Price Setting of Dental Services in the Norwegian Dental Market

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Thesis submitted as a part of the Master of Philosophy Degree in Health Economics, Policy and Management

November 2018

Foreword

The price data from the Norwegian private dental sector are provided by Hvakostertannlegen.no of the Norwegian Consumer Council. Neither Hvakostertannlegen.no nor the Norwegian Consumer Council are responsible for the analysis/interpretation of the data presented here.

2018 November

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http://www.duo.uio.no/

Trykk: Reprosentralen, Universitetet i Oslo

Summary

[Background] The prices of dental services in the Norwegian private dental market has increased significantly over the last few decades. This has occurred despite an increase in the number of dentists in relation to the population, and the enhanced dental health of Norwegians. This places a huge financial burden on adult patients over the age of 20, as they nearly receive no coverage for their expenses. This group mostly receives treatments from private dentists, who have the right to freely set prices for their services in the private market.

[Objectives] This research aims to analyze the price setting of dental services for Norwegian adults, particularly in relation to the density of dentists and clinics.

[Methods] Data was obtained from three sources; data from the private dental sector was provided by Hvakostertannlege.no; public sector data from each county's official website; other data (population, median income, and housing price) from SSB. Two datasets were compiled: <set I> included all private and public data, while <set II> included all the private and the 87 public clinics in remote areas. After the data was collected, all the independent variables (dentist density, clinic density, the median income, and the housing price), were calculated at a trade district level. Applying multivariable log-log and level-level OLS regressions with the cluster option, the prices of 14 treatments were analyzed ($p \leq 0.1$).

[Results] In <set II>, more suitable to analyze the dental market for adults, five treatments (medium & large filling, surgical extraction, simple & surgical periodontal treatment) reflected a positive relationship between prices and dentist density, while the price of surgical periodontal treatment positively correlated to clinic density. Both crown treatments negatively correlated with clinic density. Yet, the practical significance of the result is uncertain with regards to the size of the impact created to switch a consumer's clinic, given the small size of estimated coefficients (except crown treatments) and long distances among trade districts.

[Conclusion] The different impacts of density variables on different types of treatments could be explained by the degree of treatments' popularity and of the expected revenue from offering competitive prices. Also, the existence of the HELFO reimbursement seems to have an additional effect on the behavior of dentists in pricing periodontal treatments. Further research with more explanatory variables is required to conduct precise analyses of the discovered correlations and to get a better understanding of the dental market.

Acknowledgement

It is a great honor to be able to show my appreciation to all the people who have encouraged and helped me during this research.

First of all, I would like to express my sincere gratitude to my supervisor, Professor. Tor Iversen. I have learned a lot from, not only his brilliant and precise comments, but also his warm encouragement and gentle humor. I have sincerely enjoyed learning and doing my research under his supervision. I deeply thank you for your precious time, teaching, and for accepting me as your student at last.

I am greatly indebted to Professor. Jostein Grytten. When I first sent him an email regarding my thesis topic, I could not imagine that I would receive such tremendous help from him. With his valuable comments and positive attitude, I was able to finish my research. I sincerely thank you for your unforgettable help and for leading me to experience an academic research environment.

Special thanks to Irene Skau, and also for giving me critical feedback on my research, and a pleasant lunch time as well. I received generous support from Gunnar Rongen at the beginning of this research, and from Carl Christian and Øyvind Asmyhr in understanding the situation of dentists and dental clinics in Norway.

Without Hvakostertannlegen.no, this research would not have been possible. I thank Nadja Turunen and Forbrukerrådet for permitting to use their data to do this research. Also, I appreciate the help offered by Øystein Bærø to understand the public dental policy in Norway.

As a student advisor, Mari Elisabeth Mjøen helped me for the last 2 years, and I am grateful for this. My fellow master students from this program gave me memorable moments and kind encouragement. It was such a great time to spend time together.

Lastly, I am particularly grateful for the never-ending positive and energetic supports given by Faraz German. My heartfelt appreciation goes to my family and friends who always support and have faith in me.

List

Abbreviation

FFS: Fee-for-Service

HELFO: The Norwegian Health Economics Administration, *Helseøkonomiforvaltningen*

NAV: The Norwegian Labour and Welfare Administration, *Arbeids- og velferdsforvaltninga*

NOK: Norwegian Kroner (Norwegian currency)

OLS: Ordinary-least square

SID: Supplier-induced demand

SSB: Statistics Norway, *Statistisk sentralbyrå*

TI hypothesis: Target income hypothesis

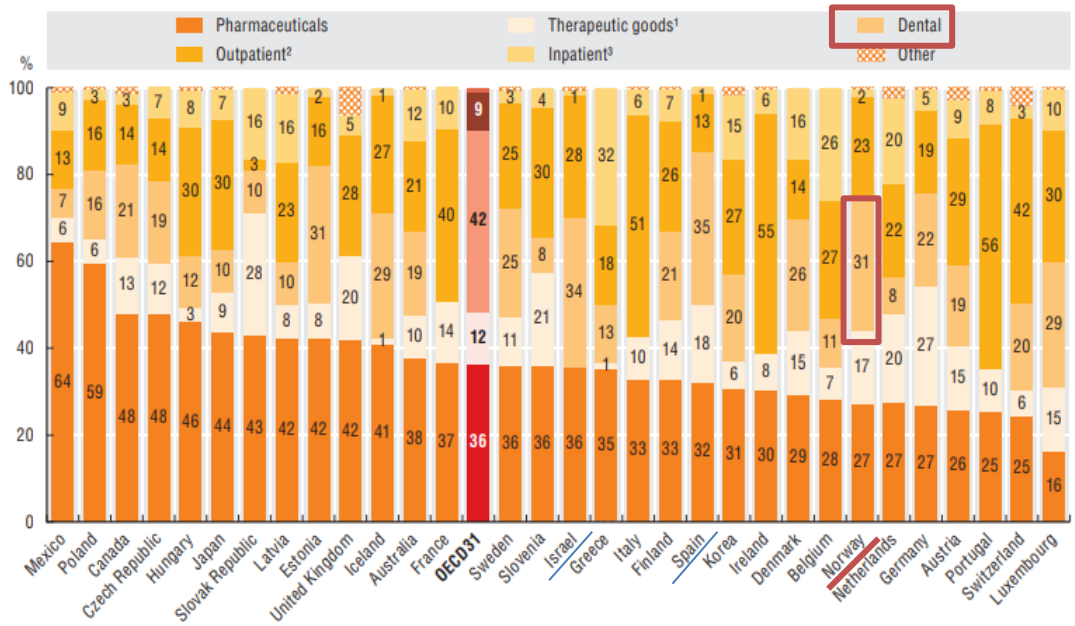
VIF: Variation inflation factor

1 Introduction

1.1 Rationale

Although most OECD countries have implemented universal health schemes for their citizens, dental care is less covered than the other categories of healthcare in these schemes (Paris et al, 2016). In Norway, dental services are often described as "forgotten" (*uteglemt* in Norwegian) in the context of health policies even though it is as important as the other health services focused upon. This is predominantly because most patients over 20 years of age visit private clinics for dental treatments, and the private sector, unregulated by governmental authority, accounts for 75% of the entire Norwegian dental sector (The Norwegian Ministry of health and care services, 2007).

However, from the point of view of the patient, dental services cannot be neglected, particularly in Norway. Figure 1 depicts that 31% of a Norwegian's out-of-pocket medical expenditure is directed toward dental care. Norwegians are ranked 3rd when it comes to the proportion of total out-of-pocket expenditure on dental services, and are only behind Spain and Israel[1]. This indicates that compulsory coverage of dental care is limited in comparison with other healthcare services with more comprehensive coverage (OECD, 2017).



[Figure 1. Out-of-pocket medical spending by services and goods in 2015]

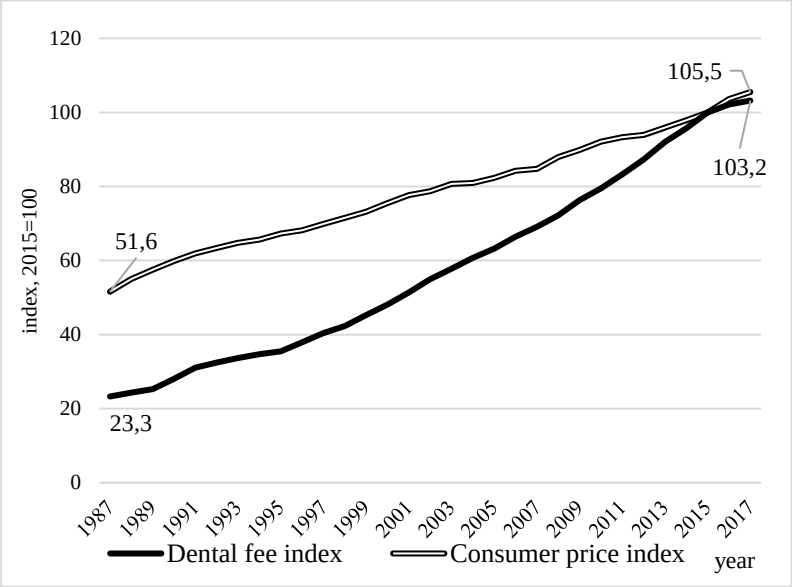
[1] OECD (2017), Health at a Glance 2017: OECD Indicators, OECD Publishing, Paris. http://dx.doi.org/10.1787/health_glance-2017-en Retrieved November 5, 2018.

Financial problems resulting from the limited coverage of dental care for adults have been a major hindrance in accessibility of dental services. Approximately 51% Norwegians consider dental treatment too expensive while the rate of respondents with low income increased from 70% in 2010 to 81% in 2016 (SSB, 2017a).

Despite the heavy financial burden borne by adult patients, relatively few researches have been conducted to examine their demands and utilization of dental services (Grytten, et al., 2007; Grytten & Dalen, 1997). This results from sparse data regarding the private dental market that is utilized by most adult patients (The Norwegian Ministry of Health and Care services, 2007).

Three significant changes in the Norwegian dental market in recent times call for attention to the dental market. These changes seem too conflicting to provide clear insight into the functioning of the dental market. The prices of dental services and the number of dentists in the Norwegian dental market have risen dramatically, while the size of the populations per dentist has decreased at the same time. Moreover, the demand for dental services per dentist, especially private dentists, has reduced as a result of improved dental health of the Norwegian population.

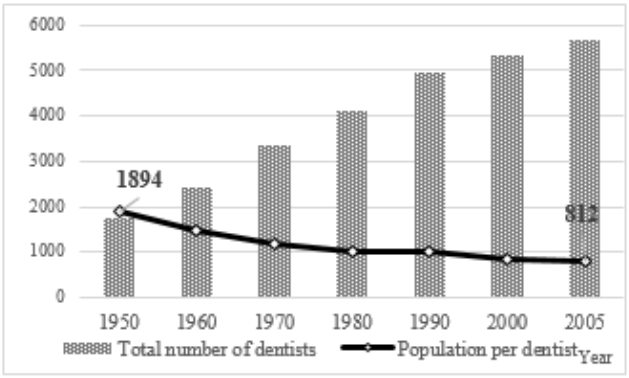
The prices of Norwegian dental health service have increased steadily and remarkably over the last few decades, as depicted in Figure 2[2]. The price inflation in the dental market has almost doubled in comparison with the inflation of standard consumer price between 1995 and 2015 (Blich, 2017).



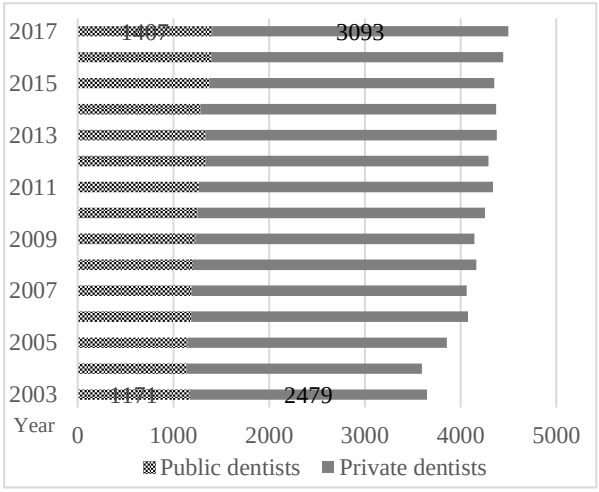
[Figure 2. Price change in the Norwegian dental health service sector]

[2] SSB (Statistics Norway). "03014: Konsumprisindeks, etter konsumgruppe (2015=100) 1979 - 2017" https://www.ssb.no/statbank/table/03014/ Retrieved November 5, 2018.

At the same time, the number of dentists in Norway has increased. Figure 3 illustrates the steady rise in the total number of dentists, included practicing and non-practicing dentists, in Norway over 50 years (Hedum, 2007).



[Figure 3. The number of dentists in Norway]



[Figure 4. The number of employed dentists]

The trend appears to have lasted in recent times as well. The population size per practicing dentist decreased from 1,207 in 2009 to 1,173 in 2017 (The Norwegian Directorate of Health, 2018). The latest number of employed private dentists is 3,093 in 2017, whereas the number of employed public dentists is 1,407, as depicted in Figure 4 (SSB, 2018).

It can be argued that the number of dentists and the prices of dental services might reflect greater and heavier demands of adult patients in Norway. For instance, their dental health might be worsening during the time period. However, contrary to this speculation, the dental health of the Norwegian population has improved as a result of enhanced standard of living, widespread usage of fluoride toothpastes, and the implementation of desirable habits for good dental health by regular visits to public dental clinics at a younger age (Holst & Schulle, 2012; The Norwegian Ministry of Health and Care services, 2007).

For instance, the mean number of decayed and filled teeth among 23-year-olds was 15.4 in 1983, but it reduced by 8.5 in 1994 (Grytten & Holst, 2002). A ten-year longitudinal study of carries in Hedmark, Norway, Dobloug and Grytten found that approximately 50% of 7,519 cohort patients, born between 1940 and 1989 had no carries for at least 8 years during the 10-year study period (Dobloug & Grytten, 2015). The positive change has been particularly noticed in the 18-year-old population. In 1985, only 1% of the total 18-year-old population were devoid of a single hole in their teeth, but this figure rose to 24% in 2016 (SSB, 2017b). It has been predicted that there might be fewer patients and less demand for dental services

for adult patients per dentist in the market in the future due to the remarkably improved dental conditions of the Norwegian population (Dobloug & Grytten, 2015; Holst & Schulle, 2012). Therefore, it seems unlikely that greater and heavier demands of the Norwegian population on dental services would increase the prices of the services.

Regardless of the low dental demands and number of patients per dentist, the prices of dental services have increased exponentially. This indicates that there is no competition in the market, since the prices of dental services have risen despite the increasing number of dentists. In this case, can it be said that dentists practically exercise their power when pricing their services in the market? However, no research has been conducted on competition or pricing in the Norwegian dental market after the study by Grytten and Sørensen (2000). Empirical researches on competition in the health service market is scarce in general, and fewer research studies have focused on competition in the dental market due to a lack of data (Gaynor & Town 2011; Grytten, et al., 1990).

Therefore, research on price setting in the Norwegian dental market is imperative in the current times. Given the three significant changes in the dental market, it is crucial to understand the relationship between the pricing and the increasing number of dentists and clinics. This research aims to find the impact of dentist density and clinic density on the pricing of dental services in the Norwegian dental market. The research questions are as follows,

Research question

- How does the density of dentists and clinics influence price setting in dental services in the Norwegian dental market?

- Sub-questions

1. Does competition work in accordance with higher densities of dentists and clinics?
2. In the absence of competition, do dentists or clinics exercise their market power when pricing?
3. Are there different impacts of the density of dentists and clinics in different types of services?
4. Does payment system relate to the different impacts in different types of services?
5. What other influences do affect to price setting in the market?

1.2 Norwegian dental system

Public sector

The purpose of providing public dental services is to ensure equal access to dental care to the entire population via subsidized dental fees (Sintonen & Linnosmaa, 2000). The public dental services in Scandinavian countries seek to provide equal quality of treatment regardless of individual, social, and economic backgrounds (Widström et al., 2005).

According to the Dental Health Services Act (*tannhelsetjenesteloven*), each county authority is responsible for the provision of sufficient dental health services in its region for the special groups defined by the law[3]: (a) all children and youth up to 18 years of age, (b) adults with mental disorders, (c) elderly people, people with chronic disease, disabled institutionalized individuals or receiving community nursing, (d) other groups prioritized by the county, and (e) adolescents between 19 and 20 years of age[4]. Public dental services, except for dental braces, are free of charge for patients belonging to groups (a) to (d), as the expenditure is financed by taxes and grants (called *rammetilskudd*) from the government (Baastad, et al., 2014). The provision of dental care for groups (b) to (d) is a minor part of production, as most patients using public dental services belong to group (a) (Grytten & Skau, 2009).

With the exception of public dental clinics in Oslo, most public clinics in other counties offer dental services to adults as well. People who live in remote areas without access to private clinics visit public clinics for dental treatment more often than those who live in cities. Since ordinary adult patients are not prioritized in the public dental service policy, public clinics in some counties offer a limited range of basic services to them. Even when they receive public dental services, they are not offered discounts or financial support, as they do not belong to the special prioritized groups. Thus, they pay the full prices set by their county.

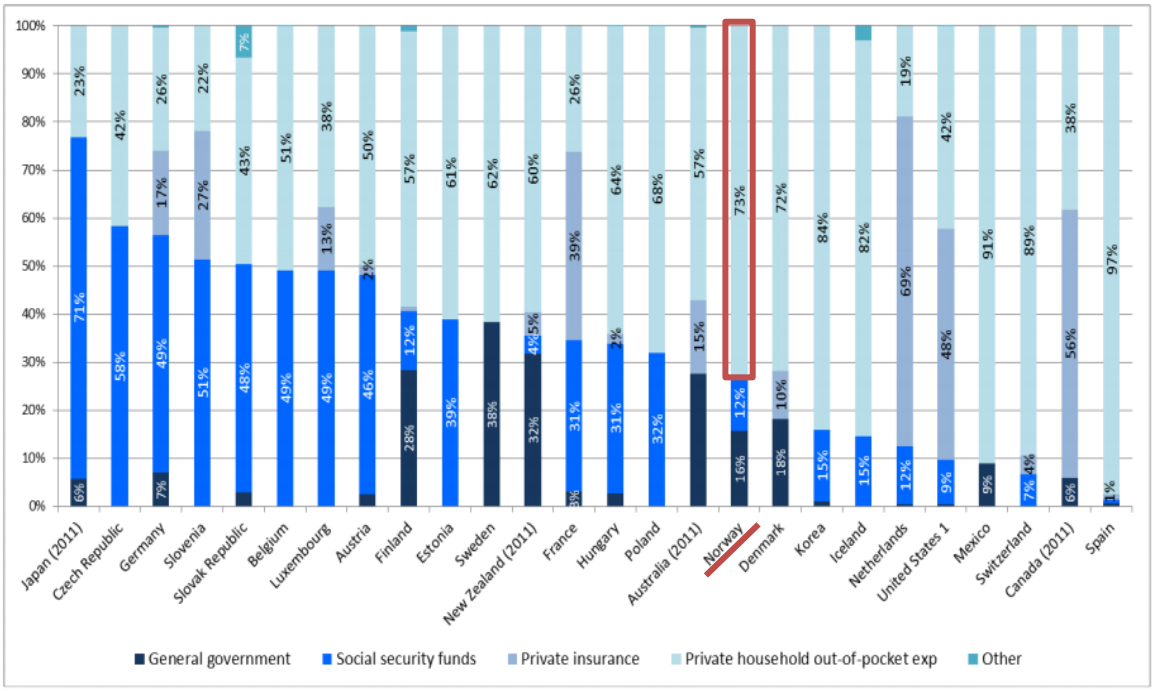
[3] Lovdata. (2018) https://lovdata.no/dokument/NL/lov/1983-06-03-54, Retrieved April 18, 2018.

[4] Individuals between 19 to 20 years old in group (5) do not have free services from public dental clinics. They have to pay 25% of costs of dental services received in public clinics, while the rest 75% is covered by the public services.

Public dentists working in public clinics are employed by county municipalities and receive a fixed salary (Grytten & Skau, 2009). This salary is determined by the county following negotiations with the representatives of the dental association of the county (Bærø, 2018).

Private sector

Most adults over 20 years of age have to pay for their dental services, and almost all the dental care services of the adults are fulfilled by private practitioners in the market (Grytten, et al., 2007). However, exceptions are made when an adult patient applies to one of 15 special conditions, such as rare medical conditions, periodontitis, bite abnormalities, tooth development disorders, and so on[5]. The Norwegian Health Economics Administration (called HELFO) partly reimburses the resultant expenditure of these special conditions. If a patient is undergoing financial difficulties, they can apply to the Norwegian Labor and Welfare Administration (called NAV) for support for their dental treatment in accordance with the Social Services Act.



[Figure 5. Spending on outpatient dental care by financing agent in 2012]

The situation explained above is depicted in Figure 5. Approximately 73% of out-patient dental care expenditure is obtained from the out-of-pocket expenses of patients, and roughly 16% and 12% is financed by the general government and the social security funds

[5] HELFO. (2018). "Hvem betaler tannlegeregningen din?» https://helsenorge.no/betaling-for-helsetjenester/hvem-betaler-tannlegeregningen-din#Tannbehandling-for-voksne", Retrieved March 7, 2018.

respectively[6]. According to a TNS Gallup survey in 2013, 88% of the 5,422 respondents above the age of 20 years had visited a dental clinic in the last two years and 77% during the previous year (Grytten, et al., 2014). The average expenditure of respondents who visited dental clinics over the previous year in 2012 was 3,200 NOK (Ibid). This expenditure seemed low, considering the Norwegian GDP per capita in 2012 was 591,455 NOK[7], accounting for 0.55% of the total GDP per capita of 2012. This low expenditure on dental services in the private market has supported the unnecessity of introducing universal social security funds for dental care for adults in Norway (Grytten, 2010).

However, this does not necessarily imply that adult patients consider the prices of dental treatments as affordable. Early SSB statistics show that 51% of Norwegians consider dental treatments too expensive (SSB, 2017a). In the latest survey with 1,003 respondents, one of every three respondents affirmed that they had not visited dental clinics because of economic reasons (Birkelund & Heyerdahl, 2018). Moreover, 89% of the respondents believed that dental health should be part of public healthcare schemes (*helsetilbudet*) so the expenditure of dental treatments could be partially or fully covered by the public sector, similar to other healthcare services (Dagsavisen, 2018). This demand was placed predominantly by the older respondents.

The right of Norwegian private dentists is often criticized as the main reason for increasing prices of dental services. Instituted on the 15th of November, 1995, Norwegian private dentists were given the right to freely establish their clinic in the place of their choice (The Norwegian Ministry of Health and Care Services, 2007). In addition, they can freely set prices for their services without negotiating with government agencies (Ibid). Norway previously had a fixed fee system wherein the dental fees were determined in the annual negotiations between the Ministry of Government Administration and the Norwegian Dental Association (Grytten & Sørensen, 2000; Grytten & Dalen, 1997). As mentioned before, there is nearly no reimbursement of ordinary dental treatments for adult patients, therefore private dentists do not receive any reimbursement from the government. Thus, the income of private dentists is determined by the fees paid by their patients that they can freely determine.

[6] Paris, V. et al. (2016). "Health care coverage in OECD countries in 2012", OECD Health Working Papers, No. 88, OECD Publishing, Paris. http://dx.doi.org/10.1787/5jlz3kbf7pzv-en Retrieved March 7, 2018.

2 Literature review

This chapter provides an overview of the previous researches into dental services and the competition in dental market. First, this researcher will give a general description of dental services that distinguish the dental market from other markets. Second, the researcher will review the previous researches on dental market. Competition and non-competition including monopoly and other theories will be explained. Most of the studies referred to in this chapter used the density of a dentist or a clinic as an important variable in analyzing the prices of dental services in the market, when trying to find whether competition works in the dental market.

Due to the limited number of researches about dentistry and competition in the dental market (Chirico, 2013), the majority of the researches reviewed here are about the primary physician market. Despite a few distinctions between the primary physician sector and the dental sector, dental studies often refer to physician studies in their analysis (Grytten & Skau, 2007; Sintonen & Linnosmaa, 2000; De Vany, et al., 1983) and a physician research extends the physician analysis model to dental market data in a part of the research (Newhouse, 1970). This interdependence occurs because dental illness and organization of dental care are thought to be closely tied with health care in general (Sintonen & Linnosmaa, 2000). Hence, competition in the dental market is very similar to that in physician market[7](Chirico, 2013). For these reasons, several studies on the primary physician market are included along with dental researches because similar effects from the common and important characteristics are assumed to be present in both the markets.

2.1 Dental services

Like physicians, dentists provide three different services to their patients: firstly, advising patients about diagnosis and treatment, secondly, offering preventive, diagnostic, and

[7] There are several differences between the dental market and the physician market. A major difference is in the area of health care insurance. Health care insurance and is more comprehensive in the physician market than in the dental market. However, in the dental market, patient copayment is smaller and there is almost no third-party payers in the dental market (Grytten, 2017). These differences will be explained in the later sections.

therapeutic services, and thirdly certifying the presence of illness or disability in the patient to other interested parties (Sloan & Hsieh, 2012).

For the past several decades, health economists have discussed how particular features of physician's services influence the physician market. Three features that make the physician market as unique have been identified. First, the asymmetry of information between the physician and the consumer has received a great deal of attention from researchers (Gaynor & Town, 2011). In addition to the complex nature of the health services, consumers are generally not well informed about the services they receive, the prices and the quality of the services, and their alternatives available in the market (Gaynor & Town, 2011; Frech III, 1996; Newhouse 1970). As a result, from their position of superiority over their patients, the physicians derive and exercise market power in deciding the type and amount of the service to offer to the patient. This has been viewed as one of main factors hindering competition in physician and dental market (Grytten, 2005; Newhouse & Sloan, 1972).

Second, unlike standardized goods in the manufacturing sector, physician's services vary considerably in quality and price depending on the individual physician (Rizzo & Zeckhauser, 1992). The physician service varies according to style and competence of a physician, and the locality where the physician practices. Therefore, there is a wide range of price dispersion for the service of a physician in a region (Chirico, 2013; Pauly & Satterthwaite, 1981; Newhouse & Sloan, 1972). Consequently, these features intensify confusion for the consumer when comparing the quality and prices of physician services (Rizzo & Zeckhauser, 1992). Hence, consumer information is regarded as a crucial component in physician market (Van Ginneken, et al., 2010; Sintonen & Linnosmaa, 2000; Rizzo & Zeckhauser, 1992; Dranove & Satterhwaite, 1992; Grembowski et al, 1988; Newhouse & Sloan, 1972).

The third point about the dental services, which may also apply to physician's services, relates to two high costs for the patients: search cost and transaction cost (Grytten, 2005; 2000; Fieldstein, 1979). Under the situation where patients have heterogeneous information and very less knowledge about the optimal amount and types of services necessary for them, the patients have to incur high cost to find a suitable dentist who can meet their needs. Consequently, the transaction cost of switching the dentist is high (Grytten, 2005; 2000). Therefore, having incurred a great cost to find a suitable dentist, the patients would naturally be reluctant to change the dentists for another one. Some researchers point out that these high search costs and transaction costs hinder competition in dental market, as patients become less

responsive to rise in price of their doctors and demotivated to switch their dentists (Grytten, 2000; Frech, III, 1996).

Based on these three characteristics above, physician's services have been characterized as "reputation goods." According to the definition by Pauly and Satterthwaite, a reputation good is "a product or service for which (a) seller's products are differentiated, and (b) consumer's search among the sellers is conducted primarily by asking relatives, friends, and associates for recommendations (Pauly & Satterthwaite, 1981: 488)." Regarding dental services, it has been generally thought that several of the dental services are "experience goods" (Grytten, 2005; Grytten & Sørensen, 2000). Without experiencing dental service directly, a patient cannot evaluate the quality of the dental service because it is challenging to obtain high-quality information in the dental market.

