configuration in table 4.26. Two pharmacies are present in 33 markets with exactly two pharmacies. However, if an additional pediatrician enters a market (two of them are present in the market), there are only 18 markets with two pharmacies.

Asymmetry can also be observed in strategic interaction between GPs and pediatricians. GPs have a significant and robust effect on the profitability of pediatricians. The effect is even more significant than the effect of GPS on pharmacies. Pediatricians have a negative effect on the entry of GPs. However, the effect is insignificant.

Table 4.25: Trivariate ordered probit model for pharmacies, GPs and pediatricians

	pharm4	**GP4**	**ped4**
lnpop	1.936***	2.098***	2.011***
wage	0.000	0.000	0.000
unem_rate	-3.12	4.272**	1.103
density	0.001*	0	0.001**
young_share	-2.87	-4.02**	-3.17
old_share	7.595***	10.18***	1.371
gamma_pharm4_GP1	1.463***		
gamma_pharm4_ped1	-0.33***		
gamma_GP4_pharm1		0.670***	
gamma_GP4_pediater1		-0.13	
gamma_ped4_GP1			1.561***
gamma_ped4_pharm1			0.393*
/atanhrho_12		0.535***	
/atanhrho_13		0.598***	
/atanhrho_23		0.380***	
θ_1	16.43***	17.29***	16.34***
θ_2	18.72***	19.34***	19.09***
θ_3	19.42***	20.28***	19.88***
θ_4	19.78***	20.91***	20.53***
rho_12		0.489	
rho_13		0.535	
rho_23		0.362	
N		895	

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

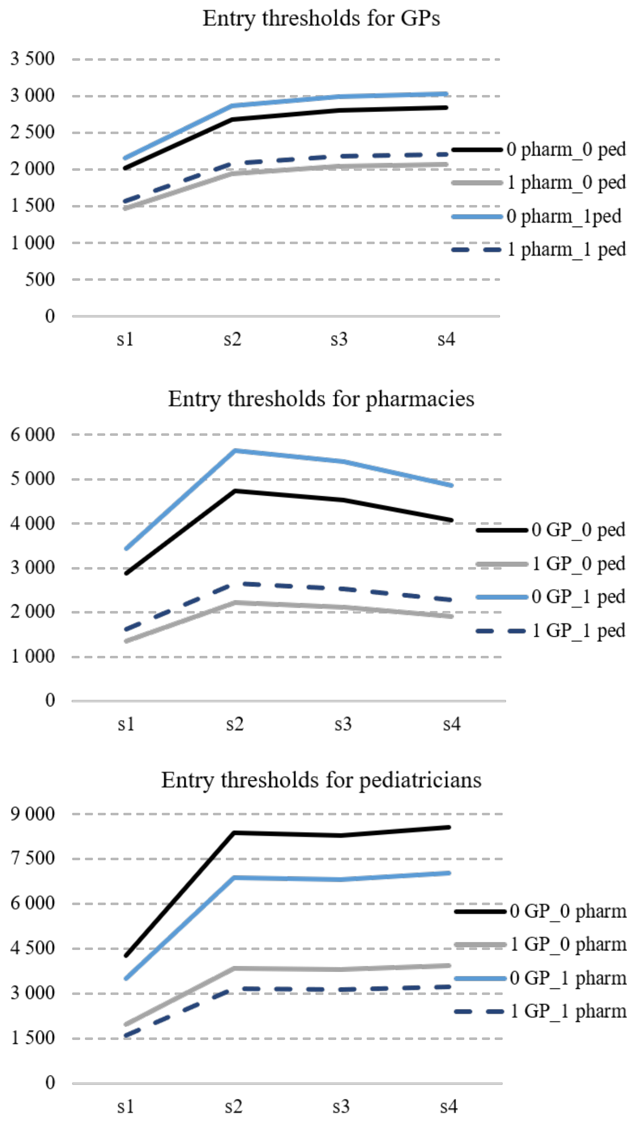
Figure 4.17 shows entry thresholds for GPs, pharmacies, and pediatricians, calculated based on parameters estimated from the trivariate ordered probit model. Entry thresholds enable us to compare the effects of the entry of specific professions and also overall effects after entry of both other type firms. We were also able to calculate other-type entry threshold ratios, shown in table 4.27.

