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Price competition in health care

An empirical analysis of Swedish dental care

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Abstract

This paper studies the effect of competition on prices on a health care market where prices are market determined; the Swedish market for dental care. The paper adds to the literature by addressing the empirical challenge of identifying the effect of competition on prices. The empirical strategy exploits that the effect of competition differs across services, depending on the characteristics of the service. Price competition is theoretically more intense for services such as examinations and diagnostics (first-stage services), compared to more complicated and unusual treatments (follow-on services). This is because consumers are better informed and thus more price sensitive with respect to first-stage services and face costs for switching once they have chosen a provider. By exploiting this difference, I identify a relative effect of competition on prices. The results suggest small but statistically significant negative effects on prices for first-stage services relative to follow-on services. A 1% increase in competition from one year to the next is followed by an increase in the price difference in the range 0.0089% to 0.017%. These are short-term effects and provide evidence of strategic behavior of clinics. Hence, substantial effects of competition on prices over time cannot be ruled out. Policy simulations suggest that the absolute effect of competition on prices is in the range -0.01% to -0.09%. Thus, the policy simulations suggest that there is room for price decreases in the Swedish market for dental care and that increased competition would be welfare enhancing.

Keywords: Competition, Firm Behavior, Pricing, Switching Costs, Asymmetric Information, Health Care, Dental Care.

Contents

1 Introduction

Many OECD countries have undertaken market-oriented health care reforms over the past decades (Gaynor, 2012). Some reforms has been motivated as a way of increasing consumer choice, while others as a means of cost control. Introducing market mechanisms into the provision of health care is assumed to facilitate cost control, by strengthening incentives for providers to become more efficient (Docteur and Oxley, 2003). At the same time, it is often argued that the special features of health care have implications for the scope for competition.[1] The development towards market-oriented reforms therefore raises questions about when and how competition works on health care markets.

In this paper, I study the effect of competition on prices in a setting where patients have a substantial cost share (on average about 80%) and prices for health care services are market determined, namely the Swedish market for dental care.

One of the main challenges of the empirical literature on competition in health care is to identify the effect of competition on prices (Gaynor and Town, 2011). The challenge stems from the endogeneity of market structure, i.e. that the market structure depends on factors that also affects prices. If not treated properly, this will yield biased estimates of the effects of competition on prices. This paper adds to the existing empirical literature by suggesting a strategy for identifying the effect of competition on prices, which is grounded in the theoretical literature on competition in health care. Identification is achieved by exploiting that competition theoretically has different effects on prices for different types of services due to differences in consumers' price sensitivity.

The theoretical starting point for the identification strategy is recognizing health care as a multiproduct industry. Following Pauly (1978), the products can be categorized roughly as being either "informative" or "active-therapeutic", where consumption of the former precedes and determines demand for the latter. Consumption can thus be viewed as taking place in two stages.

The first – informative – stage consists of examinations and diagnostics (first-stage services) and the second – therapeutic – stage consists of any subsequent treatments (follow-on services). In general, the same seller provides both kinds of services. Consumers are on average better informed about services in the first stage, as they are consumed with some frequency and are uncomplicated. Consequently, demand is more price

[1] Arrow (1963) argues that the medical industry differs sharply from the standard competitive model and that medical care cannot be understood as other "economics textbook commodities". This view has been differentiated by e.g. Pauly (1978; 1988) and Shleifer (1998). The special features of health care markets are also discussed in Dranove and Satterthwaite (2000).

sensitive for first-stage services compared to follow-on services (Dranove and Satterthwaite, 1992; Pauly, 1978). Moreover, consumers who want to switch to a different provider in the second stage will face costs, e.g. transaction costs for transferring medical records and search costs for finding a new provider. This makes demand relatively less price sensitive in the second stage compared to the first stage. In addition, switching costs make new consumers valuable from the perspective of the seller, because of their future purchases (Farrell and Klemperer, 2007; Klemperer, 1995). These arguments all suggests that sellers on health care markets where prices are market determined will compete in prices for first-stage services, whereas price competition is less fierce for follow-on services. This difference is exploited in the empirical strategy to identify the relative effect of competition on prices for first-stage services relative to follow-on services. The identification can be understood analogously to a difference-in-differences framework. Prices for both kinds of services are effected by competition, but the magnitude of the effects should, theoretically, differ across services. Focusing on the difference between the effects across services allows identification as the differencing controls for the unobserved factors that are correlated with both competition and prices.

Another important contribution to the literature is that the data used in this paper comes from administrative registers covering all dental care consumed by adults in Sweden during the years 2008–2011. This is a major improvement over the existing literature that mainly relies on imperfect price measures and markets defined by geopolitical boarders that do not necessarily delineate the actual market (Dranove and Satterthwaite, 2000). In Sweden, prices for dental care are set freely by providers as opposed to negotiated by insurance plans (as in the US setting) or being regulated. I use the actual price charged by the dentist for each service rather than constructed price measures commonly used in the existing literature. Furthermore, the data contains the coordinates of each clinic's location. Competition is defined as the number of clinics located within a fixed distance from each clinic.

Finally, by exploiting auxiliary data on the pricing of services, I perform policy relevant simulations to assess the absolute effects of competition on prices. The simulations build on the assumption that prices for follow-on services can be expressed as a function of prices for first-stage prices. The assumption reflects that sellers are relatively more constrained by competition in their price setting of first-stage services and therefore may recoup foregone profits with high prices for the follow-on services.

The reduced form results show small but statistically significant effects of competition on prices for first-stage services relative to follow-on services. Competition is measured as the number of clinics within a fixed distance from each clinic. The main results suggest that a 1% increase in the number of clinics is followed by a 0.0089% decrease in prices for basic examination and diagnostics relative to tooth extractions. The results are robust across analyses of different kinds of services and model specifications. The effects are small, but should be interpreted as short-term effects of increased competition. Consequently, substantial effects of competition on prices over time cannot be ruled out.

The simulation results suggest that a 1% increase in competition is followed by a decrease in the price for first-stage services in the range 0.02% to 0.09%. Relating this to the number of times the first-stage services are performed on average during a year, the effects corresponds to a redistribution from providers to patients of 336,000 SEK and 431,000 SEK respectively. The price decrease for follow-on services fall in the range 0.01% to 0.07%, corresponding to a redistribution from providers to patients in the range 282,000 SEK to 1.9 million SEK. Moreover, an increase of one extra clinic within 1 kilometer would decrease prices by up to 0.56% for the first-stage services and up 0.46% for follow-on services. Thus, the policy simulations suggest that there is room for price decreases. This implies that prices on the Swedish dental care market are set above the competitive level and that increased competition would increase consumer welfare by lowering prices.

The remainder of the paper is structured as follows: section 2 gives a background to the empirical literature on competition in health care. Section 3 gives a theoretical background to the empirical strategy. Section 4 gives an overview of dental care in Sweden and the data, section 5 describes the empirical strategy and, section 6 presents the results, a set of robustness tests and policy simulations. In section 7, I conclude.

2 Competition in health care

There has been a rapid and steady growth in health care spending during the past century throughout all OECD countries.[2] In the 1960s and 1970s, government efforts to control costs were aimed at the macro level, i.e. by rationing through regulation of prices and volumes. However, during the 1980's the focus of cost containment policies started shifting towards the micro level, i.e. by encouraging more efficient provision rather than cuts in entitlements (Docteur and Oxley, 2003). Markets therefore play an important role today in the provision of health care services.[3] Prices, qualities[4] and quantities are thus set through interactions in the market place between providers and payers (Gaynor and Town, 2011). Consequently, there is an increasing literature on the industrial organization of health care.

2.1 Empirical literature on price competition

The most active area in the literature on competition in health care is focused on hospital competition in the United States, more precisely the relationship between hospital concentration and prices. The recent empirical literature is surveyed in Gaynor and Town (2011) and general finding is that prices on average are higher on hospital markets with little competition.[5] However, as discussed by Capps and Dranove (2004) and Gaynor and Town (2011), there are caveats with the existing literature and the results should therefore be interpreted with some caution.

