Does a prospective payment system like the DRG induce a moral hazard behavior?

A study of supplier induced demand in the Swedish healthcare market in 2012

NEKH01 BACHELOR’S THESIS
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Abstract
This bachelor essay examine whether a prospective payment system such as the Diagnose Related Group (DRG) reimbursement system create moral hazard behavior like supplier induced demand in the Swedish healthcare market using data from 2012.
Supply induced demand in the Swedish health care sector is suggested by some descriptive evidence, but is not supported by a controlled regression analysis of an almost universal sample of healthcare consumption in Swedish hospitals.

Introduction
This bachelor essay examine whether a prospective payment system such as the Diagnose Related Group (DRG) reimbursement system gives incentive for moral hazardous behavior like supplier induced demand in the Swedish healthcare market.

Method
An ordinary least square model is used to measure the effects of individual prices on differences in outcomes.

Results
Even though a correlation exists when implementing model 1 these disappear when the controls are added in model 2. The effects of price are not significant for either of the two groups.

Discussion & Conclusion
The results are discussed from what is presented in the theory section. Supply induced demand in the Swedish health care sector is suggested by some descriptive evidence, but is not supported by a controlled regression analysis of an almost universal sample of healthcare consumption in Swedish hospitals.

Acknowledgements
I would like to thank my supervisor, Alessandro Martinello for excellent support and advices throughout the process of this essay. Thank you.
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1. Introduction

Prospective Payment Systems (PPS) such as the Diagnose Related Group (DRG) reimbursement system are being used by financiers of the healthcare market in order to control productivity and measure expenditure in the healthcare market. However, there is a risk that these schemes can create incentives to use the system in a non-ethical way by making some treatments more profitable than others. Seen from a supplier perspective, does the DRG reimbursement system lead to an increase in demand? This paper will research if evidence of supplier induced demand can be found using an almost universal sample of Swedish hospitals in 2012.

PPS are designed to ensure financial stability in the healthcare sector. The need for financial stability is exacerbated by future demographic changes which is one of the greatest challenges the OECD countries face in the future. (OECD, 2011). The awareness of possible risks with future demographic changes becomes more and more relevant in order to keep up with the welfare standard people in OECD countries are currently experiencing. One of the most important cornerstones of what we call the welfare state is the health care sector and it is often subject to reforms (Diderichsen, 1995). Not only are people getting older, the share of elderly and also less productive, people in the population are growing. The debate on how to finance the health care in the future will only intensify. Sweden is an example of an OECD country that faces these challenges and with a health spending of 9.6% of GDP Sweden is above the OECD average. (OECD, 2014). This requires increased focus on cost effective care and increasing coordination between units in the health care sector. One indicator is the use of hospital beds, which is a large cost that is being used more cost effectively in Sweden (SALAR, 2009).

To increase transparency and make up for negative externalities that follows with asymmetry in information, which characterizes the healthcare market (Arrow, 1963), SALAR and the National Board of health and welfare publish annual regional comparisons for the Swedish healthcare sector. This data makes it possible to discuss and analyze the healthcare system in a transparent way. The Confederation of Swedish Enterprise systematically produces reports in which they examine the productivity of healthcare in Sweden. (Morin, Norberg, & Oreland, 2009).

The Swedish healthcare providers use diagnosis-related-groups to measure productivity and describe the healthcare produced but also to plan reimbursement to hospitals. (Anell, 2010).
When using a reimbursement system that uses the prospective payment system and implementing this with diagnose related groups, the reimbursement received directly depends on what diagnoses and treatments that are produced. The diagnosis-related-groups are classified so that more complicated cases in the same classification are given a higher reimbursement. Therefore, analyzing whether providers of care exploit this system in order to receive a higher reimbursement relative to the resources spent on treating certain diagnosis is crucial. (Lindgren, 2014). This reimbursement system might have ethical issues. Anders Nilsson, chief of operations surgical clinic at Västmanlands Sjukhus, is worried the reimbursement system will categorize patients into profitable and non-profitable patients and by doing so conflict with the ethical principles stated in the Swedish law of priorities in the healthcare. (Nordin, 2014). The National Board of Health and Welfare states that diagnosis-related-groups are a suitable measure for productivity analysis. (Socialstyrelsen, 2014, p. 37)

In economic research there is no consensus on the effects of supplier induced demand in the healthcare market. Though it has been measured in some studies when measuring physician density in Australia (Peacock & Richardson, 2006), there is also studies denying its effect when applying it on physician density, that is the number of physicians per inhabitant, in different areas in Norway (Grytten & Sørensen, 2001). When healthcare systems have changed the reimbursement method from one to another supplier induced demand has been proven. (Ellis & McGuire, 1986).

The positive relation between reimbursements and demand might be obvious. The physician will increase the number of diagnoses to increase the profits/financial returns, in the case where a physician receives a reimbursement per diagnosis stated. Is this relationship as obvious when looking at the Swedish healthcare market? One hypothesis is that the physician is loyal to his employer, the hospital, and wants to keep his job/colleagues. Since the treated patient is not directly affected by a “classification error” which occurs when a physician “up-codes” a patient and then receives a treatment that is not as severe as the coding suggests this might be a plausible reasoning because the patient lacks the knowledge of healthcare. (Lindgren, 2014, p. 26)

In this paper I collect data from the DRG-database from Socialstyrelsen for all treatments from the counties in Sweden that used the DRG reimbursement system in 2012 and test whether the same diagnoses tend to be more frequent in counties where they are more profitable.
descriptive evidence suggesting the existence of supply induced demand in the Swedish healthcare sector, I find no evidence once I account for omitted variable bias across counties.

