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The Demand for Health Care and the Resulting Overcrowding

—

A Multiple Indicators and Multiple Causes Approach

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Abstract

In this thesis a Multiple Indicators and Multiple Causes model based on the framework by Grossman is applied in order to investigate causes of overcrowding in the Swedish health care system. The model comprises socioeconomic, lifestyle and organizational variables. Aggregated data on a county council level was analyzed in STATA and the results were at large statistically significant on at least a 10% level. Inequalities were found in the distribution of hospital beds between county councils, and in the relation between the objective need and actual utilization of inpatient care among different socioeconomic groups. Some of the organizational factors pointed to possible efficiency-enhancing measures, but it was concluded that directing patients to the right level of health care and enhanced equity in distribution of resources should be the primary focus.

Keywords: health care, health, inequalities, overcrowding, SEM, MIMIC, socioeconomic factors, Grossman
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The aim of the health service is to
ensure good health, on equal terms,
for the entire population.
(The Swedish Health and Medical
Services Act (1982:763) 2§)

1 Introduction

Health care of good quality is of great interest to the society. Accordingly, it is a frequent subject for debate. Not at least due to the fact that the resources are confined and have to be proportioned and allocated with delicacy.

Due to a new economic reality, Sweden has had to look over its welfare services and restructure the health care system. But at the same time as the number of beds per capita has fallen dramatically, new technologies and strategies have been implemented.

These new circumstances have led to divergent views on the roots to certain problems in Swedish health care. A specific matter that has been in focus for a lively and polarized debate is the heavy burden on hospitals, resulting in overcrowding, and relocation of patients between wards. These circumstances are considered to be detrimental to both patient safety and working environment. Studies from USA and Canada have pointed out that a too heavy load on emergency departments could induce, e.g., medical errors, increased spread of *Methicillin–resistant Staphylococcus aureus*, longer waiting time for health care, too early discharges from hospitals, and even patient deaths (NBHW 2012). The Swedish National Board of Health and Welfare (NBHW) have found evidence for causal effects from overcrowding and relocation on patient death also in Sweden.

Some argue that the health care resources are too scarce to meet the needs, while others stress the importance of continued work with organizational effectiveness and efficiency. Whatever the case, the Swedish Health and Medical Services Act emphasize the care systems responsibility to promote equality in health and health care, which may not be the case if some areas face larger problems with overcrowding than others.

1.1 Purpose

The purpose of this study is to conduct an exploratory analysis in order to investigate the bearing from different factors on the level of overcrowding and relocation in Swedish hospitals. More specifically, these factors are related to the equality in distribution and use of health care resources, among county councils as well as different socioeconomic subgroups, and different strategies to deal with organizational problems.

1.2 Outline of the Report

This report is structured as follows: after a short background introducing the Swedish health care systems and explaining concepts central to the issue under study, some insight into previous research on overcrowding and other related areas is provided. Then there will be a presentation of the actual research questions the report will try to answer. After a subsequent introduction of the

empirical methodology, the results are presented and interpreted. Eventually, some concluding remarks will help to answer the research questions.

2 Background

2.1 The Swedish Health Care System

Sweden performs well in international comparisons when it comes to life expectancy at birth and a variety of outcome–related performance measures. When it comes to efficiency and effectiveness, however, the performance is less impressive, with long waiting times for treatment and problems with overcrowding and relocation.

2.1.1 Structure and Financing

Sweden is divided into 21 county councils[1] that have the primary responsibility for providing their inhabitants with health care. A county council tax on taxable income covers most of the costs. Since health care needs and average income varies between county councils, there is a system for the reallocation of funds between them. How, on the other hand, each county council distributes financial resources to their own health care systems could differ, just like practices and priorities (Anell, Glenngård & Merkur 2012, Iversen 2011).

The health care services provided by the county councils can be divided in three categories–*inpatient care*, *outpatient care* and *primary care*:

Primary care performs basic medical investigations, treatment and nursing. It also has an important function as a provider of preventive care and rehabilitation. In the Swedish health care system, this is the first level and general practitioners (GPs) have the function of gatekeepers to more specialized care. Primary care is predominantly offered at health centers.

Inpatient and outpatient care (sometimes collectively denoted secondary care) provides specialized somatic care that requires more advanced resources, with respect to both technical equipment and personnel, than is available in primary care. Inpatient care is usually provided in hospitals, whereas outpatient care is provided at specialized clinics outside hospitals (SCB 2009). It is within inpatient care problems with overcrowding and relocation may occur.

[1] To be correct, some of these are called regions instead. Nevertheless, throughout this thesis, county councils and regions will interchangeably be used as collective terms for all areas.

2.2 Overcrowding and Relocation

2.2.1 Definition

In order to monitor the extension of the problems with overcrowding and relocation, the Swedish Association of Local Authorities and Regions (SALAR) and the National Board of Health and Welfare (NBHW) introduced a model for knowledge management of overcrowding and relocation of patients in 2012. This encompassed the implementation of national definitions of overcrowding and relocation that would be used in a national reporting system (NBHW 2012). The definitions are:

Overcrowding is defined as an occurrence when an admitted patient is nursed in a bed that is not meeting the demands for a disposable bed, which is a bed in inpatient care with physical formation, equipment and staff that ensures patient safety and working environment.

Relocation is defined as when an admitted patient that is nursed on another ward than the one that has specific competence and medical responsibility for the patient (NBHW 2012).

Together, these two indicators can convey the deficit of disposable beds in a specific hospital at a specific time. Henceforth, *overcrowding* will be used as a collective term for both overcrowding and relocation.

2.2.2 The Swedish Debate on Overcrowding

Sweden distinguishes itself in an international context when it comes to one of the traditionally most used measures of welfare and health care quality, the number of hospital beds per capita. This ratio is significantly lower for Sweden than for many other European countries. The situation was quite the contrary the 1970s, but the rate has steadily decreased since then (Anell, Glenngård & Merkur 2012). According to many debaters, this development is the primary explanation for the problems with overcrowding (Fölster 2003).

Then there are those who maintain that the cut in the number of hospital beds has been made possible by the implementation of improved medical technologies, treatments, and processes, allowing for a more effective use of available resources (Calltorp 2012). It is also argued that an increased emphasis on the expansion of primary and outpatient care have added up for this the lower inpatient care capacity. The relocation of resources to health care services closer to the patients is meant to improve public health, decrease inequalities in health and decrease the utilization of inpatient care. In the long run, the costs of the health care system are expected to decline as a result. Yet, some reports note that investments in alternatives to inpatient care have halted (FHI 2010). Whatever the explanation is, it seems hard to question that patients and personnel have a though situation with severe implications for their well-being (FHI 2010).

