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The Effect of Competition on the Pricing of Dental Treatments for Private Clinics in Sweden

Abstract

The purpose of this study was to evaluate if and how competition affected the pricing of dental treatments for private clinics in Sweden. The proximity to other clinics was used as a measure of competition. Data was gathered from the Dental and Pharmaceutical Benefits agency as well as Statistics Sweden to relate the price of dental treatments in private clinics to; the existence of public clinics in the same area, the number of private clinics in the area, the frequency of treatments and the median income for individuals in that region. Linear regression analysis was performed to study the effects of these variables on prices for private clinics. The results indicate that price competition is a factor that affects private clinics in Sweden. Private clinics compete in terms of prices with both the public- and the private sector. The effect of price competition between private clinics and public clinics is such that private clinics tend to lower their prices if a public clinic operates in the same area. The number of private clinics in an area positively correlates with prices of private clinics. Pricing decisions by private practices seem to also be related to the frequency of treatments, and the median income of patients, both of which, in general, positively correlate with prices. Statistically significant results in this study are not necessarily economically significant; the price sensitivity of patients has not been studied.

Author: Kevin Mohseni, 25035

Tutor: Milda Tylaite

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1. Introduction

The Swedish dental industry has over the years undergone changes related to free-market policies for pricing and subsidies given to patients. The industry is interesting from an economic and competitive perspective since there are clear distinctions between private sector clinics and public sector clinics, that both operate under the same free-pricing policy, while at the same time being guided by a standardized price list. In Sweden, it is not uncommon for issues regarding prices and subsidies for dental treatments to be discussed in a political forum or reported in the media. Complexities concerning tax levels, whether the right to free healthcare should also extend to free dental care, and the balance between a free-market and a regulated market, are factors that are open for debate.

This study will investigate the effect of competition on the prices of private clinics and attempt to shed light on the Swedish dental industry from a free-market perspective.

1.1 Background

1.1.1 The Swedish model for pricing of dental treatments

The pricing of dental treatments in Sweden is deregulated and a free-pricing regime has been in place since 1999. In 2008, a reform was implemented with new regulations for government subsidies to patients (Dental and Pharmaceutical Benefits Agency [abbr: TLV]. [04409/2014], 2015).

Part of this reform was the implementation of a reference price list for dental treatments. The reference price list in 2022 consists of 186 separate treatment codes, each with a specified reference price. This list is of interest since the subsidies that are given to patients are calculated only on the reference prices, and not on prices that differ from it (Swedish Social Insurance Agency, 2022). Therefore, it could be argued that the reference price list serves as an anchor that regulates prices despite the free-pricing regime. Based on a report from TLV ([2187/2013], 2014), in 2013 over 60 percent of dental patients in Sweden were charged a price that was within a 10 percent range of the reference price. Wigsten et al. (2018) was able to show that the mean fee charged by general dentists for root canal treatments only differs marginally from the reference price. A list of treatment codes along with a description of its segmentation can be found in [Appendix; 9.1].

The Swedish model for listing dental prices, with a long and therefore highly segmented price list, may cause difficulties for patients to compare prices for a *full* treatment. Especially since treatment codes can be combined in different ways. In recent years, TLV has released an independent price comparison website for patients, called *Tandpriskollen*, to help patients make more informed decisions related to pricing (TLV, 2022). However, this does not necessarily alleviate the problems of price comparisons. Kaufhold et al. (1999) assert that "standardized forms of provision do not exist in dentistry", and that "...alternative treatments are often available for a given pathology, requiring patient and dentist to make a choice." This choice is dependent on information that the patient cannot be expected to have.

According to a report from the Swedish Competition Authority ([1401-8438], 2018), price competition seems to be highest for treatments that are more frequently conducted. The price range when comparing treatments such as standard check-ups was lower in the market, than the price range of more complex treatments such as prosthodontic treatments. The results of the report are concluded to indicate that competition is a factor that is significant for pricing in the Swedish dental market, since patients might be more inclined to compare prices of more simple treatments such as check-ups. The theoretical background that relates to this is the idea that medical care is a multi-product industry in which diagnostic treatments can be categorized as informative transactions that in turn affect the demand of other treatments (Pauly, 1978). That is, consumer information is not the same for all treatments, hence price competition can therefore differ between different treatments. Whitney et al. (1997) found that the price of dental treatments and the quality of treatments provided, positively correlate. It is however unclear, whether patients who have limited information about dental treatments and their differences, appreciate this correlation.

1.1.2 Private- and public sector clinics

The dental industry in Sweden is divided into two distinct categories: private- and public dental clinics. The name given to public dental clinics in Sweden is *Folktandvården*, abbreviated [FTV]. Both private- and public clinics may have price lists that vary from the reference price and patients can receive similar services in both types of clinics. The market

share of private clinics measured in the number of treatments performed per year, was 59 percent in 2015 (Swedish Competition Authority. [1401-8438], 2018).