Firstly, the price variables are often constructed aggregated measures and not actual transaction prices.[6] This may be especially problematic in the US setting, where prices are set in complicated hospital-insurer contracts (Gaynor and Town, 2011) and public and private payers pay different prices for the same services (Dranove et al., 1993). Without the possibility to control for these differences, the results may be misleading.

[2] Several explanations to the health care spending growth has been put forth in the literature, the most common being technological change combined with increased coverage (Chernew and Newhouse, 2011).
[3] The US has the longest experience of competition in health care. Market-oriented reforms has been implemented or are considered in the U.K., Sweden, France, Germany and the Netherlands (Gaynor, 2012).
[4] Quality is here referred to as any non-price attributes.
[5] Similar results are found in earlier reduced form studies (e.g. Dranove et al., 1993; Noether, 1988).
[6] See for example Capps and Dranove (2004); Dranove et al. (1993); Noether (1988); Thompson (2011).

Secondly, a common approach has been to use zip-codes to create measures of concentration or delineating markets by geopolitical boarders (Dranove and Satterthwaite, 2000). Failing to take the actual distance between providers into account may lead to either defining the market as too narrow or too wide.[7]

Thirdly, the endogeneity of market structure needs to be addressed explicitly in order to estimate a causal effect of competition on prices.[8] Concerns about the endogeneity are common to *all* empirical approaches to estimate the effect of concentration on prices (Gaynor and Town, 2011). Attempts have been made to mitigate these concerns. However, they have been focused on improving concentration measures by adding structure[9] rather than finding reduced-form approaches to identify the effect under weaker assumptions. Furthermore, it is noteworthy that the literature on the industrial organization of health care has moved away from reduced form towards more structural approaches.[10]

The market for dental care is arguably more similar to the market for physician services than the hospital market. A patient consulting a physician is generally looking to resolve uncertainty (Dranove and Satterthwaite, 2000) rather than undergoing a certain treatment. This also applies to dental care. Empirical work on competition and prices on physician service markets is however very sparse[11], mainly due to lack of data. Instead, most part of the literature on physician service markets has focused on issues concerning asymmetric information and agency in the relationship between the patient and the physician (Gaynor and Town, 2011).

2.2 Economic studies on dental care

Very little economic research has been done on dental care and even less on the effects of competition. The focus of previous studies has mainly been on utilization and estimating demand elasticities. Estimates of income and price elasticities generally has the expected signs, but vary in size across studies.[12]

Grytten and Sørensen (2000) studies the short-term effect of a deregulation of the fee system for dental services in Norway. They find that the mean expenditure per consultation is not related to dentists' subjective

[7] Two providers can be in different zip-codes but still be very close to each other and thus compete for the same patients. On the other hand *all* care givers in one geographical area, say state, are not necessarily competing with each other.
[8] As discussed by Capps and Dranove (2004), some of the previous studies use cross-sectional data (e.g. Staten et al., 1988 and Melnick et al., 1992). Estimates based on cross-sectional data cannot, in general, be given a causal interpretation because of unobservable characteristics that may affect both concentration and prices.
[9] Kessler and McClellan (2000) construct a hospital-specific concentration measure based on patients' choice of hospital as a function of travel distance. A similar approach is used in Gowrisankaran and Town (2003).
[10] It is noteworthy that the literature on the industrial organization of health care has moved away from reduced form towards more structural approaches. This is also true for the broader industrial organization literature. See Nevo and Whinston (2010) for further discussion.
[11] There are examples of more structural approaches to investigate market structure and pricing conduct of physician services. See for example Wong (1996) and Gunning and Sickles (2012).
[12] See Sintonen and Linnosmaa (2000) for a review.

perception of the price elasticity directed towards their own practice. This is interpreted as evidence against dentists' exploiting their perceived market power. It is noteworthy that dentists' subjective estimates of price elasticities are lower on average than the estimated mean price elasticity. The validity of both estimates are however questionable. First, it is unclear what the dentists' perceptions are based on. Second, it is unclear how the estimate that Grytten and Sørensen (2000) call the "actual price" elasticity is identified. The results should therefore be interpreted with caution.

Grytten and Sørensen also find that a 1% increase in dentist density is associated with a fall in mean expenditures and fees in the range 0.12% to 0.31%. This is interpreted as competition having a weak effect on dentists' price setting. A concern with these results is that it is unclear what drives changes in the density.

Eriksson (2004) is the only previous study of price setting in Swedish dental care. The focus of Eriksson (2004) is price leadership rather than price competition per se.

3 Theoretical framework

This section gives the theoretical rationale for the empirical strategy to identify the effect of competition on prices. I start out with a discussion on assumptions about the nature of competition and a description of the strategy outline. I then describe the theoretical background in more detail.

The nature of competition is implicitly assumed to be monopolistic competitive in the sense that there is both an element of market power and an element of competition. Monopolistic competition has become a workhorse model for describing markets for health care. The reason is that while services are differentiated, consumers cannot perfectly observe the service attributes. Providers therefore face a downward sloping demand, implying that they can raise prices without losing all their patients to competing providers, selling similar but not identical services (Dranove and Satterthwaite, 2000). However, an important aspect is that consumers information regarding quality and price differs across types of services (Pauly, 1978).

Another important assumption for the empirical strategy is that the number of competitors surrounding each clinic can be used as a measure of competition. This is because an increase in the number of clinics in a given area will provide consumers with greater choice, making the demand facing each clinic more elastic. At the same time, it is reasonable to assume that the price elasticity of demand differs across types of services (Pauly, 1978). More precisely, that demand is more price sensitive for services that are consumed with some frequency, such as diagnostics and examinations, compared to more uncommon therapeutic services. Competition therefore has heterogeneous effects on prices.

By exploiting both the variation in competition across clinics and the difference in consumers' price sensitivity across services; I identify a relative effect of competition on prices for diagnostic services compared to therapeutic services. The identified effect is given by the difference between the average effect of competition on prices for diagnostic services and therapeutic services respectively. The purpose of the identification strategy is to address the endogeneity of market structure, i.e. that market structure is correlated with unobserved factors that affect prices. The endogeneity is driven by the fact that providers are *not* randomly allocated across the country, but rather choose to establish in areas where demand and prices are high. An observed correlation between prices and competition can therefore not be given a causal interpretation. By focusing on the difference in the effect between services across levels of competition, the unobserved endogeneity is differences away. The empirical strategy is described in further detail in section 5. In order to assess the absolute effect of competition on prices I perform policy simulations in section 6.3.

3.1 Consumer demand and price competition

The identification strategy can be understood analogously to a difference-in-differences framework. Prices for both kinds of services are effected by competition, but theoretically the magnitude of the effects should differ across services. The rationale for the strategy is best understood by considering how health care services can be characterized. An important feature with health care markets is that consumers buy information, in the form of diagnostic services and other assessments of their health status. This information is then used as a basis for decision-making about future consumption (Pauly, 1978). The consumption can thus be divided into two stages.

Following Pauly's (1978) classification, services in the first stage can be characterized as being primarily "informative", whereas services in the second stage can be characterized as "active-therapeutic". Hence, the first stage consist of examinations and diagnostics (first-stage services) and the second stage consists of somewhat more extensive treatments (follow-on services) – if found necessary in the first stage.

As mentioned above, providers are assumed to have some market power, which is mainly driven by consumers' imperfect information. However, as first-stage services are consumed relatively frequently, consumers can become informed about these services at a low cost (Pauly, 1978). On the other hand, most consumers purchase follow-on services infrequently and becoming informed about these services are costly. Hence, consumers are on average more able to evaluate prices for first-stage services compared to follow-on services. In addition, evaluating prices for follow-on services is costly and thus it is reasonable to assume that the price elasticity of demand is greater for first-stage services than for follow-on services. Moreover, first-stage services is the kind a service a patient would get when visiting a provider for the first time. These services are therefore more likely to be subject to price comparisons among patients.

