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Catherine Schaumans

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COMMITTEE

Advisors:	Prof. Dr. Frank Verboven
	Prof. Dr. Hans Degryse
	Prof. Dr. Pedro Pita Barros
	Prof. Dr. Michael Mazzeo
	Prof. Dr. Erik Schokkaert
	Prof. Dr. Patrick Van Cayseele

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Chapter 1

Introduction

What makes for a good health system? What makes a health system fair? And how do we know whether a health system is performing as well as it could? These questions are the subject of public debate in most countries around the world.

Gro Harlem Brundtland, the former Director-General of the World Health Organization of the United Nations in the World Health Report of 2000 on health systems

It is remarkable that there are such large differences in the way countries organize their health care system. The extent to which patients carry the costs of their medical consumption varies considerably across countries and the provision of health care services is in some countries based on private provision of care, while elsewhere mainly or exclusively public health provision is in place. Furthermore, there is a wide variation in the degree of regulation on market entry, pricing and product offering across countries and across health professionals.

Despite the differences in the organization of health care markets, virtually all countries of the world are facing important increases in the health care budget. Over the last two decades, the aging of the population, the higher levels of chronic disease and disability and the increased availability of new treatments and technology have exerted upward pressure on overall health-related expenditure (Saltman and Figueras 1997). OECD reports that health care budgets have increased with more than 50% since 1980. In 2005, the average OECD country spent 9% of GDP on health care provision and for the period 1995-2005, health care spending on average grew faster than GDP.

Health care reforms to contain costs have therefore been part of the political debate since the eighties. Over the last decade, the focus of policy has however shifted to the micro-level. That is, there is a growing belief among policy makers that health systems are not performing efficiently (Saltman and Figueras 1997). To increase the incentives for efficient behavior, some countries are now implementing ambitious reforms of their health system such as the implementation of performance measurement, international benchmarking, DRG financing (diagnosis related groups) and yardstick competition in hospital markets. The world is thus experimenting with many variants but there is no clearly best way to proceed: many questions about health system performance have no clear or simple answers because outcomes are hard to measure and it is hard to disentangle the health system's contribution from other factors.

In this dissertation, we evaluate the economic consequences of different regulations with respect to health professionals, i.e. general practitioners (GPs), specialists and pharmacies in Belgium. That is, the organization of the care system determines the economic environment in which these health professionals are active and therefore affects the incentives their behavior as an economic agent is subject to. In three individual essays, we study the behavior of Belgian health providers given the economic environment in which they operate. The conclusions of each of the essays have their relevance in the discussion on cost containment and the optimality of health policies related to health professionals, which are part of the international debate. The first two essays evaluate arguments related to the presence of specific entry barriers for health providers while the third essay concerns regulation that limits the choice behavior of patients. As we evaluate the behavior of Belgian health professionals, note that the delivery of health care in Belgium is mainly private and based on the principles of independent medical practice. Hospitals on the other hand are mainly public or non-profit. There is a system of compulsory health insurance, with a broad coverage of the entire population. In general, the Belgian population is quite pleased with the health care system: there is a good availability of care, there are rarely waiting lists and the quality of care is perceived as very good.

In many countries, there is intense debate as to whether entry in medical professions should be regulated or left to market forces. That is, on top of licensing procedures to ensure sufficient quality, some countries have additional barriers to entry into specific medical professions. The

European Commission has recently taken an interest in this form of professional regulation and published a report describing the state of professional regulation across European countries (Paterson et al 2003). This report has launched debate in policy and academic circles on the desirability of entry regulation in, amongst others, health care markets. The first two essays of this dissertation contribute to this debate by investigating the behavior of health professionals in Belgium. Each of the essays evaluates a specific argument that is used in the policy debate either in favor or against the presence of entry regulation for health professionals.

More precisely, in the first essay we study firm behavior given the presence of a population-based maximum on the number of entrants and high fixed margins in the Belgian pharmacy market. In this context, we draw conclusions on the validity of the public interest motivation used to sustain this regulation. That is, we evaluate whether the combination of high margins and entry restrictions as in the current regulation for pharmacies is necessary to obtain sufficient geographic coverage of pharmacy services without generating excessive entry. The second essay looks at the Belgian GP market in which there are no entry restrictions, next to licensing. As there are thus no bounds on the degree of GP competition in a local market, we study whether the remuneration system in Belgium triggers supplier-induced demand in the primary care market. That is, we study whether GPs artificially increase the demand for their services (and thus their income level) when they face a high degree of competition.

Another highly debated aspect of the organization of health provision concerns the access of patients to secondary care. About half of Western-European countries operate under a system of free access to all care, whereas the other half has a system of gatekeeping (Boerma 2003). In a gatekeeping system, access to specialists is limited by the requirement of a GP referral (=mandatory referral scheme). This enforces both the role of the GP as primary care provider and care coordinator and the rationalization of the use of more expensive secondary care.

The literature on the optimality of mandatory referral schemes is extensive and covers many different aspects. Instead of evaluating the desirability of a gatekeeping system, the third essay of this dissertation starts from the observation that some of the Western-European countries where health provision is based on free access are now starting to implement elements of gatekeeping. We therefore evaluate the validity of the fear for viability issues for the current body of specialists in case a mandatory referral scheme would be introduced. More precisely, the third essay evaluates which types of specialists are most likely to be threatened in their viability in case the Belgian care system changes from a system based on free choice to a system with a gatekeeping role for GPs.

The approach we take to study issues of regulation in the health care sector mainly stems from the field of New Empirical Industrial Organization. As data availability for health care markets is often limited due to privacy concerns, we make inference on firm behavior by studying firms' decisions to operate in a local market. This allows us to understand the determinants of market structure, such as the impact of market characteristics and the strategic interactions between firms. The methodology is based on the empirical literature of entry models which originated with the work of Bresnahan and Reiss (1990, 1991) and Berry (1992). The use of equilibrium models of entry to study health care markets is relatively new and situates itself primarily in hospital markets (Abraham et al 2007). The specific regulation in the markets of health professionals however yields interesting extensions to the entry literature.

Next to methodological contributions to this fast-growing literature, we contribute by expanding the application field of equilibrium models of entry. Whereas entry models have been primarily used to study the extent of product differentiation in a free entry context, our research questions instead focus on the impact of regulation. We demonstrate that equilibrium models of entry, next to e.g. demand estimations and merger simulation, are useful tools to increase the understanding of the working of specific markets and to achieve better regulation.

In sum, this dissertation develops advances in the structural modeling of firm behavior, while the applications focus on policy relevant issues in the organization of health care systems. The essays therefore carefully balance between Industrial Organization and Health Economics. Before presenting the research questions, the findings and the policy implications of the three individual essays on the behavior of health providers and the effects of selective professional regulation into more detail, I provide a brief introduction to the methodology used in the main part of this dissertation. I present the basic insights of the literature on estimating equilibrium models of entry and discuss the challenges and the recent advances. I furthermore summarize the contributions of this dissertation to the literature.[1]

[1] The methodology used in essay 2 stems from the health economics literature.

1.1 Methodology

The field of Industrial Organization (IO) studies the strategic behavior of firms, the structure of markets and their interactions. Partly because of its relevance for Competition Law, empirical research mainly deals with measuring the degree of competition between firms. The way of thinking on market structure and competitive conduct has however evolved considerably over the last decades. Until the early seventies, the structure-conduct-performance paradigm (the "Harvard tradition") was the dominant theory. Market structure was assumed to be determined exogenously and performance (efficiency and market power) was a direct result of market structure and firm conduct. In the seventies though, IO economists understood that firms act strategically to affect the market structure that realizes (the "Chicago School"). Theoretical work started to apply principles of game theory to describe the behavior of firms in markets and increased data availability launched the challenge for empirical work to capturing real world firm behavior.

Market structure and the degree of competitive conduct in the market are clearly interlinked, but their relation is not easily captured. In a perfectly competitive market, where prices are at marginal costs, entry has no effect on the competitive conduct. However, in imperfectly competitive markets (i.e. real markets) predicting the change in competitive conduct due to entry is no longer straightforward. E.g. the entry in a monopolistic market changes the entire business environment (duopoly). Different theoretical models try to describe conduct in an oligopoly: there are, among others, the model of contestable markets, the Cournot model of quantity competition and models of sustainable cartels (Tirole 2001). Also empirical IO economists have recently devoted considerable energy toward modeling how changes in market structure affect the extent of competition in a market (Reiss and Wolak 2005). It was however quickly clear from game-theoretic analysis of oligopoly models that equilibrium properties differ considerably with the assumptions of the game (Van Cayseele 2002). In the New Empirical IO, researchers therefore construct structural models that are tailor-made for specific industries in an attempt to accurately predict the outcomes for these particular industries (Bresnahan 1989). This however comes at the cost of a wide applicability of the results (Sutton 1997).

To analyze changes in the level of competitive conduct due to entry, the most natural way is to look at profits per unit in the market. More precisely, the price-cost margins of firms before and after entry of an additional firm measure the severity of competition in that market: the more competitive the market becomes, the higher becomes the downward pressure on price-cost margins and thus the lower is the average variable profit per consumer of the product. Unfortunately, data on price-cost margins in an industry are rarely available. The empirical literature therefore turned to demand estimation to retrieve price elasticities, which are linked through economic theory to price-cost margins (Bresnahan 1989). However, this technique typically requires knowledge of firm-level outputs, prices or costs or consumer data. Again, this type of data on individual firms is rarely available, especially for health care markets which are often shielded by privacy concerns.

What is easily observed however is the number of firms (providers) that operate in different markets. In the main part of this dissertation, we make inference on the competitive conduct and strategic interactions between firms by studying their entry decisions in local markets. The empirical literature on entry models originated with the work of Bresnahan and Reiss (1990, 1991) and Berry (1992) and has boomed since the publication of Mazzeo's work on the motel industry (2002). Bresnahan and Reiss (1991a) develops econometric models to explain the number of sellers in a localized product markets. The goal of their work is to understand how technological, demand and strategic factors affect market structure and competition. That is, without extensive data on prices and outputs, this line of research allows drawing conclusions on the drivers of profitability, competitive conduct and market interactions between firms.

Static equilibrium models of entry

The literature on equilibrium games of entry treats the observed market structure as a realization of a two-stage game. In the first stage, all firms decide whether or not to enter, based on their expected payoffs of entering. And in the second stage of the game, those that have entered the market interact with each other so that payoffs are realized. Mostly, this second stage is not structurally modeled, but instead the game puts forward a reduced form specification of payoffs to estimate. Given free entry in the market, it is assumed that those firms that decide to enter expect to be profitable. All potential firms that do not enter expect not to be profitable. This basic assumption of rational firm behavior makes it possible to relate the observation of the number of firms that enter the market to characteristics of the underlying latent profitability of firms.

Although its name suggests otherwise, equilibrium models of entry do not study entry behavior of firms. Instead, the literature deals with the behavior of the firms operating in a market. In other words, we do not study the process of firms' entry or exit, but instead focus on the resulting market structure, i.e. the number of entrants and their characteristics. Since the essays of this dissertation consider static equilibrium games of entry, i.e. we have information on the number of entrants in all local market at a certain point in time (cross section), it is assumed that we observe markets in their long run equilibrium. The model aims to describe what the long run relations are between market structures and observed market characteristics without making any inference on how the market evolved to this equilibrium.[2]

The basic equilibrium game of entry presented by Bresnahan and Reiss (1991a) concerns entry decisions by homogeneous firms in a complete information framework. All firms simultaneously decide on entry in a local market in the first stage of the game and interact in the second stage. If a firm stays out of the market, it receives a payoff of zero (or the value of an outside option, normalized to zero). Payoffs of entering the market are determined by market characteristics (X^m), which affect each firm in the same way. Furthermore, in line with the predictions from theoretical work, payoffs are decreasing in the number of competitors (N^m). Finally, there is some unobserved payoff component which is known by all players, i.e. the error term (ε^m). That is, take the following expression for payoffs in market m:

$$\pi(X^m, N) = \bar{\pi}(X^m, N) - \varepsilon^m$$

Using the equilibrium behavior of firms, we can identify how realizations of the market level error term translate into equilibrium market structures. That is, equilibrium behavior under free entry predicts that firms enter the market as long as it is profitable to enter the market (Nash equilibrium). The number of firms we observe in equilibrium therefore equals the

[2] The recently developed dynamic entry model, see e.g. Pakes, Ostrovsky and Berry (2008), do allow conclusions on the entry and exit behavior of firms. Bresnahan and Reiss (1993) discusses the incentives for firms to enter and exit into more detail, in light of the importance of unobserved sunk costs.

maximum number of firms that can be profitable given the market characteristics (X^m, ε^m). As a result, the probability that n firms operate in market m is given by the probability that firms are profitable given this market structure, while additional entry would not be profitable:

$$\Pr(N = n^m) = \Pr\left(\bar{\pi}(X^m, n^m) \geq \varepsilon^m > \bar{\pi}(X^m, n^m + 1)\right)$$

The technique to determine the market characteristics that drive payoffs and to determine the effect of competitors consists of maximizing the model's probability of observing the realized market structure. Using the model's equilibrium conditions, a reduced form specification of firms' payoffs and an assumption on the distribution of the market unobservables, the researcher constructs a likelihood function and searches the parameter space for the maximum.

Bresnahan and Reiss (1991a) applies this model to local markets of e.g. doctors, plumbers and dentists and demonstrates that the estimation results can be used to construct a measure of changes in competitive conduct due to entry. That is, when it can be assumed that variable profits are proportional to market population, we can deduce the minimum per firm market size to sustain a certain number of firm entrants. The change of these 'entry thresholds' with the number of entrants in the market gives an indication of the extent to which the degree of competition changes.[3] That is, when an additional entrant increases the degree of competition in the market, profit margins drop. This increases firms' break-even output level and thus increases the minimum market size to survive. For example, under perfect collusion, firms cooperate to sustain the monopoly profits. The entry of an additional firm therefore has no impact on profit margins (assuming that this entrant will be part of the cartel), so that the entry threshold is independent of the number of entrants. On the other hand, when firms compete, firms' entry thresholds increase as profits margins decrease: the necessary market size to be profitable in the market increases with the entry of an additional competitor.

[3] The ratio of the entry thresholds only provides insight in changes in competitive conduct and not in levels. For example, the model cannot distinguish between market that is perfectly competitive from the first entrant (p=mc) and perfect collusion in the market. In both cases, extra entry does not change the entry thresholds. Furthermore, when fixed entry costs also vary with the number of entrants, the increase in entry threshold can originates from increases in fixed costs of entry. We refer to Bresnahan and Reiss (1991a) for a full discussion.

Recent advances

The challenge of constructing a realistic equilibrium model of entry lies in allowing for firm heterogeneity. That is, instead of considering the number of entrants in a market, it is interesting to evaluate the entry decisions of different types of firms or individual firms: who enters the market? The empirical literature has mainly focused on problems of product differentiation. That is, the researcher studies to which extent firms' payoffs decrease less due to the entry of an other-type firm, compared to the entry of a same-type firm. E.g. Mazzeo (2002) studies the motel market in which he differentiates between low and high quality motels and Berry (1992) and Ciliberto and Tamer (2004) look at the impact on airline profits of other airlines servicing the same routes. It is thus assumed that payoffs of entering the market are not only decreasing in the number of firms of own type, but also in the number of firms of the other type. In other words, the entry decisions of firms of the different types are strategic substitutes: the probability of entering the market is decreasing in the action of firms of the other type. Assuming that firms of different types benefit from each others' entry decisions, i.e. entry decisions are strategic complements, yields different equilibrium conditions in the model. This case is however rarely addressed in the empirical literature (Sweeting 2007).[4]

Whereas introducing firm heterogeneity in the entry model clearly adds to the realism of the game, it entails some econometrical difficulties: entry decisions of the different types of firms are strategic interdependent so that the number of firm entrants of the other type is endogenous in the entry decision of a firm. The literature has focused on two resulting problems. First, the uniqueness of an equilibrium is not guaranteed. Second, allowing for a higher number of firm types rapidly becomes complex.

When there is strategic interdependence in the entry decisions of different type of firms, multiplicity issues arise. In other words, there is no unique market structure equilibrium for

[4] Note the difference with the concepts of substitutes and complements: the firms of different types can produce outputs that are substitutes or complements in the eyes of consumers. Instead, we consider a strategic decision of firms: firms choose whether or not to enter the market. The entry decisions of other-type firms change the marginal payoffs of entering the market. There is however a connection with the products being substitutes or complements: when the types produce e.g. substitutes, the decision of other-type firms to enter the market and to produce output in that market will generate a negative demand effect on firm's payoffs. This decreases the payoffs of entering the market. However, the entry decisions of other-type firms can also affect the payoffs of entering the market through e.g. cost aspects.

certain realizations of the model primitives. E.g. the market can sustain exactly one entrant, but the entrant can be of either type 1 or type 2: there are two possible market equilibria, $(1, 0)$ and $(0, 1)$. Therefore, the probabilities of observing the different market structures do not sum up to one, which makes the empirical model incoherent: we cannot construct a likelihood function to take to the data. Apart from the multiplicity problem, it remains hard to estimate a realistic model as the extent of firm heterogeneity is limited in the model. As indicated above in the basic model of Bresnahan and Reiss, the technique relies on specifying the mapping of the model primitives onto equilibrium market structures: only the realization of error terms within certain areas corresponds to observing specific market structures. This specification can become very complex once the researcher allows for more than two types in the market.

Several solutions to the problem of multiple equilibria have been offered in the empirical literature. First, the researcher can focus on outcomes that are unique for all model primitives, such as the number of firms rather than their identities. This is the original approach followed by Bresnahan and Reiss (1991a), but reduces firms to homogeneous entrants. A second solution consists of specifying an equilibrium selection mechanism. Whereas one can work with a random selection rule, as in Bjorn and Vuong (1984), most research has modified the structure of the game to obtain a unique prediction. Different modifications to the simultaneous entry game of complete information have been used. Berry (1992) and Mazzeo (2002) assume a sequential rather than simultaneous order of moves. In the product differentiation setting, this implies that the first mover has the advantage of pre-empting entry by other (-type) firms. Seim (2007) and Aradillas-Lopez (2007) on the other hand move from a complete information game to one of incomplete information and assume that the same equilibrium is chosen in similar markets. Einav (2003) finally assumes sequentiality in the order of moves in the incomplete information framework. A final solution prevents the misspecification of the model without solving the multiplicity issues: researchers abandon point identification of the estimates and focus instead on identifying the parameter set for which the underlying model is consistent with the data (set identification: Tamer 2003, Andrews, Berry and Jia 2004, Ciliberto and Tamer 2004). Assuming that the information set is incomplete rather than complete and the use of set identification also permit for a higher degree of firm heterogeneity in the model (Seim 2007).

Contributions

We contribute to the growing literature on the estimation of entry models in essays 1 and 3. In both papers, we allow for different types of firms to interact in the market. In essay 1, we focus on a game with two types of firms: GPs and pharmacies. In essay 3, we allow for a higher number of firm types interacting in the market, as we study the strategic interactions between GPs and different specialist types (e.g. dermatologists, gynecologists, pediatricians). Contrary to the bulk of the empirical entry literature, the research questions we address are not questions of product differentiation. As a result, in both essays we put forward entry games that are novel in the literature to address our specific research questions on health professionals.

In the first essay, we study the Belgian pharmacy and GP markets. To estimate their drivers of profitability and the effect of competitors and other-type firms on payoffs of entry, we model their entry decisions as a sequential game of complete information. The model builds on the model by Mazzeo (2002) but differs from the literature in two main respects. First, entry in the pharmacy market is not free, but restricted based on population criteria. We show in the essay that the equilibrium conditions of the free entry model (i.e. firms enter as long it is profitable to enter) can be adjusted to take up the maximum number of pharmacies that is allowed to be present in the market. Second, whereas the bulk of the literature studies product differentiation, we analyze a situation in which the entry decisions of the different types are strategic complements. That is, the model assumes that firm payoffs are increasing in the number of firms of the other type (the assumption of their entry decisions being strategic substitutes is rejected in the estimation results).

These adjustments to the equilibrium conditions of the game do not only allow us to better describe the reality, but also permit to simulate the effect on the realized market structures upon changes to the entry (and price) regulation. The essay is therefore furthermore unique in the static entry literature as it is able to draw direct policy implications on the existence and the specifics of the establishment act for pharmacies in Belgium. That is, our structural model set-up allows performing policy simulations on what the equilibrium market structure would look like under alterations of the law.

Note that we assume all GPs and all pharmacies in a market to be the same. In other words, firms of the same type are assumed homogeneous. As a future extension, it would be interesting to allow for heterogeneity in the pharmacy market, as the data permits the identification of cooperative pharmacies. These cooperative pharmacies might base their entry decisions on different payoffs compared to independent pharmacies as they are often not-for-profit. Although there are few cooperative pharmacies in our sample of markets, separately controlling for their entry decisions can provide additional understanding of the working of the pharmacy market. Remark that it is hard to allow for the extra firm heterogeneity in the model put forward in this essay and that the bias on the estimated strategic interaction effects between pharmacies and GPs is expected to be small.[5]

The third essay aims to identify the nature of the strategic interactions between GPs and specialist types, which requires the empirical model to account for three specific features. First, we do not know a priori how the strategic interactions between the types are characterized: GP payoffs can both be increasing or decreasing in the presence of different specialist types. Second, we can not exclude the possibility that the strategic interaction effects between GPs and a specific specialist type are asymmetric in sign. That is, the entry decision of a GP can be a strategic complement to the entry decision of the specialist, while the latter is a strategic substitute to the entry decision of the GP. And third, there are many different types of specialists, so that the model has to allow for a high degree of product heterogeneity. We contribute to the literature by putting forward a static entry game that copes with all three of these features. We argue in the essay that modeling and estimating firm conduct should allow for realistic and flexible strategic interactions between types of firms. This however involves abandoning either the pure strategy assumption or the assumption of complete information.

We present an incomplete information entry game with sequential entry decisions to model the entry decisions by the different physician types. Contrary to most models in the literature,

[5] First, there is no reason why the estimated coefficients that measure the effects of the presence of the number of pharmacies on the profitability of the physicians would be biased due to not accounting for firm heterogeneity in the pharmacy market. We might on the other hand overestimate the effect of physicians on pharmacy payoffs, but only to the extent that the presence of a cooperative is positively correlated to the number of physicians: if so, entry in the unprofitable market is explained by the positive effect of physician presence. Otherwise this effect is part of the market unobservables: the markets with a cooperative pharmacy have a low error realization to explain the entry above what should be profitable.

this game excludes issues of non-existence of equilibria when the strategic interaction effects are asymmetric in sign. It furthermore permits estimation of the interaction effects in the presence of a high degree of firm heterogeneity and without any restrictive assumptions on the underlying payoff functions.[6]

Some final remarks are in place. First, the incomplete information game presented in the last essay is more flexible compared to the former one. That is, whereas the model in the first essay relies on the assumption of strategic complementarity in the entry decisions of GPs and pharmacies, the model presented in the third essay allows for the identification of the interaction effects, without any prior assumptions. We however find that the estimation of the incomplete information game confirms the conclusions on the pharmacy and GP markets of essay 1. Despite the lower flexibility, the assumption of completeness of the information set is preferred in the first essay as we focus on and model only the interactions between two types of firms. Controlling for possible correlation in the models' unobservables is thus important. Second, for the reasons discussed above, the model presented in the first essay is not suitable for answering the research questions of essay 3. The inability of the more flexible model to allow for correlation in firms' unobservables is compensated by estimating the strategic interaction effects while controlling for many different types of firm entrants. Third, in principle, we would be able to answer the research questions of essay 1 and essay 3 simultaneously in one entry model of incomplete information. Currently, we assume that there are no strategic interactions between pharmacies and specialists of different types and that the strategic interactions between GPs and pharmacies and between GPs and specialist types are not affected by the entry decisions of specialists and pharmacies respectively. In other words, essay 1 does not control for the strategic interaction effects found in essay 3 and vice versa. Whereas we could allow for these effects to be present by estimating the entry decisions of all types simultaneously, the computational burden would increase rapidly and additional assumptions, e.g. on the sequence of entry, would have to be imposed for estimation.

[6] The same remark as above applies for this essay: firms of the same type are assumed to be homogeneous. As the data does not allow to identify those specialists that work in hospitals and as we have no further information on the characteristics of the physicians, relaxing this restriction is however not feasible at this point. Note that we control for the presence of hospitals in explaining the profitability of physicians to reduce the related concerns.

Finally, the entry models do not explicitly model the presence of supplier-induced demand, the topic of essay 2. However, in case inducement is present, this effect is partly captured in the estimated coefficients of the number of competitors and in the estimated coefficients of market controls which are positively correlated with GP or specialist density. In essay 1, the presence of supplier inducement can e.g. explain the finding of a lack of competitive pressure in the GP market: GPs do not require a higher market size to survive in the presence of more competitors, as they counter the negative pressure on payoffs by inducing demand. There is however no impact on the simulation results. For essay 3: in case GPs respond to the entry of a specialist by inducing demand for their services, the 'real' strategic interaction effect of specialists on GP payoffs could be overestimated. In this case, we underestimate the competitive effect of specialists on GPs and thus also the impact of gatekeeping. The presence of supplier inducement would thus strengthen our findings with respect to the viability threats associated to the introduction of mandatory referral schemes.

1.2 Research questions and findings

Essay 1: Entry and Regulation - Evidence from Health Care Professions

In chapter 2, we evaluate the presence of the Establishment Act for pharmacies in Belgium in light of the recent interest of the European Commission to deregulate professional services. As in many other countries, the number of pharmacies that can operate in a Belgian municipality is limited based on population criteria. Entry in the pharmacy market is thus restricted. Furthermore, the pharmacy market is characterized by price control: pharmacies get a fixed margin of on average 23% on every item they sell. The public interest view motivates this combination of entry regulation and high fixed margins in terms of guaranteeing availability of pharmacy services in rural areas without generating excessive entry elsewhere.

The aim of this essay is to evaluate whether there is empirical evidence to support this view. We study the effects of the current entry regulation on the entry behavior of pharmacies using a structural model of entry and simulate the expected changes in the market structure when pharmacies' entry would be liberalized and margins are dropped. These policy simulations allow us to evaluate whether the current availability of pharmacy services would deteriorate when policy changes take place, as implied by the public interest view argumentation. We specifically incorporate the physician market in the analysis (in this essay, physicians are defined as GPs) as this related market will be affected by changing policies in the pharmacy market (indirect policy effects).

To estimate the drivers of profitability, the effect of competitors and other type firms and the impact of the entry regulation, we model the entry decisions of two types of firms, physicians and pharmacies, as a sequential game of complete information. We control for the entry restrictions in the pharmacy market and assume strategic complementarity in the entry decisions of pharmacies and physicians. Using market characteristics and information on the number of pharmacy and physician entrants per local market, we estimate the effects of market characteristics on firms' payoffs of entering the market. We find little evidence of competition within type for both pharmacies and physicians and the assumption of strategic complementarity between the types is confirmed: physicians' payoffs of entering increase in the number of pharmacies that is active in the market and vice versa.

Using the estimated coefficients from the entry model in the current situation, we predict the changes in market structure in case the fixed margin for pharmacies is reduced and in case the entry is (partly) liberalized. We find that the number of both physician and pharmacy entrants decreases in case the fixed margin for pharmacy is dropped and that there would be more entrants of both types when entry in the pharmacy market is liberalized. But more importantly, the policy simulations show that a combination of entry deregulation and drops in margins in the pharmacy market can generate a similar entry pattern as currently is the case. As a result, we find that large tax savings can be obtained by decreasing the margin for pharmacies, while this not necessarily reduces the availability of pharmacy (and physician) services across the country.

The policy implications of this essay are clear. The public interest view motivates the current regulation of high margins and entry restrictions as a way to ensure availability in rural areas without excessive entry elsewhere. However, as we are able to generate a comparable provision of pharmacy and physician services under less stringent policies, we find no support for this view. On the contrary, we find that substantial savings can be reached through deregulation.

To the extent that there are no other valid arguments for the existence of the Establishment Act, our findings favor a reduction in the entry restrictions in the Belgian pharmacy market.

For the Belgian pharmacy market, we thus conclude that the current entry regulation on top of licensing is not welfare enhancing. Our essay furthermore provides a tool for policy makers to test whether the existence of entry restrictions based on population criteria in other countries or for other professional services is in the interest of the public or rather in the interest of the incumbents in the industry. This is important in the debate on the liberalization of professional services, as it sheds objective light on the desirability of competition reducing entry requirements.

Essay 2: Supplier Inducement in the Belgian Primary Care Market

The second essay, presented in chapter 3, focuses on the behavior of GPs in their competitive environment. The Belgian primary care market is characterized by a high availability of services: GP density is amongst the highest in Europe (OECD Health Data). On average, the number of patients per GP is therefore rather low. Furthermore, there is a fee-for-service system, where GPs are paid according to the number of contacts with patients, so that a change in the number of contacts directly affects GP income. At the same time, GPs can influence the demand for primary care to a large extent, because of high degrees of uncertainty and information asymmetry concerning health care services. Depending on her competitive environment, the GP can have incentives to increase the number of contacts that patients consume above what would be optimal. This is known in the literature as supplier-induced demand.

This essay performs an empirical exercise to test for the presence of this inducing behavior by Belgian GPs as it has important consequences for the optimality of health policy. That is, in case suppliers can change the preferences of consumers, the traditional neoclassic model of supply and demand used to predict the effects from policy changes does not apply.

To study whether we can find evidence of supplier induced demand in Belgium, we use a unique GP-level dataset on the yearly number of visits of all Belgian GPs. In line with the predictions from theoretical models on GP behavior, the identification strategy is based on finding evidence of marginal inducement: does per capita consumption increase with GP density? As there are important identification issues, we do not put forward a structural model for identifying inducing behavior, but instead follow an empirical approach suggested in the health economics literature by Carlsen and Grytten (1998). That is, we correct for other possible explanations of a positive link between GP density and consumption. For example, an increase in the number of GPs also implies a decrease in the transportation costs and waiting times for patients, which positively affects the demand for care (availability effect). The identification strategy consists of splitting up the effects of GP density on GP level consumption according to the level of GP density. The underlying theoretical framework predicts that the effects in the GP dense markets are instructive for inducing behavior.

We contribute to the literature in two respects. First, we provide an overview of the main ideas put forward in the empirical testing of supplier inducement. While providing a general theoretical background, we focus on the discussion of the empirical implications of the hypotheses that stem from theoretical work. E.g. we discuss how changes in the degree of information asymmetry can affect the extent to which GPs induce demand. Second, we study the presence of supplier-inducement in Belgium using a unique dataset and furthermore investigate which type of contacts GPs typically use for demand inducement: consultations or visits.

The empirical analysis of the Belgian primary care market shows a positive relation between GP density and the number of contacts per capita. Our results can furthermore not reject that Belgian GPs are partly responsible for this finding by inducing demand for their services. If they induce demand, we find that GPs have a preference to induce through consultations, despite the higher fee for visits. In the margin of the analysis, we furthermore find some indication that GPs in markets with a low GP density use their discretionary influence over the demand to reduce the number of contacts (visits).

When GPs induce demand for their services, a higher GP density level in the market is associated to higher GP care consumption and thus higher health expenditures. This extra care is furthermore not needed: patients contact GPs more often than they would in case they were fully informed. In an era of ever-increasing health care budgets, policy measures to limit the GP density on local market level can therefore be optimal. That is, a lower GP density reduces the incentives for GPs to induce demand. Total health consumption will therefore decrease, in principle without an accompanying drop in the health status. This strategy is already followed in Belgium by the installment of a limitation to the number of incoming students in medicine and the Impulseo I-plan by the Flemish government to give financial incentives to GPs to locate in areas with a low GP density.

Essay 3: Strategic Interaction between General Practitioners and Specialists: Implications for Gatekeeping

Characterizing the nature of the strategic interactions between GPs and specialist types (e.g. dermatologist, gynecologist) is the topic of the essay presented in chapter 4. Economic argumentation is not conclusive on whether a GP benefits from the presence of a specialist type or rather it is harmful for the GP. On the one hand, the presence of a specialist allows the GP to refer patients with complicated health concerns, which reduces the cost of treatment for the GP (referral effect). On the other hand, in the absence of gatekeeping, patients have the choice to visit a specialist instead of a GP, which implies that there is competition for patients between specialists and GPs (competition effect).

The aim of this paper is to conduct an empirical investigation for the Belgian physician markets on whether the referral or the competition effect dominates the relation between GPs and different types of specialists. This is not only an important feature of the health care system to know, it also contains information on the expected transition costs of the implementation of gatekeeping. That is, it is instructive for predicting which specialist types are likely to be treated in their viability when mandatory referral schemes are introduced. More precisely, when GPs are harmed by the presence of a specialist type (competition effect dominates), this implies that patients often go to this specialist type without a referral of the GP and that moreover GP care would suffice for a large part of these patients. As a result, once access to specialist care is limited to referrals, this specialist type will loose a substantial portion of its patientele which leaves them unprofitable.

We identify the strategic interactions between GPs and specialist types by modeling their entry decisions as an incomplete information game with sequential entry decisions. Using information on market characteristics and on the number of GPs and specialists of different types per market, we estimate the drivers of profitability and the strategic interaction effects between the physician types. Our results indicate that specialist types benefit from the presence of GPs in the market. On the other hand, the effect of specialists on GP payoffs depends on the specialization field. Dermatologists and pediatricians have a negative impact on GP payoffs, while the entry decisions of gynecologists, ophthalmologists and throat, nose and ear-specialists (TNE) are strategic complements to the entry decision of GPs. No significant effect is found for psychiatrists and physiologists. Our findings therefore indicate that dermatologists and pediatricians attract a lot of patients for whom GP care would suffice, while the patientele of gynecologists, ophthalmologists and TNE-specialists either get referred or correctly self-refer to these specialist types.

Across the world, policy makers are debating whether or not to implement gatekeeping into their health care system and policy makers in France, Germany and Belgium have started to introduce some elements of gatekeeping over the last years. The discussion on the implementation of mandatory referral schemes are mainly based on efficiency and cost arguments, but the empirical evidence of the benefits of a gatekeeping system are not as strong as one would want. Our essay argues that, parallel to the discussion on the desirability of gatekeeping, also the transition costs that accompany the implementation of gatekeeping should be considered. Given our results, we expect considerable transition costs to realize when gatekeeping would be introduced in the Belgian care system. Especially dermatologists and pediatricians are likely to experience a fall in the demand for their services, which can result in viability problems. It is up to the policy makers to decide whether or not to maintain the entire body of specialists through financial mechanisms or to retrain a portion of them.

Chapter 2

Entry and Regulation - Evidence from Health Care Professions

Abstract[1]: In many countries pharmacies receive high regulated markups and are protected from competition through geographic entry restrictions. We develop an empirical entry model for pharmacies and physicians with two features: entry restrictions and strategic complementarities. We find 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%. A removal of the entry restrictions, combined with a reduction in the regulated markups, would generate a large shift in rents to consumers, without reducing the availability of pharmacies. The public interest motivation for the current regime therefore has no empirical support.

[1]The paper in this chapter is joint work with Frank Verboven.

2.1 Introduction

The regulation of liberal professions, such as lawyers, notaries and pharmacies, has been a widespread phenomenon in many countries. It consists of a variety of measures restricting both entry and conduct. While U.S. courts already started to more consistently apply antitrust laws to many professional services after a Supreme Court Decision in 1975 (Wise (2000)), European countries have only recently shown an interest to liberalize professional regulation.[2]

In this paper, we look at pharmacies and physicians in Belgium to shed new light on the effects of entry and conduct regulation. As in many other European countries, both professions are subject to strict conduct regulation through regulated fees or markups and bans on most types of advertising. In addition, the number of pharmacies is restricted on a geographic basis. An establishment act imposes a maximum number of pharmacies per municipality based on population criteria, implying that new pharmacists typically need to buy up existing establishments if they want to operate independently. These regulations have often been motivated to be in the public interest. In particular, the combination of high fixed markups and tight geographic entry restrictions to pharmacies has been defended to ensure a minimum availability of supply in the less profitable regions without inducing excessive entry elsewhere. The private interest view challenges these motivations, arguing that the regulations are anti-competitive and have no beneficial effects to other parties.[3]

To evaluate the public interest motivation of the current regime, we develop an econometric model of entry by two types of professions: pharmacies and physicians (defined as general practitioners). We extend previous free entry models of Bresnahan and Reiss (1991) and Mazzeo (2002), to account for two key features specific to this market. First, entry of pharmacies is not free because of the geographic entry restrictions. In municipalities where the constraint is binding, it is therefore only possible to infer how many firms are still profitable, but not

[2] This interest is evident from Paterson et al.'s (2003) extensive report for the European Commission, describing the state of professional regulation in Europe. This report subsequently led to an official Communication, COM (2004) 83, showing the Commission's commitment to liberalize the professions.

[3] Various policy reports have recently been published. In a detailed report, the U.K.'s Office of Fair Trading (2003) concluded that free entry by pharmacies in the U.K. would benefit consumers. The O.E.C.D. (2000) obtained similar conclusions based on the experiences in a larger set of countries. But it also emphasized that a holistic view be taken: simply introducing free entry of pharmacies without any accompanying measures to lower the currently high regulated markups would likely create (or strengthen) excessive entry.

from how many firms onwards entry would become unprofitable. Second, the entry decisions of pharmacies and physicians may be strategic complements, i.e. entry by one type of firm may make entry by the other type more profitable. The entry model can be used to draw inferences about competitive interaction, both within and between the professions. In addition, it allows us to assess to which extent the geographic entry restrictions on pharmacies have limited the number of firms, either directly the pharmacies or indirectly the physicians because of their strategic interdependence.