The paper proceeds as follows. Chapter 2 presents the theoretical framework behind financing the health care market and the characteristics of a supplier induced demand. Chapter 3 presents the Swedish healthcare system and common methods of reimbursement for healthcare. Chapter 4 presents the data and method used. Chapter 5 presents descriptive and empirical result. In Chapter 6 I will discuss the findings of the results and conclude what this study have contributed in the understanding of supplier induced demand in Sweden.

2. Theory
This section will present the theoretical framework for analyzing healthcare from an economic perspective. The financing of healthcare and some of its challenges, such as supplier induced demand, will also be covered in this section.

In order to study the healthcare market from an economical perspective one needs to take to account that the healthcare market differs from traditional markets. Even though health often is measured as a commodity, it is a very complex commodity to measure. Arrow (1963) studies the complex characteristics of the health care market and related the complexity in the healthcare market to the existence of uncertainty in the case of a disease and the uncertainty in the outcome of treatments. He acknowledges that there is an issue of equity and thus the producer part cannot operate in a profit maximization manner. The healthcare market is protected by licensing, meaning not everyone can practice healthcare, and as a result a minimum quality is expected. (Arrow, 1963). With this in mind one can say that theory isn’t always put in practice since indicatives for profit maximization manners such as a supplier induced demand have been published on several occasions. (Peacock & Richardson, 2006).

Further on, how people are consuming healthcare is relevant in a study of supplier induced demand. A study on supplier induced demand need to consider how consumers form their demand for healthcare. Grossman (Grossman, 1972) presented his theories of consuming health and investing in better health in 1972. The main conclusion of his study is that by considering investing in health as investing in a durable capital stock one can gain output in the form of healthy time. (Grossman, 1972). Grossmans model, presented below, answers to what
level of health that is optimal given certain conditions. When considering health as an investment one invest in good health which in return leads to positive externalities such as increased productivity at work, one can work more for example. By investing in better health today an individual can earn more money in the future. (Grossman, 1972)

Figure 1 Grossman model

Notes:
\( r \) = market interest rate.
\( \delta \) = Rate of deprivation of health. Affected by age, living conditions.
MEI= Marginal Efficiency of Investment. (positive effect on health * salary)/(cost for investment).
If the salary increases the MEI-curve shifts outwards. (Grossman, 1972)

Since health is highly valued in monetary terms, people are willing to pay to live a healthy life, the factor of costs for treatments is relevant when people invest in their own health. This section will continue with a presentation of how healthcare is financed and some of its challenges.

The third-party payment system is what characterizes the financing of the health care market. Whether the financier is private or governmental the pattern of finance are the same. The system works as follows: The financier receives a payment in the form of a fee, or tax, from the consumer, in this case the patient. In return the consumer receives insurance against an adverse outcome, the patient gets sick. This adverse outcome for the patient is treated by a third party, the producer whom in this case is the hospital, to which the patient in many cases pay a small out-of-pocket fee. The main part of the cost is covered by the financier to whom the producer, the hospital, reports its procedures to and gets reimbursement accordingly. (Jönsson & Musgrove, 1995, pp. 41-42)
This financing model, described in Fig. 3, can create market inefficiencies because patients do not face all the costs of treatments received by the producer and thus inefficiently high health care costs are expected. This market failure is called moral hazard in economic theory and is caused by asymmetrical information. That occurs when one part in a transaction of a good is better informed about than the other part. (Rosen & Gayer, 2014, p. 190). The loss for society occurs when the demand for healthcare exceeds the optimal equilibrium, realized when the marginal benefit is equal to the marginal cost, between expenditure and consumption. Inefficiency is because the patient does not face marginal costs and the marginal benefit is lower than the marginal costs. In a case where the insured patient faces a health care market which offers a co-payment insurance scheme, the patient pays for a part of the medical bill, the effects of moral hazard on health care consumption has been analyzed by Rose and Gayer, amongst many, and illustrated in Fig. 3 Moral Hazard supply and demand.

**Figure 3 Moral Hazard**
In this example the insurance policy comes with a 20% coinsurance and with a fixed supply and elastic demand this leads to an overconsumption of medical services. The triangle of abh is the sum of dead weight loss which represents the loss for society when the marginal benefit of medical services exceeds the marginal cost. This market failure is shared by the public and private sector; it is not the one who finances the health care market that bears the blame. The failure is in the nature of the third party payment system. (Rosen & Gayer, 2014, pp. 187-191)

Solutions to this deadweight loss problem have been created by the market by introducing deductibles or a coinsurance. By introducing a deductible, essentially making the consumer pay for cost of the adverse outcome up to a certain figure, or a coinsurance, as the example described earlier, may solve some of the adverse attraction. This might give incentives to not use the insurance unless the consumer really needs it. But also there is an equity issue not to be forgotten: A solution that involves out-of-pocket spending might conflict with the principles of equity (Culyer, 1989, pp. 48-49). The relationship between changes of the out-of-pocket amount and usage of medical services in the NHS was studied by Manning et al. (Manning, 1987). The authors find that the largest decrease in use of medical services was between free and 25% and it was concluded that changes in the out-of-pocket payment have significant effects on the use of medical services. (Manning, 1987)