The difference in the price elasticity of demand across stages implies that price competition will be more intense for first-stage services compared to follow-on services. This argument is reinforced by considering that consumers will face a cost for switching provider between the first and the second stage. This cost is over and above the search cost for finding and evaluating a new provider in the second stage. The switching cost may be either perceived or real, but have in common that consumers will find it cheaper to buy all services from the same provider. Consumers would therefore become "locked-in" after purchasing first-stage services from a given provider, which makes demand for follow-on services less elastic. In addition, switching costs make new customers valuable from the perspective of sellers, because of their future purchases (Farrell and Klemperer, 2007; Klemperer, 1995). A standard results from models of switching costs is therefore that sellers compete fiercely to attract new customers and exploit locked-in customers, by charging higher prices (Padilla, 1991). These arguments all suggest that price competition will be more intense for first-stage services compared to follow-on services.

Consumers on health care markets face switching costs for several reasons. A patient who wants to switch provider after being examined will face transaction costs, because the patient will need either to be examined again or somehow transfer their medical records. Switching costs in health care can thus be viewed as start-up costs for establishing a new patient-provider relationship. Switching costs are also caused by uncertainty of the quality (and price) of untested providers. Medical care and dental care may be defined as experience goods (Nelson, 1970), in the sense that consumers learns about quality only after consuming the service. Consumers can therefore be viewed as facing a switching cost that is equal to what they at most would be willing to pay to be guaranteed that the services offered by the new provider has the same value to them as their current provider (Klemperer, 1995).

Finally, there may be what Klemperer (1995) calls psychological costs of switching, or non-economic brand-loyalty. These kinds of switching costs relates to what Samuelson and Zeckhauser (1988) calls ''status quo bias'' in decision making, referring to the inclination of sticking to a previous decision, i.e. the status quo. Samuelson and Zeckhauser (1988) and Strombom et al. (2002) find evidence of status quo inertia when studying individual health care plan choices among employees at Harvard University and University of California respectively.

A standard framework in the theoretical literature on the implications of consumer switching costs is a two-period model (Gehrig and Stenbacka, 2002; Klemperer, 1987a, 1987b, 1995; Padilla, 1992). Consumers enter the market and make their purchase in the first period. Once consumers have chosen a provider, they face switching costs and hence become locked-in (or at least attached). The main result from these models is that firms compete fiercely in the first period to attract new customers and exploit locked-in customers in the second period, by charging higher prices (Padilla, 1991).

The differing degree of competition across periods gives rise to a pricing schedule that follows a pattern of introductory offers, sometimes also referred to as a bargain-then-ripoffs structure.[13] The pattern is clearest when sellers can distinguish between new and old customers (Farrell and Klemperer, 2007). In the case of health care markets, sellers can clearly distinguish between customers in different stages, depending on what services they are purchasing. In a two-period model of switching costs, a consumer purchasing informative services would be a ''new'' customer. On the other hand, an individual that has already been examined and is about to undergo some therapeutic service, is ''locked-in''.

Another result from the core two-period model is that market shares become valuable and a determinant of future profits, because of locked-in customers' repeated purchases. The firm's problem is to set prices in the first period such that total discounted profits are maximized. Hence, the firm takes both current-period profits and the effect of current-period

[13] It is shown in Klemperer (1987a) that the effect of switching costs on competition depends on consumers' expectations about prices. If consumers have rational expectations, they will recognize that low prices today will be followed by high prices tomorrow. Foreseeing this will thus make customers less sensitive to price cuts or introductory offers. Note that the overall effect of switching costs on competition is ambiguous, as the tough first-period competition may be offset by the relaxed competition in the second-period.

markets shares on future profits into account when setting first-period prices.[14] Since firms' take overall profits into account, they are even willing to price below costs in the first period, as foregone profits can be recouped in the second period (Farrell and Klemperer, 2007).

Beggs and Klemperer (1992) model pricing with switching costs on a growing market in a multi-period setting, where the number of consumers increases for every time period. With new customers entering the market, the proportion of locked-in customers is reduced and competition for new customers is intensified. The intuition is that a steady growth in market size makes the future relatively more important, because the amount of new customers that can be locked-in (and exploited) is increasing.

The market size in terms of the number of competing firms also has implications for penetration pricing. This can be illustrated with an example of a monopolist; if consumers have nowhere else to go there is no role for penetration pricing or introductory offers (Farrell and Shapiro, 1988). In sum, the effect of switching costs on current-period prices is intensified by the number of competing firms. The difference in the pricing schedule between first-stage services and follow-on services therefore increases as the number of competing firms increases.

3.2 Summary

The theoretical framework outlined above offers two interrelated reasons for why price competition is more intense for diagnostic services compared to therapeutic services. First, consumers have more information about first-stage services compared to follow-on services as the former is purchased with some frequency. Consumers' demand for first-stage services is therefore relatively more price sensitive. Second, consumers face costs for switching provider between the first and second stage and thus find it cheaper to buy all services from the same provider. Consequently, demand for follow-on services is relatively less price sensitive. New customers are valuable from the perspective of the provider, because of their follow-on purchases.

Naturally, therapeutic services will on average be more expensive than diagnostic services, because they are generally more complicated and time consuming. However, it follows from the reasoning in 3.1 that the price difference between services will *increase* with the intensity of competition. This is because i) competition will have greater effects on services for which demand is sensitive to price and ii) it becomes more important for providers to lock in consumers as the number of competitors increases. Thus, changes in competition would be reflected by changes in the price difference across services.

[14] See Klemperer (1995) for a thorough discussion of the model.

4 Institutional setting and data

Dental care in Sweden is provided through both private clinics and the Swedish Public Dental Service, which is the county councils'[15] dental care organization. The majority (60–80%) of dental care for individuals aged 20 and above[16] is supplied by private clinics. Patients can freely choose either public or private clinics as providers and price setting is free.

The Swedish dental care system was reformed in 2008. The system now contains a general dental care subsidy, which applies to all citizens aged 20 years and above, and a high-cost protection plan. The size of the subsidy covers preventive dental care and dental care that reduce pain and enables the patient to eat, chew and speak without impediment. The subsidy is 300 SEK/year for individuals aged 20–29 years or above 74 years and 150 SEK/year for individuals aged 30–74 years. Patients are reimbursed at 50% through the high-cost protection plan for dental care costs between SEK 3 001 and SEK 15 000 during a twelve-month period. For costs above SEK 15 000 the reimbursement rate is 85%.

The Dental and Pharmaceutical Benefits Agency (TLV) decides which procedures are subsidized and determines a reference price list, which serves as a basis for calculating the size of the subsidy and reimbursements within the high-cost protection plan. The reference price list is revised every year based on general cost trends in dentistry with regard to technological developments such as new treatments and changes in the use of materials. The reference prices are supposed to reflect a "normal price" for each treatment, that reflects actual costs (SOU 2007:19).

The dental care system is administered by the Swedish Social Insurance Agency (SSIA), who also hold the Dental Care Register. Since the dental care subsidy and the high-cost protection plan applies to all dental care, both publicly and privately provided dental care is in the register.[17]

The reimbursements in the high-cost protection plan are calculated over the consumption during a twelve-month period. Therefore, all dental care is registered, even if an individual does not reach the first threshold in the high-cost protection. Hence, the register also covers dental care that is fully paid for by the patient.[18]

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[15] Sweden is divided into 21 counties at the regional level. The county councils' main responsibility is health and medical service (about 80% of total expenditures). The Swedish Public Dental Service has a legal responsibility for ensuring the supply of dental care to the citizens in the county (National Dental Service Act, tandvårdslagen (1985:125)).

[16] Dental care is free for children and young people aged 19 or under.

[17] All public clinics and about 96% of the private clinics are connected to the dental care system. Little is known about the 4% of the private clinics that operate entirely outside the national dental care system.