3 Previous Research

3.1 Overcrowding

Research trying to capture a broader picture of overcrowding and its potential causes and solutions are rather sparse and fragmented into different aspects of the problem. For one thing, this indicates that it is a complex matter, but also that there are divergent views as to its most problematic constituents. Forero, McCarthy & Hillman (2011) recognizes that many studies on possible interventions concentrates on a specific hospital and therefore miss out on the broader perspective that could be observed with appropriate public data. He urges for a better understanding of the context hospital operates in, of patients needs and of the local populations characteristics.

Alas, much of the academic research on the issue has looked on the situation in countries with health care systems that, to a more or lesser extent, differ from Swedish health care in terms of how the health care system is structured. This is not to say that those findings lack relevance for the study at hand, but that they should be interpreted in the light of Swedish conditions.

3.1.1 Causes for Overcrowding

Research on overcrowding has found a number of causes that may give rise to overcrowding. Forero, McCarthy & Hillman (2011) points out that important factors are to be found at multiple levels patients, clinics as well as the health care system as a whole. Phillips & Smallwood (2010) present some potential causes:

- An insufficient number of hospital beds.
- Patients with non-urgent needs.
- Length of stay.
- Discharge of patients being limited to specific times of the day.

The literature on overcrowding has recognized that overcrowding and relocation tend to occur when occupancy rates exceeds 90% (Hoot & Aronsky 2008, NBHW 2012). Both overcrowding and occupancy rates are, essentially, a product of demand and supply. When the demand for inpatient care exceeds the supply there is a risk for overcrowding and relocation. As health is a basic need, it is not very easy to keep the demand for health care down by throttling supply and it is not in the interest of society to keep it down if there is a true need (Hoot & Aronsky 2008). At the same time, it could be hard to tell how well the demand for health care corresponds to objective health, and by extension to the degree individuals subjective perceptions and valuation of good health influence their demand.

3.2 Health Inequalities

Inequalities in health and access to health care often follow the paths of socioeconomic differences in society. Socioeconomic status is commonly measured in terms of education, income and occupation (Masseria, Hernandez-Quevedo & Allin 2010).

A widely used proxy for socioeconomic status is income. Both absolute and relative income within a society has been shown to have an effect on health inequality. The effect of relative income, however, is suggested to be contingent on how large the inequality in income is. The income therefore becomes less important as a trajectory to health inequality below a certain threshold. These findings implies that although income is relevant to health also in countries with an extensive redistribution system, for instance Sweden, this effect is smaller than in countries larger inequalities in income, such as the USA. Instead there are other socioeconomic as well as lifestyle factors that works as the key determinants of health (Wagstaff 1986, Lynch et al. 2004). Accordingly, Mackenbach et al. (2008) found that socioeconomic inequalities in health among Northern European countries could not be considered systematically smaller than in Europe at large.

3.2.1 Utilization of Swedish Health Care by Different Socioeconomic Groups

Various studies have looked into how the utilization of health care services is distributed between socioeconomic groups. Mackenbach et al. (2008) found that among OECD countries, groups with low socioeconomic status were the predominant users of primary and inpatient care. People with high socioeconomic status, on the other hand, were more prone to seek outpatient care. However, Albin et al. (2012) found that immigrants, generally regarded as having a low socioeconomic position, had a low utilization of inpatient care in Sweden. At the same time, they are reported to have higher mortality compared to native Swedes.

The level of education has also been shown to have an impact on health care utilization in Sweden. For example, those with a low educational level to larger extent utilize inpatient services when they could have been treated in less resource intensive parts of the health care system. However, those with a high level of education are more frequent users of primary care (FHI 2010).

3.2.2 Health Inequalities and the Restructuring of the Health Care System

In a review of studies on the implications of the restructuring of European health care systems, Gelormino et al. (2011) concludes that these changes have brought about increased inequalities with regards to the health care access. Although the universal coverage employed by many European states enhances equality, increases in out-of-pocket payments have had a negative effect on the access to health care services. Further more, the trend of decentralization has created a

breeding ground for regional differences within countries.

Burström (2002) analyzed questions asked in the Swedish Survey of Living Conditions, and reviewed some other studies to investigate how inequalities in health and health care utilization in Sweden had developed during the 1990s. He recognized a possible increase in the use and access to health care, especially for persons with low income and young people. Burström suggested that these findings could be related to the restructuring of the Swedish health care system during the period of study.

3.3 The Supply of Health Care

The supply of health care is traditionally represented by the number of hospital beds per capita together with the number of doctors per capita. Over time, these two measures have become regarded as obsolete in determining the capacity and quality of the health care system as a whole (Phillips & Smallwood 2010). Other aspects of the structure and processes have been emphasized instead. One such aspect is the relative provision of primary, outpatient and hospital health care. In their study of the access to health care in two Swedish regions, Lindström et al. (2003) concluded that good access to primary care corresponds to lower utilization of inpatient and outpatient care. However, other studies have emphasized that the utilization of inpatient and outpatient care also is somewhat contingent on different factors that influence a general physicians tendency to make a referral (Gerdtham 1997).

Another issue that has gained power is how the disposable hospital beds could be utilized more efficiently. Bed management and lean processes are meant to generate smoother patient flows and to keep the load in line with capacity Phillips & Smallwood (2010).

3.4 The Demand for Health Care

A lot of research can be found regarding the drivers for and the fundamental dynamics of the demand for health care. This report presents two central models. The Grossman model has been applied in order to study a diversity of phenomena related to health, health care demand, inequalities in health etc. (e.g., Muurinen 1982, Chang 1996, Liljas 1998, Häkkinen 1991). The model by Andersen on the other hand, provides a wide and conceptual view of the determinants of health care demand. Together, the two give a more comprehensive understanding of the underlying factors affecting the demand for health care.

3.4.1 The Grossman Model

In a model developed by Grossman (1972*a*, 1972*b*, 2000) health is viewed as a capital stock, subject to depreciation but that can be increased by investments. The health capital stock provides what Grossman refers to as healthy time (as

opposed to sick time), which can be used for labor or as an input to household production. Healthy time is demanded by consumers both as an investment commodity since healthy time can be used for working and thereby increasing income, but also as a consumption good because it serves as a source of utility in itself–that is, individuals value being healthy for more reasons than only the monetary gain one gets from being able to work.