The third party financing of the health care market also makes the patients and the providers of care not directly financially responsible for their actions which causes the health care market to differ from other markets. This principal agent relationship occurs when politicians in the government acts as an agent representing the society (principal) with the mission to distribute resources to the healthcare sector. This leads to a situation where the costs and quality behind diagnoses and treatments are hard to control for from a politicians and society (patient) perspective. In cases where the producers of healthcare, in this study Swedish hospitals, can affect the demand of its services by choosing to treat more or less profitable diagnoses we experience a supplier induced demand.

The theoretical base for a supplier induced demand comes from the doctor’s utility function and is an outcome of the principal agent relationship. Evans (1974) laid the foundations for the doctor’s utility function and it has been used widely since. The doctor is assumed to
maximize its utility ($U$) in relation to income ($Y$), leisure ($L$) and the disutility that may arise from inducing the demand ($D$).

$$U = U(Y, L, D)$$

The function is maximized given the budget constraint of $Y$ and the time constraint ($T$), time is allocated for work and leisure (Grytten & Sørensen, 2001). Grytten & Sørensen state in their study on supplier induced demand among contracted physicians in Norway that salaried physicians lack economic incentives to induce demand because their personal reimbursement is fixed. They also state that inducement would lead to additional workload, less leisure and negative utility due to incorrect medical treatment (Grytten & Sørensen, 2001, p. 381). Therefore finding evidence of a supplier induced demand based on salary only in Sweden might be hard since the Swedish healthcare market share many characteristics with the Norwegian healthcare market.

Peacock & Richardson (2006) extend the reasoning of asymmetric information in a research on the theories behind supplier induced demand. They conclude that a well-informed individual will, like an uninformed individual, choose to rely on the doctor’s judgment because of the doctor experience in the subject. Supplier induced demand could therefore be a factor even in cases when the doctor faces an informed patient. (Peacock & Richardson, 2006, pp. 7-8). Further on in their research, Peacock & Richards provide descriptive statistics and concludes that supplier induced demand is the reason for the variance in their results. These descriptive results show an increase in the demand for medical services correlating with the density of doctors in different areas in Australia. An increase in doctors per 10000 led to an increase in medical services provided per person. The authors note that their correlating evidence is weak due to lack of information of the direction of causality, but stress that the correlating evidence is powerful when other variables affecting the result cannot be identified. (Peacock & Richardson, 2006, p. 7)

This finding is closely related to which type of reimbursement method that rules in each market and is also a large factor affecting incentives such as supplier induced demand in the health care. (Andersson, Janlöv, & Rehnberg, 2014, pp. 59-61)

Anders Anell stated in 2010 that this asymmetry in information is especially blatant in the healthcare sector. (Anell, 2010, p. 59). Even though the principal-agent-theory is well known and
often a base in economic research regarding reimbursement systems in the healthcare sector little 
is made to reduce the theory’s negative effects, Anell continues. The information and incentive 
gap between the financier and the practitioner in the healthcare sector are competing with mutual 
goals and makes it hard to design an efficient reimbursement system. To control for this market 
failure, Anell describes three general strategies to reduce the harm of the principal-agent problem. 
First and foremost it is stressed that new knowledge is based on clinical research and thorough 
monitoring of results achieved. Secondly the organizational culture at practice level has to be 
directed so that they concur more with the goals of the financier. Thirdly, contracts and 
incentives have to be formed in line with the development that is requested. (Anell, 2010, pp. 59-
60).

3. The Swedish Healthcare system and the reimbursement of healthcare 

In order to understand the outcome of policies and differences in practices in an organization or 
market it is reasonable to believe that it is important to have a good insight in where the decision 
making takes place. This section will describe the Swedish healthcare system and different types 
of reimbursement methods used in healthcare.

The Swedish healthcare is mainly financed through local taxation. The counties and 
municipalities levy income taxes in order to cover for healthcare expenses. A smaller portion 
consists of governmental grants and user fees. (Anell, Glennård, & Merkry, p. 49) Structurally, 
the financial flow follows the outline earlier described as a third-party financing model (Fig. 2.) 
See the appendix under “Financial flow” for a more detailed model of the financing of the 
Swedish healthcare.

There are three principles of priority statutory in Swedish law that all healthcare must take 
account for. These are:

1. The principle of human dignity. Everyone is equal and have the same value.
2. The principle of need and solidarity. The resources available must go to those in greatest 
   need.
3. The principle of cost-effectiveness. The healthcare provided must be cost effective in 
   relation to the outcome.
These principles were founded to ensure that the healthcare provided is equal and that all patients face the same treatment. The principles are graded from 1 to 3 in order to make sure these are the fundamental priorities when healthcare is provided. (Socialstyrelsen, 2007, p. 9).