The difference between private- and public clinics from the perspective of a patient is not necessarily obvious. For instance, it is not uncommon for the public sector to market their clinics and services in a similar fashion to what could be expected from the private sector - such as through social media channels and in print. There are clear legal and semantic distinctions between the two, however, the seemingly competitive nature of the public clinics is indication that perhaps this dichotomy is not necessarily the correct way to view the market. It could be the case that private clinics are not only forced to compete with one another, but also with a public sector that is actively pursuing a larger market share. In fact, an interview study with chief dental officers in public clinics in Sweden concluded that a lot of effort appears to have been made within the public sector to maintain their market share over time, by for instance working with brand-building (Palvarinne et al., 2018).

1.2 Implications for research

The combination of having a free-pricing policy, while there is a reference price list that seems to govern the price of many clinics - as well as the unclear boundaries for how to view public- and private clinics - makes the Swedish dental market interesting to explore from the perspective of price competition.

1.2.1 Contribution

Since there are key dynamics related to the Swedish dental industry that are specific to this market, adhering to results from previous literature from other countries is not necessarily useful when trying to draw conclusion relating to this industry.

Many earlier studies are reliant on survey data, which make interpretations of price competition and even the price lists, difficult – the assumption is that the price list is the same as the price charged. In addition, competition is often measured in terms of perceived competition, rather than using objective measures.

There seems to be little knowledge of the effect of competition on pricing in Sweden. Even though the basic theoretical implication of more competition would be that prices are lowered,

this is not obvious. Because of the clear distinction in the market between public- and private dental clinics, it is also interesting to know if there are differences in terms of price competition in relation to these two types of clinics.

This study adds to the existing literature by using objective measures of geographical proximity as a basis for competition. In addition, the quality of the data is higher than for many other studies. The data was acquired from the Dental and Pharmaceutical Benefits Agency and the price lists obtained per clinic showed the median of actual prices charged per treatment over a 6-month period, rather than a generic price list obtained from the clinic. This study also adds to the existing literature by involving both private- and public clinics in its analysis while controlling for other factors that might relate to pricing decisions.

This study will attempt to answer the question: *How does the proximity to private- and public dental clinics affect the pricing of private clinics in Sweden?*

2. Literature Review

2.1 General considerations

The literature on the economic aspect of the dental industry is limited due to the nature of the field. Many countries have differing policies and systems in relation to the dental industry, that affect their approach to pricing, insurance, subsidies and more. This further narrows the literature in terms of relevance for the Swedish market.

2.2 Pricing decisions and perceived competition

A natural first step to consider is how dental professionals choose to price their treatments. In general, labor cost has been shown to be the main part of total clinic costs for Swedish dental practices (Oscarsson et al., 1998). Since there are many different treatments with varying levels of material use, complexity, treatment time and so on, the cost for each treatment needs to be calculated separately. Many treatments are not necessarily subject to any significant material costs, such as check-ups, while others have substantial material costs, e.g., implant treatments. The complexities related to calculating the costs associated with each treatment, begs the question of how the pricing decisions in relation to 186 different treatment codes are conducted. If labor cost is a driving factor, then prices might be based on the value attached to, for instance, clinical experience. On the other hand, complex cost calculations might lead clinics to choose the easy option of adhering to the reference price.

In a study where dental professionals were asked about which factors that are important for their pricing decisions, unsurprisingly, Becker et al. (1991) found that the cost of the treatment was a driving factor in pricing decisions. Of nearly equal importance was the price charged by other dentists in the area. A significant difference was found in relation to how dental professionals valued the importance of the price of other dentists based on the location of the dental clinic - dental professionals in densely populated areas were more likely to evaluate the prices of other dentists, according to themselves.

Kabir and Mellor (2004) segment the cost-parameter further and found that clinical time, practice overheads and laboratory costs are the most important factors for pricing. In contrast

to Becker et al. (1991), competition from other dental clinics in the area were not rated by the dental professionals as being important for pricing decisions.

One study from Iran shows that most dental professionals claim to reduce their prices in order to attract more patients, as a way of competing with nearby clinics (Nekoei-Moghadam et al., 2019). Opposing results are yet again seen in a Finnish context where prices were found to be higher in cities with a high density of dentists. In addition, similarly to Sweden, Finland also has private- and public dental clinics. The study shows that pricing was significantly and positively related to the number of neighboring private practices, however showed no significance in relation to proximity to a public dental clinic (Widström et al., 2011).

There are however problems with analyzing and comparing the results of the different studies cited above. The studies are either partly or wholly reliant on questionnaire or survey data. The effect that competition has on pricing has often been evaluated based on the dental professionals' perceptions of their own decision making, rather than on objective measures of pricing and competition. The different contexts in terms of geography and national policy also makes the comparisons difficult. Moreover, the way that competition is defined differs in the studies, and more standardized approaches have emerged for objectively analyzing competition based on geographical location. Geographical location and proximity can be considered as reasonable measures of competition in the dental industry, as the services provided are location based.

2.3 Competition based on geographical location

For more objective measures of competition, one can look to more recent studies. Grytten and Sørensen (2000) show that, in Norway, the effect of increased competition between private clinics has a negative effect on the mean fee for a consultation. Even though the effect is significant, it is only in the range of -0.12 percent to -0.31 percent. Competition was calculated from official data sources as the number of man-labor years of private dentists per 10,000 inhabitants in a trade district. Since this study was performed not long after a free-pricing regime was implemented in Norway, it is unclear whether the result is affected by the dental market not yet maturing to the new system.