Although the authors highlight direct or indirect patient experience in characterizing dental and physician service respectively, they have different views on the necessity of increasing consumer information in dental and physician market. The former set of authors claims that the higher the number of physicians is, the lower is the quality of consumer information (Pauly & Satterthwaite, 1981). Since physician's service is a "reputation good," consumers might be confused by the information overload caused by the increasing number of physicians in their community. Thus, consumer search becomes less efficient and it may lead increases in prices of physician services. Meanwhile, the latter set of authors argues that consumers can benefit from the increase in public consumer information (Grytten, 2005; Grytten & Sørensen, 2000). More information enables patients to compare the available options so that it can be relatively easy to switch their dentists without shopping around dental clinics.

These different perspectives on consumer information could result from the distinct features of dental care. As mentioned above, dentists' services have features that are common with primary physicians. For example, dentists provide their services in a small local community, the decision of treatment is made by a single doctor, and the demand for dental services is also closely related to the local population (Dunne et al., 2013). However, dental services and primary physician services are not identical. Dental services have been regarded as more standardized than other health services, so it is easy to replace one dentist with another dentist (ibid). Besides, Sintonen and Linnosmaa specify the six distinct features of dental as follows:

First, the number of dental diseases is relatively few and the dental diseases occurrence is (more) predictable than is the case with many others. Second, patients generally experience the same dental procedure several times during their lifetime are therefore able to learn from experience about the quality of dental service. Third, dental diseases are relatively easy to diagnose and almost all relevant information for treatment decisions are obtained from X rays and photos. Fourth, there is probably a wide variety of alternative treatments available to treat a given disease than in most other cases. Fifth, there are extensive prevention possibilities, and, in dental care, prevention may actually save resources, which is often not the case in other forms of medical care. Sixth, except for dental accidents and toothache, dental care is seldom "emergency" care and untreated dental illnesses rarely have dramatic consequences on an individual's health.

(Sintonen & Linnosmaa, 2000: p.1254)

Thanks to these six features, individuals can more freely plan and spend time in deciding dental services and have more freedom to choose dental service provider. Thus, the authors believe that this relatively more freedom in choice of dentist contributes to increase the price elasticity of individual's demand for dental care (ibid).

2.2 Dental market

A market is "the area(s) within which prices are determined (Stigler & Sherwin, 1985: p.555)", so the main function of the market is "to facilitate the making of exchanges between buyers and seller (ibid)." The extent of competition, ranging from pure monopoly to perfect competition, determines the market structure (Grembowski et al., 1988). As seen in the previous section, dental (or physician) market has been regarded as a market distinct from others due to distinguishing features of dental service. These features heavily affect to the extent of competition, leading to imperfect competition in the market.

2.2.1 Competition

Competition can be defined as "a multifaceted process whereby producers strive to attract customers from their rivals by providing a more appealing combination of price and quality" (Siciliani et al., 2017: p.103). Many health economists view competition as an efficient instrument to allocate resources effectively while yielding best outcomes (welfare) to providers, consumers, and the society (Barros, et al., 2016; Goddard, 2015). Competition

offers incentives for health services providers to be more efficient while increasing their productivity, minimizes treatment costs to consumers while offering better service in accordance with consumer needs, and encourages innovation to have more efficient methods and more effective outcomes (Siciliani, et al., 2017; Feldstein, 1979). Moreover, in the situation which the efficacy of regulatory oversight is limited, allowing competition can be a wise choice (Armstrong & Sappington, 2006). Thus, many countries like Norway, the Netherlands, and Germany have introduced competition in various sectors of their health care system (Siciliani, et al., 2017; Bloom, et al., 2015; Van Ginneken, et al., 2010).

However, the concerns about competition also exist. Opponents of competition caution undesirable consequences of competition, for example, reduction in health service quality, and exacerbating inequity in the access to health services (Barros et al., 2016). Some of them express their worries that efforts for better efficiency and higher productivity in competition may overlook the fundamental aim of health care, to protect the sick (Goddard, 2015). Even in competition, it has been pointed out that providers may be interested only in certain indicators or aspects which are measurable or beneficial for them by neglecting others that are unnecessary from their points of views (Barros et al., 2016).

As health economists have contrary perspectives on competition, several researchers have investigated whether competition is an effective instrument in improving the quality or lowering the costs in the dental and physician markets, where there exists a large number of sellers and asymmetric information (Gaynor & Town, 2011).

A dental market has great potentials for competition to work in it. According to Mankiw's explanation (2017), there are many producers and consumers in a competitive market. Since producers offer almost the same goods or services, consumers can switch producers if they are not satisfied. Also, consumers' buying power is not a significant factor as each consumer purchases a small amount. Thus, producers and consumers have a negligible impact on the market price in a competitive market (Mankiw, 2017). As mentioned before, dental services can be characterized as more standardized, predictable, and comparable than other health care services, so a consumer seems likely to have greater opportunity to switch from a dentist to another easily if the patient is not satisfied with services offered (Dunne, et al., 2013; Sintonen & Linnosmaa, 2000). Also, due to the lack of third-party payer in dental care market for adults, the relationship between consumer demand and price could not be distorted by a problem, such as moral hazard (Grytten, 2017; Siciliani, et al., 2017).

Much of the research on competition in health market is focused on the hospital competition, especially the relationship between hospital concentration and prices (Chirico, 2013; Gaynor & Town, 2011). Yet, empirical research on competition in physician market is scarce, and there are even fewer researches in dental market competition due to lack of data (Gaynor & Town, 2011; Grytten, et al., 1990). Fortunately, there are four previous empirical researches highly relevant to this thesis topic that examine competition in a private dental market in Scandinavia.

Grytten and Sørensen (2000) find a weak competition effect in the Norwegian private dental market after a deregulated fee system was introduced in the private dental market in 1995[8]. In 1997, they obtained through questionnaires and used a wide range of data on fees, characteristic of practices, treatment profiles, and other diverse factors that influenced dentists' price setting. Their results show competition is likely to work in the market; the fee for a consultation decreases as dentist density rises and the mean expenditure for items of treatment per consultation reduces when competition increases. In addition, other results are against the conventional supplier-inducement hypothesis, showing that the number of recall visits and the number of types of treatment per consultation does not increase with the increasing dentist density. The researchers concluded that the private dentists did not exploit their power to control the market, and this can be interpreted as a result of the dentists' economic interests being substantially constrained by professional norms and concerns about patients. However, caution should be exercised when using these results, because this study analyzed only the short-term effects of competition after the deregulation system was introduced (Grytten & Sørensen, 2000).

A similar research was conducted in Finland. Widström and her colleagues examined the determinants of price setting in the Finnish dental market after the National Dental Care Reform in 2001-2002[9]. This Reform increased the competition in the dental market between public and private sector. Through a questionnaire administered to private dentists in Finland's ten largest cities and regression analysis of the collected data, they conclude that price competition is insignificant in the market. 78.1% of the respondents said that they did

[8] Since this reform, private dentists have been able to set up prices freely for their practices (Grytten & Sørensen, 2000).

[9] After the Reform, Finnish adults have been allowed to choose between private services and the Public Dental Services (PDS). Earlier, adults were prohibited from using public services (Widström, et al., 2011).

not consider other dentists' pricing decision when making their pricing decision, while only 17.1% answered that competition affected their price setting. They also show interesting results that prices were higher in cities with high density of dentists than in cities with low density, implying that the dental market was not functioning competitively (Widström et al., 2011).

Even in a dental market, competition can occur across different types of services and specialties. The two following empirical researches have proved this point. Chirico (2013) divides dental services into two categories: first-stage services like examinations and diagnostics, and follow-on services that are any subsequent treatments such as tooth extraction, root canal, and crown. Calculating competition variables, the number of clinics within specific distances (1 kilometer and 5 kilometers) from each clinic in Sweden, she discovered from her log regression model that a 1% increase in the number of clinics brings 0.0089% decrease in prices for "Basic examination & diagnostics" related to "Tooth extraction". Her simulation result[10] is consistent with the main result. She concluded that competition has unequal impact on price setting of different dental services, between first-stage service and follow-on services, implying that price competition is more intense for first-stage services compared to follow-on services. For this heterogeneous impact of competition across services, she found two reasons; relatively well-established consumer information about the first-stage services, and high switch cost of patient after the initial visit.

By analyzing the data obtained from a questionnaire in 2007 to a regression model, Grytten and Skau (2009) suggest that competition works across different dentistry specialties in Norway. Their results show that Norwegian specialists such as oral surgeons and orthodontists, who have exclusive professional skills that general dental practitioners do not have, such as oral surgeons and orthodontists, have higher net incomes[11] than the general dental practitioners. The difference is statistically significant at 0.0001 level. Other specialties like prosthetists, endodontists, and periodontists, who confront competition with general dental practitioners, have slightly higher net income which is not statistically significant.

[10] The simulation result showed that an increase of one clinic within 1 km of another clinic would decrease prices by up to 0.56% for the first-stage services and up to 0.46% for follow-on services (Chirico, 2013: p.7).

[11] The net income per hour of oral surgeons (NOK 1,110) is 44% higher than that of general dental practitioners (NOK 624), and that of orthodontists (NOK 923) is 32% higher than that of general dental practitioners (Grytten & Irene, 2009: p.461-462).

Based on the results, the researchers explain that, in price setting, competition seems to work between general dental practitioners and specialists who do not have clear distinction in their profession practices from general dental practitioners. However, specialists having professions that are clearly differentiated from general dental practitioners' practice are exempted from the competition with the general dental practitioners. Also, their higher net income per hour suggests that they seem to benefit from their monopoly power in the market. At the same time, the authors open the possibility that the result could be interpreted in an opposite way. That there is no significant difference between the net incomes of the general dental practitioners and the other three specialists could mean that both groups charge monopoly prices, if the reference group (general dental practitioners) charge monopoly prices[12]. Since the net income of specialists are based on the reference group, there would be no difference if both groups do the same (Grytten & Irene, 2009).

2.2.2 Non-competitive market

There are two aspects which make a dentist (or physician) 'a price setter' in the market. Asymmetric information resulting from consumer ignorance and payment system in the dental market empowers dentists to set prices of their services. As an advisor and a provider of dental service, a dentist considerably affects to the type and amount of service rendered to a patient. Due to the complex nature of health services, the patients are not well informed about the extent and the quality of the service being offered and the optimal amount of the service they need (Grytten, 2005; Sintonen and Linnosmaa, 2000; Frech III 1996; Newhouse, 1970). In this situation, personal economic interested of a dentist can intervene in the decision about which type, and amount of services are to be provided to patients (Feldstein, 1979).

In a market that is based on fee-for-services (FFS) system, health service providers could have the motivation to offer more and expensive services to patients, as by such means they could earn more income according to the number and types of services offered (Grytten, 2017, 2005). Thus, FFS has strengths to yield high-quality services to patients and higher productivity of health services providers. However, there is the risk to over-production and distorting consumer demands for the sake of economic interest of the providers (Grytten,

[12] However, the authors also mention that there are no empirical studies that show that the general dental practitioners in Norway charge monopoly prices (Grytten & Irene, 2009).

2017; Siciliani, et al., 2017; Grytten, et al., 2007; Grytten, 2005). In addition to FFS system, if it is free price setting in the market, it is likely to lead to increased costs since the providers as price setters could freely set prices of their services (Sloan & Hsieh, 2012; Grytten, 2005; Feldstein, 1979).

These two features above can be the explanatory factors of why prices of services do not decline as the number of providers in a dental market increases. This is contrary to the conventional economic principle that prices decline as more suppliers enter the market. Therefore, health economists have attempted to discover the features and the impact of these non-competitive aspects in the market. These previous empirical studies on non-competitive dental (or primary physician) market can be categorized into two groups; first, researches on monopolistic competition in the market, and second of researches based on supplier-induced demand (SID) and target income (TI) hypothesis. Both have a common basis in that dentists (or physicians) have exclusive market power to set up prices as they wish, so they charge prices higher than the price indicated at the point of equilibrium between supply and demand in a competitive market. However, the approaches of the researchers are different. Researchers with the monopolistic competition focus on determinants influencing supply, such as entry barriers that exist in the market (Doherty, 1981). On the other hand, the other research group are concerned over the behavior of dentists (or physicians) derived from asymmetric information in the market. The main interest of this research group is about the manipulation of the consumer demands or the breaching of the price setting mechanism consisting of the forces of supply and demand in the conventional market.

Monopolistic competition

There is a general tendency to describe the situation in the dentist (or physician) market as monopolistic competition. Monopolistic competition is different from monopoly. Monopoly usually implies one provider who has the power to control the prices in the market. Monopolistic competition is a market with a quite number of providers who still have some power to set price of their product in the market (Sloan & Hsieh, 2012). Thus, monopolistic competition represents a mix of two features, competition, and monopoly. In the context of dental (or physician) market, monopolistic competition describes the situation in which prices are constrained by competition as there are enough number of competing dentists (or physicians) in a given geographic area, which defeats the oligopolistic situation. However,

because of consumer ignorance, the dentist (or physician) has a strong market power to be a price setter (Gaynor & Town, 2012; Sloan & Hsieh, 2012; Frech III, 1996; Dranove & Satterthwaite, 1992; Pauly & Satterthwaite, 1981).

Newhouse (1970) claims that consumer ignorance about price and quality of services catalyze monopolistic element in a physician market. His result shows that the physician-population ratio in the U.S.A has a positive and statistically significant impact on physician fees by analyzing data of physicians and dentists. He explains the reason that low cross-elasticity of patients in changing their doctors enables each physician to act like monopolists to their patients (Newhouse, 1970). The results of researches that followed discovered a positive association of prices with the ratio of dentists to population, which supported the results of the Newhouse study (Widström, et al., 2011; Kushman & Shceffler, 1978).

A dentist (or a physician) in monopolistic competition is illustrated as a price setter in monopoly situation (Gaynor & Town, 2012; Sloan & Hsieh, 2012; Frech III, 1996; Pauly & Satterthwaite, 1981). Monopoly is referred to as an antonym to competition (Grembowski et al, 1988; Doherty, 1981). Frech III defines monopoly as "each independent physician can raise his fees without fear of losing any patients to other physicians" (Frech III, 1996; p.74). Poor consumer information exaggerates heterogeneity of products in the minds of consumers. Thus, if a service price increases, patients would visit the physician less, rather than switch and go to another physician instead. This situation can be described as one of zero cross-elasticity (Frech III, 1996).

Likewise, the demand for healthcare services has been characterized by low elasticity (or inelasticity) of demand in response to price fluctuations (Ketel et al., 2018; Sloan & Hsieh[13], 2012; Feldstein, 1979). In this condition, dentists (or physicians) set prices like isolated monopolists, so they can generate more gains by exploiting the monopoly power (Frech III, 1996; Grembowski et al, 1988). Thus, the cumulative impacts of monopoly are higher prices and lower output as compared to the prices that a more competitive condition would produce (Dotherty, 1981).

[13] However, Sloan and Hsieh assert that the inelastic demand of individual for physician's services is only applied in the short run. In the long run, if the physician increases their service fees by a large amount, then an individual, particularly one without health insurance, may switch to another physician (Sloan & Hsieh, 2012).

The monopolistic behavior of a dentist (or physician) has been proved by revealing the relationship between dentists' income and the control of the number of dentists using entry barriers. Shepard (1978) compared the prices of dental services and the dentists' mean income between 35 states that did not approve dentist licenses obtained in other states, and 15 states that had reciprocity agreements recognizing dentist licenses from the each other states in the U.S.A. He discovered that prices and the income of dentists were 12–15 percent higher in the 35 states that had exclusivity and non-reciprocity in their licensing policy.

Dentists' monopoly power has been found in recent studies as well. In a recent study, Ketel and his colleagues (2018) used data from up to 22 years after lottery to enter dentistry school was introduced to prove that the Dutch dentists extract a monopoly rent in the market. Their results showed that the Dutch dentists earn approximately €50,000 more than they would earn in their next best alternative employment. The authors explained that the supply of dentists restricted by the quota and other diverse barriers has led this monopoly rents (Ketel et al., 2018).

Hence, the monopolistic competition analysis is one of useful tools to explain non-existence of competition in the market despite the increasing number of dentists. Meanwhile, there is a critique that monopolistic competition may not be an accurate description of a physician market anymore due to the existence of insurance (Gaynor & Town, 2012). This critique seems to be more relevant to the primary physician market where there is a comprehensive health insurance. However, monopolistic competition can still be relevant to the dental market, where FFS system is dominant, and there is no third-party payer.

Supplier-induced demand (SID)

Most research of the second group, non-monopoly and non-competitive studies, are about supplier-induced demand (SID). These studies explain that the number of dental (or physician) services provided to patients would be changed through manipulation if a dentist (or physician) is more concerned with his/her own interest[14](Grytten, 2017; Sloan & Hsieh,

[14] 'Change' here means a decrease in the number of services delivered to a patient as well as an increase in the number of the services. Iversen (2016), and Sloan & Hsieh (2012) explain that the number of the health services provided by a physician seems to be reduced under capitation system in which the physician has a financial incentive to deliver less services. Also, the same decreasing tendency can occur if a physician values his/her leisure time more than taking care of a patient. However, this research focuses on the dental market for the

2012). In FFS system, a dentist (or physician) tends to increase the quantities of services to a patient by providing unnecessary services to earn more income (Grytten, 2017).

According to Sloan and Hsieh (2012), demand curves are stable in standard economic theory. However, in SID hypothesis, for the sake of a health service supplier's interest, the supplier shifts out the demand curve for his/her services by abusing consumer ignorance (Sloan & Hsieh, 2012). This shifting effort takes diverse forms, for example, making a revisit appointment or prescribing a service which seems unnecessary (or not beneficial) to the patients (ibid).

Several researches have tried to prove SID hypothesis in the dental market. Manning and Phelps (1979) revealed a result which is in line with SID. Their result showed a positive correlation between the number of dentists per 100,000 population and the amount of service demands, thus supporting the idea that dentists can shift the consumers' demand curves. Grytten and Holst (1990) found the results that demand and utilization of dental services in Norway are influenced by supplier inducement, by showing significant positive correlations between elasticities for probability of demand (0.62), and for expenditure for dental services (0.28) on the one hand and dentist: population ratio on the other hand[15].

However, an important critique has been raised by other economists in the SID hypothesis. The critique claims that the positive correlation between the density ratio and content per visit is the outcome of increased consumer demand being met (Sintonen & Linnosmaa, 2000; De Vany, et al., 1983). This can occur since patients' time cost reduces as the number of dentists in given population increases (De Vany et al., 1983). Despite the critique, the SID hypothesis is still a valuable framework to describe a non-competitive dental market.

Target income (TI) hypothesis assumes that physicians set prices and outcomes of their services to reach their target income. TI is often referred as a motivation for SID (Sloan & Hsieh, 2012). When the increase in the number of dentists (or physicians) in a given population causes less demand per dentist (or physician) in a market, dentists (or physicians)

Norwegian adult, which is based on FFS payment system, the explanation of SID in the decreasing the number of services delivered to a patient is not suggested here.

[15]However, Grytten and Holst research cannot be applied to the current Norwegian dental market because it was done when Norway had a fixed price system for dental care before November 1995.

will charge higher prices to the reduced quantity of their services offered in order to earn their target income (Sloan & Hsieh, 2012; Feldstein, 1979). In other words, the lesser is the demand per dentist, the higher will be the prices charged (Sloan & Hsieh, 2012). Therefore, TI hypothesis sheds light on the positive relationship between price freely set by health service providers and the high physician-to-population ratio (Sloan & Hsieh, 2012; Sintonen & Linnosmaa, 2000; Pauly & Satterthwaite, 1981).

However, the TI hypothesis has not been assessed empirically due to its conceptual limitation, like lack of means to discover how the dentists determine their income target (Sloan & Hsieh, 2012). Despite such difficulties, Pauly and Satterthwaite (1981) showed that a positive and significant relation between the physician-population ratio and price in the 1970s dental market in the U.S.A.

3 Method

3.1 Data

As mentioned previously, Norway's dental service is divided into the private and public sector. In order to analyze the competition in both sectors, two main data sources were used to obtain data on prices, as well as the number of dentists and clinics in Norway. General statistics data were collected from Statistics Norway (SSB).

3.1.1 Data sources

Data on the private sector was provided by Hvakostertannlegen.no, which is the price portal website for dental services in Norway operated by the Norwegian Consumer Council (*Forbrukerrådet*). The Consumer Council belongs to the Norwegian Ministry of Children, Equality and Social Inclusion, and it operates three price portal websites to provide consumers with the price information for dental services, electricity, insurance, and banking services[16].

Hvakostertannlege.no offers a broad range of detailed price information for individual clinics, both public and private, throughout Norway, enabling consumers to easily find and compare the prices of clinics in the region they live in. According to Norwegian regulation[17], dentists are obliged to provide the prices of all the services they offer to their patients on the Hvakostertannlegen.no. The number of general dentists and clinics, and the prices for each of the clinics' services, were collected from this website in March 2018. After excluding invalid results, 1,234 private clinics and 2,426 dentists were included in this research.

Regarding data on the public sector, data was collected from each county's website in Norway as each county (fylke) is responsible for its public dental service. Besides taking care of the prioritized groups, public dental clinics provide dental services to adults, so each county annually publishes prices of dental services in their public clinics on their official website. However, Oslo is excluded from the analysis of public clinics, since public dental

[16] Forburkkerrådet. https://www.forbrukerradet.no/ Retrieved August 30, 2017.

[17] Lovdata. "Forskrift om prisopplysninger mv. for varer og tjnenester-prisopplysningsforskriften," https://lovdata.no/dokument/SF/forskrift/2012-11-14-1066, Retrieved October 16, 2018.

clinics in Oslo do not offer services for adults who do not belong to its prioritized groups[18]. Most counties provide their public clinic information, the number of clinics they have, and how many dentists work on their employee list. However, Østfold and Troms counties did not offer information for how many dentists work in each clinic. As a result, the legeliste.no website was used to establish the number of dentists working in those clinics, because a number of the public clinics were not registered on Hvakostertannlegen.no. This data collection was completed in March 2018 and 1,106 dentists working at 419 public clinics were included in the analysis.

SSB is also an important data source. The number of inhabitants over 20 years old[19], the median income after taxation, and the average square meter price for freeholder housing (*selveierboliger*) in each Norwegian municipality were used in this analysis. These were collected in March 2018; however, the most recent available data of all three statistics were 2016 data at the time. The results can be found in Appendix 1.

3.1.2 Data level: Trade district level

Defining the geographic market is vital in analyzing competition, as health-care competition has a strong geographical element (Dunne et al., 2013: p.465). Previous research on competition defined the geographic markets by geographical criteria (Chirico, 2013; Noether 1988; Pauly & Satterthwatie, 1981) or by political context (Bloom, et al., 2015). In previous Norwegian research on competition, trade districts (*økonomiske regioner*) have been applied to define the range of market in competition (Grytten & Sørensen, 2000). There are currently 89 trade districts in Norway, except for the Svalbard areas, and these are divided by such criteria as labor market and trade between municipality[20]. Based on population size, labor market (the number of commuters among the municipalities), and trade statistics, SSB divides 89 trade districts and all districts have their central regions functioning as a hub location to smaller municipalities nearby (Grytten & Sørensen, 2000; Hustoft, et al. 1999).

18 Oslo Kommune. "Tannhelse og tannlege." https://www.oslo.kommune.no/helse-og-omsorg/helsehjelp/tannhelse-og-tannlege/hvem-far-gratis-tannbehandling/ Retrieved March 5, 2018.

19 SSB. "11805: Population 31.12., by age (M) 2015 – 2016." https://www.ssb.no/en/statbank/table/11805 etrieved March 5, 2018.

20 Classification of trade districts, SSB, https://www.ssb.no/en/klass/klassifikasjoner/108/versjon/966/om. Retrieved March 21, 2018.

It seems a reasonable choice to apply the trade districts level in competition research for two reasons. First, it includes municipalities which do not have dental clinics in their regions. A small population is sparsely distributed in Norway. According to SSB population data in 2016, 266 of a total 428 municipalities[21] had less than 5,000 inhabitants in Norway and only 14% of the whole population lived in those small 266 municipalities. As a result, 78 municipalities are so small that they have neither public nor private clinics (Grytten, et al., 2014). Utilizing the criteria of trade districts allows all municipalities to be included in the analysis, regardless of the existence of dental clinics.

Second, geopolitical criteria do not correspond to market definitions. Conventional research used to rely on geopolitical boundaries, such as counties, to define the market. However, distinctions by geopolitical criteria could generate a measurement error as these boundaries may not reflect the practical features of the market in the areas (Gaynor & Town, 2011). For example, geopolitical criteria do not consider the dependent or hierarchical relationships among neighboring regions caused by economic conditions, for example labor market situation, if these relationships exist. Since trade districts are set up by economic factors (labor and trade market among nearby municipalities), the trade district level is likely to correspond better to the market definition.

All independent variables' data used in this research was collected at the municipality level, and was then reorganized at the trade district level in accordance with SSB criteria. Data from both the private and the public sector were classified into trade districts by either postal code or address.

3.1.3 Data set

After collecting all the data, two data sets were made for analysis in this research:

Data set I: All data from the private and the public sectors

Data set II: All data from the private sector, and 87 public clinics in 5 counties except for 4 big cities in these counties

[21] In 2016 data, there were 428 municipalities, but from January, 2018, there are 422 municipalities in Norway after reformation.

The first dataset includes all data from both the private and the public sectors, so the results from this dataset are expected to provide a broad picture of the current situation in the Norwegian dental market. By adding 1,234 private clinics and 419 public clinics in 89 trade districts, the total observations of <set I> are 1,653.

The second data set focuses on analyzing the dental market for adults. As Chapter 1 described, Norwegian adults pay for most dental treatment they receive, except for several special cases. They visit private clinics to have treatment rather than public clinics, as public clinics mainly aim to provide services to their prioritized groups, such as the young. However, adults living in remote areas where there are no private clinics visit their public clinics for dental treatment. Hence, public clinics in these remote areas were included in <set II> in order to reflect this situation.

The five remote areas were determined by SSB statistics: Telemark, Aust-Adger, Sør-Trøndelag, Nordland, and Finnmark[22]. These were the 5 counties who provided the most public dental services to ordinary adults, as over 10% of their public clinic services were for adult patients in 2016, as described in Appendix 2. In order to maintain coherence between the other statistic variables, data from 2016 were chosen. Subsequently, 42 public clinics in these 5 counties were excluded as they are located in the trade districts with big cities (Trondheim, Arendal, Bodø, Skien) where there are no isolated areas. Consequently, 1,321 observations are in <set II>, adding 1,234 private clinics and 87 public clinics in 88 trade districts.

3.2 Variables

3.2.1 Dependent variable: Prices of 14 dental services

The dependent variable is the price in Norwegian Kroners (NOK) of each of the 14 dental services of individual clinics. Hvakosstertannlegen.no categorizes 7 different types of dental service: ①examination, ②tooth fillings, ③tooth extractions, ④periodontal treatments, ⑤root

[22]SSB. " 11961: Pasientbehandling i tannhelsetjenesten, etter pasientgruppe (F) 2015 - 2017" https://www.ssb.no/statbank/table/11961 Retrieved: June 25, 2018. Sør-Trøndelag became Trøndelag after merging with Nor-Trøndelag in January, 2018. In this analysis, public clinics in previous Sør-Trøndelag county were included by the 2016 criterion.

canal treatments, ⑥implant and crowns and ⑦braces[23]. As this research focuses on the relationship between price setting and competition in general dental practitioners, brace services offered by specialists (orthodontists) are not considered. As a result, there are 14 treatments in 6 different types of services analyzed in this research, and this is also applied to the data of 419 public clinics. The price information of all public clinics was gathered at each county website, and classified into 14 treatments. Appendix 3 displays detailed information regarding the 14 treatments and cost components in each service.

3.2.2 Independent variables

Density of dentists (*D*)

The density of dentist variable (*D)* in each trade district represents dentists per 10,000 inhabitants over 20 years old in each trade district.

$$D_i = \frac{\sum_{k=1}^{n} T_k}{\sum_{k=1}^{n} P_k} \times 10{,}000$$

n = the total number of municipalities in the trade district i
T = the number of dentists in the municipality k
P = the number of inhabitants over 20 years old in the municipality k
i = the trade district i *i= 1, 2, 3, …, 89 in <set I>, i= 1, 2, 3, …, 88 in <set II>

An increase in this variable means an increase in the number of dentists given the population in a community.