The Swedish healthcare system consists of three organizational levels that make decisions affecting the outcome of the healthcare, the national level, regional level and municipality level. On the national level it is the Ministry of Health and Social Affairs (Socialdepartementet) that is responsible to implement guidelines and objectives set by the Swedish parliament, Riksdagen. Under the Ministry of Health and Social Affairs there are eight government agencies whom are directly involved in the healthcare market. The largest of them is the National Board of Health and Welfare (Socialstyrelsen) which carries the responsibility in several areas of the healthcare sector. Among its responsibilities we can find responsibility for all the staff employed in the healthcare sector and maintenance of statistics and data. (Anell, Glenngård, & Merkýr, Health Systems in Transition, 2012, p. 26). The main part of the dataset used in this study is gathered from Socialstyrelsen.

On a regional level there are county councils and six medical care regions. These county councils and regions bear the overall responsibility for the healthcare provided. The regions can be described as collaborative initiatives with the purpose to share the knowledge, support and financial planning of healthcare. There are six regions each of one inhabiting a population of about 1 million people. (Anell, Glenngård, & Merkýr, p. 28).

The organization of healthcare in Sweden is best described as decentralized and the planning of policies has to go through several layers in order to be implemented. This policy of decentralization and self-governance has a strong history in Sweden and characterizes the Swedish healthcare market. Although this decentralized system is well set, tendencies towards more centralized governance have begun to emerge. The emerging regions since the late 1990s are an indicator for that according to Anell et al. (ibid, p.29-30).

### 3.1 Reimbursement systems

To control for costs in the healthcare market is important to sustain stability, therefore different types of reimbursement methods exists and some are more suitable for certain markets than
others. Which reimbursement system to prefer can depend on circumstances like demography for example but it is up to the politicians to decide which and according to evaluations on the subject not one reimbursement method is superior in all cases. (Lindgren, 2014, p. 52). A closer look at different common types of reimbursement systems is presented here.

The most common systems of reimbursement and their respective possible adverse outcomes are here presented. Since this study focuses on the Swedish healthcare system the main focus is on the prospective payment system and especially the diagnose related groups classification system. Characteristics of what the reimbursement systems aim for are good cost control, high productivity and cost effectiveness and good quality, both in medical results but also in patient satisfaction. (Andersson, Janlöv, & Rehnberg, 2014, pp. 73-74) But the prospective payment system has also led adverse outcomes such as supplier induced demand proven on several occasions. E.g. (Ellis & McGuire, 1986)

*Fixed reimbursement per period*
This type of reimbursement pays in the form of grants in fixed amounts per period. A budget is set in order to cover for the expenses to come. The method is prospective but since financiers take to account previous spending the method carries some retrospective resemblance. This might lead to an ineffective use of resources since an excess from a period can be considered inefficient and resources might be spent accordingly. This reimbursement creates good cost control and might give low incentives to select resource demanding patients. (Andersson, Janlöv, & Rehnberg, 2014)

*Fee-for-service*
This is a type of retrospective reimbursement method where the hospital gets reimbursed after treatment in full. This gives incentives to treat all types of patients and not reject cases that are not cost effective. One downside with this reimbursement method is that receiving payment in full gives low incentives to promote cost effective treatments. (Andersson, Janlöv, & Rehnberg, 2014, p. 75)

*Capitated payment method*
A capitated payment method is a prospective payment method where the producer receives reimbursement per patient. The supplier of health care receives the reimbursement in advance
based on how many inhabitants a certain area has or how many patient that is listed at the clinic. This reimbursement method puts the producer in a risky situation because the actual health care demanded is complicated to calculate. This gives incentives to minimize costs but also to make way for more effective treatments and/or focus on precaution treatments. A capitated payment method gives low incentives to increase the demand and/or accessibility for the patients and there is a risk that costs are not eliminated but simply transferred when remitting patients to specialist’s treatment. (Andersson, Janlöv, & Rehnberg, 2014, p. 76)

**Goal based reimbursement**
This reimbursement method is a type of prospective reimbursement method in which a goal is set and a bonus paid of the goal is met. This creates incentives to increase production and quality, but only in relation to the goals set. This might indirectly lead to other fields to suffer because of the reimbursement only to be attached to the fixed goal. This type of reimbursement aims to increase quality of health care but it is hard to measure, this leads to a large uncertainty when calculating to which fields the goal should be directed to. (Andersson, Janlöv, & Rehnberg, 2014).

**Value based reimbursement**
The value based reimbursement method is a relative new theory that aims to shift focus from measuring the amount of care given at different hospital levels to measuring outputs in terms of increased health. (Andersson, Janlöv, & Rehnberg, 2014, p. 79). Arrow stated in 1963 that connecting the reimbursement to the benefit of a treatment is ideal, albeit utopian (Arrow, 1963, pp. 964-965). This method to measure increased health and the quality output of inputs is more commonly used in the pharmaceutical market. TLV, the Swedish dental and pharmaceutical benefits agency, is one of many that use Quality Adjusted Life Years (QALY) to measure the effects of health care treatments in cost-benefit analysis. (TLV, 2014)

**Prospective payment system and how it is implemented in Sweden**
A prospective payment system aims to control for costs and increase the incentives to do so. A predetermined reimbursement is decided for each treatment and is therefore enhancing incentives for increased productivity. (Andersson, Janlöv, & Rehnberg, 2014, p. 76)
To implement a prospective payment system the use of Diagnose Related Groups (DRG) is widely used. Diagnose related groups was developed at Yale university in the 1960s with the purpose to increase quality control in hospitals. (Socialstyrelsen, 2011). Diagnose related groups serves as a tool to describe a hospitals case-mix, which is one way of describing what patients they treat and for how long etc. By assigning each diagnose with a weight one can easily find out if a diagnose is demanding in terms of resources. The DRG-weight is a relative measure on treatment costs for one average patient. A higher weight indicates a higher cost. The average cost for all treatments during one year is given the weight 1.0 and the weight for each DRG (treatment) is given by dividing its average cost with the cost for DRG 1.0 (Socialstyrelsen, 2011). For example, if the average cost for every treatment in one hospital is 27 000 kr and the average cost for a treatment DRG XX is 64 000 kr the DRG weight for DRG XX = 64 000 / 27 000 = 2,37.