The presence of a pediatrician in the market increase entry thresholds for GPs. The effect is, however, small (only 7 percent). On the other hand, entry of additional pharmacy decreases entry thresholds of GPs almost by 30 percent. If there is at least one pharmacy and at least a pediatrician in the market, entry thresholds will decrease (complementary effect of a pharmacy prevails). However, the decline is smaller (22 percent) compared to the situation when there is the only pharmacy without pediatrician.

Table 4.26: Market configuration for pediatricians and pharmacies

	pediater4					
pharm4	0	1	2	3	4+	Total
0	381	34	0	0	0	415
1	145	203	14	0	0	362
2	8	33	18	3	0	62
3	2	6	6	4	0	18
4+	1	5	11	10	11	38
Total	537	281	49	17	11	895

Figure 4.17: Entry thresholds from trivariate model



Source: authors compilation

The presence of a pediatrician increases the entry threshold for pharmacies by 20 percent. However, additional entry of a GP would almost totally outweigh that effect. ETR for GPs without and with the pediatrician is almost the same.

Both pharmacies and GPs have complementary effects on pediatricians. Therefore an entry of both will decrease entry thresholds of pediatricians. The entry of pharmacy decreases the entry threshold by more than 50 %, entry of GP only 20 %.

The presence of both at the same time would lead to a decrease of entry thresholds over 60 %.

Table 4.27: Inter-format ETR for pharmacies, GPs and pediatricians

	pharmacies	GPs	pediatricians
pharmacies		0.73	0.46
GPs	0.47		0.82
pediatricians	1.19	1.07	
total effect	0.56	0.78	0.38

Pharmacies, GPs, and dentists

Similarly to pediatricians, dentists have a negative effect on the profitability of pharmacies since the estimated parameter is significant and negative. The presence of a dentist, therefore, increases the entry threshold of pharmacies by approximately 17 %. On the other hand, the effect of pharmacies on dentists is small and insignificant. The explanation can be that patients leaving the dentist office (practice) usually do not need drugs (maybe only something for pain). If we look at the market configuration, it can be observed that pharmacies are negatively correlated with dentists.

Dentists have a negligible and insignificant effect on the profitability of GPs. The entry threshold remains the same regardless of the presence of a dentist in a market. However, the effect of GP on dentists is very robust and significant. Entry thresholds, therefore, decrease to 50 % of the original size, if a dentist is already in the market.

Dentists benefit from the presence of both professions, the entry threshold decrease below 50 % if both other-type firms are present. Even after the negative effect of dentists, the overall entry threshold is lower for pharmacies than for GPs, if both other-type firms are present.

GPs, pediatricians and dentists

The last model we have estimated is with strategic interactions between GPs,

Table 4.28: Inter-format ETR for pharmacies, GPs and dentists

	pharmacies	GPs	dentists
pharmacies		0.74	0.92
GPs	0.46		0.50
dentists	1.17	0.97	
total effect	0.54	0.72	0.46

pediatricians, and dentists (table 4.29). Interactions between pediatricians and dentists are relatively small, negative, and insignificant. The effect of GP on pediatricians and dentists is (again) powerful and significant. Entry thresholds for pediatricians drop to almost one-third of an original volume if the GP is present. The entry threshold for dentists, on the other hand, declines almost by 60 %. In this specification of the model, the presence of both dentists and pediatricians decreases the entry thresholds of GPs. However, the effects are not very strong. The entry thresholds decrease only by 8 and 14 percent.

Table 4.29: Inter-format ETR for GPs, pediatricians and dentists

	GP	pediatricians	dentists
GPs		0.36	0.43
pediatricians	0.92		1.12
dentists	0.86	1.09	
total effect	0.79	0.39	0.48

Why are the results from bivariate and trivariate models so different?