Hvakostertannlegen.no provides the number of dentists working in a clinic, dentists' names, and their professions. Since this research focuses on competition among general dental practitioners in the market, the number of specialists in a clinic are excluded. There are two reasons for this. First, the total number of general dental practitioners is much larger than that of specialists, and public concern over accessibility to health care services is mainly with regards to primary medical care (Sloan, 1976). Second, Grytten and Skau (2009) have already

[23] Hvakostertannlegen.no, "Behandlinger," https://www.hvakostertannlegen.no/behandlinger, Retrieved October 12, 2018

proved that there is no competition impact on specialists with orthodontist or oral surgeon professions in the Norwegian dental market, as mentioned in Chapter 2.

Density of clinics (*C*)

The density of clinic variable (*C)* in each trade district represents clinics per 10,000 inhabitants over 20 years old in each trade district, defined as

$$C_i = \frac{\sum_{k=1}^{n} L_k}{\sum_{k=1}^{n} P_k} \times 10{,}000$$

n = the total number of municipalities in the trade district i
L = the number of clinics in the municipality k
P = the number of inhabitants over 20 years old in the municipality k
i = the trade district i i= 1, 2, 3, …, 89 in <set I>, i= 1, 2, 3, …, 88 in <set II>

In the same manner as for the density of dentists, an increase in this variable represents an increase in the number of clinics given the population in a region.

This data, both private and public, was collected in the same manner as the collection of data on the number of dentists, and was also classified into each trade district. Special public clinics, such as emergency clinics and clinics in prisons in all counties, were excluded since these appear irrelevant to the visits of ordinary patients in a community.

Median income after tax (*I*)

The income variable is a median income after taxation (*I*) of all households in each trade district[24]. The value was calculated follows,

$$I_i = \frac{\sum_{k=1}^{n} (X_k \times M_k)}{\sum_{k=1}^{n} X_k}$$

n = the total number of municipalities in the trade district i
X = the number of inhabitants between 20-66 years old in the municipality k
M = the median income after tax of the municipality k
i = trade district i *i= 1, 2, 3, …, 89 in <set I>, i= 1, 2, 3, …, 88 in <set II>

[24] SSB. 06944: Inntekt etter skatt, etter husholdningstype. Antall husholdninger og median (K) (B) 2005 – 2016, https://www.ssb.no/statbank/table/06944 Retrieved March 7, 2018.

Later, each *I* was transformed to the logarithm (ln) in this thesis model in order to make its distribution of sample normal, and to check the elasticity of each dependent variable.

This variable is used for two purposes. First, it is a control variable in the price difference among regions which might be caused by the difference in the income level. The difference in median income was 174,651 NOK between the regions with the highest and lowest income levels. Second, it is a variable that examines the positive relationship between the income level and prices of treatment in a region. Providers in regions with a higher income level may charge higher prices in dental treatment.

Housing price (*H*)

Inputs of dentists play key roles in dentists' pricing decisions. These main inputs of dentists are office space, capital equipment, office staff and so on (Dunne et al, 2013). There were no available data on these dentists' expenditure data, such as rent, at the municipality level or at the clinic level. As a result, the average price of a square-meter of freeholders' housing in each municipality was used, as this reflects an economic feature of the real estate market in each region. Although this variable may not represent directly the actual rent fee of each clinic, the rent fee that dentists pay is affected by the real estate market situation in the same region.

SSB categorizes 6 different housing types, but only 4 of those housing types were considered in this analysis and classified into 3 types, adopting the housing criteria of the Norwegian Tax Administration (*Skatteetaten*)[25]: detached house (*enebolig*), separated house (*småhus*, including *rekkehus* and *tomannsboliger*), and apartment building (*boligblokk*).

In order to calculate this variable, three data sets for freeholders were merged: (1) the average price of square meter of three housing types in each municipality[26], (2) the number of those

[25] Skatteetaten. "Forklaring av ord og begreper om formuesverdi." https://www.skatteetaten.no/person/skatt/hjelp-til-riktig-skatt/bolig-og-eiendeler/bolig-eiendom-tomt/formuesverdi/annen-bolig-sekundarbolig/forklaring-av-ord-og-begreper/ Retrieved March 9, 2018.

[26]SSB. "06035: Selveierboliger. Gjennomsnittlig kvadratmeterpris og antall omsetninger (K) 2002 – 2016," https://www.ssb.no/statbank/table/06035. Retrieved March 9, 2018

housing types in each municipality[27], and (3) the average price of a square meter of three housing types at the county level[28]. The data of (3) at the county level was used to fill up missing data in the data of (1) at the municipality level.

The average price of a square-meter of freeholders' housing at the municipality level was obtained, as below. Like the income variable, the logarithm transformation was applied to this variable in order to make it normally distributed and to observe its elasticity.

$$H_i = \sum_{k=1}^{n} \left(\frac{PE_k \times NE_k}{TH_i} + \frac{PS_k \times NS_k}{TH_i} + \frac{PB_k \times NB_k}{TH_i} \right)$$

$$TH_i = \sum_{k=1}^{n} (NE_k + NS_k + NB_k)$$

n = the total number of municipalities in the trade district i
P = price of house
N = the number of houses
E = the number of detached houses in the municipality k
S = the number of separated houses in the municipality k
B = the number of apartment buildings in the municipality k
TH_i = the sum of total number of those housing types in the trade district i
i = the trade district i *i= 1, 2, 3, …, 89 in <set I>, i= 1, 2, 3, …, 88 in <set II>

3.3 Model

Multiple variable regression with a cluster option is a method used to analyze the two data sets in this research. Two different types of regression are utilized for different aims. The first type of level-level linear regression (1) is used to examine the increasing cost related to the change in density variables, while the income and housing price variables are transformed into natural logarithms. Although the income and housing price variable are log-transformation, the regression (1) is regarded as level-level regression because the two density

[27] SSB. "06265: Boliger, etter bygningstype (K) 2006 – 2017," https://www.ssb.no/statbank/table/06265/ Retrieved March 9, 2018.

[28] SSB. "06035: Selveierboliger. Gjennomsnittlig kvadratmeterpris og antall omsetninger (K) 2002 – 2016," choose region as «Fylker», https://www.ssb.no/statbank/table/06035/ Retrieved March 9, 2018.

variables and dependent variable to be estimated are in natural units in the regression. The second type of regression (2) is log-log linear regression, to observe the elasticities of each independent variable into price. Each type of the two regressions consists of 4 models, and all 4 models have been applied to all 14 treatments in <set I> and <set II> respectively, as Table 1 illustrates below.

	Set I. All private and all public clinics Observation=1,653		Set II. All private clinics and the 87 public clinics in 5 counties Observation =1,321	
	1. level-level regression	2. log-log regression	1. level-log regression	2. log-log regression
Models	A	a	A	a
	B	b	B	b
	C	c	C	c
	D	d	D	d

[Table 1. Summary of model structure]

3.3.1 Multiple variable regression

Regression is used to study the relationship between the dependent variable and independent variable(s); how the dependent variable varies with changes in the independent variable(s) (Wooldridge, 2009). Multiple variable regression, widely used in economics, is a useful method to observe the simultaneous effect of independent variables on a dependent variable through the least squares principle that minimizes the sum of the squared residuals (Newbold, et al., 2013). Compared to simple regression analysis, multiple regression analysis is considered a better tool to predict the dependent variable, since more of the variation in the dependent variables can be explained by added independent variables. Consequently, this multiple regression analysis has more flexibility as it incorporates general functional form relationships by including each function of all independent variables in the equation, instead of relying on one independent variable in the simple regression analysis (Wooldridge, 2009).

In order to examine the relationships between price and independent variables, the four models below are designed in both regression types. The (1) level-level regression will show impacts of density variables on price from the estimated coefficient, which are presented in direct measurement form, Norwegian kroner (NOK). The estimated coefficients of the controlling variables of income and housing prices suggest how the price varies when there is a 1% increase in these controlling variables.

(A) $Y_{i,t,o} = constant + \beta_1 * D_i + \beta_2 * C_i + \varepsilon$

(B) $Y_{i,t,o} = constant + \beta_1 * D_i + \beta_3 * \ln I_i + \beta_4 * \ln H_i + \varepsilon$

(C) $Y_{i,t,o} = constant + \beta_2 * C_i + \beta_3 * \ln I_i + \beta_4 * \ln H_i + \varepsilon$

(D) $Y_{i,t,o} = constant + \beta_1 * D_i + \beta_2 * C_i + \beta_3 * \ln I_i + \beta_4 * \ln H_i + \varepsilon$

Y = price of service in an individual clinic, *o*
D = density of dentists in a trade district, *i*
C = density of clinics in a trade district, *i*
ln I = natural logarithm of median income after tax in a trade district, *i*
ln H = natural logarithm of average price per square-meter of freeholder's house in a trade district, *i*
i = the trade district *i*
t = the type of treatment among 14 treatments
o = the observation number of clinic in datasets

The models for the log-log regression (2) are the same as the level-level regression (1), except that all dependent and independent variables are changed into natural logarithm formation. The logarithm transformation is extensively used in economics, especially in analyzing cost data, as the transformation reduces skewness of cost distribution by making the distribution relatively normal. In addition to this strength, economists use this log transformation to discover elasticity, which is the coefficient estimate of an independent variable in log regression, as it indicates percentage differences (Glick et al, 2015). Therefore, the log-log regressions (2) will give the price elasticity of each independent variable.

(a) $lnY_{i,t,o} = constant + \beta_1 * lnD_i + \beta_2 * lnC_i + ln\varepsilon$

(b) $lnY_{i,t,o} = constant + \beta_1 * lnD_i + \beta_3 * \ln I_i + \beta_4 * \ln H_i + ln\varepsilon$

(c) $lnY_{i,t,o} = constant + \beta_2 * lnC_i + \beta_3 * \ln I_i + \beta_4 * \ln H_i + ln\varepsilon$

(d) $lnY_{i,t,o} = constant + \beta_1 * lnD_i + \beta_2 * lnC_i + \beta_3 * \ln I_i + \beta_4 * \ln H_i + ln\varepsilon$

ln Y = natural logarithm of price of service in an individual clinic, *o*
ln D = natural logarithm of density of dentists in a trade district, *i*
ln C = natural logarithm of density of clinics in a trade district, *i*
ln I = natural logarithm of median income after tax in a trade district, *i*

ln H = natural logarithm of average price per square-meter of freeholder's house in a trade district, *i*
i = the trade district *i*
t = the type of treatment among 14 treatments
o = the observation number of clinic in datasets

The first equations (A), (a), in two regression models, only include the two density variables of dentists and clinics, to provide a quick view on the price. Next, the density variable of dentists is presented in the second equations (B), (b), with two other controlling variables, income and housing price. In contrast, the third equations (C), (c) hold the variable of clinic density with the two controlling variables. The reason for separately applying the two density variables of dentists and clinics in different equations is to observe whether competition aspects might occur differently in the density of dentists and clinics. For example, even if the number of dentists grows, competition might not appear when more dentists work at one dental clinic. Conversely, the clinic is likely to gain more power in the market. The last equations (D), (d) include all 4 variables and these will provide comprehensive and simultaneous relationships of the independent variable on price. Due to the limited space, the results of (D) and (d) are presented and discussed in the thesis, and the rest are presented in Appendix 4 and 5.

Coefficients of independent variables are estimated using the least squares procedures (Newbold, et al., 2013). If a coefficient of an independent variable has a positive sign, it means that a price of a treatment (dependent variable) is expected to be increased by the size of the coefficient, as the independent variables rise by one unit while all the other variables are constant. In contrast, a negative coefficient sign means that the price is expected to be decreased as units of independent variables increases. In this competition analysis, if β_1 and/or β_2 have negative values, the result implies that competition works in the market as the higher densities of dentists and/or clinics are the lower prices of treatment in the market are. Positive coefficients of these density variables imply that dentists and/or clinics exercise their market power in the market. Each *p*-value ($0 \leq p \leq 0.1$) from regression results was used as a measurement to check whether the coefficient has a statistically significant impact on the price or not.

The error term, ε means 'unobserved' factors other than independent variables which affect the dependent variable in the relationship (Newbold, et al., 2013; Wooldridge, 2009). The

error term, ε, is assumed to be a random variable to the independent variable, so they are not linearly related. In addition to this assumption, ε is assumed to be normally distributed, having a mean of 0 and a constant variance (ibid).

In terms of multiple variable regression, caution must be exercised in multicollinearity and heteroscedasticity when analyzing cross-sectional data, since these may cause biased results in the regression. Multicollinearity occurs when more than two independent variables are highly correlated in the multiple regression model, making it difficult to distinguish which independent variable is actually related to change in the dependent variable (Newbold, et al., 2013; Wooldridge, 2009). Hence, a variation inflation factor test (VIF) was conducted to test multicollinearity in each regression result in this research. It has been discussed that the choice of the cutoff value for VIF test is arbitrary (O'Brien, 2007; Wooldridge, 2009). 10 is widely accepted by researchers as a cutoff value since the value over 10 indicates a sign of severe multicollinearity in the result. Meanwhile, from a conservative perspective, the VIF value less than 5 indicates that the collinearity is not a problematic issue to consider and is acceptable at tolerance level (Information Resources Management Association, 2017; Knapp, 2017). Therefore, 5 was selected as the cutoff value of VIF test in this analysis.

Heteroscedasticity describes the situation when the variance of the error terms are not constant, breaching one of the Gauss-Markov assumptions that the error has homoscedastic variance across all observations (Wooldridge, 2009). Under the presence of heteroscedasticity, the standard errors based on the least square principle are no longer valid, as they become biased without the homoscedasticity assumption; accordingly, the procedures for deriving confidence intervals and *t* statistics based on these standard errors may become unreliable as well (Newbold, et al., 2013 ; Wooldridge, 2009). Heteroscedasticity can appear when the size of the error variance is related to one of the independent variables, or when the variance changes in accordance with the expected values of the dependent variable (Newbold, et al., 2013).

In order to ensure valid and efficient least square principles in the results even under heteroscedasticity existence, two methods were used in this research. The first option is to use the cluster option, which applies robust standard error in regression. Derived from the robust estimator of variance (also called the sandwich estimator, or the Huber and White estimator), the robust standard errors are constant even under the circumstance in which the error terms are heteroscedastic (Stata press, 2017; Wooldridge, 2009). As a result, additional tests for

heteroscedasticity after regression, such as the Breusch-Pagan test, are not necessary. The other option is to utilize log-log linear regressions (2), which are regarded as being relatively free from heteroscedasticity (ibid; Newbold, et al., 2013).

3.3.2 The cluster option

In this research, multiple variable regression was conducted while simultaneously implementing the cluster option in StataSE 15. There are two reasons to practice the cluster option. First, values of independent variables in this research are 'clustered data' which are defined as "as data that can be classified into a number of distinct groups or clusters within a particular study" (Galbraith, et al., 2010: p.10601). Galbraith and her colleagues point out that observations within a same cluster are more similar than other observation from different clusters, since individual observations were classified into different clusters (ibid). As all independent data were classified into 89 trade districts in <set I> and into 88 districts in <set II> according to their municipality, it is a reasonable choice to utilize the cluster option.

Second, the choice of cluster option is a way of ensuring robust regression methods. The cluster option in StataSE 15 changes the formula to calculate the standard errors (Deb, et al., 2017). It calculates the standard errors based on the 'sandwich estimator' of variance, which is often called Huber and White, or the robust estimator of variance, so the robust variance option is used to obtain robust standard errors (Stata press, 2017). Moreover, cluster-robust standard errors provide a "correct" standard error in the measurement even if the observations are correlated (Cameron & Miller, 2015; p.323), because the key assumption of the clustered robust error is that "the errors are uncorrelated across clusters while errors for individuals belonging to the same cluster may be correlated" (ibid; p.320). As data comes from 89 or 88 trade districts in this research datasets, prices of treatments within a district may not be independent, and accordingly, residuals are not independent within a district. In this case, the cluster option is an appropriate choice to ensure unbiased results. Thus, all the standard errors suggested in the next chapter and the Appendix are cluster-robust standard errors based on the sandwich estimator (White, Huber, or robust) estimator of variance.

As explained for heteroscedasticity above, ordinary least squares (OLS) regression generates biased results when its assumptions, such as normality and homogeneity of variance of residuals, are violated (Andersen, 2013; Ender, 2000). In contrast, robust regression methods make adjustment in the estimates that consider some of the flaws violating OLS assumptions

in the data. Consequently, the estimates of standard errors are more robust than the normal standard error of the OLS outcome, as cluster robust error are larger while the estimated coefficients are the same (Deb, et al., 2017). For this reason, the results from the practice with the robust standard error option are more conservative, so they are viewed as more trustworthy than the results from ordinary practice.

3.3.3 Hypotheses of this research

Based on statistics provided in Chapter 1 and the literature review in Chapter 2, this research assumes the following hypotheses,

- The prices of dental treatments in a region with higher dentist or clinic density per 10,000 population are expected to be higher than those in a region with lower density.

- The prices of examination are expected to be lower in a region with higher density of dentist and clinics, as found in a study by Grytten and Sørensen (2000) and Chirico (2013). As the examination is a first-level service, a clinic with more competitors in the market would offer lower prices of examination in order to draw more new customers. However, other follow-on therapeutic services would not be influenced by the competition (rather be higher), as a patient is likely to be locked to the clinic for further treatment. Due to the low quality of consumer information in the market, the patient is unlikely to search for new clinics after vising the initial clinic.

- The other independent variables, such as the median income and housing price, are expected to have a positive relationship with the prices of treatments. This is because dentists or clinics consider the characteristics of the market they are positioned in as well as their expenditures. Thus, if a clinic located in a region with inhabitants falling into a higher median of income and with higher housing prices (predominantly in cities), there is a positive relationship between its service price and these two independent variables.

Microsoft Excel 2016 and StataSE 15.1 for Windows was used to analyze the two datasets.

4 Results

The descriptive statistics of prices (NOK) of 14 dental services are provided in two datasets, <set I> and <set II>, and are shown in Table 2. There are no huge differences between the two datasets.

<set I> All clinics	Obs N=1653	Mean	Standard deviation	Median	Min	Max
Examination	1653	889	134	880	240	1490
Small filling	1641	724	19	700	300	1470
Medium filling	1641	1145	155	1140	595	1175
Large filling	1641	1420	193	1420	795	2500
Simple extraction	1568	1013	213	990	450	2050
Surgical extraction	1279	1892	585	1800	200	3785
Simple periodontal treatment	1481	742	268	700	185	2800
Surgical periodontal treatment	789	800	339	800	235	2650
1 root canal filling	1401	3277	550	3300	1000	5350
2 root canals filling	1398	3800	549	3800	1300	6050
3-4 root canals filling	1403	4798	684	4800	1800	7050
Implant in the upper jaw	292	13203	2563	13000	7500	30000
A crown on a molar tooth	1588	5600	843	5800	3560	8080
A crown for an implant	565	11493	4240	11650	4240	30000
<set II> All private clinics, and some public clinics in 5 counties	Obs N=1321	Mean	Standard deviation	Median	Min	Max
Examination	1321	896	142	900	240	1490
Small filling	1309	729	130	710	300	1470
Medium filling	1309	1139	170	1130	595	1775
Large filling	1309	1426	211	1400	795	2500
Simple extraction	1294	1033	226	1002	450	2050
Surgical extraction	1089	1766	541	1645	200	3785
Simple periodontal treatment	1149	669	260	590	185	2800
Surgical periodontal treatment	620	740	357	650	235	2650
1 root canal filling	1211	3210	531	3200	1000	5350
2 root canals filling	1208	3754	540	3772	1300	6050
3-4 root canals filling	1206	4730	656	4700	1800	7050
Implant in the upper jaw	281	13089	2546	13000	7500	30000
A crown on a molar tooth	1256	5840	728	5840	3560	8080
A crown for an implant	461	11332	2223	11500	4240	30000

[Table 2. Descriptive statistics of prices in data sets]

Table 3 below describes density variables (i) and (ii) in each trade district, according to the type of dataset. In contrast to conventional beliefs, Oslo is not the region with the highest density of dentists or clinics in Norway, even though it is the most populous city in the country. Although the datasets show that it has the highest numbers of dentists and clinics in Norway, the number of dentists per 10,000 inhabitants over 20 years of age is relatively low. This feature was found in other big cities, such as Bergen, Trondheim, and Stavanger, as well.

County	**Trade district no.**	**Name of trade district**	**Set I**		**Set II**	
			(i) Dentists per 10,000 inhabitants over 20 years	(ii) Clinics per 10,000 inhabitants over 20 years	(i) Dentists per 10,000 inhabitants over 20 years	(ii) Clinics per 10,000 inhabitants over 20 years
1. ØSTFOLD	191	Halden	10,06	4,03	7,25	3,62
	192	Moss	10,73	4,08	8,16	3,43
	193	Fredrikstad /Sarpsborg	9,19	4,07	7,42	3,62
	194	Askim/Mysen	6,07	3,80	5,31	3,29
2. AKERHUS	291	Follo	7,15	3,37	5,26	2,95
	292	Bærum/Asker	8,33	3,47	7,08	3,02
	293	Lillestrøm	8,53	3,98	6,85	3,36
	294	Ullensaker /Eidsvoll	7,56	2,88	5,58	2,34
3. OSLO	391	Oslo	8,70	3,88	8,70	3,88
4. HEDMARK	491	Kongsvinger	4,60	3,84	2,05	2,05
	492	Hamar	6,43	3,22	4,47	2,38
	493	Elverum	10,26	4,81	6,73	3,21
	494	Tynset	7,80	6,06	2,60	2,60
5. OPPLAND	591	Lillehammer	7,87	3,94	4,92	2,95
	592	Gjøvik	9,60	4,35	6,70	3,26
	593	Midt-Gudbrandsdalen	8,61	3,83	5,74	2,87
	594	Nord-Gudbrandsdalen	9,48	8,13	5,42	4,74
	595	Hadeland	12,88	7,10	9,77	6,22
	596	Valdres	6,44	3,58	2,15	1,43
6. BUSKERUD	691	Drammen	7,96	3,41	5,12	2,77
	692	Kongsberg	10,00	5,77	6,54	3,85
	693	Hønefoss	12,47	6,89	8,86	4,92
	694	Hallingdal	5,57	5,57	1,86	1,86
7. VESTFOLD	791	Tønsberg/Horten	8,13	3,59	6,12	3,17
	792	Holmestrand	8,31	4,62	6,47	3,69
	793	Sandefjord/Larvik	11,51	5,48	8,85	4,63
	794	Sande/Svelvik	4,89	2,44	1,63	0,81
8. TELEMARK	891	Skien/Porsgrunn	9,95	3,66	7,20	3,20
	892	Notodden/Bø	11,95	2,60	11,95	2,60
	893	Kragerø	2,60	1,73	2,60	1,73
	894	Rjukan	8,68	6,51	8,68	6,51
	895	Vest-Telemark	10,91	6,37	10,91	6,37
9. AUST-AGDER	991	Risør	4,08	4,08	4,08	4,08
	992	Arendal	7,53	2,89	4,49	1,76
	993	Lillesand	5,18	3,45	5,18	3,45

	994	Setesdal	11,16	6,38	11,16	6,38
10. VEST-AGDER	1091	Kristiansand	11,28	4,31	9,18	3,76
	1092	Mandal	7,95	4,24	5,30	3,18
	1093	Lyngdal/Farsund	8,23	4,11	6,86	2,74
	1094	Flekkefjord	7,86	4,72	3,93	2,36
11. ROGALAND	1191	Egersund	6,72	5,04	3,92	3,36
	1192	Stavanger/Sandnes	9,54	4,29	6,65	3,47
	1193	Haugesund	8,30	4,09	4,58	2,85
	1194	Jæren	8,48	3,24	4,74	2,24
12. HORDALAND	1291	Bergen	8,88	4,05	5,99	3,22
	1294	Odda	6,19	3,10	2,06	1,03
	1295	Voss	7,93	3,17	5,55	2,38
	1296	Sunnhordland	6,39	3,65	3,42	2,28
13. SOGN-OG-FJORDANE	1491	Florø	6,79	4,24	3,39	2,55
	1492	Høyanger	9,01	7,51	1,50	1,50
	1493	Sogndal/Årdal	10,91	4,75	4,27	1,90
	1494	Førde	7,46	4,66	3,73	2,33
	1495	Nordfjord	8,76	4,15	3,23	2,30
14. MØRE-OG-ROMSDAL	1591	Molde	7,66	4,23	4,43	2,62
	1592	Kristiansund	8,63	4,67	5,03	3,23
	1593	Ålesund	10,47	4,96	7,03	3,58
	1594	Ulsteinvik	7,98	4,69	3,75	2,35
	1595	Ørsta/Volda	14,71	6,69	10,03	5,35
	1596	Sunndalsøra	6,32	6,32	3,79	3,79
	1597	Surnadal	6,71	4,02	1,34	1,34
15. (Sør) TRØNDELAG	5085	Trondheim	8,52	3,43	5,45	2,60
	5086	Frøya/Hitra	9,38	4,02	9,38	4,02
	5087	Brekstad	6,76	4,22	6,76	4,22
	5088	Oppdal	13,67	5,47	13,67	5,47
	5089	Orkanger	8,65	3,46	8,65	3,46
	5090	Røros	9,83	8,19	9,83	8,19
16. (Nør) TRØNDELAG	5091	Steinkjer	6,81	4,76	3,74	3,40
	5092	Namsos	7,43	5,40	4,05	4,05
	5093	Stjørdalshalsen	9,80	4,13	5,16	3,09
	5094	Levanger /Verdalsøra	8,53	3,55	3,20	2,49
	5095	Grong	17,46	9,98	2,49	2,49
	5096	Rørvik	5,22	1,31	5,22	1,31
17. NORDLAND	1891	Bodø	10,13	4,59	3,96	2,22
	1892	Narvik	13,18	7,73	13,18	7,73
	1893	Brønnøysund	12,93	6,96	12,93	6,96
	1894	Sandnessjøen	11,04	8,49	11,04	8,49
	1895	Mosjøen	11,04	5,52	11,04	5,52
	1896	Mo i Rana	6,43	3,61	6,43	3,61
	1897	Lofoten	12,36	5,91	12,36	5,91
	1898	Vesterålen	13,20	6,81	13,20	6,81
18. TROMS	1991	Harstad	12,84	4,82	6,82	2,81
	1992	Tromsø	8,37	3,74	4,63	2,39
	1993	Andselv	11,14	5,14	2,57	1,71
	1994	Finnsnes	9,40	3,36	4,70	2,01
	1995	Nord-Troms	10,36	4,60	-	-
19. FINNMARK	2091	Vadsø	10,79	8,30	10,79	8,30
	2092	Hammerfest	10,69	4,58	10,69	4,58

2093	Alta	7,49	4,28	7,49	4,28
2094	Kirkenes	10,13	3,80	10,13	3,80

[Table 3. Descriptive statistics of two density variables, (i) and (ii). in data sets]

Regression results from the two datasets are presented in the following subsections. As was mentioned earlier, only the results from the (D) and (d) regression models including independent variables (i) to (iv) are present. The results of the other models can be found in Appendixes 4 and 5. Before the results are presented, it should be noted that the following interpretation of the statistically significant estimated coefficients in the results has been made with the assumption that all of the other independent variables are constant, *ceteris paribus*.

4.1 Data set 1: All private and all public data

Table 4 shows the results of analyzing 14 treatment services provided in all private and all public clinics in <set I>. The clustered robust standard errors are given under the coefficients row and are expressed in parentheses. Eight of the dental services have prices that are related to the dentist density or clinic density at the maximum 10% significance level: examination, small filling, medium filling, large filling, simple extraction, simple periodontal treatment, surgical periodontal treatment, and whole crown for an implant.

The highlighted cells in Table 4 indicate statistically significant results for either dentist density or clinic density. Overall, except for three treatments, two periodontal treatments and one implant in the upper jaw, the density of dentists (in row i) has positive signs in its estimated coefficient, implying that the prices of treatments are expected to rise as the dentist density increases. When counting the statistically valid results in dentist density at the 10% significance level, five treatments are significant: examination, small filling, medium filling, large filling, and simple extraction. These elasticities range from 0.06 to 0.15 in log-log regression results.