Annually Socialstyrelsen calculate national DRG weights using data representing almost 70% of all hospitals in Sweden and the counties sets their own prices for DRG 1.0, for example Skåne pays 44 452:- and Uppsala 46 135:-. (Socialstyrelsen, 2011) One notable factor is that the costs differ across counties. Breaking your arm in one county may be more expensive for the taxpayers in another.

This reimbursement method incentivizes high productivity and makes it easy to compare data between hospitals. One downside with diagnose related group is that it can incentivize an overproduction of profitable diagnosis and a lower production of diagnoses not that profitable. (Morin, Norberg, & Oreland, 2009, pp. 8-9).

4. Data & method

4.1 Data

The majority of the data used in this study is gathered from the database for diagnose related groups supplied by the Swedish National Board of Health and Welfare. (Socialstyrelsen, 2014). The variables are on both county level and hospital level. I also acquired data by email directly from county-representatives. The cross sectional data is from 2012 as it is the latest year with the best representation among the variables. More recent data is available but they tend to be not as complete as the data from 2012. Due to not all counties in Sweden using the diagnose-related-group system not all counties are represented in the final dataset.
The original dataset listed around 93000 observations describing the outcome for all diagnose related groups for every hospital in all counties in Sweden. By sorting out hospitals that could not be identified (private hospitals) and adding control variables the dataset ended up with 39000 hospital level observations. Counties that do not use the DRG system or couldn’t list their prices was also excluded from the analysis. Below I describe the variables used for my analysis.

**Independent Variables**

*Price*

Out of 21 counties in Sweden 14 are represented in the data used in this study. Listed in the table are the counties with their county-number and their price for DRG-weight 1.0.

<table>
<thead>
<tr>
<th>County</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uppsala</td>
<td>46135</td>
</tr>
<tr>
<td>Östergötland</td>
<td>43560</td>
</tr>
<tr>
<td>Jönköping</td>
<td>43560</td>
</tr>
<tr>
<td>Kalmar</td>
<td>43560</td>
</tr>
<tr>
<td>Blekinge</td>
<td>42965</td>
</tr>
<tr>
<td>Skåne</td>
<td>44452</td>
</tr>
<tr>
<td>Halland</td>
<td>41625</td>
</tr>
<tr>
<td>Västra Götaland</td>
<td>41625</td>
</tr>
<tr>
<td>Örebro</td>
<td>46135</td>
</tr>
<tr>
<td>Dalarna</td>
<td>46135</td>
</tr>
<tr>
<td>Västernorrland</td>
<td>48379</td>
</tr>
<tr>
<td>Jämtland</td>
<td>48379</td>
</tr>
<tr>
<td>Västerbotten</td>
<td>48379</td>
</tr>
<tr>
<td>Norrbotten</td>
<td>48379</td>
</tr>
</tbody>
</table>

Note: Prices in 2012 SEK

*Weights*

The weights used are the national weights calculated by the National Board of Health and Welfare. The DRG-weight is a relative measure on treatment costs for one average patient. A higher weight indicates a higher cost. The average cost for all treatments during one year is given the weight 1.0 and the weight for each DRG (treatment) is given by dividing its average cost with the cost for DRG 1.0 (Socialstyrelsen, 2011).
Control Variables

*Average age treated*
This is the average age at the time of dismissal of the patient. This is an important variable because age is a factor often related with appreciating a patient’s health status. (Gall & al, 1982)

*Average time treated*
The average time treated is the number of days treated divided by the sum of treatments for each diagnose. This term is also referred to as length of stay and is a key indicator in measuring performance and hospital efficiency for hospital management. (Kulinskaya, Kornbrot, & Gao, 2005)

*Staff in the healthcare sector*
This is data describing how many employees that are employed in the healthcare sector per county. It consists of 28 different working titles ranging from doctors and nurses to dentists and specialists in surgery, to mention a few.

*Average income*
This is the average income in each county.