Grossmans work culminates in an expression of the marginality state for new investments in health, where the marginal costs associated with an investment in the health stock is set to be equal to the marginal gains--both measured in utility, that is, the gains from health capital as a consumption good; and in monetary return, namely, the gains from health capital as an investment commodity. Most empirical applications of Grossmans model tend to focus on the investment sub model, since it allows for powerful predictions from rather simple analyses. The full proof can be found in Grossman (1972*a*, 2000), but an extract is sufficient in order to get an overall understanding of the relationship between health, health supply and underlying socioeconomic factors.

Assume that the amount of healthy time (denoted h) available in a given period i is $h_i = \phi_i H_i$ where H_i is the stock of health and ϕ_i is the flow of healthy time per unit stock. Net investments in the health stock is given by

$$H_{i+1} - H_i = I_i - \delta_i H_i \tag{3.1}$$

where I_i is gross investments and δ_i is the depreciation rate of the health stock, assumed to depend only on age and increase as the individual gets older. Individuals are assumed to invest in health according to their household production function

$$I_i = I_i(M_i, T_i, E_i) \tag{3.2}$$

where M_i is health care, T_i is the time required for production and E_i is the level of education—assumed to be a proxy for human capital and serving as catalyst in the production function. Grossman does however remark that lifestyle factors such as physical exercise in reality also enters the production function and can serve as substitutes for health care. An individual is also subject to budget and time constraints setting the upper limit for health investments. The marginality state of the investment function is written as

$$\frac{G_i W_i}{\pi_{i-1}} = r - \tilde{\pi}_{i-1} + \delta_i \tag{3.3}$$

where G_i is the marginal product of the stock of health in the production of healthy time ($\partial h_i/\partial H_i$), W_i is the wage and π_{i-1} is the marginal cost of gross investments in health in the previous period. The left-hand side can be interpreted as the marginal monetary rate of return of an investment in the health stock (that is, the numerator states how much additional money one would get in this period, from investing π_{i-1} in the previous period). The right-hand side can be interpreted as the marginal costs of such an investment, where $\tilde{\pi}_{i-1}$ is the percentage change in marginal cost of an investment in health between period $i-1$ and i, r is the interest rate and δ_i is the health stocks rate of depreciation. The marginal efficiency of capital (MEC, seen in Figure 3.1) is seen as the demand function for health and shows the relationship between the health stock and the rate of return. An assumption is that the production of health ($\partial h_i/\partial H_i$) is subject to diminishing returns, making the MEC curve to slope downwards. The supply curve, S, illustrates the relationship between the health stock and the capital cost. Since the cost of capital (the right-hand side of Equation 3.1) is independent of the health stock, the supply curve is infinitely elastic.

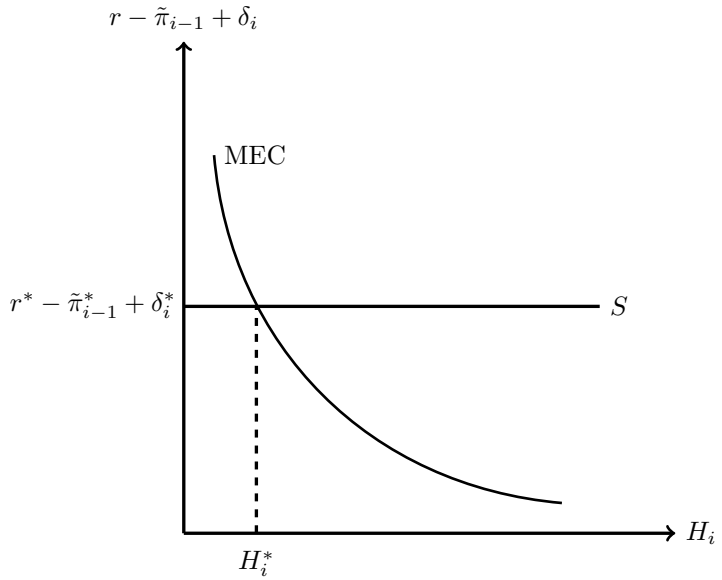

Figure 3.1: The MEC curve where H^*_i is the optimal health stock for a given cost of health capital (Grossman 1972*a*,*b*).

Equation 3.3 and the MEC curve can be used to predict changes in the demand for health and in gross investments, as a response to changes in ingoing socioeconomic variables. To see why, age and wage can serve as examples.

An increase in age will increase the cost of health capital by increasing depreciation, thus shifting the optimal health stock to the left in Figure 3.1. This decrease in health does not necessarily result in a decrease in the demand for health care. In the investment function 3.1, an increase in the depreciation rate reduces the amount of health capital provided by a specified amount of gross investment (I_i). If this decline in health supply exceeds the decline in demand, an individual has the incentive to close this gap thus increasing gross investments and thereby the demand for health care used as input in the household production function 3.2. Grossman shows that an increase in age will have a positive impact on the demand for health care if the elasticity of the MEC curve is less than 1.

The wage of an individual measures his market efficiency, or to put it differently the rate at which he can convert time into money. If an increase in wage did not influence the cost of health capital–the return on investment would be expected to increase by as much. This is however not the case, since time is an input variable to the health household function. If x is the part of the total investment cost accounted for by time, and $(x-1)$ the part accounted for by health care–the actual increase in the rate of return for a given stock of health capital will be $(1-x)$. Thus an increase in income is expected to increase the demand for health and health care assuming x is not 1. This can be illustrated by a shift in the MEC curve to the right. Wagstaff (1986) used data from Denmark in his analysis and argues that since health care is so heavily subsidized most of the cost will be accounted for by time, implying that the effects of changes in income will not be as large as compared to in other countries. By applying a similar logic, one can derive the expected change in health and health care from altering the educational level and price of health care as seen in Table 3.1.

Table 3.1: The expected change in health and health care demand as a result of an increase in the various socioeconomic variables according to Grossmans model.

Variable	Health	Health care
Age	< 0	> 0[1]
Education	> 0	< 0[1]
Income	> 0	> 0
Price of health care	< 0	< 0

[1] Provided the elasticity of the MEC curve is less than 1.

3.4.2 The Andersen Model

The Andersen model was introduced by Ronald M. Andersen in 1968 and has been further developed numerous times (Andersen 1995, 1968). The basic concept is that the use of health care is determined by categories of factors interacting with each other. In its simplest form, the model consists of three groups of factors, starting with predisposing variables that through enabling factors and perceived need create a demand for health care.