The density of clinics (in row ii) shows mixed results, with a positive and a negative correlation between the clinic density and the prices of treatments. The negative coefficients of clinic density imply that competition affects the dental market, because a higher clinic density is expected to lower the prices of treatments. The density of clinics has a negative impact on the price of a simple extraction and a whole crown for an implant ($p \leq 0.1$). On the contrary, simple periodontal treatment and surgical treatment, the density of clinics has statistically significant and positive coefficients at the 10% significance level.

[Table 4. Results of <set I>]

set 1	Examination		Small filling		Medium filling		Large filling		Simple extraction		Surgical extraction		Simple periodontal treatment	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2
(i) Dentists per 10,000 inhabitants > 20 years	9.29**	0.09**	9.01**	0.09**	10.56**	0.07*	12.46**	0.06*	17.91**	0.15**	14.30	0.11	-9.00	-0.09
	(3.82)	(0.03)	(3.83)	(0.04)	(4.93)	(0.03)	(6.20)	(0.03)	(7.22)	(0.06)	(23.20)	(0.11)	(5.78)	(0.07)
(ii) Clinics per 10,000 inhabitants > 20 years	-9.52	-0.05	-7.33	-0.04	-10.55	-0.04	-11.15	-0.03	-20.91*	-0.09*	32.68	0.05	16.47*	0.07
	(6.39)	(0.03)	(6.37)	(0.04)	(9.32)	(0.04)	(11.53)	(0.04)	(10.85)	(0.05)	(34.08)	(0.10)	(9.36)	(0.07)
(iii) Median income of a trade district	239.27**	0.32***	-46.76	-0.06	9.41	0.00	7.23	0.00	170.83***	0.15**	713.52***	0.36***	102.19	0.15
	(101.08)	(0.11)	(52.95)	(0.07)	(104.66)	(0.08)	(125.85)	(0.08)	(64.78)	(0.06)	(235.59)	(0.13)	(142.80)	(0.19)
(iv) Average housing price per m^2 of freeholder	-0.357	-0.02	50.92****	0.05***	33.98*	0.01	48.34***	0.02*	108.79****	0.09****	57.83	0.03	-62.08***	-0.09****
	(13.03)	(0.01)	(11.54)	(0.01)	(17.07)	(0.01)	(20.07)	(0.01)	(16.41)	(0.01)	(55.64)	(0.03)	(17.77)	(0.02)
R^2	0.03	0.03	0.05	0.04	0.02	0.01	0.02	0.02	0.07	0.07	0.01	0.01	0.02	0.02
Mean VIF	1.54	1.51	1.54	1.51	1.54	1.51	1.54	1.56	1.56	1.52	1.61	1.58	1.55	1.52
Number of clusters	89		89		89		89		88		85		89	
Number of observation	1653		1641		1641		1641		1568		1279		1481	

p**** = 0, 0 < p*** ≤ 0.01, 0.01 < p** ≤ 0.05, 0.05 < p* ≤ 0.1

set 1	Surgical periodontal treatment		1 root canal filling		2 root canals filling		3-4 root canals filling		Implant in the upper jaw		Crown on a molar tooth		Crown for an implant	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2
(i) Dentists per 10,000 inhabitants > 20 years	-1.27	-0.01	10.95	0.05	16.04	0.05	12.31	0.04	-179.58	-0.08	38.78	0.07	70.71	0.06
	(11.22)	(0.14)	(20.72)	(0.05)	(20.80)	(0.04)	(26.14)	(0.04)	(176.73)	(0.14)	(34.01)	(0.05)	(88.07)	(0.06)
(ii) Clinics per 10,000 inhabitants > 20 years	29.32**	0.21**	15.97	0.01	3.60	-0.00	-0.44	-0.01	106.52	-0.00	-93.32	-0.08	-270.00**	-0.10**
	(12.41)	(0.10)	(35.52)	(0.05)	(36.20)	(0.04)	(45.99)	(0.04)	(281.89)	(0.12)	(72.15)	(0.06)	(119.88)	(0.05)
(iii) Median income of a trade district	193.57	0.36	1386.59****	0.43****	1217.92****	0.33****	907.65***	0.19***	-3613.18**	-0.24**	1383.08***	0.26***	99.25	0.09
	(196.41)	(0.26)	(268.20)	(0.08)	(203.11)	(0.05)	(305.00)	(0.06)	(1575.65)	(0.12)	(521.24)	(0.10)	(1207.38)	(0.11)
(iv) Average housing price per m^2 of freeholder	76.02**	0.077*	-28.37	-0.01	42.09	0.00	94.94	0.01	406.27	0.00	430.73****	0.08****	-385.36*	-0.05**
	(29.99)	(0.04)	(48.58)	(0.01)	(43.72)	(0.01)	(59.00)	(0.01)	(365.12)	(0.02)	(110.03)	(0.02)	(216.76)	(0.02)
R^2	0.01	0.01	0.04	0.04	0.03	0.03	0.01	0.02	0.02	0.02	0.09	0.09	0.01	0.01
Mean VIF	1.65	1.62	1.59	1.56	1.59	1.56	1.59	1.54	1.62	1.68	1.54	1.51	1.48	1.42
Number of clusters	80		86		86		87		62		89		70	
Number of observation	789		1401		1398		1403		292		1588		565	

Across the <set I> data, most treatment prices are positively correlated with the logarithm of the income variable (iii). It has the largest impact on treatment prices of the independent variables. When the median of the income in a trade district increases by 1%, the extent of the significant log coefficients varies from 0.24 ($p \leq 0.05$) for an implant in the upper jaw to 0.43 ($p=0$) for one root canal.

The coefficients of the logarithm of the housing price (iv) have mixed signs for different treatment prices. The statistically significant results of the coefficients indicate a positive correlation with treatment prices, however. The estimated elasticities of the variable range from –0.09 ($p=0$) for a simple periodontal treatment to 0.09 ($p=0$) for a simple extraction.

A more detailed analysis of all four models (A) to (D) and (a) to (d) in each treatment, the price of examination shows constantly positive significant coefficients with the dentist density (i), and the log of the income (iii) variable in all four regression models.

The second type, three filling treatments, shows that the density of dentists (i) is positively correlated with the filling price at the maximum 10% significance level across the log-log regression models, whereas all of the coefficients of the same density variable are significant at the 5% level in the level-level regression model. The logarithm of the housing price (iv) has a positive correlation with each filling price in the level-level regression model, but these significant results are weaker in the log-log regression model.

Two tooth extraction treatments, the third type, have in common the finding that the log-income variable (iii) is significant at the 1% level; there is a positive coefficient for these two treatments in all of the regression results. Although the surgical extraction treatment has the log-income variable (iii) as the only significant variable in the regressions, all four independent variables, (i) to (iv), are significant in most of the regression results for simple extraction. One interesting point in the result for simple extraction is that the coefficients of dentist density and clinic density have opposite signs; the density of dentists has a positive correlation with the price at the 5% significance level, whereas the clinic density is negatively correlated with the price at the 10% level. Comparing the results for surgical extraction, the coefficient of the clinic density variable for surgical tooth extraction has a positive sign, although it is not statistically significant at any level.

In the fourth type, periodontal treatments, the density of clinics (ii) is positively correlated with the prices of treatments; statistically significant results are indicated in (1-A), (1-D), and (2-a) for simple periodontal treatment ($p \leq 0.1$) and in (1-C), (1-D), (2-c), and (2-d) for surgical periodontal treatment ($p \leq 0.05$). The elasticity of the clinic density (0.21) for surgical treatment is the largest among the significant elasticities of the dentist (i) and clinic (ii) density variables in <set I>. The log-housing price variable (iv) indicates opposite signs for its elasticities in two treatments: –0.09 ($p=0$) for simple periodontal treatment and 0.077 ($p \leq 0.1$) for surgical treatment.

The log-income variable (iii) has been found to be the only variable that has a statistically significant coefficient for the fifth treatment type, three root canal procedures, in all regression results. The estimated coefficients are positively correlated with prices, whereas the elasticity ranges from 0.19 ($p \leq 0.05$) for 3-4 root canals treatment and 0.43 ($p=0$) for 1 root canal treatment.

The last categories of treatment, implant and crown, have relatively large coefficients of two density variables in the level-level regressions, owing to the high prices of these treatments. The price of an implant in the upper jaw is negatively correlated with the log-income variable (iii), which is the only significant variable at the 5% level in all of the results. The dentist density (i) has negative coefficients across all of the results, yet none of them are significant. The crown treatments seem to be affected by the clinic density (ii), because the prices declined when the clinic density (ii) rose. The coefficient of the variable (ii) is statistically valid for a crown on an implant only, having a –0.10 elasticity to price ($p \leq 0.05$), however. When it comes to the coefficient from the level-level regression, the coefficient of clinic density is –270 NOK ($p \leq 0.05$). The elasticity of the log-income variable (iii) is 0.26 ($p \leq 0.01$) for the price of a molar tooth crown, but it is insignificant for a crown on an implant. The log-housing price variable (iv) has a highly significant and positive correlation for the price of a molar tooth crown, with 0.08 elasticity ($p=0$), but it is significant at the 10% level for a crown on an implant, with –0.05 elasticity.

4.2 Data set 2: All private data and 87 public data

Analysis of the results from <set II> would be more appropriate for the dental market for adults in Norway, because most adults are unlikely to visit public clinics unless they live in remote areas where private clinics do not exist. It is not sufficient, however, to include only the private sector when analyzing the dental market because doing so does not incorporate the data on adults in isolated areas, who do go to public clinics. Therefore, <set II> attempts to reflect this situation. The results are suggested in Table 5.

The prices of seven treatments have statistically significant and positive correlations with two density variables; the treatments are medium filling, large filling, surgical extraction, simple periodontal treatment, surgical periodontal treatment, crown on a molar tooth, and crown for an implant. Regardless of the small changes in the sizes of significant coefficients for the dentist density (i) and clinic density (ii) variables, most of the results are in line with those of <set I>: medium filling, large filling, surgical periodontal treatment, and crown for an implant. Most of the other significant coefficients of the log-income (iii) and the log-housing price (iv) variables in <set I> are still significant in <set II> at the similar significance level as before.

At the same time, there are some noticeable changes in <set II> compared with <set I>. The coefficients of dentist density (i) and clinic density (ii) are no longer significant for the examination, small filling, and simple extraction in the same regression model of <set II>. However, three new significant coefficients for the two density variables appear for surgical extraction, surgical periodontal treatment, and crown for a molar tooth. For surgical treatment, the coefficient of the density of the dentist variable (i) has a positive coefficient at the 5% significance level, whereas its elasticity is 0.21. In the result from the level-level regression model, the coefficient of dentist density (i) is 60 NOK, which is the largest of the significant and positive coefficients related to two density variables, (i) and (ii), in the results of <set II>. Regarding surgical periodontal treatment, the price becomes positively correlated with the density of dentists (i) at the 5% level in the equation (1-D) by having 20 NOK as its coefficient, but the coefficient is not significant at the log-log level (2-d). The estimated elasticity of clinic density for surgical periodontal treatment is 0.23 ($p \leq 0.05$).

[Table 5. Results of <set II>]

set 2	Examination		Small filling		Medium filling		Large filling		Simple extraction		Surgical extraction		Simple periodontal treatment	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2
(i) Dentists per 10,000 inhabitants > 20 years	4.42	0.04	6.25	0.05	12.92**	0.07**	16.31**	0.06*	14.07	0.09	60.06**	0.21**	13.75*	0.14*
	(4.90)	(0.04)	(4.00)	(0.04)	(5.82)	(0.03)	(7.52)	(0.03)	(8.82)	(0.06)	(24.08)	(0.08)	(8.23)	(0.07)
(ii) Clinics per 10,000 inhabitants > 20 years	-8.43	-0.04	-5.76	-0.04	-16.20	-0.06	-18.34	-0.05	-20.74	-0.08	2.33	-0.01	16.33	0.05
	(7.78)	(0.04)	(7.44)	(0.05)	(11.13)	(0.04)	(14.32)	(0.04)	(14.74)	(0.06)	(44.06)	(0.10)	(14.47)	(0.09)
(iii) Median income of a trade district	328.64**	0.43**	38.66	0.03	102.90	0.05	110.07	0.04	408.56****	0.35****	552.47***	0.20	94.62	0.10
	(125.93)	(0.14)	(49.69)	(0.07)	(105.30)	(0.08)	(126.32)	(0.08)	(62.79)	(0.07)	(206.02)	(0.12)	(144.35)	(0.20)
(iv) Average housing price per m^2 of freeholder	-1.76	-0.02	47.64****	0.05***	37.35*	0.02	48.25**	0.02*	101.55****	0.08****	34.63	0.01	-18.31	-0.05*
	(14.57)	(0.01)	(12.57)	(0.02)	(19.59)	(0.01)	(22.39)	(0.01)	(22.35)	(0.02)	(62.86)	(0.03)	(20.72)	(0.02)
R^2	0.04	0.04	0.04	0.03	0.03	0.02	0.03	0.02	0.07	0.06	0.06	0.05	0.04	0.03
Mean VIF	2.55	2.56	2.55	2.56	2.55	2.56	2.55	2.56	2.54	2.55	2.59	2.60	2.50	2.51
Number of clusters	88		88		88		88		88		88		84	
Number of observation	1321		1309		1309		1309		1294		1089		1149	

p**** = 0, 0 < p*** ≤ 0.01, 0.01 < p** ≤ 0.05, 0.05 < p* ≤ 0.1

set 2	Surgical periodontal treatment		1 root canal filling		2 root canals filling		3-4 root canals filling		Implant in the upper jaw		Crown on a molar tooth		Crown for an implant	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2
(i) Dentists per 10,000 inhabitants > 20 years	20.00**	0.09	21.85	0.03	30.48	0.05	33.94	0.05	33.03	0.03	-15.90	-0.00	136.85	-0.08
	(9.68)	(0.09)	(25.19)	(0.04)	(25.92)	(0.03)	(34.05)	(0.04)	(201.98)	(0.12)	(29.59)	(0.04)	(97.80)	(0.05)
(ii) Clinics per 10,000 inhabitants > 20 years	26.92*	0.23**	16.75	0.02	-0.80	-0.00	12.38	-0.00	151.44	0.02	-136.88**	-0.11**	-283.68*	-0.10*
	(14.52)	(0.10)	(52.98)	(0.06)	(55.04)	(0.05)	(69.94)	(0.05)	(324.77)	(0.12)	(53.54)	(0.04)	(165.84)	(0.06)
(iii) Median income of a trade district	143.48	0.11	1263.80****	0.38****	1239.29****	0.31****	987.73***	0.19***	-837.85	-0.03	836.50**	0.18***	703.56	0.10
	(213.86)	(0.29)	(248.64)	(0.07)	(208.10)	(0.05)	(304.11)	(0.06)	(1269.12)	(0.09)	(346.15)	(0.07)	(1996.98)	(0.18)
(iv) Average housing price per m^2 of freeholder	83.96	0.06	-8.66	-0.01	65.71	0.01	158.71**	0.02**	810.56**	0.03	444.57****	0.09****	-329.97	-0.04**
	(27.34)	(0.04)	(48.18)	(0.01)	(50.93)	(0.01)	(69.29)	(0.01)	(360.30)	(0.02)	(64.01)	(0.13)	(216.62)	(0.02)
R^2	0.06	0.06	0.04	0.03	0.04	0.03	0.03	0.03	0.03	0.02	0.20	0.18	0.01	0.01
Mean VIF	2.56	2.59	2.60	2.60	2.60	2.60	2.60	2.59	2.47	2.86	2.52	2.53	2.30	2.33
Number of clusters	77		86		86		87		61		87		69	
Number of observation	620		1211		1208		1206		281		1256		461	

The crown for a molar tooth has one more significant coefficient in the regression result compared with the result of <set I>, which negatively correlates with the price. The elasticity of clinic density (ii) is –0.11 ($p \leq 0.05$), and its negative elasticity was found in all regression models. This implies that competition accompanying an increase in clinic density lowers the price of a molar tooth crown.

When looking at the category of simple periodontal treatment, one can see an interesting change in that the price is positively affected by the dentist density (i). The estimated elasticity is 0.14 at the 10% significance level. In the results for <set I>, however, the corresponding elasticity has a negative sign by indicating that the price of simple periodontal treatment is expected to be lower as the dentist density increases, but it is not statistically significant in <set I>.

As was mentioned earlier, the log-income (iii) and log-housing (iv) variables present results similar to those of <set I>, with similar sizes of and the same signs of their coefficients. The log of the income variable (iii) seems to be as remarkable as in <set II>, and like it is in <set I>, because the coefficients of this variable have the largest values across all three root canal treatments ($p \leq 0.01$), from 1,263 NOK to 987 NOK.

At the same time, there are a few dramatic changes in the log-income (iii) and log-housing (iv) variables. For example, the estimated elasticity of the log-income variable (iii) for simple tooth extraction becomes doubled, from 0.15 ($p \leq 0.05$) in <set I> to 0.35 ($p=0$) in <set II>, whereas the elasticity of the other independent variables' coefficients remains nearly the same as before in <set I>. The opposite change is found for surgical tooth extraction. The elasticity of the log-income variable (iii) is reduced from 0.36 ($p \leq 0.01$) in <set I> to 0.20 in <set II>, but the 0.20 elasticity is not significant.

With regard to the log-housing price variable (iv), the statistically significant coefficients correspond to those of <set I>. There are new significant results for the (iv) variable shown in 3-4 root canals treatment and an implant in the upper jaw. For the 3-4 root canals treatment, the estimated elasticity is 0.02 ($p \leq 0.05$). The coefficient becomes 810 NOK ($p \leq 0.05$) for the implant in the upper jaw, but the elasticity is insignificant in the log regression.

More details of the results for all treatments in <set I> and <set II> are presented in Appendixes 4 to 5. The results, with statistically significant coefficients of dentist density (i)

or clinic density (ii) in the final models (D) and (d) for each dataset, are presented in Table 6 below.

	set I				set II			
	(i) Dentists per 10,000 inhabitants over 20 years		(ii) Clinics per 10,000 inhabitants over 20 years		(i) Dentists per 10,000 inhabitants over 20 years		(ii) Clinics per 10,000 inhabitants over 20 years	
	NOK	Elasticity	NOK	Elasticity	NOK	Elasticity	NOK	Elasticity
Examination	9.29**	0.09**						
Small filling	9.01**	0.09**						
Medium filling	10.56**	0.07*			12.92**	0.07**		
Large filling	12.46**	0.06*			16.31**	0.06*		
Simple extraction	17.91**	0.15**	-20.91*	-0.09*				
Surgical extraction					60.06**	0.21**		
Simple periodontal treatment			16.47*	0.07	13.75*	0.14*		
Surgical periodontal treatment			29.32**	0.21**	20.00**	0.09	26.92*	0.23**
1 root canal filling								
2 root canals filling								
3-4 root canals filling								
Implant in the upper jaw								
Crown on a molar tooth							-136.88**	-0.11**
Crown for an implant			-270.00**	-0.10**			-283.68*	-0.10*

p**** = 0, $0 < p$*** ≤ 0.01, $0.01 < p$** ≤ 0.05, $0.05 < p$* ≤ 0.1

[Table 6. Summary of statistically significant coefficients in density variables]

5 Discussion

5.1 Further analysis

5.1.1 Check non-linearity

A further analysis was carried out to look for possible nonlinearity in the statistically significant results with density variables in the two datasets. The extent of changes in the coefficients could be different in the density values (e.g., it might have a quadratic pattern). Thus, all trade districts are divided into five subgroups, depending on dentist density and clinic density, respectively. Subgroup 1 has the smallest value and subgroup 5 has the highest value in the category of two density variables. Each subgroup consists of 17 or 18 districts. The means of each group for the significant treatments (8 from <set I> and 7 from <set II>) have been calculated and plotted with their confidence intervals in Appendixes 6 to 7.

Plotting of the coefficients shows the coefficients of the two density variables for each subgroup and the confidence intervals of the coefficients in dummy regressions for the same (1-D) model. The dummy regression set up the fifth subgroup as its reference group. The coefficient plots are conducted only if the confidence interval of the fifth subgroup's mean does not overlap with the mean of the fourth subgroup. This aims to test whether this distinct deviation of the fifth subgroup is statistically significant or not.

A few of the plots for the means and the coefficients display fairly linear patterns. In the results of <set I>, there is a continuous downward pattern for simple extraction in the means of the clinic density subgroups, whereas in <set II>, there is a constantly upward pattern for surgical tooth extraction and surgical periodontal treatment in the mean plots. Except for these cases, there are no clear nonlinear patterns found in the analysis.

5.1.2 Reliability of price data

One needs to exercise caution when examining the reliability of price data for the private sector used in this research. As was mentioned earlier, all price data from the private sector were collected and provided by Hvakostertannlegen.no in March 2018. Some data for private clinics could be out of date, and some private clinics and dentists were not registered on the

website so there are no data for them. It is up to each dentist to decide whether to register and update the information for his or her clinic, including the prices of services offered. Although Norwegian regulations[29] require dental service providers to offer information about the prices of their services on Hvakostertannlegen.no, there does not seem to be a governing agency that checks to see whether all providers have actually posted their information on the website. The inflation method could have been applied to the prices updated before 2018, but it could not do this because there was no way to distinguish the latest update date among obtained price data.

Therefore, the reliability of the price data for the private sector was checked by comparing this research data provided by Hvakostertannlegen.no with the price data from the Norwegian Dental Association. The association data were gathered in 2016 by means of questionnaires sent to private dentists in Norway. The aggregated means of five services (examination, small tooth filling, medium tooth filling, large tooth filling, and crown on a molar tooth) were compared in each trade district. It is, however, not allowed to publish the association data, as it is internal.

There are relatively small differences, ranging from -94 NOK to 53 NOK, between the aggregated means of the five services, both in this study's data and the association's data from 2016. Correlations between the five services in the two data sets are depicted in Table 7. When checking scatter plots, most samples are located densely, except for some outliers.

	Examination	Small filling	Medium filling	Large filling	A crown on a molar tooth
Correlation *r*	0,507	0,592	0,630	0,699	0,480

[Table 7. Correlations between data from Hvakostertannlegen.no and the association]

Assuming that all dentists increase their prices annually without lowering any prices affected by competition in the market, the inflated prices, according to the SSB's consumer price index, were estimated. The gaps between data from the association and the research data provided by Hvakostertannlegen.no become larger (ranging from 37 NOK to 79 NOK), because the data from the association have been inflated by the consumer price index. Therefore, the price data provided by Hvakostertannlegen.no could have been lower than it actually was, assuming that all of the private dentists in the dental association dataset increase

[29] Lovdata. "Forskrift om prisopplysninger mv. for varer og tjenester-prisopplysningsforskriften", https://lovdata.no/dokument/SF/forskrift/2012-11-14-1066, Retrieved October 16, 2018.

their prices annually. Unfortunately, there is no previous research on how often Norwegian private dentists change their prices. In a study on Finnish private dentists, Widström and her colleagues (2010) reported that 59% of private dentists in Finland change prices at least once a year. To summarize, even presuming that all Norwegian private dentists charge higher prices every year, the differences do not seem to be critical in the extent of the treatment prices.

These comparisons suggest two points: first, private dentists registered on the Hvakostertannlegen.no website are likely to offer accurate information about their clinics and prices. This is because they are aware that consumers refer to the information provided on the website when deciding on which clinic to visit. In the same Finnish study mentioned earlier, 56.5% of the private dentists in the research believed that patients compared prices when deciding on which dentist to visit (ibid). This could be one reason for the absence of the absurd differences between the actual costs that dentists reported to the association and the competitive costs they offered to consumers. It is reasonable to assume that the data from Hvakostertannlegen.no is reliable.

The second point is related to the concern that the sample of data from Hvakostertannlegen.no might be biased, because the private dentists registered on the website may have been concerned about offering competitive prices so they could attract new patients. These dentists recognized that the price information on the website could heavily influence a consumer's choice as to which clinic to visit. Thus, in order to attract more patients with competitive prices, the prices registered on the website could be slightly lower than the actual prices charged in the market. On the contrary, dentists who had enough regular patients might have been less interested in offering competitive prices and in posting their prices on the website and, consequently, they may not have registered on the website. This means that the sample from Hvakostertannlege.no could have a higher proportion of dentists (or clinics) that are eager to offer and advertise their competitive prices to consumers. However, this factor would not matter much in the reliability of the data. The difference in the number of private dentists between the association data and the website data is 46; the total number of private dentists in the 2016 association data is 2,472, whereas the total number in the Hvakostertannlegen.no data is 2,426. The "missing" 46 dentists account for 1.8% of the association sample, a size that seems too small to make a huge difference. In conclusion, the price data from Hvakostertannlegen.no are highly reliable.

5.2 Implication

The results of this study have shown that dentist density is positively correlated with most treatments in the two datasets, and there are 10 significant results across the two datasets at the maximum 10% level of significance. At the same time, the prices of 4 treatments are negatively correlated with the clinic density, and 3 treatments prices are positively correlated with the clinic density both at the maximum 10% level of significance.

These findings are different from those in similar research studies on the dental market in Norway and Sweden in that the main findings in those studies showed that competition works in the Norwegian and Swedish dental markets. Grytten and Holst (2000) found that there was a weak impact of competition on the Norwegian dental market by discovering that the consultation fee decreased (–0.12%) as the dentist density increased. However, this present research study shows that the fee for an examination is positively correlated with the dentist density.

The Swedish research of Chirico (2013) is in line with the study of Grytten and Holst. She discovered that the impact of clinic competition was greater on first-stage services, such as examination and diagnostic services, compared with follow-on services, such as tooth extraction. According to the results of this present study, it seems that clinic density could lower the prices of some treatments but that only a few factors have a significant relationship with clinic density, and these are not first-stage services.

The results of the Finnish study are similar to those of this present research, showing that the price level for one surface filling increased by 0.041 ($p \leq 0.01$) when the number of competitors increased nearby (Widström, et al., 2010). However, regarding the price of small filling, there is a positive correlation between the price of a small filling and the dentist density, and the correlation is significant only in <set I>. The clinic density, which is positively correlated with price in the Finnish study, is negatively correlated with the filling price in this present study, but this is not statistically significant.

5.2.1 Practical significance

The main results illustrate the statistically significant correlation between the density variables and the prices of several treatments; the prices for crown treatments are negatively

correlated with the clinic density, whereas the prices for the other treatments with significant correlations are expected to increase when there is a higher density of dentists or clinics in a trade district. In other words, competition is at work in the pricing of crown treatments, but in the pricing of other treatments, dentists or clinics seem to make pricing decisions based on factors other than competition.

The sizes of all of the significant coefficients from the level-level regressions are reasonably small, compared with each treatment price. Therefore, the estimated significance coefficient was compared with the mean price in the two datasets, in order to figure out how the sizes of these coefficients could be practically meaningful in changing consumer choices. The results are presented in Table 8.

Set I: All private and all public clinics (N=1653)				
Coefficients of treatments (NOK)	Dentists per 10,000 population (i)	Clinics per 10,000 population (ii)	Mean price (NOK)	The % of the mean
Examination	9.29**		889	1,04
Small filling	9.01**		724	1,24
Medium filling	10.56**		1145	0,92
Large filling	12.46**		1420	0,88
Simple tooth extraction	17.91**	-20.91*	1013	-0,30 1.76¤
Simple periodontal treatment		16.47*	742	2,22
Surgical periodontal treatment		29.32**	800	3,67
Crown for an implant		-270.00**	11493	2,35

p**** = 0, $0 < p$*** ≤ 0.01, $0.01 < p$** ≤ 0.05, $0.05 < p$* ≤ 0.1

Set II: All private clinics and 87 public clinics in 5 counties (N=1321)				
Coefficients of treatments (NOK)	Dentists per 10,000 population (i)	Clinics per 10,000 population (ii)	Mean price (NOK)	The % of the mean
Medium filling	12.92**		1139	1,13
Large filling	16.31**		1426	1,14
Surgical tooth extraction	60.06**		1766	3,40
Simple periodontal treatment	13.75*		669	2,06
Surgical periodontal treatment	20.00**	26.92*	740	6,34 2,70¤
Crown on a molar tooth		-136.88**	5840	2,34
Crown for an implant		-283.68*	11332	2,53

The results marked with ¤ only count the coefficients ($p \leq 0.05$) if there are two coefficients at the different significance levels.

