# Regional and Urban Economics

## Dental industry

Sindre Halvorsen Øveraas , Sebastian Mena Fløysand, Alen Colakovic & Mona Lisa Jones

## Abstract

## Introduction

Our main task in this assignment is to perform an analysis of geospatial determinants of firm activity. More specifically we are to focus on the Norwegian dental industry in this regard, and see how geospatial determinants such as distances to shopping malls and CBDs (Central Business Districts), as well as population density can determine dental businesses income and general financial operations. As an example, central questions in this assignment will be; "Is it more beneficial to be highly centralized in urban areas with high population density and many competitors, or is it a greater advantage to be less centralized to the advantage that the nearest competing company is considerably further away?", "Which determinants appear to be most significant for economic benefit?"

### Hypothesis

The location choice of firms providing service to end consumers, significantly determine their ultimate growth potential.

### Research question

What is the most profitable location for dental practice?

## Literature Review

### Previous literature on Shopping malls

### Theoretical Framework

Location theory gives regional economics its scientific disciplinary identity and constitutes its theoretical methodological core Capello (2011). It has typically microeconomic foundation and uses theoretical models as well as adopting a statistical and geographical approach Capello (2011). Furthermore, the theory uses the concept of externalities as disparities in the spatial distribution of activities, thereby laying the territorial bases for dynamic approaches Capello (2011).

Regional growth theory involves spatial aspects of economic growth and territorial distribution of income Capello (2011). It also involves generating geographical advantages, in terms of easy or difficult access of a particular area Capello (2011).

Harald Hotelling's locational equilibrium is determined by a logic of profit maximization whereby each producer controls its own market area. Productivity advantages of cities and urban clusters with a high density of firms increase profit by attracting a larger number of potential customers, and more productive workers Capello

(2011). Furthermore, the attractiveness of a central location increase the cost of rent. Alonso's bid rent model indicates the most profitable location for firms. Closer to the centre with agglomeration attributes or in rural areas with spacial monopoly and low rent. In gravitational models, the attractiveness of the retail location, represent the size of the retail centre. Furthermore, it depends on the variety of goods which can be purchased at the same location McCann (2013).

A generalized Models based on Newton law of gravity can be applied to estimate flows between two points such as, cities or other points of interest Capello (2015). The model of potential has the capacity to measure the potential of attractiveness to a place. Furthermore, predicting places of future growth potential for firms, shopping malls or public service more specifically dentist practice Capello (2015).

### Interdependent location choice, the Hotelling's model (1929)

The model assume that given the location of producers, and given demand uniformly distributed geographically (in linear or circular form) the market is divided into areas within each of which there operates a single firm in a duopoly environment. Furthermore, no relocation costs and demand only depend on location choice Capello (2015).

The location game starts off with the total market of AB, firm A in the middle of location A and firm B starts in the middle of location B. One firm starts relocating closer to the other to take some of the customers in the other market area Capello (2015). The other respond by doing the same and the game continues until both end up in the middle of the market on the broader of AB. The end of the game is the position where neither can increase sales volume by moving position Capello (2015).

A simple explanation of why two dentists providing the same service, at the same price might locate next to each other. Nevertheless, despite increasing the transportation cost for patients. Perhaps the simplest way to explain why there is a natural tendency for retailers to cluster in space; a tendency which may help explain the existence of larger agglomerations.

### Marshall's agglomeration principles

Marshall (1920) broadly divides externalities within agglomeration in three main categories with potential to drive sales. Firstly, knowledge spill over within industries or product specific technological knowledge. Furthermore, market transactions in terms of value chain transactions with industry-specialized buyers and suppliers. Lastly, competition for specialized production factors such as labour and product market competition (**nielsen2021Nielsen?**).

There are solidly established conclusions regarding the excistanse of agglomeration economies (**puga2010Puga?**). However, less proof of their estimated magnitude therefore identifying the causes of agglomeration economies is proving more difficult (**puga2010Puga?**). Nevertheless, there is a large theoretical literature that develops these mechanisms (**puga2010Puga?**). (**duranton2004Duranton?**) discuss these classifications and identify learning, sharing and matching as the main causes of agglomeration economies.