We apply the model to a data set for Belgium, which is representative for many other European countries with geographic entry restrictions on pharmacies. The data contain information on the number of pharmacies and physicians per market (town), and the corresponding demographic characteristics in 2001. Regarding competitive interaction, we find that entry into one profession has a positive effect on the profitability of entry into the other profession, suggesting that the entry decisions by firms of different professions are strategic complements. Furthermore, entry does not lead to intensified (non-price) competition among firms of the same profession. Regarding the geographic entry restrictions, we find that they have substantially limited the number of firms. A simple removal of all geographic entry restrictions without any accompanying measures would more than double the number of pharmacies, and also indirectly increase the number of physicians by 7% due to strategic complementarities. Combining a full removal of the entry restrictions with an absolute reduction in the pharmacies' gross markups by up to $7.5 - 15\%$ (down from the current 23%), would keep the total number of pharmacies in the country constant. Our overall conclusions are that an appropriate combined policy of reduced geographic entry restrictions and reduced regulated markups can lead to a large shift in rents to consumers (tax payers) without necessarily reducing geographic coverage. This strongly indicates that the current regime of high regulated markups and restricted entry protects the private interests of pharmacies rather than the public interest.

There is a small related empirical literature on free entry and social inefficiency. Berry and Waldfogel (1999) show how free entry of radio stations can be inefficient in an imperfectly competitive market. Hsieh and Moretti (2003) look at real estate agents, and document the inefficiency of free entry in a market with fixed regulated markups.[4] In contrast to these studies, we concentrate on a case of restricted entry. In principle, given that markups are regulated at a distortionary high level, it may be socially desirable to introduce a second distortion and restrict entry. However, our analysis shows how a properly *combined* policy of loosening the entry restrictions and lowering the markups may lead to large shifts in rents from pharmacies to consumers (tax payers) without reducing the availability of supply. In the concluding section, we come back to the question whether these shifts in rents are beneficial.

Our analysis also relates to empirical work on vertical restraints. Lafontaine and Slade (2008) review a number of cases, including work on exclusive territory restrictions. They compare the estimated welfare effects of voluntary restraints with those of government-mandated restraints. They conclude that voluntary restraints tend to have beneficial welfare effects, whereas mandated restraints tend to have detrimental effects. Our results appear to further strengthen this broad conclusion.

The paper is organized as follows. Section 2.2 describes the markets of pharmacies and physicians, with the entry and conduct regulations, and introduces the data set. Section 2.3 presents the econometric entry model and section 2.4 discusses the empirical results. Section 2.5 analyzes the implications for policy reform and section 2.6 concludes.

2.2 The markets of pharmacies and physicians

Health care markets are subject to extensive regulation in most countries. The regulations have often been motivated by efficiency considerations; Dranove and Satterthwaite (2000) provide an overview of the various market failures associated with the supply of basic health care services. In addition, equity concerns and private interests have often been invoked to explain the government interventions. In this section we provide a selective overview of the health care markets in which the pharmacies and physicians operate in Belgium. We focus on those elements that motivate our econometric model. We begin with a discussion of the entry process, including the

[4] For a theoretical analysis of the conditions under which free entry may be socially inefficient, see for example Mankiw and Whinston (1986).

presence of geographic entry restrictions on the pharmacies as imposed by the Belgian government. We next discuss the general economic and regulatory factors influencing the nature of competitive interaction within and between the two professions. Finally, we provide descriptive statistics of our collected data set, documenting some of the discussion and introducing our subsequent econometric analysis.

2.2.1 Entry and geographic restrictions

Both pharmacies and physicians need to satisfy minimum educational standards. Physicians, which we define as general practitioners (as opposed to specialists), need to obtain a university degree in medical sciences. Until recently, every high school graduate was eligible to start this degree. Since 1998, some measures have been installed to restrict the number of incoming students, e.g. an introductory examination at the start of the first year in Flanders. However, this potential entry restriction is irrelevant for our empirical analysis, which covers the year 2001 (i.e. before the 1998 incoming students graduated). In practice, only a minority of the students (about 25%) with a medical degree choose to become a physician (in the sense of a general practitioner). Other employment opportunities are to become a specialist, an occupational health officer, an expert for the health insurer, etc. There are no essential further restrictions to setting up a physician's practice.[5] In particular, a physician can choose to locate an establishment anywhere in Belgium. According to the WIV (2002), the majority of physicians (about 78% in 2001) operate as a single-person establishment. In recent years, there has been a development to form associations of several physicians, but these are considerably less developed than in other countries.

Pharmacies also need to satisfy minimum educational standards; see Philipsen (2003) for a detailed review. A university degree in pharmaceutical sciences provides the right to independently prepare and sell drugs in an existing establishment. However, in contrast to the physicians' case, this degree is not sufficient to entitle one to set up a new establishment. Since 1974, there exists an establishment act, imposing geographic entry restrictions on the number of

[5] There are some requirements of secondary importance. The Medical Committee needs to certify the medical degree. Furthermore, the applicant has to enroll with the medical association (Order of Physicians) and to register at the National Institute of Health Insurance (RIZIV).

pharmacies based on population criteria. Many other European countries have adopted similar acts. The most comparable population-based establishment acts exist in Finland, France and Portugal. Other countries with geographic entry restrictions in some form include Spain, Italy and the U.K.

More specifically, the act stipulates that there should be no more than one pharmacy per 2,000 inhabitants in small municipalities (with fewer than 7,500 inhabitants); no more than one pharmacy per 2,500 inhabitants in intermediate municipalities (with a number of inhabitants between 7,500 and 30,000); and no more than one pharmacy per 3,000 inhabitants in the larger municipalities. For example, in a municipality with 6,000 inhabitants, there can be no more than one pharmacy per 2,000 inhabitants, implying that there can be at most 3 pharmacies. The act provides slightly more lenience, i.e. lower threshold population levels, if the physical distance between a new candidate pharmacy and any incumbent is sufficient large. Because of the establishment act, people with a university degree in pharmaceutical studies have only two ways to start an independent pharmacy: either apply for a new establishment at a location where the entry restrictions are not yet binding, or buy an existing pharmacy from an incumbent. The latter is the more common event; it is often a transaction between an incumbent who has reached retirement age and a candidate pharmacist who has obtained several years of experience in the same or in another pharmacy. With the average number of pharmacists (with a university degree) working in a pharmacy at 1.5, most pharmacies operate as single-person establishments as in the physicians' case.

2.2.2 Competitive interaction

We first discuss the geographic dimension, showing that competitive interaction essentially takes place at the local level. Next, we discuss the relevant institutional factors determining the (local) competitive interaction within each of the professions and between the two professions.

Competitive interaction at the geographic level

Consistent with earlier health care studies, it is reasonable to define the relevant geographic markets at the town level. The population within each town is typically concentrated around the center, with the exception of the densely populated urban areas, which we will exclude from our sample. As will be discussed below, both physicians and pharmacies cannot engage in advertising or other active promotional selling activities, so that it is reasonable to expect that the patients' choices are largely guided by local information. Furthermore, survey evidence indicates that the majority of patients do indeed not travel outside their town to visit a physician. In the Netherlands, a country with similar demographic characteristics as Belgium, 85% of the patients travel less than 5 kilometers, which usually falls within the geographic boundaries of the town. Furthermore, 94% of the Belgian patients have a single fixed physician, which is conceivably located close to the patient's home. For the pharmacies, a recent study by the OFT (2003) finds that only 6% of the patients visit their pharmacy while commuting to work, further confirming the local nature of competitive interaction. Note that our market definition for assessing competitive interaction is narrower than the municipalities on which the establishment act is based: municipalities typically consist of $1-4$ towns (59% of municipalities with 1 town; 90% of the municipalities with 4 or fewer towns).

Competitive interaction within each of the two professions

Physicians provide medical consultations on a fee-for-service basis. A fixed price is negotiated between the government and the health insurer. Physicians are free to charge a higher price, but the social insurance companies do not reimburse patients for the extra price. In practice, only 15% of the physicians have not signed the fixed price agreement. Self-regulation traditionally prevented physicians from competing through advertising, though in recent years and under pressure of the European Commission there has been an increased tolerance towards informative advertising. While price and advertising competition have traditionally been quite limited, physicians have a broad range of other possible instruments to compete for patients: availability (consultation hours, waiting times and possibility to make appointment), quality and time spent on medical consultations (which can show a large variation among physicians), and willingness to provide medical prescriptions and sick-days.

Pharmacies have the exclusive right to sell drugs. In contrast to most other countries, this exclusivity applies to both prescribed drugs and over-the-counter (OTC) drugs. The prices of drugs are fixed by the Ministry of Economic Affairs, after negotiations with the pharmaceutical companies and the pharmacies' association. The pharmacies obtain a fixed margin of 31% of the drug price, up to a ceiling of 7.44€ per package. Because this ceiling has not been adjusted, the average percentage margin has gradually declined from 28% in 1994 to 23% in 2001 (de Bruyn (1994) and De Bruyn (2006)). In sum, for most products there is essentially no price competition. Advertising has until recently also been prevented due to self-regulation by the pharmacies' association, but there are various potential non-price instruments: availability (opening hours), quality of service and advice, and the supply of an assortment of general care products.

To summarize, competition among physicians and among pharmacies has until recently been limited with respect to price and advertising instruments, but there are a variety of other possible instruments at their disposal to compete for patients. We will come back to this in the empirical analysis when interpreting our results on the effects of entry on competition.

Competitive interaction between the two professions

The two professions' core services are potentially strong complements: physicians provide medical consultations and prescribe drugs, while pharmacies are responsible for selling the drugs. As a result, the nearby presence of one profession could strongly benefit the other profession (since geographic proximity matters, as we discussed above). The degree of complementarity is however not perfect and it may actually be asymmetric: not all consultations end with a prescription, and several drugs can be sold by pharmacies without a prescription. If patients would often visit the physician without a subsequent visit to the pharmacy (because no drug was prescribed), then the presence of a pharmacy would only have a small impact on the physicians' profit. Hence, pharmacies would only be weak complements to physicians. Conversely, if patients would often visit a pharmacy without a preceding visit to the physician (because the drug requires no prescription or was prescribed by a specialist), then physicians would only be weak complements to pharmacies. The degree of complementarity in both directions is therefore an empirical question. The above study by the OFT (2003) suggests a strong complementary link between both professions: up to 47% of U.K. patients go to the pharmacy immediately after having visited their physician.

While the professions' core services are complementary, they regularly operate on each other domain, so that they may also be viewed as providing substitute services. This has led to many conflicts between pharmacies and physicians.[6] In addition to providing medical advice, physicians frequently offer free drugs to their patients, obtained from the pharmaceutical companies as a way to promote their products. The pharmacies do not oppose to such drug promotions *per se*, but they claim that the distribution should remain the exclusive right of the pharmacies. Conversely, pharmacies also provide services that are in the physicians' domain. They offer an increasing amount of independent medical advice to patients when selling their drugs. This development has actually been actively promoted by the European Commission: in the near future, pharmacies will be partly rewarded on a fee-for-service basis, rather than as a percentage of their sales, giving them additional incentives to provide medical advice; they will also obtain the right to substitute the prescribed drugs by equivalent but less expensive generic alternatives. Furthermore, even if physicians would not want to sell drugs and pharmacies would not want to provide medical advice, their services may be literally substitutable in a fair number of cases. In sum, while the professions' core services appear to be complementary, they may also be substitutable to some extent.

This discussion has largely focused on the demand-side factors influencing the extent of competitive interaction between pharmacies and physicians. In principle, competitive interaction may also stem from supply-side factors. For example, pharmacies and physicians may generate knowledge spill-overs and learning effects, which can affect both their variable and fixed costs. The health care literature we have surveyed has however not put emphasis on these sources of competitive interaction. We will therefore interpret our subsequent empirical findings on the strategic interdependence of entry decisions as largely stemming from the discussed demand-side sources.

2.2.3 Overview of the data

An overview of the data documents part of the above discussion, and introduces our subsequent econometric analysis. The data set contains information on 1,136 markets in 2001, defined at the town-level as motivated by our earlier discussion of the relevant geographic markets. To

[6] An interesting discussion of the conflicts arising from competition between physicians and pharmacies is provided in an article of the Belgian newspaper De Standaard (08/06/2004), with the self-explanatory translated title "Why physicians want to sell drugs, and pharmacies want to provide medical consultations."

reduce potential problems with overlapping markets, we do not include urban towns, which are defined by a population density of more than 800 inhabitants per km^2 or a population of more than 15,000. This reduces our sample of towns to 847. We obtained similar conclusions based on the full sample of 1,136 towns. We have information on the number of active pharmacies and physicians per market from RIZIV (the National Institute of Health insurance).[7] We combine this with information on the demographic characteristics of each market from NIS (National Institute of Statistics), Ecodata (Federal Government Agency for Economics) and RSZ (the National Institute of Social Security).

Table 2.1 presents counts of the observed market configurations, which we will model in our econometric analysis. For example, there are 142 markets with no pharmacies or physicians, and 58 markets with one pharmacy and two physicians. There are also several market configurations that never occur, e.g. three physicians and more than three pharmacies. More generally, the table shows that there is a quite strong correlation between the number of pharmacies and physicians; the correlation coefficient is 0.85. This strong correlation may be due to common observed and unobserved factors influencing the profitability of pharmacies and physicians. However, our discussion above suggests that the correlation may also be due to the fact that both professions provide complementary services. Our econometric analysis will attempt to distinguish between these alternative possibilities (conditional on distributional assumptions).

The final row shows the percentage of all markets (broken down by the number of pharmacies), in which the geographic entry restriction imposed on the pharmacies is binding, in the sense that no additional pharmacies are allowed to enter by the establishment act. This will be important in our empirical analysis. The entry restrictions are binding for 82.3% of all the markets. Binding entry restrictions occur the least frequently in markets with two established pharmacies, but even here the percentage is quite large (74.7%). Note that the entry restrictions are also frequently binding in markets without pharmacies. While this may seem counterintuitive, it follows from the fact that the markets (towns) are smaller than the municipalities on which the establishment act is based. It is therefore possible that no pharmacies are allowed to

[7] In accordance with RIZIV, a physician is defined as a generalist with more than 49 patients and annually more than 199 consultations, of which more than 0.9% are house visits. Our results are robust against stricter definitions.

Table 2.1: Observed market configurations*

		number of pharmacies							Total
		0	1	2	3	4	5	6+	
	0	142	11	1	0	0	0	0	154
	1	62	36	2	0	0	0	0	100
	2	27	58	3	0	1	0	0	89
	3	6	38	16	3	0	0	0	63
number of	4	8	35	31	4	0	0	0	78
physicians	5	0	13	20	5	1	1	0	40
	6	0	12	22	15	2	1	0	52
	7	0	5	18	23	2	1	0	49
	8	0	6	7	12	12	1	0	38
	9	0	3	9	11	6	2	0	31
	10	0	0	9	9	11	4	3	36
	11+	1	2	8	20	35	25	26	117
Total		246	219	146	102	70	35	29	847
restricted entry		199	179	109	85	61	35	29	697
% of total		80,9	81,7	74,7	83,3	87,1	100,0	100,0	82,3

* Source: RIZIV as discussed in the text.

enter in one town, because there are already too many pharmacies in other towns of the same municipality. Note also that when the entry restrictions are binding, the establishment act may sometimes be violated. This is due to historical factors, since many pharmacies were set up in anticipation of the act, and these pharmacies were not forced to shut down at the moment the act was introduced.[8] However, the excess number of pharmacies is generally small in these cases, and it is in any case not relevant for our econometric framework below.

Table 2.2 provides summary statistics on the demographic variables, which may affect the profitability of both professions. We include information on population size, the percentage of young people (under the age of 18), the percentage of elderly (over the age of 65), the percentage of foreigners, the unemployment rate, mean income, and a dummy variable to account for structural differences between the region of Flanders and Wallonia.

[8] In some cases a violation of the entry restrictions may be due to an exception clause in the act, which allows an additional entry under certain circumstances (population and distance of existing pharmacies).

Table 2.2: Summary statistics*

Variable	Description	mean	std. dev.
# pharmacies	Number of pharmacies	1.76	1.81
# physicians	Number of physicians	4.93	4.62
ln(population)	Logarithm of population	7.91	1.13
% young	Fraction of population, 17 years or younger	22.50	2.55
% old	Fraction of population, 65 years or older	16.11	2.79
% foreign	Fraction of population with foreign nationality	4.27	5.67
% unemployed	Unemployment rate	5.61	2.80
Flanders	Dummy variable, 1 for the region of Flanders	0.39	0.49
mean income	Mean income (in 10,000€)	2.47	0.40

* 847 observations (markets in 2001). Source: RIZIV, NIS, Ecodata, and the RSZ as discussed in text.

2.3 The entry model

Section 2.2 shows that several central institutional facts should be incorporated in our empirical framework. First, the interaction within and between pharmacies and physicians is local, and it is reasonable to define the geographic markets at the town level. Second, pharmacies and physicians on balance 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. Third, the entry of pharmacies is regulated. For each municipality (typically consisting of about $1-4$ towns) there is a maximum number of pharmacies based on population criteria. Entry by physicians is not restricted on a geographic basis. Fourth, conduct is regulated: pharmacies received a regulated average gross margin of 23% in 2001, and physicians are paid on a fee for service basis. Both professions are also subject to advertising restrictions, but can potentially compete in other dimensions (e.g. opening hours, quality of service).

Our entry model will incorporate these features. The model fits in the recent empirical entry literature, as initiated by Bresnahan and Reiss (1990, 1991) and Berry (1992). This literature models entry as a strategic game, and aims to draw inferences about unobserved payoffs – a latent variable – from the equilibrium relationship between the observed market structure and market characteristics, such as market size. Our own model is a static one, in the spirit of Mazzeo (2002); for dynamic entry models see Pakes, Ostrovsky and Berry (2008) and their review of other recent work. Mazzeo distinguishes between two types of substitute firms, and he models the total number of firms of each type as the (unique) equilibrium outcome of a strategic free entry game. We extend the static entry literature in two respects. First, we account for the fact that entry may not be free, i.e. there may be binding entry restrictions for one of the two types of firms (pharmacies). Second, we allow for the possibility that the entry decisions of firms of different types are (net) strategic complements, rather than strategic substitutes.[9] Vives (2005) provides a background overview of games with strategic complementarities. His framework includes applications when the firms' decision variables are continuous, but it can also be applied to situations where the decision variables are discrete as in our entry context.

2.3.1 Payoffs

There are two types of firms, $i = 1, 2$. Firms of type 1 are pharmacies, and firms of type 2 are physicians. Each firm decides whether or not to enter the market. The entry decisions can be summarized by the total number of firms of each type i entering the market, as denoted by the random variable N_i. Equilibrium realizations of this random variable are denoted by n_i. Because of the geographic entry restrictions the maximum allowed number of pharmacies in the market is $\overline{n}_1$, so $N_1 \leq \overline{n}_1$. Following the discussion in section 2.2, $\overline{n}_1$ is equal to the maximum allowed number of pharmacies in the municipality minus the number of firms in the other markets of the same municipality. If $N_1 < \overline{n}_1$, the entry restriction is not binding in equilibrium; if $N_1 = \overline{n}_1$ the entry restriction is binding.

Firms of the same type are identical, i.e. there is no heterogeneity between firms of the same type, similar to Mazzeo (2002). Hence, firms of the same type have the same payoff functions. If a firm of either type i does not enter, its payoffs are normalized to zero. If a firm of type i enters, its payoffs depend on the total number of entering firms of both types, as given by:

$$\pi_i^*(N_1, N_2) = \pi_i(N_1, N_2) - \varepsilon_i, \tag{2.1}$$

[9] Previous work has not considered the possibility that entry is restricted. As far as we know, the possibility that entry decisions are strategic complements has also not been treated within an equilibrium entry model, although there are some related papers: Sweeting (2005) on the timing of radio commercials and Cohen and Mazzeo (2005) on branch investments.

where $\pi_i(N_1, N_2)$ is the deterministic component of payoffs, and ε_i is a random component, unobserved to the econometrician. The precise relationship between the payoffs and the number of firms of each type reflects the nature of competitive interaction. Our first assumption is that entry decisions by firms of the same type are strategic substitutes. Davis (2006) provides a careful analysis of this assumption in a general class of quantity games including discrete entry games.[10] In our framework, the assumption that entry decisions by same-type firms are strategic substitutes means that a firm's marginal profits from entering (i.e. $\pi_i^*(N_1, N_2) - 0$) decreases when another firm of the same type decides to enter. This simply amounts to assuming that a firm's payoffs (under entry) are decreasing in the number of firms of the same type.

Assumption 1. (Entry decisions by firms of the same type are strategic substitutes)

$$\pi_1(N_1 + 1, N_2) < \pi_1(N_1, N_2)$$

$$\pi_2(N_1, N_2 + 1) < \pi_2(N_1, N_2)$$

for all N_1 and N_2. This assumption is consistent with the previous empirical entry literature, and is central to characterize the Nash equilibrium outcomes below.

Regarding firms of different types, we assume that their entry decisions are strategic complements or independent. This is in line with our background discussion in section 2.2.2, which showed that the pharmacies' and physicians' core services are complementary even though some degree of substitutability between related services cannot be ruled out. Intuitively, we assume that a firm's payoffs are increasing in the number of firms of the other type, but not by too much.

[10] See in particular Davis' Assumption 3 and his subsequent discussion. Let s_j denote firm j's action and s_{-j} firm j's competitors actions. In Davis' framework, a single index function $Q(s_j, s_{-j})$ summarizes the effects of the competitors' actions on profits, whereas in our framework there are two index functions (for the two types of firms). Our framework is however more restrictive in several other respects: firms (of the same type) are identical, a firm's action is either to enter or not to enter, $s_j = \{1, 0\}$, and the index function (for a single type) is simply the number of firms, i.e. the sum of all entry decisions, $N = Q(s_j, s_{-j}) = \sum_{k=1}^{K} s_k$, where K is the number of potential entrants.

Assumption 2. (Entry decisions by firms of different types are strategic complements or independent)

(a)
$$\pi_1(N_1, N_2) \leq \pi_1(N_1, N_2 + 1)$$
$$\pi_2(N_1, N_2) \leq \pi_2(N_1 + 1, N_2)$$

(b)
$$\pi_1(N_1 + 1, N_2 + 1) < \pi_1(N_1, N_2)$$
$$\pi_2(N_1 + 1, N_2 + 1) < \pi_2(N_1, N_2)$$

for all N_1 and N_2. Assumption 2 (a) states that a firm's payoffs (under entry) are either increasing in or independent of the number of firms of the other type. Hence, the marginal profits from entering (i.e. $\pi_i^*(N_1, N_2) - 0$) weakly increase when a firm of the other type decides to enter, so that their entry decisions are (weak) strategic complements. Assumption 2 (b) 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.[11] It is also possible to reverse Assumption 2, i.e. assume that entry decisions by firms of different types are strategic substitutes (but not by too much). This would be similar to Mazzeo (2002). We have also considered such a model, but found that it was not supported by the data.

Note finally that our assumptions allow for the possibility of asymmetries in strategic interdependence. Hence, consistent with our discussion in section 2.2.2, it is possible that the entry decision of a pharmacy has a stronger positive impact on a physician than vice versa. The reverse is also possible. We will come back to this when discussing our empirical results.

Based on Assumptions 1 and 2, we can now derive the equilibrium number of firms and the implied likelihood function to be taken to the data. In the empirical analysis, we will verify whether these assumptions are indeed satisfied at the obtained parameter estimates.

2.3.2 Equilibrium with nonbinding geographic entry restrictions

When entry restrictions are not binding, i.e. $N_1 < \overline{n}_1$, each firm freely decides whether or not to enter, given the entry decisions of the other firms. As is well-known, there are many pure-

[11] Strictly speaking, we only require one of the pair of inequalities in Assumption 2 (b) to be strict.

strategy Nash equilibria in this entry game. Bresnahan and Reiss (1990) resolve this problem in two alternative ways. First, they aggregate the non-unique Nash equilibrium outcomes to obtain an econometric model for the total number of firms entering in a Nash equilibrium. In their application in which all firms are substitutes, this yields a unique prediction for the total number of entering firms. Second, they put additional structure to the entry game and assume that firms move sequentially. This alternative approach yields a unique subgame perfect Nash equilibrium at the disaggregate firm level. Mazzeo (2002) can be viewed as a combination of both approaches: he specifies a model for the total number of firms per type entering in a Nash equilibrium, and then refines the Nash equilibrium to obtain a unique prediction for the total number of firms per type.[12] We take a related approach here.

The market configuration (n_1, n_2) is a Nash equilibrium outcome if and only if the random component of profits $\varepsilon = (\varepsilon_1, \varepsilon_2)$ satisfies the following conditions:

$$\begin{aligned} \pi_1(n_1+1, n_2) &< \varepsilon_1 \leq \pi_1(n_1, n_2) \\ \pi_2(n_1, n_2+1) &< \varepsilon_2 \leq \pi_2(n_1, n_2). \end{aligned} \tag{2.2}$$

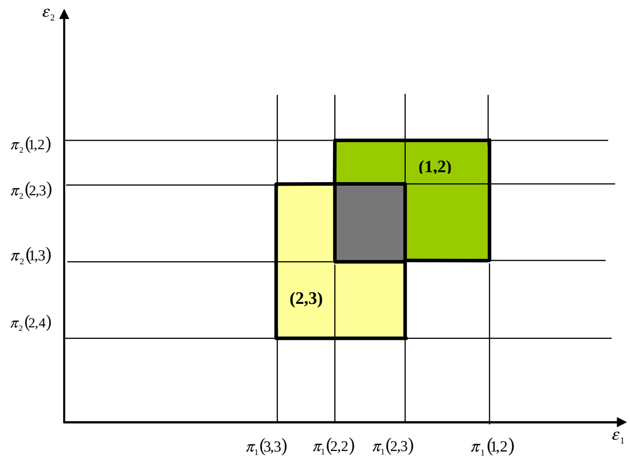
When (2.2) is satisfied, n_1 firms of type 1, and n_2 of type 2 find it profitable to enter, and no additional firm of either type has an incentive to enter; hence (n_1, n_2) is indeed a Nash equilibrium outcome. If ε has full support, Assumption 1 guarantees that there are realizations of ε for which (2.2) holds, so that the market configuration (n_1, n_2) is observed with positive probability.

However, (n_1, n_2) may show multiplicity with other Nash equilibrium outcomes for some realizations of ε. Intuitively, the multiplicity stems from coordination problems, as is illustrated in Figure 2-1. The bold lines delineate the areas of ε for which the market configurations $(1, 2)$ and $(2, 3)$ are the Nash equilibrium outcomes. The shaded rectangle is the area of overlap, where both market configurations are Nash equilibrium outcomes. Note that the area of multiplicity

[12] There have also been alternative approaches to the multiplicity of equilibria in static entry games. See, for example, Ciliberto and Tamer (2004) and Seim (2006).

would disappear if firms are independent, i.e. if the conditions in Assumption 2(a) hold with equality, so that $\pi_1(2,2) = \pi_1(2,3)$ and $\pi_2(1,3) = \pi_2(2,3)$. As the extent of complementarity increases, the area of multiplicity increases. Figure 2-2 shows an extreme case of strong complementarity. In this case, the entire area of ε for which $(1,2)$ is a Nash equilibrium outcome is a subset of the area of ε for which $(2,3)$ is a Nash equilibrium. Hence, there would be no ε for which $(1,2)$ is a Nash equilibrium without $(2,3)$ also being one. Assumption 2(b) rules out this possibility, since it requires that $\pi_1(2,3) < \pi_1(1,2)$ and $\pi_2(2,3) < \pi_2(1,2)$.

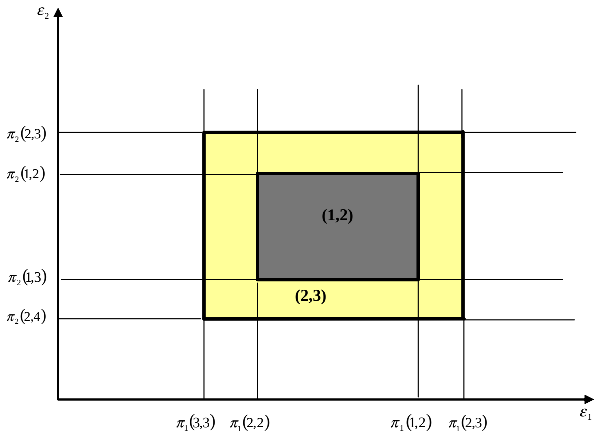
Figure 2-1: Nash equilibria with strategic complements



In general, the multiplicity of Nash equilibrium outcomes can be characterized as follows. If firms of different types are independent, i.e. Assumption 2(a) holds with equality, then the market configuration (n_1, n_2) is the unique Nash equilibrium outcome in the area of ε satisfying (2.2). In contrast, if the entry decisions of firms of different types are strategic complements, i.e. Assumption 2(a) holds with strict inequality, then (n_1, n_2) may show multiplicity with other Nash equilibrium outcomes for some realizations of ε. In the Appendix, we show the following three results:

1. (n_1, n_2) may only show multiplicity with Nash equilibrium outcomes of the form $(n_1 + m, n_2 + m)$, where m is a positive or a negative integer. For example, if $(1,2)$ is a Nash equilibrium outcome, there may be multiplicity with, say, $(0,1)$ or $(2,3)$ or $(3,4)$ but not with $(2,4)$.

Figure 2-2: Nash equilibria – strong strategic complements



2. (n_1, n_2) necessarily shows multiplicity with $(n_1 + 1, n_2 + 1)$ and $(n_1 - 1, n_2 - 1)$. The area of multiplicity with $(n_1 + 1, n_2 + 1)$ is given by:

$$\begin{aligned} \pi_1(n_1 + 1, n_2) &< \varepsilon_1 \leq \pi_1(n_1 + 1, n_2 + 1) \\ \pi_2(n_1, n_2 + 1) &< \varepsilon_2 \leq \pi_2(n_1 + 1, n_2 + 1), \end{aligned} \tag{2.3}$$

and similarly for $(n_1 - 1, n_2 - 1)$.

3. While (n_1, n_2) may also show multiplicity with $(n_1 + m, n_2 + m)$ for $m > 1$ or $m < 1$, these areas of multiplicity are necessarily a subset of the areas of multiplicity with $(n_1 + 1, n_2 + 1)$ and $(n_1 - 1, n_2 - 1)$.

Taken together, these results imply that the areas of ε for which (n_1, n_2) shows multiplicity with any other Nash equilibrium outcome are simply given by the areas of overlap with the outcomes $(n_1 + 1, n_2 + 1)$ (given by (2.3)) and $(n_1 - 1, n_2 - 1)$.

The multiplicity problem follows from the weak structure implied by the Nash equilibrium concept. To obtain unique predictions, we put additional structure on the entry game. We assume that firms make their entry decisions sequentially, i.e. after observing all previous entry decisions, and impose the subgame perfect Nash equilibrium refinement.[13] When entry decisions

[13]This approach is in the spirit of Mazzeo (2002), but adapted to the circumstances of our application to health

of other-type firms are strategic complements, it is not necessary to make specific assumptions regarding the exact ordering of entry moves. This additional structure makes it possible to assign a unique subgame perfect equilibrium outcome to every realization of ε. Suppose ε is such that both (n_1, n_2) and (n_1+m, n_2+m) are Nash equilibrium outcomes (with m a positive or negative integer). The outcome with the fewest number of firms cannot be subgame perfect, since there would then always be an additional firm of one type with an incentive to enter, in anticipation of triggering further entry by a firm of the other type as well. Hence, when there are multiple Nash equilibrium outcomes, the one with the largest number of firms is the unique subgame perfect equilibrium. Making use of our earlier characterization of the multiplicity of Nash equilibrium outcomes, it immediately follows that (n_1, n_2) will be a subgame perfect Nash equilibrium outcome if and only if (i) ε satisfies conditions (2.2) and (ii) ε does not satisfy conditions (2.3). This can be illustrated on Figure 2-1. The market configuration $(1, 2)$ is a subgame perfect Nash equilibrium outcome if and only if ε falls in the relevant area bounded by the bold lines, minus the shaded area in the lower left corner.

Assuming that ε has a bivariate density $f(\cdot)$, it is now possible to derive the probability that the market configuration (n_1, n_2) will be observed as the unique subgame perfect equilibrium outcome when entry restrictions are not binding:

$$\begin{aligned}\Pr(N_1 &= n_1, N_2 = n_2) = \int_{\pi_1(n_1+1,n_2)}^{\pi_1(n_1,n_2)} \int_{\pi_2(n_1,n_2+1)}^{\pi_2(n_1,n_2)} f(u_1, u_2) \mathrm{d}u_1 \mathrm{d}u_2 \\ &- \int_{\pi_1(n_1+1,n_2)}^{\pi_1(n_1+1,n_2+1)} \int_{\pi_2(n_1,n_2+1)}^{\pi_2(n_1+1,n_2+1)} f(u_1, u_2) \mathrm{d}u_1 \mathrm{d}u_2. \qquad (2.4)\end{aligned}$$

care professions. Mazzeo assumes that firms can choose their type at or after entering. We instead assume that firms first choose their type. The potential entrants of each type subsequently make their entry decision without being able to change their type. This is a reasonable assumption in our setting, since training to become physician or pharmacy is costly and time consuming. In practice, physicians and pharmacies rarely retrain. Note that our assumption that firms choose their type before entering yields subgame perfect equilibrium conditions that are computationally more tractable than Mazzeo (2002).

2.3.3 Equilibrium with binding geographic entry restrictions

Non-geographic entry restrictions, e.g. minimum requirements of competency, are common to all firms and do not require a special treatment. They directly enter the payoffs of the firms through observable or unobservable factors affecting fixed costs.

Binding geographic entry restrictions, in contrast, require modifying the traditional free entry framework. In this case $N_1 = \overline{n}_1$, so that there may be type 1 firms (pharmacies) that have an incentive to enter but are not able to do so because of the entry restriction. This has the following immediate implication. From the market configuration $(\overline{n}_1, n_2)$ it is no longer possible to infer that entry by $\overline{n}_1 + 1$ firms would be unprofitable. Hence, with binding entry restrictions the market configuration $(\overline{n}_1, n_2)$ is a Nash equilibrium outcome if and only if ε satisfies the following conditions:

$$\begin{aligned} \varepsilon_1 &\leq \pi_1(\overline{n}_1, n_2) \\ \pi_2(\overline{n}_1, n_2 + 1) < \quad \varepsilon_2 &\leq \pi_2(\overline{n}_1, n_2). \end{aligned} \tag{2.5}$$

For firms of type 2 these conditions are still the same as in (2.2). For firms of type 1 they are different, since it is no longer possible to infer a lower bound on profits from observing $(\overline{n}_1, n_2)$. This actually simplifies the problem of multiple Nash equilibrium outcomes. With nonbinding entry restrictions, we showed that (n_1, n_2) may only show multiplicity with Nash equilibrium outcomes of the form $(n_1 + m, n_2 + m)$, with m either a positive or a negative integer. When the entry restrictions are binding, it is immediately obvious that there can no longer be such multiplicity for positive integers m. Hence, $(\overline{n}_1, n_2)$ can only have multiplicity with equilibria of the form $(\overline{n}_1 + m, n_2 + m)$, for negative integers m. However, similar to the case of nonbinding entry restrictions, the equilibrium with the fewer number of firms cannot be selected as the subgame perfect Nash equilibrium. The market configuration $(\overline{n}_1, n_2)$ is therefore the unique subgame perfect Nash equilibrium if and only if ε satisfies (2.5).

The probability of observing the market configuration $(\overline{n}_1, n_2)$ as the subgame perfect Nash equilibrium when entry restrictions are binding becomes:

$$\Pr(N_1 = \overline{n}_1, N_2 = n_2) = \int_{-\infty}^{\pi_1(\overline{n}_1, n_2)} \int_{\pi_2(\overline{n}_1, n_2+1)}^{\pi_2(\overline{n}_1, n_2)} f(u_1, u_2) \mathrm{d}u_1 \mathrm{d}u_2. \tag{2.6}$$

2.3.4 Econometric specification

We can now specify the likelihood function for our cross-section of markets on observed market configurations and the corresponding market characteristics. We suppress a market subscript m indexing the unit of observation. For both markets with nonbinding and binding entry restrictions, there is a unique subgame perfect Nash equilibrium outcome for every possible realization of ε. Hence, the probabilities of observing a market configuration, as derived by (2.4) and (2.6), can be sensibly used to construct the likelihood function. Defining a dummy variable $d = 1$ if $N_1 < \overline{n}_1$ and $d = 0$ otherwise, the contribution to the likelihood function of a representative observed market configuration is:

$$l = d \Pr(N_1 = n_1, N_2 = n_2) + (1 - d) \Pr(N_1 = \overline{n}_1, N_2 = n_2), \tag{2.7}$$

where the probability terms are defined above by (2.4) and (2.6).

Specify the density $f(\cdot)$ as the bivariate normal density, with a parameter ρ measuring the correlation between ε_1 and ε_2. There are some interesting special cases of this model. First, suppose that the payoffs are independent of the number of firms of the other type, i.e. Assumption 2(a) holds with equality, so $\pi_i^*(N_1, N_2) = \pi_i^*(N_i)$ for each type i. In this case the second term in (2.4) vanishes, so that the model reduces to a bivariate ordered probit model with censoring, where the censoring refers to observations where the entry restrictions are binding. Second, if in addition the entry restriction is not binding for any observation, the model reduces to an uncensored bivariate ordered probit model. Third, if the correlation parameter $\rho = 0$, we end up with two traditional ordered probit models, one for each type, as estimated by Bresnahan and Reiss (1991) and several subsequent contributions. In the empirical analysis, we will also present the results from the first two special cases and compare it with the general model.

It remains to specify the payoffs $\pi_i^*(N_1, N_2)$ entering the likelihood function through the probabilities (2.4) and (2.6). Consider the following linear specification:

$$\pi_i^*(N_1, N_2) = \lambda_i \ln(S) + X\beta_i - \alpha_i^j + \gamma_i^k / N_i - \varepsilon_i. \tag{2.8}$$

The variable S is market size, measured by the number of consumers (population), X is a vector of other observed market characteristics, such as average income, percentage of elderly, and λ_i and β_i are the corresponding type-specific parameters. The parameters α_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.

The fixed effects α_i^j are similar to the "cut-values" in simple ordered probit models, and measure the effect of j firms of the own type on payoffs.[14] The fixed effects γ_i^k measure the effect of k firms of the other type on payoffs, and reflect the extent of strategic complementarity between the entry decisions of different types. One may reasonably expect the complementarity effect to be stronger when there are few firms of the own type. We incorporate this by dividing γ_i^k by the number of firms of the own type.[15] A more general approach would be to specify a full set of fixed effects α_i^{jk} for every market configuration, instead of the additive specification $\alpha_i^j + \gamma_i^k / N_i$. This more general specification would however require a too large number of parameters to be estimated.