[Table 8. Comparison of the coefficients' size and means of treatment prices]

The sizes of all of the significant coefficients are relatively small compared with the means of the treatments; the highest outcome is 3.67% in <set I> and 6.34% in <set II>. The extent of

the impacts on prices, whether the lowering of prices due to competition or the raising of prices due to the market power of dentists or clinics, does not seem to be significant in changing consumer behavior in the market.

Because of transaction cost and search cost in the market, consumers are unlikely to switch dentists or clinics just because of a small price change. Previous research studies have shown that Norwegian patients over 20 years old have only a few treatments per year (Grytten, et al., 2012; Grytten 2005, 2000). This fact is supported by the TNS-Gallup statistics on dental treatment patterns among Norwegian adults, which reveal that over 64.9% of the patients who visited a dental clinic last year spent less than 2,000 NOK (Grytten, et al., 2014). Because of this low number of dental visits and the low costs associated with them, a patient can see that the financial gains which the patient might accrue from finding a new dentist, on top of the effort needed to do so, would be minimal.

In addition, switching dentists has a psychological cost for patients that might make them reluctant to change to a more beneficial alternative, and dentists may benefit from this factor (Armstrong & Sappington, 20006; Grytten, 2005). Consumers in the health care market have a subjective status quo bias, making them resistant to change even if it means change for the better. This is why the private dental market has often been characterized as having a high proportion of regular patients (McGuire, 2011; Grytten, 2000). These regular patients have a high level of consumer loyalty and might feel emotional stress if they end an established relationship with their dentists (Grytten, 2005).

The cost of searching for a new dentist could be even higher when the number of dentists increases because it is difficult to obtain quality information when so much information is available. By analyzing primary care physician services in 92 metropolitan areas in the United States in the 1970s, Pauly and Satterthwaite (1981) found that an increase in the number of providers selling “reputation goods” raised prices because the increase made a consumer search less efficient. The researchers discovered that the information variables were significant at the 5% level in setting physician prices, so they concluded that difficulties in consumer searches, derived from an increase in the number of physicians in the market, caused the prices of physician services to increase. This is because consumers (patients) are not homogeneous in terms of responding to and evaluating their treatments; they have idiosyncratic preferences about the prices of and quality of physician services they receive (Pauly, 1988; Dranove & Satterhwaite, 1992; 2000). Thus, the cost of searching by a

consumer for a good alternative would be even higher, because it is more difficult to obtain quality consumer information when the number of dentists or clinics rises.

It could be argued that potential benefits are crucial, particularly for the patient group with a lower income level. According to SSB statistics, 81% of people with a low income think that it is too expensive to go to a dental clinic in Norway, whereas only 51% of the rest of the respondents with other income levels think that is true (SSB, 2017a). In a previous Norwegian study, Grytten and his colleagues found there were no significant differences in the income elasticity on demand among different income groups, and there was no significant relationship between income level and use of dental treatment in general (Grytten, et al., 2012). Therefore, it is hard to determine how critical it would be for expected price changes to influence the switching of dentists for people with a low income. The price elasticity for dental services is generally low, at around 0.1% or 0.2% based on previous research findings, so it is reasonable to expect that small differences in treatment prices would only slightly affect the demand for dental services (Grytten, 2005).

Of course, because the coefficient expresses the change in price from a marginal change in density variables (dentists or clinics per 10,000 inhabitants), the price difference could be greater if the difference in density is greater. The patient, however, would have to travel to a faraway clinic in a distant region to benefit from a higher price difference, because the density variables are calculated at the trade district level, which consists of several neighboring municipalities. Accordingly, the travel cost, including the time needed for travel, becomes higher. For example, in <set I>, Kragerø has the lowest density (2.60) of dentists per 10,000 population, and one of its closest neighboring trade districts, Skien/Porsgrunn, has a dentist density of 9.95. A patient living in the Skien/Porsgrunn trade district could save, at most, around 215 NOK when receiving surgical periodontal treatment by going to a dental clinic in Kragerø, but the person would have to drive for an hour or use public transportation, which would take 80 minutes, to get to the clinic in Kragerø. Given this fact, the price changes dependent on density variables would not be so significant in the practical context.

Nevertheless, the results of this research would raise substantial concerns about patients with the greatest needs for dental treatment, if the price data provided by Hvakostertannlegen.no are relatively lower than the actual market prices and the trend is steady. The TNS-Gallup survey shows that 5.5% of the 4,248 respondents answered that they spent over 10,000 NOK in the last year for dental treatments (Grytten, et al., 2014). Consultation was the most popular

service as 62.9% of the respondents received it in the previous year. Filling a tooth was the commonest treatment (received by 51.8% of the respondents on the survey), and crown treatment was the next most common (received by 17%). The other treatments received were root canals (14.5%), tooth extractions (13.3%), periodontal treatment (13.3%), and implantations (2.6%). Based on these facts, if price for the treatments of filling a tooth, tooth extraction, and periodontal procedures increase as the density of dentists or clinics increases, patients who need many treatments will be more vulnerable in the dental market, and it will be the older patients who spend the most (Grytten, et al., 2014).

5.2.2 Different strategies in pricing

An interesting finding in the results is that dentists and clinics may implement different pricing strategies depending on the level of demand for treatments. Treatments for which the price rises with an increase in the density variables are those that are in fairly high demand in the market compared with other treatments. As was mentioned before, over half of adult patients who visited dental clinics had a tooth filled, and this treatment was the most popular one offered to adult patients among 9 types of dental treatments in the TNS-Gallup survey (Grytten, et al., 2014). The results show that all three filling treatments have a positive relationship between their prices and the dentist density in <set I>, whereas only the medium filling and large filling treatments have such a relationship in <set II>. The same pattern is seen for the prices of other treatments, such as tooth extraction and periodontal procedures, which were the fourth most common treatments in the survey. Of the respondents, 13.3% visited dental clinics for those two treatments, respectively, and the sum of the percentages of the two treatments was 26.6% (ibid.). Therefore, a dentist might earn extra profits by charging higher prices for the treatments that are most commonly offered to patients.

A pricing strategy might be a countermeasure by which a dentist can cope with somewhat threatening changes that have occurred in of the dental market in Norway. The oral health of the Norwegian population has improved dramatically during the last few decades, thanks to a better standard of living, the universal use of fluoride toothpaste, and beneficial oral health practices that have become habitual because of regular visits to public dental clinics when patients were young (Holst & Schulle, 2012; The Norwegian Ministry of Health and Care services, 2007). Approximately 24% of 18-year-olds have never had any tooth carries (SSB, 2017c). Even in persons born in the middle years of the 20th century, the number of carious

teeth declined from the year 2003 to the year 2012 (Dobloug & Grytten, 2015), and over 62% of Norwegian adults over 60 years of age believe that they have good dental health (Grytten, et al., 2014). Also, about 77% of Norwegian adults responding to the survey reported that they had been to dental clinics at least once in the last year (ibid.), and such regular visits prevent dental problems from developing to a catastrophic stage. Consequently, the need for dental care, mainly restorative treatments, will be lower in the future (Dobloug & Grytten, 2015). These changes could be seen as a threat to the volume of business for dentists and clinics.

Contrary to what one might think, the number of dentists has been increasing, even though the needs of dental patients have decreased over the years because of their improved dental health. The number of Norwegian dentists with regard to population numbers is higher than in most countries (Grytten, 2005). In such a conflicting situation, in which the number of competitors increases while the expected number of patients and services per dentist provided decreases, it could be a rational and safe choice for dentists to increase prices at a certain level to secure their incomes. If they lower prices to attract more patients when the number of competitors is growing but the needs of patients are declining, the lowered price would not guarantee to attract more patients and to compensate their expected loss from charging lower prices to their existing patients.

The next question would be why the clinic density lowers the price of a molar tooth crown (in <set II> only) and an implant crown (in both datasets), a finding different from the way in which dentist density raises prices in other significant results. It looks more surprising given that the crown treatment is the second most popular treatment, with 17.7% of the adult respondents receiving it in 2012 in the TNS-Gallup survey (Grytten, et al, 2014). Unfortunately, no relevant studies have been performed so far on the effects of competition on crown prices. Two hypotheses for this situation are therefore suggested here.

The reduced expenditure for producing crowns could be one reason for the lowered prices of crown treatments. The procedure has become more efficient thanks to advanced technology, and, above all, the expenditure for producing a crown has declined owing to the competition between Norwegian dental technicians and, mainly, Chinese technicians (Nygaard, 2016). Most public clinics and quite a number of private clinics have been using imported crowns produced in developing countries such as China in order to offer lower prices to their patients (Nygaard, 2016; Nordrum, & Ekerholt 2010). The competition among dental technicians that

produce crowns may lower the costs of crowns to a clinic, and the clinic can then pass along the lowered cost to its patients.

Another hypothesis is that the absolute numbers of the coefficients of crown services are large, even though the values are less significant when they are compared with their total prices. The estimated coefficients of clinic density in a crown for a molar tooth in this research are –270 NOK ($p \leq 0.05$) in <set I> and –283.68 NOK ($p \leq 0.1$) in <set II>. The coefficient of an implant crown is –136.88 NOK in <set II>. These are not as small as the significant coefficients of 20 NOK or 30 NOK for other treatments. Hence, patients might be likely to be more sensitive to price changes for crown services. This would be reasonable given that most patients needing crowns were over 60 years old and were also the patients that spent the most (approximately 4,000 NOK) on dental treatments (Grytten, et al., 2014).

At the same time, the reduced prices would not have a huge influence on clinic revenues. The mean price of an implant crown and a molar tooth crown is 11,332 NOK and 5,840 NOK, respectively, in <set II>. These high prices apparently have evolved from the high costs of providing these services, but at the same time, the revenues accrued from them are still high, even if patients pay 5,703 NOK for a molar crown and 11,048 NOK for an implant crown. In summary, competition works in crown services because clinics still could maintain their high margins for these services but patients might become more sensitive to changes in crown prices.

5.2.3 Payment and financing system

A different remuneration system can influence the behavior of dentists and patients (Grytten, 2005). A significant distinction between dentistry and medicine is that third-party payers are not involved in dentistry. Fee-for-service (FFS) is the typical payment system in dentistry (Grytten, 2017). In the FFS system, payment is based on the number and types of services offered (Iversen, 2016), and a dentist's income is directly related to the practices available to patients (Grytten, 2017; Sloan & Hsieh, 2012). In the Norwegian private dental market, the features of FFS appear more noticeable, because private dentists have the full autonomous right to set their service prices (Grytten & Sørensen, 2000). Therefore, the FFS system and the free right of private dentists to set prices could contribute to higher prices for some treatments because dentists can raise their prices as much as they want.

The finding discovered in this research seems different from that of conventional studies on the FFS system and the market power of health care providers. The previous studies have described a relationship between FFS and the supplier-induced demand, which states that dentists or physicians provide additional services (i.e., more than the optimal number of services) in order to increase or secure their incomes when they encounter a shortage of patients in the market (Grytten, 2017; 2005; Iversen, 2016). Supplier-induced demand explains mainly how services are increased by the inducement of health care providers. This research, however, does not discuss whether the number of dental services has grown in accordance with price changes, because of the lack of data about the number of services dentists delivered.

Several studies have suggested empirical findings against supplier-induced demand in the dental market in terms of the increasing prices caused by the increasing number of dentists (De Vany, et al., 1983; House, 1981). These studies argue that the positive correlation between prices and provider density results from the preferences of patients who are willing to pay higher fees for consuming less their time cost. Patients differ with regard to their views on the value of time. Patients with lower incomes prefer to wait longer to receive services as long as they pay less for the services, but some patients are likely willing to pay higher fees if they have only a short wait for the services (House, 1981). Usually, persons with a higher income and more advanced level of education demand more health care services and place a higher value on time (ibid.).

In this situation, dentists need to consider not only their competitive prices but also the combination of the fee and the waiting time commensurate with the value a patient places on time. Also, health care providers consider their income potential when they choose a location for their practices (Rizzo & Zeckhauser, 1992). If a dentist wants to establish a clinic in an affluent area where the population has a higher level of income and places a high value on time, the dentist will schedule fewer patient visits per day but will charge higher fees for the reduced volume of care to meet the needs of the population in the area. An empirical U.S. study showed that populations who preferred a shorter waiting time and higher fees required more dentists per capita (House, 1981). The study discovered that the number of minutes one had to wait in the office and the number of days one had to wait for an appointment were negatively and significantly correlated with the prices of dental services, whereas the dentist-to-population ratio significantly reduced the office wait. The result of another U.S. study

supported House's research. De Vany and his colleagues concluded that dentists in regions where patients demanded shorter office waits were generally less productive, because patients paid higher fees for the intermittent down time of shorter patient queues. Consequently, this reduced rate of production meant that more dentists were needed per capita to service the population (De Vany, et al., 1983).

Overall, the target income hypothesis might be more appropriate for explaining the results of this study. In order to secure income in the harsh market conditions, dentists are likely to charge higher prices for treatments that are most frequently offered to patients. Quoting the criticism of Dyckman and Evans, House mentions that health care providers choose fees only on the basis of a preferred income, not on the basis of market constraints imposed by spirited competition among providers (House, 1981, p. 593). Although no one has examined what target dentists set as the goal for their income, it is likely that they try to secure their income by increasing fees for popular services. They might not be afraid of losing their patients because some regular patients have consumer loyalty, the cost of switching dentists is high for patients, and price elasticity is quite low on dental demand. Also, dentists might be skeptical about the expected benefits of lowering their service prices to attract new patients, given that fewer patients will have a few treatments. It is apparent that the dentist's income will decrease if the impact of lowering prices is not substantial enough to bring in new customers and to offset a profit loss from charging lower prices for existing patients.

The other interesting finding in this research concerns the moral hazard in the market of dental service providers. There are relatively large positive coefficient sizes compared with means for simple treatments and surgical periodontal treatments in two datasets. This indicates that the extent of increasing prices for these two treatments is greater than for other treatments. This could be derived from the fact that costs of periodontal treatments are partly reimbursed by the Norwegian Health Economics Administration (HELFO). HELFO sets up the reimbursement prices (*refusjon*) to dentists as 180 NOK for a simple periodontal treatment of less than 30 minutes, and 515 NOK for a surgical periodontal treatment. At the same time, a patient needs to pay 415 NOK and 355 NOK, respectively, by means of his/her own deductible cost unless the patient holds the free card 2 for Norwegian health services (*frikort* 2). The patient also pays the price gap (*mellomlegget*) between the actual price charged by the dentist and the remuneration price paid by HELFO. For example, if the fee for a simple periodontal treatment taking less than 30 minutes is 700 NOK, HELFO pays 180 NOK and

the patient pays 520 NOK total, which is the amount of the deductible (415 NOK) plus the gap price (105 NOK).

Because patients receiving periodontal treatments are reimbursed by HELFO, they could be less sensitive to the prices of treatments. In traditional economic theory, this is a crucial topic in explaining the health insurance market. The quantity of a demanded health care service grows when the out-of-pocket cost to patients needing the service declines because some or all of the costs are paid by insurance; in other words, having insurance makes health care more affordable. This situation is described as a "moral hazard" (McGuire, 2012; Sloan & Hsieh, 2012; Grytten, 2005). The HELFO reimbursement might increase the likelihood that patients will go to a dental clinic when they need periodontal treatment, compared with times when they need other treatments not reimbursed by HELFO. There is no certainty about whether the HELFO reimbursement contributes to improving the accessibility of periodontal treatments, because price elasticity is low in the demand for dental services (Grytten, 2005).

The HELFO reimbursement might be significant to dentists and clinics in setting the fees for treatments. In a previous U.S. study, it was been found that third-party reimbursement (Medicare in the U.S. context) had a much more consistently positive and greater impact on average revenues of physicians than on usual physician fees (Sloan, 1976, p. 338). Because patients become less sensitive to prices of treatments when HELFO reimburses them for the costs, dentists could increase the prices to a fairly significant extent compared with other treatments. This appears in the findings on surgical periodontal treatment in <set II>, because the increases in the two density variables raise the price of the treatment. Moreover, dentists and clinics might not reduce their prices lower than the HELFO refund amount, even if they are able to offer lower prices than the HELFO remuneration amount in a competitive market situation.

Statistics show that there was a remarkable increase in the expenditures for periodontal treatments and rehabilitation with the treatments, from 63 million NOK in 2004 to 298 million NOK reimbursed by Norwegian social security benefits in 2008 (Grytten, 2010). Still, there is no evidence on whether the rapid growth in periodontal treatments was caused by the moral hazard of patients or dentists (and/or clinics), and the situation could not be examined in this study.

5.3 Limitations and suggestions for future research

5.3.1 Model

All regression results show low R^2. Thus, even if the findings look interesting, the explanatory power of the models is low (Newbold et al, 2013; Wooldridge, 2009). R^2 could be higher if more independent variables had been included in the regressions. However, due to lack of appropriate and available variables at the municipality level, it was impossible.

Omitted variables are problematic to regression models in general, because the estimated result could be biased owing to the omitted variables (Bloom, et al., 2015). Also, there could be missing endogenous factors, which are likely unobservable, which might affect the dependent variable (Gaynor & Town, 2011). Therefore, one needs to be aware that the limited extent of available data may cause an omitted-variable bias. Because this research focuses on the supply side, omitted variables can be expenditure variables of dentists and clinics, for example, salaries for the staff or expenditures on new equipment.

The characteristics of health service providers, such as age, years of experience, and level of foreign medical education, are found to be important variables in the price setting practices of dentists. For instance, Rizzo and Zeckhauser (1992), in an empirical U.S. study, found that physicians with a foreign medical education background tended to charge lower prices, whereas physicians with board certificates seemed to charge higher prices than others.

To carry out a more specific analysis, it is desirable to include variables affecting dental demands, as well, such as the age, gender, or education level of patients in a region. Several previous studies have revealed that patients' characteristics are significant in determining their visits to dental clinics (Grytten & Skau, 2017; Grembowski et al, 1988; Hay, et al, 1982; Manning & Phelps, 1979). Moreover, the TNS-Gallup survey demonstrates the differences in dental treatment expenditures among different age-groups; the age-group between 20 and 39 years has the lowest expenditures (2,600 NOK) and the age-group over 80 years has the highest expenditures (4,300 NOK). These differences in expenditures among different age-groups reflect variations in the types of treatments they receive; older patients receive the most fillings and crowns (Grytten, et al., 2014). If the age-group had been categorized in each

trade district in this analysis, the researchers might have found a correlation between the composition of the population in a district and the prices of treatments.

One should keep in mind that coefficients in the multiple regression in this research are "conditional coefficients." The estimated coefficient depends on the other independent variables included in the model (Newbold, et al., 2013). Hence, the result could change in accordance with changes in the independent variables. Also, the results of this research do not imply or mean the causality between density variables and price variations. The findings show the associations between treatment prices and density variables (dentist density and clinic density). This does not mean that a marginal change in a density variable causes a change in the prices of treatments (ibid).

5.3.2 Price information

These estimated coefficients become less practically significant because a price in this research does not represent the full price paid when a consumer receives a service. The full price of a dental service consists of a money price and a time price (i.e., how much value a patient places on the time needed to receive a service), from traveling to the clinic to waiting at a clinic (Sintonen & Linnosmaa, 2000; Grytten, et al., 1990; Grembowski et al, 1988). In this research, the money price represents the fees for the services that are applied, but the time price is not taken into account due to the lack of data. Several previous research studies emphasized the importance of the time cost in their analyses, and the time cost is negatively related to the number of visits or dental demand (Sintonen & Linnosmaa, 2000; Sintonen & Malijanen, 1995; De Vany, et al., 1983; Hay et al., 1982; Holtmann & Odgers, 1976). For example, Sintonen and Malijanene (1995) found that the total visit time elasticity was –0.205 on the probability of visiting in the Finnish dental market, a finding that is larger than the total price elasticity (–0.069) in their research.

Due to the lack of available time price data, it is unknown whether the positive correlation between prices and density variables is derived from the impact of the time cost. According to previous Norwegian research, however, there was no significant impact of the time cost on dental demands (Grytten, 1990). The recent TNS-Gallup survey also showed that the time cost would not be significant in the Norwegian market, although there were no distinguishing differences between municipalities with a lower dentist density and a higher dentist density. In general, 37% of Norwegian adults were able to receive treatment within three days, and

about 70% of the respondents had treatment within a week. Also, 78.6% of the respondents reported that they were satisfied with their waiting time (Grytten, et al., 2014).

Although it was not possible to include time cost in this study, this research attempted to try and neutralize the impact of time cost by introducing density variables (dentists and clinics per 10,000 population, respectively). The density population ration variable reflects the net supply of dentists available to the adult population (Sintonen & Linnosmaa, 2000, p. 1273) and helps control differences in the non-monetary costs of care that are not captured by the travel time component of time price (Muller & Monheit, 1988, p. 64). However, the result could have been more precise had the density variables reflected the number of dentists or clinics in a certain distance criterion (Noether, 1988), as applied by Chirico in her research.

The finding in the results could have been more precise had the calculation of the expenditure and revenue of each treatment been possible, especially in explaining the estimated coefficients of periodontal treatments, partly reimbursed by HELFO, and of crown services. Sloan (1976) suggested using the average revenue of health care providers because the money price has two shortcomings. First, he pointed out the possibility that the published money price could be overstated if price discrimination occurred when providing a service. Second, a dentist may increase the total price not by charging a higher price to a service but by separately billing some components of a service. For example, the dentist can charge separately for x-ray pictures from an examination service that were included in the previous service. Then, a patient will not only pay the same amount of money as before for the examination but shall also be required to pay extra for the x-ray service, the separate component. However, the price guideline offered by Hvakostertannlegen.no in this research may help minimize such deficiencies with coherent criteria in pricing.

Meanwhile, there is significant recognition of the importance of providing accurate consumer information on the Norwegian dental market. The president of the Norwegian Dental Association wrote an article encouraging Norwegian private dentists to provide real information on their prices to Hvakostertannlege.no (Steinum, 2018). She highlighted that it is important to provide actual prices of services on Hvakostertannlegen.no, not just the lowest prices, in order to provide accurate information to consumers and to receive the correct amount of reimbursement for patients and for dentists. If dentists post their lowest prices and they are far different than their actual prices, the Norwegian government will think that the price level of dental services is remaining the same and it will not realize that the amount of

reimbursement for patients and dentists needs to be increased. In summary, she emphasized the significance of practical information, not only to patients but also to dentists.

5.3.3 Quality assumption

This research assumes that the quality of service is homogeneous among dentists and, thus, that price differences in service do not imply that there is a difference in quality either between providers or between sectors. The relationship between quality and price, and between quality and competition, could not be examined in this analysis, owing to no available data on the quality measurement of dental services.

Differences in the quality of services may exist, depending on dentists' competence, and such differences could lead to price differences for the same service among providers, as proved in previous research (Stigler & Sherwin, 1985; Weaver et al, 1985). At the same time, several studies on physician and dental markets also assumed that the quality of service is considerably homogeneous (Grembowski et al, 1988; Pauly & Satterthwaite, 1981).

Norwegian adult patients seem to be highly satisfied with the services provided by private dentists across different regions and for different age-groups (Steinum, 2018; The Norwegian Dental Association, 2016; Grytten, et al., 2004). Also, the quality of dental services in the private and public sectors could be homogeneous. A previous study found that the incentive and remuneration system would not affect the quality of treatment in public clinics; there were no differences in the quality of public dental services provided by dentists having a fixed salary contract and dentists having a combined per capita and fixed salary contract in 2000 (Grytten, et al., 2009). Based on the study's finding, it could assume that dentists in the public and private sectors may not be severely affected by the remuneration system, because the quality of their services is unaffected by it. Considering all these findings, the quality of dental services in Norway is assumed to be high and consistent.

The lack of quality indicators is not the only problem in this research. Many experts in the field of health economics have attempted to find credible indicators to reflect the quality of health care services, and they agree that it is difficult to measure such a quality (Steinum, 2018; Rizzo & Zeckhauser, 1992; Grembowski et al, 1988). Therefore, to have a comprehensive understanding of the dental market, it is necessary to develop more available indicators by collecting various types of data on the dental care sector.

6 Conclusion

This research aims to analyze price setting of dental services for Norwegian adults, particularly in relation to the density of dentists and clinics in a trade district. The prices of dental services in the Norwegian private dental market has increased significantly over the last few decades. This has occurred despite an increase in the number of dentists in relation to the population, and the enhanced dental health of Norwegians. This places a huge financial burden on adult patients over the age of 20, as they nearly receive no public coverage for their expenses. This group mostly receives treatments from private dentists, who have the right to freely set prices for their services in the private market.

Based on the findings of previous studies and statistics, this research assumed that the prices of dental treatments in a region with a greater number of dentists or clinics in relation to the population size are expected to be higher than those in a region with lower density of dentists or clinics. However, the examination prices would be lower in regions with a higher density of dentists or clinics in order to attract more new patients who would be unlikely to switch clinics after the initial visit. Simultaneously, the prices would be positively correlated with the level of medium income and housing price.

Data was obtained from three sources; data regarding the private dental sector was provided by Hvakostertannlege.no of the Norwegian Consumer Council; public data was collected from each county official website; SSB was a source of the median incomes and housing prices in different municipalities. Two datasets were compiled: <set I> included all private and public data while <set II> included all the private and 87 public clinics in remote areas. After the data was collected, all the independent variables, such as dentist density, clinic density, the median income, and the housing price, were calculated at a trade district level. Applying multivariable log-log and level-level OLS regressions with the cluster option in StataSE 15, the prices of 14 treatments were analyzed at a maximum 10% significance level.

In <set I>, the prices of five treatments were positively correlated with dentist density, while in the case of two treatments, there was a positive relationship between prices and clinic density. The prices of implant crowns and simple extractions were negatively correlated with clinic density, implying that competition worked in this service. In <set II>, five treatments reflected a positive relationship between prices and dentist density, while the price of surgical

periodontal treatment positively correlated to clinic density. Both crown treatments negatively correlated with clinic density. The income and housing variable mostly had a positive relation with the prices of treatments.

Dentists or clinics exercise their market power in the pricing of most common services, since they might not be afraid of losing patients. Some regular patients exercise consumer loyalty, while the switch cost may seem high to patients and price elasticity is low on dental demand. Moreover, they could be skeptical about the benefits of lowering service prices to attract new patients, given that fewer patients will have fewer treatments. It is apparent that their income would decrease if the impact of lowering price was not substantial enough to bring in new customers and offset their profit loss by charging their old patients lower prices. However, the practical significance of the result is uncertain with regard to the size of the impact created to switch a consumer's clinic, given the small size of estimated coefficients and long distances among trade districts.

Meanwhile, competition can be observed in pricing crown services. This may be deducted from the competition in dental technician market that might lower the clinic's cost in ordering a crown from a technician. Alternatively, clinics may lower their crown service prices because patients are more sensitive to larger price changes than the other common services. Additionally, clinics can continue to preserve an acceptable level of profit by lowering prices (up to -270 NOK), since crown service prices are usually very high.

Lastly, it appears that the prices of periodontal treatments are influenced by the reimbursement of HELFO. These two treatments have positive correlations with density variables, and the sizes of the estimated coefficients are large in comparison with their mean prices. This implies that dentists or clinics may charge more for these two treatments, since patients become less sensitive to the prices as a result of the copayment of HELFO.

Although this research study has several limitations, it attempts to analyze the impact of dentist density and clinic density on the pricing of dental services in the market. There are more voices speaking out to "bring back teeth to body (*tennene tilbake til kroppen*)" in the Norwegian public health policy. Similar to other healthcare services, adult Norwegians would prefer to have greater public coverage in their dental expenditure. In order to cope with this increasing demand, precise and comprehensive research focused on the dental market is required in the future.