*Gini coefficient*
This variable explains the income equality per county. Many studies support the connection between health status and socioeconomic status. E.g. (Berndt, Fisher, & Rajendrababu, 2003)

<table>
<thead>
<tr>
<th>Group1</th>
<th>DRG-weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>L08A Surgery against obesity, gastric bypass</td>
<td>3,8340</td>
</tr>
<tr>
<td>P01A Cesarean section</td>
<td>2,2224</td>
</tr>
<tr>
<td>C35 ÖLI otitis Upper respitourial infection</td>
<td>0,5876</td>
</tr>
<tr>
<td>C17 Surgery for sleep apnea</td>
<td>0,7880</td>
</tr>
<tr>
<td>F30 Appendectomy</td>
<td>1,2320</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group2</th>
<th>DRG-weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>E04 Heart valve Surgery</td>
<td>7,5396</td>
</tr>
<tr>
<td>E18 Percutan Coronar Intervention</td>
<td>1,8064</td>
</tr>
<tr>
<td>E47 Heart failure</td>
<td>1,2344</td>
</tr>
<tr>
<td>D30 Lung emboli</td>
<td>1,0684</td>
</tr>
<tr>
<td>D46 Chronically obstructive Lung disease</td>
<td>0,9480</td>
</tr>
</tbody>
</table>
4.2 Method

The dataset constructed for this study contains detailed data for healthcare from an almost universal sample of hospitals in different counties in Sweden. Because of the extensive work for obtaining and matching the data I decided to focus on data from 2012 in order to ensure good quality in the analysis.

To best analyze this cross-sectional healthcare outcome the Ordinary Least Square regression method is applied. To test the if supplier induced demand is present in differing prices the OLS function is used to specify the functional relationship between the dependent variable (outcome of treatment measured here in number treated) and the independent, exogenous prices, variables. The statistical program used is STATA, because of its capabilities to handle datasets with many variables and observations. I will proceed in two steps.

First, this study tests if there is a correlation between the outcome, the number treated, and the price and weights. Second I observe the effect of adding control variables in a second model. There are some limitations and possible disadvantages of using the ordinary least square method. The problem of omitted variable bias occurs when one or several important variables which are correlated with both the outcome variable and the explanatory variables of interest are left out. This problem is avoidable by adding many variables; by adding incorrect variables the estimation will be inefficient but not biased. (Dougherty, 2011, pp. 250-251).

I divide diagnoses in two groups with different characteristics, see Table 2. Group 1 consists of diagnoses that are considered more instantly treatable than the diagnoses in group 2. An instantly treatable disease requires fewer resources than the more complicated diagnoses that requires long term follow ups and is therefore more profitable. Supplier induced demand would imply that diagnosis in Group 1 are affected more by the reimbursement than diagnosis in Group 2, which act as a comparison. To correctly select diagnosis I consulted a medical doctor.

Supplier induced demand implies an effect of the price for the treatment on the number of patients treated. This hypothesis is what this regression tests. According to the principles of priority statutory described in chapter 3 there should not be large differences across counties. Supplier induced demand instead implies that $\beta_1 > 0$ and $\beta_2 > 0$ for group 1 but not for group 2.
The OLS-estimation in this study is estimated using these following function models:

**Model 1**

\[
\text{NumberTreatedGroup}(1,2)_{i} = \alpha + \beta_1 \text{Price}_i + \beta_2 \text{Weight}_i + \varepsilon_i
\]

**Model 2**

\[
\text{NumberTreatedGroup}(1,2)_{i} = \alpha + \beta_1 \text{Price}_i + \beta_2 \text{Weight}_i + \beta_3 \text{Price}_i \cdot \text{Weight}_i + \beta_4 \text{Staff}i
\]

\[
+ \beta_5 \text{AverageAgeTreated}_i + \beta_6 \text{AverageTimeTreated}_i
\]

\[
+ \beta_7 \text{AverageIncome}_i + \beta_8 Gini_{i} + \varepsilon_i
\]

5. Results

I will start by presenting some descriptive statistics for the two diagnose groups then I will perform the tests discussed in chapter 3. For more specific graphs for each diagnose see the appendix.

5.1 Descriptive statistics

![Figure 4 Supply demand relationship for Group 1 and Group2, instantly treatable diagnoses and complicated diagnosis](image)

Fig. 4 shows that the number of treated individuals for 100 000 inhabitants for the “treatable”-diagnosis (Group1) on the left and more complicated (Group 2) on the right. Each point in the graph represents a hospital and is grouped in staples because they share the same price in each country. We see an increase in the number of treated for Group 1 and recalling that the prices in
each county equal the reimbursement for the weight 1.0 we can see that hospitals with higher prices produce more treatments in Group 1 but not in Group 2. This makes sense because the diagnoses in group 1 are more profitable than in Group 2. Another observation is that some hospitals stand out with substantially more treatments; an explanation for this might be that some hospitals are specialized for certain diagnoses and takes up a larger portion of patients.

**Figure 5 Treatment duration for Group 1 and Group 2, at different hospitals**

Figure 5 shows the relationship between number of treated patients and the average time treated at each hospital in this study. The graphs clearly show a correlation between how many patients treated and longer treatments. The characteristics of the graphs differs some, the largest cluster of hospitals is found between 2.5 and 4.5 days for Group 1 while the same pattern is not shown for Group 2. This indicates that Group 1 is more predictable in its characteristics, it is easier to predict the treatment for a non-complicated diagnose. The same pattern, that a larger number of treated increases the time treated imply that hospitals are getting crowded and have to take longer to treat many patients.
Figure 6 Patients treated per county and doctors per 10000

Figure 6 shows the correlation between General Practitioners per 10.000 and the number of treated patients in every county taking part in this study. The two counties that stand out in the lower right part of the quadrant are the two biggest regions representing among 1 million inhabitants each, Västra Götalands region and Region Skåne. The county in the far upper left part of the quadrant is Norrlands region, this region is far less populated than the two other regions with more doctors per 10.000 inhabitants. One interpretation of this graph is that there are large differences in policy across counties; another is that it is more popular among doctors to live in larger cities than in the countryside.