[18] Apart from purely aesthetic dental care, which is never reimbursable.

4.1 Data

The data comes from the Dental Care Register at The Swedish Social Insurance Agency linked to geographical variables collected at Statistics Sweden. The Dental Care Register covers all dental care produced at clinics that are subscribed with the dental care benefit system, which is 96% of all clinics in Sweden.

The Dental Care Register contains diagnosis, treatments, visits and prices among other variables. The price variables includes the price charged by the dentist for each service, the gross price for all treatment items in one visit and the total price paid by the patient, i.e. the price net of allowance and any reimbursement. The Dental Care Register covers over 47 million treatments during the studied period. See table 1 for summary statistics.

The geographic variables contain information about the clinics' location, given by the midpoint coordinate of a 100 x 100 meter square around the clinic. The coordinates are defined within the national horizontal reference system RT 90. All data covers the period July 2008–June 2011.

4.2 Descriptive statistics

Table 1 provides some summary statistics for dental care in Sweden during the studied period June 2008–July 2011. There are roughly four times as many private clinics as public clinics and consequently, the majority of patients visit private clinics. It is noteworthy that the Swedish Dental Service, i.e. the public clinics, is responsible for children’s dental care. However, the data only covers patients aged 20 years and above. The total number of patients for public clinics is therefore understated in table 1.

Tabell 1. Summary statistics, dental care in Sweden June 2008–July 2011. Patients aged 20 years and above.

	Period		
	2008/2009	*2009/2010*	*2010/2011*
Number of clinics			
All	3,655	3,600	3,493
Private	2,876	2,859	2,786
Public	779	741	707
Number of patients			
All	3,953,833	4,132,015	4,161,111
Private	2,341,998	2,428,678	2,432,766
Public	1,611,835	1,703,337	1,728,345
	Clinic type		
	All	*Private*	*Public*
Number of patients per day per clinic			
Mean	46.3	32.5	66.8
Standard deviation	86.0	56.6	109.8
Number of patients per year per clinic			
Mean	7,648.4	5,007.1	11,597.3
Standard deviation	11,500.2	7,645.5	14,321.2

4.3 Operationalization of variables

The measure of competition is constructed by counting all clinics[19] within a certain distance from the clinic. In the baseline model, I use 1 km as a distance, but for robustness checks I increase the distance to 5 km.

Table 2 provides descriptive statistics for the competition measures. The means are the number of clinics within the specified distance. There is large variation and the clinics with most competitors within 1 kilometer are located in big cities.

[19] Clinics are defined as the unique combination of an organizational number and an establishment number (CFAR) at a given coordinate. The identity numbers for clinics (mottagningsnummer) from SSIA are not used in this definition. This is done to minimize the risk of incorrectly defining clinics with more than one identification number as different clinics.

Tabell 2. Competition measure, means.

Variable	*Mean*	*SD*	*Min*	*Max*
Competition measure, all clinics				
Clinics within 1 km	17.4	33.2	0	218
Clinics within 5 km	72.6	132.0	0	520
Clinics within 1 km, geographical areas				
Metropolitan municipality	57.3	59.4	0	218
Large city	14.1	11.6	0	49
Forest counties	2.0	2.3	0	13
All other areas	3.7	5.7	0	192

Note: SD = Standard deviation. Definitions of geographical areas are given in the appendix.

Table 3 summarize mean prices and occurrences for services included in the analysis. First-stage services are defined as the kind of service a patient generally would get during a routine check-up or when visiting the dentist for the first time. The first-stage services are therefore defined as examinations performed by a dentist or a dental hygienist. The follow-on services are defined as a somewhat complicated treatment for which the patient has a diagnosed need, e.g. a cavity or a bacterial infection. All prices are in SEK.[20] As expected, the first-stage services are on average cheaper than the follow-on services. Only services that account for at least 0.5% of the total amount of services in the register are included.[21] One common service that has not been included in the analysis are fillings. The reason is that it is not straightforward whether filling a cavity should be viewed as a follow-on service or not. Even though it clearly is a treatment preceded by an examination, an uncomplicated filling may be performed in connection with an examination performed by a dentist.[22]

In the main analysis, I use basic examination and tooth extractions. The reason is that these services are the most common first-stage service and follow-on service respectively. The other services listed in table 3 are used to perform sensitivity analyses.

Basic examination performed by a dentist is the single most common service in the register and accounts for about 17% of all services. It contains basic diagnostics and minor treatments such as removal of dental calculus and fluoride rinsing. Full examination performed by dental hygienist is a somewhat more comprehensive examination, as it also contains an assessment of the patients' general health status and habits. A patient may be called back for an examination by a dentist to further evaluate findings made by the dental hygienist. However, the most common procedure is that patients with e.g. indications of caries, are called back to see a dentist for treatment rather than re-examination.

[20] 1 SEK ≈ $ 0.15 in September 2013.
[21] There are 42,645,349 services registered during the period July 2008–June 2011.
[22] Other services among the top 0.5% that have been excluded are acute examinations, x-rays (apart from pictures taken during examinations), information and instruction for patients at risk for e.g. caries, professional tooth cleaning in connection with examination and non-surgical periodontal therapy (somewhat more complicated dental plaque removal).

Tooth extraction simply refers to the removal of a tooth. Teeth may be removed with different techniques and for several reasons, e.g. tooth decay, fractions or infections. Non-surgical tooth extraction, which is the most common type of extraction in the register, is used in the analysis. Crown therapy is used to restore teeth. A crown encircles or caps the tooth and is used when the tooth is severely damaged. Clinic-made crowns are made in plastic material.[23] Root canal therapy refers to treatments of the pulp or the tissue surrounding the root. It is used to treat bacterial infections that may occur due to e.g. deep cavities or fractures.

Tabell 3. Prices and occurrences for first-stage and follow-on service.

Type of service	*Price*	*SD*	*Max*	*Min*	*Occurrences*
First-stage services					
Basic examination, performed by dentist	671.3	64.7	578	885	7 319 327
Full examination, performed by dental hygienist	613.7	65.8	390	777	2 331 199
Follow-on services					
Tooth extraction, one tooth	815.7	77.2	690	1114	940 712
Root canal, one filling	2444.0	300.1	1894	3232	280 362
Clinic-made crown, plastic material	1533.9	131.4	1100	2025	244 574

Note: SD = Standard deviation, all prices in SEK.

[23] Another kind of crown therapy is "Laboratory-made crown" (service no. 801), which is a crown made by using a methodology called CAD/CAM (computer-aided design/computer-aided manufacturing). Laboratory-made crowns may in some cases be replaced by implant therapy, which is in general more expensive than 801. This has led to misreporting in the price variable for 801; the service type is registered as 801 whereas the prices are for the replacement services.

5 Empirical strategy

In the following, I discuss the empirical strategy and how the effect of competition on prices is identified.

Suppose that the relationship between prices and competition could be described by the following simple model:

$$\log p_{tjl} = \alpha + \beta \log c_{tj} + u_{tjl} \quad (1)$$

Where $\log p_{tj}$ is the log price charged by clinic j, in area l,in time period t and $\log c_{tj}$ is log competition. The parameter of interest is β, capturing the effect of competition on prices. Simply estimating (1) by running a regression is not sufficient to establish a causal relationship. The identification problems can be illustrated by decomposing the error term into three parts; $u_{tjl} = \eta_l + a_{tj} + \varepsilon_{tjl}$. The term η_l captures overall demand in area l. It is correlated with c_{tj} if there, for example, are more clinics in areas with higher incomes.[24] The term a_{tj} captures demand for both types of services facing clinic j, and changes in demand over time. Given that high demand is reflected by high prices, a_{tj} is correlated with c_{tj} if clinics choose to establish where prices historically have been high. The potential relationship can be expressed as $a_{tj} = f(p_{t-1,j})$. The implication is that c_{tj} is not strictly exogeneous. The last part of the error term, ε_{tjl}, is an idiosyncratic error. Estimating (1) with OLS will yield biased estimates of β.[25] Since η_l and a_{tj} are unobservable parts of the error, they cannot fully be "controlled away". However, I can use that β in (1) differs across services as discussed in section 3.