A larger market allows for a more efficient sharing of local infrastructure and facilities, a variety of intermediate input suppliers, or a pool of workers with similar skills (**puga2010Puga?**). Dispite higer rent the dental industry and shopping malls, seams to reap higher benefits in more populated areas as they are dependent on being located where there is a higher volume of patiants to drive sales. The attraction for the consumers and users of public facilities is overall cost reduction (**puga2010Puga?**). Hence, the larger the population sharing facilities the lower the cost per user (**puga2010Puga?**). Presumably, industrial factories and business clusters are more dependent on being close to raw materials and industrial action.

Furthermore, a larger market also allows for a better matching between employers and employees, improved chances of finding suitable and better quality of matches (**puga2010Puga?**). Shopping malls require skilled workers to drive sales. However, they are not so dependent on highly educated workers as dentists whom

according to resent study, tend to prefer bigger cities (as they are highly educated) (**davis2020Davis?**). More-so, cites provide a constant market for specialized skills and more productive work force (**puga2010Puga?**). Perhaps, a possibility for higher wages being compensated by more efficient workers in bigger agglomeration economies. That said the Norwegian cities might differ from the american cites in the study, as the population and clusters are no where near the same size. Lastly, a larger market can also facilitate learning by promoting the development and widespread adaptation of new technologies and business practice (**puga2010Puga?**).

*"Interactions with experienced workers helps acquire valuable skills and experienced workers remain in cities to share the rent of this learning process. Besides this purposeful transition of knowledge, the information literature on learning in cities has also emphasized the casual and unintended flow of information facilitated by big cities."* (**puga2010Puga?**)

**Urban location of dentist; The Alonso model**

The model demonstrate geographical locations tied up to location. It is an urbanized formulation of the nineteenth century von Thünen model Capello (2015). Moreover, in this case used to get an indicating of where the most profitable location for dental practise might be located. Alonso assumes the existence of a city that cannot be build instantaneously, and therefore of an effective rent-curve from the city centre to the periphery. Furthermore, it determines the location for a new firm willing to locate in the city and the profit the firm can obtain, which might be different from the normal or average price competition Capello (2015). As the Von Thünen assume a uniformed space where all land is equally fertile, this model envisages a city, endowed with infrastructure which cover the entire city in all directions whereas unit transport costs are constant in space. More-so, the town or city has a single city centre, and the city centre of business district (CBD) is generally defined as the most attractive for all firms. Capello (2015). The model also assume perfect competition and unlimited demand, in other words it is supply-orientated Capello (2015). Furthermore, demonstrating a specific production function with fixed coefficients and constant returns to scale.Rent obtained in the model is the remainder left after transport, production costs and profit has been subtracted from revenues Capello (2015). The bid-rent curve will in this case demonstrate the prise of rent within Bank and Financial locations, Retail locations, and industrial locations.