The predisposing variables consist of socioeconomic factors such as gender and age, assumed to influence the behavior of an individual and how disposed a person is to visit a hospital or to seek medical advice from a doctor. Enabling factors are supposed to facilitate or prevent the use of health care services for individuals predisposed to use them—they indicate the costs associated with using the services. Examples from this group are income, insurance, prices and the availability of health care. These factors can be related to inequalities in health, since, for example, a high income may enable an individual to use health care to a greater extent compared to a low-income counterpart. Finally the perceived health is intended to provide a measure of how individuals view their own health status.

Critics of the Andersen model argues that organizational factors should be given more attention in the creation of demand for health care services (Patrick et al. 1988, Kelley et al. 1992, Gilbert, Branch & Longmate 1993). As a response to this, Andersen included the health care system as an additional group of variables when further developing his model. This group consists of national health policy measures as well as resources and organizational aspects of health care systems (Andersen 1995).

3.5 Summary of Previous Research

The research on overcrowding and relocation is not very comprehensive. However, the research there is points out, e.g., number of hospital beds, length of stay, time for discharge, and patients seeking the wrong level of health care as possible contributors. Hence, it is a multifactorial problem that derives from the supply as well as demand for inpatient care.

To meet demand, health care services should be distributed according to need. This distribution may suffer from inequalities, leaving some groups of people underserved. Seemingly inconsistent, such inequalities have also been found in Sweden and other welfare states. This is related to other socioeconomic factors than income, due to the redistribution of wealth.

Grossman provided a theoretical framework that can be used to analyze the effects of various socioeconomic factors on the demand for health and health care. It captures an individuals subjective view and valuation of good health based on his or her socioeconomic status. Another important aspect of Grossmans model is that the demand for health care is seen as derived from the demand for health. Andersen provides a conceptual view of causes of the demand for health care, and thereby including a broader range of input variables. The enabling factors he discusses also link to inequalities in health among socioeconomic groups, where factors such as wage and the price of health care services as included in Grossmans model can prevent lowincome individuals from using health care services to such an extent as there actual, objective health status really requires.

The urgent problem with overcrowding and relocation makes it important to

fill out the void in knowledge that exists in Sweden about the root causes. Due to the existence of apparent inequalities in health in Sweden, it is not impossible that overloaded hospitals are an expression for insufficient health care resources. However it may also be an expression for inefficiency. With an innovative approach it might be possible to shed further light on this issue. Research questions that will be addressed are:

- Is it possible to perceive any health and health care inequalities related to the prevalence of overcrowding and relocation?
- What further insights into the issue can different socioeconomic indicators give?
- Do organizational factors indicate the existence of structural and efficiency problems in hospitals and within the health care system?
- What solutions to the problems with overcrowding do the findings suggest?

4 Empirical Methodology

4.1 Conceptual Model

The model structure is based on the theoretical framework provided by Grossman, in the sense that socioeconomic factors are assumed to influence both the demand for health and the demand for health care. Possible differences among socioeconomic groups can thereby be observed. Another cornerstone in Grossmans model is the understanding of health care utilization as a derived demand from health–that is, individuals do not demand health care in itself but rather good health. In order to model this dependency the health stock is treated as an ingoing variable to the health care demand function.

Grossmans model has however been criticized for its simplistic nature, which has led to many empirical extensions (Cropper 1977, Dardanoni & Wagstaff 1987). Among other things, Cropper argued that different lifestyle and environmental factors also influence the depreciation rate of the health stock in the same way as age—for instance, increased alcohol consumption increases the depreciation rate. Grossman (2000) remarks that lifestyle factors such as physical exercise can serve as a substitute for health care in the health production function. An increased physical activity would according to this logic increase health and in the same time decrease the use of health care services due to a substitution effect. Therefore the framework by Grossman is extended to include lifestyle variables assumed to have a direct effect on the health and through this an indirect effect on the use of health care. The same extension can be found in other empirical applications of Grossmans model (e.g., Häkkinen 1991, van Vliet & van Praag 1987, van de Ven & van der Gaag 1982).

The purpose of this study is to investigate the causes of overcrowding, which is in turn highly correlated with occupancy rate. The occupancy rate can be defined as:

$$\frac{Total\ number\ of\ hospital\ days\ consumed\ by\ the\ population\ per\ year}{365 \times Number\ of\ hospital\ beds}$$

where the total number of hospital days consumed by the population is a measure of demand for health care (SAL 2010). Hence, occupancy rate will be used as a proxy for overcrowding and health care demand. As described in the review of previous research, overcrowding can be a result of factors associated with demand (e.g., socioeconomic variables and the objective health status), but also factors of supply, in terms of physical hospital beds as well as efficiency measures. Drawing upon the ideas of Andersen (1995), an additional vector is included comprising organizational factors–assumed to have a direct effect on the demand for health care.

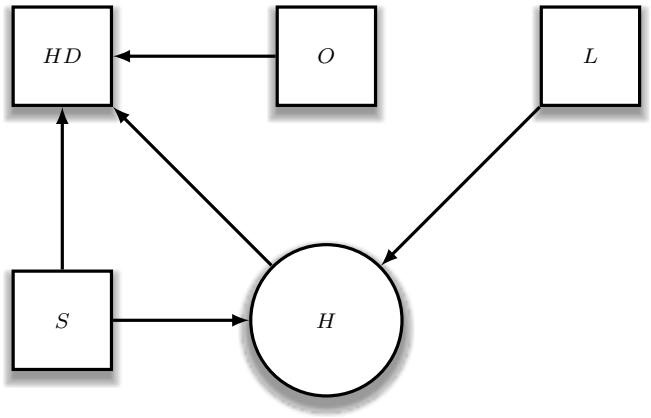

Figure 4.1: The conceptual model. H is health, L is lifestyle variables, O is organizational variables, S is socioeconomic variables and HD is the demand for health care. The graphic design is based on Erbsland, Ried & Ulrich (1995).

4.2 Econometric Specification

A Multiple Indicators and Multiple Causes (MIMIC) model is a type of structural equations model (SEM), and an estimation technique to evaluate casual relationships when dealing with latent variables. This model was developed by Jöreskog (1973) and Goldberger (1974). A variable is said to be latent if it is not directly observed or measured, but is instead assumed to be caused by various exogenous variables (Jones 2000). In order to obtain a latent variable one uses directly observable and measurable endogenous variables—that is, indicators–that are highly, or ideally perfectly, correlated with the underlying latent variable being studied. The MIMIC design has been widely used in health econometric studies for modeling the demand for health and health care treating health as a latent variable (e.g., van Doorslaer 1987, Wagstaff 1993). It should be noted that the latent variable health has a positive correlation with good health.