Consider two kinds of services, $k = 1, 2$, where $k = 1$ represents the first-stage service and $k = 2$ represents the follow-on service. We can write:

$$\log p_{tjl1} = \beta_1 + \beta_{11} c_{tj} + u_{tjl1} \quad (2)$$

$$\log p_{tjl2} = \beta_2 + \beta_{12} c_{tj} + u_{tjl2} \quad (3)$$

Where the outcome variables, $\log p_{tjlk}$, is the mean log price of treatment k at clinic j, in area l, in year t. β_k captures the average price for services of type k. With a log-log specification, β_{1k} captures the average elasticity of prices for services of type k with respect to competition. Because of the differences in consumers' price sensitivity it is assumed that $\beta_{11} > \beta_{12}$, reflecting that the average effect of competition on prices is larger for the

[24] This is the case if the income elasticity is positive. Tentative results suggests a positive income elasticity for dental care (Grönqvist, 2012; Holtmann and Olsen Jr, 1976; Manning and Phelps, 1979).

[25] This is because and $cov(u_{tj,} c_{tj}) \neq 0$ and we get:

$$p\lim \hat{\beta} - \beta = \frac{cov(u_{tjl}, c_{tj})}{var(u_{tjl})} > 0$$

first-stage services compared to the follow-on services. The error term, u_{tjlk} can still be thought of as consisting of three parts. The idiosyncratic error term ε_{tjlk}, is service-specific. However, overall demand η_l and changes in overall demand, a_{tj}, are common to both the first-stage service and the follow-on service. Subtracting (2) from (3) gives:

$$\log p_{tjl1} - \log p_{tjl2} = \delta_1 + \delta_2 \log c_{jt} + \varepsilon_{tjl1} - \varepsilon_{tjl2} \qquad (4)$$

where $\delta_1 = \beta_1 - \beta_2$ and $\delta_2 = \beta_{11} - \beta_{12}$. δ_2 is the relative elasticity of prices with respect to competition, for first-stage services versus follow-on services. By taking the difference over service types for given levels of competition, η_l and a_{tj} have been differenced away. Hence, the identifying assumption is that the unobserved factors η_l and a_{tj} are only associated with the level of competition. This assumption is consistent with clinics establishing in areas where demand for first-stage services are high. Note that the competition measure is general to all services as it captures the number of clinics within a certain distance.

When η_l and a_{tj} have been differenced away, we now only have the idiosyncratic error terms, ε_{tjlk}. I can therefore estimate (4) with OLS, adding a dummy d for the first-stage service:

$$\log p_{tjkl} = \alpha_0 + \alpha_1 d + \alpha_2 \log c_{jt} + \alpha_3 d \log c_{jt} + \varepsilon_{tjlk} \qquad (5)$$

Model (5) exploits variation in competition across clinics. α_1 captures the average association between $k = 1$ and price and α_2 captures the average association between competition and price. The parameter of interest is α_3 capturing the difference across services in the average effect of competition on prices $(\beta_{11} - \beta_{12})$ interacted with competition. Following the reasoning in the theoretical background, α_3 is hypothesized to be negative, reflecting that competition has a relatively larger effect on first-stage services compared to follow-on services.

Apart from the identification issues discussed above, there may also be a clinic specific component of the error, γ_j. By further adding the year specific effect γ_{t}, we get:

$$\log p_{tjkl} = \alpha_0 + \alpha_1 d + \alpha_2 \log c_{jt} + \alpha_3 d \log c_{jt} + \gamma_j + \gamma_{\mathrm{t}} + \varepsilon_{tjkl} \qquad (6)$$

The variation used in the estimation of model (6) is the within-clinic variation in competition. The identifying assumption is that the evolution of the price difference between services on the clinic level would have been unchanged in the absence of a change in competition.

Given that the unobserved part of the error term is indeed associated with the level of competition rather than clinic specific characteristics or some year specific shock common to all clinics, models (5) and (6) should yield quantitatively similar results. This is because the differencing across services solves the fundamental market endogeneity problem and therefore the cross-sectional variation in competition should be sufficient to identify α_3.

6 Results

6.1 Main results

This section presents the results from the baseline estimation. The sample used in the analysis contains clinics that have performed both the first-stage service and the follow-on service during the same year. In addition the sample is restricted to be balanced over time.[26] The estimation sample differs, depending on what services are included in the analysis.

Table 4 gives the main results. The first column gives the pooled OLS estimates of the baseline model (5) where the only included control variable is a public clinic dummy. The results from the pooled OLS-estimate, in column 1, suggest that a 1% increase in competition is followed by a 0.0089% decrease in the price for ''Basic examination & diagnostics'' relative to "Tooth extraction''. This estimate can be related to the mean of clinics within 1 km, which is 22.6 for the estimation sample. An increase in competition with one new clinic corresponds to a 4.4% increase in the competition measure. Thus, one extra clinic within 1 km is followed by an increase in the price difference between basic examinations and tooth extractions with 0.0395% (≈ 4.4x0.00899).

The point estimates does not change when adding clinic fixed effects (column 2) and a time-dummy (column 3) capturing year specific shocks, but precision is increased. The estimated effect of competition on prices from the pooled OLS is thus not driven by unobserved heterogeneity across clinics or year specific factors. However, this is not surprising, as the differencing across service types, described in section 5, removes clinic specific factors that are common to all services.

[26] Including all clinics does not change the results qualitatively.

Tabell 4. Tooth extraction vs. Basic examination & diagnostics, performed by dentist.

	(1)	*(2)*	*(3)*
*Interaction: K*competition1km*			
Elasticity	-0.00899***	-0.00899***	-0.00899***
Standard error	(0.000942)	(0.00258)	(0.00258)
Constant	6.713	6.762	6.667
Clinic FE	No	Yes	Yes
Time dummy	No	No	Yes
R^2	0.631	0.785	0.826
adj. R^2	0.631	0.753	0.800
N	15,864	15,864	15,864

Standard errors are clustered at the clinic level and the pooled model is estimated with a public clinic dummy. All regressions are weighted with the number of patients at each clinic per year.
$^{***}p< 0.001$

6.2 Sensitivity analyses

To test the results sensitivity to the choice of services, the models have been estimated with examinations performed by either dentists or dental hygienists as the first-stage service and all other services in the register as follow-on services.[27] The elasticities are negative and statistically significant, falling in the range -0.019% to -0.022%. This indicates that the main results reported above are not an artifact of the choice of services. Furthermore, in order to test the sensitivity of the results to functional form the same models have been estimated in levels instead of logs. This does not change the inference from the log-log estimates; the elasticities are negative and statistically significant. Results from these estimations are given in the appendix, table B1–B5.

As a further sensitivity analysis, I re-estimate the models using clinics within five kilometers as a measure of competition. The point estimates are smaller, but the results do not change qualitatively. When adding a clinic fixed effect and year dummy the results are no longer statistically significant. The results are given in table 5.

[27] Estimation with and without fixed effects for time and clinic.

Tabell 5. Tooth extraction vs. Basic examination & diagnostics, performed by dentist. Competition within 5 kilometers.