Results from trivariate models are significantly different compared to bivariate models. Based on parameter estimates from trivariate models, pediatricians and dentists seem to have a negative effect on the profitability of pharmacies. Does this mean that pharmacies and pediatricians are, in fact, substitutes? We assume that not. The explanation could be more straightforward - GPs and pharmacies have lower thresholds for market entry. Therefore we expect that GPs and pharmacies are already in the market when first pediatricians decide to enter. The full complementary effect is, therefore captured by the interaction between pharmacies and GPs, which caused that the interactions between pharmacies and pediatricians (or dentists) are relatively smaller.

4.6 Counterfactual analysis

4.6.1 Entry of new pharmacies due to strategic interactions

A paper by Schaumans and Verboven (2008) suggest that removal of the entry restrictions, combined with a reduction in the regulated markups, would generate a substantial shift in rents to consumers, without reducing the availability of pharmacies in Belgium.

Inspired by these results, we simulate some changes in the market structure of pharmacies and physicians in Slovakia and examine its direct and indirect effects. This results will be driven by behavioral effect, not in changes in external market conditions such as demand or cost characteristics.

Predicted entry of firms

In our scenario, we would like to observe what would happen with a number of pharmacies if there were better coverage of rural areas by physicians.

In the first step, we will predict the expected number of firms on 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) as optimal. According to Kišš (2018), there is a shortage of physicians in Slovakia - there are currently 1500 GPs missing. Based on the comparison, we will be able to identify exact markets with a lower than predicted number of physicians.

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:

$$E(y_i) = \sum Pr(y_i = N | S_{gp}, S_{pharm})N. \tag{4.1}$$

Tables 4.30 and 4.31 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 4.30: 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 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.

Table 4.31: 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

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. What is even more interesting, the model predicts that 4 markets that are vacant at the moment should have three GPs.

Despite the low number of markets with higher than predicted numbers of physicians, it would be interesting to examine possible over-prescription of drugs in these markets, in line with research by Schaumans (2015), who concluded over-prescription of drugs in case of more intense competition.

Simulated entry of new firms

In the next step, we will simulate the entry of new physicians into markets, where the predicted number of physicians is one higher than the observed number (e.i. one physician will enter the market where the model predicts a shortage of one physician). This situation is shown in table 4.32. This assumption increases the number of physicians by 349. Specifically, we simulate entry of 228 new physician into vacant markets (so new monopoly markets emerge) and entry of 85 GPs into previously monopoly markets.

Based on these predictions, we are subsequently able to estimate additional entry of pharmacies thanks to the presence of new physicians through complementary effect. The presence of new GPs decrease entry thresholds for pharmacies, as we showed

Table 4.32: 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

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 4.33. There would be the additional entry of 176 pharmacies following the new entry of physicians. Most pharmacies (164) would enter currently vacant markets and became monopolies. Another 12 pharmacies would enter current monopoly markets. Note, that the effect would be stronger if we simulate entry of all predicted physicians (e.g. where our model predicts entry of two physicians with zero observed).

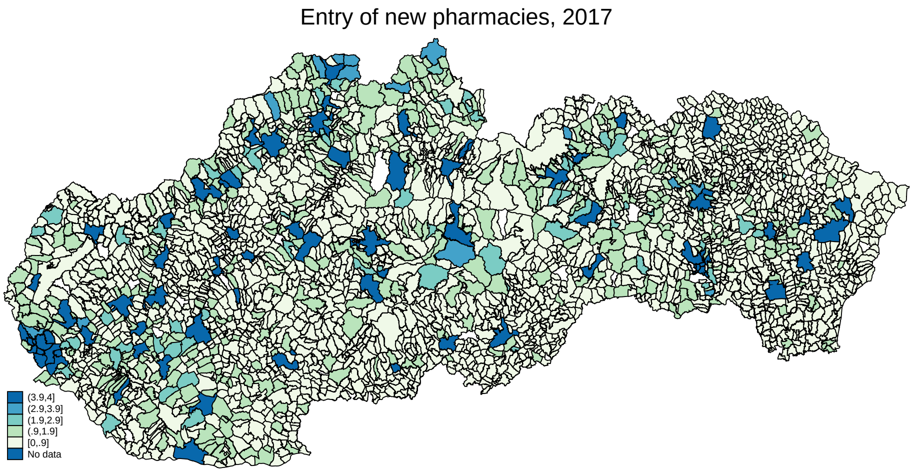
Table 4.33: Entry of new pharmacies following entry of GPs

	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. We show markets with the entry of new pharmacies following the entry of physician on a

Figure 4.18. However, since we restricted our sample to avoid overlapping markets, the presented results of empirical analysis focus mainly on smaller (often rural) areas.