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Appendix

County	Trade district number	Name of trade district	Population over 20 years old	Mean of Income after tax(NOK)	Mean price per square meter of freeholders' housing (NOK)
1. ØSTFOLD	191	Halden	24842	454 603	19798
	192	Moss	46581	492 954	27325
	193	Fredrikstad/Sarpsborg	113142	475 045	23406
	194	Askim/Mysen	39516	484 496	20078
2. AKERHUS	291	Follo	95057	591 145	37639
	292	Bærum/Asker	135603	618 254	47675
	293	Lillestrøm	160627	557 216	33719
	294	Ullensaker/Eidsvoll	55551	521 141	28149
3. OSLO	391	Oslo	523006	446 000	66278
4. HEDMARK	491	Kongsvinger	39093	445 880	15096
	492	Hamar	71520	481 039	21846
	493	Elverum	31190	453 541	17258
	494	Tynset	11545	462 324	16701
5. OPPLAND	591	Lillehammer	30482	487 201	24120
	592	Gjøvik	55183	465 678	18648
	593	Midt-Gudbrandsdalen	10455	453 573	12282
	594	Nord-Gudbrandsdalen	14764	458 735	15598
	595	Hadeland	22524	507 575	19084
	596	Valdres	13966	445 338	16776
6. BUSKERUD	691	Drammen	140719	511 203	28695
	692	Kongsberg	25991	521 102	22395
	693	Hønefoss	30473	480 173	22366
	694	Hallingdal	16161	454 503	18575
7. VESTFOLD	791	Tønsberg/Horten	94729	492 683	26543
	792	Holmestrand	10827	501 712	21037
	793	Sandefjord/Larvik	71213	477 743	23895
	794	Sande/Svelvik	12271	529 014	23522
8. TELEMARK	891	Skien/Porsgrunn	87464	480 844	19455
	892	Notodden/Bø	19244	461 776	15173
	893	Kragerø	11546	443 603	16139
	894	Rjukan	4606	460 000	14560
	895	Vest-Telemark	10997	474 781	14827
9. AUST-AGDER	991	Risør	7360	451 035	15853
	992	Arendal	62376	486 980	19699
	993	Lillesand	11589	535 629	21622
	994	Setesdal	6273	476 236	16938
10. VEST-AGDER	1091	Kristiansand	90447	493 364	25186
	1092	Mandal	18870	489 749	18468
	1093	Lyngdal/Farsund	14587	507 835	16209
	1094	Flekkefjord	12719	505 211	17646
11. ROGALAND	1191	Egersund	17847	535 672	19431
	1192	Stavanger/Sandnes	207582	562 591	30743
	1193	Haugesund	80764	509 382	18640
	1194	Jæren	40117	570 753	26352
12. HORDALAND	1291	Bergen	325627	517 511	34781
	1294	Odda	9688	488 997	23162
	1295	Voss	12614	506 322	25030

	1296	Sunnhordland	43837	538 958	18633
13. SOGN-OG-FJORDANE	1491	Florø	11783	525 347	21736
	1492	Høyanger	6661	490 242	17040
	1493	Sogndal/Årdal	21073	516 703	20802
	1494	Førde	21456	525 178	22265
	1495	Nordfjord	21693	517 574	17477
14. MØRE-OG-ROMSDAL	1591	Molde	49616	509 390	20768
	1592	Kristiansund	27822	476 570	17762
	1593	Ålesund	72565	523 295	22294
	1594	Ulsteinvik	21314	528 615	15120
	1595	Ørsta/Volda	14951	511 763	18981
	1596	Sunndalsøra	7912	484 169	16314
	1597	Surnadal	7455	497 465	15846
15. (Sør) TRØNDELAG	5085	Trondheim	192601	507 180	37139
	5086	Frøya/Hitra	7462	454 630	19469
	5087	Brekstad	11839	473 999	20236
	5088	Oppdal	7314	475 262	17100
	5089	Orkanger	17347	500 946	19932
	5090	Røros	6106	469 690	18608
16. (Nør) TRØNDELAG	5091	Steinkjer	29382	490 092	15883
	5092	Namsos	14802	509 001	15666
	5093	Stjørdalshalsen	19387	517 667	24138
	5094	Levanger/Verdalsøra	28130	500 767	17686
	5095	Grong	4009	459 204	14461
	5096	Rørvik	7656	485 570	16941
17. NORDLAND	1891	Bodø	63193	508 944	25936
	1892	Narvik	22000	479 811	19688
	1893	Brønnøysund	10053	473 796	18854
	1894	Sandnessjøen	11773	477 490	18123
	1895	Mosjøen	12686	470 043	18219
	1896	Mo i Rana	24901	491 515	21652
	1897	Lofoten	18615	469 651	17919
	1898	Vesterålen	23481	471 370	15654
18. TROMS	1991	Harstad	24919	490 057	21459
	1992	Tromsø	66914	503 288	35058
	1993	Andselv	11665	488 373	23431
	1994	Finnsnes	14899	480 895	19731
	1995	Nord-Troms	8688	475 708	25876
19. FINNMARK	2091	Vadsø	12050	459 758	18801
	2092	Hammerfest	19646	488 472	20523
	2093	Alta	18686	525 972	23222
	2094	Kirkenes	7897	504 000	19055

[Appendix 1. Descriptions of trade districts]

Pasientgruppe: Øvrig voksen befolkning, 2016	Andel undersøkt/behandlet (prosent)
0100 Østfold fylkeskommune	0,8
0200 Akershus fylkeskommune	0,6
0300 Oslo fylkeskommune	0,3
0400 Hedmark fylkeskommune	8,7
0500 Oppland fylkeskommune	5,8
0600 Buskerud fylkeskommune	4,7
0700 Vestfold fylkeskommune	2,4
0800 Telemark fylkeskommune	10,2
0900 Aust-Agder fylkeskommune	10,4
1000 Vest-Agder fylkeskommune	2,2
1100 Rogaland fylkeskommune	9,8
1200 Hordaland fylkeskommune	5,2
1400 Sogn og Fjordane fylkeskommune	0,0
1500 Møre og Romsdal fylkeskommune	6,0
1600 Sør-Trøndelag fylkeskommune	11,8
1700 Nord-Trøndelag fylkeskommune	8,7
1800 Nordland fylkeskommune	11,6
1900 Troms fylkeskommune	9,0
2000 Finnmark fylkeskommune	19,3

[Appendix 2. Percent of public clinics services to adult patients (*Øvrig voksen befolkning*)]

1. Examination	1) Examination Examination of tooth, gums, cavity, 2 x-ray pictures, and simple cleansing
2. Tooth fillings	2) Small tooth filling Filling to one side of tooth to replace lost or damaged substance of tooth, hygiene services and necessary expenditure to the treatment except anesthetic
	3) Medium tooth filling Filling which expands more than two sides of a moral tooth, hygiene services and necessary expenditure to the treatment except anesthetic
	4) Large tooth filling Filling which expands over three sides of a moral tooth, hygiene services and necessary expenditure to the treatment except anesthetic
3. Extractions	5) Simple extraction Extraction a tooth or root without surgery, anesthetic, hygiene services and necessary expenditure to the treatment
	6) Surgical extraction Surgical extraction, anesthetic, hygiene services and necessary expenditure to the treatment
4. Periodontal treatments	7) Simple periodontal treatment Treatment less than 30 minutes, hygiene services and necessary expenditure to the treatment except anesthetic
	8) Surgical periodontal treatment Surgical treatment, hygiene services and necessary expenditure to the treatment except anesthetic
5. Root canal treatments	9) 1 canal treatment Root filling of one dead root canal in two visits, anesthetic, hygiene services and necessary expenditure to the treatment, excluding a permanent filling or crown.
	10) 2 canals treatment Root filling of two dead root canals in two visits, anesthetic, hygiene services and necessary expenditure to the treatment, excluding a permanent filling or crown.
	11) 3-4 canals treatment Root filling of three or four dead root canals in two visits, anesthetic, hygiene services and necessary expenditure to the treatment, excluding a permanent filling or crown.
6. Implant and crowns	12) Implant on the upper jaw front Dental implant on the jaw bone, anesthesia, components and equipment related to the implant, hygiene services and necessary expenditure to the treatment, except a crown on the implant
	13) Crown on a molar tooth A ceramic crown and necessary expenditure to the treatment, excluding a permanent filling, without metal on a molar tooth, anesthetic, hygiene services
	14) Crown for an implant A whole ceramic crown on an implant on the front upper jaw, anesthetic, hygiene services and necessary expenditure to the treatment

[Appendix 3. Treatment price and its components]

[Appendix 4. All results of <set I>]

Examination 89 clusters, observations=1653								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	9.48** (4.16)	5.75* (2.98)	X	9.29** (3.82)	0.09** (0.04)	0.06** (0.02)	X	0.09** (0.03)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-13.09** (6.45)	X	0.40 (5.15)	-9.52 (6.39)	-0.05 (0.04)	X	0.00 (0.03)	-0.05 (0.03)
Median income of a trade district (iii), *I*	X	259.79** (99.83)	245.15** (108.06)	239.27** (101.08)	X	0.34*** (0.10)	0.33*** (0.12)	0.32*** (0.11)
Average price of freeholder per square meter (iv), *H*	X	8.17 (12.58)	5.05 (14.04)	-0.357 (13.03)	X	-0.01 (0.01)	-0.01 (0.01)	-0.02 (0.01)
Mean VIF	1.67	1.03	1.19	1.54	1.55	1.01	1.17	1.51
R^2	0.01	0.02	0.03	0.03	0.01	0.03	0.03	0.03

Small filling 89 clusters, observations=1641								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	11.34*** (3.69)	6.29** (2.61)	X	9.01** (3.83)	0.12*** (0.04)	0.06** (0.03)	X	0.09** (0.04)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-16.76** (5.82)	X	2.31 (4.74)	-7.33 (6.37)	-0.09** (0.05)	X	0.01 (0.03)	-0.04 (0.04)
Median income of a trade district (iii), *I*	X	-30.83 (48.07)	-40.91 (50.69)	-46.76 (52.95)	X	-0.03 (0.06)	0.04 (0.06)	-0.06 (0.07)
Average price of freeholder per square meter (iv), *H*	X	57.52**** (10.29)	56.18**** (11.74)	50.92**** (11.54)	X	0.06**** (0.01)	0.06*** (0.01)	0.05*** (0.01)
Mean VIF	1.67	1.03	1.19	1.54	1.55	1.10	1.18	1.51
R^2	0.02	0.05	0.04	0.05	0.02	0.03	0.03	0.04

Medium filling 89 clusters, observations=1641								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	12.14*** (4.80)	6.64 (3.23)	x	10.56** (4.93)	0.08** (0.03)	0.04* (0.02)	X	0.07* (0.03)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-17.46* (8.82)	X	0.73 (6.67)	-10.55 (9.32)	-0.06** (0.04)	X	0.00 (0.03)	-0.04 (0.04)
Median income of a trade district (iii), *I*	X	32.35 (101.67)	16.27 (104.13)	9.41 (104.66)	X	0.02 (0.08)	0.02 (0.08)	0.00 (0.08)
Average price of freeholder per square meter (iv), *H*	X	43.49** (16.90)	40.14** (17.83)	33.98* (17.07)	X	0.02* (0.01)	0.02* (0.01)	0.01 (0.01)
Mean VIF	1.67	1.03	1.19	1.545	1.55	1.01	1.18	1.51
R^2	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.01

Large filling 89 clusters, observations=1641								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	14.71** (6.02)	8.32* (4.22)	x	12.46** (6.20)	0.08** (0.03)	0.04* (0.02)	X	0.06* (0.03)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-20.89* (10.58)	X	2.17 (8.38)	-11.15 (11.53)	-0.05 (0.03)	X	0.00 (0.03)	-0.03 (0.04)
Median income of a trade district (iii), *I*	X	31.47 (120.69)	15.32 (125.62)	7.23 (125.85)	X	0.02 (0.08)	0.01 (0.08)	0.00 (0.08)
Average price of freeholder per square meter (iv), *H*	X	58.38*** (18.83)	55.61*** (20.57)	48.34*** (20.07)	X	0.03** (0.01)	0.03** (0.01)	0.02* (0.01)
Mean VIF	1.67	1.03	1.19	1.54	1.55	1.01	1.18	1.56
R^2	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.02

Simple extraction 88 clusters, observations=1568								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	22.47*** (6.86)	9.91** (4.60)	X	17.91** (7.22)	0.20*** (0.06)	0.08** (0.04)	X	0.15** (0.06)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-44.54**** (10.91)	X	-2.20 (7.06)	-20.91* (10.85)	-0.20*** (0.05)	X	-0.01 (0.03)	-0.09* (0.05)
Median income of a trade district (iii), *I*	X	215.86*** (60.61)	176.13*** (66.21)	170.83*** (64.78)	X	0.19*** (0.06)	0.16** (0.06)	0.15** (0.06)
Average price of freeholder per square meter (iv), *H*	X	127.60**** (17.00)	117.83*** (17.28)	108.79*** (16.41)	X	0.11*** (0.01)	0.10*** (0.01)	0.09*** (0.01)
Mean VIF	1.72	1.04	1.20	1.56	1.59	1.02	1.19	1.52
R^2	0.04	0.07	0.07	0.07	0.04	0.06	0.05	0.07

Surgical extraction 85 clusters, observations=1279								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	15.03 (23.33)	27.15 (19.66)	X	14.30 (23.20)	0.12 (0.11)	0.15 (0.09)	X	0.11 (0.11)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	11.87 (32.28)	X	47.19 (28.76)	32.68 (34.08)	-0.00 (0.09)	X	0.11 (0.08)	0.05 (0.10)
Median income of a trade district (iii), *I*	X	641.46*** (225.55)	710.98*** (234.36)	713.52*** (235.59)	X	0.33*** (0.12)	0.36*** (0.13)	0.36*** (0.13)
Average price of freeholder per square meter (iv), *H*	X	27.77 (52.27)	63.42 (55.33)	57.83 (55.64)	X	0.02 (0.02)	0.03 (0.03)	0.03 (0.03)
Mean VIF	1.78	1.06	1.24	1.61	1.66	1.04	1.23	1.58
R^2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Simple periodontal treatment 89 clusters, observations=1481								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	-11.61** (5.56)	-2.90 (5.14)	X	-9.00 (5.78)	-0.14 (0.06)	-0.04 (0.06)	X	-0.09 (0.07)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	26.99*** (8.22)	X	6.79 (8.71)	16.47* (9.36)	0.16** (0.06)	X	0.20 (0.06)	0.07 (0.07)
Median income of a trade district (iii), *I*	X	65.65 (139.28)	97.93 (139.45)	102.19 (142.80)	X	0.12 (0.19)	0.14 (0.19)	0.15 (0.19)
Average price of freeholder per square meter (iv), *H*	X	-77.14**** (15.96)	-67.13**** (18.07)	-62.08*** (17.77)	X	-0.11**** (0.02)	-0.10**** (0.02)	-0.09**** (0.02)
Mean VIF	1.70	1.03	1.20	1.55	1.57	1.01	1.18	1.52
R^2	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.02

Surgical periodontal treatment 80 clusters, observations=789								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	0.80 (11.60)	10.87 (9.46)	X	-1.27 (11.22)	0.01 (0.15)	0.14 (0.12)	X	-0.01 (0.14)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	13.33 (11.78)	X	28.05** (11.01)	29.32** (12.41)	0.11 (0.09)	X	0.20** (0.08)	0.21** (0.10)
Median income of a trade district (iii), *I*	X	117.40 (192.15)	193.71 (195.68)	193.57 (196.41)	X	0.25 (0.25)	0.36 (0.26)	0.36 (0.26)
Average price of freeholder per square meter (iv), *H*	X	47.57* (25.58)	75.54** (29.53)	76.02** (29.99)	X	0.03 (0.03)	0.07* (0.04)	0.07* (0.04)
Mean VIF	1.86	1.07	1.25	1.65	1.74	1.04	1.24	1.62
R^2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

1 root canal filling 86 clusters, observations=1401								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	8.16 (22.00)	17.20 (16.02)	X	10.95 (20.72)	0.04 (0.06)	0.06 (0.04)	X	0.05 (0.05)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	1.53 (34.69)	X	27.18 (27.18)	15.97 (35.52)	-0.00 (0.05)	X	0.04 (0.04)	0.01 (0.05)
Median income of a trade district (iii), *I*	X	1353.24**** (269.35)	1386.35**** (275.47)	1386.59**** (268.20)	X	0.43**** (0.08)	0.43**** (0.08)	0.43**** (0.08)
Average price of freeholder per square meter (iv), *H*	X	-42.71 (44.15)	-23.72 (49.07)	-28.37 (48.58)	X	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
Mean VIF	1.76	1.05	1.22	1.59	1.64	1.03	1.22	1.56
R^2	0.01	0.04	0.04	0.04	0.01	0.04	0.04	0.04

2 root canals filling 86 clusters, observations=1398								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	15.77 (21.59)	17.45 (15.46)	X	16.04 (20.80)	0.06 (0.05)	0.05 (0.03)	X	0.05 (0.04)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-21.76 (34.99)	X	19.97 (26.50)	3.60 (36.20)	-0.03 (0.04)	X	0.02 (0.03)	-0.00 (0.04)
Median income of a trade district (iii), *I*	X	1210.42**** (209.34)	1216.41**** (211.67)	1217.92**** (203.11)	X	0.33**** (0.05)	0.33**** (0.05)	0.33**** (0.05)
Average price of freeholder per square meter (iv), *H*	X	38.85 (40.83)	48.77 (43.53)	42.09 (43.72)	X	0.00 (0.01)	0.01 (0.01)	0.00 (0.01)
Mean VIF	1.77	1.05	1.22	1.59	1.64	1.03	1.22	1.56
R^2	0.01	0.03	0.03	0.03	0.01	0.03	0.03	0.03

3 root canals filling 87 clusters, observations=1403								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	15.42 (27.19)	12.16 (19.27)	X	12.31 (26.14)	0.05 (0.05)	0.03 (0.03)	X	0.04 (0.04)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-31.86 (44.06)	X	12.33 (33.79)	-0.44 (45.99)	-0.05 (0.04)	X	0.00 (0.03)	-0.01 (0.04)
Median income of a trade district (iii), *I*	X	908.56*** (309.71)	908.42*** (310.05)	907.65*** (305.00)	X	0.20*** (0.06)	0.20*** (0.06)	0.19*** (0.06)
Average price of freeholder per square meter (iv), *H*	X	95.34* (55.83)	100.77* (58.58)	94.94 (59.00)	X	0.02* (0.01)	0.02* (0.01)	0.01 (0.01)
Mean VIF	1.76	1.04	1.21	1.59	1.62	1.02	1.20	1.54
R^2	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02

Implant on a upper jaw 62 clusters, observations=292								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	-161.17 (181.00)	-138.76 (129.53)	X	-179.58 (176.73)	-0.06 (0.14)	0.08 (0.10)	X	0.08 (0.14)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	89.73 (286.13)	X	-59.42 (236.20)	106.52 (281.89)	-0.00 (0.12)	X	-0.04 (0.09)	-0.00 (0.12)
Median income of a trade district (iii), *I*	X	-3830.30** (1647.15)	-3301.25** (1468.05)	-3613.18** (1575.65)	X	-0.24* (0.12)	-0.23** (0.11)	-0.24** (0.12)
Average price of freeholder per square meter (iv), *H*	X	326.14 (358.81)	438.70 (356.87)	406.27 (365.12)	X	0.01 (0.02)	0.04 (0.02)	0.00 (0.02)
Mean VIF	1.86	1.15	1.27	1.62	1.92	1.17	1.29	1.68
R^2	0.01	0.02	0.02	0.02	0.01	0.02	0.01	0.02

Crown on a molar tooth 89 clusters, observations=1588								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	60.43 (37.30)	4.25 (24.23)	X	38.78 (34.01)	0.13** (0.05)	0.02 (0.04)	X	0.07 (0.05)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-199.87*** (69.28)	X	-51.43 (51.90)	-93.32 (72.15)	-0.19*** (0.06)	X	-0.03 (0.04)	-0.08 (0.06)
Median income of a trade district (iii), *I*	X	1584.28*** (502.46)	1410.80*** (533.14)	1383.08*** (521.24)	X	0.30*** (0.09)	0.27*** (0.10)	0.26*** (0.10)
Average price of freeholder per square meter (iv), *H*	X	514.43**** (95.52)	453.89**** (106.08)	430.73**** (110.03)	X	0.09**** (0.01)	0.08**** (0.02)	0.08**** (0.02)
Mean VIF	1.68	1.03	1.19	1.54	1.58	1.01	1.17	1.51
R^2	0.05	0.09	0.09	0.09	0.05	0.09	0.09	0.09

Crown for an implant 70 clusters, observations=565								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	65.90 (90.36)	-18.24 (79.33)	X	70.71 (88.07)	0.05 (0.06)	0.00 (0.06)	X	0.06 (0.06)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-203.64* (119.82)	X	-188.06 (103.73)	-270.00** (119.88)	-0.06 (0.05)	X	-0.06 (0.05)	-0.10** (0.05)
Median income of a trade district (iii), *I*	X	260.74 (1221.45)	-33.00 (1247.39)	99.25 (1207.38)	X	0.10 (0.11)	0.08 (0.12)	0.09 (0.11)
Average price of freeholder per square meter (iv), *H*	X	-255.70 (223.55)	-382.61* (224.25)	-385.36* (216.76)	X	-0.03* (0.02)	-0.04* (0.02)	-0.05** (0.02)
Mean VIF	1.86	1.15	1.27	1.62	1.92	1.17	1.29	1.68
R^2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

[Appendix 5. All results of <set II>]

Examination 88 clusters, observations=1321								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	0.03 (5.54)	0.51 (3.00)	X	4.42 (4.90)	0.00 (0.05)	0.01 (0.02)	X	0.04 (0.04)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-8.30 (7.74)	X	-1.71 (4.82)	-8.43 (7.78)	-0.03 (0.04)	X	0.00 (0.02)	-0.04 (0.04)
Median income of a trade district (iii), *I*	X	331.02*** (124.02)	317.88** (122.34)	328.64** (125.93)	X	0.44*** (0.13)	0.43** (0.12)	0.43** (0.14)
Average price of freeholder per square meter (iv), *H*	X	4.28 (12.18)	3.74 (12.47)	-1.76 (14.57)	X	-0.01 (0.01)	-0.02 (0.01)	-0.02 (0.01)
Mean VIF	3.07	1.11	1.10	2.55	3.09	1.10	1.08	2.56
R^2	0.01	0.04	0.04	0.04	0.01	0.04	0.04	0.04

Small filling 88 clusters, observations=1309								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	13.00*** (4.33)	3.58 (2.32)	X	6.25 (4.00)	0.11*** (0.04)	0.03 (0.02)	X	0.05 (0.04)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-19.15** (7.55)	X	3.74 (4.36)	-5.76 (7.44)	-0.09** (0.05)	X	0.02 (0.03)	-0.04 (0.05)
Median income of a trade district (iii), *I*	X	40.30 (48.42)	23.38 (51.12)	38.66 (49.69)	X	0.04 (0.06)	0.03 (0.07)	0.03 (0.07)
Average price of freeholder per square meter (iv), *H*	X	51.78**** (10.62)	55.40**** (10.39)	47.64**** (12.57)	X	0.06**** (0.02)	0.06**** (0.01)	0.05*** (0.02)
Mean VIF	3.07	1.11	1.10	2.55	3.09	1.10	1.08	2.56
R^2	0.02	0.02	0.02	0.04	0.02	0.03	0.03	0.03

Medium fillings 88 clusters, observations=1309								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	17.29*** (4.73)	5.41 (3.71)	x	12.92** (5.82)	0.10*** (0.03)	0.02 (0.02)	X	0.07** (0.03)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-26.77** (10.87)	X	3.43 (7.01)	-16.20 (11.13)	-0.09** (0.04)	X	0.00 (0.02)	-0.06 (0.04)
Median income of a trade district (iii), *I*	X	107.52 (107.90)	71.30 (110.92)	102.90 (105.30)	X	0.07 (0.08)	0.04 (0.08)	0.05 (0.08)
Average price of freeholder per square meter (iv), *H*	X	48.97** (18.68)	53.38** (17.53)	37.35* (19.59)	X	0.03* (0.01)	0.03** (0.01)	0.02 (0.01)
Mean VIF	3.07	1.11	1.10	2.55	3.09	1.10	1.08	2.56
R^2	0.02	0.02	0.02	0.03	0.02	0.02	0.01	0.02

Large fillings 88 clusters, observations=1309								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	22.25*** (6.19)	7.81* (4.38)	x	16.31** (7.52)	0.09*** (0.03)	0.02 (0.02)	X	0.06* (0.03)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-31.98** (13.49)	X	6.43 (8.44)	-18.34 (14.32)	-0.08* (0.04)	X	0.01 (0.02)	-0.05 (0.04)
Median income of a trade district (iii), *I*	X	115.31 (129.02)	70.20 (134.02)	110.07 (126.32)	X	0.06 (0.08)	0.04 (0.08)	0.04 (0.08)
Average price of freeholder per square meter (iv), *H*	X	61.42*** (20.42)	68.49*** (19.34)	48.25** (22.39)	X	0.03** (0.01)	0.03*** (0.01)	0.02* (0.01)
Mean VIF	3.07	1.11	1.10	2.55	3.09	1.10	1.08	2.56
R^2	0.02	0.03	0.02	0.03	0.02	0.02	0.01	0.02

Simple extraction 88 clusters, observations=1294								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	24.10*** (7.81)	4.46 (4.75)	X	14.07 (8.82)	0.17*** (0.05)	0.03 (0.29)	X	0.09 (0.06)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-49.22*** (14.80)	X	0.61 (7.75)	-20.74 (14.74)	-0.19*** (0.06)	X	0.00 (0.03)	-0.08 (0.06)
Median income of a trade district (iii), *I*	X	141.23**** (67.50)	373.36**** (69.10)	408.56***** (62.79)	X	0.38***** (0.07)	0.35***** (0.07)	0.35***** (0.07)
Average price of freeholder per square meter (iv), *H*	X	116.46**** (19.89)	118.94**** (17.71)	101.55***** (22.35)	X	0.10***** (0.02)	0.10***** (0.01)	0.08***** (0.02)
Mean VIF	3.07	1.11	1.10	2.54	3.09	1.10	1.08	2.55
R^2	0.02	0.07	0.07	0.07	0.03	0.06	0.06	0.06

Surgical extraction 83 clusters, observations=1089								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	57.78*** (18.50)	64.16***** (12.60)	X	60.06** (24.08)	0.21*** (0.06)	0.19***** (0.04)	X	0.21** (0.08)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-7.09 (37.85)	X	92.34***** (22.03)	2.33 (44.06)	-0.03 (0.09)	X	0.18*** (0.06)	-0.01 (0.10)
Median income of a trade district (iii), *I*	X	551.80*** (204.42)	387.55* (217.01)	552.47*** (206.02)	X	0.21* (0.11)	0.18 (0.13)	0.20 (0.12)
Average price of freeholder per square meter (iv), *H*	X	32.89 (51.48)	107.62** (45.91)	34.63 (62.86)	X	0.01 (0.03)	0.05* (0.02)	0.01 (0.03)
Mean VIF	3.14	1.12	1.12	2.59	3.13	1.10	1.10	2.60
R^2	0.05	0.06	0.04	0.06	0.04	0.04	0.03	0.05

Simple periodontal treatment 84 clusters, observations=1149								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	10.05 (6.74)	21.33**** (4.81)	X	13.75* (8.23)	0.08 (0.06)	0.18**** (0.04)	X	0.14* (0.07)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	21.12* (12.37)	X	36.91**** (8.05)	16.33 (14.47)	0.10 (0.08)	X	0.19*** (0.05)	0.05 (0.09)
Median income of a trade district (iii), *I*	X	89.77 (144.75)	55.05 (145.37)	94.62 (144.35)	X	0.08 (0.20)	0.08 (0.21)	0.10 (0.20)
Average price of freeholder per square meter (iv), *H*	X	-29.95 (18.17)	-2.59 (18.59)	-18.31 (20.72)	X	-0.06** (0.02)	-0.02 (0.02)	-0.05* (0.02)
Mean VIF	3.08	1.12	1.12	2.50	3.07	1.10	1.10	2.51
R^2	0.03	0.03	0.03	0.04	0.03	0.04	0.03	0.03