5.2 Hypothesis testing
The next part of this section presents the results of the regression of the two models and tests the hypothesis of supplier induced demand.

Table 3 describes the outcome of the regression models presented in chapter 4.2. We see that for every increase in price the number treated in Group 1 increases by about 1%. For Group 2 this correlation is negative, for every increase in price the number treated decreases by about 1%. As the descriptive results suggests, these results imply that healthcare providers in Sweden induce healthcare demand.
Table 3 Outcome of controlled regression analysis

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) Group 1</th>
<th>(2) Group1</th>
<th>(3) Group2</th>
<th>(4) Group2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>0.00988**</td>
<td>-0.0127</td>
<td>-0.0106**</td>
<td>-0.0111</td>
</tr>
<tr>
<td></td>
<td>(0.00501)</td>
<td>(0.0112)</td>
<td>(0.00501)</td>
<td>(0.0112)</td>
</tr>
<tr>
<td>Weight</td>
<td>-0.0179***</td>
<td>-0.0290*</td>
<td>-0.0170***</td>
<td>-0.0190</td>
</tr>
<tr>
<td></td>
<td>(0.00501)</td>
<td>(0.0152)</td>
<td>(0.00501)</td>
<td>(0.0152)</td>
</tr>
<tr>
<td>Price*Weight</td>
<td>-0.00415</td>
<td>-0.00905</td>
<td>0.00362</td>
<td>0.00751</td>
</tr>
<tr>
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<td>(0.0131)</td>
<td>(0.00501)</td>
<td>(0.0131)</td>
</tr>
<tr>
<td>Staff per county</td>
<td>-2.84e-05***</td>
<td></td>
<td></td>
<td>7.59e-06</td>
</tr>
<tr>
<td></td>
<td>(8.01e-06)</td>
<td></td>
<td></td>
<td>(8.03e-06)</td>
</tr>
<tr>
<td>Avg age treated</td>
<td>-0.00510***</td>
<td></td>
<td>0.00321***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.000417)</td>
<td></td>
<td>(0.000418)</td>
<td></td>
</tr>
<tr>
<td>Avg income</td>
<td>-3.94e-06***</td>
<td></td>
<td>-2.06e-08</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.46e-06)</td>
<td></td>
<td>(1.46e-06)</td>
<td></td>
</tr>
<tr>
<td>GINI county level</td>
<td>1.080</td>
<td></td>
<td>-0.200</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.766)</td>
<td></td>
<td>(0.768)</td>
<td></td>
</tr>
<tr>
<td>Avg time treated</td>
<td>-0.00173</td>
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<td>-0.00198</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.00126)</td>
<td></td>
<td>(0.00127)</td>
<td></td>
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<tr>
<td>Constant</td>
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<td>1.004***</td>
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<td>-0.120</td>
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<td>(0.00501)</td>
<td>(0.255)</td>
<td>(0.00501)</td>
<td>(0.256)</td>
</tr>
<tr>
<td>Observations</td>
<td>39,856</td>
<td>24,808</td>
<td>39,856</td>
<td>24,808</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.000</td>
<td>0.008</td>
<td>0.000</td>
<td>0.003</td>
</tr>
</tbody>
</table>

However while a correlation exists when implementing model 1 (in the table rows (1) and (3)) these disappear when the controls are added in model 2 (rows (2) and (4)). The effects of price are not significant for either of the two groups. The correlation between the outcome variable and explanatory variables implies that the first models are subject to omitted variable bias.

An interesting result is the GINI variable which shows that the level of equality in a county has a larger effect than staff per county for example. In Group 2 there is a positive correlation with the average age but a negative for Group 1. This makes sense because the more complicated Group 2 contains diagnoses such as heart failure for example which is more common among elderly.
6. Discussion & conclusions

This study tests if supplier induced demand exists in the Swedish healthcare market. From the data collected I find that there is no significant evidence of a supplier-induced moral hazard behavior in either of the diagnose-related-groups studied. Correlation for prices and patients treated exists, but disappear when control variables are included.

The positive correlations and the negative correlations in the results, and the unconditional regression result in, table 3, are indications of supplier induced demand because the more instantly treatable group 1 is less resource demanding and more profitable than the more complicated group 2.

The correlation observed in number treated and average days treated may indicate that some hospitals show evidence of lack in efficiency, although this is hard to measure because of the complexity in measuring health as an outcome (Arrow, 1963).

The age variable behaves as expected as the more complicated diagnoses are likely increasing with age. The likelihood of a patient being treated for obesity at high age is not as high as for an older person. The reason for that I is that because the procedure is considered cost effective in the future, a patient suffering from obesity is more likely to be sicker in the future and the effects of an obesity surgery are noticable first after a few years.