Figure 4.18: Entry of a new pharmacies following new entry of physician



4.6.2 Regulation of pharmacies based on population

Government manifesto of the government elected in 2020 committed to introduce new regulation of pharmaceutical market based on demographic-geographic criteria. In this section, we provide with simple description of the possible effects of restriction of pharmacy network based on population criteria.

Until 2004, there had to be at least 5000 inhabitants per pharmacy in the market in Slovakia. Based on our data, we are able to show how would the market configuration would look like, if the new government decided to introduce the same regulation.

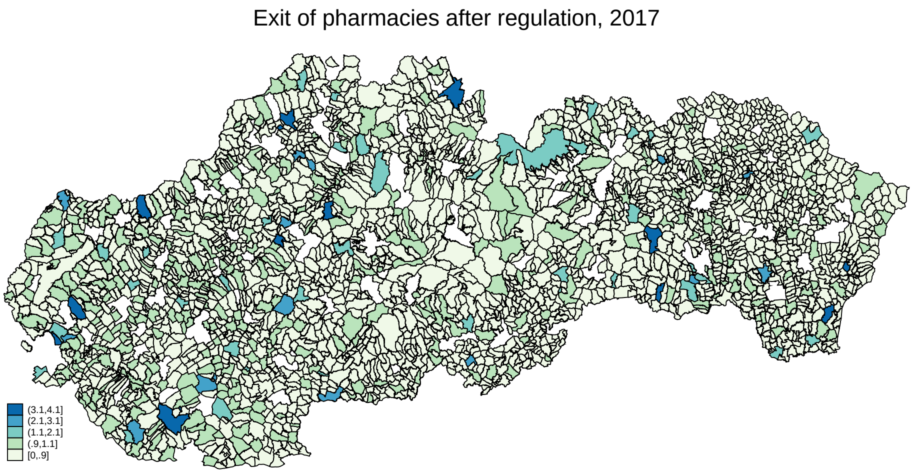
Table 4.34 shows comparison of actual and "regulated" market configuration for pharmacies. Numbers on the diagonal represents markets, which would not be affected by the regulation. Above the main diagonal we are able to observe markets, where population per pharmacy is currently above the thresholds. Under the diagonal we observe markets, that would experience exit of pharmacies, if such regulation would be introduced.

Table 4.34: Predicted exit due to regulation of pharmacies

	Regulation of pharmacies					
pharm4	0	1	2	3	4+	Total
0	2292	32	0	0	0	2324
1	280	122	0	0	0	402
2	18	41	3	0	1	63
3	1	15	6	0	0	22
4+	0	15	26	13	60	114
Total	2591	225	35	13	61	2925

Almost another 300 markets (compared to current state) would remain without pharmacies after the regulation, of which 280 are current monopoly markets. Altogether, 415 markets would experience some decline in number of pharmacies. Total reduction in number of pharmacies would be 589. On the other hand, 32 markets would have space for entry of new pharmacies.

Figure 4.19: Entry of a new pharmacies following new entry of physician



Summary and conclusions

Health is one of the most critical areas that influence the quality of life. Quality of healthcare has an important impact on every member of society, not only on his health status, but it also enhances access to education and the job market, increases productivity and wealth, reduce health care costs, improve relations, and of course, brings a longer life (OECD, 2020).

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.