Surgical periodontal treatment 77 clusters, observations=620								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	27.39*** (9.98)	33.23**** (5.88)	X	20.00** (9.68)	0.15* (0.07)	0.28**** (0.05)	X	0.09 (0.09)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	8.69 (15.39)	X	55.18**** (9.64)	26.92* (14.52)	0.16* (0.08)	X	0.32**** (0.05)	0.23** (0.10)
Median income of a trade district (iii), *I*	X	131.30 (217.51)	74.16 (208.90)	143.48 (231.86)	X	0.03 (0.29)	0.10 (0.29)	0.11 (0.29)
Average price of freeholder per square meter (iv), *H*	X	63.35*** (22.51)	104.14**** (23.65)	83.96*** (27.34)	X	0.02 (0.03)	0.08** (0.03)	0.06 (0.04)
Mean VIF	3.29	1.13	1.15	2.56	3.27	1.10	1.13	2.59
R^2	0.05	0.06	0.05	0.06	0.06	0.05	0.06	0.06

1 root canal filling 86clusters, observations=1211								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	5.00 (26.37)	29.71** (11.41)	X	21.85 (25.19)	0.01 (0.05)	0.05** (0.02)	X	0.03 (0.04)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	17.93 (51.82)	X	49.91* (25.18)	16.75 (52.98)	0.01 (0.06)	X	0.05 (0.03)	0.02 (0.06)
Median income of a trade district (iii), *I*	X	1259.77*** (251.14)	1210.13*** (243.21)	1263.80*** (248.64)	X	0.37**** (0.07)	0.37**** (0.07)	0.38**** (0.07)
Average price of freeholder per square meter (iv), *H*	X	-20.91 (41.41)	18.72 (36.67)	-8.66 (48.18)	X	-0.01 (0.01)	-0.00 (0.13)	-0.01 (0.01)
Mean VIF	3.15	1.11	1.10	2.60	3.15	1.09	1.08	2.60
R^2	0.01	0.04	0.03	0.04	0.01	0.03	0.03	0.03

2 root canals filling 86 clusters, observations=1208								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	24.75 (23.90)	30.11** (11.87)	X	30.48 (25.92)	0.06 (0.04)	0.04 (0.02)	X	0.05 (0.03)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-19.85 (52.22)	X	45.40* (26.27)	-0.80 (55.04)	-0.03 (0.05)	X	0.04 (0.03)	-0.00 (0.05)
Median income of a trade district (iii), *I*	X	1239.47*** (209.46)	1162.97*** (213.15)	1239.29*** (208.10)	X	0.31**** (0.05)	0.30**** (0.05)	0.31**** (0.05)
Average price of freeholder per square meter (iv), *H*	X	66.29 (45.08)	103.80*** (38.42)	65.71 (50.93)	X	0.01 (0.01)	0.02* (0.01)	0.01 (0.01)
Mean VIF	3.15	1.11	1.10	2.60	3.16	1.10	1.08	2.60
R^2	0.01	0.04	0.03	0.04	0.01	0.03	0.03	0.03

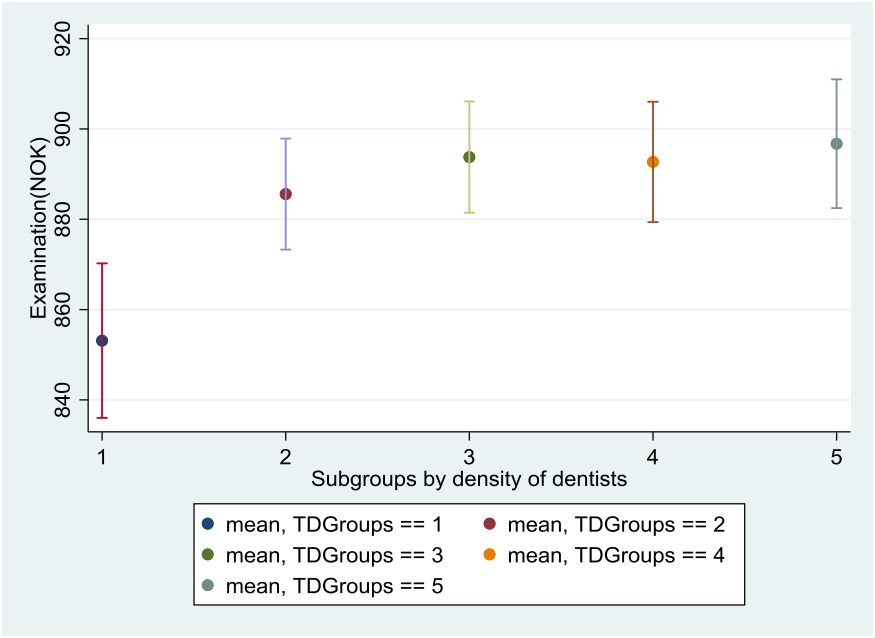
3-4 root canals filling 87 clusters, observations=1206								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	45.82 (28.17)	39.75** (15.31)	X	33.94 (34.05)	0.07** (0.03)	0.05** (0.02)	X	0.05 (0.04)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-32.90 (64.02)	X	64.00* (32.98)	12.38 (69.94)	-0.04 (0.05)	X	0.04 (0.03)	-0.00 (0.05)
Median income of a trade district (iii), *I*	X	984.28*** (305.96)	905.81*** (309.90)	987.73*** (304.11)	X	0.19*** (0.06)	0.19*** (0.06)	0.19*** (0.06)
Average price of freeholder per square meter (iv), *H*	X	149.51** (60.70)	201.82*** (51.43)	158.71** (69.29)	X	0.02* (0.01)	0.04*** (0.01)	0.02** (0.01)
Mean VIF	3.16	1.10	1.10	2.60	3.13	1.09	1.08	2.59
R^2	0.01	0.03	0.03	0.03	0.01	0.03	0.03	0.03

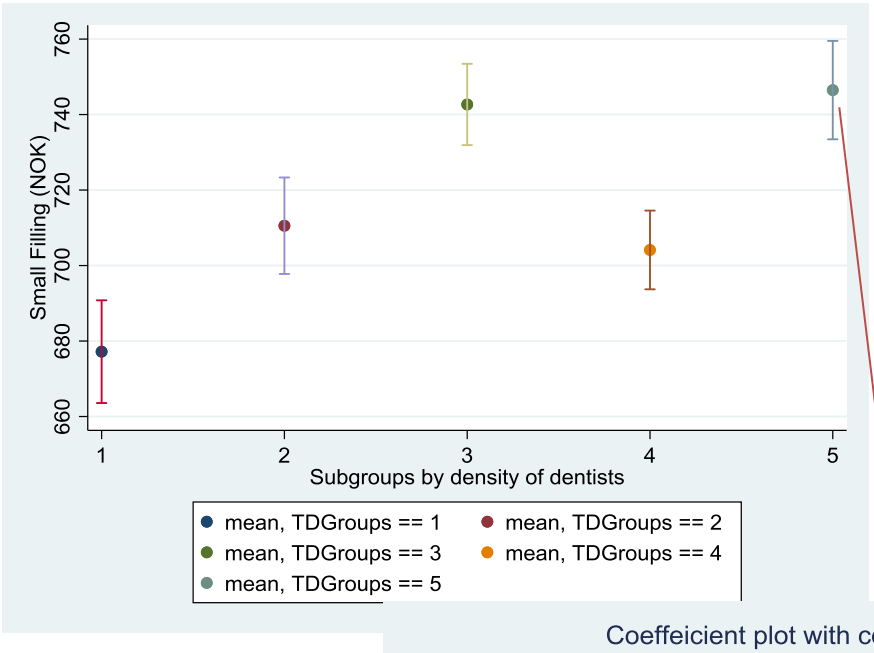
Implant on the upper jaw 61 clusters, observations=281								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	123.26 (182.45)	107.54 (103.87)	X	33.03 (201.98)	0.07 (0.10)	0.05 (0.06)	X	0.03 (0.12)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-13.67 (316.56)	X	195.86 (160.66)	151.44 (324.77)	-0.00 (0.11)	X	0.05 (0.06)	0.02 (0.12)
Median income of a trade district (iii), *I*	X	-882.56 (1271.56)	-965.56 (1161.11)	-837.85 (1269.12)	X	-0.03 (0.09)	-0.04 (0.09)	-0.03 (0.09)
Average price of freeholder per square meter (iv), *H*	X	712.50** (302.56)	835.01*** (272.74)	810.56** (360.30)	X	0.03 (0.02)	0.04* (0.02)	0.03 (0.02)
Mean VIF	3.24	1.18	1.18	2.47	3.86	1.16	1.16	2.86
R^2	0.01	0.03	0.03	0.03	0.01	0.02	0.02	0.02

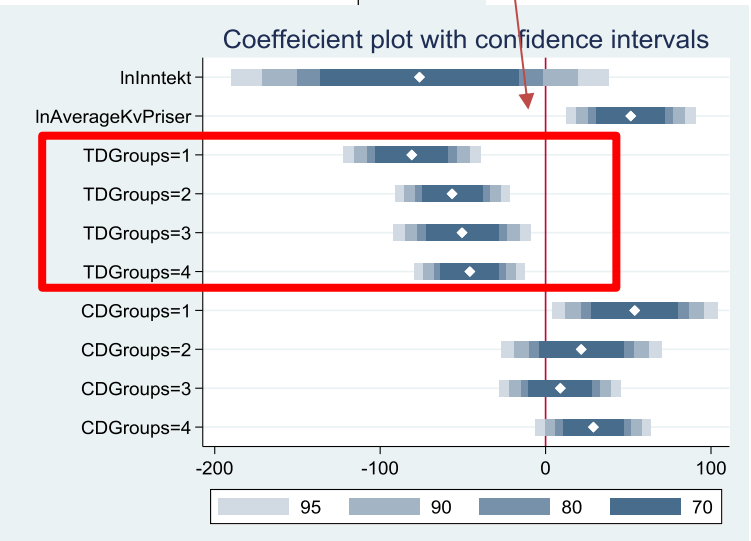
Crown on a molar tooth 87 clusters, observations=1256								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	38.27 (39.56)	-79.47**** (16.53)	X	-15.90 (29.59)	0.08 (0.04)	-0.09**** (0.02)	X	-0.00 (0.04)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-258.02**** (62.80)	X	-160.89*** (27.54)	-136.88** (53.54)	-0.22**** (0.05)	X	-0.12**** (0.02)	-0.11** (0.04)
Median income of a trade district (iii), *I*	X	869.94** (344.51)	877.21** (341.67)	836.50** (346.15)	X	0.21*** (0.06)	0.18*** (0.07)	0.18*** (0.07)
Average price of freeholder per square meter (iv), *H*	X	542.23*** (59.57)	425.29*** (53.10)	444.57*** (64.01)	X	0.10**** (0.01)	0.08**** (0.11)	0.09**** (0.13)
Mean VIF	3.06	1.11	1.10	2.52	3.08	1.09	1.08	2.53
R^2	0.12	0.17	0.20	0.20	0.11	0.17	0.18	0.18

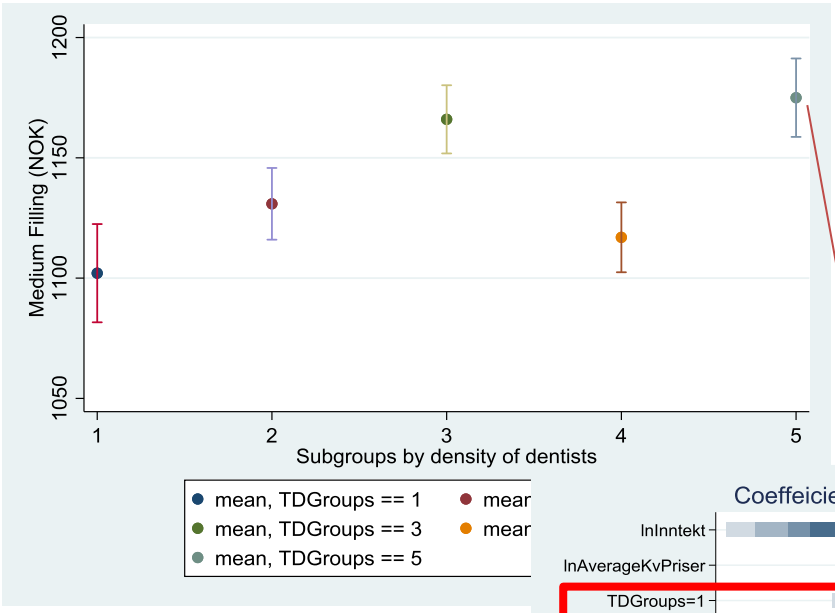
Crown for an implant 69 clusters, observations=461								
	1. level-level regression $Y = D + C + \ln I + \ln H$				2. log-log regression $\ln Y = \ln D + \ln C + \ln I + \ln H$			
Variable \ Model	A	B	C	D	a	b	c	d
Dentists per 10,000 inhabitants over 20 years (i), *D*	87.47 (90.75)	17.22 (61.23)	X	136.85 (97.80)	0.03 (0.05)	0.01 (0.03)	X	-0.08 (0.05)
Clinics per 10,000 inhabitants over 20 years (ii), *C*	-212.41 (157.16)	X	-70.08 (96.04)	-283.68* (165.84)	-0.06 (0.06)	X	-0.02 (0.03)	-0.10* (0.06)
Median income of a trade district (iii), *I*	X	588.92 (1945.94)	111.23 (1879.55)	703.56 (1996.98)	X	0.10 (0.18)	0.06 (0.18)	0.10 (0.18)
Average price of freeholder per square meter (iv), *H*	X	-222.95 (208.21)	-233.27 (204.17)	-329.97 (216.62)	X	-0.03* (0.02)	-0.03* (0.01)	0.04** (0.02)
Mean VIF	3.01	1.16	1.10	2.30	3.18	1.15	1.09	2.33
R^2	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01

[Appendix 6. Further analysis of subgroups in <set I>]








Medium Filling (NOK)
1050
1100
1150
1200
1
2
3
4
5
Subgroups by density of dentists
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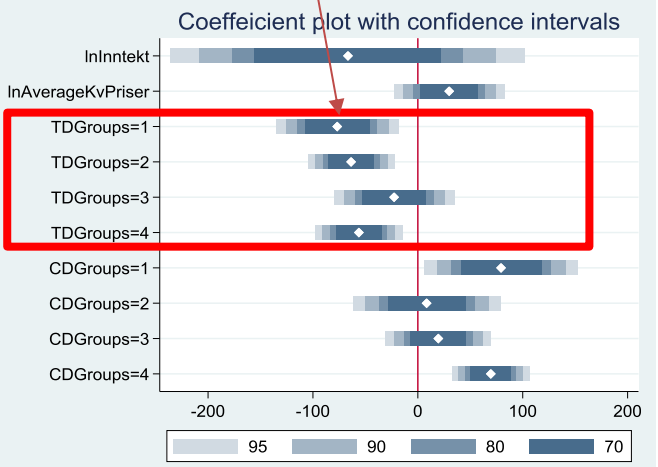
mean, TDGroups == 3
mean, TDGroups == 5
mear
mear


Coeffeicient plot with confidence intervals
lnInntekt
lnAverageKvPriser
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TDGroups=2
TDGroups=3
TDGroups=4
CDGroups=1
CDGroups=2
CDGroups=3
CDGroups=4
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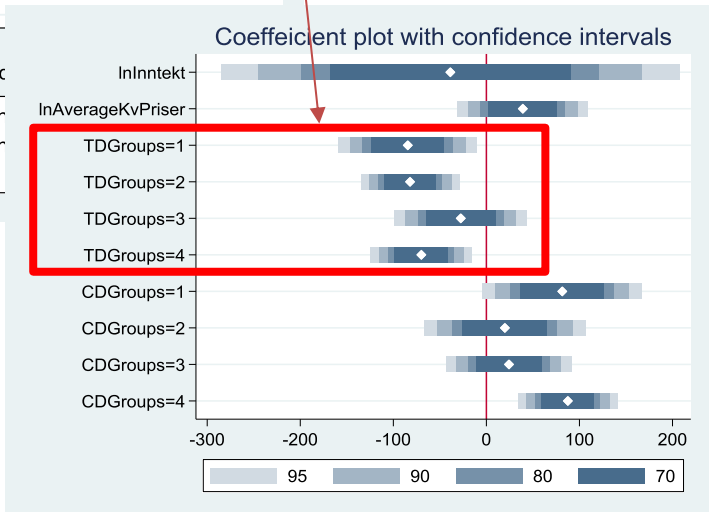
-100
0
100
200
95
90
80
70


Large Filling (NOK)
1350
1400
1450
1500
1
2
3
Subgroups by density of d
mean, TDGroups == 1
mean, TDGroups == 3
mean, TDGroups == 5
mear
mear


Coeffeicient plot with confidence intervals
lnInntekt
lnAverageKvPriser
TDGroups=1
TDGroups=2
TDGroups=3
TDGroups=4
CDGroups=1
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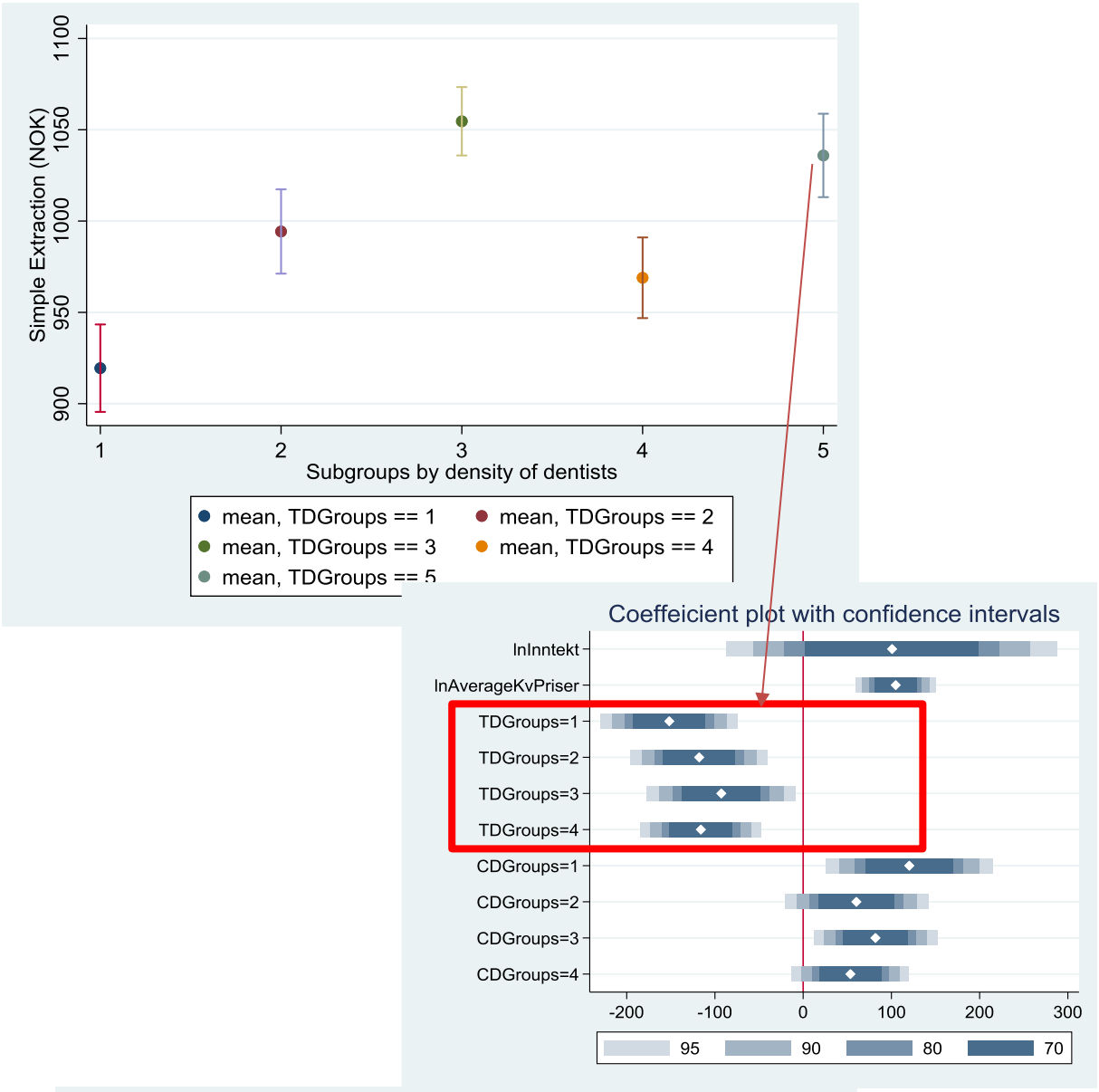
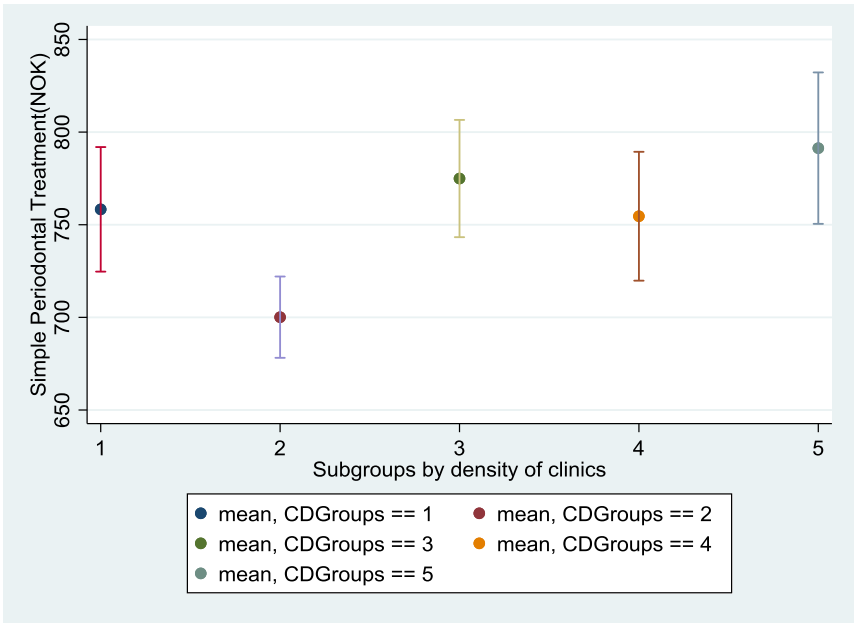
-200
-100
0
100
200
95
90
80
70


Simple Extraction (NOK)
900
950
1000
1050
1100
1
2
3
4
5
Subgroups by density of dentists
mean, TDGroups == 1
mean, TDGroups == 2
mean, TDGroups == 3
mean, TDGroups == 4
mean, TDGroups == 5
Coeffeicient plot with confidence intervals
lnInntekt
lnAverageKvPriser
TDGroups=1
TDGroups=2
TDGroups=3
TDGroups=4
CDGroups=1
CDGroups=2
CDGroups=3
CDGroups=4
-200
-100
0
100
200
300
95
90
80
70
Simple Extraction(NOK)
900
950
1000
1050
1100
1
2
3
4
5
Subgroups by density of clinics
mean, CDGroups == 1
mean, CDGroups == 2
mean, CDGroups == 3
mean, CDGroups == 4
mean, CDGroups == 5