	(1)	*(2)*	*(3)*
*Interaction: K*competition5km*			
Elasticity	-0.00133^{+}	-0.00133	-0.00133
Standard error	(0.000730)	(0.00199)	(0.00199)
Constant	6.717	6.848	6.692
Clinic FE	No	Yes	Yes
Time dummy	No	No	Yes
R^2	0.613	0.772	0.814
adj. R^2	0.613	0.738	0.786
N	17,596	17,596	17,596

Standard errors are clustered at the clinic level and the pooled model is estimated with a public clinic dummy. All regressions are weighted with the number of patients at each clinic per year.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The models have been estimated separately for different types of geographical areas. The elasticites are -0.0192% for "Metropolitan municipalities" and -0.0121% for "Large cities". These areas are defined as municipalities with a population of over 200 000 inhabitants and a population of 50 000–200 000 respectively. The point estimate is negative but not statistically significant for "Forest counties", defined as sparsely populated counties (consisting of several municipalities) with a large proportion of forest land. Municipalities that does not fit into any of the aforementioned categories forms the group "All other areas". The elasticity for this group, consisting of about half of all municipalities, is -0.012%. The significance level drops from 0.001 to 0.10 when adding clinic fixed effects. The point estimates follow a similar pattern when using competition within 5 kilometres. The elasticities are around -0.011% for "Metropolitan municipalities", "Large cities" and "All other regions", but only statistically significant on the 10%-level when adding clinic fixed effects for "All other regions". The point estimates are negative but not statistically significant for "Forest counties". Definitions of the geographical areas are given in the appendix.

Table 6 present results where the first-stage service is defined as "Full examination, performed by dental hygienist". A 1% increase in competition is followed by a 0.017% decrease in the price for "Full examination" realtive to "Tooth extraction". The mean of clinics within 1 km is 16.3 for the sample used in the analysis. Relating the point estimate to the mean number of clinics gives that one extra clinic within 1 km is followed by an increase in the price difference between full examinations and tooth extractions with 0.102% (≈ 6x0.017).

The sample is about half of that used in the baseline model. This can be explained by the fact that auxiliary personnel such as dental hygienists are much more common in public clinics. Therefore, many private clinics are excluded from the estimation sample.

Tabell 6. Tooth extraction vs. Full examination, performed by dental hygienist.

	(1)	*(2)*	*(3)*
*Interaction: K*competition1km*			
Elasticity	-0.0171***	-0.0171***	-0.0171***
Standard error	(0.00137)	(0.00298)	(0.00298)
Constant	6.718	6.756	6.663
Clinic FE	No	Yes	Yes
Time dummy	No	No	Yes
R^2	0.777	0.864	0.889
adj. R^2	0.777	0.839	0.869
N	8 054	8 054	8 054

Standard errors in parentheses. Standard errors are clustered at the clinic level and the pooled model is estimated with a public clinic dummy. All regressions are weighted with the number of patients at each clinic per year.
$^{*}p< 0.05$, $^{**}p< 0.01$, $^{***}p< 0.001$

The results from the analysis using root canal therapy and clinic-made crowns are given in the appendix. The results are qualitatively similar to the main results in table 4 and shows that an increase in competition with 1% is followed by a decrease in the price for first-stage services relative to follow-on services in the range 0.0043% to 0.0057%.

6.3 Policy simulations

The policy relevant effect is (mainly) the *absolute* effect of competition on prices, rather than the relative effect. In this section, I asses the absolute effect by performing policy simulations.

Recall that the relative effect, α_3, is derived from the difference $\beta_{11} - \beta_{12}$, where β_{1k} is the average effect of competition on prices for services of type k, where $k = 1$ represents the first-stage service.

As discussed above, firms' compete to attract customers who are in the first stage. When customers face switching costs, sellers may try to recoup foregone profits from low prices for first-stage with high prices for the follow-on services. An interpretation of β_{11} and β_{12} is therefore that β_{11} depends on competition, whereas β_{12} is a choice variable for the firm. In other words, the price for first-stage services is determined by competition with other firms, whereas the price for the follow-on services is set such that overall profits are maximized.[28] The parameter β_{12} can thus be thought of as a function of β_{11}. This can be expressed in the following simple way:

$$\beta_{12} = \rho\beta_{11} \qquad (7)$$

If $\rho < 0$, the negative effect of competition on prices for first-stage services is offset by a positive price effect for follow-on services. In other words, firms increase prices for follow-on services as competition increases. This would require substantial switching costs, since firms otherwise would lose follow-on customers to competitors.

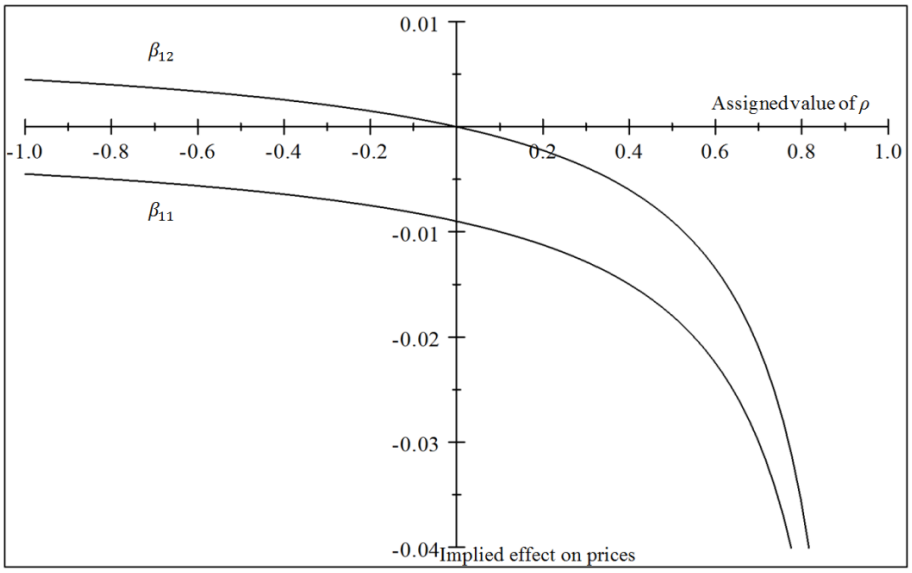
[28] See Farrell and Klemperer (2007) for a review of the literature on pricing with switching costs.

If $\rho > 0$, competition has a negative effect on prices for both kinds of services. However, up to the point where $\rho = 1$, the negative effect is larger for first-stage services. Note that if $\rho = 1$ the average effect of competition on prices β_{1k}, does not vary across services and hence α_3 is not identified.

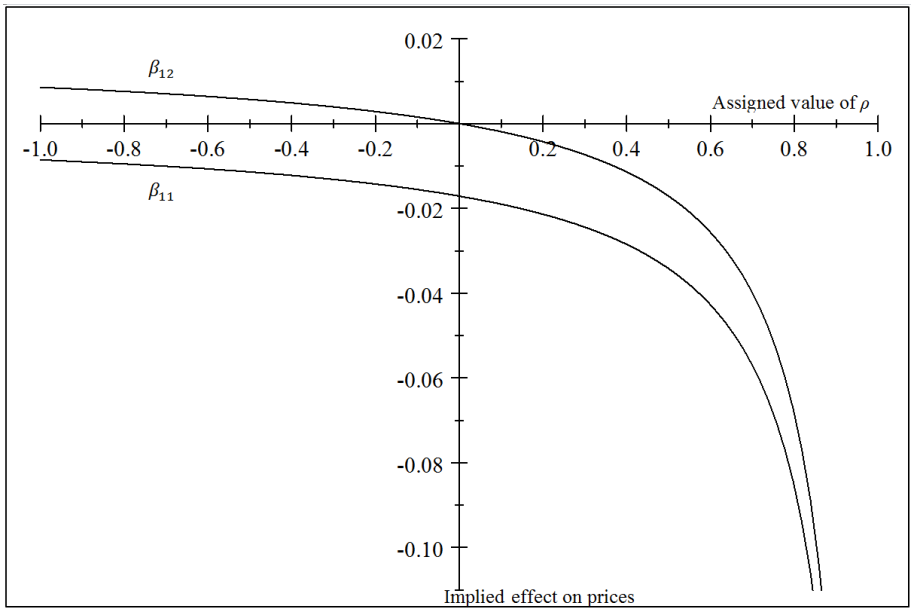
From (8), we get $\alpha_3 = \beta_{11}(1 - \rho)$ and by rearranging, we get:

$$\beta_{11} = \frac{\alpha_3}{(1 - \rho)}$$

By plugging in values for ρ we can back out the implied β_{11} (and β_{12}). Figure 1 plots the simulation results for β_{11} and β_{12} from the estimate of α_3 for "Tooth extraction" versus "Basic Examination & Diagnostics". Figure 2 plots the results for "Tooth extraction" versus "Full examination, performed by dental hygienist". The figures shows the implied values for β_{11} and β_{12}, for $-1 < \rho < 1$.