As is common in discrete choice models, the scale of the payoffs is not identified. To proceed with estimation, we restrict the standard deviation of ε_i, σ_i, to be equal to one. This restriction is irrelevant for our empirical analysis in section 2.4. In our counterfactual analysis in section 2.5, however, we need to identify the scale of the payoffs, so we will then put additional structure on the payoffs. Apart from the scaling issue, the fixed effects are not all identified. For each

[14] Some studies simply include the number of own-type firms as an explanatory variable, i.e. they include a term $-\alpha_i N_i$ instead of the fixed effects α_i^j. This is more restrictive, as it assumes that the differences between two consecutive fixed effects are always the same (α_i).

[15] This has the intuitive implication 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. Not dividing γ_i^k by N_i would imply that the effect of an other-type entrant on the aggregate own-type profits would increase with the number of own-type firms.

type i we set the first own-type fixed effect to zero, i.e. $\alpha_i^1 = 0$.[16] Furthermore, for each type i we set $\gamma_i^0 = 0$.

Note that the strategic complementarities (the γ_i^k) are identified through our parametric assumptions. Intuitively, conditional on observed market characteristics the number of pharmacies and physicians may be correlated because of strategic complementarities (captured through the γ_i^k) or because of unobserved market characteristics affecting both professions payoffs (captured through the correlation parameter ρ). We distinguish between both possibilities based on the assumption that the error terms have a bivariate normal distribution. Other entry models with two or more types make similar parametric assumptions to obtain identification, e.g. Mazzeo (2002).[17] To identify the strategic complementarities non-parametrically would require appropriate exclusion restrictions, i.e. specifying certain market characteristics that affect either the pharmacies' payoffs or the physicians' payoffs and not both. Since there are no obvious such restrictions in our application, we rely on our parametric assumptions to obtain identification.[18]

Assumptions 1 and 2 imply that the model is internally consistent if the estimated fixed effects α_i^j and γ_i^k entering (2.8) satisfy the following conditions for all i, j and k:

$$\begin{aligned} \alpha_i^{j+1} &> \alpha_i^j \\ \gamma_i^{k+1} &\geq \gamma_i^k \\ \alpha_i^{j+1} - \gamma_i^{k+1}/(N_i+1) &> \alpha_i^j - \gamma_i^k/N_i. \end{aligned} \tag{2.9}$$

Since we normalized $\alpha_i^1 = 0$ and $\gamma_i^0 = 0$, it also follows that the fixed effects α_i^j and γ_i^k should

[16] The constant term β_i^0 in the vector β_i then becomes identified. Alternatively, one can normalize $\beta_i^0 = 0$, and estimate α_i^1.

[17] Mazzeo (2002) also assumes a normal distribution to identify the effects of other-type firm entry decisions, which are strategic substitutes in his case. While he does not estimate ρ, he performs a robustness analysis of his results by assuming alternative values of ρ.

[18] This relates closely to the identification issues encountered in measuring complementarities in organizational design with a single decision maker. Athey and Stern (2003) develop a structural framework to identify complementarities and show the importance of proper exclusion restrictions. Miravete and Pernias (2006) apply their framework using a maximum likelihood approach.

all be positive. The first row of inequalities in (2.9) simply says that an additional firm of the own type decreases the payoffs.[19] The second row 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. In the empirical analysis, we will verify whether these conditions are satisfied. If they are, the estimates are consistent with the initial assumptions of the model.

2.4 Empirical analysis

Our empirical entry model with entry restrictions and strategic complementarities is given by (2.7), where the probabilities are defined by (2.4) and (2.6) and the payoffs are given by (2.8). The model is internally consistent if Assumptions 1 and 2 are satisfied, i.e. if the estimated own-type and other-type fixed effects α_i^j and γ_i^k satisfy the conditions in (2.9).

There may be up to 11 pharmacies and up to 21 physicians in a market, implying a large number of fixed effects α_i^j and γ_i^k. It is necessary to impose restrictions on the pharmacies' own-type fixed effects α_1^j, since the entry restrictions are always binding in markets with more than 4 pharmacies: for $j > 4$, we therefore restrict α_1^j such that there is no further competitive entry effect.[20] To estimate the other-type fixed effects, γ_i^k, we impose restrictions following a "bottom-up" approach: we begin with a limited number of other-type fixed effects and then add more until they no longer differ significantly from the previous one. We end up with a specification with one significant other-type fixed effect in the pharmacies' payoffs, γ_1^1, and four significant other-type fixed effects in the physicians' payoffs, $\gamma_2^1 \dots \gamma_2^4$ (where we set $\gamma_1^k = \gamma_1^1$ for $k > 1$, and $\gamma_2^k = \gamma_2^4$ for $k > 4$). The model is internally consistent, i.e. the estimated parameters satisfy all the conditions given by (2.9). Note that we also estimated an alternative model, in which the entry decisions of firms of different types are strategic substitutes (the

[19] This is similar to the requirement of the cut-points in traditional ordered probit models. The condition $\alpha_i^{j+1} > \alpha_i^j$ is a sufficient but not a necessary condition for Assumption 1 to be satisfied. The necessary and sufficient condition is slightly weaker, i.e. $\alpha_i^{j+1} > \alpha_i^j - \gamma_i^k/((N_i(N_i+1))$. We present the sufficient condition, since it is easier to interpret in the empirical analysis, and since it was always met anyway.

[20] To obtain these restrictions on α_1^j, for $j > 4$, we start from Bresnahan and Reiss' (1991) entry thresholds measures of competition. Define the entry thresholds $S_i^{j,k}$ as the market size at which the j-th firm of type i would just be willing to enter when there are k firms of the other type, i.e. the market size such that (2.8) is equal to zero. If the per-firm entry threshold for the j-th own-type entrant is the same as that of the $(j-1)$-th own-type entrant (given that there are no other type firms), there is no competitive entry effect. Using (2.8), it can be verified that this is the case if $\alpha_1^j = \alpha_1^{j-1} + \lambda_1 \ln((N_1 - 1)/N_1)$. Hence, we impose this restriction on the pharmacies' own-type effects for $j > 4$.

reverse of Assumption 2). However, we found that the estimated parameters often violate that model's assumptions, i.e. the other-type firms often have a positive effect on payoffs, while the assumption of strategic substitutes requires the opposite. See Schaumans and Verboven (2006) for details on that model.

Table 2.3 presents the parameter estimates. The specification in the third column is our general model, accounting for both entry restrictions and strategic complementarities. For comparison purposes, the specification in the first column presents the estimates of an uncensored bivariate ordered probit model, which assumes no binding entry restrictions and no strategic complementarities (all $\gamma_i^k = 0$). The specification in the second column shows the estimates of a censored bivariate ordered probit model. This still assumes there are no complementarities, but it accounts for the fact that entry restrictions on pharmacies are binding in some of the markets.

A comparison between the first and the second column clearly demonstrates the importance of accounting for the presence of geographic entry restrictions on pharmacies. Several of the parameters change to a substantial extent. A Hausman test confirms that the parameters differ significantly across the two estimators (test-statistic of 531.9). Hence, the consistent model which accounts for the entry restrictions should be preferred. Furthermore, a comparison between the second and the third column shows that the γ_i^k are jointly significant (likelihood ratio test statistics of 41.78). This indicates that there are significant strategic complementarities between the entry decisions of pharmacies and physicians. These estimates take into account that the error terms entering the two professions' payoffs may be correlated, as captured by the parameter ρ. Recall however our earlier discussion that we do not identify the strategic complementarities based on exclusion restrictions, but rather based on our parametric assumptions, including the bivariate normal distribution for the error terms.

We now discuss the parameter estimates of the general entry model in more detail. Market size, as measured by population, is the most important market characteristic affecting the pharmacies' and physicians' payoffs. This is consistent with the results from previous entry models, such as Bresnahan and Reiss (1991). In line with expectations, the population's age distribution has an important impact on payoffs. More specifically, the percentage of elderly in a

Table 2.3: Estimation results*

	Bivariate ordered probit models				General model with strategic complements	
	No account for entry restrictions		Account for entry restrictions			
Pharmacies' payoff equation						
constant	-19.05	(1.18)	-14.09	(3.40)	-13.54	(1.82)
ln(population)	2.49	(0.06)	1.95	(0.12)	1.43	(0.13)
% young	-0.31	(2.48)	0.73	(9.18)	0.22	(4.26)
% old	10.18	(2.43)	19.00	(5.20)	19.32	(3.54)
% foreign	-1.03	(0.94)	-0.94	(0.96)	-1.00	(1.08)
% unemployed	9.20	(2.22)	22.71	(4.85)	23.06	(4.40)
Flanders	-0.03	(0.14)	0.13	(0.34)	0.11	(0.25)
income	-0.43	(0.14)	-0.35	(0.18)	-0.32	(0.19)
α_1^2	2.26	(0.11)	1.50	(0.18)	1.09	(0.23)
α_1^3	3.64	(0.13)	2.56	(0.20)	1.94	(0.30)
α_1^4	4.83	(0.15)	3.14	(0.22)	2.37	(0.35)
γ_1^1	–		–		0.78	(0.29)
Physicians' payoff equation						
constant	-19.41	(0.94)	-19.28	(1.12)	-17.42	(0.98)
ln(population)	2.54	(0.07)	2.53	(0.08)	2.27	(0.07)
% young	3.45	(2.08)	2.22	(2.25)	2.02	(2.15)
% old	6.85	(1.84)	6.81	(1.90)	5.98	(1.89)
% foreign	-3.61	(0.73)	-3.58	(0.69)	-3.43	(0.72)
% unemployed	2.30	(1.83)	2.29	(1.98)	0.67	(1.89)
Flanders	-0.65	(0.12)	-0.56	(0.13)	-0.58	(0.13)
income	0.32	(0.11)	0.32	(0.12)	0.37	(0.11)
α_2^2	1.30	(0.10)	1.32	(0.10)	1.23	(0.10)
α_2^3	2.34	(0.12)	2.36	(0.12)	2.27	(0.13)
α_2^4	2.99	(0.13)	3.09	(0.13)	2.91	(0.14)
γ_2^1	–		–		0.16	(0.19)
γ_2^2	–		–		2.01	(0.29)
γ_2^3	–		–		3.89	(1.01)
γ_2^4	–		–		5.99	(0.83)
ρ	0.32	(0.03)	0.05	(0.07)	-0.15	(0.09)
Log Likelihood	-2,255.6		-1,761.5		-1,740.6	

* The number of observed markets is 847. Standard errors are in parentheses. The other estimated α_2^j are not shown; constraints on the other α_1^j and γ_i^k are discussed in the text.

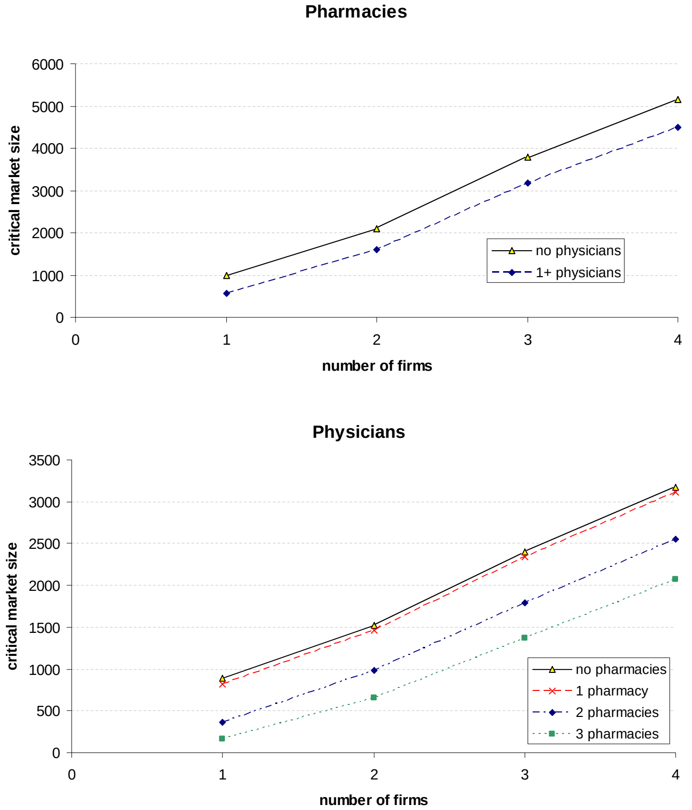
market has a positive and significant effect on both professions' payoffs; the effect is stronger for the pharmacies. The other market characteristics only have a significant effect on the payoffs of one of the two professions. The percentage of foreigners has a negative effect on payoffs, but the effect is significant only in the case of physicians. Physicians do not obtain significantly different payoffs in markets with higher unemployment, whereas pharmacies tend to obtain significantly higher payoffs in such markets, consistent with other studies showing that the unemployed tend to consume more drugs. Income per capita positively and significantly affects the physicians' payoffs. Finally, there are some regional differences: payoffs to physicians are significantly lower in the region of Flanders than in the other two regions (Brussels and Wallonia). This may be due to either different medical consumption habits or to better alternative employment opportunities in the region of Flanders.

The own-type fixed effects α_i^j are all positive and show an increasing pattern, as required by the first condition in (2.9). This implies that additional entry by firms of the same type lowers payoffs (strategic substitutes). The same pattern occurs for the other-type fixed effects γ_i^k, satisfying the second condition in (2.9). This means that additional entry by firms of different types raises payoffs (strategic complementarity). Finally, one can verify that the third condition in (2.9) is satisfied for all observed market configurations. Intuitively, this means that the extent of complementarity between firms of different types is lower than the extent of substitutability between firms of the same type.

Note that the strategic complementarities implied by the other-type effects γ_i^k are asymmetric: pharmacies tend to yield larger benefits to physicians than vice versa. As discussed in section 2.2.2, such an asymmetry in complementarities could not be ruled out *a priori*. It can be interpreted as follows. On the one hand, a visit to the physician may rather likely result in a prescription and in a subsequent visit to the pharmacy. Hence, physicians tend to benefit strongly from the nearby presence of pharmacies. On the other hand, a visit to the pharmacy may often occur without a necessary preceding visit to the physician, because of over-the-counter drugs, or drugs prescribed by specialists. Hence, a pharmacy is less dependent on the nearby presence of physicians.

Further insights in the magnitude of the fixed effects can be obtained from the entry thresholds implied by the model. These are the critical market sizes (population levels) required to

Figure 2-3: Entry thresholds of pharmacies and physicians



support a certain number of firms, for a given number of firms of the other type. Figure 2-3 shows the entry thresholds for pharmacies (top part) and physicians (bottom part) in relation to the number of firms. For both professions the critical market size to support a certain number of firms increases roughly proportionally with the number of firms. Following Bresnahan and Reiss (1991), one may interpret such a proportional relationship as evidence that additional entry does not lead to intensified competition. In section 2.2.2 we already discussed that neither pharmacies nor physicians can use price or advertising to compete. Our estimates thus imply that both professions do also not appear to use the other non-price instruments (such as quality of service) in response to additional entry. Some caution is however warranted. In general, the entry threshold ratios are only informative about the *change* in competition in response to entry, but not about the *level* of competition to start with. In principle, it could thus be possible that even monopoly pharmacies and physicians already behave competitively, because of the threat of new entry as in contestable markets. However, at least for the pharmacies, this possibility appears to be rather unlikely. As Table 2.1 showed, the entry restrictions stemming from the establishment act are binding in the majority of the markets, so that most monopoly pharmacies are effectively protected from the threat of new entry.

As a final point on Figure 2-3, note that the lines shift downwards 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 complementarities between both professions.

2.5 Policy reform towards pharmacies

According to the public interest view, pharmacies receive high regulated markups in combination with tight geographic entry restrictions to ensure a sufficient coverage of pharmacies in the less attractive areas, without triggering excessive entry elsewhere. To evaluate whether this view has empirical support, it is necessary to assess the combined effects of both liberalizing entry and reducing the regulated markups.

Our counterfactual analysis essentially proceeds as follows. First, to account for entry liberalization, we adjust the maximum allowed number of pharmacies per municipality upwards by a factor $\Phi \geq 1$. Equivalently, this amounts to dividing the population threshold criteria set out in the establishment act by this factor Φ. For example, $\Phi = 1.1$ amounts to lowering the required number of inhabitants per pharmacy from $2,000$ to $1,818$. Second, to account for the pharmacies' reduced regulated markups, we adjust the net markups downwards by a factor $0 \leq \Delta \leq 1$. For example, $\Delta = 0.75$ means that net markups drop to 75% of the original levels. We then use the parameter estimates of the entry model to make new entry predictions under alternative levels of Φ and Δ. For $\Phi = 1$ and $\Delta = 1$, we obtain the status quo predictions of the current regime (same entry restrictions and same markups). If Φ is arbitrarily large, we obtain predictions when entry becomes completely free. The reader who is not interested in the details of our approach can skip section 2.5.1 and immediately go to the discussion of our findings in section 2.5.2.

2.5.1 Approach

We first discuss how to make entry predictions after entry liberalization without changing the pharmacies' regulated markups (alternative values of Φ keeping $\Delta = 1$). For each market, we take $1,000$ draws from the estimated bivariate normal distribution for the error terms ε_1 and ε_2. For each market and draw, we compute the maximum number of pharmacies and physicians that can profitably enter, subject to the considered entry restriction (Φ). We then average these numbers over the $1,000$ draws to obtain the expected number of pharmacies and physicians per market. There is one issue stemming from the fact that the establishment act restricts the maximum allowed number of pharmacies at the municipality level and not at the market (town) level, which is the unit of our analysis. For example, entry liberalization may allow for one additional pharmacy in a certain municipality, but this does not stipulate in which market within the municipality the additional pharmacy may enter. In our counterfactuals we will assume that the extra allowed pharmacy will enter (if profitable) in the market where the profits are highest. More generally, if entry liberalization allows for one or more than one additional pharmacies in a municipality, we assume that they enter (as long as profitable) in the markets where profits are the highest.[21]

We also make entry predictions after a reduction in the pharmacies' regulated markups (in combination with entry liberalization). More precisely, we look at a drop in the net markups μ by a factor Δ, where $0 \leq \Delta \leq 1$, i.e. a drop from μ to $\mu\Delta$. To model the effects of such a markup drop, we require a more precise economic interpretation of the pharmacies' payoffs $\pi_1^*(N_1, N_2)$, as specified earlier by (2.8). In a direct interpretation the payoffs are simply profits. We adopt an alternative interpretation here. Define a pharmacy's profits as $\Pi_1^*(N_1, N_2) = S\mu R(N_1, N_2)\exp(-\varepsilon_1) - F_1(N_1, N_2)$, where S is the number of consumers (defined before), $R(N_1, N_2)$ is revenues per consumer, $F_1(N_1, N_2)$ is fixed costs, and ε_1 is a multiplicative error term capturing unobserved variable profits or fixed costs. This assumes that the variable profits (first term) are proportional to the number of consumers S, and that the net markup

[21] As a robustness check, we also did our counterfactuals under the assumption that the establishment act applies at the market (town) level rather than at the municipality level. This is a simpler but less realistic approach, yet the counterfactual results are similar. See Schaumans and Verboven (2006).

μ is constant and uniform across markets. Both assumptions are reasonable for pharmacies.[22] Pharmacies then enter if and only if $\Pi_1^*(N_1, N_2) \geq 0$, or equivalently if and only if

$$\pi_1^*(N_1, N_2) = \ln(S) + \ln(\mu) + \ln\left(R(N_1, N_2)/F_1(N_1, N_2)\right) - \varepsilon_1 \geq 0. \tag{2.10}$$

Hence, the payoffs $\pi_1^*(N_1, N_2)$ receive the interpretation of the logarithm of the ratio of variable profits over fixed costs, and all included variables should be interpreted as affecting this ratio.[23] Specifying $\ln\left(R(N_1, N_2)/F_1(N_1, N_2)\right) = X\overline{\beta}_1 - \overline{\alpha}_1^j + \overline{\gamma}_1^k/j$ and substituting into (2.10), we essentially obtain our earlier payoff specification (2.8). The main difference is that the coefficient on $\ln(S)$ is now restricted to 1 (because variable profits are proportional with S). Consequently, the standard deviation of ε_1, i.e. σ_1, becomes identified: we can interpret the earlier estimated population coefficient λ_1 as $1/\sigma_1$. Furthermore, we can interpret the earlier estimated intercept β_1^0 as $\left(\overline{\beta}_1^0 + \ln(\mu)\right)/\sigma_1$, i.e. as containing the net markup μ. We can therefore model a lowering of the pharmacies' net markups from μ to $\mu\Delta$ as a reduction in the intercept from β_1^0 to $\beta_1^0 + \lambda_1 \ln(\Delta)$. Using this new intercept, we can proceed as before to make entry predictions for alternative values of Φ and Δ.

Our counterfactuals consider a relative reduction in the net markup from μ to $\Delta\mu$. To retrieve the absolute reduction in the gross markup ν (currently regulated at 23%), we would require additional information on the variable retail costs other than the wholesale costs. A reasonable starting point is to assume that the other variable retail costs are zero, so that $\mu = \nu$.[24] The absolute reduction in the gross regulated markups is then simply $\nu(\Delta - 1)$, where $\nu = 23\%$. As a robustness check, we will also consider the possibility that there are other variable retail costs, so $\mu < \nu$. It can be verified that the implied absolute gross markup reduction is then given by $\left((1-\nu)/(1-\mu)\right)\mu(\Delta - 1)$. In this formula, we again have $\nu = 23\%$, and we set $\mu = \nu - 10\% = 13\%$, i.e. we assume that other variable retail costs amount to 10%.

[22] Gross markups are regulated at a uniform rate and our empirical results showed no evidence of non-price competition. Furthermore, there are no scale economies in distribution to pharmacies, apart from the fixed costs of setting up a pharmacy.

[23] This is similar to Genesove (2001), and it differs from e.g. Bresnahan and Reiss (1991) who directly interpret $\pi_1^*(N_1, N_2)$ as profits (so that the error term has the interpretation of an additive profit component).

[24] The pharmacies' most important other retail costs are labor costs. It is not unreasonable to treat these as fixed, since time spent on servicing patients is essentially fixed during opening hours (in contrast to physicians who spend a variable amount of their time on servicing patients).

2.5.2 Findings

Table 2.4 summarizes the entry predictions under alternative regulatory policies towards entry and markups of pharmacies. The results are based on the estimates of the general model with strategic complements (third part of Table 2.3). We obtain similar results from the model without strategic complements (second column of Table 2.3 with $\gamma_i^k = 0$), except that there are of course no indirect effects on the physicians in that case. Table 2.4 compares three entry regimes: the status quo entry regulation (Panel A with $\Phi = 1$), "partial" entry deregulation where the maximum allowed number of pharmacies in each market is doubled (Panel B with $\Phi = 2$), and a full free entry situation (Panel C with Φ large). We also consider four possible net markups (four different columns): no change in the markups ($\Delta = 1$), relative drops to 75% and 50% of the original levels ($\Delta = 0.75$ and $\Delta = 0.5$) and a non-uniform markup drop to $\Delta = 0.4$ for large markets (above-average population size) and $\Delta = 0.6$ for small markets. To illustrate, the relative net markup reduction of $\Delta = 0.5$ amounts to an absolute gross markup reductions from 23% to 11.5% if there are no other variable retail costs than wholesale costs, and to 5.8% if other variable retail costs amount to 10%.

The first column of Table 2.4 shows the predictions under the three entry regimes, assuming no changes in markups.[25] The total number of pharmacies (the sum across all markets) is predicted to increase from $1,515$ to $2,330$ (or +54%) under partial entry deregulation, and to $4,140$ (or +173%) under full free entry. The current entry restrictions, which Table 2.1 documented to be binding in more than 80% of the markets, are thus also economically important. Furthermore, the first column shows that entry deregulation would also have indirect effects on the physicians. Their number would increase from $4,371$ to $4,563$ (or +4%) under partial entry deregulation, and to $4,683$ (or +7%) under full free entry. These effects stem from our earlier finding that the entry decisions of pharmacies and physicians are strategic complements. Finally, the first column shows how the geographic coverage of health care services changes after entry deregulation. For example, full free entry would drastically reduce the number of markets without a pharmacy from 242 to 145. This large reduction stems from the fact that

[25] The model predicts the status quo outcomes reasonably well. For example, Table 1 showed that there are 246 (154) markets without any pharmacy (physician), whereas the model predicts that there are 242 (152) such markets.

Table 2.4: Summary entry predictions under alternative regulatory policies*

	net markup change			
	$\Delta = 1$	$\Delta = 0{,}75$	$\Delta = 0{,}5$	nonuniform
Panel A - no change in entry restrictions (Φ = 1)				
number of pharmacies	1515	1437	1273	1230
number of physicians	4371	4337	4269	4264
number of markets without pharmacy	242	254	286	279
number of markets without physician	152	153	154	154
Panel B - maximum number of pharmacies doubles (Φ = 2)				
number of pharmacies	2330	2067	1663	1595
number of physicians	4563	4488	4362	4343
number of markets without pharmacy	186	207	255	244
number of markets without physician	144	146	150	150
Panel C - full free entry in the pharmacy market (Φ is large)				
number of pharmacies	4140	3191	2176	2088
number of physicians	4683	4566	4399	4391
number of markets without pharmacy	145	180	242	227
number of markets without physician	127	136	145	143

* $\Phi = 1$ refers to no change in entry restrictions, $\Phi = 2$ a doubling in the maximum number of allowed pharmacies, and Φ large to full free entry. Similarly, $\Delta = 1$ refers to no change in the net markups, $\Delta = 0.75$ to a drop in the net markups by 25% and $\Delta = 0.5$ to a drop in the net markups by 50%. Finally, column 'nonuniform' gives the entry predictions under a nonuniform regime of markup drops: towns with a lower than average population size get a markup drop of $\Delta = 0.6$, whereas a markup drop of $\Delta = 0.4$ applies to bigger towns. All entry predictions are based on the parameter estimates of the general entry model with strategic complements, last column of Table 2.3.

the current entry restrictions were actually binding for 199 of the uncovered pharmacy markets, as documented earlier in Table 2.1.[26]

Policy makers such as the O.E.C.D. have warned against too simple conclusions regarding the effects of liberalizing entry regulations. According to the public interest view the high regulated markups and tight entry restrictions ensure a sufficient coverage of pharmacies in the less attractive areas, without triggering excessive entry elsewhere. To evaluate this view, it is therefore important to look at the *combined* effects of lowering markups and liberalizing entry restrictions. The second and third columns of Table 2.4 show the effects from uniformly

[26]Recall that this is due to the fact that the entry restrictions apply at the larger municipality level rather than at the market level. Hence, the constraint may be binding in an uncovered market if there are already too many pharmacies in other markets of the same municipality.

scaling down markups by a factor $\Delta = 0.75$ or $\Delta = 0.5$. If this is done without liberalizing the entry restrictions (panel A), the total number of pharmacies evidently drops from $1,515$ to respectively $1,437$ and $1,273$. Geographic coverage would also decrease: the number markets without pharmacies increases from 242 to respectively 254 and 286. In contrast, if the markup reductions are combined with entry liberalization (panels B and C), the number of pharmacies would no longer decrease. For example, the number of pharmacies increases from $1,515$ to $2,176$ if a 50% net markup reduction is combined with full free entry.[27] Furthermore, reduced geographic coverage is no longer necessarily a source of concern under a combined policy. For a markup reduction of $\Delta = 0.75$, the total number of markets without any pharmacy actually drops from 242 to 207 under partial entry liberalization and to 180 under full free entry. For a larger markup reduction of $\Delta = 0.5$, geographic coverage slightly worsens from 242 to 255 unserved markets under partial deregulation, but it remains unchanged at 242 unserved markets under full free entry (panel B third column).

To avoid that geographic coverage goes down after a large markup reduction, the government could use additional instruments. For example, it could favour pharmacies in the smaller markets through non-uniform markup regulation. The fourth column of Table 2.4 shows the effects from scaling down the markups in a non-uniform way, by a factor $\Delta = 0.4$ in markets with an above-average population size and by $\Delta = 0.6$ in markets with below-average population size. Such a policy indeed helps to improve geographic coverage. For example, when the non-uniform markup drop is combined with full free entry the number of markets without a pharmacy goes down to 227.

In sum, the public interest motivation for combining high markups and tight entry restrictions as a way to ensure geographic coverage does not find empirical support. The government may in fact ensure a higher geographic coverage by simultaneously liberalizing the entry restrictions and lowering the regulated markups (either uniformly or in a non-uniform way by favouring the pharmacies in the smaller markets).

[27] The indirect effects on physicians are small but the availability of physicians usually slightly increases when entry liberalization is combined with a lowering of the markups.

To further explore this, it would be interesting to know the optimal number of firms and the required policies to ensure this. A complete welfare analysis is not possible within our empirical framework. However, we can address a related question that sheds partial light on this issue. We ask how the entry restrictions can be liberalized (through Φ) and the net markup can be reduced (through Δ) in such a way that the total number of pharmacies in the country remains constant at the current predicted level of $1,515$. We then also compute the associated reductions in the absolute gross markups and the number of markets without any pharmacy. By keeping the total number of pharmacies constant, we maintain the current level of duplicated fixed costs in the country, and look at the effects on the pharmacies' rents and local geographic coverage.[28]

Table 2.5 shows the results from this policy experiment. The first and second columns show the combinations of entry restrictions and net markups such that the total number of pharmacies in the country remains constant at the predicted status quo level. To illustrate, multiplying the maximum allowed number of pharmacies to $\Phi = 1.75$ requires a drop in the net markups to $\Delta = 47\%$ of the original levels. In general, as the entry restrictions become more liberalized (higher Φ), the net markups should drop by more (lower Δ) to keep the total number of pharmacies in the country constant. With full free entry, the net markups can drop to 34.6% of the original levels. To know how these changes translate into absolute reductions of the regulated gross markups, the third and fourth columns consider the cases with no other variable retail costs than wholesale costs ($\mu = \nu$), and with other variable retail costs amounting to 10% ($\mu = \nu - 10\%$). Gross markups can drop by a large amount, even if there are other variable retail costs. For example, if entry would become fully free, the regulated gross markups can decrease by between 7.5% and 15% in absolute terms without changing the total number of pharmacies. Note however that in this policy experiment the number of markets without a pharmacy would increase. Hence, a combined entry/markup policy such that the total number of pharmacies is kept constant reduces geographic coverage to some extent. To preserve geographic coverage, a relatively moderate entry liberalization policy may therefore be adequate. For example, setting $\Phi = 1.5$ already implies a substantial markup drop of $\Delta = 0.533$ to keep the total number of pharmacies constant, and raises the number of unserved markets to only 259. Furthermore,

[28] Of course, if the current number of pharmacies is actually too high, it would be even better to further reduce the markups for a given entry policy (and vice versa if the current number is too low).

Table 2.5: Entry restrictions, markups and geographic coverage keeping the total number of pharmacies constant*

degree of entry restriction Φ	net markup drop by factor Δ	absolute gross markup drop		number of markets without pharmacy
		$\mu = \nu$	$\mu = \nu - 10\%$	
1	1.000	0 %	0 %	243
1.25	0.664	-7.7 %	-3.9 %	250
1.5	0.533	-10,7 %	-5.4 %	260
1.75	0.471	-12.2 %	-6.1 %	270
2	0.433	-13.0 %	-6.5 %	278
2.25	0.411	-13.6 %	-6.8 %	283
2.5	0.396	-13.9 %	-7.0 %	288
large	0.347	-15.0 %	-7.5 %	308

* For each considered Φ (first column), the relative net markup drop Δ is computed (second column) such that the total number of pharmacies remains constant at the predicted status quo level of $1,515$. The third and fourth column show the absolute gross markup drops corresponding to the relative net markup drop Δ, assuming that retail costs other than wholesale costs amount to respectively 0% (so that $\mu = \nu$) and 10% (so that $\mu = \nu - 10\%$). The fifth column shows the corresponding number of markets without pharmacy.

a non-uniform markup drop may be introduced to improve geographic coverage. For example, $\Phi = 1.5$ can be combined with a markup drop of $\Delta = 0.433$ in markets with above-average population size and $\Delta = 0.791$ in markets with below-average population size. This would also keep the total number of pharmacies constant, and at the same time improve geographic coverage to only 235 unserved markets.[29]

Overall, these policy counterfactuals illustrate that the government can generate potentially large budgetary savings from liberalizing entry without reducing the availability of supply.

2.6 Conclusions

We have studied the role of professional regulation in health care professions. We have looked at geographic entry restrictions on Belgian pharmacies, as combined with high regulated markups. We consider both the direct impact of the regulations on the pharmacies, and the indirect impact on the physicians. We find that the geographic entry restrictions have substantially

[29] More generally, we considered policies of alternative Φ and non-uniform markup drops such that the total number of pharmacies remains constant. The results from these counterfactuals are available on request. They show that geographic coverage improves if the markup drop is sufficiently non-uniform.

reduced the number of pharmacies, and have also reduced the number of physicians (since the professions' entry decisions are strategic complements). Given that the markups are regulated at a distortionary high level, these entry restrictions may in principle be socially desirable. We have therefore also looked at the combined effects of the entry restrictions and regulated markups. Our results shows that a suitably designed policy that simultaneously liberalizes the entry restrictions and lowers the regulated markups would lead to substantial shifts in rents from pharmacies to consumers (tax payers) without necessarily reducing the availability of supply.

The next question is whether these findings are sufficiently strong to warrant conclusions to liberalize the professions. The answer depends on the nature of the current rents to pharmacies. If they are simply a transfer, liberalization would only have distributional effects. Two arguments may, however, be provided as to why the pharmacies' current rents may be socially wasteful. First, their rents are to the detriment of consumers as taxpayers. This will be inefficient to the extent that the required taxes create distortions elsewhere in the economy. Second, the rents themselves may have been dissipated in the form of wasteful investments. Along the lines of Posner's (1975) argument, pharmacies and their organization would need to engage in inefficient lobbying and related activities to maintain the rents.

We hope that our analysis will stimulate additional research, which is highly relevant from a policy perspective. In the U.S., efforts have already been done to liberalize entry and conduct regulation, but exceptions such as taxicabs remain. In Europe, policy makers have only recently opened the debate to reform the liberal professions, and to make their practices in line with competition policy. The European Commission recently published a large report by Paterson et al. (2003) documenting the country-specific regulations of several professions, such as accountants, engineers, lawyers, pharmacies, and notaries. As another example, the U.K.'s Office of Fair Trading (2003) published a report on reforming the pharmacies. Our analysis shows how these policy issues can be addressed by suitably adapting empirical models of free entry to account for entry restrictions and other relevant factors.

2.7 Appendix

This Appendix first characterizes the multiplicity of Nash equilibria outcomes when the entry decisions of firms of different types are strategic complements.

If the entry decisions by firms of different types are strategic complements, i.e. Assumption 2(a) holds with strict inequality, then (n_1, n_2) may show multiplicity with other equilibrium outcomes of the general form $(n_1 + m_1, n_2 + m_2)$. The three Claims below show that the multiplicity can be characterized in a simple way if Assumptions 1 and 2 are satisfied. Taken together, these Claims imply that the areas of ε for which (n_1, n_2) shows multiplicity with any other Nash equilibrium outcome are simply given by the areas of overlap with $(n_1 + 1, n_2 + 1)$ and $(n_1 - 1, n_2 - 1)$.

Define $A(n_1, n_2)$ as the set of ε for which (n_1, n_2) is a Nash equilibrium outcome, as given by the conditions (2.2) in the text. Furthermore, define $B(n_1, n_2, m_1, m_2)$ as the set of ε for which both (n_1, n_2) and $(n_1 + m_1, n_2 + m_2)$ are a Nash equilibrium, i.e. $B(n_1, n_2, m_1, m_2) = A(n_1, n_2) \cap A(n_1 + m_1, n_2 + m_2)$, where m_1 and m_2 are positive or negative integers.

Claim 1. *$B(n_1, n_2, m_1, m_2)$ is empty if $m_1 \neq m_2$. I.e., (n_1, n_2) may only show multiplicity with Nash equilibrium outcomes of the form (n_1+m, n_2+m), where m is a positive or a negative integer.*

Proof: Suppose to the contrary that there are also equilibrium outcomes of the form $(n_1 + m_1, n_2 + m_2)$, where $m_1 \neq m_2$. There are several cases:

(i) If $m_1 > 0$ and $m_2 < 0$, then $\varepsilon_1 \leq \pi_1(n_1 + m_1, n_2 + m_2) \leq \pi_1(n_1 + m_1, n_2) \leq \pi_1(n_1 + 1, n_2)$, by the conditions for $(n_1 + m_1, n_2 + m_2)$ to be a Nash equilibrium, by Assumption 2(a) and by Assumption 1.

(ii) If $m_1 > 0$ and $m_2 \geq 0$, and $m_1 > m_2$, then $\varepsilon_1 \leq \pi_1(n_1 + m_1, n_2 + m_2) \leq \pi_1(n_1 + m_1 - m_2, n_2) \leq \pi_1(n_1+1, n_2)$, by the conditions for (n_1+m_1, n_2+m_2) to be a Nash equilibrium, by Assumption 2(b), and by Assumption 1.

(iii) If $m_1 \geq 0$ and $m_2 > 0$, and $m_1 < m_2$, then $\varepsilon_2 \leq \pi_2(n_1+m_1, n_2+m_2) \leq \pi_2(n_1, n_2+m_2-m_1) \leq \pi_2(n_1, n_2+1)$, by the conditions for (n_1+m_1, n_2+m_2) to be a Nash equilibrium, by Assumption 2(b), and by Assumption 1.

(iv) If $m_1 < 0$ and $m_2 > 0$, then $\varepsilon_2 \leq \pi_2(n_1+m_1, n_2+m_2) \leq \pi_2(n_1, n_2+m_2) \leq \pi_2(n_1, n_2+1)$, by the condition for (n_1+m_1, n_2+m_2) to be Nash, by Assumption 2(a) and by Assumption 1.