The intersection between healthcare economics and Industrial Organization (IO) is currently a hot research area (Snyder and Tremblay, 2018). Even though healthcare professions have their specifics, they are not necessarily more distinctive than other markets that IO economists have studied for decades. The tools that have been used by IO economists can also be applied to health markets. By studying the relationship between market structure and measures of market size, which is a central concept for IO, economists can gain insight into the determinants of firm profitability, the role of fixed and sunk costs, as well as the nature of competition.

Entry model pioneered by Bresnahan and Reiss (1991) (in Slovak conditions already employed by Lábaj et al. (2018b)) 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). Moreover, the approach proposed by Schaumans and Verboven (2008) or Cleeren et al. (2010) also allows estimating inter-format ETR - change in entry thresholds with the entry of the additional type of the other type. The assumption is that firms (in our case healthcare providers) can benefit from the near presence of each other if they provide complementary services. Better coverage of one profession (e.g. GPs) can, therefore, ease entry for another profession (pharmacies).

The empirical research of this doctoral thesis focused on the analysis of changes in healthcare markets in the Slovak economy. The research covers several healthcare providers (pharmacies, GPs, dentists, pediatricians) and occasionally a few more (e.g. ophthalmologists). However, the main subject of research is the relationship between pharmacies and GPs. Both GPs and pharmacies represent an entry point to the healthcare for almost every patient.

This research extends the existing literature in several ways. (1) Until now, only competitive conduct within pharmacies, physicians, and dentists was studied in Slovak healthcare markets (Lábaj et al., 2018b). We extend the research with other healthcare providers, such as pediatricians, ophthalmologists, cardiologists, or surgeons. Moreover, we provide updated estimates for pharmacies, GPs, and dentists as well. (2) Strategic interactions between healthcare providers are the area which has not been examined very often until now (we are aware of the two papers by Schaumans and Verboven (2008) and Schaumans (2008)). We employ a bivariate ordered probit model, used by the former on pharmacies and GPs, to examine strategic interactions between several pairs of healthcare providers in Slovakia. Above the relationship between pharmacies and GPs, we also examine the effects of pediatricians and dentists. (3) The bivariate approach was already used in several papers analyzing the relationship between market structure and market size (e.g. Cleeren et al. (2010) for supermarkets and discounts). However, as far as we are aware, the trivariate model has not been employed yet. We provide first empirical evidence on the strategic interactions between three professions, specifically healthcare providers in local Slovak markets.

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 affects 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.

Schaumans and Verboven (2008) presented first empirical evidence on the relationship between GPs and pharmacies using a bivariate ordered probit model. We build on this approach and estimated strategic interactions between these two professions in Slovakia, to provide evidence on the effects of an increase in GPs supply in rural regions on entry thresholds of pharmacies and other healthcare professions. Moreover, we extend the literature with strategic interactions between other professionals as well - specifically pediatricians and dentists. We can confirm that GPs and pharmacies are strong complements compared to the effects of other specialists. Results from the bivariate model suggest that GPs, pharmacies, pediatricians, and dentists provide mutually complementary services. Nevertheless, the effects are asymmetric in size.

In Slovakia, mandatory referral schemes is implemented, where a GPs decide on the access of patients to specialist care. GPs should therefore have especially substantial impact on profitability of specialists in Slovakia. Based on our results we conclude that GPs are the most robust complement for all examined specialists. Entry thresholds tend to decrease by 70-80 % with the presence of the GP. Effects of other specialists on profitability of a GPs are smaller. The results support our expectation, that because of mandatory referral system in Slovakia, GPs are strong complements for all examined specialists.

Trivariate models have not been employed for the estimation of IO entry models yet. In this thesis, we provide with first empirical results from trivariate ordered probit models, where we can take interactions between three healthcare providers simultaneously into account. Results from univariate models, where numbers of different specialists were included between explanatory variables, suggest that size of the positive effect decline if more specialists were included in the models. If we estimated the trivariate ordered probit model for pharmacies, GPs, and pediatricians, we would observe the negative effect of pediatricians on the profitability of pharmacies and GPs. This is an important finding, even though the effects are relatively small and in case of GP insignificant. This suggest that a bivariate approach can provide biased estimates of the complemenarity between professions. GPs and pharmacies have lower thresholds for market entry, compared to other professions. Therefore we expect that GPs and pharmacies are already in the market when first pediatricians decide to enter. The full complementary effect is, therefore captured by the interaction between pharmacies and GPs, which caused that the interactions between pharmacies and pediatricians (or dentists) are relatively smaller.