For physicians (that is, non-dentist healthcare practitioners), based on tax-ID information as a basis for location and competition, Austin and Baker (2015) were able to show that areas with high average physician concentration had significantly higher prices than low-concentration areas. One might posit that the healthcare market is relatively similar to the dental market. The distinction between the two is nevertheless not uncommon, even though dentistry can be argued to be part of healthcare. Due to the wide range of results regarding competitive pricing in the dental industry itself - and the different pricing, insurance, and subsidy dynamics between healthcare and dental care - exploring further into the realm of healthcare as opposed to dental care is not an area of focus in this study.

Ghoneim et al. (2020) used geocoding and proximity as definitions of competition and studied the effects of competition on clinical decision-making. Interestingly, the competition that was measured based on the spatial analysis was compared to the perception of competitive pressure of dental practitioners, and there was incongruence between the two. Although the study does not look at pricing per se, the result further strengthens the idea that more studies on competitive pricing based on objective measures of competition are needed.

Since the density of dental clinics can vary, their geographic distribution is also interesting from a socio-economic perspective. Kruger et al. (2011) found that fewer dental practices were located in areas that have residents of lower socio-economic status. Again, the relationship to pricing was not studied.

In theory, “price competition is known to be a centrifugal force” - pushing suppliers away from each other in terms of location, meaning closely situated suppliers will need to lower their prices to compete - and “proximity is only sought for in the case of product differentiation.” (Shaw & Gilly, 2000). It is however not a simple task to differentiate dental treatments, and the results from the studies mentioned in this text do not always support the theoretical idea of price competition and location.

3. Materials and Method

3.1 Data

Price data was gathered from TLV in September 2022, and the information in the data pertains to the six-month period 01/01/2022 – 30/06/2022. In the TLV dataset, all dental clinics that were integrated with the Swedish Social Insurance Agency through their patient-management system, and had performed treatments during this period, were listed. For a patient to receive subsidies for their treatment, this integration is necessary. A clinic that cannot allow a patient to receive subsidies, will almost certainly not be able to attract any patients. Therefore, the data can be assumed to include practically all Swedish dental clinics, with little or no exceptions.

For the six-month period, the TLV data, lists each treatment code, the reference price per treatment code, the median price charged per treatment code per clinic, the number of times each treatment code was used per clinic, as well as zip-codes, addresses and names of the clinics. The data does not consider subsidies given to patients; it is not necessarily the case that prices charged were paid entirely by the patient. However, the effect of subsidies is true for all clinics, and were for the purposes of this study non-problematic.

Median income data for individuals in Sweden was obtained from Statistics Sweden [Abbr: SCB] in November 2022, and pertains to 2020, which was the most recent and reliable data that could be obtained. All median income values were based on 2020-prices.

The data from SCB lists the median income for individuals 20 years of age and older, segmented by municipality. Income was defined as employment income as well as income from business activities. Employment income includes income from salaries, pensions, sickness benefits, and other taxable income from the Swedish Social Insurance Agency.

3.2 Ethical considerations

The data collected is considered public information and hence no consent is needed to obtain the data. There is no information in the data about the dental practitioners nor the patients/individuals. Information that can be considered sensitive based on the General Data Protection Regulation (GDPR), the Patient Data Act- and/or the Patient Safety Act in Sweden, is not found in the data.

3.3 Method

Linear regression analysis was used to study the relationship between independent variables and the prices of private clinics.

Clinics were segmented into two types, FTV (public) or non-FTV (private). To study the effect of competition, a 4-digit zip-code area was used as a proximity measure. Swedish zip-codes can have a maximum of 5 digits, and dropping the last digit means looking at a slightly larger area. Median income measures were matched with the municipality for each clinic.

The method for choosing the length of the zip-code is discussed further in section [7] of this paper. See [Appendix; 9.2] for a map showing the geographical segmentation of zip-codes.

A list of variables can be found in Table 1 with descriptions for each variable. Not all variables were included in the linear regression models.

Table 1. List of Variables

Variable	Definition
price_M	Dependent variable. The median price charged over the six-month period per treatment code.
price_R	The reference price for each treatment code.
treatment_code	The treatment code for each treatment.
zip4	4-digit zip code, excluding the last digit of the full 5-digit zip code.
FTV	Dummy variable. 0 = the clinic is not an FTV clinic, 1 = the clinic is an FTV clinic.
FTV_in_zip4	Dummy variable: 0 = there is no FTV clinic in the 4-digit zip code area, 1 = there is an FTV clinic in the 4-digit zip code area.
number_private	Number of private clinics in a 4-digit zip-code area.
frequency	Number of times each treatment code was used by each clinic in the six-month period.
clinic_ID	A unique identifier for each clinic.
med_inc	Median income for individuals per year, for each municipality.
kommun	The municipality for each clinic

Note: This table lists the variables from the data.