Effects on Land Use
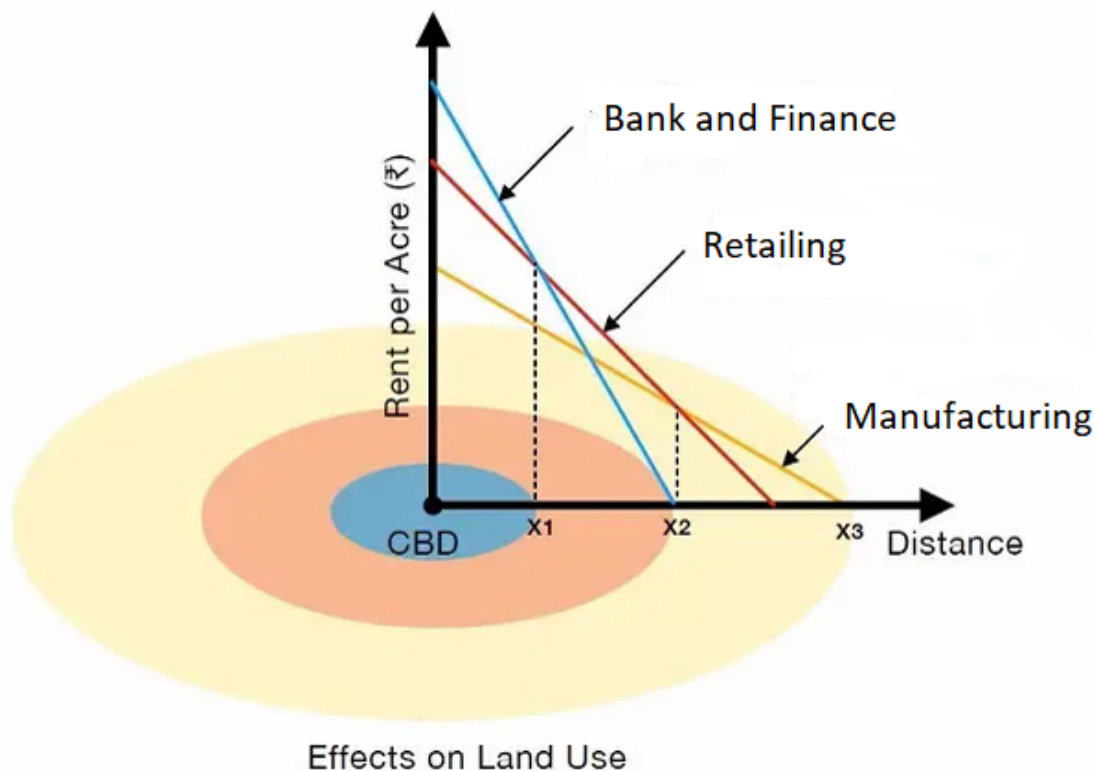
The illustration shows three categories: The most expensive rent closest to the centre is the Bank and finance district, followed by the retail agglomeration areas and industrial sites furthest away from the central point. Dental practices are service orientated thus depending on population density and central activities. Opening hours are relay outside of office hours. Production cost does not appear to be important in this case since dentist is a public service. Hence, not dependent of regular transportation of sales goods. The rent realized by the landowner is the envelope of the three rent supply curves Capello (2015). From a Marshallian way of thinking dentists should cluster somewhere in this pink area to reap maximum sales volume. Other than locating in the inner circle dentists may also increase their profits further out in to other retail agglomeration area. The attractiveness might be high in these places due to economies of scope. As the positive benefits from the Marshallian agglomeration attributes play out. Subsequently, increasing profit by trading higher transportation cost for lower rent. In addition fewer dentists to compete with. The attendances to break out of the clusters support Hotelling's game theory of spatial competition which suggests that the spatial monopoly power provides an incentive for firms to use location as a competitive weapon to achieve spatial monopoly (**mccann2013McCann?**).

**Gravitational models**

The centre attracts firms, people and activities. Furthermore, it influence the central points in diverse ways such as commuter movements, disfustion of knowledge, corporations and network and personal relationship Capello (2015). More-so, they are generated by the intensity of the flows generated between places Capello (2015). The gravitational pull to a place of interest for a dentist will determine how much sales can be generated by locating there. Several locations can then be measures against each other to determine profit maximisation. These models has the potential to measures the future attractiveness of a place. Changes in infrastructure such easier

access to a place might change the attractiveness of a place or move the flow of people. An example of this could be Rogfast, improving the connection between Haugalandet and Stavanger. Subserviently, increasing the gravitationally pull between the two places. Furthermore, The model uses population and distance to measure the attractiveness and relations between two places Capello (2015). Rogfast might move the population of Haugesund further south and a new town centre might occur competing with other retail clusters in years to come. On the other hand the flow of people towards Raglamyr might increase until the potential new centre place has grown. These models have predictive capacity and can be used to estimate the potential impact. In particular, location of new productive activity in an area Capello (2015). For instance predict where to build a shopping centre Capello (2015). A new shopping centre further south in Haugaland or expansion of excising retail agglomeration areas might be of interest. As a result of increased population. By taking these factors in to account dentist could predict the most profitable locations in years to come by predicting the amount of people that will move from one city to another or tow different points of interest within a city.