The model comprises the following interdependent functions:

$$H^* = k_1 + \alpha_1 Z_1 + \alpha_2 Z_2 + \xi_1 \tag{4.1}$$

$$HD = k_2 + \beta_1 H^* + \beta_2 Z_2 + \beta_3 Z_3 + \epsilon_1 \tag{4.2}$$

$$H_i = \lambda_{hi} H^* + \varepsilon_i,\ i = 1, 2, 3, 4 \tag{4.3}$$

where λ_{hi}, α_1, α_2, β_1, β_2, β_3 are coefficients, k_1 and k_2 are constants, ε_i, ξ_1 and ϵ_1 are error terms, H_i are indicators of health, H^* is the latent variable health and HD is the demand for health care for which occupancy rate is used as a proxy. Z_1 is a vector with lifestyle variables, Z_2 is a vector with socioeconomic variables and Z_3 is a vector with organizational variables. There are four indicators of the latent variable health H^*, in turn reflecting the objective health—that is, the true need for health care. As a consequence, the effect of socioeconomic factors (Z_2) on the demand for health care is twofold consisting of both an indirect demand via H^*, corresponding to an objective need for health care, and a subjective direct demand.

The above Equations 4.1, 4.2 and 4.3 can be illustrated in the following path diagram:

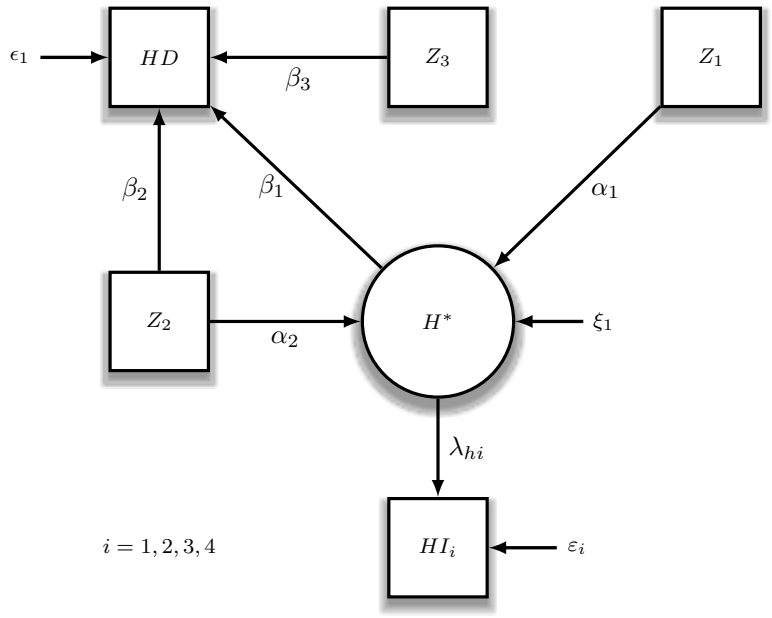

Figure 4.2: Path diagram of the model.

In order to run the model the STATA software and the built-in function for constructing structural equation models will be used. The standard errors are set to be heteroskedasticity-consistent, since the assumption of multivariate normality is unlikely to hold (Gouriéroux, Monfort & Trognon 1984). Alas, in doing so, one limits the number of tests that otherwise could have been performed in order to investigate different aspects of the model to a minimum.

4.3 Delimitations in the Structural Design

In order to reduce the complexity of the model, delimitations have been imposed. Socioeconomic factors are likely to affect the lifestyle of individuals, suggesting

a connection from the first to the latter. More generally, adequate pathways and the true directions of causality are not always clear-cut. A relevant consideration is to what extent bad health in the county councils is a result of inadequate health care. For simplicity, it is assumed that this effect is small compared to the effect of bad health on the inadequacy of health care resources.

5 Data

5.1 Sources, Quality and Reliability

Since the empirical application requires various types of variables for the structural equation model; i.e., socioeconomic, lifestyle, organizational efficiency and health care supply; data were collected from several reliable public sources in order to obtain a comprehensive set of variables: SCB, FHI, KOLADA and NBHW. The data was considered to be of good quality and reliable, nevertheless, with some uncertainty for some self-rated data.

Using data aggregated at county council level entails a limit to the number of observations available, since there are only 21 county councils in Sweden. This is far too few to implement a structural equation model. The recommendation is to use at least 200 observations (Kline 2010). As a consequence longitudinal data was collected for the years 2001 to 2012, providing a total of 231 observations. Since structural equation models not readily allow for time series dependency, the rather strong, but necessary, assumption of independence between all observations was made. Problems may arise from such a procedure as a result of the time dependency causing the variance of some parameters to become smaller.

5.2 Health Indicators ($\boldsymbol{HI}$)

Four factors are used as health indicators, whereof three are the same self-rated health measures as included by Häkkinen (1991). The fourth indicator used is life expectancy at birth, serving as a good indicator for health (NBHW 2012) and providing a more objective measure than does the other three. Häkkinen (1991) used individual data for his study and was therefore limited to using subjective measures of health.

5.3 Health Care Demand ($\boldsymbol{HD}$)

As mentioned, occupancy rate will be used as a proxy for health care demand in terms of overcrowding. The Swedish data on overcrowding and relocation available from SALAR were found not to meet the needs of this study. Data had only been collected for about half a year and the quality could not yet be guaranteed. Additionally, the other parameters needed were not possible to obtain for that period of time.

5.4 Lifestyle Factors ($\boldsymbol{Z_1}$)

The lifestyle factors included in the model are all expected to have a negative effect on health. Smoking, overweight, risky alcohol consumption and sedentary leisure time are all of them among the main lifestyle related causes of ill-health in Sweden (Allebeck, Moradi & Jacobsson 2006). To have a BMI of 25 or more

may intuitively correlate with physical activity, but the data shows no such correlation.

5.5 Socioeconomic Factors (Z_2)

Grossman emphasized the role of education, income and age when it comes to consumption of health and health status. Wagstaff (1986) argued that since health care services are heavily subsidized in Denmark, most of the cost for health care will be accounted for by time–an argument that is transferable to Swedish condition. Thus, a very small increase in health care demand would be expected as a result of an increased income, or perhaps no change at all. This is supported by other findings in previous research, stating that income is considered to be of less relevance than, for example, education in a welfare state like Sweden. An estimation of the model presented here will perhaps arrive at similar results.