4. Results

4.1 Descriptive statistics

4.1.1 Price comparisons

The effect that an FTV-clinic located in the same 4-digit zip-code area as a private clinic had on prices was studied using a dummy variable (*FTV_in_zip4*). The prices of the two types of clinics in relation to the reference price was therefore analyzed prior to the regressions, in order to possibly identify differences that might be interesting from a price competition perspective.

After cleaning for non-available data, the total number of clinics, including FTV- and private clinics, were 3,382 of which 2,795 (82.64%) were private clinics and 587 (17.36%) were FTV-clinics. 77.62% of all prices charged were higher than the reference price. There were clear differences, depending on which treatment code series that the price related to. In general, treatment codes starting with the numbers 7, 8 or 9 (restorative-, prosthodontic- and orthodontic treatments) were more likely to have a price that was higher than the reference price, and less likely to have a price that was less than or equal to the reference price.

For the two types of clinics, the percentage splits of items with prices that were lower, equal to or greater than reference prices can be seen in Table 2.

Table 2: Price Comparison

Prices in relation to Reference price	FTV	Private
<	4.33%	6.62%
=	17.50%	15.89%
>	78.17%	77.48%

Note: Percentage of price items that were lower, equal to, or higher than the reference price in FTV- and private clinics.

In general, the split is similar between FTV- and private clinics. However, the average difference between the price and the reference price for FTV-clinics was 308.14 SEK, and 783.1 SEK for private clinics. These initial results might indicate that price competition would lead private clinics to lower their prices if they are located near an FTV-clinic - if private clinics indeed choose to compete with FTV-clinics based on price.

4.1.2 Summary statistics

The statistics reported in this section relates solely to private clinics in the dataset.

Each price item in the data related to a certain treatment code. Only those treatment codes, and therefore also price items, that had been charged over the six-month period were seen in the data. Price items that were in the 1st and 99th percentile were removed, and a total of 136,216 price items could be found for private clinics, with a corresponding number of occurrences for the other variables in Table 3. The count for *med_inc* and *number_private* should be interpretated as the number of line-items where the variable occurs in the dataset and is therefore misleading.

Table 3. Summary statistics for private clinics

Variable	price_M	price_R	frequency	med_inc	number_private
Count	136,216	136,216	136,216	136,216	136,216
Min	81	60	1	235,808	1
Max	16,100	14,985	3,482	420,000	49
Mean	2,778.671	2,183.401	40.15801	308,702.3	10.07427
p50	1,420	1,175	7	302,522	6
SD	3,093.79	2,325.163	108.7825	29,703.66	10.88236
Skewness	1.849297	1.878819	7.432315	.7119895	1.74013
Kurtosis	6.054019	6.591617	95.14437	3.087939	5.555986

Note: Summary statistics for private clinics. Prices, reference prices, frequencies, median income, and number of private clinics in a specific 4-digit zip-code area.

The minimum and maximum price charged was 81 SEK and 16,100 SEK, respectively. The median price charged was 1,420 SEK, with a standard deviation of 3,094 SEK.

Prices and reference prices follow a similar distribution in terms of skewness and kurtosis, indicating that prices are set with respect to reference prices.

The frequency of treatments varied greatly. The median frequency was 7, and the data showed a high number for kurtosis of 95.14. The maximum number for frequency was 3,482, and related to a relatively large clinic and treatment code 103; emergency check-ups.

The distribution for median income was similar to a standard normal distribution pattern, although slightly right-skewed. The median value for median income across municipalities was 302,522 SEK.

The minimum number of private clinics, in a 4-digit zip-code area that contained a private clinic, was 1, while the maximum was 49. High values for *number_private* are associated with zip-code areas in large cities. The distribution was right-skewed with a mean of 6 and a kurtosis of 5.56. Table 4 provides further information on certain variables in the dataset in relation to private clinics.

Table 4. Unique values

Variable	treatment_code	zip4	clinic_ID	kommun
Unique Values	172	802	2795	259

Note: Unique values for private clinics - treatment codes, zip codes, clinic identifiers and municipalities

259 out of 290 municipalities in Sweden were represented. A total of 802 different zip-code areas were identified as including private clinics, based on the 4-digit zip-code area (4-digit zip-code areas are henceforth referred to simply as zip-code areas).

Of the 2795 private clinics, 1,200 (42.94%) were located in a zip-code area that had an FTV-clinic and 1,595 (57.06%) were not in such an area.

The total number of treatment codes available for analysis were 172, out of a total of 186 treatment codes for the year 2022. Treatment codes for all different types of treatments that patients may receive, were however still available in the data.

4.2 Regressions

The main regression was structured as follows in terms of variables:

price_M ~ FTV_in_zip4 + frequency + number_private + med_inc + treatment_code_FE

With *treatment_code* as a factor variable that was absorbed in the regressions. In addition, the regressions were run for *FTV* = 0, meaning that private clinics were the basis for the analysis.