Figur 1. Policy simulation: Tooth extraction vs. Basic Examination & Diagnostics, performed by dentist.



Figur 2. Policy simulation: Tooth extraction vs. Full examination, performed by dental hygienist.

It is clear that the welfare implications for consumers differ depending on where we are on the abscissa, i.e. the value of ρ. If ρ is positive, competition has negative effects on prices for both types of services. Therefore, ρ can be thought of as a measure of the overall competitiveness of the market.

In order to say something about welfare implications, I need to assess the value of ρ. An estimate of ρ should reflect overall competitiveness and from (7) we have that ρ captures how β_{11} and β_{12} are related. A natural measure of competitiveness is firms' market power, defined as their ability to set prices above costs (Corts, 1999). I therefore define ρ as the average markup for first-stage services relative to the average markup for follow-on services. Mark-ups are defined by relating treatment prices to their respective reference price (described in section 4). Using reference prices as a proxy for marginal costs, I get an estimate of the mark-up in the following way:

$$M_{kjt} = \frac{P_{kjt} - Ref.P_{kt}}{P_{kjt}}$$

P_{kjt} is the average price for treatment k at clinic j in year$t$ and $Ref.P_{kt}$ is the average reference price for treatment k in year t. On average, the mark-up is higher for tooth extractions compared to examinations, implying a lower mark-up for the latter. Finally, I define ρ in the following way:

$$\rho_{jt} = \frac{M_{2jt} - M_{1jt}}{M_{2jt}} \qquad (8)$$

Where M_{1jt} is the average markup for examinations and M_{2jt} is the average markup for tooth extractions. M_{kjt} can be smaller than zero and larger than one, as clinics may set prices below and well above the reference price.

Consequently, ρ_{jt} is not restricted to be in the range -1 to 1. As a means of normalization I therefore use the median of ρ_{jt} as an estimate of ρ, rather than the mean.

The estimated value of ρ is 0.56 (mean 1.44) for "Tooth extractions vs. Basic Examination & Diagnostics". The backed out average response in prices to a 1% increase in competition is -0.0203% for first-stage prices and -0.0133% for the follow-on prices. Relating this to an increase in the number of clinics gives that one extra clinic within 1 km, would decrease prices for "Basic examinations and diagnostics" with 0.09%, corresponding to a price decrease with about 0.63 SEK. Considering that "Basic examinations and diagnostics" are on average performed 2.4 million times per year, the price decrease corresponds to a redistribution from providers to patients of over 1.5 million SEK on average per year.

The estimated value of ρ is 0.81 (mean 1.40) for "Tooth extractions vs. Full Examination, performed by dental hygienist". This corresponds to a decrease in prices of -0.092% for the first-stage service and -0.0075% for the follow-on service. An increase of one extra clinic within 1 km, would decrease prices for "Full Examination, performed by dental hygienist" with -0.56%. This corresponds to a price decrease with about 3.4 SEK and a redistribution from sellers to buyers of 2.6 million SEK on average per year.

The policy simulations thus suggest that the absolute effects of competition are negative for prices for both types of services. This in turn implies that competition is welfare enhancing for consumers by lowering prices. In addition, the results suggest that prices are set above the efficient level as there is room for price decreases.

7 Conclusion

Markets today play an important role in the provision of health care services throughout the developed world. There is therefore a growing literature on the industrial organization of health care markets. A large part of the literature is focused on the effects of competition on prices. However, much of the existing empirical literature fails to credibly identify the effect. This paper suggests a framework to identify the effect of competition on prices in a setting where price setting is free and competition is patient-driven, namely the Swedish market for dental care.

The rationale for the identification strategy comes from the theoretical literature on competition in health care and switching costs. The strategy exploits that the effect of competition differs across services; price competition is more intense for services such as examinations and diagnostics (first-stage services), compared to more complicated and unusual services (follow-on services). This is because patients are relatively better informed about first-stage services and face costs for switching once they have chosen a provider. Consequently, consumers' demand is relatively less price sensitive to follow-on services and therefore competition has heterogeneous effects across services. By exploiting this difference in the effect of competition on prices, I identify a relative effect of competition.

The results show small, but statistically significant negative effects of competition on the price difference between first-stage services and follow-on services. Competition is measured as the number of clinics within a fixed distance from each clinic. A 1% increase in competition is followed by an increase in the price difference in the range -0.0089% to -0.017%. This implies that one more clinic within a radius of one kilometer lowers prices for first-stage services relative to follow-on services with up to 0.1%. The results are robust for different kinds of model specifications and across analyses of different kinds of services.

In order to assess the policy relevant *absolute* effect of competition on prices I add the assumption that prices for follow-on services can be expressed as a function of the average effect on first-stage prices. This reflects that sellers recoup foregone profits from low prices for first-stage services with high prices for follow-on services. By exploiting auxiliary data on the pricing of services, the model assumptions allow me to perform simulations to assess the absolute effects.

The simulation results suggest that the absolute effect of competition on prices is negative for both kinds of services. This implies that even though the magnitude of the effect on prices indeed differs across services, competition increases welfare for consumers. A 1% increase in competition is followed by a decrease in the price for first-stage services in the range 0.02% to 0.09%. Relating this to the number of times the first-stage

services are performed on average during a year, the effects corresponds to a redistribution from providers to patients of 336,000 SEK and 431,000 SEK respectively. The price decrease for follow-on services fall in the range 0.01% to 0.07%, corresponding to a redistribution from providers to patients in the range 282,000 SEK to 1.9 million SEK. Moreover, an increase of one extra clinics within 1 kilometer, would decrease prices for the first-stage services by up to 0.56%. This corresponds to a price decrease with about 3.4 SEK and a redistribution from sellers to buyers of 2.6 million SEK on average per year.

Furthermore the policy simulations suggest that there is room for price decreases. This implies that prices on the Swedish dental care market are set above the competitive level and that increased competition would increase consumer welfare by lowering prices. While all simulation results point in the same direction, it is noteworthy that the economic significance of the welfare improvement varies depending on which reduced form estimate the simulation is based on.

In sum, the reduced form results, suggests that competition has an effect on the *difference* between first-stage services and follow-on services. These results are robust across different definitions of services and specifications. Combined with the policy simulations, the conclusion is that i) the absolute effect of competition on prices is negative for both kind of services and ii) competition on average has greater negative effects for first-stage services compared to follow-on services.

All effects should be interpreted as short-term effects of competition as the identifying variation is changes in competition from one year to the next. It is therefore interesting that providers show evidence of strategic behavior in their price setting. Furthermore, substantial effects of competition on prices over time cannot be ruled out.

An important result in this paper is that competition indeed has different effects on prices for different types of services. This is a feature with competition on health care markets that was pointed out several decades ago by Pauly (1978), but has been widely overlooked in the empirical literature.

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Appendix

Tabell B1. First-stage services vs. All other services in register.

	(1)	*(2)*	*(3)*
*Interaction: K*competition1km*			
Elasticity	-0.0222**	-0.0194***	-0.0191***
Standard error	(0.00749)	(0.00408)	(0.00405)
Constant	7.104	6.895	6.925
Clinic FE	No	Yes	Yes
Time dummy	No	No	Yes
R^2	0.009	0.030	0.034
adj. R^2	0.009	0.024	0.027
N	533209	533209	533209

Standard errors are clustered at the clinic level and the pooled model is estimated with a public clinic dummy.
$^{*}p< 0.05$, $^{**}p< 0.01$, $^{***}p< 0.001$

To test the sensitivity of the results to functional form, the models (5)–(7) are estimated in levels instead of logs. The results and corresponding elasticities are given in table B2–B5.