(v) If $m_1 \leq 0$ and $m_2 < 0$, and $m_1 > m_2$, then $\pi_2(n_1, n_2) \leq \pi_2(n_1, n_2+m_2-m_1+1) \leq \pi_2(n_1+m_1, n_2+m_2+1) < \varepsilon_2$, by Assumption 1, by Assumption 2(b), and by condition for (n_1+m_1, n_2+m_2) to be Nash.

(vi) If $m_1 < 0$ and $m_2 \leq 0$, and $m_1 < m_2$, then $\pi_1(n_1, n_2) \leq \pi_1(n_1+m_1-m_2+1, n_2) \leq \pi_1(n_1+m_1+1, n_2+m_2) < \varepsilon_1$, by Assumption 1, by Assumption 2(b), and by the condition for (n_1+m_1, n_2+m_2) to be Nash.

In all cases we have obtained a contradiction with the conditions (2.2) for (n_1, n_2) to be a Nash equilibrium outcome.

Claim 2. *$B(n_1, n_2, 1, 1)$ and $B(n_1, n_2, -1, -1)$ are not empty. I.e., (n_1, n_2) shows multiplicity with (n_1+1, n_2+1) and (n_1-1, n_2-1).*

Proof: The set $B(n_1, n_2, 1, 1)$ is given by the conditions (2.3) in the text. Since we assume that Assumption 2(a) holds with strict inequality, this set is not empty. A similar reasoning applies to the set $B(n_1, n_2, -1, -1)$.

Claim 3. *$B(n_1, n_2, m, m) \subset B(n_1, n_2, 1, 1)$ if $m > 1$, and $B(n_1, n_2, m, m) \subset B(n_1, n_2, -1, -1)$ if $m < -1$. I.e., while (n_1, n_2) may also show multiplicity with $(n_1 + m, n_2 + m)$ for $m > 1$ or $m < 1$, the areas of multiplicity are a subset of those with $(n_1 + 1, n_2 + 1)$ and $(n_1 - 1, n_2 - 1)$.*

Proof: The set $B(n_1, n_2, m, m)$ is given by:

$$\begin{aligned} \pi_1(n_1 + 1, n_2) &\leq \varepsilon_1 \leq \pi_1(n_1 + m, n_2 + m) \\ \pi_2(n_1, n_2 + 1) &\leq \varepsilon_2 \leq \pi_2(n_1 + m, n_2 + m), \end{aligned} \tag{2.11}$$

which may or may not be empty. Since the left-hand-side in (2.11) is the same as in (2.3), and the right hand side in (2.11) is less than in (2.3) by Assumption 2(b), we have $B(n_1, n_2, m, m) \subset B(n_1, n_2, 1, 1)$ if $m > 1$. A similar reasoning applies to show that the set $B(n_1, n_2, m, m) \subset B(n_1, n_2, -1, -1)$ if $m < 1$.

Chapter 3

Supplier Inducement in the Belgian Primary Care Market

Abstract: We perform an empirical exercise to address the presence of supplier-induced demand in the Belgian primary care market, which is characterized by a fixed fee system and a high density of General Practitioners (GP). Using a unique dataset on the number of contacts of all Belgian GPs, we first investigate whether we can find evidence of demand inducement. We furthermore investigate which type of contacts GPs typically use for inducing demand: consultations or visits. Our results indicate that there is a positive effect of GP density on per capita consumption of primary care. We cannot reject that GPs are responsible for part of this effect through inducing behavior. Furthermore, GPs especially employ consultations to induce demand.

3.1 Introduction

According to OECD Health Data, on average OECD-countries spend 8.9% of their GDP on health care (2003). The public health expenditure even amounted to 10.1% of GDP for Belgium in 2003. In this era of ever-increasing budgets for health care, studying the functioning of health care markets becomes very important. The key to controlling the budget namely lies in providing the correct set of incentives to all parties involved. Only when one fully understands how e.g. consumers and suppliers make their decisions in this market, one can hope to construct a tool to restrain the increase in public health expenditures.

Researchers often look at demand and supply inefficiencies in the health insurance system for explaining the high consumption levels. But also the role of the General Practitioner (GP, referred to as 'she') is important in constructing policies to reduce the overall consumption of medical care. That is, because of the high degree of information asymmetry in health care markets, patients delegate authority to health providers, so that GPs control the health consumption of their patients to a considerable extent (Arrow 1963, Zweifel and Manning 2000). It is thus crucial to understand the behavior of the GP and her reaction to changes in her direct environment. One of the most debated issues concerning their behavior is the question whether or not GPs induce demand for primary health care: do GPs exploit their agency relation by providing excessive care when they face a negative income shock?

It should not be surprising that the study of supplier-induced demand (SID) is well documented in health economics since it has far-reaching implications (Reinhardt 1989). If it is true that suppliers, and more specifically health providers, induce demand for their services, the standard neoclassic models no longer apply. That is, the traditional relationship between demand and supply does not exist for the medical care markets when consumer preferences are strongly influenced by health providers. This affects to a large extent the optimality of different public health policies. For example, if GPs engage in inducing demand, restrictions on the number of GPs can be a good idea, whereas drops in fees would not have a significant impact on the budget (Schroeder 1992). However, although SID is well documented, there is neither a unanimous opinion on the presence of inducement nor on the approach for testing it (McGuire 2000).

The market under investigation in this paper is the Belgian primary care market. According to the literature, the Belgium health care system provides the perfect setting for demand inducement by GPs: patients are charged only a co-payment for the care they receive, GPs are paid according to a fixed fee schedule and the number of GPs per capita is high. Furthermore, there is some prior indication of inducement. Schokkaert and Van de Voorde (2005) study the change in public health expenditure after the increase in co-payment in 1994 and the linear drop in fees for health providers in 1997. They document that public health expenditures only experienced a small drop as the immediate price effect was compensated by quantity increases in the following years (see also Van de Voorde et al 2001 and Cockx and Brasseur 2001[1]). There are thus reasons to believe that inducement is present in the Belgian health care system.

We perform an empirical exercise to test for inducing behavior by Belgian GPs. A unique data set on the individual performance of all registered GPs in Belgium is used to investigate the relation between the number of visits per GP and GP density. Identification of inducement is based on the conjecture that when GPs induce demand for their services, per capita consumption in a region increases proportionally with GP density (McGuire 2000). We start the empirical analysis by looking at initial indications in the raw data, after which we resort to regression analysis to test for the inducement hypothesis. We estimate the impact of GP density on the number of contacts per GP to draw conclusions on the effect on per capita utilitzation of care. We use instrumental variables to correct for the reverse causation argument of GPs locating where the demand is highest. Furthermore, to control for an increase in demand due to consumer preferences instead of inducing behavior by GPs (a higher GP density implies lower travel and waiting costs) we estimate the effect of GP density for different groups of markets, where the level of GP density of markets determines the grouping. This follows the argument by Carlsen and Grytten (1998) that availability is especially an issue in markets with a low GP density while inducement occurs mainly in markets with a higher GP density.

[1] In both papers, the price elasticity of demand is estimated based on detailed data of Belgian consumers and their consumption of medical care. They use the increase of the out-of-pocket price of primary health care in 1994. The price elasticity of demand provides indirect evidence of SID since, in the presence of SID, the reaction of the demand to price changes is diluted by the reaction of the supply side. Both papers find small price elasticities, which can indicate that part of the reduction in demand due to the price increase is countered by demand inducement by the GPs (Cockx and Brasseur 2001 adjusts the estimated elasticities for Belgium in Van de Voorde et al 2001 downwardly).

Next to investigating the presence of inducement, we additionally look at the way GPs induce demand.[2] That is, GPs can increase the number of contacts by inducing either consultations or visits. The costs and benefits associated to inducing a contact namely differs across the types of contacts, which yields different incentives for the GP to induce demand. It is informative to investigate which type of contacts Belgian GPs typically employ for their inducing behavior, as it yields insights in the relative importance of the different cost and benefit aspects of inducement.

The results of our cross-sectional study on Belgian GPs indicate a positive effect of GP density on per capita consumption of GP services. Contrary to the conclusions of Carlsen and Grytten (1998) and subsequent work on Norway, our findings cannot reject the presence of inducing behavior of GPs, although part of the effect is to be ascribed to availability effects and/or downward demand management by GPs. We thus find indications of the presence of supplier-induced demand in the Belgian primary care market. Further analysis shows that Belgian GPs seem to prefer the use of consultations to induce demand, despite the higher fee for visits.

In this paper we start in Section 3.2 by introducing the concept of supplier inducement and the general modelling approach in the literature. It should be clear that we do not develop in detail any specific model of inducement or GP behavior. Instead we discuss elements from different models in the literature and focus on the main intuitions. The paper focuses on the empirical exercise and we refer to McGuire (2000) for further background. Section 3.3 discusses the organization of the Belgian primary care market, where we make the link with issues of supplier-induced demand and present the data for testing inducement in the Belgian primary care market. Section 3.4 presents the empirical approach taken in this paper for testing the presence of inducing behavior by Belgian GPs. We discuss both the underlying principles of the technique and the empirical implementation. The results of the empirical analysis of the Belgian primary care market are presented in Section 3.5. After finding some evidence of supplier inducement by Belgian GPs, we investigate in Section 3.6 which type of contacts GPs employ for their inducement activity. Section 3.7 concludes.

[2] The most related question that has been addressed in the literature is the distinction between inducing the number of contacts or inducing the content of a treatment (Birch 1988, Delattre and Dormont 2003). We instead focus only on the number of contacts and look at the number of different types of contacts: consultations and visits.

3.2 The study of demand inducement

The origin of supplier inducement can be traced to two features of health care markets. First, there is an extensive information asymmetry between GPs and patients (Arrow 1963). Second, the GP has a dual role as both the advisor of the patient as well as the provider of the health services (Wolinsky 1993). These features enable the GP to guide the decision process to a considerable extent. More specifically, the GP can exert direct influence on the demand function of the consumer by altering the patient's perceptions of his needs and of the capacity of medical technology to satisfy them (Evans 1974). The GP can thus recommend services that do not pass the objective patient cost-benefit thresholds (Dranove 1988). When an exogenous shock exert a negative pressure on her income/utility level, the GP can have the incentive to induce more contacts with her patients to maintain her income/utility level, in case she is reimbursed according to the number of contacts. As a result, the inducement hypothesis predicts that when e.g. an additional GP enters the market or GPs' fees drop, there is a higher consumption level in that market, which is driven by the behavior of GPs.

As inducing behavior of the health professions would have important implications for the optimality of health care policy, we investigate whether this behavior is present in the Belgian primary care market. Note the difference between inducement and useful agency (McGuire 2000). In case the individual consumer underestimates his demand for care ('illness behavior', Mechanic 1968), the influence of GPs on the demand of patients is in line with his behavior as a perfect agent. Supplier inducement in contrast involves the use of her discretionary influence on the preferences of patients to consume redundant care. This results in overconsumption of the medical care, generated by the economic self-interest of GPs. On the other hand though, remark that more care is generally considered to be good, especially given the negative externalities of an illness. In this light, the regulator himself often provides incentives to patients to consume more care through public campaigns for regular check-ups. This paper does not consider the impact of supplier inducement on health outcomes but investigates the presence of inducement because of the consequences for public policy (Labelle et al 1994).

The hypothesis of supplier inducement is hard to test since a sound analysis should capture all the peculiarities of the health care markets. As Grytten et al. (1995) put it:

> A sound analysis requires a model that deals with the provision of suboptimal, optimal and supraoptimal levels of health care; it should account for a world of ill-informed and perhaps misinformed consumers; the model should take into account that physicians are both concerned with the patient's well-being and their own well-being; and finally, institutional factors should be taken into account. Often, health services are provided in markets which are subject to complex government subsidies and regulations.

Furthermore, the empirical testing of supplier inducement is complicated as pure consumer demand is never separately observed in the data: the observed consumption of care is the results of both consumer and producer preferences. There is however an extensive literature that models the decision problem of the GP and although it can not account for all the specifics of the problem, testable hypotheses are put forward with respect to the presence of supplier inducement. Due to the identification problem related to the demand for care, the literature mainly tests for the presence of marginal SID, i.e. the change in consumption due to changes in GP behavior when income shocks occur.

The type of information on the use of primary care provision determines to a large extent which type of conclusions on inducement can be drawn. Traditionally town-level data was used, as in e.g. Fuchs (1978), but these aggregated approaches were highly criticized due to identification issues (e.g. Auster and Oaxaca 1981, Frank 1985). As in the recent years data availability has improved considerably, micro-models to refine the testing are developed. However, not only is there no consensus on the methodology to correctly identify inducing behavior, also the results are far from conclusive.

Empirical models of inducing behavior are designed to test hypotheses generated by a model of GP behavior. Most of the models in the literature are partial models of utility maximization (or disutility of discretion models) in the spirit of Evans (1974).[3,4] In general, GP utility is assumed to be affected by three components, as represented in:

$$U^{GP} = U^{GP}(Y, W, D) \tag{3.1}$$

First, GP utility is positively affected by the income level, Y. Since we will study a setting of a fee-for-service system, income is directly related to the number of contacts the GP supplies through the fee level. Marginal utility of income is decreasing: a change in GP income has a stronger impact on the utility level when the income level is relatively low ($U_Y^{GP} > 0$, $U_{YY}^{GP} < 0$). Second, GP utility is negatively affected by the workload, W (or positively affected by the amount of leisure): for every contact the GP completes, some effort and time are required. GP utility is furthermore decreasing concavely in workload. That is, when the GP has only a few contacts, the utility loss associated to effort costs of an additional contact is small, while that extra contact will substantially decrease GP utility when the GP is already struggling to finish her work ($U_W^{GP} < 0$, $U_{WW}^{GP} < 0$). Finally, GP utility is affected by costs resulting from exerting discretionary influence on the demand, D. In other words, deviating from the consumer's optimal level of provision by e.g. inducing behavior comes at a cost. Inducement costs are related to the effort and time costs to convince patients to consume the extra contact and to pay the extra price. They also include moral costs associated with deviating from the optimal level of provision ('internal conscience' in Evans 1974, McGuire and Pauly 1991 or the effect of patients' utility on GP utility in Calcott 1999). These costs have a negative impact on GP utility and are increasing convexly in the amount of induction: it continues to take a

[3] We combine elements from different models. For more rigorous theoretical models, we refer to Evans 1974, McGuire and Pauly 1991, Gruber and Owings 1996 and McGuire 2000.

[4] Other models include models of profit maximization, where profits are maximized instead of utilities (Stano 1987, Dranove 1988). In the target income theory, GPs do not maximize their utility or income but target some 'optimal' income level. It is however a black-box how the target income is determined (Newhouse 1970). In price rigidity models, the reaction of GPs to e.g. a fee cut is to be explained by incentives to bring the market in a new equilibrium (Cromwell and Mitchell 1986, Delattre and Dormont 2003) and in models based on persuasion games, the utilization of care is a result of a consensus between GP and patient (Pauly 1980, Rochaix 1989).

higher effort level to induce extra contacts and the internal justification of inducement becomes harder the higher the level of induced demand. Also, in an intertemporal consideration, the GP risks losing patients once the inducing behavior is revealed (Dranove 1988, Wolinsky 1993). The more one induces demand, the higher is the risk of detection ($U_D^{GP} < 0$, $U_{DD}^{GP} < 0$).

The consumer side of the care market is mostly not specified within the inducement models and is taken as exogenous. In general though, the consumer demand for GP services is determined by consumer utility, which depends on at least three factors. First, obviously the general health status is important: the worse the general health, the higher is the need for health care and thus the higher is the utility of consuming care services. Second, demand is affected by the shadow price of GP care. This consumer price consists of two components: the co-payment for the consumed GP services (fixed) and the costs of access to health care, i.e. transportation and waiting time. The utility of the patient, and thus the demand for GP care, is higher the lower the fee, the distance and the waiting time. Finally, the presence of alternative health care provision also affects the demand for GP services.

GPs are assumed to maximize utility by setting the amount of contacts to induce. The GP takes into account that an induced contact increases utility through the extra income it generates, but decreases the utility through an increase in workload and inducement costs. She will thus make a trade-off between the marginal benefits of inducement and the marginal costs. Assuming for simplicity that GP utility is linear in its components and with f the remuneration of a GP per contact, w the workload associated to a contact[5] and ic the cost of induction (which depends on the amount of inducement), the trade-off can be represented as:

$$U_Y^{GP}.f \lesseqgtr U_W^{GP}.w + U_D^{GP}.ic \tag{3.2}$$

To come to testable hypotheses, the first order condition(s) of the maximization problem of the GP is examined: how does the degree of inducement vary with e.g. price levels, the number of providers or the innate demand for care.

[5]It can also be assumed that w differs according to whether it is an induced visit or not. That is, it can be expected that the workload of an induced visit is less for the GP as the contact in actually not required.

Reviewing the literature, we can identify three general empirical techniques to study supplier inducement. First, most of the empirical work investigates how differences in the environment of GPs affect the utilization of care. This involves either differences in the fees paid to GPs (Feldstein 1970) or differences in the number of direct competitors in the market (Cromwell and Mitchell 1986, Carlsen and Grytten 1998). In both cases, GP income differs depending on the location of the GP. Therefore, once controlled for differences in the demand of care, variation across locations in the use of primary care can indicate inducing behavior by GPs in less profitable locations. Second, inference on the presence of demand inducement can be made by looking at different types of providers, care services or consumers. That is, when a country holds two types of GPs that work under a different remuneration system, differences in the incentives can results in variation in the provided levels of care by the different types, which can be used to identify inducement (Grytten et al 1995). The same variation can results from the presence of different consumer types where e.g. some are better informed or some are differently ensured (Hay and Leahy 1982) and in the presence of different components of the care provision (Birch 1988, Rossiter and Wilensky 1984, Delattre and Dormont 2003). Finally, natural experiments are studied to identify changes in the behavior of GPs as a reaction to changes in their income level. Mostly, these studies look at changes in the number of competitors and price or cost changes throughout time (Rice 1983, McGuire and Pauly 1991, Guiffrida and Gravelle 2001), but also changes in the demand structure can be used as an identifying variation in the use of care (Gruber and Owings 1995).

3.3 The Belgian primary care market

The paper aims to empirically test for the presence of GP induced demand in Belgium. This section explores the organization of the Belgian primary care market as it determines the economic environment in which GPs operate. We briefly relate this to the likelihood that the Belgian market is characterized by inducing behavior of GPs. We also present the dataset on the performance of GPs that is used in the analysis below. In the next section, we will elaborate on how this paper tests for the presence of supplier inducement in the Belgian primary care market, given the available data.

3.3.1 Organization of primary care

The Belgian health care market is characterized by a very good availability of health care. For the primary care market, there is on average one active GP per 803 inhabitants (2001). Consumers can choose freely among all GPs and since there is no gatekeeping role for GPs, there is moreover direct access to also specialist care. For a total population of about ten million there are close to $40,000$ active physicians (GPs and specialists), which makes Belgium the second physician dense country in Europe, after Greece (OECD Health Data). As a result, there generally are no waiting lists.

The delivery of health care in Belgium is mainly private and based on the principles of independent medical practice. Minimum educational standards are in place, but once a GP is licensed, she can operate anywhere in the country. GPs typically operate from an office in which they receive their patients (i.e. consultations) and also perform visits at patients' homes. Our data shows that on average 39% of all GP contacts are visits. With this high frequency of visits, Belgium is at the top of the international ranking (Boerma and Groenewegen 2001). Moreover, GPs are joined in a system of night and weekend duty to guarantee permanent access to primary care.

GPs are reimbursed for their activities through a fee-for-service system, where the GP receives a fixed fee per contact with a patient, with the fee independent of the number of contacts. Fee schedules are established periodically as an agreement between all parties involved (sickness funds, government and GP representation) and differ for consultations and visits. Although GPs can opt out of the negotiated fees by formally rejecting them, reports indicate that 85% of all GPs comply with the fixed fees (RIZIV/INAMI 2001). Moreover, GPs who commit themselves to continue training and to be involved in the local organization of the primary health care, get an official 'accreditation' which entitles them to charge a higher (fixed) fee for consultations.[6] The higher fee however does not imply a higher consumer price. In 2001, the fee for a consultation was fixed at 15.53€ for an accredited GP and at 14.75€ for other GPs, whereas the fee for visits was set at 19.9€, independent of the GP being accredited.

[6] This can be interpreted as a signal of quality toward the consumers, although not all GPs (a minority) are in a position to get the accreditation.

An important difference with other countries is that GPs get no extra reimbursement for the number of prescriptions or the number of laboratory tests they request. This implies that the GP has no benefits of inducing more tests and therefore will not be inclined to do so. The only means for GPs to induce demand is through increasing the number of contacts. To generate a higher number of contacts, the GP can e.g. overstate the importance of regular check-ups or follow-ups or perform extra laboratory tests of which the results then need to be discussed in an extra contact.

Finally, Belgian consumers contribute to the costs of primary care through a co-payment, where a third-party (sickness fund) pays the remaining cost. Although the consumer's co-payment is relatively high in Belgium (18% for GP consultations), the frequency of GP contacts is much higher compared to other European countries. That is, the Belgian Health Survey of 2001 indicates that, on average, Belgians have yearly 6.5 contacts with a GP, whereas the EU average tops at 3.6 (EUPHIX).[7]

Given these features, the Belgian primary care market provides an excellent setting for GP inducement. First, the high GP density implies a limited pool of patients for each GP. The pressure on the average GP income is thus considerably high, which adds to persuading her to induce additional demand for her services. Second, due to the fee-for-service system, GP income is positively related to her activity. Any reduction in consumers' utilization thus automatically leads to a proportional decrease in GP income, as she has very few options to increase the revenue per item of service. Third, since patients only pay a part of the costs, their marginal costs of a higher utilization are rather low, relative to the benefits for the GP. In other words, consumers are less sensitive to using another contact. Note also that due to the high GP density, it is unlikely to have demand excesses (there are no waiting list).[8]

[7] Note that this is the average number of contact with a GP only. The same survey indicates that the average number of contacts with specialists is a bit more than 3 per year (WIV 2002). EUPHIX indicates an average of 4.9 visits per capita for Belgium in 2001, which is still higher than in the other European countries listed.

[8] Remark that the basic characteristics of the Belgian primary health care market is similar to the Norwegian one, studied extensively by Grytten et al (1995), Carlsen and Grytten (1998), Sørensen and Grytten (1999) and Grytten and Sørensen (2001). However, Belgium only has contract physicians and no salaried physicians (that work independently of a hospital).

3.3.2 Data

We use a unique dataset from RIZIV/INAMI, the National Institute for Sickness and Disability Insurance of Belgium, on the location and performance of non-specialists as they are mainly responsible for the primary care. The identification of the genuinely active and available GPs from the dataset is in accordance with a new regulation that is effective since July 1st, 2006. This stipulates that a GP only remains certified in case she has at least 500 contacts in one of the last five years. We furthermore restrict a GP to have at least 50 patients in one of the last five years.[9,10] This selection is not an exclusion of small GPs, but rather a selection of the GPs that are available to the public, active and somewhat viable. We identify 12, 137 GPs in 2001, for which we observe yearly GP-level data. Due to privacy reasons, the records are however anonymous which leaves us with little GP-specific information.

We categorize our data into four groups of variables; we have an indicator of the supply of primary care, indicators of the level of consumption of primary care and GP-specific control variables from RIZIV/INAMI. This dataset is enriched with additional market-specific demand and supply controls for 2001. We continue by discussing these variables in more detail and refer to Table 3.1 and Table 3.2 for the descriptive statistics of respectively the supply and consumption variables and the market-level demand and supply characteristics. Table 3.1 provides additional insight in the supply and consumption variables by assigning markets to one of five groups according to their GP density: group 1 contains the 20% markets with the lowest GP density, whereas group 5 collects the 20% markets with the highest GP density (GP dense markets).

Note that we use performance data from 2000 to 2004 to select GPs. Although we have access to it, we do not use the panel in the subsequent analysis, but focus instead on the year 2001. Next to data issues, the identification in the panel estimation (with a fixed effect estimator)

[9] A patient is uniquely assigned to the GP which he contacted most during that year. About 95% of the Belgian population indicates having a *fixed* GP (2001). Patients do come in contact with other GPs in case primary care is needed outside working hours (during guard duty).

[10] Our selection criterion is based on "Ministerieel besluit tot vaststelling van de criteria voor de erkenning van huisartsen (21/02/2006)". The selection criterion is applied to exclude the GPs who are solely or mainly connected to companies/government and who only do guard duty. These should not be considered as real rivals of the regular GPs. Adding the restriction of at least 50 patients in one year is done on suggestion of RIZIV/INAMI. Note that for physicians with at least 500 contacts, the restriction to at least 50 patients is not at all strong.

would be based on entries and exits of GPs from particular markets, so that the variation clearly suffers from the potential reverse causation argument: GPs generally move to more profitable areas. Robustness checks for the other years are performed under the assumption of constant market characteristics and we find no deviations from the general conclusion of the paper.

Supply indicator

As measure of local supply of primary health care, we define GP density, denoted by R, as the ratio of the number of active GPs in the local market (N) to the number of inhabitants (x$10,000$). This measure takes into account the magnitude of the local market and thus gives a good proxy of the degree of competition in the direct environment of the GP. Since the majority of the population has a fixed GP and since patients in general do not travel far for primary care, GP density is defined on the level of Belgian zip codes.[11] We identify all Belgian zip codes with at least one active GP, i.e. we work with information on 993 out of the $1,144$ zip codes.[12] As presented in Table 3.1, the average GP density in 2001 is 12.45. On average , a market thus held one GP per 803 inhabitants. However, there is a high degree of variation across markets: the first group of markets, with the lowest GP density, have an average of 7.12 GPs per $10,000$ inhabitants, whereas the group 5-markets are characterized by an average GP density of 20.25. Remark that there are significantly more GPs operating in group 3- and group 4-markets. As their GP density is moderate, this implies that the markets of group 3 and 4 also on average have a larger population size. The cities of Belgium are thus not to be found in group 5, which collects the markets with the highest GP density. There instead is a hull-shaped relation between GP density and population and population density. That is, the market with the lowest population density and the lowest number of inhabitants are part of the 20% markets with either the lowest or the highest GP density. The appendix gives an insight in the spread of the GP density across Belgium zip codes for 2001.

[11] Since GPs are anonymous in the dataset, we only have limited information on their location (only zip code). This prevents us to work on a lower level of aggregation. Furthermore, data on the patient flows would help us determine the relevant market. We however have no access to this information. As a robustness check, we also perform the analysis on a bigger relevant market definition (municipalities).

[12] For the other markets, we have no information on health consumption. In the empirical analysis below, the number of inhabitants of the dropped markets will help explain the consumption in nearby markets.

Table 3.1: Descriptive statistics (2001) - markets divided into 5 groups according to GP density

	Total		**group 1**		**group 2**		**group 3**		**group 4**		**group 5**	
Variable	mean	(st.d.)	mean	(st.d.)	mean	(st.d.)	mean	(st.d.)	mean	(st.d.)	mean	(st.d.)
A. Supply Indicators (market level)												
nobs	933		198		199		198		198		200	
N	12.20	(15.78)	5.49	(6.81)	12.25	(10.82)	15.31	(14.60)	15.80	(22.39)	12.18	(17.45)
R	12.45	(5.48)	7.12	(1.55)	9.81	(0.50)	11.41	(0.93)	13.59	(0.66)	20.25	(6.88)
B. Consumption Indicators (GP level)												
nobs	12137		1090		2437		3046		3129		2435	
PAT	574.66	(405)	731.1	(452)	681.1	(425)	598.1	(406)	519.1	(375.5)	440.20	(337.9)
Q	3909.2	(2583)	4790.1	(2792)	4462.3	(2739)	4137.0	(2604)	3531.0	(2390)	2962.1	(2093)
Q_consult	2281.5	(1627)	2900.8	(1779)	2796.1	(1719)	2426.2	(1666)	2032.0	(1489)	1629.2	(1238)
Q_visit	1539.8	(1371)	1792.6	(1465)	1766.8	(1492)	1618.5	(1337)	1420.2	(1312)	1254.5	(1246)
C. GP specific Information (GP level)												
accr	0.78	(0.41)	0.86	(0.33)	0.86	(0.34)	0.82	(0.38)	0.75	(0.43)	0.66	(0.46)

Source: own calculations based on RIZIV/INAMI dataset.
As introduced in the text, N denotes the total number of GPs in the market, R the GP density (number of GPs per capita *10,000), PAT the yearly number of patients, Q the yearly number of patient contacts, *Q_ consult* the yearly number of consultations, *Q_ visit* the yearly number of visits during working hours and accr the degree of accreditation. nobs finally denotes the number of observations. Group 1 collects the 20% markets with the lowest GP density, whereas group 5 contains the 20% markets with the highest GP density.

Performance/Consumption indicators

Our data includes the yearly number of patients and the yearly number of contacts for every GP in 2001. In the subsequent analysis we focus on the yearly number of contacts per GP, denoted by Q. We find that the average Belgian GP had a total of $3,909$ contacts in 2001 or 6.8 contacts with each of her patients[13]. The dataset also provides a split up of the total number of contacts according to the type of contact. We concentrate on the number of consultations ($Q\_consult$) and the number of visits during working hours (Q_visit). As indicated before, there is a high consumption of visits, with an average of $1,540$ visits per GP per year. The average GP finally performed $2,282$ consultations in 2001. There however is a high degree of variation in the performance of GPs, also after grouping GPs according to the GP density in the market in which they are active. As expected, the average GP has a higher number of patients and a higher number of contacts (of all types) when she operates in a market with a low GP density compared to a GP dense area. The percentage visits on the other hand is lower in markets with a low GP density: whereas an average GP in group 1-markets completes 37% of her contacts at patients' homes, on average 42% of all contacts are visits in markets of group 5.

GP-level control variables

Because the data is anonymous, there is only limited information on the individual GP. Next to the location in which she operates (zip code), we only have information on her level of accreditation (*accr*). This gives the percentage of time the GP chose to work under the accreditation system in that year; e.g. a GP that becomes accredited only from July onward will have a level of accreditation of 50%. The average level of accreditation is rather high at 78%. This average can roughly be interpreted as the fraction of the GPs that are accredited. Upon closer investigation of this GP-level variable we find an important link with the GP density in the market. That is, whereas in areas with a low GP density on average 86% of the GPs is accredited, the accredited GPs only account for 66% of the GPs in GP dense areas. To

[13] To give some idea of the magnitude of this figure, taking that a full time GP works six days out of seven and takes two holidays of two weeks a year, this implies that the average GP has 13 contacts per day. Note that the performance figures are considerably higher in case we focus attention to those GPs that are neither just entering or have decided to exit the market. For 2001, the yearly average number of visits per GP would then be $4,300$, of which $2,503$ were office visits and $1,702$ were visits during working hours.

the extent that this relation is not due to e.g. difference between Belgian Communities, this finding is counterintuitive since we would expect that the higher competition in GP dense areas would urge GPs to get a higher price for every contact they complete. On the contrary, it is in the regions with a high workload per GP, that GPs are typically accredited.[14]

Market-level control variables

For every GP, we add information on demographic characteristics (2001) of the market in which she operates (Table 3.2).[15] We use several indicators of the composition of the population in local markets: the age structure of the inhabitants (*kids*, *young*, *adults* and *old*) and the gender (*female*) and nationality composition (*foreign*). Furthermore, we add the region of the local market (*Flanders*, *Brussels* and *Wallonia*), the mean income level (*meaninc*) and the unemployment rate (*unempl*).[16] The general attitude towards health issues is proxied by the use of medication (both prescribed and OTC drugs). The variable *drugs* measures the average monthly units of all medication consumed in 2002.[17] These variables proxy the average health status and the health habits of the local population. We also add data on the location and the capacity of both hospitals (*hospbeds*) and rest and nursing houses (*restbeds*). The presence of such institutions will have its impact on the workload of a GP, irrespective of her behavior. For example, until recently, emergency rooms of hospitals were often used as a substitute for GP contacts, especially by less well-off individuals (partly because of payment modalities).

[14] It is possible that there is a relation with the percentage of visits: GPs get no extra reimbursement for being accredited when performing visits. As the percentage visits is higher in GP dense areas, the benefits of being accredited are smaller.

[15] The market-specific characteristics are provided by the NIS (National Institute of Statistics), Ecodata (Federal Government Agency for Economics) and RSZ (the National Institute of Social Security).

[16] In WIV (2002) the link between the demographic variables and the health status is studied. It shows e.g. that subjective health is decreasing in age and increasing in the education level. The subjective health is also better in Flanders compared to the other regions of Belgium and females are more susceptible to chronic diseases whereas men smoke more.

[17] We use data from IMS Health Belgium, that provided us with sales of medication according to geographic regions. The data is on a higher level of aggregation than our market definition (147 regions) so we assume a homogeneous use of drugs within these regions. We work with the units sold instead of with the value of the medication sold, since this would reflect the income level of the population.

Table 3.2: Summary statistics of market level variables (2001)

Variable	Explanation	Mean	St.d.	Min.	Max.
(993 obs)					
	MARKET DEMAND CONTROLS				
$kids$	percentage population in age category 0 - 10 years	0.118	0.015	0.067	0.195
$young$	percentage population in age category 10 - 24 years	0.185	0.017	0.118	0.264
$active$	percentage population in age category 24 - 64 years	0.535	0.023	0.445	0.632
old	percentage population in age category 65+ years	0.166	0.027	0.065	0.306
$female$	percentage female population	0.509	0.012	0.467	0.575
$foreign$	percentage foreign population	0.057	0.070	0.001	0.595
$Flanders$	dummy variable: market is part of region of Flanders	0.488	0.500	0	1
$Brussels$	dummy variable: market is part of region of Brussels	0.022	0.147	0	1
$unempl$	unemployment rate	0.058	0.033	0.013	0.162
$meaninc$	mean income level (in 10,000€)	2.499	0.387	1.641	4.133
$hospbeds$	number of hospital beds nearby (< 5km) (x1,000)	0.154	0.438	0	3.509
$restbeds$	number of beds in rest and nursing houses nearby (< 5km) (x1,000)	0.258	0.552	0	5.560
$drugs$	average monthly units of medication sold in pharmacies (x10,000)	2.511	2.418	0.874	25.744
	MARKET SUPPLY CONTROLS				
$agree$	percentage of physicians that signed the fixed fee agreement	0.896	0.173	0	1
fem	percentage of female physicians	0.306	0.183	0	1
$exp-10yrs$	percentage of physicians with less than 10 years of experience	0.329	0.204	0	1
$exp10-20yrs$	percentage of physicians with between 10 and 20 years of experience	0.371	0.215	0	1
$exp+20yrs$	percentage of physicians with more than 20 years of experience	0.298	0.186	0	1
	INSTRUMENTS				
$mpop$	the number of inhabitants	10282	12088	271	110867
$npop5$	populations in nearby markets (range < 5km)	9202.3	26884	0	305282
$lnmpop$	the logarithm of the number of inhabitants	8.718	1.063	5.602	11.62
$dens$	population density ($mpop$/surface)	612.6	1028	16.12	100041

Source: the market demand controls and the instruments are drawn from data from NIS (the National Institute of Statistics), Ecodata (Federal Government Agency for Economics), RSZ (the National Institute of Social Security), RIZIV/INAMI and IMS Health Belgium. The market supply controls stem from data of RIZIV/INAMI.

Finally, as we have very little information on the individual GPs, we construct some additional market-level variables to proxy GP characteristics. We use a general dataset of RIZIV/INAMI on characteristics of non-specialists. This dataset provides insights in the percentage of active non-specialists per market that signed the fixed fee agreement discussed above (*agree*) and on the percentage females (*fem*). We find that almost 90% of non-specialists charge the same fixed fee as stipulated in the agreement. This share is however negatively correlated with GP density: it drop from 93% in group 1 markets to 85% in group 5 markets. On average 30% of non-specialists in a local market are female and this percentage is increasing in GP density. We furthermore construct proxies of the experience level of the active non-specialists per market: we define three variables that capture the percentage non-specialists with an experience level of respectively less than 10 years (*exp-10yrs*), between 10 and 20 years (*exp10-20yrs*) and more than 20 years (*exp+20yrs*). There is a more or less even spread these experience categories, although there is a high degree of variation within local markets. There is a small correlation with GP density: the percentage non-specialists with little experience is increasing in GP density, whereas the percentage of medium and highly experienced GPs decreases in GP density. This indicates that entry more often occurs in GP dense areas.

3.4 Empirical approach

Our dataset consists of the location and the performance (i.e. number of contacts) of all active and available Belgian GPs that operate in an environment where prices are fixed on the national level. Therefore, the empirical approach followed in this paper is in the tradition of the strand of empirical work that looks for systematic differences across geographical markets in the level of per capita consumption of primary care according to the number of GPs in the market (GP density). We first present the theoretical framework that yields testable hypotheses on supplier-induced demand and subsequently discuss the empirical implementation of it.

3.4.1 Hypotheses on inducement

Building on the GP utility maximization model (section 3.2), consider the consequences for GP utility of a higher level of supply. The presence of an extra GP in the market reduces the number of patients per GP and therefore the total number of contacts per GP. This directly reduces the income level and thus GP utility. On the other hand, the higher supply results in a lower workload, which positively affects GP utility. The relevant question is how the higher level of supply affects the trade-off for the inducement decision of the GP, as presented in expression (3.2). That is, as GPs induce demand whenever marginal benefits (income) outweigh marginal costs (workload and inducement costs) of inducing an extra contact, will the GP induce more or less demand in the presence of more direct competitors?

First, compared to a situation with fewer GPs in the market, the marginal benefit of inducing one contact is higher. This stems from the fact that the marginal utility of income is decreasing: the income level is lower in the presence of more GPs, so that the fee of an extra contact yields a higher increase in utility. Second, compared to the situation with fewer GPs in the market, the workload of the GP is lower as there are fewer patients per GP (more leisure). Since the utility loss of the extra workload is increasing in the workload, inducing a contact has lower marginal costs compared to a situation with fewer GPs. In sum, both the income and workload component of the trade-off imply that GPs have increased incentives to induce (more) demand. However, these incentives are tempered by inducement costs. Although the mere inducement costs are not affected by the increase in the number of direct competitors, the utility loss is increasing in the induced amount of contacts. The same goes for the risk of losing patients: the more one induces, the higher is the probability of detection. Although these costs temper the degree of inducement, models of utility maximization in general predict that the level of inducement increases in the number of direct competitors in a given market.