4.2.1 Main regression

Table 5. Model 1 – Regression Results

Variable	Coefficient
FTV_in_zip4	-53.00398***
frequency	.0473019***
number_private	4.085302***
med_inc	.0021711***
_cons	2088.578***
N	136,216
R^2	0.9383
Adj R^2	0.9382

Note: Model 1: Linear regression analysis of factors influencing the price levels for private clinics. All variables were significant. price_M ~ FTV_in_zip4 + frequency + number_private + med_inc + treatment_code_FE. * p<0.05; ** p<0.01; *** p<0.001.

Linear regression analysis revealed that the occurrence of an FTV-clinic in the zip-code area, is significantly and negatively associated with the average price levels of private clinics. The frequency of treatments, the number of private clinics in the area and median income were significantly and positively associated with price levels of private clinics.

The economic effect on prices for private clinics with an FTV-clinic in the same area, was -53 SEK on average.

A one unit increase in frequency had a limited economic effect on prices of 0.05 SEK. Since the median frequency was 7, with a high kurtosis value of 95.14, the implication is that performing treatments at median frequency would lead to an average price increase of 0.33 SEK.

Each additional private clinic would increase the prices in the area by 4.09 SEK on average. In the zip code area with the maximum number of private clinics, 49, the prices could be expected to on average be 215.11 SEK higher.

The median income variable had a coefficient of 0.0021711. The summary statistics showed that median income had a standard deviation of 29,704 SEK, which implies an average 64.50 SEK increase in prices for each standard deviation increase in median income. In addition, the results imply that the municipality with the highest median income of 420,000 SEK would have prices that on average were about 400 SEK higher than the municipality with the lowest median income of 235,808 SEK.

As standalone numbers the values of the price effects are difficult to analyze from an economic perspective, since prices in the dataset ranged from 81 SEK to 16,100 SEK. Therefore, linear regressions segmented by treatment code series were analyzed to study whether the effects could be more specified to certain types of treatments.

4.2.2 Regressions segmented by treatment code series

Regressions were performed to see whether different treatment code *series* showed different characteristics. The treatment codes can be segmented into 9 different series. The 100-series corresponds to all treatment codes from 100 to 199, and the same applies for other series. See [Appendix; 9.1] for further detail on treatment codes.

Table 6. Model 2 – Regression Results

price_M	100 series	200 series	300 series	400 series	500 series
FTV_in_zip4	-18.6807***	-9.5494**	-7.5102**	-102.1685***	-34.3411***
frequency	0.0408***	0.0596***	-0.0011	-0.3255	1.3335**
number_private	0.8547***	0.6555***	0.6358***	5.8541***	3.2638***
med_inc	0.0002***	0.0003***	0.0003***	0.0037***	0.0025***
_cons	681.1845***	414.0762***	791.2428***	1821.6351***	3006.3269***
N	22315	7714	17276	17524	12307
R^2	0.8490	0.7740	0.8575	0.8391	0.9418
Adj R^2	0.8488	0.7738	0.8574	0.8388	0.9417
price_M	600 series	700 series	800 series	900 series	
FTV_in_zip4	-74.5365***	-20.8437***	-58.0543***	-550.8669***	
frequency	7.1462***	0.4976***	-1.0847**	-13.8451	
number_private	6.4947***	1.7426***	7.8224***	21.0678***	
med_inc	0.0024***	0.0006***	0.0033***	0.0181***	
_cons	2653.1422***	1184.2244***	3984.3839***	4171.3634***	
N	3944	17106	34970	3060	
R^2	0.8230	0.7248	0.9316	0.4027	
Adj R^2	0.8226	0.7246	0.9315	0.4001	

Note: Model 2: Linear regression analysis of factors influencing the price levels for private clinics – segmented by treatment code series. price_M ~ FTV_in_zip4 + frequency + number_private + med_inc + treatment_code_FE. * p<0.05; ** p<0.01; *** p<0.001

The existence of an FTV-clinic (*FTV_in_zip4*) was significantly and negatively associated with *price_M* for all series. The most dramatic economic effect of -550.90 SEK could be seen for the 900-series which corresponds to implants and/or orthodontic treatments. The smallest economic effect was -7.50 SEK and -9.60 SEK for the 200- and 300-series respectively, which relate to prophylactic- and hygiene treatments.

For *frequency*, results varied both in terms of significance, magnitude, and signs of coefficients. The 600-series, which corresponds to treatments relating to jaw function, showed

the highest positive and significant value of 7.10, and the 500-series had a relatively high coefficient of 1.30. The 800-series, prosthodontic treatments, had a significant yet negative coefficient of -1.08. Frequency was insignificant for the 300-, 400-, and 900-series.

The number of private clinics (*number_private*) in an area was positively and significantly associated with price for all series. The coefficients ranked based on magnitude could loosely be arranged in 3 tiers. The low-tier related to the 100-, 200-, 300- and 700-series ranging from 0.64 (200-series) to 1.74 (700-series.) Medium-tier related to the 400-, 500-, 600- and 800-series ranging from 3.30 (500-series) to 7.80 (800-series). The high-tier related to the 900-series with a coefficient of 21.10.