To be sure on capturing the value of education within the well-educated Swedish population, education is here represented by those who have attended graduate school or have a post secondary education of three years or more. In the light of previous research on the consumption of inpatient health care, high education is expected to have a negative impact on this demand, but a positive impact on health (FHI 2010). These effects are consistent with Grossmans reasoning.

Age is, according to Grossman, expected to correlate negatively with health, but positively with health care demand provided the elasticity of the MEC curve is below 1. Immigrants are expected to have poorer health than the average, but the consumption of inpatient care is found not to reflect these circumstances (Albin et al. 2012).

5.6 Organizational Factors (Z_3)

Since occupancy rate is a ratio of supply and demand, the impact of both these factors on the complex problem of overcrowding could be analyzed. Factors reflecting supply are here denoted organizational factors. Number of hospital beds per capita is not included among these, since it is used when calculating the occupancy rate.

The included factors affect supply and other organizational aspects directly or indirectly. The average length of hospital admission could be positively correlated with the occupancy rate by slowing down the flow of patients through the organization. Another factor is number of doctor visits in outpatient and primary care per person and year. If negatively correlated with occupancy rate, it may appear as a means to relieve the load on inpatient care. The third factor is public health care cost per *diagnosis-related group* (DRG) point in inpatient care. DRG-points are used for standardized weighting of nursing workload. In other words, the factor can be used to compare how much a county council

spends in relation to output (SAL 2010).

Table 5.1: Descriptive statistics (N = 231)[1].

Variable	Definition	. Mean	Standard deviation
Socioeconomic factors (Z_1)			
age	mean age (years)	41.67229	1.217558
lnincome	ln of median income	4.846192	0.0827031
highed	grad. school or ! 3 years of post sec. as highest level of education (ratio)	0.1056587	0.0271838
imigr	born abroad (ratio)	0.1247229	0.0495109
Lifestyle factors (Z_2)			
smoker	daily smokers (ratio)	0.1306399	0.0185004
alcohol	risky drinking (ratio)	0.1260119	0.0173419
bmi	BMI of 25 or higher (ratio)	0.48313	0.0269495
physact	sedentary leisure time (ratio)	0.1322917	0.0137379
Organizational factors (Z_3)			
outpri	no. doctor visits in outpatient and primary care per person and year	2.586171	0.3103108
avestay	average length of hospital admission	5.839522	0.6174665
costdrg	cost per DRG-point	4.382254	0.3251249
Demand for inpatient health care (HD)			
occbeds	occupancy rate (ratio)	0.8518924	0.0908323
Health indicators (HI)			
lnlife	life expectancy at birth (years)	4.390323	0.008777
lnself	bad self-rated health (ratio)	0.0633785	0.0098257
lnlongdise	long-standing disease (ratio)	0.3124302	0.0203393
lnanx	anxiety (ratio)	0.1545222	0.0176566

[1] Some variables miss data for a few years. This could possibly result in convergence problems when running the model, however removing all observations with missing values would have left to few observations to perform our analysis, thus it was inevitable to include them as well.

6 Results and Interpretation of Results

Table 6.1: Estimation results: Structural equations (p-values in brackets).

Indicator	Health (H^*)	Occupancy Rate (HD)
Health (H^*)		-1.618495
		(0.049)
Age	0.0017643	0.0494945
	(0.000)	(0.000)
Income	0.0191161	0.1850282
	(0.002)	(0.024)
Education	0.0981609	-1.03012
	(0.057)	(0.000)
Immigrant	0.0909404	0.4795074
	(0.000)	(0.010)
Smoker	0.0000789	
	(0.997)	.
Alcohol	-0.1339057	
	(0.000)	
BMI	-0.0608396	
	(0.007)	
Physical inactivity	-0.2763151	
	(0.000)	
No. visits in outpatient and primary care		0.095187
		(0.000)
Average length of stay		-0.0013334
		(0.891)
Cost per DRG-point		-0.0237738
		(0.000)
R^2	0.6374698	0.5142443

Table 6.2: Direct, indirect and total effects of the socioeconomic factors on the occupancy rate (p-values in brackets).

	Occupancy rate		
Explanatory variable	Direct	Indirect (HD)	Total
Age	0.0494945	-0.0028555	0.0466389
	(0.000)	(0.090)	(0.000)
Income	0.1850282	-0.0309393	-0.1540889
	(0.024)	(0.106)	(0.059)
Education	-1.03012	-0.158873	-1.188993
	(0.000)	(0.100)	(0.000)
Immigrant	0.4795074	-0.1471865	0.3323209
	(0.010)	(0.054)	(0.054)

Tables 6.1 to 6.3 present the results from the structural equation model. Table 6.1 contains the results from the structural part of the model, whereas Table 6.3 (see section 6.5) contains the results from the measurement part. Table 6.2 shows the direct, indirect and total effects of the socioeconomic variables on the demand for health care.

When interpreting the results, one must keep in mind that the demand for health care is represented by occupancy rate, a ratio of demand and supply. To analyze a direct measure of demand may appeal to the intuition, but would be to aim off target. After all, the utilization must be seen in the light of the provision of services.

As mentioned, the assumption of robust errors precludes a wide array of postestimation tests. However, a test to identify omitted paths that could enhance the goodness-of-fit is reported in Table A1 in Appendix.

6.1 Health (H)

Health, as a proxy for objective health status, had a negative effect on the occupancy rate which may seem self-evident, since healthier individuals may demand less health care. Nevertheless, the result can be interpreted as if county councils with a relatively healthy population have a richer supply of inpatient care relative their needs than county councils where the population health is poorer.

6.2 Lifestyle Factors (Z_1)

All of the lifestyle factors were expected to have a negative effect on health and this is the result for three out of four factors, the exception being the positive, but statistically insignificant, effect of smoking. Increases in BMI, physical inactivity and alcohol consumption all serve to decrease the objective health status and thus increase the need for health care.

6.3 Socioeconomic Factors (Z_2)

In concordance with Grossman's (2000) theories, higher income has a positive effect on both health and the demand for health care. Since the demand for health care services is represented by an increase in occupancy rate, it is tempting to suggest that high-income groups are underserved regarding inpatient care. However, as this demand is direct it is reflecting a subjective need that not corresponds well to their actual need for health care services. In other words, the high occupancy rate might be an expression for an overutilization, rather than a shortage in hospital beds. Further more, it seems as if income is a socioeconomic factor having an impact even in Sweden even though some of the previous research have suggested that income should have a rather moderate effect on equality in extensive welfare systems (Mackenbach et al. 2008).