**Retail Agglomeration and Economies of Shopping Centres**

Town and cities have long had shopping districts in which stores are concentrated. To some extent such centre points were the result of uncoordinated store-location decisions Brueckner (2011). Nevertheless, not coincidentally according to Hotelling's theory (1929). He describes the concentration of retail stores by a market desire to create a Nash equilibrium. At this point all retailers expected sales maximisation outcome cannot be improved by changing position. Contradictory to the assumption that consumers will shop at the nearest retailer, they are willing to travel significantly further to reach certain central places. Marshall (1920) points out another explanation for this in his seminal work on agglomeration. That being,intra-industry knowledge spillovers as mechanisms leading to formation of industry cluster Nielsen et al. (2021). In this case the dental industry information spillovers are bounded in geographical space. Hence, the need to locate in close proximity. That being the latest equipment, in order to work faster or the right personnel to attract more patients. Another way to drive sales in this area could be by dentist specialisation and patients referrals between dentists.

Another important externalities expressed in Marshall (1920) theory is market transactions. Whereas, geographical proximity reduces transaction cost through several mechanism Nielsen et al. (2021). The market transactions can be extended to the endogenous location of specialized human capital Nielsen et al. (2021). "It is well known among economists and other social scientists that large cities have disproportionately large shares of highly educated workers, and the trend has been growing in recent decades." Baker (n.d.) Presumably, larger cities would then be more attractive to dentists in terms of cost and quality of specialised labour in smaller towns. Especially, those trying to achieve spatial monopoly end up loosing profit by overpaying for labour or in worst case scenario not finding enough dentists labour and end up compromising on quality. In both cases growth potential would be compromised.

Marshal also points out the competition within the geographical location. Hence, the marketplace and business districts give consumers low search and switching costs Capello (2015). The fact that owners of stores seem to prefer highly concentrated shopping. More-so, it suggests that the sales volumes outweigh the loss attributed to greater price competition.

**Shopping Malls**

Owners of shopping malls "orchestrate" the process of retail agglomeration that happens naturally in towns and cities Brueckner (2011). Naturally, the same retail agglomeration and Nash equilibrium may occur in shopping malls if not more intensely as the shops are in closer proximity. Furthermore, the potential for more knowledge spillovers, higher volume of market transaction and more competition. When retail agglomeration is orchestrated by the owner of a shopping mall, the strength and direction of such externalities are taken into account Brueckner (2011). Much so, because the price of rent is dependent on the overall revenue of a shopping mall. Hence, the owner of the mall wants to choose the mix of stores and their sizes taking these externalities, attributes and anchor stores attractiveness into account Brueckner (2011). The Norwegian retail market for

alcoholic beverages is controlled by the state monopoly. Anchor-stores such as the Wine-monopoly bring in a higher volume of consumers (**lai2013Lai?**). For example, shoppers visiting the Wine-monopoly in a mall may also visit a clothing store, and even find it beneficial to use public services at the same time. Nevertheless, they are limited in numbers and needs government approval. Each municipality must apply to get the wine monopoly in their area. One of the factors considered in this process is the death of city centre. A possible reason for this is so called "predatory malls" which are purposely built to overtake the exciting local market. Perhaps more so if malls cater for cinema, restaurants, bars and other attributes in conjunction with the city centre. Not to mention the upper hand of easy road access and free parking.

## Data

In quantitative studies this section provides details about dataset, variables, instruments and measurement procedures used in the study. If the data was collected by the authors this section will describe how the sample was collected. If specific instruments were constructed to collect the data they will be described here and included in the appendix. Procedures used to measure variables are often described in sufficient detail to permit replication. In economic papers, this section describes the empirical model and estimation strategy used by the authors.

### Data description

For this assignment we where provided with different geospatial data in the geographic information software QGIS to calculate the relationship of the different variables that might determine firm activity. This geospatial data included Norwegian commune data which contained the administrative boundaries of the Communes, presented in the software as different divisions of lines that distinguish the different commune boundaries. We where also provided with different point layers, such as the geometric centers of communes, urban city centers or Central Business Districts (CBD), all businesses in Norway which are regarded as dental services, and all Norwegian shopping malls. We where also provided with a QGIS layer with population density estimates, visualized with 100x100 raster graphics.