The median income variable (*med_inc)* was similar in its overall variation between different series to *number_private*. The 100-, 200-, 300- and 700- series showed coefficient of less than 1/1000. The 400-, 500-, 600- and 800-series had coefficients of less than 1/100 and the 900-series had a coefficient of 0.0181. The interpretation being that an increase of median income of 29,704 SEK (1 standard dev for *med_inc*) would increase the average price, by the coefficient multiplied by 29,704; 5.94 SEK for the 100-series and 537.64 SEK for 900-series.

The adjusted R-squared values ranged from 0.72 to 0.94, except for the 900-series that had a value of 0.40.

4.2.3 Regressions segmented by region

Further regressions were performed to see whether different geographies showed different characteristics. The zip-codes were used to segment the country into three regions: North, Mid and South. North corresponded to the zip-codes starting with an [8] and [9], Mid included zip-codes starting with [1], [6] and [7], and South ranged from zip-codes starting with a [2] to [5]. That is, the North region included all 4-digit zip-codes from 8000 to 9999, and the same logic applies for other regions.

The zip codes follow a geographical logic where low numbers are southern regions and high numbers are northern regions of Sweden. The exception is the 1000-region that relate to the Stockholm area. The 2000-region includes Malmo and the 4000- region includes Gothenburg. It is worth noting that the 8000- and 9000-regions cover a relatively large geographical area in the north of Sweden, roughly similar to the areas of all other regions combined. See [Appendix; 9.2] for a map of the regions.

Table 7. Model 3 - Regression Results

Variable	North	Mid	South
FTV_in_zip4	-139.9786***	-85.7755***	11.7028*
frequency	0.0641**	0.0650***	0.0201*
number_private	7.5519***	5.9708***	2.4221***
med_inc	0.0005	0.0021***	0.0009***
_cons	2557.2421***	2124.9651***	2437.9836***
N	12235	60458	63463
R^2	0.9535	0.9313	0.9456
Adj R^2	0.9528	0.9311	0.9454

Note: Model 3: Linear regression analysis of factors influencing the price levels for private clinics – segmented into three geographical regions. price_M ~ FTV_in_zip4 + frequency + number_private + med_inc + treatment_code_FE. * p<0.05; ** p<0.01; *** p<0.001

The total number of observations of 136,156 differs from previous regressions since there was one private clinic with a total of 60 listed prices, with no given zip-code in the dataset.

The existence of an FTV-clinic (*FTV_in_zip4*) was significant for all regions. In the North and Mid regions, the variable negatively correlated with prices with coefficients of -139.98 and -85.78, respectively. In the South region, the variable positively correlated with prices with a coefficient of 11.7.

The number of private clinics significantly and positively correlated with prices for all regions, ranging from a coefficient of 2.42 in the South-region to 7.55 in the North region.

Median income was insignificant in the North-region however positively and significantly associated with prices in the Mid and South regions, with coefficients of 0.0021 and 0.0009 respectively. In other words, the coefficient for median income in the Mid region was approximately 2.3 times higher than the South-region in terms of magnitude. Applying the same logic as in earlier regressions, this means a 1 standard deviation increase in median income of 29,704 SEK would be expected to increase prices by 26.70 SEK for the South region and 62.40 SEK in the Mid region, on average.

Frequency was positively and significantly associated with prices in all regions. The median frequency for all treatments was earlier shown to be 7, this would expect to correspond with a price increase of 0.45 SEK (North), 0.46 SEK (Mid) and 0.14 SEK (South), on average.

5. Discussion

5.1 Evaluation of results

This paper aimed to answer the question of how the proximity to private- and public clinics affected the price setting of private clinics. From the initial analysis of the difference between prices and reference prices between FTV- and private clinics, a hypothesis could be formed that if private clinics do compete with FTV-clinics based on price, then the effect would probably be that private clinics would lower their prices, in order to more closely match FTV prices.

The results indicated that, as a general rule, the existence of an FTV-clinic did, in fact, affect the prices of private clinics in the same area negatively. Based on the initial price analysis and price competition theory, it is unsurprising that prices would be lower for a clinic in an area with a market player with generally lower prices. It is however interesting that private clinics seem to experience price pressures from the public sector. This seems to confirm that the distinction between the public- and private sector is not necessarily the correct way to view the Swedish dental market from a competitive perspective.

There was however one exception; when segmenting the country into three regions, the results showed a positive effect on prices of private clinics for *FTV_in_zip4*, in the South-region. This positive effect on prices is difficult to interpret since there are many factors that contribute to pricing and competition. To suggest that this specific region chooses to view the existence of an FTV-clinic in the area in a way that stands in opposition to the rest of the market, is highly speculative. One speculation however, that might be reasonable, is that perhaps FTV-clinics in this area have chosen to price their treatments at a high level, meaning private clinics do not experience the same negative price pressures in this region.

For the number of private clinics in an area, the results indicate that as the number of private clinics increase, the prices also increase. The results from previous studies showed varying results in relation to this variable, although the unreliability of the data for these studies should be considered since survey data was the main basis for analysis. The coefficients vary in magnitude between different regions; however it seems to be the case that the further north a clinic is, the higher the effect is on price in relation to number of private clinics in the area. For the treatment code segmentation (section 4.2.2), a pattern where more complex treatments

lead to higher coefficients could be seen. For example, 100-, 200-,300- and 700- series relate to diagnostic treatments, cleaning and restorations, and the coefficient for these were low. While the more complex treatments such as the 800-series had higher coefficients, with the highly specialized orthodontic treatments of the 900-series having the highest coefficient. The proportional effect that these coefficients have on prices have not been studied, and therefore it is not surprising that more expensive treatments have higher coefficients.