Higher education has a positive effect on health and a negative effect on occupancy rate, both directly and indirectly. Also this is in line with Grossmans predictions. He expects educational level to serve as an efficiency factor in the production of health care, where highly educated people are hypothesized to be more efficient producers of health. Other studies show the same results (e.g., Häkkinen 1991, Wagstaff 1986, van Vliet & van Praag 1987). In reality this could

imply that highly educated people are more prone to have a lifestyle that benefits good health. The negative impact on the use of health care also indicates, that they might use other types of input variables to their health production function as substitutes for medical care. Previous studies on Swedish conditions have revealed the same effect on the use of inpatient health care, and that those with a high level of education instead seem to be using primary care to a greater extent (FHI 2010).

The results further suggest that an increased age increases the objective health status as well as the occupancy rate. Better health indirectly decreases the demand for health care and as a result the occupancy rate. However, that elderly people should have a better health than the average population contradicts Grossman as well as common sense. The reason for this surprising result could be the use of longitudinal observations, resulting in a lower variance of the underlying data. In addition, an increase in occupancy rate suggests elderly people use health care to a greater extent than other people. This is, as opposed to the result for the contribution to common health, in line with Grossmans prediction and what one would expect.

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Immigrants are shown to have a better health compared to the population as a whole and are also increasing the occupancy rate thus indicating that they are more frequent users of health care. Albin, Hjelm, Ekberg & Elmståhl (2012) found that immigrants in Sweden tend to have a low utilization of inpatient care and relatively bad health, so the obtained results contradict their findings. An explanation could be that immigrants happen to be overrepresented in county councils were the average demand for health care services are high thereby indicating a deficiency in using data aggregated at county level. However, if the results would be correct, the direct effect on health care utilization might reflect an overuse of inpatient resources, rather than underdimensioned hospitals.

6.4 Organizational Factors (Z_3)

By including the number of visits in outpatient and primary care per inhabitant, the aim was to be able to observe an effect on the occupancy rate thus implying that county councils that are able to get a larger part of the demand for health care taken care of outside of the impatient care have a lower occupancy rate.

The results does, however, not support this, instead indicating that it does not lower the occupancy rate and in extension.

Perhaps it would have been more appropriate to include a relative measure of inpatient health care to health care outside the inpatient care rather than an absolute measure, since such a ratio could capture the effect of inhabitants in an overall unhealthier county council demanding more health care in general. Such a conclusion could, nevertheless, imply that unhealthier county councils lack resources at all levels of the health care system to meet the populations need.

Shifting focus to cost per DRG-point, it seems like increasing funds is affecting the occupancy rate negatively. This could perhaps imply that an increase in monetary resources assigned to the county councils inpatient care would lower the occupancy rate. However, it might also imply that hospitals in regions with a low objective need still get more resources in relation to output than is the case in county councils with a unhealthier population—thus, reflecting an unequal distribution of resources.

Lastly, the average length of hospital stay has a negative impact on the occupancy rate, which of course is somewhat contradictory. Perhaps this implies that the lower occupancy rate, the longer the hospitals can let the patients stay. The result is however very insignificant.

6.5 Health Indicators (HI)

Table 6.3: Estimation results: measurement equations (p-values in brackets).

Explanatory variable	Health (H^*)	R^2
Life expectancy at birth	1 (constrained)	0.7751918
	(0.000)	
Bad self-rated health	-0.932714	0.5295784
	(0.000)	
Long-standing disease	-2.553226	0.8590343
	(0.000)	
Anxiety	-0.474828	0.0377524
	(0.012)	

The measurement model gives a satisfying result all of the included explanatory variables have the expected sign. The life expectancy is automatically fixed at 1 and all the other variables are expected to correlate negatively with health since they are all measures of bad health. In addition, these indicators turn out to explain a lot of the variance in health, except for anxiety as indicated by R^2.

7 Concluding Remarks

The results of this study may indeed have shed some light on the mechanisms behind overcrowding and related health care inequalities. Firstly, a potential bias in patient capacity and in overcrowding was found, in favor of county councils wit a relatively good public health. Even if it would be the case that the health care systems capacity and quality was divided equally between the county councils with respect population size, it would not necessarily imply health care equality. Since needs and patterns of health care utilization differ throughout Sweden, some parts of the population would then experience inadequate health care, while some others would have excessive resources.

Such differences in need between county councils may correspond to the prevalence of different socioeconomic groups. This study found evidence for some of the existing theories and earlier findings about how the utilization of health care could be attributed to different markers of socioeconomic position, especially for education. However, utilization and need is not the same, and the results from the model that was specified, suggests that different socioeconomic groups might use inpatient care more than needed.

Hence, even if it might give an effect to, for instance, discharge patients earlier and distribute more resources to the inpatient care, it could be of importance to look beyond demand in order to concentrate on the real need. To decrease hospital capacity would not make the situation better, unless adequate substitutes for those with moderate needs are provided. However, the study suggests that expanding outpatient and primary care may not be sufficient, at least not if its capacity and organization is not planned thoroughly.

All in all overcrowding is not just a question about how many hospital beds there are, but also where they are placed geographically. In addition, it is also a question about how well the community councils can organize their resources as to enable patients the access to health care at the right level. Perhaps there is a need for better coordination and increased learning between county councils to eradicate the inequalities in health and health care that exists in Sweden, despite its extensive welfare system.

The model developed and applied in order to arrive at these conclusions fulfilled its purpose well. It allowed for a closer look at different aspects and interconnections that makes up this complex problem. However, a MIMIC approach is exploratory to its nature and offers vast opportunities. Continued work is demanded in order to find out how to best picture reality and to explore other possible explanations to the problem. One possible development of the model is to find a way to better separate issues that relates specifically to either demand or supply. It is not very easy to draw conclusions from the organizational factors in the present model, since these measures' relation to supply and demand were not observable. Another improvement is to make the model better on handling longitudinal data sets.

Other developments of the methodology could be the utilization of more specific data, perhaps on an individual level. That would maybe allow for a multilevel study that could compare individual and contextual effects. In addition, it would be of interest to perform a qualitative study as a complement to the quantitative.

The problem with overcrowding is very complex and must be studied thoroughly. This study has hopefully given some more insight into this difficult matter, and introduced new methods that could be employed in future research. However, whatever further developments are made of this study, more research devoted to this and adjacent issues would be highly appreciated. Problems within health care and public health are collective issues of life and death that, in one way or the other, concerns us all.