Adding to this model, remember that the opportunity to induce demand is driven by the presence of information asymmetry in the market and that the higher the information asymmetry in the market, the higher is the potential for inducement (Dranove 1988, Rochaix 1989, Calcott 1999). When the number of GPs in the market increases, the degree of information asymmetry in the market changes as well and this affects the costs of inducement.[18] The direction of this effect depends on assumptions on consumer behavior. When health care services are considered reputation goods and the market is monopolistically competitive, information

[18] Formally, this implies the cost of induction (ic) is a function of GP density (R).

on GPs stems from those who contact the GPs[19]. Following the argumentation in Pauly and Satterthwaite (1981), when there are more GPs in the market, there are fewer patients per GP so that the (average) amount of information on any specific GP diminishes. Information asymmetry thus increases with the number of GPs, so that the opportunity to induce demand increases (the inducement costs decrease). This 'consumer information model' thus predicts that there will be more inducing behavior in GP dense markets, as is in line with the predictions above. On the other hand though, it can be argued that when consumers especially search for a good agent, i.e. a GP that does not misuse her agency position, the availability of more GPs in the market decreases the search costs for external information. Patients especially search for external validation of the services they receive from their individual GP. The more providers in the market, the higher is the probability that other consumers have information on alternative GPs and the lower are the costs for gathering information on any other GP to create a benchmark. It is thus easier for the patient to detect inducing behavior when the number of GPs in the market is higher, which increases the cost of inducement for GPs. If this reasoning holds, there will be fewer incentives to induce demand when GP density is high.[20] To take away from this discussion is that the effect of more providers in terms of changes in the degree of information asymmetry in the market can alter the predictions of the basic model.

As models of utility maximization predict more inducement to take place when there are more providers in the market, the estimation of the variation in per capita consumption due to differences in GP density across markets has been a popular empirical strategy. There are however some problems with the identification of inducement in this context. The finding of a positive correlation between per capita consumption and supply can be ascribed to and explained by some other effects (Reinhardt 1985). First and foremost, an availability effect can be the cause of the positive correlation between consumption and supply (Birch 1988). That is, an increase in supply triggers a decrease in the shadow price of GP care: the access costs of care decrease as the average travel and waiting time drop. Therefore, optimal consumer

[19]This is related with the view of treatment as a sequence of actions and learning process (see McGuire 2000).

[20]When patients detect inducement, they can either decide to contact another GP or decide to reduce the number of times to contact any GP (demand impedement): e.g. the GP makes an 'offer' and the patient chooses to reject it (Rochaix 1989). Remark that data for Belgium and empirical work on how patients choose care providers (Hoerger and Howard 1995) indicate that patients rarely change GP and use especially recommendation of relatives and friends.

behavior results in an increase in the demand for primary care services as a reaction to supply increases. Second, the positive relationship between per capita consumption and GP density can be explained by the presence of excess demand, i.e. an increase in supply allows for this excess demand to be met. Alternatively, the effect can stem from the mere fact that GPs choose to locate their office in markets with a higher demand (reverse causation).

In the empirical analysis, the econometrician is typically able to reject the rationing effect within the estimation and to control for the reverse causation effect by treating the supply variable as endogenous (Stano 1985). Controlling for or separately identifying the availability effect however hinges on hypotheses from the theoretical framework (Escarse 1992). In this paper, we follow the identification strategy as proposed in Carlsen and Grytten (1998). That is, it is hypothesized that inducement and availability effects occur for different types of markets. More precisely, in markets with a low GP density increases in per capita consumption due to increases in the supply of care is the result of consumer behavior (availability effect). In markets with a high GP density on the other hand, the positive relation stems from GP inducement.

The conjecture on availability and inducement effects in Carlsen and Grytten (1998) is based on the assumption that consumer utility is not linear in distance and waiting time. Instead, when access costs for care are high, consumers' marginal utility gains from drops in time and distance are higher compared to lower access costs. As a result, the impact of an increase in the number of GPs has a differential impact on consumer behavior for markets with different GP density levels. In markets with a low GP density, where there is a high number of patients per GP and thus high access costs for care, the presence of an extra GP decreases the shadow price of care significantly which triggers an increase in consumption. On the other hand, in a GP dense market the average access costs for care are already low, so that an additional drop due to increases in the supply of primary care has virtually no effect on the consumer utility level and thus on consumer demand. Availability effects thus occur mainly in markets with a low GP density.

GP utility maximization in turn predicts that GP behavior is affected in the opposite way by the level of GP density. The increase in the number of competitors decreases the number of patients per GP. This decreases the number of visits and thus GP income. In line with the previous discussion, in GP scarce markets GPs have on average a high income level, so that the drop in GP utility due to the income drop is not important. The presence of the extra GP also reduces GP workload which positively affects utility. In GP scarce areas, this effect is important as the baseline workload was high (increasing marginal disutility). It is therefore unlikely that there are incentives to induce demand in this type of markets, given also the presence of inducement costs. Also note that in case availability effects are important in this market, little change in income and workload is to be expected due to an increase in the number of competitors. For markets with a high GP density and thus few patients per GP, the situation reverses. The already modest GP income and their already low workload decrease due to increased competition (availability effects are unlikely). Therefore a lot can be gained from inducing an extra visit, at a small workload cost. Taken together, with the costs of inducement constant over markets, GP induced demand occurs especially in market with a higher GP density.

In conclusion, a positive effect of GP density on per capita consumption is predicted to stem from availability effects in GP scarce markets and from inducing behavior by GPs in GP dense markets. These predictions from the theoretical model form the basis of the testable hypotheses we can take to data.

It should be noted though that GPs can also use their discretionary influence over the preferences of consumers to demand less care than the optimal level. That is, GPs have incentives to reduce the number of contacts in case the marginal costs of the last contact outweigh the marginal benefit of it: reducing the demand for primary care increases the utility level of the GP. This type of demand management is expected to occur when the workload of GPs is very high, i.e. in markets with a low GP density. When an additional provider enters the market, the workload drops and with it, the incentives for GPs to downwardly manage demand. The finding of a positive relation between GP density and per capita consumption in the markets of group 1 are thus not solely to be attributed to consumer behavior (availability effects).

To complete the discussion, remember that the effect of the degree of information asymmetry can change the model predictions in terms of the inducing behavior. Whereas the consumer information model (Pauly and Satterthwaite 1981) strengthens the predictions of the model, a high GP density in the market can be associated with lower incentives to induce demand when patients are assumed to search for a perfect agent. That is, in the latter case inducement costs increase in GP density as information asymmetry decreases and with it the risk of losing patients in the future. When there are more GPs in the market, the individual GP then has incentives to act more as a perfect agent, which results in a decrease of the incidence of supplier inducement.

3.4.2 Implementation

Abstracting from other possible explanations, inducement is characterized by the finding of a positive correlation between per capita consumption and supply. As the data we work with consists of GP-level information on consumption, consider the following reduced form explaining the per GP number of contacts. We denote the number of contacts of GP i which operates in local market j as Q_{ij} and R_j represents the GP density in that local market.

$$\ln(Q_{ij}) = \alpha_1 + \beta \ln(R_j) + controls_{ij} + \varepsilon_{ij} \tag{3.3}$$

Coefficient β then captures the percentage change in *per GP* consumption due to a percentage increase in GP density (elasticities). An easy transformation of the model shows that the effect of a percentage increase in GP density results in an increase of $(\beta + 1)$ percent in *per capita* consumption.[21] As a result, the absence of any effect of GP density on *per capita* consumption requires that β is estimated not significantly different from -1. Intuitively, if per capita consumption is not increasing with an additional entrant, GPs share the total workload among one more GP. Furthermore, the absence of an effect on GP workload ($\beta = 0$) implies that per capita consumption is increasing proportionally with GP density. Intuitively, if every GP maintains her workload, but now an extra GP is active, total consumption has to increase.

[21] Denote population size of market j as $mpop_j$, the number of GPs as N_j and total consumption as Q_j (per GP consumption is denoted as Q_{ij}). We can rewrite the logarithm of total consumption as follows: $\ln\left(\frac{Q_j}{mpop_j}\right) = \ln\left(\frac{Q_j}{N_j}\frac{N_j}{mpop_j}\right) = \ln\left(\frac{Q_j}{N_j}\right) - \ln\left(\frac{N_j}{mpop_j}\right) = \ln(Q_{ij}) - \ln(R_j)$. Given equation (3.3), the effect of GP density on the per capita consumption is given by $\ln\left(\frac{Q_j}{mpop_j}\right) = \alpha_1 + (\beta_1 + 1)\ln(R_j)$.

In sum, the necessary condition for the presence of supplier inducement in a health care system is that β is estimated significantly larger than -1. (Carlsen and Grytten 1998, Delattre and Dormont 2003).

As the finding of an effect of GP density on per capita consumption can also be explained by GPs locating in the most attractive locations, the empirical analysis should control for this possible reverse causation. Since we estimate the demand for a single GP, we escape the identification critique by Auster and Oaxaca (1981) where it is shown that the effect of market supply on market demand can not be identified. It can furthermore be argued that endogeneity concerns related to the effect of GP density on GP level consumption of care are not severe: individual level unobservables are less correlated with overall market demand. However, to ensure the validity of the results, the empirical analysis below will treat GP density as being endogenous.

To separately identify the inducement effect from availability effects, we divide the local markets into five equal-sized groups, according to GP density. That is, group 1 contains the 20% markets with the lowest GP density, while group 5 collects the markets with the 20% highest GP density. We work with five groups instead of with three (Carlsen and Grytten, 1998) as we want to allow for a richer range of effects. First of all, we expect the middle groups to contain valuable information. Because of the generally high GP density in Belgium, the markets with the lowest GP density are hardly GP scarce areas. We thus expect that availability effects might quickly disappear and inducement can be something GPs resort to quite fast (e.g. already in markets with a medium GP density). Secondly, Belgium holds markets with a very high GP density (see section 3.3.2). It is thus possible that changes in the information asymmetry have an impact on inducing behavior (as in the search theory). With DRx_j a dummy variable for local market j to be assigned to group x ($x \in [1, 5]$), the reduced form to be estimated is given by:

$$\begin{aligned} \ln(Q_{ij}) &= \alpha_1 + \alpha_2 DR2_j + \alpha_3 DR3_j + \alpha_4 DR4_j + \alpha_5 DR5_j + \beta_1 \ln(R_j) \times DR1_j \\ &\quad + \beta_2 \ln(R_j) \times DR2_j + \beta_3 \ln(R_j) \times DR3_j + \beta_4 \ln(R_j) \times DR4_j \\ &\quad + \beta_5 \ln(R_j) \times DR5_j + controls_{ij} + \varepsilon_{ij} \end{aligned} \tag{3.4}$$

We thus split up the effect of GP density on the number of contacts over five groups, with β_k the effect of GP density in local markets of group k. This splitting-up of the effect is the basis of the identification strategy: following the hypotheses of Carlson and Grytten (1998), it allows us to separately identify inducement effects from availability effects.[22]

The availability hypothesis expects a positive effect of GP density on *per capita* consumption only in GP scarce areas. Group 1 collects the markets with the lowest GP density in Belgium. We will refer to this group as GP scarce market, although this concept is relative. In case GP density is low enough to generate substantial changes in consumer utility due to drops in access costs of GP care, we expect to find β_1 to be estimated significantly larger than -1 and possibly close to zero, as this implies a proportional increase with GP density. Possibly these effects remain present in the group 2-markets (and group 3). In the latter markets, the effect of availability should however be less than in the group 1-markets as the average distance and waiting time are smaller. We thus expect to find that, in the presence of only availability effects, β_2 (and possibly β_3) is still significantly larger than -1, but more negative compared to β_1. For the markets with a higher GP density, changes in the availability of health services are expected not to have any impact on the demand. In other words, we expect to find estimated coefficients (β_3,) β_4 and β_5 not significantly different from -1.

On the other hand, the effect of GP density on *per capita* consumption can be driven by inducing behavior of GPs. Since it is expected that inducement is optimal only given a certain level of GP density, we expect to find coefficients that are not significantly different from -1 for GP scarce areas. In markets with a higher GP density on the other hand, the estimated coefficients will be such that a higher GP density implies a higher per capita consumption (or a lower drop in per GP consumption). It is hard to conjecture on the level of GP density for which it becomes optimal for GPs to induce demand as a response to intensified competition. Given the generally high levels of GP density in Belgium, we expect this to occur rather soon (i.e. group 3-markets). Note that in case a higher GP density is associated to decreases

[22] Note that this specification only differs slightly from Carlsen and Grytten (1998). There are more groups and GP density is interacted with every group to facilitates interpretation of the estimated coefficients: in Carlsen and Grytten (1998), group 1 is used as the base group, which implies that the effect of GP density for markets of group 2 is given by $(\beta_1 + \beta_2)$ instead of by β_2 as in our specification.

in information asymmetry, markets with a high GP density (e.g. group 5-markets) could be characterized by less inducement compared to markets with a lower GP density (search theory). Under the consumer information model on the other hand, there is expected to be a further increase in inducement.

We can summarize the implications of the two hypotheses as follows:

	group 1	group 2	group 3	group 4	group 5
H_0: availability	$\beta_1 = 0$	$0 \geq \beta_2 \geq -1$	$0 > \beta_3 \geq -1$	$\beta_4 = -1$	$\beta_5 = -1$
H_0: inducement	$\beta_1 = -1$	$\beta_2 = -1$	$0 \geq \beta_3 > -1$	$\beta_4 = 0$	$0 \geq \beta_5 \geq -1$

Both the availability and the inducement effects can be present simultaneously in the Belgian primary care market. This would result in the finding of significant effects on per capita consumption for almost all groups, depending on how 'long' availability effects last and how 'soon' GPs start inducing demand.

Finally, note that the neoclassic model also predicts that a supply increase results in an increase in the total consumption of the good/service. However, this mechanism is driven by a simultaneous drop in prices. As in Belgium prices are fixed and fixed independently of the GP density, the interpretation of the positive relation between per capita consumption and GP density is simplified.

3.5 Empirical analysis

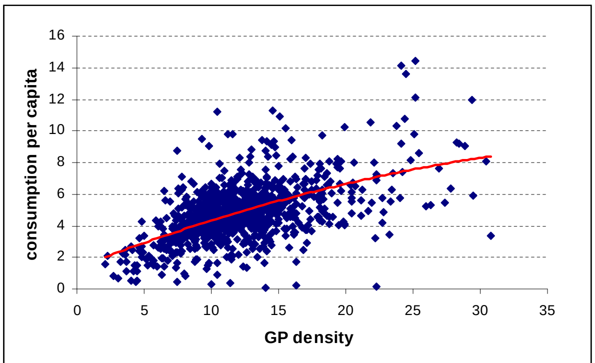
We are now ready for the empirical analysis of the presence of supplier inducement in the Belgian primary care market. We start the discussion with interpreting initial insights in the data after which we move to applying the empirical approach on the number of contacts per GP as discussed above.

3.5.1 Initial insights

Regional differences in the consumption of health care services are often the trigger of studying GP behavior. More precisely, high variation in usage ratios between areas of the same country that have a comparable demand for care is a necessary condition for the presence of supplier inducement (McPherson 1990). Although we know already that this clearly is not a sufficient condition, it is a natural starting point. Aggregating the data to the zip code level, we find a high variation in the total number of contacts with GPs, but more importantly also in the number of GP contacts per capita. In particular, we find that the average per capita consumption of primary care in the dataset equals 4.89 with a standard deviation of 2.07. Variation across markets remains present once we aggregate to municipality level (mean=4.85, sd=1.33) and to province level, for which the average number of per capita consumption varies from 4 to 5.12 contacts per year. The Belgian primary care market is thus characterized by significant variation in per capita consumption.

Furthermore, this variation in per capita consumption is connected to the degree of competition in the GP market. That is, plotting per capita consumption levels of care with respect to GP density, as is presented in Figure 3-1, reveals a positive link between per capita consumption and per capita number of GPs. Again, this is a necessary condition for the presence of supplier inducement. We thus have reasons to closer investigate GP behavior in Belgium.

Figure 3-1: Consumption per capita according to GP density (nobs=983 zip codes)*

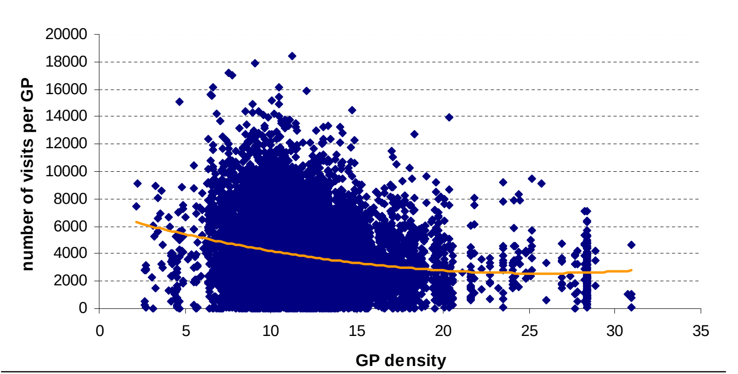


* We exclude the 10 zip codes with the highest GP density (more than 31 GPs per 10,000 inhabitants), to show that the trend is not driven by outliers. Including these local markets amplifies the effect.

On market level, the average number of contacts per patient of a GP can give some indication of inducement. Since the costs of establishing the agency relation is important, the marginal cost of inducing is generally smaller for the current clientele (Birch 1988). Therefore, we believe that the ratio of the number of contacts to the number of patients contains information on the inducing behavior of GPs. We compute the average number of GP contacts per patient per market and first relate this to the average number of patients per GP. We find that there is a negative significant correlation between both variables: the higher the number of patients, the lower the average number of consultations per patient.

Finally, we can look at the disaggregate data for some initial insights. We focus on the number of contacts of the average GP. Figure 3-2 indicates that the number of contacts of the average GP is decreasing in GP density. The higher the number of GPs per capita, the lower is the number of patients per GP, so that the pool of patients from which the GP can draw is smaller. This implies that we can reject the rationing hypothesis: in case there are demand excesses, an increase in GP density would not result in a decrease in the number of contacts per GP, as extra GPs only meet (part of) the excess. But more importantly, note that this trend is convex: the higher GP density in the market, the smaller is the effect of an increase in GP density on the number of contacts per GP. This is a first indication of the presence of demand management and/or availability effects.

Figure 3-2: Number of visits per GP according to GP density of the market (nobs=12,076 GPs)*



* We excluded the 10 zip codes with the highest GP density (more than 31 GPs per 10,000 inhabitants), to show that the trend is not driven by the outliers. Including these local markets amplifies the effect.

The econometric model as described above can be used to identify whether this trend is significant and which type of markets drives the convexity. That is, if the convexity is driven by the markets with a low GP density, the convexity is proof of availability effects, whereas GP dense markets causing convexity of the relation implies evidence of inducing behavior of the GPs.

3.5.2 Supplier inducement in the Belgian primary care

Identification

To control for possible endogeneity concerns, we instrument the effect of GP density on the number of contacts with GPs. In line with Carlsen and Grytten (1998), we use variables based on the number of inhabitants as instruments. It is thus assumed that population measures only affect the demand for GP services through GP density, which in turn hinges on the assumption that per capita consumption does not depend on the number of inhabitants in the market. Furthermore, the number of inhabitants measures market size and market opportunities, what implies a correlation with the number of entrants in the market and thus the density of health providers. The lower panel of Table 3.2 presents the descriptive statistics of the four instruments we use in the estimation: the number of inhabitants in the relevant market (*mpop*) and the logarithm of the population (*lnmpop*), population density in the local market (*dens*) defined as the number of inhabitants per squared kilometre and finally, the number of inhabitants in markets within a range of 5 km (*npop*5), accounting for the possible absence of GPs in nearby markets. We use a transformation of population to allow for a flexible relation between population and GP density. For population density, there is no reason why a patient would demand more contacts per GP when there is a higher/lower population density, other than the extent to which this affects GP density.[23] The nearby population measure is added to control for potential demand in the area. Note that for the model in which the endogenous variable is interacted with dummies, the instruments are interacted as well.[24]

Since we work with GP-level data, endogeneity concern on GP density in the estimation of the number of contacts per GP is rather limited. Therefore, we report both the results of the OLS and the IV-estimation. Concerning the validity of our instruments, we use the validity test proposed in the market-level analysis of Dranove and Wehner (1994): instruments are only valid if the correlations between the residuals of the OLS-estimation and the instruments

[23] Since the local markets are relatively small in terms of surface, the transportation cost component in the shadow price of care can be neglected.

[24] This implies that we treat the group dummies as being exogenous. Previous work (Carlsen and Grytten 1998) makes the same assumption.

are low and insignificant, implying that they would be excluded from the demand equation. Correlation matrices indicate that all instruments are valid for the estimation of the number of contacts per GP and first-stage estimates indicate statistical insignificant partial correlations of all instruments with the explanatory variable. Finally, a heteroskedasticity-robust validity test on the over-identifying restrictions is not rejected. The conclusions in terms of inducing behavior in the Belgian primary care market are also checked to be robust against the exclusion of some of the instruments (e.g. population density) and against the inclusion of other transformations of population (e.g. population squared).

As indicated in section 3.3.2, we define the relevant market as the zip code area. However, it might be that consumers cross the border of the zip code area for primary health care to e.g. a market with a higher supply (Dranove and Wehner 1994). To correct for this border-crossing, we also ran the analyses when the relevant market is the municipality and when GP density is thus defined accordingly. We have moreover experimented with the exclusion of big cities as they attract commuters. Although individual parameter estimates differ, the results on the finding of inducement and availability are not sensitive to either experiment.

Also, implementation of the model implies correcting for market and physician controls. As Grytten et al (1995) indicates, the health status is an important predictor of the number of contacts. Omitting variables capturing the health status would lead to biased results. But also GP characteristics are important. Suppose e.g. that markets with a high GP density also typically attract a higher percentage of male GPs. As male GPs more often work full-time and thus have more contacts, omitting GP-specific characteristics leads to falsely concluding in favour of demand inducement in GP dense areas. We use the market-level demand and supply controls introduced in section 3.3.2 and presented in Table 3.2 to obtain unbiased results on the effect of GP density on per GP consumption of primary care.

Finally, in the estimation procedure we control for common shocks in the demand of GPs that share the same market. That is, we allow the GP-specific error terms to be correlated within the market (cluster). The estimation thus consists of a clustered IV regression of the reduced form presented in equation (3.4). We report heteroskedasticity-robust standard errors.

Results on Supplier Inducement

We start by estimating the model that explains the total number of contacts per GP in which we make no distinction according to GP density (equation 3.3). This provides initial insights on the relation between GP density and per GP (or per capita) consumption of primary care services. The first two columns of Table 3.3 present the results of this estimation. The OLS-estimation indicates a significant negative effect of GP density on the number of contacts. The coefficient is estimated accurately: it is significantly different from both −1 and 0. More precisely, the results suggest that a 1% increase in GP density leads to a significant decrease in number of contacts per GP of 0.284%. In terms of per capita consumption, the results imply that a 1% increase in GP density leads to a 0.716% increase in per capita consumption.[25] Once we correct for the possible endogenous nature of the supply, by estimating using instrumental variables, the estimated coefficient of the effect of GP density on primary care usage is no longer significantly different from zero. It however remains significantly different from −1. This implies that per capita consumption increases in GP density and possibly proportionally so. Do patients react strongly to increased availability? Or rather, do GPs have so much power over the demand that they can almost fully absorb an increase in competition? To get a better insight, we move to the model that can distinguish between these possibilities.

The third and fourth column of Table 3.3 present the results of the estimation of equation (3.4), in which the effect of GP density on per GP consumption is split up over five groups. This allows us to infer in which group of markets GP density affects the consumption of primary care, where we group markets according to their GP density. For the interpretation of these effects, we report Wald-tests on the estimated coefficients of GP density (β_k) in Table 3.4 for respectively the OLS and the IV estimation.

Without instrumentation, we find that β_1 is significantly different from −1, while this coefficient is not estimated significantly different from zero. This indicates a possible proportional increase in per capita consumption of primary care with an increase in GP density, for markets

[25] With the estimated coefficient negative, we can exclude demand rationing as the remaining alternative explanation for a positive effect of supply on per capita consumption. Demand rationing would namely imply that individual GPs are not affected by an additional entrant.

with the lowest GP density in Belgium (among the 20% lowest). For markets of group 2, we find that GP density proportionally reduces the consumption of care per GP. In other words, per capita consumption is not affected by an increase in the number of providers. Given the hypotheses from the model put forward in section 3.4, we find that GP density in the group 1 markets is sufficiently low for the presence of availability effects. That is, consumer utility is affected by decreases in access costs to care to such an extent that consumers increase their consumption of GP care. The availability effect however dies out once GP density increases further (group 2). For completeness, this positive relation in the group 1 markets can also be explained by GPs downwardly managing the demand for their services instead of by consumer preferences.

As GP density continues to increase, we again find evidence of some relation between per GP consumption of primary care and GP density. As availability effects have died out, this relation is explained by the behavior of GPs. For group 3-markets, per GP consumption decreases with GP density, but less than proportionally. GPs thus exert some discretionary influence on the demand of markets with a medium GP density. Finally, a proportional increase of per capita utilization with GP density is found in the markets of group 4 and group 5: β_4 and β_5 are estimated significantly different from -1 while not significantly different from zero. Based on the theoretical model attributes, this positive partial correlation is attributed to inducing behavior of the GPs in these GP dense areas.

When we correct for the possible endogeneity of GP density in the explanation of per GP consumption, the main conclusion remains although the coefficients are estimated very imprecisely. For market with the lowest GP density (group 1), per capita consumption increases proportionally with GP density as β_1 is significantly different from -1, while not estimated significantly different from zero. Contrary to the OLS estimation, no effect is found for markets with an intermediate GP density. However, in markets with the highest GP density (group 5), we again find evidence of the positive relation between GP density and per capita consumption. That is, per GP utilization of care does not decrease with GP density.[26]

[26] Remark that as the coefficients in this IV estimation are estimated imprecisely, the estimated coefficients of GP density for the different groups of markets are no longer significantly different from each other.

Table 3.3: Estimation results of cross-section analysis on the total number of contacts per GP, without and with distinction on the level of GP density (2001)

	(1) OLS		**(2) IV**		**(3) OLS**		**(4) IV**	
	Coeff.	(St. E.)	Coeff.	(St.E.)	Coeff.	(St.E.)	Coeff.	(St.E.)
Effect of GP density								
β_1	-0.284***	(0.04)	-0.067	(0.22)	-0.115	(0.12)	0.232	(0.47)
β_2	-		-		-0.720**	(0.30)	0.266	(2.17)
β_3	-		-		-0.472**	(0.18)	1.689	(3.09)
β_4	-		-		0.124	(0.30)	1.123	(1.41)
β_5	-		-		0.013	(0.09)	0.075	(0.30)
Supply Control variables								
accr	1.002***	(0.04)	1.011***	(0.04)	1.002***	(0.04)	1.004***	(0.04)
agree	0.053	(0.08)	0.047	(0.09)	0.054	(0.08)	0.046	(0.09)
fem	-0.365***	(0.08)	-0.381***	(0.09)	-0.329***	(0.08)	-0.312***	(0.09)
exp1020yrs	0.367***	(0.08)	0.426***	(0.09)	0.373***	(0.08)	0.381***	(0.09)
exp+20yrs	0.321***	(0.10)	0.430***	(0.14)	0.325***	(0.09)	0.360**	(0.11)
Demand Control variables								
kids	-1.343	(0.89)	-0.857	(1.17)	-1.610*	(0.90)	-1.901*	(1.10)
young	-2.454***	(0.81)	-2.512**	(1.10)	-2.657***	(0.80)	-2.801***	(0.92)
old	-1.645***	(0.61)	-1.999*	(1.03)	-1.651***	(0.58)	-1.757***	(0.67)
female	3.144***	(0.97)	2.974***	(1.10)	3.140***	(0.95)	2.848**	(1.12)
foreign	-0.733***	(0.18)	-0.673***	(0.21)	-0.739***	(0.17)	-0.785***	(0.19)
Flanders	0.081**	(0.03)	0.132	(0.10)	0.054*	(0.03)	0.059	(0.04)
Brussels	-0.156**	(0.07)	-0.163**	(0.08)	-0.134**	(0.06)	-0.128*	(0.07)
unempl	1.431***	(0.51)	1.513***	(0.56)	1.307***	(0.50)	1.337**	(0.64)
meaninc	-0.107***	(0.03)	-0.130***	(0.04)	-0.112***	(0.03)	-0.117***	(0.04)
hospbeds	-0.086***	(0.02)	-0.097***	(0.03)	-0.079***	(0.02)	-0.092***	(0.03)
restbeds	-0.001	(0.02)	-0.001	(0.03)	-0.013	(0.02)	-0.001	(0.03)
drugs	0.005**	(0.00)	0.005**	(0.00)	0.005***	(0.00)	0.004**	(0.00)
α_1	7.221***	(0.52)	7.024***	(0.86)	6.978***	(0.56)	6.494***	(1.10)
R^2	0.22		0.22		0.22		0.22	

Column (1) and (2) give the results for the estimation of equation 3.3, with no distinction according to GP density. Column (3) reports the estimated coefficients for the estimation of equation 3.4, with towns divided into five equal sized groups according to the GP density. β_1 relates to the towns with a GP density amongst the 20% smallest in Belgium, whereas β_5 refers to the 20% markets with the highest GP density. IV estimation is performed using *mpop*, *npop5*, *dens* and *lnmpop* as instruments for logarithm of GP density (R). Standard errors are reported between brackets. *,** and *** indicate significance at respectively a 10, 5 and 1% level. The other constants (α_5) are estimated insignificant and therefore not reported.

Table 3.4: Wald tests on the estimated coefficients of the effect of GP density on number of contacts per GP for five groups of markets (2001)

	OLS-estimation				IV-estimation			
	β_k = -1		$\beta_k = 0$		β_k = -1		$\beta_k = 0$	
	F	(prob)	F	(prob)	F	(prob)	F	(prob)
β_1	55.23	(0.000)	0.93	(0.335)	6.96	(0.009)	0.25	(0.619)
β_2	0.84	(0.359)	5.60	(0.018)	0.34	(0.560)	0.02	(0.903)
β_3	8.35	(0.004)	6.66	(0.010)	0.76	(0.384)	0.30	(0.585)
β_4	13.62	(0.000)	0.17	(0.684)	2.28	(0.131)	0.64	(0.424)
β_5	115.2	(0.000)	0.02	(0.893)	12.48	(0.000)	0.06	(0.806)

The Wald-tests are based on the coefficient estimates of the OLS and IV estimations of equation (3.4) for total number of contacts, as presented in Table 3.3. β_1 gives the effect of GP density on per GP consumption in the 20% markets with the lowest GP density of Belgium (group 1), whereas the effect of the 20% markets with the highest GP density is represented by β_5.

The results of our estimations indicate that per capita consumption increases as GP density increases. Furthermore, our findings can not rule out that this effect is partly due to GP behavior: Belgian GPs induce demand for their services. Depending on the specification one prefers (instrumentation or not) this inducing behavior is present already in medium dense markets or is mostly a feature of the markets with the highest GP density. Next to this inducement effect in the primary care market, we also find evidence of either a reaction of consumers to the increased availability of care or downward demand management by GPs in the 20% markets with the lowest GP density.

Results on control variables

For completeness, consider also the effects of the variables controlling for GP characteristics and market demand. For the supply control variables, we find that GPs who have a (higher level of) accreditation complete more contacts on yearly basis. As expected, the percentage of female providers in the market reduces the number of contacts per GP. This indicates that female GPs either have fewer contacts or work part-time. Finally, the higher the percentage of providers with an intermediate or high experience level, the higher is the number of contacts. As it takes some time to build a patientele, we indeed expect GPs with little experience to complete fewer contacts.

For market demand characteristics and with the percentage of adults (24-64 years) as the base group, the percentages of kids, youngsters and elderly in the population have a negative impact on the utilization of GP care. First, remember that we control for GP density in the estimation. As a results, the estimated coefficients give the effect on the number of contacts per GP, net of the effect on the number of providers that chose to enter this market. Interpretation is therefore not straightforward. The findings of the negative effects can be rationalized by several dynamics in the market. First, (parents of) kids often resort to the care of pediatricians, which reduces the number of contacts of this age groups with GPs. The negative sign for the elderly can be explained by a similar argument as they resort to other types of care, such as retirement homes and geriatric care. Note that we also separately control for the percentage female population, which is highly correlated with the percentage elderly. For the percentage population in the 10-24 age group, it could be argued that their general health status is better than that of adults and that the type of care they seek is often specialized (dermatologist, physiologist). Also the fact that adults need a sick note to be excused from work and are the most important consumers of drugs (prescriptions) can help explain the results.

Further, in line with reports on the use of health care services in general, the higher the percentage of the female population, the higher is the use of GP care. Possibly due to different habits and culture, the percentage foreigners has a negative effect on the number of contacts. Also the mean income level of the market has a negative impact on the number of GP contacts. This implies that the higher the income level in a town, the lower is the workload of the average GP, after controlling for the total number of providers that enter the market. This can be due to several reasons. Whereas it is tempting to conclude that money prevents illness, this effect is more likely due to the fact that higher incomes more easily substitute toward specialist care. It is also possible that we pick up an education effect and that we find that it is harder to induce demand for your services if your patients are highly educated (Pauly 1978). This is also in line with the finding of a positive impact of the unemployment rate in the market on the number of contacts with a GP. Note also the unemployed is often unemployed because of health problems. Finally, for the regional effects, we find that the use of primary care per GP is significantly less in the Brussels area and possibly higher in Flanders, compared to the southern part of Belgium.

We also find the number of hospital beds to have a negative influence on the workload of the GP. Since the proximity of many hospital beds generally implies the presence of many specialists, this variable can indicate the ease to refer a patient to a specialist or the ease for patients to substitute towards specialist contacts or towards emergency contacts. It should be noted that once we controlled for the number of hospitals beds, the inclusion of a variable proxying specialist density has no significant impact on the number of contact with the average GP in the market and has no effect on the conclusion on inducement and availability effects. The number of beds in rest and nursing homes has no significant impact on the number of visits per GP. Finally, the general attitude towards health, proxied through the use of medication, is found to positively influence the number of contacts GPs perform.

In addition, we estimated the model with separate coefficients for the control variables for the different groups of markets. First, the conclusions in terms of the effect of GP density on per capita consumption remain valid. Second, most of the control variables have a significant impact on only some groups of markets. Note that the grouping of markets according to GP density results in a decrease in the variance of some of the controls, which helps explain part of the results. For the supply controls, we find that the accreditation level of GPs significantly impacts the number of contacts per GP for all groups, whereas the experience level affects only the markets with a higher than average GP density. The age and gender composition of the population is especially important for explaining the number of contacts per GP in the markets of group 3 and group 4, although some significant effects are also found for group 1-markets. The utilization of GP care in markets with a lower than average GP density is affected by the mean income level. As there is no significant impact on the higher GP density markets, the education effect mentioned before is unlikely to explain the negative effect. The unemployment rate and the percentage foreigners affect per GP consumption only in high density markets. Finally, regional dummies, the presence of alternative care and the level of consumption of drugs affect mainly the consumption of care in the markets of group 1.

3.6 Type of contacts

As we have found indication that Belgian GPs are to some extent inducing demand for their services, it is furthermore interesting to investigate which type of contacts GPs typically employ for this activity. We distinguish between two types of contacts: consultations ($Q\_consult$) and visits during working hours (Q_visit).[27] Before going to the empirical analysis, we first conjecture on which type of contacts GP employ for inducement following the theoretical discussion in section 3.2.

3.6.1 Inducing consultations or visits

Utility maximization implies that GPs are most likely to induce demand for those contacts that have the best trade-off between marginal benefits and marginal costs of inducement (Evans 1974 and Rossiter and Wilensky 1984). In terms of the theoretical framework put forward in this paper, expression (3.2) indicates that the likelihood of inducing demand is higher the higher are the fees (f) and the lower are the workload intensity (w) and the costs of inducement (ic). We compare the components of marginal costs and benefits of inducement for the two types of contacts to conjecture whether GPs are more likely to induce consultations or visits.

As indicated in section 3.3.1, the fee a GP receives for a consultation is substantially lower than the reimbursement for visits. The marginal benefits of inducement are thus higher for visits. All other things equal, utility maximization therefore predicts that a GP will rather be inclined to induce demand on visits than on consultations. As for the workload intensity, consultations have a lower effort cost, since the patient incurs the transportation and waiting costs. By definition, it is the GP who incurs the transportation and time costs in case of a visit. Under the assumption that the difficulty of an average visit and consultation is the same[28], the effort costs of the average visit are higher compared to a consultation. This utility component

[27] We do not consider visits outside working hours, because they do not take place in the same time frame. Furthermore, they only represent a small part of all contacts. Finally, as Giuffrida and Gravelle (2001) indicates, most GPs regard out-of-hours work as a negative aspect of their medical career (a source of stress), even though the fee for a night visits is often rather high compared to other visits (on average 32.49€ in 2001).

[28] Some argue that a visit is more difficult because the GP has less material at hand to examine and treat the patient. Also, it might be that visits imply more severe sickness (although this is probably true for a certain percentage of visits, it is hard to generalize this).

therefore suggests a preference of GPs to induce consultations over visits. Note though that the higher the GP density becomes, the lower are also the transportation costs for GPs to visit patients, which reduces the preference of inducing consultations over visits.

It is hard to find convincing arguments on whether the costs of inducement are higher or lower for visits compared to consultations. First, the different types of contacts typically concern different consumer types. WIV (2002) reports that e.g. elderly and females make significantly more use of visits. It can be conjectured that it is takes less effort to induce an extra visit with elderly, but also that the moral costs of inducing a contact with this age group are higher. Second, one can argue that it takes less effort to convince a patient to consume an additional visit compared to an additional consultation as patients bear no transportation costs. On the other hand though, the monetary contribution is higher for a visit. As inducement is expected to matter especially in GP dense areas, the utility difference of the monetary contribution is expected outweighs the utility difference of the access costs. If there is a difference, it probably takes less effort to induce an additional consultation. Third, with respect to the intertemporal costs of inducing demand, the higher the number of contacts of a certain type, the more information about this type of contact is available in the market. Since the majority of contacts are consultations (and since specialists perform consultations but no visits), it can be that the information asymmetry is changing faster for consultations compared to visits. Depending on whether this change in information asymmetry increases (consumer information model) or decreases (search theory) the opportunities to induce demand, the cost associated to the risk of losing patients is resp. less or more important for consultations.