Based on our estimation of entry thresholds, we are able to estimate the expected number of firms (pharmacies and physicians) on each market. Predicted market configuration of pharmacies is closer to prediction from our model compared to GPs. We also implemented a counterfactual scenario to estimate additional entry of pharmacies thanks to the presence of new physicians. The better coverage of GPs in the market (where the model predicts that 1 GP is missing) would lead to entry of new pharmacies. Specifically, there would be an additional entry of 176 pharmacies following the simulated new entry of 349 physicians. Moreover, we examined the possible effect of the demographic regulation set on 5000 inhabitants per pharmacy. Such regulation would lead to an exit of 589 pharmacies from 415 markets.

Several methodological challenges should be addressed in future research in more detail. Most importantly, first results from trivariate model that we presented in this research, substantially differ from bivariate model results. Future research should focus exclusively on the explanation of these effects. Moreover, specific attention that could shed more light into this problem, should be given to multiple equilibria problem, which we briefly discussed in section 3.1.3. At last but not least, the results from univariate ordered spatial models provided with more consistent results for entry thresholds for several healthcare providers (especially ophthalmologists and surgeons) compared to simple model, but also enabled to control for spatial spill-overs. Future research should extend also bivariate (or multivariate) models with spatial interactions.

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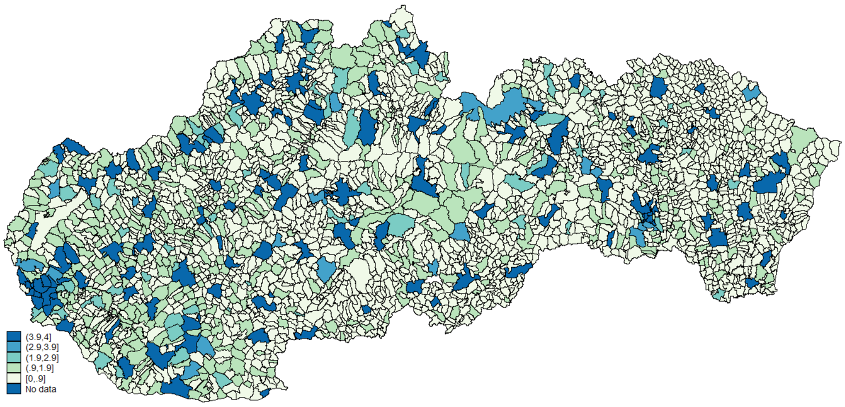
Appendices

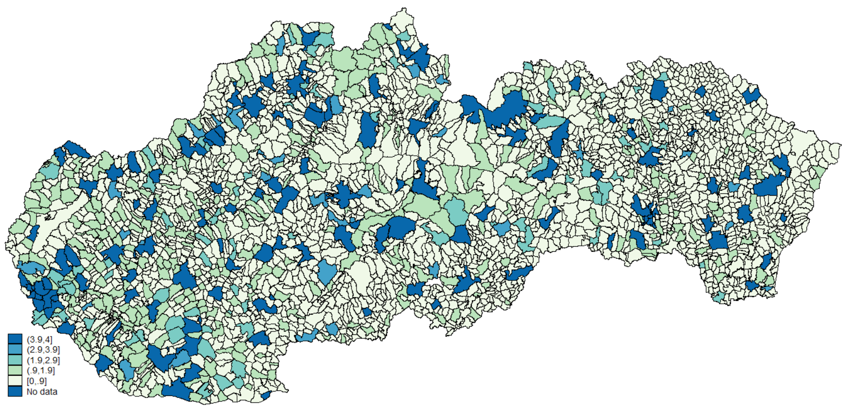
Appendix 1: Density of pharmacies and GPs in Slovak municipalities in 2017