The two counties that stand out (lower right corner of the quadrant) in Fig. 8 are Skåne and Västra Götaland, both included in separate regions which inhabit around 1 million people each. This result could indicate that the centralization initiatives taken by the regions results in lower exertion of the healthcare provided. The decline of the number treated relative doctors per 10,000 inhabitants contradicts the results found in Australia (Peacock & Richardson, 2006). That hospitals in larger regions in Sweden have more doctors per 10,000 inhabitants and also a lower rate of treated per inhabitant can be considered as non-indicative for a supplier induced demand in Sweden. Because a supplier induced demand implies that more diagnoses are found in an area with higher physician density as in Peacock & Richardson (2006), my results indicates the opposite for Swedish counties. The reason for this can simply be because of the characteristics of the Swedish healthcare system, Swedish doctors have a fixed sallary.

When considering the different layers of policy and management in the organizational structure of the Swedish healthcare system, described in Chapter 3, I conclude that asymmetric information flows and competing interests due to the principal-agent relationships occurring in a
decentralized system are factors of importance that contribute to forming the differences across counties.

The differences of days treated for different diagnosis in the results is interesting. One could reason that if a hospital treats many cases of one certain diagnose they get more effective in their procedures and therefore they should increase their productivity. Another interpretation could be that the hospitals treat the patient “in-house” efficient and don’t need to spend that much resources as the days treated suggest, and therefore they can earn money from the financier by treating an “efficient” patient. The reason for the differences in average days treated could be due to long waiting lists. Simply that hospitals with higher average days treated have a higher working load relative its resources.

These interpretations of the relative relationship between average days treated and number treated in the results are hard to consider as evidence of an existence of a supplier induced demand. The average days treated results prove that large differences are a fact and the result may be interpreted as indications of a supplier induced demand but more analyzing over time may give better evidence. Measuring average days treated is a good measurement for this, especially when considering the principles of priority statutory described in chapter 3. These results may prove that the healthcare provided is not always equal.

For future studies I recommended that time-series variation is used to measure variations in practices over time since the diagnosis-related-group system is an ongoing work getting more and more detailed, which helps when controlling for omitted variable bias. This study contributes with indicative results that variations are evident across counties, but are likely not due to supplier induced demand.
7. References


## 8. Appendix

### 8.1 Regression

Table 1

<table>
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<tr>
<th>VARIABLES</th>
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<tr>
<td>c.std_price#c.std_weight</td>
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<td>-0.00905</td>
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<td>-0.120</td>
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<td>0.000</td>
<td>0.008</td>
<td>0.000</td>
<td>0.003</td>
</tr>
</tbody>
</table>

### 8.2 Indicative evidence of differences in supply

The indicative results are divided into two groups. Diagnosis regarded as treatable (group 1) and more complex diseases (group 2).
Descriptive Graph 3

Descriptive Graph 4
## Diagnosis and weights 1

<table>
<thead>
<tr>
<th>Group</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Group1</strong></td>
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</tr>
<tr>
<td>L08A Surgery against obesity, gastric bypass</td>
<td>3,8340</td>
</tr>
<tr>
<td>P01A Cesarean section</td>
<td>2,2224</td>
</tr>
<tr>
<td>C35 ÖLi otitis Upper respitourial infection</td>
<td>0,5876</td>
</tr>
<tr>
<td>C17 Surgery for sleep apné</td>
<td>0,7880</td>
</tr>
<tr>
<td>F30 Appendectomi</td>
<td>1,2320</td>
</tr>
<tr>
<td><strong>Group2</strong></td>
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</tr>
<tr>
<td>E04 Heart valve Surgery</td>
<td>7,5396</td>
</tr>
<tr>
<td>E18 Percutan Coronar Intervention</td>
<td>1,8064</td>
</tr>
<tr>
<td>E47 Heartfailure</td>
<td>1,2344</td>
</tr>
<tr>
<td>D30 Lung embolia</td>
<td>1,0684</td>
</tr>
<tr>
<td>D46 Chronicly obstructive Lung disease</td>
<td>0,9480</td>
</tr>
</tbody>
</table>

**Group1**

![Diagrams showing scatter plots and fitted lines for different groups and conditions.](image-url)
8.3 The Swedish healthcare system and Financial flow

Two decision makers under the national level except Socialstyrelsen are of more interest for this study than others and have to be prioritized in order to fit the scope of this study. These are the Swedish Social Insurance Agency (Försäkringskassan) and SALAR (Sveriges Kommuner och Landsting).

The Swedish Social Insurance Agency administrates the different aspects of what makes the social insurances in Sweden. The agency is responsible for insurance benefits such as sickness insurance and child allowance. One of its main goals is to work for returning people who have ended up outside the workforce because of illness or other social circumstances back into it. This ongoing work is what characterizes the Swedish Social Insurance Agency and they are represented in all of Sweden’s 21 counties and have about 250 local offices to support and serve on more local level. (ibid, p.26)

The SALAR is an association representing all the Swedish counties and municipalities on the national level. The SALAR represent the biggest employers in Sweden with over 1 million employees and about one third of them in the healthcare sector (in 2009). One of the association’s main goals is to work for local self-governance and independency and thus providing counties and municipalities with the support to do so. (ibid, p.27) This support can take its form in several ways but one example is the continuous work with reports and evaluations of the healthcare sector. (SALAR, 2009).

At the municipality level the responsibility takes the form of long term care for its citizens. Among the responsibilities in the healthcare we find care for elderly and disabled people but also long term psychiatric patients. They also provide some nursing homes and home care. (Ibid, p. 28-29).