Taking these components together yields a mixed story. The marginal benefit of inducing an extra visit is higher compared to an extra consultation. On the other hand, the cost side suggests the opposite. Depending on which effect dominates, the GP will prefer inducement through one type of contact over the other one.[29]

Finally, remember that the availability effect implies an increasing per capita consumption because of the preferences of consumers. An additional GP in the market decreases time and transportation costs to have access to the primary care, which results in an increase of the

[29] A GP can only induce a contact when there is a initial relation with the patient. Therefore, the fact that GPs perform visits (in the guard duty system) to attract new patients is not relevant here.

demand. Since for visits the GP incurs the transportation costs, the availability effect will be considerably less for this type of contacts compared to for consultations. And because the opportunity costs of waiting for the GP are generally low for a visit, we expect availability effects to be virtually non-existing for visits.

3.6.2 Empirical analysis

We estimate the effect of GP density and market and supply control variables for the number of consultations and the number of visits during working hours of a GP. Again, to distinguish between inducement and availability effects, we estimate the effect of GP density for five groups of markets according to their level of GP density (equation 3.4). We also control for common shocks in the demand of GPs that share the same market by allowing the GP-specific error terms to be correlated within the market (cluster) and report heteroskedasticity-robust standard errors. To control for possible endogeneity of GP density in the estimation of the number of contacts of different types, we use instrumental variable regressions. Importantly, whereas the number of inhabitants, its logarithm and the nearby population are good instruments for both types of contacts, population density does not pass the tests described above for visits (section 3.5.2). For the IV estimation, we thus include population density as an explanatory variable of the number of GP visits instead of as an instrument for GP density. Table 3.5 presents the estimated coefficients of the estimation for consultations and visits respectively, with both the OLS estimates and the IV estimates. Table 3.6 gives the corresponding Wald-tests on the estimated coefficients β_k for both type of contacts. Note that the IV-coefficients are estimated very imprecisely.

Start by looking at the results for the number of consultations per GP. The estimated coefficients of both the OLS and the IV estimation put forward evidence of both availability effects (or downward demand management) amongst markets with the 20% lowest GP density and inducement effects in the markets with a high GP density (group 4 and 5). The results of the IV estimation deserve some further attention. Although the effect is only significant at a 10% significance level, we find a positive impact of GP density on per GP consumption of care.[30]

[30] The effect of GP density on the number of per GP consultations remains significant under different combinations and the exclusion and inclusions of instruments.

In other words, per capita consumption of GP care increases more than proportionally with increases in GP density. For the markets of group 5, this is no longer the case: at most, there is a proportional increase in per capita consumption. Our discussion on the possible impact of GP density on information asymmetry can provide an interpretation for this: the lower degree of information asymmetry on consultations in markets of group 5 compared to group 4 markets can limit the extent to which GPs induce demand. In other words, the increase in the number of providers decreases the degree of information asymmetry in the market, as in line with the conjecture that patients are searching for a perfect agent. That is, when there are more close competitors, it is easier for a patient to find a benchmark for the behavior of his GP, which decreases information asymmetry and thus increases the risk of detection of inducing behavior of GPs. Note that we at least find no evidence of the effect suggested by the consumer information model of Pauly and Satterthwaite (1981). The increase in the number of competitors does not seem to increase the information asymmetry in the market, as this would increase the incentives to induce even more demand.

For visits during working hours, the results of the OLS estimation and the IV estimation differ. The OLS estimates indicate a positive relation between per capita consumption and GP density in group 1- and group 5-markets. Consistent with the model, this indicates the presence of availability and/or downward demand management and inducement effects. We however expected to find no availability effect for visits as the GP incurs the transportation costs. Our results for group 1-markets thus indicate the presence of important consumers costs associated to waiting or that GPs actively reduce the demand for visits in these markets with a low GP density, with the latter case more probable explanation (Boerma and Groenewegen 2001). The IV estimates on the other hand indicate no impact of GP density on per GP consumption, except for markets of group 5. First, there is no evidence of an availability effect. Second, there is a positive effect of GP density on per capita consumption in high density market. Remark that we control for population density when estimating of the number of visits per GP. Therefore, our findings cannot be explained by a substitution from visits to consultations triggered by the lower population density (and thus the high distances) in markets of group 5.[31]

[31] As we also estimate a constant term per group, the argument that GPs complete more visits in higher density

The results on the impact of supply controls are in line with the results for the total consumption of GP care. An accredited GP performs more consultations and visits and also the experience level of GPs affects the number of both contact types. However, the percentage of female physicians (-) and of very experienced GPs (+) has only a significant impact on the number of visits.

We find different effects of market controls on per GP consumption of the different types of contacts. More precisely, we can attribute the effects on the total number of contacts mostly to one of the types. There is however a striking differences in the effect of the percentage of kids (under the age of 10). Whereas there is significantly less demand for consultations when the proportion of this age category is high, there is significantly more demand for visits (i.e. parents mainly go to the paediatrician with their young children, but specialists generally do not perform visits). The negative impact of the percentage young is attributed to fewer visits compared to adults, whereas the elderly population only negatively affects the number of consultations of GPs. For the other market-level effects, the impact on total contacts of GPs can be attributed to consultations for the region of Flanders (+) and the number of hospital beds (-), whereas the number of beds in rest and nursing homes (-), the mean income level (-), the unemployment rate (+), the percentage of foreigners (-) and the region of Brussels (-) have their impact on the number of GP visits.

In conclusion, the estimation results indicate that GPs use both types of contacts to induce demand. However, GPs seem to resort to inducing consultations more and possibly more quickly (in the sense of less competitive pressure) than to inducing visits. We also find some indication of downward demand management by GPs and of an information effect in the market that limits the possibility of further inducing consultations. This can be due to patients looking for a perfect agent, so that the information asymmetry in the market decreases with the increase in the number of providers.

markets because they simply have the time for it is not explaining our results on inducing behavior.

Table 3.5: Estimation results of simultaneous cross-section analysis on the number of different types of contacts per GP (2001)

	Consultations				Visits			
	OLS		IV		OLS		IV	
	Coeff.	(St.E.)	Coeff.	(St.E.)	Coeff.	(St.E.)	Coeff.	(St.E.)
Effect of GP density								
β_1	-0.078	(0.16)	0.453	(0.57)	-0.145	(0.19)	-0.289	(0.78)
β_2	-0.540	(0.39)	-2.023	(2.80)	-0.895	(0.66)	7.756	(9.70)
β_3	-0.597**	(0.23)	3.529	(4.59)	-0.488	(0.38)	-0.927	(7.89)
β_4	0.227	(0.43)	5.004*	(2.58)	0.191	(0.73)	-0.511	(2.92)
β_5	0.097	(0.11)	-0.166	(0.40)	-0.384	(0.27)	1.131	(0.82)
Supply Control variables								
accr	1.069***	(0.04)	1.067***	(0.04)	2.184***	(0.08)	2.202***	(0.08)
agree	-0.182**	(0.09)	-0.169	(0.11)	0.492***	(0.16)	0.365	(0.23)
fem	-0.170	(0.10)	-0.157	(0.13)	-0.716***	(0.18)	-0.622***	(0.22)
exp1020yrs	0.243**	(0.10)	0.257**	(0.11)	0.707***	(0.17)	0.803***	(0.21)
exp+20yrs	0.098	(0.11)	0.153	(0.15)	0.800***	(0.21)	1.059***	(0.27)
Demand Control variables								
kids	-1.600	(1.14)	-3.136*	(1.66)	3.755*	(1.91)	4.410**	(2.29)
young	-0.207	(1.01)	-0.740	(1.32)	-10.72***	(1.77)	-10.28***	(2.46)
old	-1.789**	(0.73)	-1.989**	(0.96)	-1.290	(1.37)	-2.100	(1.47)
female	1.771	(1.45)	0.246	(1.75)	9.513***	(2.32)	10.63***	(3.00)
foreign	-0.598***	(0.22)	-0.616**	(0.27)	-1.535***	(0.40)	-1.733***	(0.53)
Flanders	0.210***	(0.04)	0.180***	(0.06)	-0.158***	(0.08)	-0.099	(0.11)
Brussels	-0.001	(0.08)	-0.054	(0.10)	-0.591***	(0.13)	-0.449*	(0.21)
unempl	-0.058	(0.62)	-0.277	(0.89)	4.931***	(1.14)	4.459**	(1.69)
meaninc	-0.072*	(0.04)	-0.080	(0.05)	-0.241***	(0.08)	-0.293***	(0.09)
hospbeds	-0.058***	(0.02)	-0.137***	(0.05)	-0.120***	(0.04)	-0.079	(0.08)
restbeds	-0.023	(0.03)	0.040	(0.04)	-0.027**	(0.04)	-0.095	(0.10)
drugs	0.006*	(0.00)	0.008	(0.01)	0.001	(0.01)	-0.001	(0.01)
dens	-		-		-0.052**	(0.02)	-0.030	(0.27)
α_1	6.706***	(0.85)	6.711***	(1.52)	2.164*	(1.21)	1.944	(2.08)
R^2	0.19		0.16		0.25		0.24	

The table shows the results of the simultaneous estimation of the number of different type of contacts on GP level, with towns divided into five equal sized groups according to the GP density. β_1 relates to the towns with a GP density amongst the 20% smallest in Belgium, whereas β_5 refers to the 20% markets with the highest GP density. Column (1) reports the estimated coefficients for the consultations, while Column (2) gives the results for visits during working hours. IV estimation is performed using *mpop*, *npop5*, *dens* and *lnmpop* as instruments for logarithm of GP density (*lnR*) in the consultation regression and using *mpop*, *npop5* and *lnmpop* for the visit regression. Standard errors are reported between brackets. *,** and *** indicate significance at respectively a 10, 5 and 1% level.

Table 3.6: Wald tests on the estimated coefficients of the effect of GP density on number of consultations and visits per GP for five groups of markets (2001)

	OLS-estimation				**IV-estimation**			
	β_k = -1		β_k = 0		β_k = -1		β_k = 0	
	F	(prob)	F	(prob)	F	(prob)	F	(prob)
A. Consultations								
β_1	35.12	(0.000)	0.25	(0.619)	6.49	(0.011)	0.63	(0.427)
β_2	1.39	(0.240)	1.92	(0.167)	0.13	(0.715)	0.52	(0.470)
β_3	2.97	(0.085)	6.54	(0.011)	0.98	(0.323)	0.59	(0.442)
β_4	8.11	(0.005)	0.28	(0.599)	5.42	(0.020)	3.76	(0.053)
β_5	98.34	(0.000)	0.77	(0.381)	4.26	(0.039)	0.17	(0.681)
B. Visits								
β_1	19.84	(0.000)	0.57	(0.450)	0.84	(0.360)	0.14	(0.710)
β_2	0.03	(0.874)	1.83	(0.177)	0.81	(0.367)	0.64	(0.424)
β_3	1.77	(0.183)	1.61	(0.205)	0.00	(0.993)	0.01	(0.907)
β_4	2.68	(0.102)	0.07	(0.793)	0.03	(0.867)	0.03	(0.861)
β_5	5.15	(0.023)	2.00	(0.158)	6.72	(0.010)	1.89	(0.169)

The Wald-tests are based on the coefficient estimates of the OLS and IV estimations of equation (3.4) for total number of contacts, as presented in Table 3.5. β_1 gives the effect of GP density on per GP consumption in the 20% markets with the lowest GP density of Belgium (group 1), whereas the effect of the 20% markets with the highest GP density is represented by β_5.

3.7 Conclusion

This paper studies the Belgian primary care market for empirical evidence of supplier induced demand. Using GP-level data on all registered Belgian GPs (rather than a sample), we test whether a higher GP density results in a higher per capita consumption of GP services, due to the behavior of the GP. Furthermore, we investigate the way GPs induce demand. That is, do GPs employ consultations or rather visits to increase the demand for their services. Our empirical approach is based on the utility maximization framework of Carlsen and Grytten (1998).

The empirical analysis shows a positive relation between GP density and the number of contacts per capita. Our results can furthermore not reject that Belgian GPs are partly responsible for this finding by inducing demand for their services. If they induce demand, we find that GPs have a preference to induce through consultations, despite the higher fee for visits. In the margin of the analysis, we furthermore find some indication that GPs in markets with a low GP density use their discretionary influence over the demand to reduce the number of contacts (visits). Also, our findings seem not to support the consumer information model of Pauly and Satterthwaite (1981) where it is conjectured that the presence of more providers increases the information asymmetry in the market and thus the discretionary power of providers. Instead, we find some indication of an information effect that limits the opportunities to induce demand when competition becomes fierce. Note that whereas we conclude with some indication of the presence of inducement in Belgium, it remains unclear whether the inducing behavior of GPs decreases consumer welfare (Labelle et al 1994).

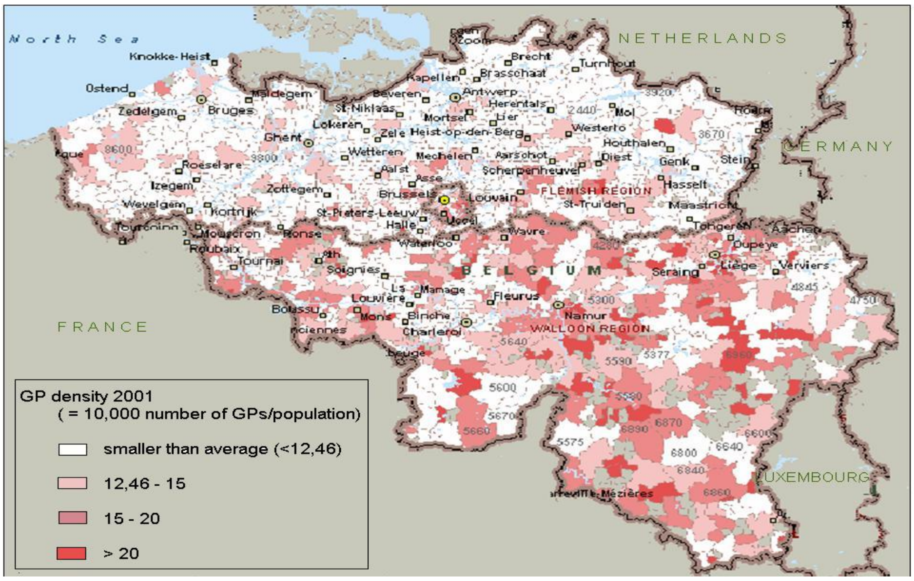
Two caveats in our analysis are worth mentioning. First, the empirical exercise is limited to Belgian GPs. We thus only look at inducing behavior by the primary care providers, whereas it is expected that also specialists resort to inducing behavior. Second, due to data availability we have very little GP-specific information and specific information on the health status of the population. As a result, the explanatory power of the model is limited. Do note though that the explanatory power of the estimation in this paper does better than reference work, in which the R^2 amounts to only 0.16 (our $R^2 = 0.22$).

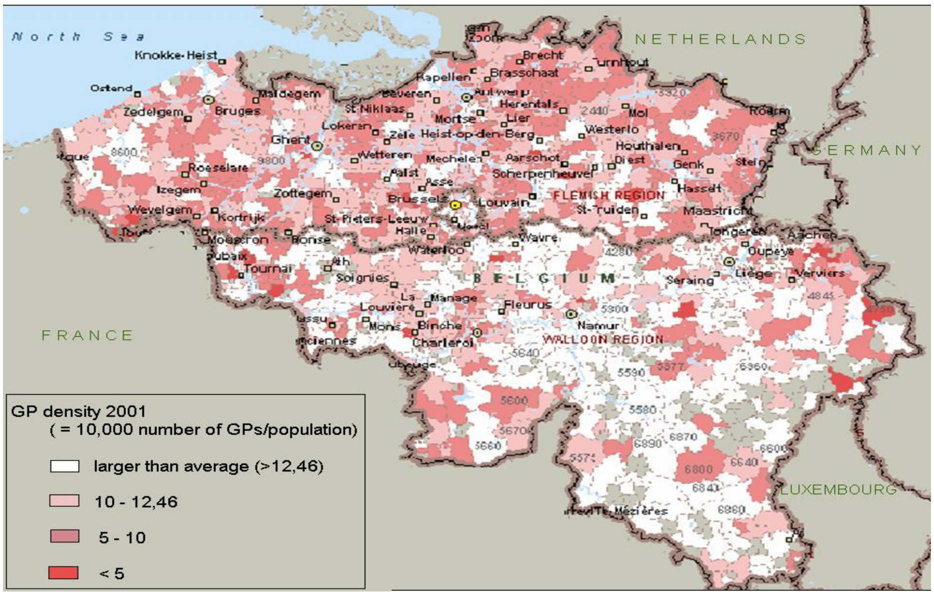
Evidence on SID by GPs in other countries has been mixed. Rossiter and Wilensky (1983) for example finds evidence of physician-initiated medical expenditures in the US, based on market level data. Some evidence of SID is found in France by Delattre and Dormont (2003), based on a panel data study of a sample of GPs. There also is some clear indication that physicians in general do respond to financial incentives in the UK (Croxson et al 2001).

On the other hand, in a series of papers on Norway where the system is comparable to the Belgian health care system, Grytten and co-authors find no empirical evidence of inducing behavior of GPs. However, whereas the institutional setting is more or less the same, the level of GP density is much lower in Norway. Grytten et al (1995) documents that for the 20% Norwegian markets with the highest GP density, the average population per physician is $1,818$. In Belgium on the other hand, the 20% most GP dense markets have an average of only 496 inhabitants per GP. It might therefore be that the level of competition for which the benefits of inducing outweigh the costs of inducing is not yet reached in Norway. Put differently, if the GP density in Belgium would be decreased to the Norwegian level, it is expected that the incentives for GPs to induce demand will disappear.

The finding of indications of GP-induced demand in Belgiium has some implications for public health policy. To limit the extent to which GPs induce demand, regulating the number of GPs in a local market can be a good idea. In this sense, our findings could be seen as an argument in favour of the existence of the numerus clausus of GPs, limiting the inflow in the profession. It is however especially the recently installed project of the Flemish government to improve the geographical spread of GPs across the country that is expected to have an impact on inducing behavior by GPs and thus on the health expenditure. This project, named Impulseo I, provides financial incentives to start an office in markets with a low GP density. Secondly, our results highlight the presence of positive consequences of the decrease in the number of students that opt for a career as GP. Whereas the media talks about a daunting shortfall of GPs in Belgium, limiting the inducing behavior of the GPs is an expected positive effect of this evolution. Significantly decreasing the number of GPs however has consequences for the overall availability of primary care, which is something the regulator may not want to abate.

3.8 Appendix


North Sea
NETHERLANDS
GERMANY
FRANCE
LUXEMBOURG
BELGIUM
FLEMISH REGION
WALLOON REGION
GP density 2001
(= 10,000 number of GPs/population)
smaller than average (<12,46)
12,46 - 15
15 - 20
> 20


North Sea
NETHERLANDS
GERMANY
FRANCE
LUXEMBOURG
BELGIUM
FLEMISH REGION
WALLOON REGION
GP density 2001
(= 10,000 number of GPs/population)
larger than average (>12,46)
10 - 12,46
5 - 10
< 5

Chapter 4

Strategic Interaction between General Practitioners and Specialists: Implications for Gatekeeping

Abstract: We propose to estimate strategic interaction effects between general practitioners (GPs) and different specialist types to evaluate the viability threat for specialists associated to the introduction of a mandatory referral scheme. That is, we show that the specialists' loss of patientele when patients can only contact them after a GP referral has important consequences for the viability of the specialist types whose entry decisions are strategic substitutes in GPs entry decisions.
To estimate the strategic interaction effects, we model the entry decisions of different physician types as an equilibrium entry game of incomplete information and sequential decision making. This model permits identification of the nature of the strategic interaction effects as it does not rely on restrictive assumptions on the underlying payoff functions and allows for the strategic interaction effects to be asymmetric in sign. At the same time, the model remains computationally tractable and allows for sufficient firm heterogeneity.
Our findings for the Belgian physician markets, in which there is no gatekeeping, indicate that entry decisions of dermatologists and pediatricians are strategic substitutes in the entry decisions of GPs, whereas the presence of gynecologists, ophthalmologists and throat, nose and ear-specialists has a positive impact on GP payoffs of entry. Our results thus indicate that transition costs are likely upon the implementation of gatekeeping and that these costs are mainly associated to the viability of dermatologists and pediatricians.

4.1 Introduction

In health systems with gatekeeping, patients can access secondary care only following a referral from their general practitioner (GP).[1] Since the presence of a gatekeeper is believed to contribute to efficiency and cost containment, policy makers in countries without gatekeeping are increasingly interested in the adoption of a mandatory referral scheme. France for example introduced a system of non compulsory coordinated care pathways for patients in January 2005, which includes the introduction of a preferred GP scheme and a reduction in patients' freedom of choice through financial incentives (HealthPolicyMonitor). Belgium and Germany recently introduced price differences between referred specialist visits and self-referrals and financial incentives are given to register with a preferred GP.[2]

The introduction of (elements of) gatekeeping however changes the entire organization of health care provision and affects the market opportunities for health providers. As a mandatory referral scheme restricts access to specialists, secondary care remains only available for those patients that really require it. Whereas this explains the believed efficiency benefit, it also entails a possible loss in viability for the current body of specialists. That is, the specialists' patientele will drop to the extent that patients were using their free choice of health provider to consume secondary care while GP care would have sufficed (i.e. patients wrongly self-refer). As a result, the changing market opportunities can lead to a decrease in the number of specialists that is sustained in the market. The related transition costs are relevant for the policy debate on the introduction of gatekeeping. Amongst others, policy makers have to decide whether or not to maintain the entire body of specialists through financial mechanisms or to retrain a portion of them.[3]

Quantifying the extent to which different specialist types are likely to be threatened in their viability is however hard. Constructing a direct measure would require detailed patient-level

[1] To be more specific, gatekeeping is present in a health care system if the following three criteria are fulfilled: Enrolment of patients with a specified GP for a fixed period of time; payment for GPs is mainly by capitation per enrolled patient; and specialist care is usually only granted following referral by a GP (De Maeseneer et al 1999). This paper focuses on the mandatory referral scheme (element 3) in the discussion on gatekeeping.

[2] For the US, 70% of all Americans with health insurance were enrolled in some form of managed care plan (Gried 2000). Several of the HMOs also practice gatekeeping. Recently, however, some HMOs have relaxed the restrictions on access to specialists (Ferris et al 2001).

[3] Also, the network incentives for GPs and specialists will increase substantially, resulting in an additional change in market conduct and market structure.

or specialist-level data, with an objective measure of the necessity of secondary care. As this data is not available, this paper suggests studying the strategic interaction effects of specialist types on GP payoffs as a proxy of this threat.[4]

But the nature of the strategic interactions between general practitioners and specialists is a priori not clear. That is, there are arguments for both complementarity and substitutability of their services. On the one hand, GPs and specialists are intended to be complementary: the GP is trained to have a very broad knowledge on all current medical problems and can refer the more complicated and more care intensive cases to specialists, who are in turn better trained in specialized fields. GPs thus benefit from the presence of a specialist as they can refer when it would otherwise require a lot of effort to treat the patient. We refer to this as the referral effect. On the other hand, to some extent GPs and specialists deliver the same services, i.e. they diagnose patients and propose (and possibly perform) a treatment. Mainly when patients can choose freely among health providers, specialists are competing for patients with GPs.[5] This is referred to as the competition effect. Whereas GPs benefit from the option to refer, they thus also risk that patients visit the specialist directly. This is especially detrimental for GPs when it concerns health problems GPs can treat at reasonable costs. With both effects present, it is not clear a priori whether the referral or the competition effect dominates the strategic interactions between GPs and different specialist types. Furthermore, this critically depends on the type of specialist and the regulatory framework in which health professionals are active.

We argue that specialist types whose presence currently has a negative impact on GP payoffs are most likely to experience viability problems upon the introduction of a mandatory referral scheme. That is, the negative effect indicates that the competition effect dominates the referral effect. Furthermore, it shows that many patients self-refer to specialists while often specialist care is not required. This is exactly the flow of patients that is excluded under a mandatory referral scheme.

[4]Throughout the paper, we assume that only GPs will be assigned as gatekeepers. Gynecologists and pediatricians are thus not allowed to act as the primary care doctor for certain population groups. A US study by Kirk et al (1998) indicates that only a minority of gynecologists identify themselves as primary care providers.

[5]Newhouse (1990): "In reality, however, there is a certain amount of competition among specialties; this is perhaps most apparent between a general (or family) practitioner, on the one hand, and a general internist (or general pediatrician) on the other hand, but almost all specialists perform some services or procedures that other specialists also perform." (p.211)

To infer whether the competition or the referral effect dominates the strategic interaction of different specialist types with GPs, we model their entry decisions as a strategic game in the tradition of Bresnahan and Reiss (1991a) and Mazzeo (2002). The paper proposes the use of a sequential incomplete information game to answer the research question. These modeling assumptions avoid issues of non-existence of equilibria in case the strategic interaction effects are asymmetric in sign. They furthermore avoid restrictions on the underlying payoff function with respect to the effect of other-type firms, while allowing for sufficient firm heterogeneity. Contrary to most models in the literature, our model thus has the appropriate flexibility to identify the nature of the strategic interaction effects, while it remains computationally tractable. We apply the structural entry model to the Belgian physician markets, which are characterized by free choice of physician and a fee-for-service system. We simultaneously estimate the drivers of profitability and strategic interaction effects for GPs and different specialist types.

Our results indicate that specialist types benefit from the presence of GPs in the market. On the other hand, the effect of specialists on GP payoffs depends on the specialization field. Dermatologists and pediatricians have a negative impact on GP payoffs, while the entry decisions of gynecologists, ophthalmologists and throat, nose and ear-specialists (TNE) are strategic complements to the entry decision of GPs. No significant effect is found for psychiatrists and physiologists. Our findings therefore indicate that dermatologists and pediatricians attract a lot of patients for whom GP care would suffice, while the patientele of gynecologists, ophthalmologists and TNE-specialists either get referred or correctly self-refer to these specialist types. We thus expect considerable transition costs when gatekeeping would be introduced in the Belgian care system. Especially dermatologists and pediatricians are likely to experience a fall in the demand for their services, which can result in viability problems.

There is a large literature that evaluates the efficiency gains and the quality or budget effects of the presence of a gatekeeper in health care systems (Kulu-Glasgow et al 1998, Delnoij et al 2000, Gerdtham and Jönsson 2000, Ferris et al 2001, Brekke et al 2007). This paper deviates from the literature as we instead start from the observation that several European countries (e.g. Germany, France and Belgium) are currently introducing elements of gatekeeping. Policy makers seem to be convinced that the arguments in favor of gatekeeping outweigh the possible negative effects. Although we perform no welfare analysis, we want to increase awareness of the transition costs that accompany the change in the health care system due to changing market opportunities for health providers. Our analysis is furthermore related to the literature on managed care (Glied 2000) and physician behavior, such as on the referral practice of GPs (Marinoso and Jelovac 2003), on the degree of specialization in the care markets (Baumgardner 1988, Newhouse 1990) and on the competitive behavior between experts and non-experts (Bouckaert and Degryse 2000).

The methodology used in this paper contributes to the growing literature on equilibrium models of entry. Traditionally, the focus of modeling entry decisions of different firm types has been on questions of product differentiation: are firm payoffs affected to the same extent by the entry of other-type firms as they are by the entry of same-type firms? The literature provides a wide range of applications such as on the competition between airlines (Berry 1992, Ciliberto and Tamer 2004), between motels (Mazzeo 2002) and between banks (Cohen and Mazzeo 2007). There are only few examples that cover positive strategic interaction effects, i.e. strategic complementarity (Sweeting 2007, Schaumans and Verboven 2008). The current paper distinguishes itself from previous work as it is a priori not clear how the strategic interaction effects are characterized. As a result, we do not follow the common practice of making restrictive assumptions on the effect on payoffs of other-type firms to construct a well-defined likelihood function. That is, we do not restrict the strategic interaction effects to be negative or positive. Furthermore, we do not impose the interaction effects to be symmetric in sign. The latter is needed as we can not exclude that e.g. GPs are strategic complements for specialists' payoffs, while these specialists are strategic substitutes in the entry decision of GPs.

The paper is organized as follows. We start in Section 4.2 by discussing the characteristics of the organization of health care markets in Belgium and issues of gatekeeping. We explain how identification of strategic interaction effects between physician types translates into the probability of viability issues upon the introduction of gatekeeping. Section 4.3 presents the entry model to determine the strategic interaction effects and discusses the particular strengths of the model given the research question. Section 4.4 follows with the data description and the empirical implementation of the equilibrium model to the Belgian physician markets. The results of the analyses are presented and discussed in Section 4.5 and Section 4.6 concludes.

4.2 The Organization of Health care Markets

Before introducing the equilibrium model of entry to identify strategic interaction effects between GPs and different specialist types, we briefly discuss the characteristics and the organization of the primary and secondary health care in Belgium. We focus on the entry requirements, the conduct and the interaction between physician types. We continue with some background on the literature on gatekeeping and focus on providing additional intuition on how the estimation of an entry model is of interest for the discussion on the introduction of mandatory referral schemes.

4.2.1 The Belgian Health care Market

The delivery of health care in Belgium is mainly private and based on the principles of independent medical practice. The Belgian health care market is characterized by a high physician density. For 2005, we account for the presence of one GP per 859 inhabitants. Furthermore, for a total population of about ten million there are close to $40,000$ active physicians (GPs and specialists), which makes Belgium the second most physician dense country of Europe, after Greece (OECD Health Data). The high availability of medical care is also associated with a high consumption level of care services: Belgians on average have 4.6 contacts with a GP and 2.3 contacts with specialists per year.

Entry into the medical professions is conditional on minimum educational standards (licensing). First of all, because of the high physician density in Belgium, the government decided in 1998 to limit the inflow of professionals. This regulation is transposed in the Flemish region (North) to restrictions on the inflow of students for medical studies, whereas the Walloon region (South) opted for a limitation further in the educational cycle. All medical students start with a six-year program, which covers the basics for all physician types, followed by a one-year introduction to the preferred specialization, which mostly consists of internships. After this initial period of seven years, medical students start their study of a specialty to obtain a license to practise: such fields of specialization include e.g. general medicine, gynecology and dermatology. Again, there exists a restriction on the number of students that can start in each specialization field. These further studies consist of two years of internships and seminars for GPs and on average 5 years of study and internships for the different specialist types. It should be noted that retraining to another specialization field is very rare: also retraining from a specialist type to a GP requires additional study. Apart from these educational requirements and some administration, entry in the Belgian physician markets is free. That is, a certified and registered physician of any type can choose to locate an office anywhere in Belgium.[6]

Most GPs operate solo, frequently without any staff except perhaps a medical secretary.[7] GPs typically perform a combination of open office hours, appointments and home visits. Furthermore, most GPs are enrolled in a local system of night and weekend duty to ensure availability of primary care at all times. Specialists are on the other hand often associated to hospitals. However, some fields of specializations do not necessarily require the hospital environment for their services, which results in a situation in which specialists have several offices: one within the hospital and a private practice. Depending on the type, patients therefore often visit specialists outside the hospital: this is especially the case for dermatologists, pediatricians, ophthalmologists and gynecologists (about 50% of all specialist visits). In this context, specialists typically perform consultations on appointment.

Both GPs and specialists are in general remunerated through fee-for-service payment where fee levels are set at the national level by the Convention Committee of the mutualities and physicians. As a result, a drop in workload directly translates into a decrease of income. The fee-for-service system furthermore prevents price competition amongst physicians of the same type. A consultation with a specialist is however substantially more expensive than a GP contact: in January 2005, patients' copayment for a consultation was 3.29€ with a GP, while the patient pays on average more than 10€ for a specialist contact. Although there is no price competition and furthermore self-regulation traditionally prevented physicians to compete through advertising, physicians do however have a wide range of other instruments they can

[6] This is in contrast to the regulation in some neighboring countries. In The Netherlands and Germany, there is regulation on the number of physicians per local market. Belgium has similar regulation for the pharmacy market. Adjustments to the entry model for these entry restrictions for the study of these markets are demonstrated in Schaumans and Verboven (2008).

[7] 75% of the population indicates visiting a GP that operates solo (WIV 2006). The percentage of GPs working solo is expected to be a bit higher than this. Note that there are centers, known as integrated health care practices, which operate as a multidisciplinary team. The number of such practices is growing, although there is still only a small minority of people affiliated to them. Our dataset however does not allow us to identify them.

use to compete with: quality of treatment, time spend on a consultation, availability, home visits (for GPs), waiting time and so on.

The Belgian health care system does not include a gatekeeping role for GPs. Neither referral nor enrolment system is in place. There is free choice of physician and since the functions and roles of most health care personnel have not been clearly defined, specialists often form the first point of contact. Therefore, as discussed in the introduction, GPs benefit from the presence of specialists as they can refer to them, but at the same time their presence is a source of competition. Note that for specialists, referrals are likely to be less costly as the initial tests have already been performed and the health problem is very likely to match the specialist's expertise.

A study by WIV (2006) on the utilization of medical services in Belgium reports that about 6% of GP contacts end in a referral to a specialist. The bulk of specialist contacts concerns follow-ups: only 31% of specialist contacts are new, compared to 82% for GPs. Furthermore, about 55% of these new contacts occur on the patient's own initiative. However, there is a large difference according to the type of specialist: for contacts to dermatologists (gynecologists), patients initiate 68% (67%) of the contacts, whereas for internists or (neuro-) psychiatrists only resp. 41% and 26% of the contacts are self-referrals. The high frequency of self-referred specialist contacts suggests that specialists are responsible for limiting the demand for GP services. We however have no indication on the character of the complaint and thus on whether or not a GP would be able to treat these patients. A study in the Netherlands, one of Belgium's neighboring countries, though indicates that patients self-refer for medical complaints for which they expect to end up at the specialist anyway and when the problem is considered to be specific for the specialist (Kulu-Glasgow et al 1998). Remember that patients do have an incentive to contact a GP for general or minor health concerns, instead of a specialist because of the price difference.

Containment of health expenditure has been on the political agenda since the eighties and in 1993, some initiatives were launched to serve this purpose: amongst others there was a significant increase of copayment. But with the challenges of ageing and the development of expensive new medical techniques, initiatives on cost containment and efficiency remain important. In 1999, the Belgian authorities started with financial incentives for patients to participate in a system of enrolment with a preferred GP. Over the first five years, more than 30% of the population already enrolled. Moreover, in 2004, 95% of the population indicates having a regular GP (WIV 2006) and a 2001-survey of one of the Belgian mutualities indicates that 75% of the patientele of a GP is loyal to his/her GP.[8] This indicates that the majority of patients seem not to be 'shopping around' as far as GP care is concerned. Secondly, as of February 1st, 2007 a specialist contact that is not initiated by a GP referral has become more expensive for the patient, although the price difference of 5€ is only valid for one visit per year.[9] It is thus clear that initial steps towards a gatekeeping system are taken, while the debate on implementing a full gatekeeping system is still ongoing.

The characteristics of the Belgian health care markets motivate the modeling assumptions made in the entry model presented in section 4.3. First, because of the educational requirements in the physician markets, each firm knows its type before the entry game starts. Entrants therefore make no type choice. Furthermore, although licensing limits the total number of potential physician entrants, the lack of restrictions on the number of entrants in a local market implies that the pool of entrants for a specific local market is large.[10] Second, since the majority of GPs still operate in a solo-practice and because data availability prevents identifying those physicians connected to a group or hospital, we treat all entry decisions as individual decisions. The presence of hospitals will however be an important indicator for the profitability of mainly specialist types.

4.2.2 Gatekeeping

Gatekeeping delegates the responsibility of the use of all secondary care to GPs through their referral behavior (Scott 2000). As such, GPs are in charge of effectively and efficiently guiding

[8] Loyalty is here defined as not having any contacts with any other GP throughout the year. (Socialistische Mutualiteit, 'Flits' Oktober 2001).

[9] De Artsenkrant, No. 87 (31/01/2007). Note that because we are working on data prior to the introduction of the fee-differential related to a referral, the model is able to capture the way specialists and GPs interact in the absence of gatekeeping.

[10] To the extent that there are too few licensed physicians to cover the different geographic markets, the model changes in the constant term: the positive payoff condition to trigger entry is then replaced by the condition of payoffs higher than the best alternative. This is just a matter of normalization of the outside option.

patients through the health care system. The introduction of gatekeeping is therefore believed to make the use of secondary care more efficient. That is, an informed player (the GP) decides on the use of the expertise of specialists rather than patients, who are subject to uncertainty, asymmetric information and moral hazard (Arrow 1963). Furthermore, as the GP becomes the primary coordinator and communicator, the enhanced long run relationship can further increase efficiency as it allows taking the more general background of the patient into account. Gatekeeping is also believed to contribute to cost control, as it prevents wasteful duplication of diagnostic tests and unnecessary use of expensive secondary care (Franks et al 1992). These possible cost (quality) and efficiency gains of a gatekeeping role for GPs make legislators prone to implement it in their health system.[11]

Although the arguments in favor of gatekeeping seem convincing, there is actually little empirical evidence for the believed efficiency and cost benefits. For example, Barros (1998) and Delnoij et al (2000) both find that the magnitude of health expenditure is not affected by the presence of a gatekeeping role. The only effect they can account for is a slower increase in the costs (for ambulatory care) in time. Ferris et al (2001) find little evidence of substantial changes in the use of specialty services by US HMO members in the first 18 months after abolishing gatekeeping and Nivel (2003) indicates that gatekeepers are in general not better informed about their patients.[12] Brekke et al (2007) furthermore suggests that gatekeeping can be associated with overspecialization and excessive quality competition and survey results indicate a lack of support by patients and physicians for the introduction of gatekeeping. Also the danger of diagnostic delay is used as an argument against the introduction of gatekeeping.