For *med_inc*, a similar pattern could be seen where more complex treatments, and therefore also treatments that tend to have higher prices, had higher coefficients. This could be argued to show that the purchasing power of patients is taken into account for pricing decision. For more common and less complex treatments with lower (yet still significant and positive) coefficients for *med_inc*, it seems that that prices are not adjusted as much to match the purchasing power of patients. One explanation, based on arguments put forth by Pauly (1978), could be that these treatments are seen as part of a multi-product selection where basic treatments are seen as informative transaction and/or transactions that attract patients to a clinic, that in turn affect the demand for more complex treatments. There could therefore be incentives not to raise the prices on these treatments too much, since the patient is likely to accept higher prices for other treatments once they have already visited the clinic.

Median income was significantly and positively correlated with price in all but one instance, in the North-region where the variable was not significant. This exception might be explained by the existence of only slight variations in median income between different municipalities in the North-region, and therefore there might not have been enough variations in the data to allow for any significance to be found. This explanation is however speculative. Another reason for the insignificance of the variable in this case is the fact that median income was matched with the municipality of each clinic, and not with the 4-digit zip-code.

The cause and effect relationship between the variables and price is not obvious, and this is especially true for *number_private*. This study does not evaluate whether prices increase as an effect of additional private clinics establishing themselves in the area, or if private clinics choose to establish in areas where high prices are generally more accepted by the market. The latter seems to be a more logical interpretation. *FTV_in_zip4* however has a slightly different dynamic, partly because it is a dummy variable, and also since there is no clear indication that

FTV-clinics choose to establish themselves in areas based on the socio-economic nature of that area.

Although the coefficients for many variables were statistically significant. It could be argued that the significance of variables in a study such as this one, should be viewed in light of the idea of economic significance. The economic significance of a price difference for an individual paying for a treatment is subjective, however, some generalizations could be made.

The difference between economic significance and statistical significance was clear for the variable measuring frequency. Although there were variations for this variable in terms of magnitude, significance, and sign - in general, frequency had a positive effect on price. Nevertheless, the economic significance of performing a treatment at median frequency of 7, or even at higher frequencies of 1 standard deviation for frequency (108.90), can be argued to have a marginal effect on prices from the perspective of a patient. Exceptions to this were the 500- and the 600-series with relatively high coefficients of 1.30 and 7.10, respectively. To understand this, one might speculate about how these treatments are viewed and performed at a clinic. For instance, 500-series treatments relate to root-fillings and are relatively complex; it is not uncommon for general dentists to refer these treatments to specialists. Therefore, it could be argued that if a dentist chooses to perform these treatments, they are aware of the fact that they perform these treatments more often than others, and might be more inclined to attach a value to this fact.

5.2 Evaluation of method

A 4-digit zip-code area was chosen as a measure of proximity. This variable is however not standardized in terms of geographical area. That is, all zip-code areas are not of the same size. This means that the way proximity is defined, is not related to the distance between different clinics. The walking distance between two practices in two different zip-codes might vary greatly, while in this study still being seen as having the same statistical value. The downside of not using distance, is that it is difficult to get a standardized result, and it could even be the case that two clinics in two different zip-code areas, are closer to each other than to other clinics in their respective zip-code areas.

The benefit of the chosen method, however, is that there is an argument to be made for a geographical area serving as an isolated region in which patients might travel. For instance, in large cities, a subway station and its surrounding areas are seen as one area. Even though there might be a clinic that is closer than the clinics in a certain area, one might expect a patient not to choose that clinic if it requires them to travel to a different station.

Another reason for why zip-codes serve as a good measure of proximity is that there is a difference between different regions in relation to what is perceived as a long distance. Individuals who live outside of big cities for example, are probably more used to travelling longer distances, and therefore a larger zip-code area compared to one in a big city, might still have the same effect in terms of perceived proximity. This last argument is perhaps the strongest argument for using zip-codes rather than distance.

The data that was available for median income was not optimal. The only reliable data that could be retrieved from official sources related to 2020, and was segmented by municipality, rather than the zip-code. This means that the results are not as reliable, or at least not as specific, as they could have been. It could however be argued that the change in median income between 2020 and 2022 has probably not been so dramatic as to lead to differing overall results in the regressions, and that the municipalities do provide an overarching result that is good enough, even though more specificity would be preferrable.

FTV_in_zip4 was chosen to be a dummy variable, as opposed to *number_private*. This choice was made from the perspective of the dental market in general. FTV clinics are usually not located in the same areas, so their distribution would probably be such that there would only be either 1 or 0 FTV-clinics in an area. In addition, from the perspective of a private clinic and competition, the question that is asked is probably whether there is an FTV-clinic in the area or not, rather than how many there are.