To carry out a more complete data analysis of the influencing factors of the activity of Norwegian dentist services, we had to collect more data than what we already had been presented with. We firstly utilized QGIS to calculate different other statistics and variables. Regarding the Norwegian shopping malls layer we added the variable "Wine-monopoly" as a false/ true variable to determine which Norwegian malls had a hard liquor store. We added the number of stores which are in each mall, to use as an estimate for the malls sizes. The malls opening hours have also been included in this layer. From SSB, we gathered data on the average municipal sales per inhabitant in retailing for each Norwegian commune. Lastly we created 2 kilometer buffer zones around dentists and CBDs to determine population density in these areas.

After calculations in QGIS we transferred our data to RSTUDIO to do the primary statistical analysis of our data. The data is then merged into two different data frames. The first one containing Norwegian communes as the unit of observation, which includes geometric commune centers to the nearest mall, the retail per capita per commune, the different commune numbers and the size of the nearest mall, including the true/ false "Winemonopoly" variable. The second data frame use dentists as the unit of observations. This data frame include data on the distances from CBD to dentists, distances from dentists to the nearest mall, including variables of the mall size and the "Winemonopoly" variable, different significant accounting figures for the different dentist businesses, such as total sales revenue and EBIT (Earnings Before Interests and Taxes).

To obtain a first impression and a simple understanding of our data, we have decided to make use of scatterplots. The scatterplot presented in **?@fig-1** show the relationship of average spending on retail amongst inhabitants and the distance from geometrical commune centers to nearest malls, which indicate that most malls are in a 50

km radius of commune centers, and that Norwegians on average spend between 50 thousand to 120 thousand on retail.

We furthermore have used plots to look at the relationship between the income of dentist's businesses and the distance from CBDs. In the first scatterplot we see some extreme figures of 1 billion+ income which we choose to ignore and deem as outliers, as we notice that these figures are accounting figures for an entire group of companies under the same legal name. By ignoring these outliers we are then left with the scatterplot in **?@fig-3**. This scatterplot shows a tendency of a negative relationship between the variables, which might suggest that dentists might earn more closer to CBDs. The last scatterplots we have chosen to calculate is concerning the relationship of dentists EBIT which is earnings before interest and taxes, compared to their distances to the nearest shopping mall. Just as the previous scatterplot, we also see here a tendency of a negative relationship between the variables. A decent number of dentists run at a loss, having negative earnings before interest and taxes.

**Empirical Specification**

**Econometric Approach**

**Estimation strategy**

**Analytical framework**

SEDA (Spatial Explanatory Data Analyses)

Spatial data analysis is a rapidly growing area in Statistics Haslett (1992). The Journal of the statistics society define such data as being objects in space, which objects have physical location. Furthermore, the analyses are spatial if these locations are relevant to the interpretation of the data Haining, Wise, and Ma (1998).

The examination of the data involves the examination of data collected from q-gis maps; `it will involve little more. Graphical techniques for examining such maps are thus a central part of the methodology. A number of such techniques are discussed."` Haslett (1992).

`What data are used?`

`What has been calculated?`

# Results

# Discussion

# Conclusion

# Acknowledgements

# References

Brueckner, Jan K. 2011. *Lectures on Urban Economics.* MIT Press.

Capello, Roberta. 2011. "[PDF]location, Regional Growth and Local Development Theories," January. https://www.academia.edu/48547951/_PDF_Location_Regional_Growth_and_Local_Development_Theories.

———. 2015. *Regional Economics.* 2nd ed. Routledge. https://doi.org/10.4324/9781315720074.

Haining, R., S. Wise, and J. Ma. 1998. "Exploratory Spatial Data Analysis." *Journal of the Royal Statistical Society: Series D (The Statistician)* 47 (3): 457–69. https://doi.org/10.1111/1467-9884.00147.

Haslett, John. 1992. "Spatial Data Analysis—Challenges." *Journal of the Royal Statistical Society: Series D (The Statistician)* 41 (3): 271–84. https://doi.org/10.2307/2348549.

McCann, Philip. 2013. *Modern Urban and Regional Economics.* Second edition. Oxford University Press.

Nielsen, Bo Bernhard, Christian Geisler Asmussen, Cecilie Dohlmann Weatherall, and Ditte Håkonsson Lynge-mark. 2021. "Marshall Vs Jacobs Agglomeration and the Micro-Location of Foreign and Domestic Firms." *Cities* 117 (October): 103322. https://doi.org/10.1016/j.cities.2021.103322.