[11] A bit simplified, more or less half of the Western-European countries do restrict access to secondary care by referral (UK, Spain, the Netherlands, Italy, Ireland, Denmark, Norway and Portugal), whereas the other half do not delegate this role to their GPs (Belgium, France, Germany, Sweden, Switzerland, Luxembourg, Greece and Austria). The United States is characterized by a mixed system, depending on the patient's choice of health insurance. Patients that are enrolled in an HMO are generally monitored by a gatekeeper, whereas patients that choose to sign in on a PPO have direct access to all care. However, several HMO's in the US are gradually opening up access to specialist care for their enrolled patients (e.g. Harvard Vanguard Medical Associates). Source: CESifo 2000 DICE, Boerma 2003.

[12] Evidence on the general health outcomes would be instructive in the discussion but is hard to come by. There is some indirect evidence that gatekeeping has a positive effect on health outcomes in Macinko et al (2003). Here it is shown that countries with a strong primary care system (Primary Care score test) are more successful in preventing mortality. Since countries with gatekeeping generally have a stronger primary care system, the positive relation might carry through (Gress et al 2004).

An additional argument against the implementation of gatekeeping concerns costs related to altering an existing care system based on free choice towards a system with mandatory referrals. One such transition cost is directly related to the viability of the active professionals.

In a system with free choice, a patient can visit a specialist or a GP, irrespective of whether or not he/she requires specialist care. In case the patient needs specialist care, the GP will refer the patient to the appropriate specialist. The choice of directly contacting a specialist reduces transaction costs in case the patient would end up with this specialist type either way, but holds the risk of paying a higher fee than necessary (when one could have been treated by the GP) or the risk of delay or a wrong treatment (when the patient visits the wrong type of specialist). With the introduction of gatekeeping, the option of directly visiting the specialist is excluded. All patients visit the GP in a first instance and only those that need specialist care are redirected to the appropriate specialist type. This implies that specialists loose a part of their patientele: those patients that only need GP care will no longer end up in the specialist's office. In case specialists are paid according to a fee-for-service system, this drop in patientele directly affects their profitability. And to the extent that this flow of patients is important, the changing market opportunities due to the installment of a gatekeeper affect the viability of specialists and therefore reduces the total number of specialists that can operate in the market. This argument is in line with survey results from Germany where specialists indicate to fear financial losses due to gatekeeping (Gress et al 2004).

For insights on the likelihood of these viability issues for a specialist type, we rely on the strategic interaction effect of this type of specialists on the entry decision of GPs. This strategic interaction effect captures whether GP payoffs are increasing or rather decreasing in the number of specialists in the market. To facilitate the discussion, take for now that GP payoffs are given by variable profits minus fixed costs:

$$\pi_{GP} = q \cdot S \cdot (p - mc) - F$$

with q the average number of patient's contacts with a GP, S the total number of patients, p the fixed fee, mc the average marginal cost of a contact and F the fixed costs. GP payoffs are affected in different ways by the presence of specialists. First, it allows GPs to refer complicated or care intensive cases which reduces the average marginal costs of treatment for the GP (mc). In general, payoffs are thus higher when specialists are present in the market, due to the referral effect.[13] Second though, patients can contact the specialist instead of the GP (competition effect). This implies a drop of the average number of contacts a patient has with the GP (q). However, when patients self-select and only go to the specialist directly when they actually need specialist care, the drop in the number of contacts is associated with a drop in GP marginal costs. It is therefore especially when most patients wrongly diagnose themselves as in need of specialist care that GP payoffs will decrease due to the competition effect. That is, average marginal costs do not drop, while patients contact the GP less frequently.

When GP payoffs are increasing in the number of specialists of a certain type, the benefits of referrals outweigh the costs of competition (strategic complementarity). Patients that require the care of these specialists thus mainly access secondary care through the GP (high referral effect) and only few patients misdiagnose themselves in their self-referred visits to specialists (low competition effect). On the other hand, payoffs decreasing in the number of specialists of a type indicate that the competition effect dominates the referral effect (strategic substitutes). Patients access secondary care primarily through self-referral (or more precisely, GPs rarely need to refer patients to this specialist type), while many of them don't require specialist care (high competition effect).

Again, the introduction of a mandatory referral scheme excludes the possibility of patients to access secondary care directly. All patients that previously visited specialists while GP care would have sufficed will no longer be part of the specialist's patientele. Given the previous discussion, we know that this will especially threaten the viability of those specialist types that negatively affect GP payoffs. That is, for these specialist types, the loss of patientele will be substantial.

[13] Whereas the number of visits of these patients to the GP drops, the availability of the GP increases, which could counterbalance the drop in number of visits. That is, other patients visit the GP more frequently as the shadow price of care (=monetary+transportation costs+waiting costs) decreases.

4.3 Entry Model

In this section, we present a static entry model to estimate the strategic interaction effects between specialist types and GPs. This allows us to determine whether the competition effect or the referral effect dominates the impact of specialist types on GP payoffs. In turn, this is instructive for the likelihood of viability threats for a specialist type once gatekeeping is introduced: the profitability of mainly specialist types whose entry decisions are strategic substitutes for the entry decision of GPs will be affected (section 4.2.2).

We propose to model the entry decisions of the different types of physicians as a sequential game of incomplete information with firm heterogeneity: firms have private information about their payoffs in a market and the types make their entry decisions in a pre-specified order. We start this section by introducing the model set up, firm behavior and the equilibrium of the game. This is followed by a discussion on the choice of the modeling assumptions: the model is especially designed to identify the signs of strategic interaction effects, while allowing for sufficient firm heterogeneity and asymmetric strategic interaction effects. We contrast our model mainly to models of complete information.

4.3.1 The Empirical Model

The empirical model to tackle our research question is closest related to the incomplete information game in Einav (2003). In a study to explain the observed demand patterns in the movie industry, Einav presents a sequential game of incomplete information to explain the timing decision of movie distributors. Each firm makes a zero/one decision for the 'entry' of the movie in a time horizon. Our model differs in two respects. First, in our setting firms make decisions to enter geographic markets. The unit of observation is therefore a local market as opposed to a point in time. Second and more importantly, the setting of Einav concerns few potential entrants with observable heterogeneity, for which he considers the timing decision separately. This paper on the other hand groups physicians into homogeneous types and looks at the aggregate decision of each physician type. We thus study the equilibrium number of entrants per type, which increases the dimensionality of the model. We subsequently present firm payoffs of entering the market and the assumptions of the game and discuss firm behavior and the conditions under which a market structure is the unique Bayesian Nash equilibrium.

Set-up and payoffs

Let the set of players in market m be grouped in T types, with $\mathcal{F}_t$ potential firms of type t ($t \in [1,T]$). The action space of all players consists of entering or not entering the market. Following the discussion in section 4.2.1 (and as in Einav 2003), firms are considered to be individual decision makers and are not ex ante the same.[14] Each firm knows its type before the entry game starts and all types have a large pool of potential entrants. We denote GPs as firms of type 1 and the different specialist types are assigned type 2 to type T. While payoffs of not entering the market are normalized to zero, we represent payoffs of a firm f of type t entering market m by the following reduced form:

$$\begin{aligned} \pi^m_{f,t} &= \bar{\pi}_t(\mathbf{X}^m, n^m_1, ..., n^m_t) - \varepsilon^m_{f,t} \\ &= \beta_t \mathbf{X}^m + \alpha_t n^m_t + \sum_{\substack{j=1 \\ j \neq t}}^{T} \gamma_{tj} n^m_j - \varepsilon^m_{f,t} \end{aligned} \tag{4.1}$$

Firm payoffs depend on market characteristics ($\mathbf{X}^m$, such as the number of inhabitants) and the entry decisions of other firms. Type-specific coefficients allow for the payoffs to vary across types. Furthermore, payoffs vary across (same-type) firms because of firm-specific characteristics. These firm-specific characteristics are assumed to be unobserved by both the researcher and other firms ($\varepsilon^m_{f,i}$), although the distribution of the random variable of which the private information is a realization is known by all players.[15] Since firms of the same type are therefore observationally the same, the exact identity of the entrants of a type is irrelevant for payoffs. Instead, payoffs are affected by the realized number of entrants of the different types in the market ($n^m_1, ..., n^m_T$). Consistent with the existing literature, same-type firms are strategic substitutes, so that payoffs are decreasing in the number of firms of the own type: $\alpha_t < 0$.[16]

[14] This is in contrast with for example Mazzeo (2002), where firms make both an entry decision and a type decision. In his setting, all firms are ex ante homogenous.

[15] The firm-level error can be interpreted as both non-strategic considerations that make some players more likely to choose to enter this specific market or as an optimization error (Einav 2003).

[16] Note that we use this assumption in deriving the equilibrium behavior of the firms, but do not restrict the related coefficient in the estimation procedure. Instead, the data demonstrates this competitive effect.

For the effect on payoffs of the number of entrants of other types, we make a simplifying assumption:

$$\gamma_{tj} = 0 \qquad \forall t \neq 1, j \neq 1$$

It is assumed that payoffs of all specialist types ($t \neq 1$) are affected only by the number of own-type rivals and by the number of GPs in the market. In other words, the entry decisions of firms of different specialist types are independent from each other, at least in first order: there remain some indirect effects between specialist types through their simultaneous effect on the GP market. The restriction on the strategic interaction effects reduces the computational burden of the model to a considerable extent, so that it allows for the estimation of a high degree of firm heterogeneity. Given the characteristics of the application, the assumption is not strong: specialists rarely refer patients directly to other specialist types.[17,18] Note that GPs' payoffs (type 1) on the other hand are affected by the number of physicians of all types.

In contrast to most of the existing empirical literature, we make no assumptions on the signs of the strategic interaction effects. Instead, estimation of the model will yield insights on this. A negative effect ($\gamma_{tj} < 0$) indicates that the entry decisions of type-j firms are strategic substitutes to the entry decision of firms of type t: the entry of a type-j firm in the market yields an additional competitive effect. A positive effect ($\gamma_{tj} > 0$) on the contrary implies strategic complementarity in the entry decisions for firms of type t as payoffs of entering a market increase in the number of other-type firms. Furthermore, the strategic interaction effects between any two types of firms are allowed to be asymmetric, both in magnitude ($\gamma_{12} \neq \gamma_{21}$) and in sign ($\gamma_{12} < 0$ & $\gamma_{21} > 0$). The latter is a particular strength of the model and worth elaborating on: for expositional reasons we delay the discussion to section 4.3.2. Remark that the current

[17] The restriction is more severe within the context of a hospital in which specialists do 'refer' to each other. As our dataset does not allow us to identify which specialists are associated to which hospital, we can however not control for this. The number of hospital beds will however be taken up as an explanatory variable in the estimation of the model, to partly control for this.

[18] In case the application does not allow to make similar simplifying assumptions on the strategic interaction effects, the researcher has to go back to a $(T + 1)$-stage game, in which a precise order is specified (see Einav 2003 for the consequences).

application cannot exclude the possibility of this asymmetry in sign: whereas specialists are expected to be positively affected by the entry decision of GPs, the competitive effect can dominate the strategic effect of a specialist type on GP payoffs.

With firms' payoffs of entering market m at hand, we model their entry decisions as a strategic three-stage game: in the first stage, all potential entrants of type 1 simultaneously make their entry decisions. In the second stage, type-2 to type-T players simultaneously decide on entry. When all potential entrants made their entry decisions, all firms that have entered market m interact with each other and payoffs are realized.

Two remarks are in place. First, the assumption that GPs make their entry choices first is motivated by the consideration that a GP's patientele is mainly trust-based and very local whereas this is rather reputation-based in the specialists' markets. As such, GPs sunk costs of entering a specific local market and therefore their commitment power is higher.[19] Second, because of the assumption on the strategic independence of specialists types, the simultaneous entry stage for all specialist types (stage 2) yields the exact same market equilibrium as a game in which the different types would enter sequentially in a pre-specified order: the second stage would then consist of $(T-1)$ stages (see Einav 2003).

Firm behavior and Equilibrium

As payoffs contain a private information component, firms make entry decisions based on their expected payoffs of entry. Each firm forms its expectation on payoffs using all observable information in the market and the private realization of its unobservables, together with a conjecture on the actions of all other firms. Note that the choice behavior depends only on the expected actions of other firms and not on the exact realizations of the unobservables of the other firms (as is the case in complete information games). Using this information, each firm decides whether or not to enter the local market m. Since firms are assumed to be rational

[19] This is in contrast with the general argument that material investments to enter a market as a specialist are higher. Note though that these costs are not market-specific. To the extent that specialists are mainly associated to hospitals, their sunk costs can be higher, which would justify a reverse order of play. The current sequence of entry decisions is however convenient as it reduces computational burden in the presence of more than two types. Finally, note that instead of making an assumption on the sequence of entry, Einav (2003) allows to estimate the likelihood of the different orders of play. This however requires that the dataset is very rich.

payoffs maximizers, firms enter when they deem it to be profitable. Therefore, in the long run, the equilibrium market structure in market m consists of the maximum number of firms that is viable, given their product differentiation.

Firms furthermore decide according to a pre-specified order of play: GPs (type 1) are the first-movers while the different specialist types simultaneously decide in the second stage of the game. As a result, the model can be solved backwardly for its perfect Bayesian equilibrium (Einav 2003).

Second stage

In the second stage of the game, type-1 firms have already made their entry decisions and the $\mathcal{F}_t$ potential entrants of the other types t ($t \in [2, T]$) now simultaneously decide on entry in market m. They use all available information and thus condition their choice behavior on the observed number of type-1 entrants ($N_1 = n_1^m$). Furthermore, the entry decisions are independent across type. Given the payoff specification in (4.1), firms of type 2 to type T thus base their entry decision on the following conditional expected payoffs of entering market m:

$$\begin{aligned} E(\pi_{f,t}^m | n_1^m) &= E\left(\bar{\pi}_t(\mathbf{X}^m, n_1^m, N_t)\right) - \varepsilon_{f,t}^m \\ &= \beta_t \mathbf{X}^m + \alpha_t E(N_t | n_1^m) + \gamma_{t1} n_1^m - \varepsilon_{f,t}^m \end{aligned} \tag{4.2}$$

For notational convenience, we often refer to the deterministic part of these expected conditional payoffs as $E\left(\bar{\pi}_t^m | n_1^m\right)$. With all other determinants of payoffs observed, type-t firms only conjecture on the choice behavior of their own-type rivals to form their expected payoffs. Each individual type-t firm enters the market when its private information realization allows profitable entry, given the expected market structure: $E(\bar{\pi}_t^m | n_1^m) \geq \varepsilon_{f,t}^m$.

As payoffs of all firms of the same type are observationally symmetric and the distribution of the private information is common knowledge (G), all firms of type t have in equilibrium the same conjecture on the number of entrants of its type in market m. That is, firm f's conjectured probability of a rival firm g entering the market is the same as the probability of any other rival entering and also the same as the conjecture any rival has about the probability that firm f enters: $\Pr_{f,t}\left(E(\bar{\pi}_t^m|n_1^m) \geq \varepsilon_{g,t}^m\right) = \Pr_{g,t}\left(E(\bar{\pi}_t^m|n_1^m) \geq \varepsilon_{f,t}^m\right) = G\left(E(\bar{\pi}_t^m|n_1^m)\right)$.[20] This also implies that the probability of being viable in a market with (n_1^m, n_t^m) entrants is the same for all firms of type t. As a result, the probability that the equilibrium market structure consists of n_t^m entrants of type t coincides with the probability that a single firm is profitable (and thus enters) given this market structure but would not be profitable in the presence of an additional competitor (i.e. $n_t^m + 1$ entrants). For any realization of the number of type-1 firms ($N_1 = n_1^m$), the probability that in the Nash equilibrium, n_t firms of type t ($t \in [2, T]$) enter market m can be written as:[21]

$$\begin{aligned} \Pr\left(N_t = n_t^m|n_1^m\right) &= \Pr\left(\bar{\pi}_t(\mathbf{X}^m, n_t^m, n_1^m) \geqslant \varepsilon_{f,t}^m > \bar{\pi}_t(\mathbf{X}^m, n_t^m + 1, n_1^m)\right) \\ &= G\left(\bar{\pi}_t(\mathbf{X}^m, n_t^m, n_1^m)\right) - G\left(\bar{\pi}_t(\mathbf{X}^m, n_t^m + 1, n_1^m)\right) \end{aligned} \quad (4.3)$$

First stage

Potential entrants of type 1 make their entry decisions first and decide based on their expected payoffs of entering market m. In contrast to the second movers, type-1 firms conjecture on the choice behavior of their own-type rivals and of the firms of all other types:

$$\begin{aligned} E(\pi_{f,1}^m) &= E(\bar{\pi}_1(\mathbf{X}^m, N_1, N_2, ..., N_T) - \varepsilon_{f,1}^m \\ &= \beta_1\mathbf{X}^m + \alpha_1 E(N_1) + \sum_{\substack{j=1 \\ j\neq t}}^{T} \gamma_{1j} E(N_t) - \varepsilon_{f,1}^m \end{aligned} \quad (4.4)$$

The potential entrants however anticipate on the choice behavior of type-t firms: their decision rules are deduced from their equilibrium behavior in the second stage of the game as given in expression (4.3). Note that the decision rules of the type-2 to type-T firms depend on

[20] In the presence of firm-specific characteristics, type-t firms can be considered as heterogeneous and not only the number but also the identity of the entrants becomes relevant for payoffs. Expectations can then differ across firms (Seim 2007).

[21] Remark that we get the same probability of observing a market structure as in the case where the error term is the same for and observed by all type-t physicians (only!). This is due to the symmetry assumption.

the realization of the number of entrants of type 1 so that the expectation of the number of other-type firms depends directly on the expectation of the number of same-type rivals. The expected number of firms of type 2 to type T in market m in the payoffs of type-1 firms ($E(N_t)$ in expression 4.4) can thus be updated by integrating out over the probability of observing n_t^m specialists of type t entering the market, conditional on the number of type-1 firms:

$$E(N_t) = \sum_{n_t^m \in \mathcal{F}_t} \Pr\left(N_t = n_t^m | E(N_1)\right) \cdot n_t^m \qquad \forall t \neq 1 \tag{4.5}$$

As a result, the expected payoffs can be written to only depend on the expectation of the number of entrants of the own type ($E(\bar{\pi}_1(\mathbf{X}^m, N_1, N_2, ..., N_T) = E(\bar{\pi}_1(\mathbf{X}^m, N_1))$. The symmetry of the payoffs of type-1 firms and the common knowledge of the distribution of the private information component implies that all GPs form the same equilibrium conjecture on the number of entrants. Furthermore, individual rational behavior yields conditions for the equilibrium number of type-1 firms entering the market. That is, the probability that a market structure with n_1^m firms of type 1 is a Nash equilibrium, is given by the probability of a type-1 firm being profitable in the presence of n_1^m rivals, but unprofitable with an additional entrant in the market:

$$\begin{aligned} \Pr(N_1 = n_1^m) &= \Pr\left(E(\bar{\pi}_1(\mathbf{X}^m, n_1^m)) \geqslant \varepsilon_{f,1}^m > E(\bar{\pi}_1(\mathbf{X}^m, n_1^m + 1))\right) \\ &= G\left(E(\bar{\pi}_1(\mathbf{X}^m, n_1^m))\right) - G\left(E(\bar{\pi}_t(\mathbf{X}^m, n_1^m + 1))\right) \end{aligned} \tag{4.6}$$

Perfect Bayesian Nash Equilibrium

From the second stage of the game, we derive the equilibrium behavior of all firms of type 2 to type T (i.e. of all specialist types) conditional on the number of entrants of type 1. In the first stage of the game, we deduced the equilibrium number of type-1 entrants that realizes taking into account the reactions of the other types to these entry decisions. In sum, the assumption of rational firm behavior yields a probability of observing a number of firms of any type in the market (equations (4.3) and (4.6)). Combining both stages, the probability of observing market structure $(n_1, n_2, ..., n_T)$ in market m is described by:

$$\begin{aligned} \Pr \quad (N_1 = & \; n_1^m, N_2 = n_2^m, ..., N_T = n_T^m) \\ = & \quad \Pr(N_1 = n_1^m) \cdot \Pr(N_2 = n_2^m | n_1^m) \cdot ... \cdot \Pr(N_T = n_T^m | n_1^m) \end{aligned}$$

Given a specification of the reduced form payoff function for firm types and an assumption on the distribution of the private information, the estimation proceeds through the maximization of a likelihood function, where every market is treated as an independent game. With $n_t^{m^*}$ the observed number of entrants of type t in market m, the likelihood function is given by:

$$L(\beta_t, \alpha_t, \gamma_{tj}) = \prod_{m=1}^{M} \Pr(N_1 = n_1^{m^*}, N_2 = n_2^{m^*}, ..., N_T = n_T^{m^*}) \tag{4.7}$$

4.3.2 Discussion

The entry model put forward in section 4.3.1 is one of incomplete information and firms deciding in a pre-specified order. These modeling assumptions are used explicitly to meet the requirements of the research question at hand:

1. We intend to identify the sign of the strategic interaction effects between different physician types.

2. We cannot exclude the possibility that the strategic interaction effects between GPs and a specialist type are asymmetric in sign. That is, GPs' payoffs might decrease in the number of a specialist type, while this specialist type benefits from the presence of GPs in the market.

3. There exists a lot of different types of physicians: GPs, dermatologists, pediatricians, gynecologists, psychiatrists, and so on. We thus want to allow for sufficient firm heterogeneity (at least more than two firm-types).

The bulk of the literature considers games of complete information: all characteristics of payoffs are common knowledge for the firms, including the realization of the error terms. Therefore, the action of every firm depends not only on the realization of its own unobservables, but also on the realization of the unobservables of the other potential entrants. We use a graphical representation of the entry game to show that when the information set is complete, the probability of observing a market structure critically depends on the nature of the strategic interaction effects. Figure 4-1 represents the empirical model with two types and one potential entrant for each type under complete information and simultaneous decision making for three cases: (A) the interactions between firms is given by strategic substitutability (payoffs of entry decrease in the entry of the other type), (B) strategic complementarity in the entry decisions of both firms (firms benefit from the presence of the other type firm) and (C) the strategic interaction effects are asymmetric in sign. The X-axis represents realizations of the unobservables of the firm of type 1, whereas the Y-axis gives the realizations of the unobservables of the type-2 firm. The broken lines represent threshold values for entry: if the realization of the own error term lies below this threshold value, rational firm behavior prescribes firms to enter the market (e.g. $\bar{\pi}_1(\mathbf{X}^m, 1, N_2) \geq \varepsilon_1^m$). As this entry decision depends on the realization of the error of the other-type firm, each firm has two threshold values, one for the entry decision when the firm is the only entrant ($n_{-i}^m = 0$) and one for the entry decision when the other firm is present in the market ($n_{-i}^m = 1$). Given the threshold values of both firms, we can associate equilibrium market structures to error term realizations. The areas associated with equilibrium market structures (n_1^m,n_2^m) are depicted on the graphs.

The problem with complete information games should be clear directly: while we aim to identify the nature of the strategic interaction effects, the probability associated to a market structure depends on the assumption made on the strategic interaction effects.[22] In other words, when the researcher want to take a complete information game to the data, defining the likelihood function implies making an assumption on the nature of the strategic interaction effects. It is straightforward that we do not want to make such assumptions. Moving towards a setting of incomplete information avoids this: firms make their entry decisions based on their expected

[22] Look back at Figure 4-1, assuming without loss of generality that firm 1 moves first (to solve for the multiplicity issue). The equilibrium mapping for market structure $(0, 1)$ is a rectangle in the strategic complementarity case, whereas it takes a different form under the assumption that the entry decisions are strategic substitutes.

payoffs, which consists of a conjecture of the likelihood of entry of the other firm given observable information on the other firm's payoffs. Firms use this conjecture to determine its entry decision: the firm will enter in case expected payoffs are positive (e.g. $E(\bar{\pi}_1(\mathbf{X}^m, 1, N_2^m)) \geq \varepsilon_{f,1}^m$). Figure 4-2 gives the graphical representation of the empirical game under incomplete information and simultaneous decision making. Importantly, the same mapping results for the three possible cases of strategic interactions between firms. That is, as opposed to the complete information game, each firm only has one threshold value due to the independence of its entry decision of the realization of the error term of the other-type firm. The strategic interactions between firms however determine the level of these threshold values.

The second requirement of the empirical application is the fact that the strategic interactions need to be flexible. In a setting of complete information and pure equilibrium strategies, a game with strategic interactions that are asymmetric in sign suffers from issues of non-existence of an equilibrium for certain realizations of the model primitives. In case one firm is harmed by the presence of the other, while the other firm benefits from the presence of the first, as depicted in panel C of Figure 4-1, it is possible that any strategy by the players has a profitable deviation by at least one of them.[23] For such realizations of the model primitives no equilibrium exists, so that no well-defined likelihood function can be specified. Models of complete information therefore do not only require the strategic interactions to be known a priori, but also that the strategic interaction effects between two types have the same sign. When in contrast firms decide based on expectations of the actions of the other players, as in Figure 4-2, an equilibrium exists for all realizations of the model primitives. Note though that while an equilibrium always exists, the incompleteness of the information set gives rise to ex-post regret. That is, once the entry decisions of the other players become clear, the firm's decision to (not) enter might not have been the optimal one. Remark furthermore that an alternative solution to the non-existence problem in the complete information game consists of allowing for mixed-strategy equilibria (Bajari et al 2007, Aradillas-Lopez 2007).

[23] The firm of type 1 is willing to enter the market if it can be alone in the market. But in case the type-1 firm enters, it is optimal for the type-2 firm to enter as well since its entry is profitable given this market structure. However, in the latter case, the type-1 firm would not be profitable.

Whereas an equilibrium always exists in the incomplete information game, the issue of multiple equilibria remains. For the same model primitives, the equilibrium conjecture on the behavior of other firms might not be unique (Berry and Reiss 2006). Most of the empirical work on incomplete information games constrains the shape of the payoff function or assumes that the same equilibrium is chosen in similar markets to solve for multiplicity concerns (Seim 2007, Aradillas-Lopez 2007, Vitorino 2007).[24] However, as in games of complete information, the assumption of sequentiality results in unique equilibria as well: the second mover conditions its choice on the action of the first mover, so that the first mover can perfectly anticipate his choice behavior. Given the sequentiality assumption, only the first mover is subject to ex-post regret (Einav 2003). For the current application, we work with the sequentiality assumption to solve for the unique Bayesian Nash equilibrium. For completeness, we add the graphical representation of this model with the firm of type 1 as the first mover in Figure 4-3, where panel A and panel B respectively present the case in which the firm of type 1 is a strategic substitute or a strategic complement in the entry decision of the type-2 firm.[25]

Finally, allowing for a high degree of firm heterogeneity is less demanding in an incomplete information setting (Seim 2007). Within the complete information framework, specifying the conditions for which a specific market structure with e.g. three firm-types is the equilibrium is complex: it results in complicated regions of integration. Recent developments in the literature however do allow for estimating a higher degree of firm heterogeneity in this setting, but reduces identification to the set of models for which the data is consistent (e.g. Ciliberto and Tamer 2004[26]). Instead, an incomplete information setting retains point identification while being less computationally intensive.

[24] Sweeting (2007) is an exception as this paper uses the multiplicity of equilibria explicitly in the identification strategy.

[25] Note that the specification of this model is invariant to the nature of the strategic interaction effect: the relevant threshold values for any market structure to be an equilibrium is the same in both panels.

[26] Ciliberto and Tamer (2004) does more than just dealing with the multiplicity concerns: they also allow for a flexible estimation of the underlying payoffs through giving up on point identification of the model. This method implies that the data itself will be used to determine how the areas of error term realizations connected to a certain market structure are defined. Computational burden however increases fast when the binary model is extended to estimating the number of firms of a type entering the market. Furthermore, although type specific variables and exclusion restrictions are not per se needed, they help reduce the bounds of the parameter set. Finally, an extension of the model is needed to allow for mixed equilibria when the strategic interaction effects do not have the same sign. Apart from these technical drawbacks in the empirical implementation, this methodology however does allow for a flexible estimation of the strategic interactions and correlation in the unobservables.

Related to this computational burden, we decrease the complexity of the equilibrium and therefore the computation time further by assuming strategic independence between the different specialist types. In his timing game, Einav (2003) demonstrates the development of an equilibrium market structure in case there is strategic dependence between all types. That is, in a $(T+1)$-game where the order of play is clearly determined, all but the last mover anticipate on the behavior of some types and all but the first mover condition their expectations on other firms' choices. Finally, as indicated by Einav (2003) the equilibrium calculus is linear in the number of players in the market, and thus has the benefit over simultaneous incomplete information games, which rely on numerical search algorithms.

In sum, the modeling assumptions made are specifically required by the nature of the research question at hand.[27] First, the specification of the empirical model is invariant to the nature of the strategic interaction effects and thus makes no related assumptions on the underlying payoff function. Second, it allows for asymmetric strategic interaction effects in GP-specialist interactions, as it avoids related issues of non-existence of equilibria. Furthermore, we can model and estimate the entry decisions of multiple types of firms simultaneously while retaining point identification.

4.4 Empirical Implementation

To use the empirical entry model to explain the characteristics of the Belgian primary and secondary care markets, it remains to specify the reduced form payoff functions for the physician types and to make an assumption on the distribution of firm level unobservables. We start the empirical implementation section by introducing the data on the Belgian health care markets after which we discuss further implementation and identification issues.

[27] A recent working paper by Vitorino (2007) addresses a related issue using a simultaneous game of incomplete information. She studies the presence of agglomeration effects of shopping centers and also uses the property of the incomplete information game of allowing for the effect of same type stores to be either positive (agglomeration dominates) or negative.(competition dominates). The setting is quite different though. She considers a limited number of potential entrants (3) with firm-specific characteristics of a limited number of potential types (3) to choose to enter a shopping mall. Note that there is a different interpretation of the concept of 'same-type effects' as in the current paper (Vitorino's types are comparable to our classes of specialists). Instead of assuming sequential entry, it is assumed that the same equilibrium is picked in similar markets. As a result, her estimation approach is more complex to solve for the equilibrium.

4.4.1 Data on Belgian health care markets

In this section, we present the dataset for the study on Belgian GPs and specialists. The first step in the application of the entry model to Belgian physician markets consists of defining the relevant geographic market. There is however little guidance on this: unlike in the US, antitrust has not addressed any cases of merging physician offices, because this phenomenon is marginal in Belgium and prices are fixed. We nonetheless know that physicians cannot engage in advertising or other promotional selling activities. Therefore, patient choice is largely guided by local information. Furthermore, 95% of the Belgian population indicates having a regular GP which is conveniently located close to their home. The town might thus be as far as the sphere of influence for a GP reaches. For specialists on the other hand, it is generally believed that patients are willing to travel further, making the relevant geographic market of specialists larger (Ettinger 1998).

Belgium is made up of towns that are grouped into 586 municipalities, where the average municipality counts $17,590$ inhabitants. In this paper, we define the municipality as relevant geographic market for all physician types.[28] Allowing for differences in relevant market definition is subject of future research. For the empirical implementation of the model, we drop the big cities ($> 100,000$ inhabitants) from the dataset and concentrate on markets with at least one physician (of any type) active. This reduces the dataset to 576 Belgian municipalities.

Health providers

Privacy concerns limit the data availability on health care professionals to a location measure (= zip code). For general practitioners, we rely on a dataset of the Belgian Institute for Sickness and Invalidity Insurance (RIZIV/INAMI). From this dataset, we deduce the number of GPs that are truly active and available to the public (outside of hospitals). The selection of active and available GPs is based on their performance. As selection criterion we use a recent regulation (July 1st, 2006) which states that GPs will only remain certified if they have more than 500 visits in one of the last five years. From dialogue with RIZIV/INAMI, we add the restriction

[28] The relevant geographic market of a GP can be smaller than this, whereas the relevant geographic market of some specialist types can be larger. Working on an intermediate level (municipality) seems to be a good compromise. This definition is also in line with the empirical work on physicians in for example Baumgardner (1988) that works on US county level and Newhouse (1990) that uses the US towns as market definition.

that GPs should have at least 50 patients in one of the last five years.[29] We used data on the number of visits of all registered GPs from 2000 until 2004 to deduce the number of active GPs in the beginning of 2005. This procedure results in the identification of $11,842$ GPs. These GPs have on average $3,794.27$ contacts per year (s.d. $3,464$) and each serves on average 591.55 patients (s.d. 408).[30]

For specialists, a dataset from Dendrite Belgium gives the number of active specialists in Belgian zip codes according to their self-reported field of specialization in April 2005.[31] We opt to work with every location where a specialist is active. That is, we are not able to distinguish between the locations in terms of the time a specialist spends at certain offices. However, even if the specialist is only active in a local market for a small time period, he/she will still be available to patients and can thus be considered to interact with other health care providers.[32] We furthermore aggregate specialties as to come to a manageable and more or less homogenous group of specialist types and define three classes of specialists. First, there are those who are claiming a role in the first line care (WIV 2006). In this class, we identify dermatologists (der), gynecologists (gyn), pediatricians (ped) and ophthalmologists (opht). The second class of specialists are in principle concerned with second or third line care, but often have a private office outside the hospital. This class consists of psychiatrists (psych), throat, nose and ear-specialists (TNE) and physiotherapists (phys).[33] A third class of medical specialists is especially active in hospitals. Whereas internists (int) and surgeons (sur) are also available for private

[29] The basic selection rule corrects for non-specialists uniquely associated to a company and retired GPs that still treat their own family. As they are not open to the public, their impact on other GPs or specialists can be assumed away. The limitation with respect to the number of patients aims to filter out those GPs that only perform guard duty. They are excluded as they do not work within the same time frame as the genuine GPs, so that they cannot be considered genuine competitors.

[30] An official report of RIZIV/INAMI (03/07) indicates the presence of $11,799$ active GPs in 2005. We do not have the appropriate data to simulate their criteria exactly, although we are pretty close.

[31] There can be some difference between the official field of specialization, by their RIZIV-number or by the hospital they might work for, and the self-reported field of expertise. We choose to work with the self-reported fields as they probably capture the specialists' activities best. Furthermore, we do not use the field of 'general medicine', as it overlaps with the GP dataset. Note finally, that the RIZIV/INAMI dataset could not be used for specialists, as the home address is reported instead of the working address.

[32] An alternative is to work based on the preferred address of the specialist. We believe that this understates the availability of specialists as well as the effect its presence has on other physicians in the same markets. We furthermore restrict the sample of specialists to those who have finished their degree completely. In other words, we do not take up assistants, which however do treat people. As they are always connected to a specialist, we regard the entire work staff of the specialist as one. The presence of assistants however helps to justify the use of all the working addresses of specialists.

[33] Note that some of the specialist groups we use, are a groups of different specialists. For example, physiotherapists comprise both the specialists in sports health and in physiotherapy.

Table 4.1: Total and average number of physicians per municipality in Belgium, according to physician type for the sampled markets (nobs=576)

Physician type	**Total number of physicians**	**Average per market mean**	**(s.d.)**
GP	9,884	17.16	(16.76)
der	776	1.35	(3.24)
gyn	1,431	2.48	(7.06)
ped	1,082	1.88	(4.99)
opht	1,052	1.83	(4.14)
psych	1,924	3.34	(9.12)
TNE	708	1.23	(3.15)
phys	846	1.47	(2.75)
int	3,814	6.62	(19.77)
sur	2,700	4.69	(12.64)
hos	5,936	10.31	(28.48)

Source: own calculations based on RIZIV (2005) and Dendrite (2005).

consultations, there is no direct access to the remainder of the specialists. We consider them as one group which we name the 'hospital specialists' (hos). Our focus lies on the first and second class of specialists.

A count of the Belgian physicians according to their type in the sampled municipalities is presented in the first column of Table 4.1. We identify for example 776 dermatologist and 1,431 gynecologist offices in Belgium. The average number of physicians per type on municipality level is given in the second column of the table. There are on average 17 GPs active in the selected municipalities, with a large variance: the dataset consists of both markets with only 1 GP and with more than 100 active GPs. The average number of specialists lies a lot lower at between 1 and 3 specialists of each type per market. Many municipalities lack specific specialists: on average 57% of all municipalities does not hold a specialist type. This is especially the case for markets that do not have a hospital: for these 74% of the markets, there are on average only 0.7 specialists of a specific type active. Note though that only 19% of all municipalities have no specialist of any type. It is also clear from the data that there is a strong positive correlation between the numbers of physicians of each type in a market. For example, the number of GPs has the highest correlation with the number of dermatologists, with a correlation coefficient of 0.85 and the correlation between specialist types averages around 86%.

Market characteristics

To control for demand and cost characteristics in the different municipalities and for differences in the value of the outside option, we add a dataset with market characteristics for which the descriptive statistics are presented in Table 4.2. According to studies on health status and morbidity, the age, gender and ethnicity composition together with the socio-economic status of the service population are important indicators for the demand of GP care (Boerma 2003). We have information from the National Institute of Statistics (NIS) on the number of inhabitants (*pop*, in thousands) and the population density (*dens*). The dataset moreover includes variables indicating the age composition of the local population. We opt to work with seven age groups; '*age0_4*' gives the percentage population under the age of 5, '*age5_14*', '*age15_29*', '*age30_44*', '*age45_59*' and '*age60_75*' give the percentage population in the respective age groups and finally '*age75+*' gives the percentage elderly, defined as over the age of 75. Further market characteristics are the percentage female population (*female*), the mean income level measured in ten thousand euros (*income*), the unemployment rate (*unempl*) and the percentage of foreign population (*foreign*).

We also add other sources of health supply that can have an effect on the profitability of physicians. We control for the number of hospital beds in the municipality (*beds_hosp*) and the number of beds in retirement homes (*beds_rest*). Finally, we have dummy variables indicating in which of the 11 provinces/regions of Belgium the market is located, to identify common profitability shocks (or value of the outside option) across municipalities in the same area. Note already that our conclusions on the strategic interaction effects between physician types are robust against different grouping of age categories and against the use of region dummies and alternative measures related to hospitals.