Tabell B2. Tooth extraction vs. Basic examination & diagnostics, performed by dentist. Levels of price and competition.

	(1)	*(2)*	*(3)*
*Interaction: K*competition1km*			
Mean	-0.264***	-0.264***	-0.264***
Standard error	(0.0259)	(0.0774)	(0.0774)
Constant	832.1	849.6	792.9
Municipality FE	No	Yes	Yes
Time dummy	No	No	Yes
R^2	0.595	0.765	0.802
adj. R^2	0.595	0.723	0.767
N	24490	24490	24490

Standard errors in parentheses. Standard errors are clustered at the clinic level and the pooled model is estimated with a public-clinic dummy.
$^{*}p< 0.05$, $^{**}p< 0.01$, $^{***}p< 0.001$

Tabell B3. Elasticities corresponding to level estimates; Tooth extraction vs. Basic examination & diagnostics, performed by dentist.

Elasticity evaluated at mean	- 0.03217343
Standard error	(0.00389449)
Elasticity evaluated at median	-0.00791389
Standard error	(0.00095795)
Elasticity evaluated at 25th percentile	- 0.00119611
Standard error	(0.00014479)
Elasticity evaluated at 75th percentile	- 0.03544857
Standard error	(0.00429094)

Tabell B4. Tooth extraction vs. Full examination, performed by dental hygienist. Levels of price and competition.

	(1)	*(2)*	*(3)*
*Interaction: K*competition1km*			
Mean	-0.517***	-0.517***	-0.517***
Standard error	(0.0380)	(0.0858)	(0.0858)
Constant	834.4	840.2	786.9
Municipality FE	No	Yes	Yes
Time dummy	No	No	Yes
R^2	0.756	0.852	0.875
adj. R^2	0.756	0.822	0.850
N	12 922	12 922	12 922

Standard errors in parentheses. Standard errors are clustered at the clinic level and the pooled model is estimated with a public-clinic dummy.
$^{*}p< 0.05$, $^{**}p< 0.01$, $^{***}p< 0.001$

Tabell B5. Elasticities corresponding to level estimates; Tooth extraction vs. Full examination, performed by dental hygienist.

Elasticity evaluated at mean	-0.03784808
Standard error	(0.0031434)
Elasticity evaluated at median	- 0.00996568
Standard error	(0.00082768)
Elasticity evaluated at 25th percentile	- 0.00194939
Standard error	(0.0001619)
Elasticity evaluated at 75th percentile	- 0.04032168
Standard error	(0.00334884)

Table B6–B9 present results from when models (5)–(7) are estimated separately for different geographical regions. The definitions of geographical areas are taken from the Swedish Association of Local Authorities and Regions (SKL). "Metropolitan municipalities" are defined as municipalities with a population of over 200 000 inhabitants, i.e. Stockholm, Gothenburg and Malmo. "Large cities" (31 municipalities) are defined as municipalities with 50 000–200 000 inhabitants with more than 70% of the population living urban areas. "Forest counties" are sparsely populated counties (consisting of several municipalities) with a large proportion of forest land. These counties are Värmland, Dalarna, Gävleborg, Jämtland, Västernorrland, Västerbotten and Norrland excluding the municipalities in the Large city category. All other municipalities are in the category "All other areas".

Tabell B6. Tooth extraction vs. Basic examination & diagnostics, performed by dentist. Metropolitan municipalities.

	(1)	*(2)*	*(3)*
*Interaction: K*competition1km*			
Elasticity	-0.0192***	-0.0193***	-0.0192***
Standard error	(0.00169)	(0.00562)	(0.00562)
Constant	6.703	6.699	6.642
Municipality FE	No	Yes	Yes
Time dummy	No	No	Yes
R^2	0.564	0.750	0.795
adj. R^2	0.563	0.711	0.763
N	4 826	4 826	4 826

Standard errors in parentheses. Standard errors are clustered at the clinic level and the pooled model is estimated with a public clinic dummy.
$^{*}p< 0.05$, $^{**}p< 0.01$, $^{***}p< 0.001$

Tabell B7. Tooth extraction vs. Basic examination & diagnostics, performed by dentist. Large cities.

	(1)	*(2)*	*(3)*
*Interaction: K*competition1km*			
Elasticity	-0.0121***	-0.0121***	-0.0121***
Standard error	(0.00223)	(0.00353)	(0.00353)
Constant	6.724	6.860	6.681
Municipality FE	No	Yes	Yes
Time dummy	No	No	Yes
R^2	0.725	0.846	0.883
adj. R^2	0.725	0.823	0.865
N	4 438	4 438	4 438

Standard errors in parentheses. Standard errors are clustered at the clinic level and the pooled model is estimated with a public clinic dummy.
$^{*}p< 0.05$, $^{**}p< 0.01$, $^{***}p< 0.001$

Tabell B8. Tooth extraction vs. Basic examination & diagnostics, performed by dentist. Forest counties.

	(1)	*(2)*	*(3)*
*Interaction: K*competition1km*			
Elasticity	-0.00593	-0.00590	-0.00588
Standard error	(0.00573)	(0.00758)	(0.00759)
Constant	6.737	6.748	6.667
Municipality FE	No	Yes	Yes
Time dummy	No	No	Yes
R^2	0.755	0.893	0.942
adj. R^2	0.754	0.877	0.933
N	1 180	1 180	1 180

Standard errors in parentheses. Standard errors are clustered at the clinic level and the pooled model is estimated with a public clinic dummy.
$^{*}p< 0.05$, $^{**}p< 0.01$, $^{***}p< 0.001$

Tabell B9. Tooth extraction vs. Basic examination & diagnostics, performed by dentist. All other areas.

	(1)	*(2)*	*(3)*
*Interaction: K*competition1km*			
Elasticity	-0.0122***	-0.0120^{+}	-0.0120^{+}
Standard error	(0.00239)	(0.00594)	(0.00595)
Constant	6.706	6.716	6.653
Municipality FE	No	Yes	Yes
Time dummy	No	No	Yes
R^2	0.575	0.736	0.776
adj. R^2	0.574	0.695	0.742
N	5 420	5 420	5 420

Standard errors in parentheses. Standard errors are clustered at the clinic level and the pooled model is estimated with a public clinic dummy.
$^{+}\ p < 0.10$, $^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

Table B10–B11 gives the results from defining "Root canal" and "Clinic-made crown" as the follow-on service.

Tabell B10. Root canal, one filling vs. Basic examination & diagnostics, performed by dentist.

	(1)	*(2)*	*(3)*
*Interaction: K*competition1km*			
Elasticity	-0.00429***	-0.00429*	-0.00428*
Standard error	(0.00113)	(0.00211)	(0.00211)
Constant	7.799	7.955	7.736
Municipality FE	No	Yes	Yes
Time dummy	No	No	Yes
R^2	0.978	0.984	0.991
adj. R^2	0.978	0.981	0.990
N	15 390	15 390	15 390

Standard errors in parentheses. Standard errors are clustered at the clinic level and the pooled model is estimated with a public clinic dummy.
$^{*}p< 0.05$, $^{**}p< 0.01$, $^{***}p< 0.001$

Tabell B11. Clinic-made crown, plastic material vs. Basic examination & diagnostics, performed by dentist.

	(1)	*(2)*	*(3)*
*Interaction: K*competition1km*			
Elasticity	-0.00591***	-0.00591*	-0.00596*
Standard error	(0.000967)	(0.00237)	(0.00237)
Constant	7.338	7.369	7.278
Municipality FE	No	Yes	Yes
Time dummy	No	No	Yes
R^2	0.965	0.981	0.986
adj. R^2	0.965	0.978	0.984
N	14 320	14 320	14 320

Standard errors in parentheses. Standard errors are clustered at the clinic level and the pooled model is estimated with a public-clinic dummy.
$^{*}p< 0.05$, $^{**}p< 0.01$, $^{***}p< 0.001$

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