Since this study seems to be one of the first studies of its kind to be performed in a Swedish context, it was interesting to make use of all the available data. This had benefits in terms of the amount of data, however, further cleaning of the data could have been performed for more specific results. For instance, there was no differentiation between specialist clinics, and non-

specialist clinics. In addition, dental chains and stand-alone clinics where not viewed differently. Price differences between specialist and non-specialist clinics do exist, and dental chains might choose to have the same pricing policy regardless of the area in which they operate. These factors could mean that the results in this study are less reliable.

Other improvements in terms of variables could be useful for future analysis. Variables that could be of interest include: the number of dental practitioners that work at the clinic, the number of years since establishment of the clinic, and the clinical experience of the dental personnel. All these variables might be of interest for pricing decisions. The data that is available for these variables is however highly unreliable, and manual gathering of the data with an acceptance of higher margins of error are necessary.

6. Conclusion

Price competition is a factor that affects private clinics in Sweden. Private clinics compete in terms of prices with both the public- and the private sector. The effect of price competition between private clinics and public clinics is such that private clinics tend to lower their prices if a public clinic operates in the same area. The number of private clinics in an area positively correlates with prices of private clinics, however, the causality is unclear.

Pricing decisions by private clinics seem to also be reliant on the frequency of treatments, and the median income of patients - both of which, in general, correlate positively with prices. There are differences in the effect that the variables mentioned have on price when considering different geographies as well as different types of treatments.

Statistically significant results in this study are not necessarily economically significant; the price sensitivity of patients has not been studied.

7. Robustness tests

7.1 Heteroskedasticity, multicollinearity and normality

Normality was assumed after prices were truncated, removing the 1st and the 99th percentile of prices from the dataset.

Heteroskedasticity was tested for using a Breusch-Pagan and Cook-Weisberg test, and was shown to be an issue for the regressions. 'Robust standard errors' was used in order to obtain unbiased standard errors for the coefficients in the linear regression models.

Multicollinearity was tested for, using variance inflation factor (VIF). Multicollinearity was not an issue in any of the regressions. Values never exceeded 1.21 for any variable.

7.2 Choosing length of zip-codes

Different variations for the length of the zip-codes were tested. The split between the number of private clinics that were in an area with an FTV-clinic, and the number of private clinics that were not in such an area, was of interest for this analysis.

The total number of private clinics in the data were 2,795. The 5-digit zip-code resulted in 407 private clinics (14.60% of total) being in the same zip-code area as an FTV-clinic. For the 4-digit and the 3-digit zip-code areas, the corresponding values were 1,200 (42.93% of total) and 2,245 (80.32% of total), respectively.

Based on this information, the length of the zip-code that resulted in the most interesting split for this study was deemed to be the 4-digit zip-code.

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9. Appendix

9.1 Treatment codes and reference prices

A selection of treatment codes that relate to each of the nine treatment-code series is listed below. The different series can roughly be described as follow: 100 – series; Checkups and X-rays, 200-series; Prophylactic treatments, 300-series; Periodontal treatments (cleaning), 400-series; Surgical treatments, 500-series; Endodontic treatments (root-filling), 600-series; Jaw-function treatments, 700-series; Restorations (fillings), 800-series; Prosthodontic treatments (Crowns, bridges), 900-series; Orthodontic treatments and more.

Table 8. Reference prices

Åtgärd	SEK
100 - Undersökning, riskbedömning och hälsofrämjande åtgärder	
100 - Undersökning, riskbedömning och hälsofrämjande åtgärder	
101 - Basundersökning, utförd av tandläkare	900
103 - Kompletterande eller akut undersökning, utförd av tandläkare	390
123 - Röntgenundersökning, helstatus	850
200 - Sjukdomsförebyggande åtgärder	
201 - Information eller instruktion vid risk för munhälsorelaterade sjukdomar eller problem	450
300 - Sjukdomsbehandlande åtgärder	
341 - Behandling av parodontal sjukdom eller periimplantit, mindre omfattande	555
342 - Behandling av parodontal sjukdom eller periimplantit, omfattande	1085
400 - Kirurgiska åtgärder	
401 -Tanduttagning, en tand	1115
420 - Implantat, per styck, tilläggsåtgärd	2945
421 - Operation avseende käkbensförankrade implantat, ett implantat	3295
500 - Rotbehandling	
501 - Rensning och rotfyllning, en rotkanal	3565
600 - Bettfysiologiska åtgärder	
601 - Bettskena i hård akrylat i överkäken, utförd på bettfysiologisk indikation, per skena	3675
700 - Reparativa åtgärder	
701 - Fyllning av en yta på framtand eller hörntand	635
800 - Protetiska åtgärder	
800 - Permanent tandstödd krona, en per käke	6005
900 - Tandreglering och Utbyteså tgärder	
900 - Tandreglering, aktiv behandling högst 6 månader	9405

Note:. Selection of treatment codes and reference prices in SEK, for 2022. (Dental and Pharmaceutical Benefits Agency, 2022).

9.2 Map of zip-codes

Map of zip-codes, based on the first 2 numbers of a zip-code (Postnord, 2017).