Figure 20: Density of pharmacies in Slovakia



Source: authors compilation

Figure 21: Density of physicians in Slovakia



Source: authors compilation

Appendix 2: Results from trivariate ordered probit model

Table 35: 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 36: 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 22: Entry thresholds from trivariate model

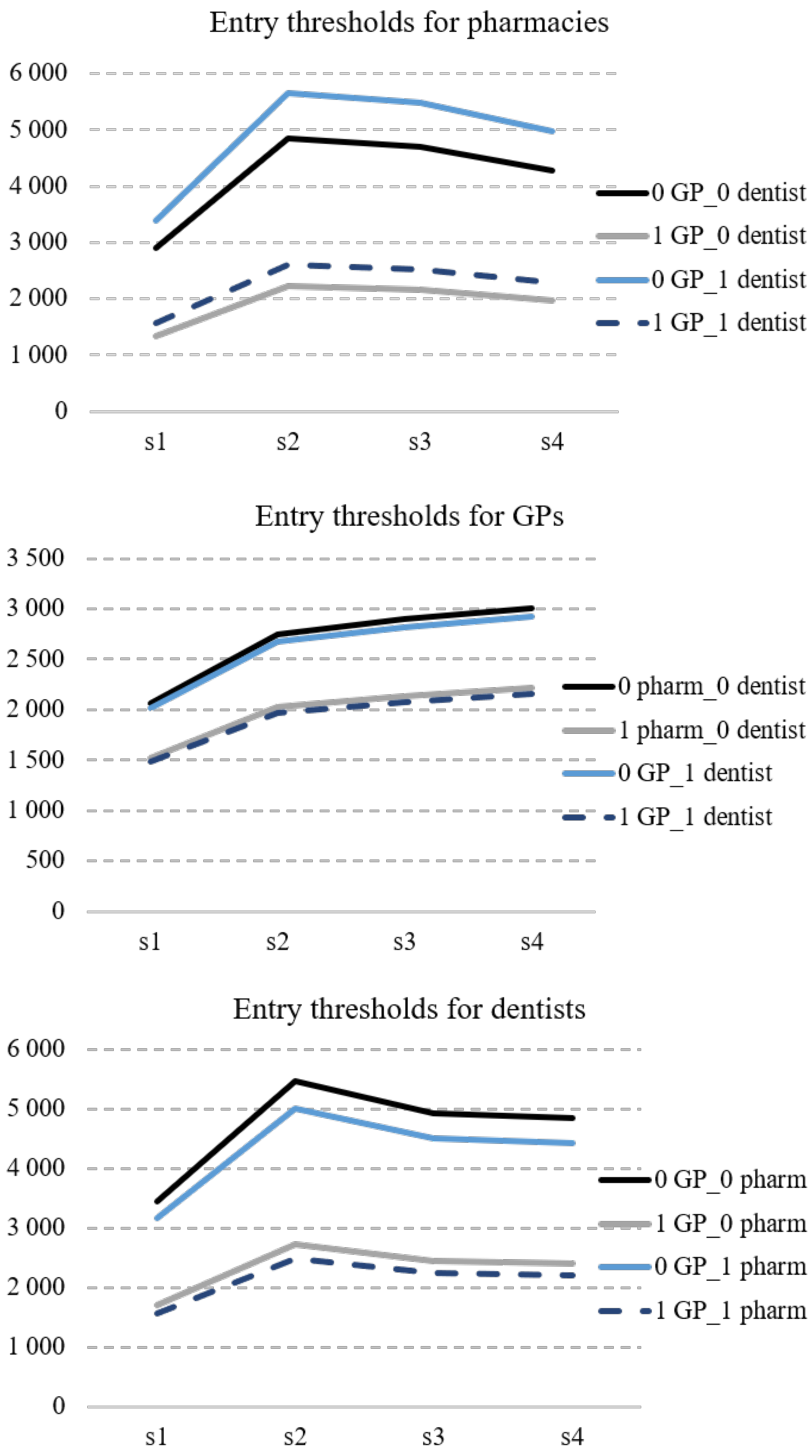


Figure 23: Entry thresholds from trivariate model