4.4.2 Model implementation and Identification

We use the payoff specification as introduced in equation (4.1) in which both the market characteristics and the number of firms enter linearly (for computational reasons). Note that this implies that we assume that an extra entrant always has the same impact on payoffs, irrespec-

Table 4.2: Descriptive statistics of market characteristics (nobs=576)

Variable		**Mean**	**(s.d.)**
pop	number of inhabitants (x1,000)	15.01	(13.59)
dens	population density (x1,000)	0.50	(0.83)
age0_4	percentage under age of 5	0.06	(0.01)
age5_14	percentage in age category 5 − 14	0.13	(0.01)
age15_29	percentage in age category 15 − 29	0.18	(0.01)
age30_44	percentage in age category 30 − 44	0.23	(0.01)
age45_59	percentage in age category 45 − 59	0.20	(0.01)
age60_75	percentage in age category 60 − 75	0.14	(0.02)
age75+	percentage over age of 75	0.07	(0.01)
female	percentage female	0.51	(0.01)
foreign	percentage foreigners	0.05	(0.06)
income	mean income level (x10,000)	2.51	(0.37)
unempl	unemployment rate	0.05	(0.03)
beds_hosp	number of hospital beds (x100)	1.55	(4.18)
beds_rest	number of beds in retirement homes (x100)	1.85	(2.20)
Ant	province dummy for Antwerpen	0.12	(0.33)
Bru	region dummy for Brussels	0.03	(0.16)
VlB	province dummy for Vlaams-Brabant	0.11	(0.32)
Bwa	province dummy for Brabant wallon	0.05	(0.21)
WVl	province dummy for West-Vlaanderen	0.11	(0.31)
OVl	province dummy for Oost-Vlaanderen	0.11	(0.31)
Hai	province dummy for Hainaut	0.12	(0.32)
Lie	province dummy for Liege	0.14	(0.35)
Lim	province dummy for Limburg	0.07	(0.26)
Lux	province dummy for Luxembourg	0.08	(0.27)
Nam	province dummy for Namur	0.06	(0.25)

Source: NIS (2001), RIZIV (2005). See text for the definitions of the variables.

tive of the number of entrants that is already present in the market.[34] We allow for asymmetries both in magnitude and in sign, in the strategic interaction effects by estimating type-specific coefficients. Standard t-tests suffice to infer the nature of strategic interactions between Belgian physicians of different types. The market characteristics control for the demand of medical care and for the inherent profitability of the local market: we use the market characteristics discussed above in the analysis (section 4.4.1). Note that we use the age category $5 - 14$ and the region of Brussels as the baseline and that we have no exclusion restrictions: all market characteristics can affect the payoffs of all physician types.

We treat the model unobservables ($\varepsilon^m_{f,t}$) as realizations of a standard logistic distribution. Using this distributional assumption of the private information component of payoffs, we can specify the probabilities of observing n^m_t physicians of type t, defined in equations (4.3) and (4.6), as ordered logit expressions:[35]

$$\begin{cases} t = 1: & \Pr(N_1 = n^m_1) = \frac{\exp(E(\bar{\pi}_1(\mathbf{X}^m, n^m_1)))}{1+\exp(E(\bar{\pi}_1(\mathbf{X}^m, n^m_1)))} - \frac{\exp(E(\bar{\pi}_1(\mathbf{X}^m, n^m_1+1)))}{1+\exp(E(\bar{\pi}_1(\mathbf{X}^m, n^m_1+1)))} \\ t \neq 1: & \Pr\left(N_t = n^m_t | N_1\right) = \frac{\exp(\bar{\pi}_t(\mathbf{X}^m, n^m_t, N_1))}{1+\exp(\bar{\pi}_t(\mathbf{X}^m, n^m_t, N_1))} - \frac{\exp(\bar{\pi}_t(\mathbf{X}^m, n^m_t+1, N_1))}{1+\exp(\bar{\pi}_t(\mathbf{X}^m, n^m_t+1, N_1))} \end{cases}$$

These probabilities are used directly to form the likelihood function as specified in equation (4.7). Remark that GPs decide based on expected payoffs, where they anticipate the choice behavior of the different specialist types. Calculating these expected payoffs therefore implies computing the probability of observing any number of specialists of any type conditional on any possible number of GP entrants (equation 4.5).[36] For estimation, we reduce the dimensionality of the problem by limiting the number of physicians of each type to a maximum of 30 ($\forall t : \mathcal{F}_t =$

[34] Theoretically, one can estimate a more realistic pattern of effects, with e.g. fixed effects for all market structures. However, our dataset restricts the extent to which we can identify such parameters: we have few markets with a low number of GP entrants and a lot of markets with no specialist entrants. Our assumption furthermore contains the number of parameters to estimate.

[35] We can also estimate the model under the assumption that the unobservables are distributed according to a standard normal. This yields ordered probit expressions and our conclusions are robust against the distributional assumption.

[36] Note that the computational benefit of assuming GPs to move first lies here. In case the different specialist types were to decide first, each of them would have to anticipate on the choice behavior of the GPs, which condition on the entry decisions of all specialist types. As a result, one specialist type now has to take into account the choice behavior of all other specialist types.

30). With 87.5% of our markets containing less than 30 GPs and virtually all municipalities having less than 30 specialists of a specific type, this assumption is not restrictive.

Estimation of the model identifies the coefficients related to the market characteristics (β_t) and the coefficients related to the number of firms of own type and of the other types (α_t, γ_{tj}). All these coefficients are identified up to the scale of the error term. Furthermore, the effects of the other-type firms are not separately identified from possible correlation in the unobservables. The current framework does not allow for correlation in the realizations of the error terms.[37] Consequently, the finding of a positive (negative) interaction effect can be due to real complementarities (substitutability) between the professionals, but can also originate from a positive (negative) correlation in the market unobservables.[38] We follow two approaches to limit the related concerns: first, we correct for a lot of market characteristics, as to reduce the magnitude of the unobservables and second, we estimate the model while allowing for a high degree of firm heterogeneity in the market, which reduces the possible bias on the individual interaction effects in the GP payoff function.

Ideally, we would estimate a specification with a payoff function for all physician types separately. However, despite the reduction of computational burden due to the assumption of strategic independence between specialist types, we are still confronted with optimization problems (we have no exclusion restrictions). We therefore use the classes of specialists to reduce the number of firm types in the empirical model (see section 4.4.1). With our primary interest in the effect on GP payoffs of specialists of classes 1 and 2, we estimate the model twice. In the first estimation, we focus on the strategic interaction of the entry decisions of GPs and specialist types of class 1, while grouping the other specialist types by class. That is, we specify payoffs for seven physician types: GPs, dermatologists, gynecologists, pediatricians, ophthalmologists, class-2 specialists and class-3 specialists. The second estimation does the same but then considers the specialist types of class 2. Payoffs are defined for six types: GPs,

[37] Note that models of complete information in general do not alleviate this problem: whereas they do allow for correlation in strategic interaction effects, separate identification of the correlation coefficient from these effects is not straightforward and requires good instrumentation in the payoffs of all types (Athey & Stern 2003).

[38] Also note that the assumption implies no correlation between the unobservables of the same firm in two markets and no correlation between the unobservables of two same type firms in the same markets. Complete information models on the other hand assume there to be perfect correlation within type - the error term realization is market and type specific but not firm specific. The reality probably lies in between.

psychiatrists, TNE-specialists, physiologists, class-1 specialists and class-3 specialists. Note that the entry behavior of class-3 specialists is always included as an endogenous control variable in the identification of the strategic interaction effects of the other specialists.[39] Our conclusions seem to be robust against alternative groupings of specialist types.

4.5 Estimation Results and discussion

Tables 4.3 and 4.5 present the results of the estimation of the empirical entry model in which we focus on the first class of specialists, for the strategic interaction effects and the market characteristics respectively. The estimated coefficients for the specification with class-2 specialists are given in Tables 4.4 and 4.6. The different columns of the tables give the estimated coefficients for the different physician types of the simultaneous estimation.

As a goodness-of-fit measure, we simulate the number of entrants of all types given the market characteristics. That is, for $1,000$ random draws for the error terms (from a logistic distribution), we calculate the equilibrium number of entrants in each market. We are able to predict the number of entrants rather accurate: the observed number of entrants of all types always lies within the confidence bounds of the mean of our simulated number of entrants per market. Following Berry and Waldfogel (1999), we compute the correlation of the predicted and the actual number of entrants per type to construct a R^2 for the regression. For the estimation with the class-1 (class-2) specialist types, we get an average R^2 of 0.82 (0.84).[40]

First, consider the estimated coefficients for the strategic interaction effects in Tables 4.3 and 4.4. The estimation results indicate that the effect of the number of firms of the own type is always negative. The higher the number of same-type rivals, the lower payoffs of entering the market. This is both consistent with economic theory and required by the equilibrium model we put forward. For the effect of the number of firms of the other types, the results are

[39] Remark that we make the simplifying assumption that all specialist types of the same class are homogeneous. This implies that the entry of e.g. an internist has the same impact on internists' payoffs as the entry of a surgeon does. As we are not primarily interested in this group, we allow for this stringent assumption to lighten further computational burden.

[40] Note that the estimation with the focus on the class-2 specialists yields a very high predictive power for GPs with a type-specific R^2 of 0.93. The estimation with the class-1 specialists does worse in predicting the number of GP entrants (R^2=0.67), but the predictive power for the specialist types remains accurate.

Table 4.3: Estimation results on the strategic interaction effects of the empirical model with seven types: GPs, dermatologists (der), gynecologists (gen), pediatricians (ped), ophthalmologists (opht), class-2 specialists (class2) and class-3 specialists (class3)*

	GP	**der**	**gyn**	**ped**	**opht**	**class2**	**class3**
N_GP	**−1.252**	**0.042**	**0.048**	**0.068**	**0.083**	*0.047*	0.055
	(0.13)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.05)
N_der	*−68.185*	**−0.982**	–	–	–	–	–
	(39.04)	(0.06)					
N_gyn	**57.928**	–	**−0.580**	–	–	–	–
	(21.05)		(0.03)				
N_ped	*−40.435*	–	–	**−0.759**	–	–	–
	(21.10)			(0.04)			
N_opht	**31.617**	–	–	–	**−0.904**	–	–
	(16.64)				(0.06)		
N_class2	**−5.787**	–	–	–	–	**−0.541**	–
	(1.85)					(0.03)	
N_class3	−0.054	–	–	–	–	–	**−0.265**
	(0.10)						(0.01)

* Each column gives the estimated coefficients of the effect of the number of physicians of the different types (rows) on the payoffs of a physician type. Standard errors are reported within brackets. Class 2 groups all psychiatrists, TNE-specialists and physiologists together, while class 3 groups internists, surgeons and hospital specialists. The associated estimated coefficients for the market controls are presented in Table 4.5.

Table 4.4: Estimation results on the strategic interaction effects of the empirical model with six types: GPs, psychiatrists (psych), throat-, nose- and ear specialists (TNE), physiologists (phys), class-1 specialists (class1) and class-3 specialists (class3)*

	GP	**psych**	**TNE**	**phys**	**class1**	**class3**
N_GP	$-$**0.933**	**0.067**	**0.081**	0.039	0.013	0.074
	(0.07)	(0.03)	(0.02)	(0.03)	(0.04)	(0.05)
N_phys	$-$0.148	$-$**0.575**	–	–	–	–
	(0.65)	(0.03)				
N_TNE	**4.437**	–	$-$**0.841**	–	–	–
	(1.32)		(0.06)			
N_phys	-0.600	–	–	$-$**0.986**	–	–
	(0.90)			(0.06)		
N_class1	$-$**1.056**	–	–	–	$-$**0.430**	–
	(0.39)				(0.03)	
N_class3	0.152	–	–	–	–	$-$**0.263**
	(0.07)					(0.02)

* Each column gives the estimated coefficients of the effect of the number of physicians of the different types (rows) on the payoffs of a physician type. Standard errors are reported within brackets. Class 1 groups all dermatologists, gynecologists, pediatricians and ophthalmologists together, while class 3 groups internists, surgeons and hospital specialists. The associated estimated coefficients for the market controls are presented in Table 4.6.

mixed. First, the number of GPs in the market positively affects payoffs of all specialist types (insignificant for physiologists). This can be explained by the lower workload of referred visits compared to self-referrals. That is, when a patient is referred by a GP, basic tests have been performed and the specialist can directly target the established health issues. A self-referral in contrast requires the specialist to spend more time and to perform more tests before he can pin down the real issue.

The strategic interaction effects in the GP payoff function on the other hand have varying signs. GP payoffs are positively affected by the number of gynecologists, ophthalmologists and TNE-specialists in the market. In other words, the benefits for GPs from the ability to refer outweigh the costs associated with the free access to these specialist types. Patients that require the care of these specialists thus mainly access secondary care through the GP (high referral effect) or correctly self-refer (low competition effect). The number of dermatologists and pediatricians however has a negative impact on GP probability of entry. The costs due to the competition for patients here outweigh the referral benefits. A high proportion of the patients that use these types of secondary care services thus visit specialists without a referral while not necessarily requiring it (high competition effect). Finally, we find no significant effect of the presence of psychiatrists and physiologists on GP payoffs. For Belgium, we can thus conclude that the use of gynecologists', ophthalmologists' and TNE-specialists' services can be considered as complementary to GP services, whereas the use of dermatologists' and pediatricians' services are mainly substitutes to GP services.

The results from the Belgian health survey (WIV 2006) can help explain this grouping. This survey indicates pediatricians and dermatologists as the two specialist types that generate the lowest percentage of follow-up contacts (62% and 56% respectively). Therefore, a large part of their income depends on the new visits for which they can compete with GPs. The survey also identifies these specialist types as attracting the highest percentage of patients that self-refer (73% and 68%). For gynecologists and ophthalmologist on the other hand, the survey indicates that the percentage of follow-up contacts is high (82% and 73%), which implies fewer incentives to compete directly with GPs.

To illustrate the meaning of the magnitudes of the estimated strategic interaction effects, we simulate the predicted change in the number of GP entrants due to changes in the number of a specialist type under the current behavior of patients, GPs and specialists. The results of such simulation are especially relevant in the direction of the change that they indicate and no so much in the magnitude of this change.[41] For 1,000 random draws for the error terms (from a logistic distribution), we calculate the equilibrium number of GP entrants in each market given 0, 1, 2 or 3 specialists of a type, holding market characteristics and the observed number of entrants of other types constant.[42] For dermatologists (pediatricians), we find that the equilibrium number of GP entrants decreases in the presence of more of these specialists. More specifically, the average market sustains 15.85 (15.15) GPs in the absence of dermatologists (pediatricians), while this decreases to an average of 8.24 (9.46) GPs when there is 1 of these specialists present in all markets and to 4.80 (6.06) GPs when every market holds 3 dermatologists (pediatricians). For e.g. gynecologists (TNE-specialists) the predictions go in the opposite direction as GPs benefit from the presence of these specialist types. Whereas the average market sustains 5.14 (10.28) GPs in the absence of gynecologists (TNE-specialists), the average number of GPs increases (non significantly) to 18.73 (14.68) when there is 1 of these specialists present in all markets and to 24.31 (23.12) GPs when every market holds 3 gynecologists (TNE-specialists).

The findings on the nature of the strategic interaction effects have further relevance for policy makers. When a mandatory referral scheme would be introduced in Belgium (or in case the price difference between referrals and self-referrals for specialist visits are sufficient to induce a comparable change in behavior by patients), the market opportunities of all health professionals change. The main effect of this is to be expected for dermatologists and pediatricians. That is, these specialist types now realize a substantial part of their business (income) from

[41] We assume in the estimation that the effects of the number of firms of any type is linear. This implies that the effect of the first specialist-entrant has the same impact on GP payoffs as the entry of the third entrant of the same type. This might not be entirely realistic, but reduces the computational burden in the estimation to a significant extent. Also, we assume the behavior of all players to be constant over the different scenarios: obviously this is a strong assumption. Put differently, in a small market with e.g. 1 GP we simulate the impact on his profitability of entry of an entry by various numbers of specialist entrants, even though this could not realize in reality as the population size does not allow for any specialist to enter.

[42] Note first that the status-quo prediction of the average number of GPs in a market is rather accurate for the estimation of the class-2 specialists: in the presence of the observed number of entrants of all types, the average equals 13.28, with the observed average, after we reduce the maximum number of entrants per market to 30 for estimation, equals 14.49. The average number of GP entrants per market under the observed number of specialists in the estimation on the class-1 specialist types does worse with 7.67, but a large standard deviation.

unnecessary self-referrals. Since this patient flow gets diverted to GPs upon the introduction of gatekeeping, substantial drops in patientele are likely. Since patients that use gynecologist, ophthalmologist and TNE-care mainly get referred to specialists or correctly self-refer, the main source of profitability is expected to remain intact for these health professionals.

An important remark is in place. In the analysis, we estimate the net effect of the presence of specialist types on GP payoffs. Therefore, the finding of a positive effect only implies that the referral effect dominates the competition effect. It can thus be the case that the competition effect is very big, but that the referral effect is slightly more important. In this case of course, a substantial impact of the introduction of gatekeeping is to be expected as well. That is, still a large proportion of the patientele (and the income) of the specialist type results from wrong self-referrals. Whereas dermatologists and pediatricians are expected to experience the largest drop in market demand, the other specialist types will also be affected to some extent by the introduction of mandatory referral schemes. We thus identify the 'lower bound' of the effect.

Consider for completeness the estimation results of the effects of market characteristics on the entry probabilities of the physician types in Tables 4.5 and 4.6. Caution is to be advised in the interpretation of these results: our controls for market demand, costs and outside option are aggregate and exhibit a strong colinearity. In general though, we find that GP payoffs of entering a market are positively affected by population size. The bigger the potential market, the more profitable and thus probable is entry of a GP. Some less significant effects are found for the income level of the population and the presence of hospitals (only in one of the specifications). The finding of the positive effect of mean income level is unexpected. That is, most studies find a negative impact: a lower income also indicates a lower health status and mostly a lower use of specialist care. Also the positive impact of the number of hospital beds might be surprising as emergency rooms of hospitals are often used as an alternative for GP care in the weekend or at night (although the regulator tries to limit this). Note though that we also control for the number of specialists in these hospitals, which makes a clean interpretation hard. Other demographic characteristics seem not to matter for GP payoffs, once the presence of specialist types is accounted for.

The effects of market characteristics show similar patterns for the different specialist types. Market size (population) and the presence and size of hospitals are important indicators for the profitability of any specialist: the higher the number of inhabitants (except for psychiatrists) and the higher the number of hospital beds, the higher the probability of observing more specialists of any type. For most types, the age structure of the population also has an effect. With the baseline the percentage of kids ($5 - 14$), the percentage of toddlers ($0 - 4$) and the percentage population in the $45 - 59$ age category lower the payoffs of entry of (gynecologists), pediatricians and ophtamologists. On the other hand, entry payoffs of most specialist types are positively affected by the percentage population in the $15 - 29$ age group. The results seem not to be very intuitive in all cases, but should be taken into context. Consider e.g. pediatrician payoffs is negatively affected by the percentage toddlers. The estimation controls for a lot of other characteristics of the market. Therefore, this coefficient has the interpretation of the residual effect of the percentage toddlers, conditioned on e.g. the percentage of females in the market and conditional on the percentage of young adults. As expected, the percentage females and the mean income level positively affect the payoffs of especially the class-1 specialists. The unemployment rate of the population negatively affects especially pediatricians. Finally, the province/region dummies are all estimated negatively, which can indicate a low value of the outside option for health professionals in the Brussels region. These dummies are however not significant for the GP and for class-3 specialists.

Table 4.5: Estimation results on the market characteristics of the empirical model with seven types: GPs, dermatologists (der), gynecologists (gyn), pediatricians (ped), ophthalmologist (opht), class-2 specialists (class2) and class-3 specialists (class3)*

	GP		**der**		**gyn**		**ped**		**opht**		**class2**		**class3**	
pop	1.39	(0.21)	0.10	(0.02)	0.08	(0.01)	0.06	(0.02)	0.07	(0.02)	0.11	(0.03)	0.14	(0.04)
dens	0.11	(1.44)	0.04	(0.15)	0.28	(0.12)	0.17	(0.17)	-0.31	(0.20)	0.45	(0.23)	0.24	(0.44)
age0_4	-34.87	(75.2)	-23.86	(17.02)	-32.67	(16.5)	-44.65	(20.2)	-38.53	(18.4)	-44.33	(18.1)	-4.27	(37.1)
age15_29	28.40	(47.8)	31.20	(8.42)	45.39	(9.00)	55.89	(11.0)	25.95	(9.81)	26.89	(8.65)	22.44	(19.3)
age30_44	-5.56	(36.2)	-4.94	(7.02)	-6.12	(6.58)	-8.24	(8.66)	-5.94	(8.46)	-3.24	(9.45)	-0.16	(15.0)
age45_59	-2.15	(36.0)	-13.10	(7.29)	-11.58	(6.63)	-18.14	(8.19)	-20.00	(7.96)	-5.05	(8.42)	0.43	(16.2)
age60_75	-51.45	(34.5)	13.12	(8.05)	7.26	(7.46)	9.57	(9.94)	9.47	(9.82)	-26.26	(9.45)	8.53	(17.3)
age75+	38.52	(38.6)	-1.01	(9.26)	11.01	(9.49)	15.48	(11.8)	-0.94	(10.6)	19.23	(11.0)	24.25	(21.0)
female	27.58	(56.5)	33.33	(11.2)	39.20	(9.90)	39.48	(12.1)	26.58	(12.4)	30.21	(14.5)	38.24	(26.2)
foreign	-6.04	(4.92)	0.64	(1.25)	-0.96	(1.35)	-2.05	(1.65)	0.34	(1.61)	-1.44	(2.09)	-3.12	(3.90)
income	2.68	(1.66)	0.73	(0.31)	0.87	(0.29)	0.97	(0.37)	0.61	(0.35)	0.59	(0.40)	0.53	(0.74)
unempl	14.94	(21.2)	1.04	(4.52)	-8.16	(4.73)	-13.32	(5.66)	1.15	(5.70)	-7.05	(5.88)	-5.59	(11.5)
beds_hosp	4.63	(1.64)	0.32	(0.04)	0.33	(0.03)	0.40	(0.04)	0.47	(0.04)	0.97	(0.06)	1.58	(0.10)
beds_rest	-0.24	(0.49)	-0.02	(0.05)	0.04	(0.05)	0.08	(0.07)	-0.05	(0.07)	-0.07	(0.09)	0.01	(0.18)
constant	3.06	(111)	-21.31	(8.30)	-25.96	(7.54)	-24.18	(9.43)	-11.32	(8.98)	-12.32	(10.1)	-27.34	(17.9)

* Each column gives the estimated coefficients of the market characteristics (rows) on the payoffs of a physician type. Standard errors are reported within brackets. Class 2 groups all psychiatrists, TNE-specialists and physiologists together, while class 3 groups internists, surgeons and hospital specialists. The estimated coefficients of the strategic interaction effects are reported in Table 4.3. The estimation procedure furthermore controlled for province/region dummies. These are all estimated negative (the Brussels region is the baseline), but are not significant for class-3 specialists and for GPs.

Table 4.6: Estimation results on the market characteristics of the empirical model with 6 types: GPs, psychiatrists (psych), throat-, nose- and ear specialists (TNE), physiologists (phys), class 1 specialists (class1) and class 3 specialists (class3)*

	GP		**psych**		**TNE**		**phys**		**class1**		**class3**	
pop	1.03	(0.10)	0.02	(0.02)	0.05	(0.02)	0.08	(0.02)	0.19	(0.03)	0.13	(0.04)
dens	-1.45	(0.66)	0.34	(0.34)	0.37	(0.19)	-0.07	(0.25)	0.02	(0.32)	0.19	(0.41)
age0_4	-41.13	(45.5)	-12.46	(32.0)	-29.99	(26.6)	-46.36	(31.7)	-35.39	(30.8)	1.59	(33.7)
age15_29	48.56	(25.6)	26.96	(16.9)	21.39	(11.6)	55.63	(16.6)	37.60	(15.7)	27.13	(19.1)
age30_44	0.16	(24.1)	-2.60	(17.7)	-12.59	(11.1)	21.55	(16.0)	-17.55	(15.5)	6.18	(18.0)
age45_59	-21.45	(20.8)	6.88	(17.5)	-1.92	(11.9)	4.00	(15.4)	-23.13	(14.1)	3.47	(16.0)
age60_75	15.83	(19.9)	-6.01	(17.0)	-10.63	(12.7)	2.92	(16.7)	2.24	(14.9)	-11.83	(16.2)
age75+	19.55	(25.8)	20.28	(20.7)	3.14	(15.7)	26.54	(22.3)	-5.33	(18.8)	27.42	(21.6)
female	51.55	(33.4)	3.60	(21.1)	53.87	(20.4)	43.75	(22.9)	70.57	(22.8)	40.54	(27.8)
foreign	-5.80	(3.10)	-0.26	(3.38)	-1.41	(2.09)	0.36	(3.25)	-1.00	(2.22)	-2.39	(3.82)
income	2.53	(1.04)	0.45	(0.60)	0.68	(0.39)	0.44	(0.64)	0.68	(0.58)	0.50	(0.74)
unempl	13.66	(12.3)	-12.82	(10.4)	-11.88	(7.14)	7.20	(9.56)	-16.95	(8.47)	-4.67	(11.4)
beds_hosp	0.32	(0.56)	0.67	(0.03)	0.32	(0.05)	0.35	(0.05)	0.74	(0.07)	1.54	(0.10)
beds_rest	0.01	(0.28)	0.11	(0.11)	0.04	(0.08)	-0.25	(0.09)	0.06	(0.12)	0.01	(0.19)
constant	-31.20	(25.0)	-6.65	(17.2)	-27.6	(14.2)	-39.49	(17.2)	-30.38	(16.4)	-32.86	(18.9)

* Each column gives the estimated coefficients of the market characteristics (rows) on the payoffs of a physician type. Standard errors are reported within brackets. Class 1 groups all dermatologists, gynecologists, pediatricians and ophthalmologists together, while class 3 groups internists, surgeons and hospital specialists. The estimated coefficients of the strategic interaction effects are reported in Table 4.4. The estimation procedure furthermore controlled for province/region dummies. These are all estimated negative (the Brussels region is the baseline), but only significantly negative for the class-1 specialists and for psychiatrists and TNE-specialists.

4.6 Conclusion

This paper investigates the nature of the strategic interactions between general practitioners and specialists of different types. More precisely, we study whether GPs benefit from the presence of a specialist due to the option of referral, or that rather the competition effect a GP experiences from specialists dominates their interaction. The entry literature lends itself nicely for studying health care markets, as data availability is often an issue. We put forward a sequential incomplete information entry game that has the flexibility to identify the sign of the strategic interaction effects between different types of firms. The model is designed to avoid restrictions on the underlying payoff functions with respect to the effect of other-type firms and to avoid issues of non-existence of equilibria in case the strategic interaction effects are asymmetric in sign. At the same time, the model remains computationally tractable and allows for sufficient firm heterogeneity. We use this game to study the strategic interactions in the Belgian physician markets, in which there is no gatekeeping role for GPs.

Whereas the entry literature has traditionally focused on questions of product differentiation, this paper demonstrates the use of entry models to tackle a different type of research question. That is, we study the precise nature of the strategic interactions between different types of firms. Although the entry literature has boomed in the last five years, not much attention has been given to this problem. Because of the tradition of studying problems of product differentiation, the assumption of types being strategic substitutes in the entry decision is ubiquitous. Often the strategic interactions between types of firms are however not this simple: even though the competition effect is most obvious, at least some positive effect from the presence of other-type firms are likely (think of e.g. agglomeration effects, Vitorino 2007). When modeling the strategic interactions between types of firms, it is therefore advisable to allow for the possibility that this positive effect is present and possibly dominates the negative effect. To model and estimate firm conduct while allowing for these more flexible interactions between firm types requires the researcher to abandon either the pure strategy equilibrium assumption or the assumption of complete information, with the latter strategy demonstrated in this paper.

For the Belgian physician markets, the results indicate that we can group specialists into three categories. First, the decisions of certain specialist types are strategic complements to the entry decision of GPs. This category includes gynecologists, ophthalmologists and throat, nose and ear-specialists (TNE). As GP payoffs are increasing in the number of specialists of these types, we find that the competition effect (patients go to the specialist instead of to the GP) is dominated by the referral effect (GPs' cost of treatment drop). Patients are especially referred to these specialist types or correctly self-refer to them. A second group of specialists consists of dermatologists and pediatricians, whose entry decisions are found to be strategic substitutes in the entry decision of GPs. These specialist types especially compete for patients with GPs. Self-referred visits make up a significant part of the income of these specialists and often concern health issues that do not require specialist care. The availability of a third group of specialist services has no significant impact on GP payoffs. That is, the positive referral effect balances out against the negative competition effect for psychiatrists and physiologists. On the other hand, specialists of all types benefit from the presence of GPs in the market.

As there is no gatekeeping in Belgium, the sign of the strategic interaction effects of specialist types on GPs' entry decisions is furthermore instructive for the likelihood of viability threats upon the introduction of gatekeeping into the care system. As the mandatory referral scheme excludes the possibility for patients to self-refer to a specialist, our findings suggest that mainly dermatologists and pediatricians are likely to be threatened in their viability with the introduction of gatekeeping. This is especially the case when gatekeeping is gradually introduced as in the case in Belgium and neighboring countries. That is, in case a mandatory referral scheme is implemented without the accompanying capitation system, the income level of specialists is directly affected. Furthermore, because of this, specialists have incentives to (start to) induce more demand for their services as to maintain their income level. The anticipated benefits in terms of cost containment would then not realize. Remark that data from RIZIV/INAMI on the number of contacts per GP for 2000-2004 indicates that the average workload of GPs has dropped over this time period: the average GP used to have $4,025.25$ contacts per year (s.d. $2,587$), whereas this average dropped to $3,794.27$ contacts per year in 2004 (s.d. $3,464$). The drop in the average contacts per year goes hand in hand with a drop in the average GP income level. We therefore expect that in a first reaction to the introduction of a mandatory referral scheme, GPs will experience the opportunity to restore their income level (in the current fee-for-service system). GPs will therefore have no incentives to redirect as many patients as possible to specialized care, so that the realization of substantial income drops for certain types of specialists is likely, at least in the medium run.

In case the mandatory referral scheme is combined with a capitation system, comparable problems emerge. To ensure viability, the fixed fee per patient enrolled with a specialist will have to be set high, both in absolute terms and compared to the capitation for the GP, as the number of patients per specialist will be relatively low. From a budget perspective, this will not be maintainable. In case the regulator puts a more realistic fixed fee for specialists, a proportion of the health professionals will experience viability problems and the transition costs will materialize. Note that the only way viability issues would not emerge is when GPs do not get the correct incentives. That is, in case GPs minimize their effort level and always refer patients to specialists, the current body of specialists can be sustained.

4.7 Appendix

Figure 4-1: Empirical entry game under complete information and simultaneous decision making (2 firms).
Panel A represents the mapping in case payoffs of both firms are decreasing in the presence of the other firm (strategic substitutes), panel B assumes strategic complementarity in the entry decisions for both firms and panel C represents the case with asymmetric strategic interaction effects (in sign): the decision of firm 2 is a strategic substitute for the decision of firm 1, while firm 1's decision is a strategic complement to the decision of firm 2.

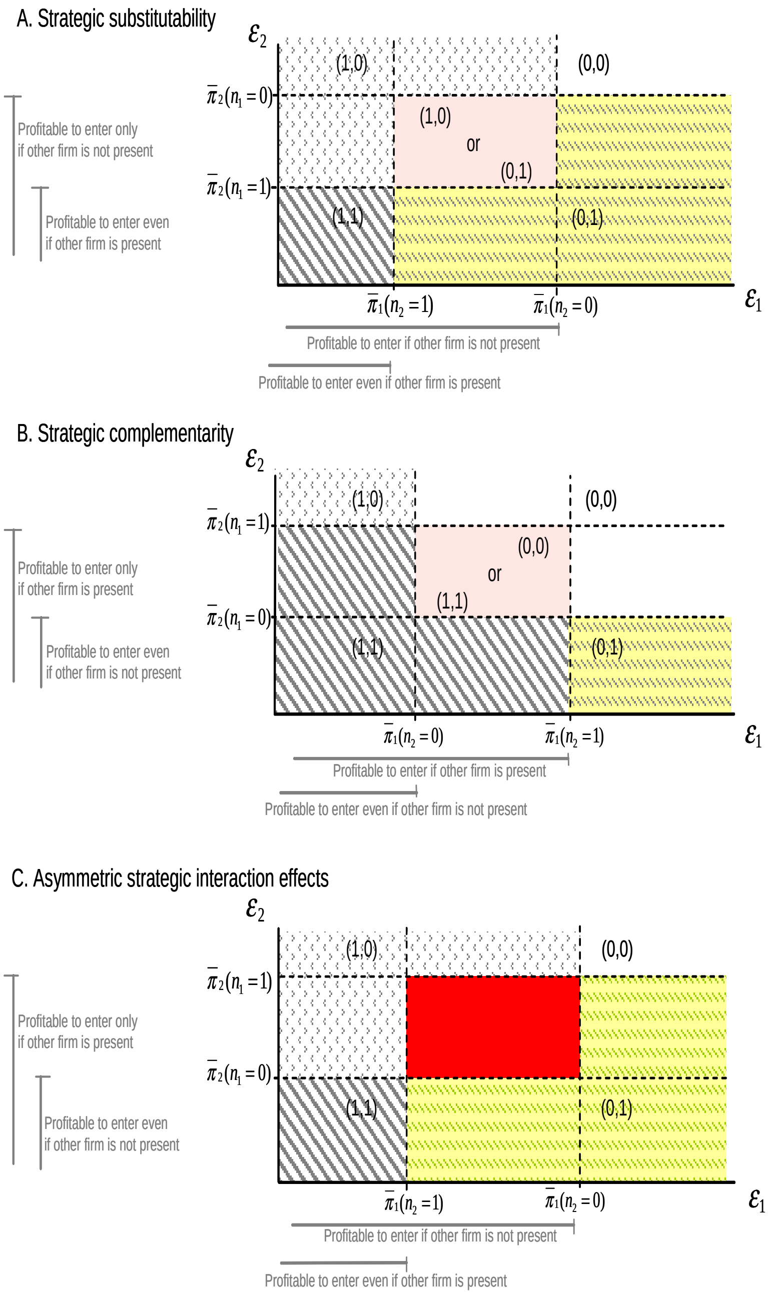


Figure 4-2: Empirical entry game under incomplete information and simultaneous decision making (2 firms)

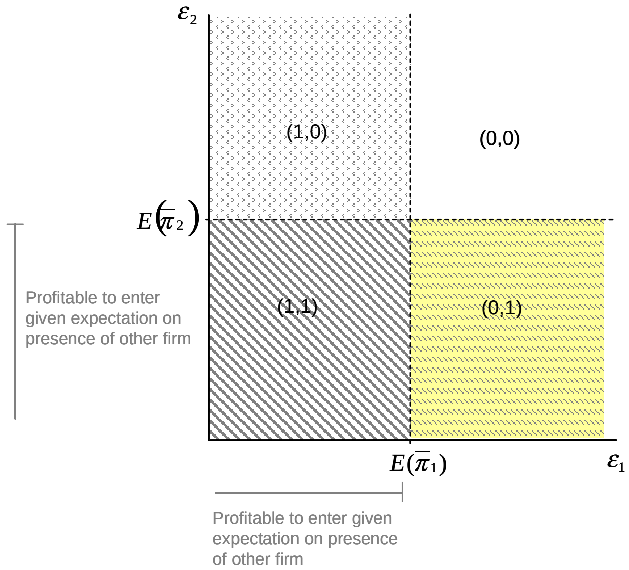
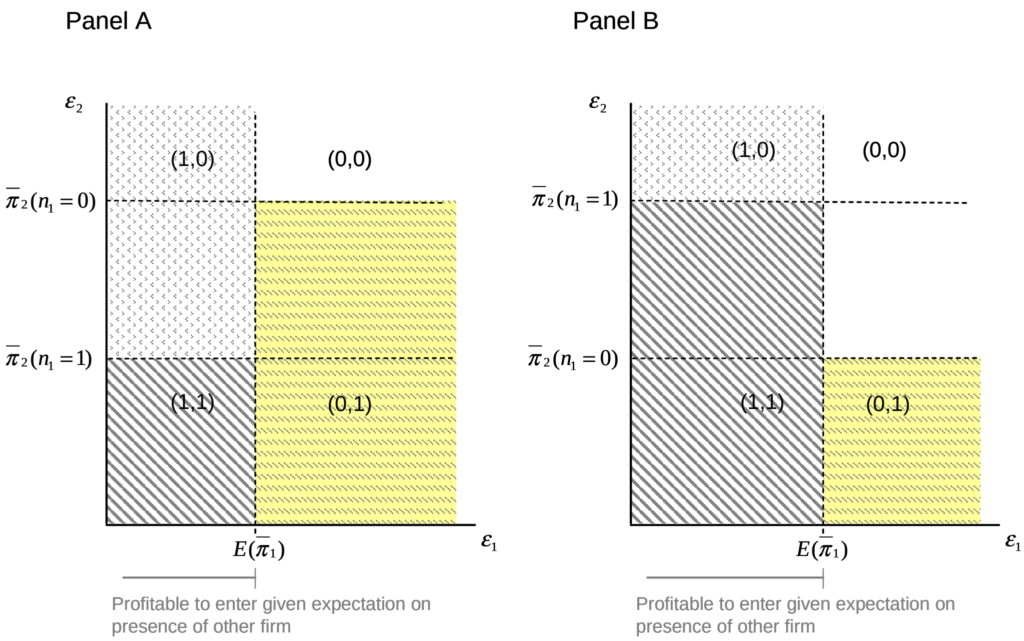


Figure 4-3: Empirical entry game under incomplete information and sequential decision making (firm 1 decides first).
Panel A represents the mapping when the entry decision of firm 1 is a strategic substitute in the entry decision of firm 2, whereas panel B assumes payoffs of entry for firm 2 are increasing in the presence of firm 1 (strategic complement).



Chapter 5

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