Simple Periodontal Treatment(NOK)
650
700
750
800
850
1
2
3
4
5
Subgroups by density of clinics
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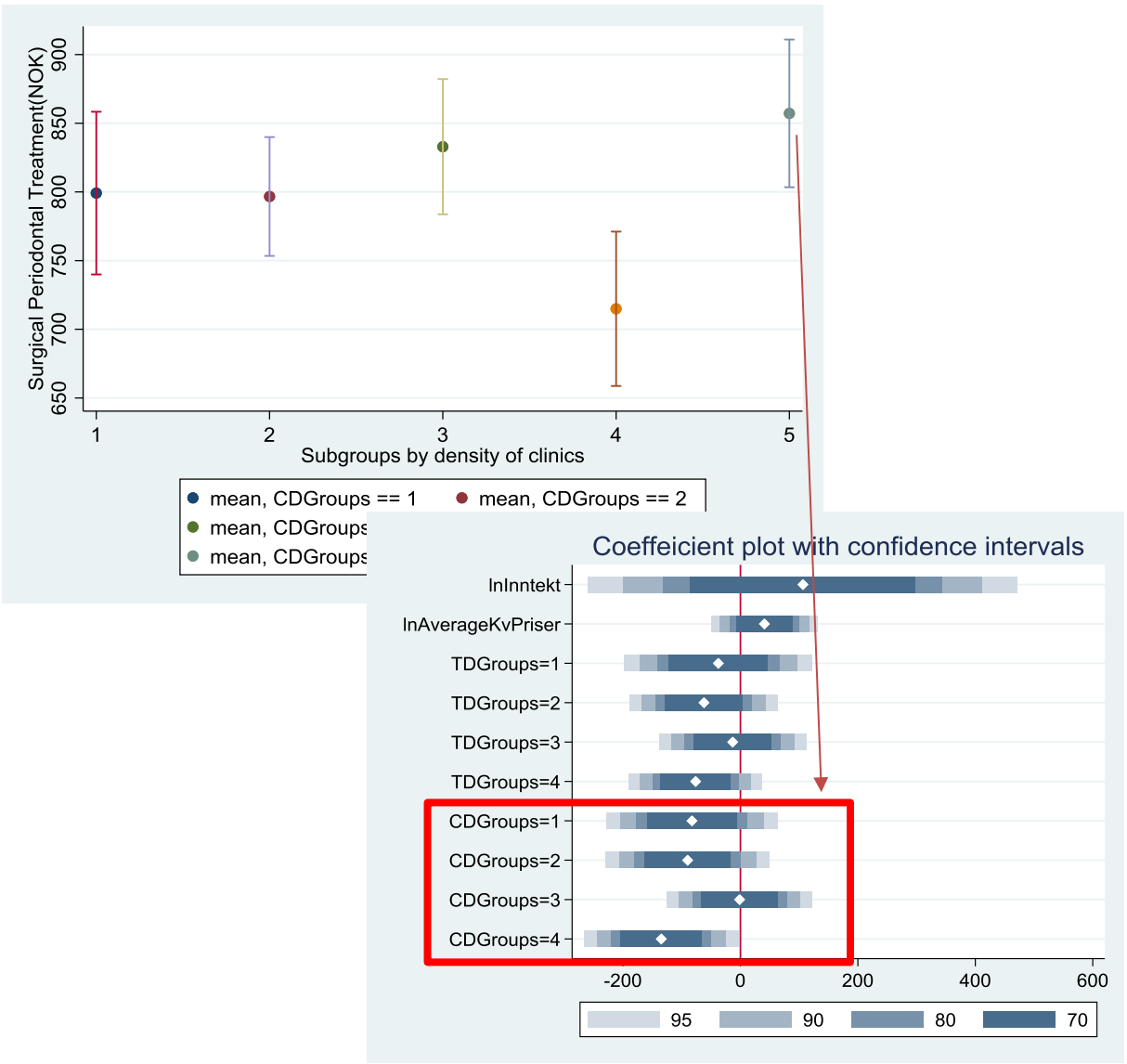
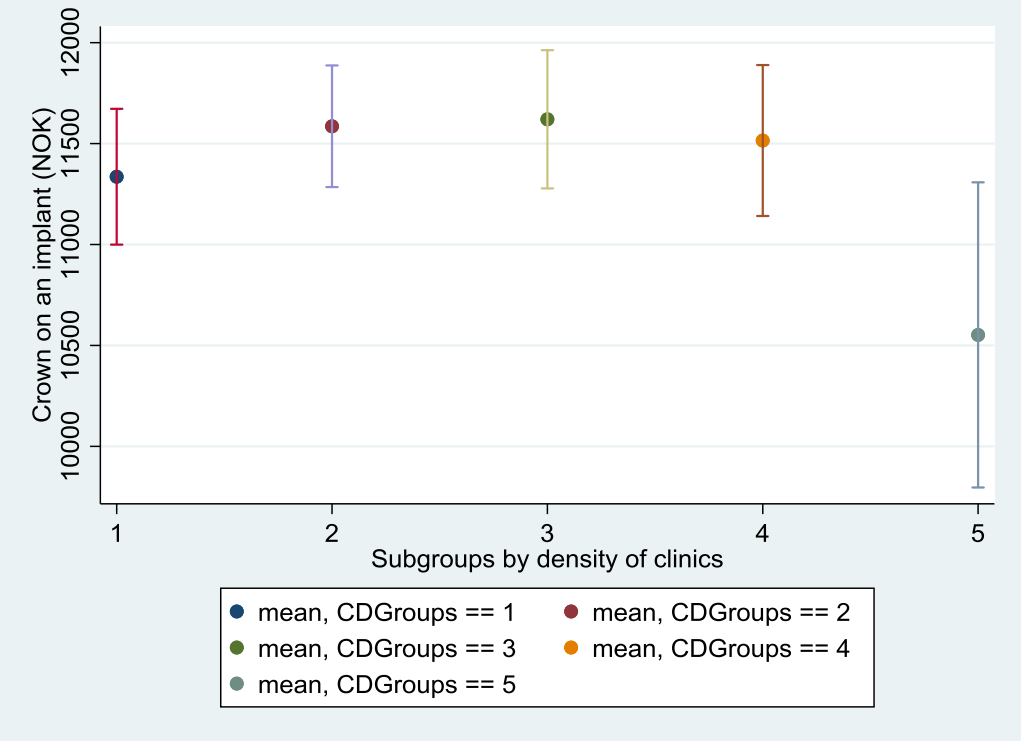
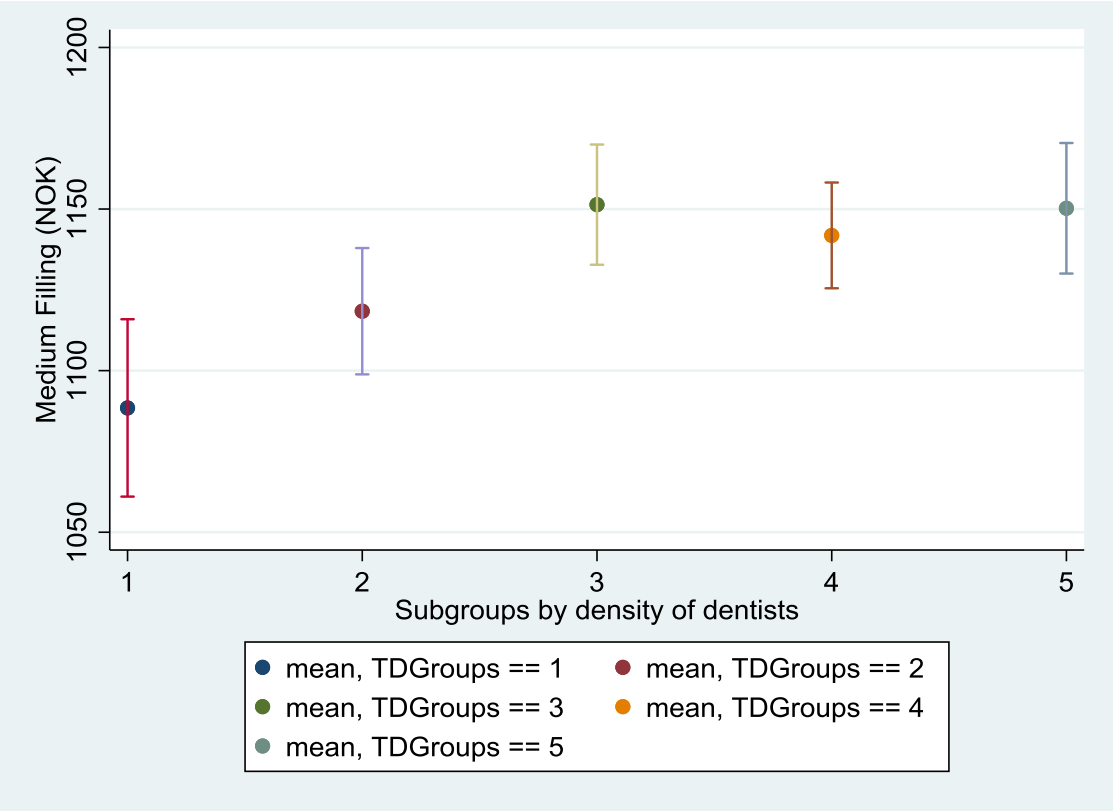
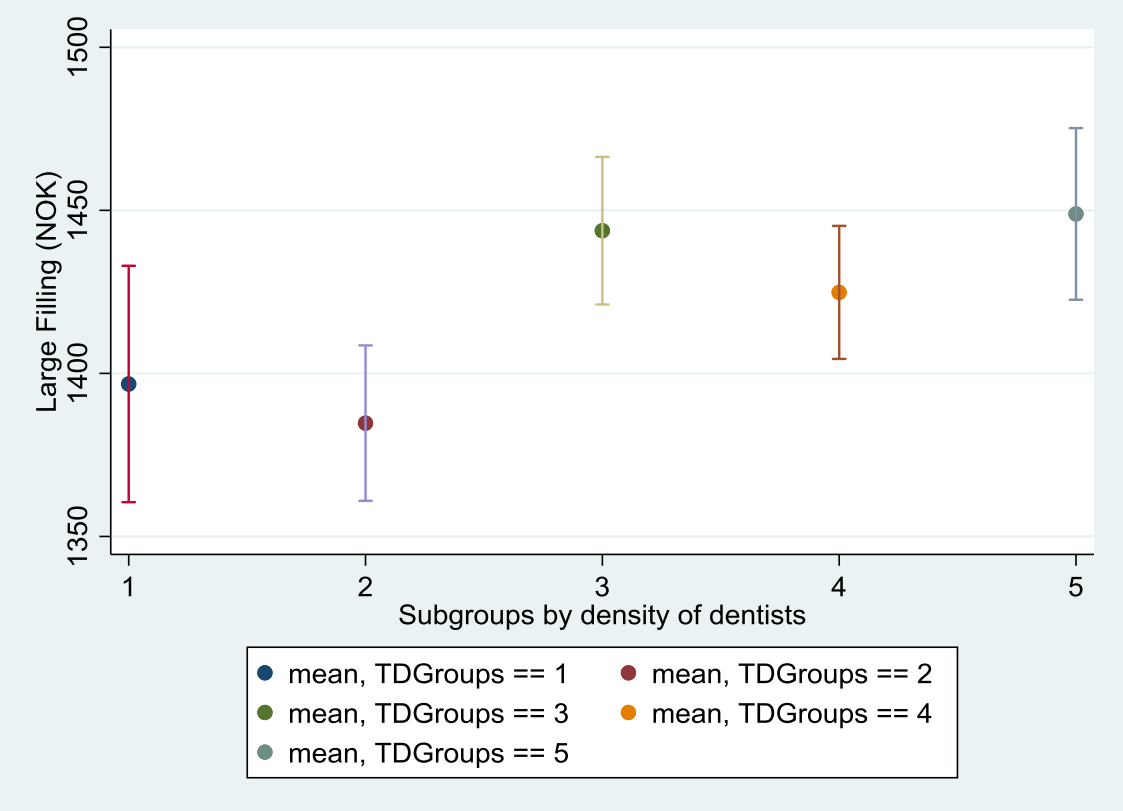
mean, CDGroups == 2
mean, CDGroups == 3
mean, CDGroups == 4
mean, CDGroups == 5

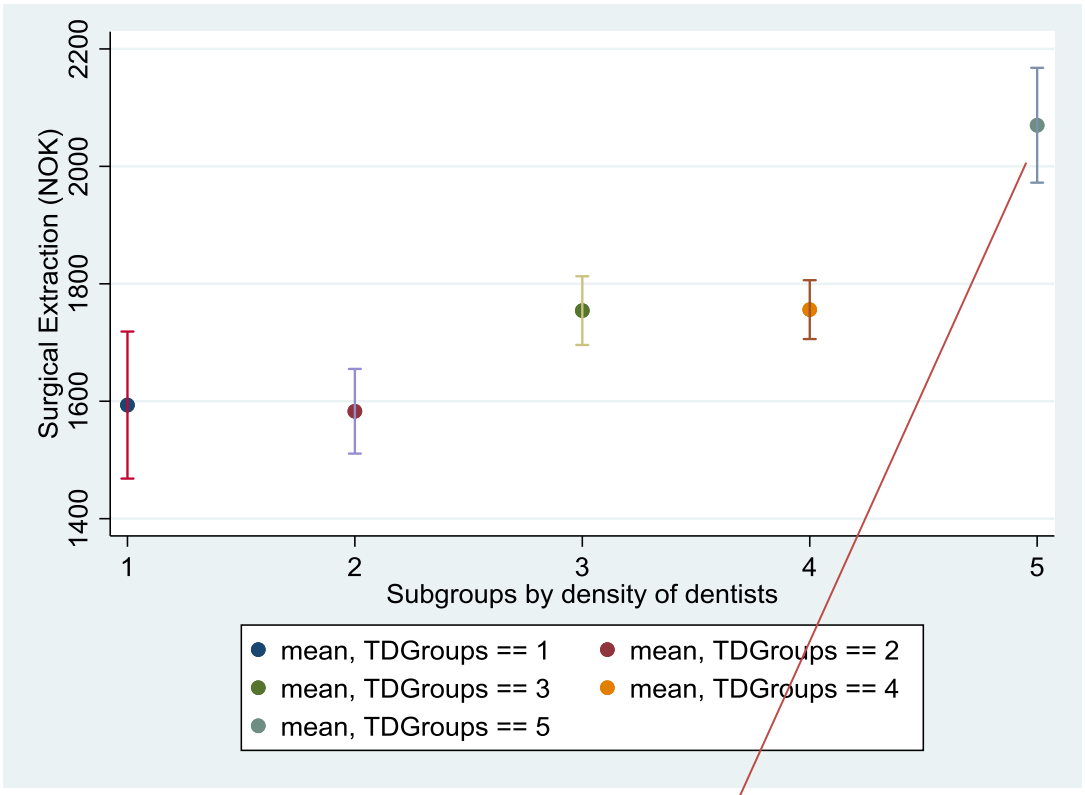

Surgical Periodontal Treatment(NOK)
650
700
750
800
850
900
1
2
3
4
5
Subgroups by density of clinics
mean, CDGroups == 1
mean, CDGroups == 2
mean, CDGroups
mean, CDGroups
Coeffeicient plot with confidence intervals
lnInntekt
lnAverageKvPriser
TDGroups=1
TDGroups=2
TDGroups=3
TDGroups=4
CDGroups=1
CDGroups=2
CDGroups=3
CDGroups=4
-200
0
200
400
600
95
90
80
70

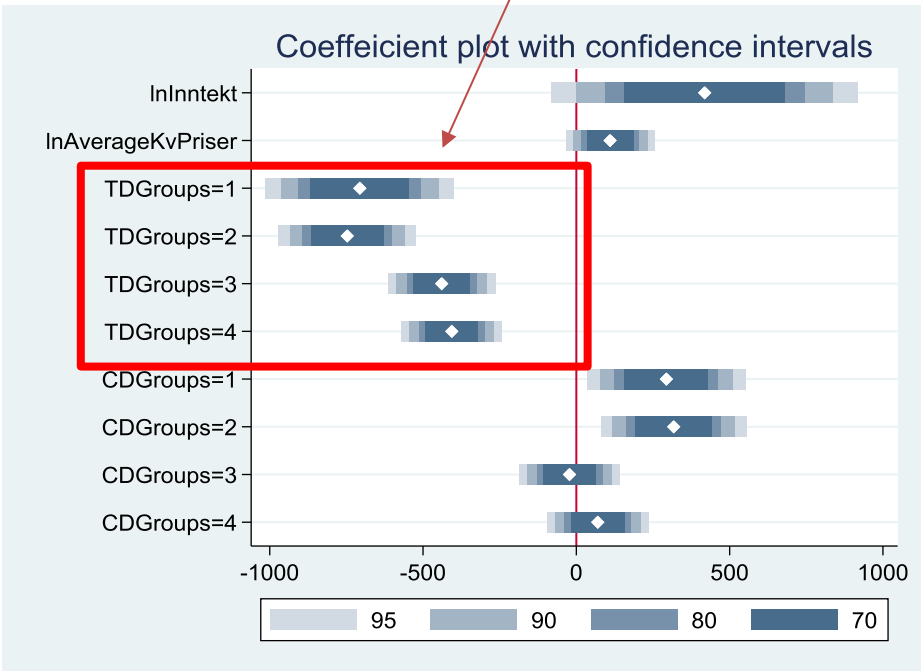

Crown on an implant (NOK)
10000
10500
11000
11500
12000
1
2
3
4
5
Subgroups by density of clinics
mean, CDGroups == 1
mean, CDGroups == 2
mean, CDGroups == 3
mean, CDGroups == 4
mean, CDGroups == 5

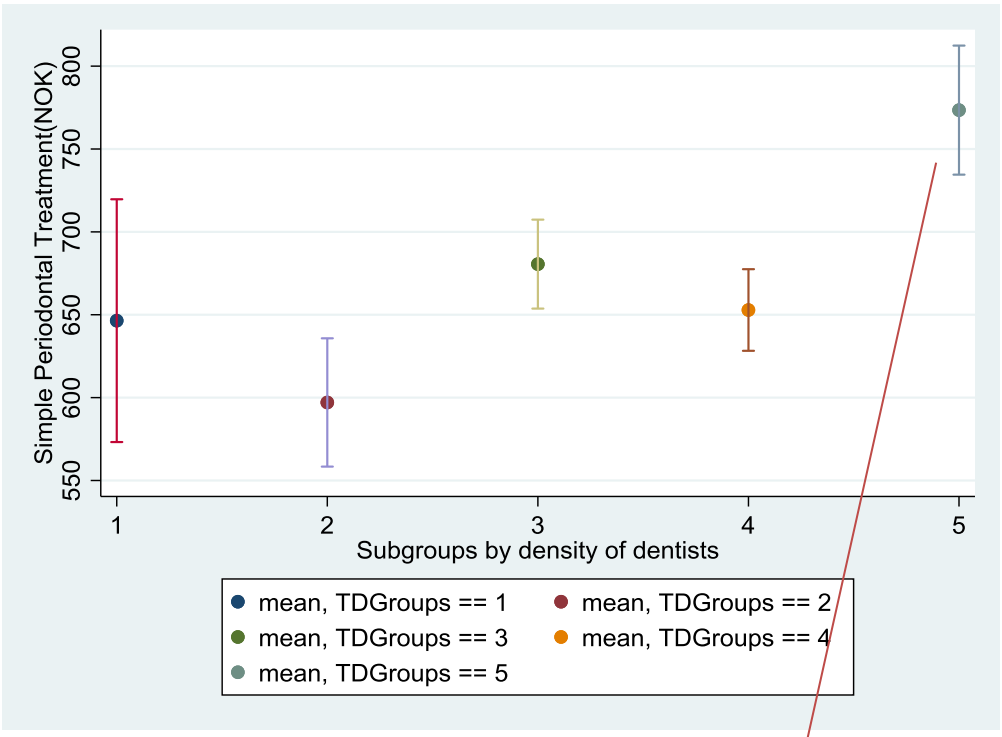
[Appendix 7. Further analysis of subgroups in <set II>]

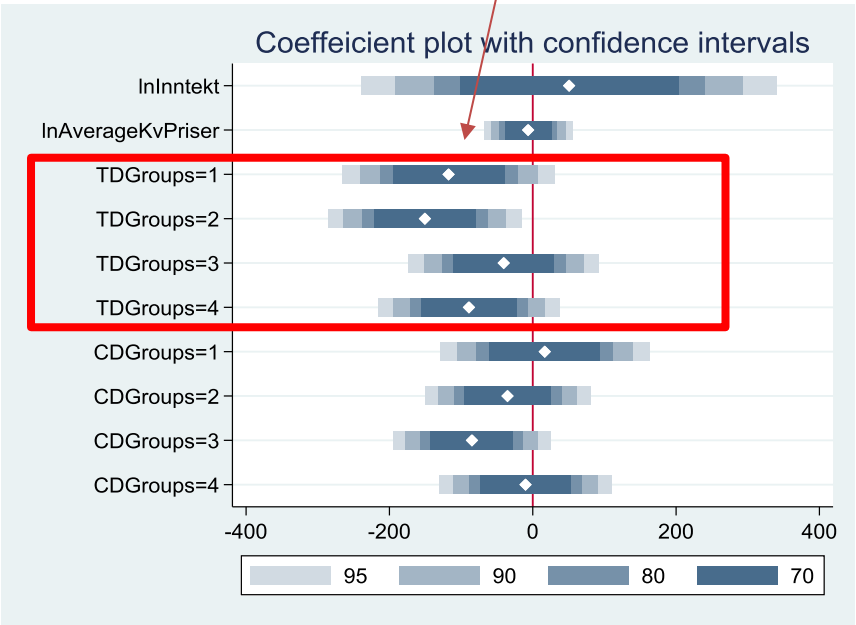


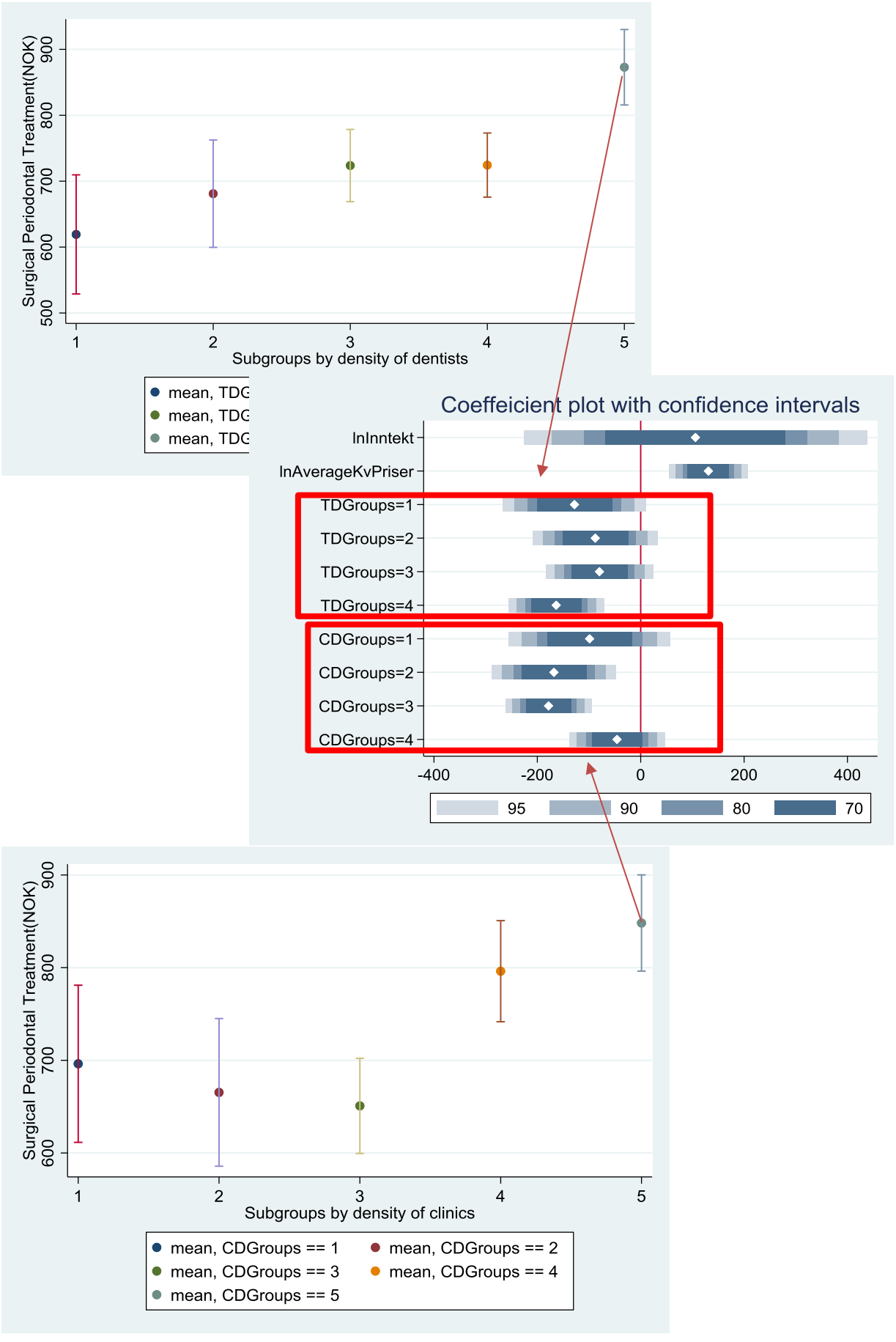


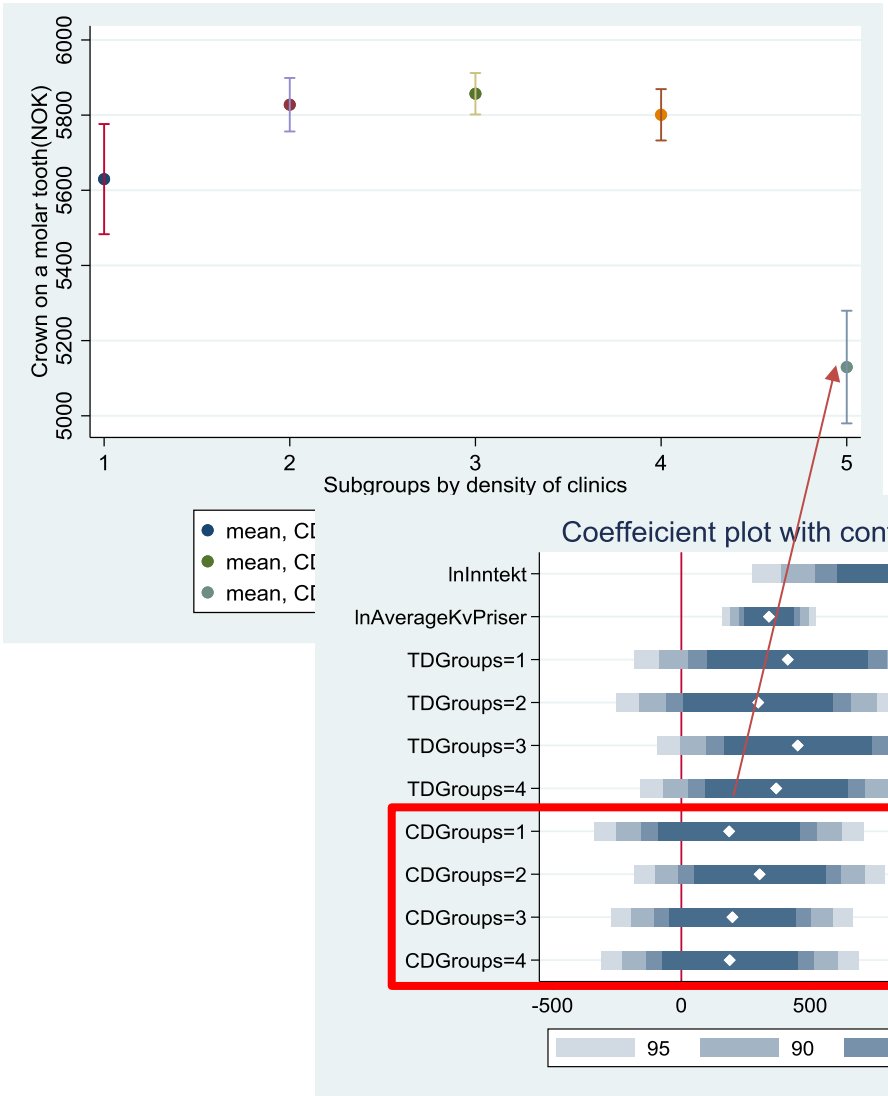

Surgical Extraction (NOK)
1400
1600
1800
2000
2200
1
2
3
4
5
Subgroups by density of dentists
mean, TDGroups == 1
mean, TDGroups == 2
mean, TDGroups == 3
mean, TDGroups == 4
mean, TDGroups == 5


Coeffeicient plot with confidence intervals
lnInntekt
lnAverageKvPriser
TDGroups=1
TDGroups=2
TDGroups=3
TDGroups=4
CDGroups=1
CDGroups=2
CDGroups=3
CDGroups=4
-1000
-500
0
500
1000
95
90
80
70

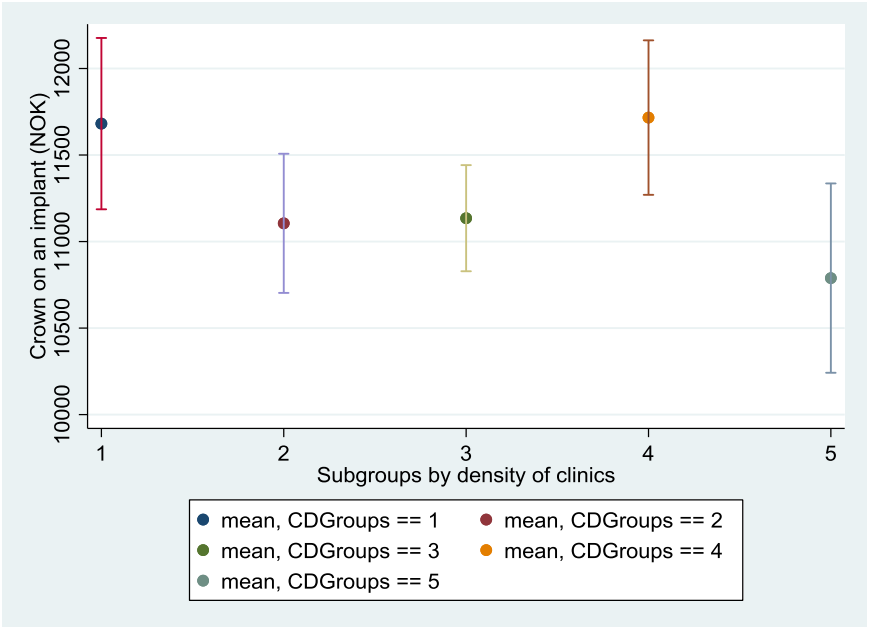

Simple Periodontal Treatment(NOK)
550
600
650
700
750
800
1
2
3
4
5
Subgroups by density of dentists
mean, TDGroups == 1
mean, TDGroups == 2
mean, TDGroups == 3
mean, TDGroups == 4
mean, TDGroups == 5


Coeffeicient plot with confidence intervals
lnInntekt
lnAverageKvPriser
TDGroups=1
TDGroups=2
TDGroups=3
TDGroups=4
CDGroups=1
CDGroups=2
CDGroups=3
CDGroups=4
-400
-200
0
200
400
95
90
80
70


Surgical Periodontal Treatment(NOK)
500
600
700
800
900
1
2
3
4
5
Subgroups by density of dentists
mean, TDG
mean, TDG
mean, TDG
Coeffeicient plot with confidence intervals
lnInntekt
lnAverageKvPriser
TDGroups=1
TDGroups=2
TDGroups=3
TDGroups=4
CDGroups=1
CDGroups=2
CDGroups=3
CDGroups=4
-400
-200
0
200
400
95
90
80
70
Surgical Periodontal Treatment(NOK)
600
700
800
900
1
2
3
4
5
Subgroups by density of clinics
mean, CDGroups == 1
mean, CDGroups == 2
mean, CDGroups == 3
mean, CDGroups == 4
mean, CDGroups == 5


Crown on a molar tooth(NOK)
5000
5200
5400
5600
5800
6000
1
2
3
4
5
Subgroups by density of clinics
mean, CD
mean, CD
mean, CD

Coeffeicient plot with confidence intervals
lnInntekt
lnAverageKvPriser
TDGroups=1
TDGroups=2
TDGroups=3
TDGroups=4
CDGroups=1
CDGroups=2
CDGroups=3
CDGroups=4
-500
0
500
1000
1500
95
90
80
70


Crown on an implant (NOK)
10000
10500
11000
11500
12000
1
2
3
4
5
Subgroups by density of clinics
mean, CDGroups == 1
mean, CDGroups == 2
mean, CDGroups == 3
mean, CDGroups == 4
mean, CDGroups == 5