8 Summary

There is an animated debate in Sweden about the heavy load on hospitals and the connected problems of overcrowding and relocation of patients to other wards, and how these matters deteriorate patient safety as well as working environment. Some suggest that it essentially is a matter of inadequate hospital capacity, while others mean that the problem is a consequence of inefficiency and other organizational factors.

By use of an exploratory analysis, this study investigated if there could be any connections between the equality in distribution and use of health care resources in Sweden, among county councils as well as different socioeconomic subgroups, and the prevalence of overcrowding in hospitals.

To the background of relevant theory concerning, for example, overcrowding and health inequalities, a MIMIC model with health status as a latent variable was outlined in order to study the complex connections between different indicators and causes relating to the occurrence of overcrowding.

The model built on Grossman and Andersens theories about what drives demand for health and health care. Data on different socioeconomic and lifestyle indicators was collected from Swedish public authorities and analyzed in the computer software STATA. Occupancy rate was used as a proxy for overcrowding and relocation, due t their close correlation. The results made it possible to analyze the impact on occupancy rate from the need and utilization of health care in different county councils and by different subgroups, as well as from different organizational factors. Most of the results were statistically significant and corresponded to what was expected. The conclusion was drawn that there were clear differences in the supply of hospital beds and health as well as utilization of inpatient care between different county councils and socioeconomic groups. Further more, although hard to interpret, the organizational factors indicated that there where some different measures that could be taken in order to enhance efficiency.

However, as long as there are patients that do not seek the right level of health care or do not need it, and an unequal distribution of resources, the primary focus should perhaps be on giving the right level of care to the patients and better knowledge sharing between county councils.

References

Albin, B., Hjelm, K., Ekberg, J. & Elmståhl, S. (2012), 'Utilization of in-hospital care among foreign-born compared to native swedes 1987–1999', *Nursing Research and Practice* **2012**.

Allebeck, P., Moradi, T. & Jacobsson, A. (2006), 'Sjukdomsbördan i sverige och dess riskfaktorer'. [The disease burden in Sweden and its risk factors, in Swedish].

Andersen, R. M. (1968), Behavioural model of families' use of health services, Research Series 125, University of Chicago, Center for Health Administration Studies, Chicago, IL.

Andersen, R. M. (1995), 'Revisiting the behavioral model and access to medical care: does it matter?', *Journal of Health and Social Behavior* **36**(1), 1–10.

Anell, A., Glenngård, A. H. & Merkur, S. M. (2012), 'Sweden: Health system review', *Health systems in transition* **14**(5), 1–159.

Burström, B. (2002), 'Increasing inequalities in health care utilisation across income groups in sweden during the 1990s?', *Health Policy* **62**(2), 117–29.

Calltorp, J. (2012), 'How can our health systems be re-engineered to meet the future challenges? the swedish experience', *Social Science & Medicine* **74**(5), 677–9.

Chang, F. (1996), 'Uncertainty and investment in health', *Journal of Health Economics* **15**(3), 369–76.

Cropper, M. L. (1977), 'Health, investment in health, and occupational choice', *Journal of Political Economy* **85**(6), 1273–94.

Dardanoni, V. & Wagstaff, A. (1987), 'Uncertainty, inequalities in health and the demand for health', *Journal of Health Economics* **6**(4), 283–90.

Erbsland, M., Ried, W. & Ulrich, V. (1995), 'Health, Health-Care, and the Environment - Econometric Evidence from German Micro Data', *Health Economics* **4**(3), 169–182. 3rd European Workshop on Econometrics and Health Economics, Univ Antwerp, Studiecentrum Econ Sociaal Onderzoek, Antwerp, Belgium, Sep 28-30, 1994.

FHI (2010), *Svenska lädomar av Marmot-kommissionens rapport Closing the Gap.* [Swedish lessons from the Marmot Commission's report Closing the Gap, in Swedish].

Fölster, S. (2003), *Den sjuka vården: en granskning av hur sjukvårdens resurser används*, Ekerlid, Stockholm. [The sick health care: an investigation of how the health care system's resources are used, in Swedish].

Forero, R., McCarthy, S. & Hillman, K. (2011), 'Access block and emergency department overcrowding', *Critical Care* **15**(2), 216.

Gelormino, E., Bambra, C., Spadea, T., Bellini, S. & Costa, G. (2011), 'The effects of health care reforms on health inequalities: a review and analysis of the european evidence base', *International Journal of Health Services* **41**(2), 209–30.

Gerdtham, U. G. (1997), 'Equity in health care utilization: further tests based on hurdle models and swedish micro data', *Health Economics* **6**(3), 303–19.

Gilbert, G. H., Branch, L. G. & Longmate, J. (1993), 'Dental care use by u.s. veterans eligible for va care', *Social Science & Medicine* **36**(3), 361–70.

Goldberger, A. S. (1974), *Frontiers in Econometrics*, Academic Press, New York, chapter Unobservable variables in econometrics, pp. 193–213.

Gouriéroux, C., Monfort, A. & Trognon, A. (1984), 'Pseudo maximum likelihood methods: Theory', *Econometrica* **52**(3), 681–700.

Grossman, M. (1972*a*), *The Demand for Health: A Theoretical and Empirical Investigation*, number nr. 119 *in* 'National Bureau of Economic Research New York, NY: Occasional paper', New York : National Bureau of Economic Research.

Grossman, M. (1972*b*), 'On the concept of health capital and the demand for health', *Journal of Political Economy* **80**(2), 223–55.

Grossman, M. (2000), *The human capital model*, Vol. 1, Part A, Elsevier, chapter Chapter 7, pp. 347 – 408.

Häkkinen, U. (1991), 'The Production of Health and the Demand for Health-Care in Finland', *Social Science & Medicine* **33**(3), 225–237.

Hoot, N. R. & Aronsky, D. (2008), 'Systematic review of emergency department crowding: Causes, effects, and solutions', *Annals of Emergency Medicine* **52**(2), 126–136.

Iversen, T. (2011), *Vägval i vården - en ESO-rapport om skillnader och likheter i Norden*, Stockholm. [Crossroads in the Health Care Sector - an ESO report on differences and similarities in the Nordic Countries, in Swedish].

Jones, A. M. (2000), Health econometrics, *in* A. J. Culyer & J. P. Newhouse, eds, 'Handbook of Health Economics', Vol. 1, Part A, Elsevier, chapter Chapter 6, pp. 265 – 344.

Jöreskog, K. G. (1973), A general method for estimating a linear structural equations system, *in* A. S. Goldberger & O. D. Duncan, eds, 'Structural Equations Models in the Social Sciences', Seminar Press, New York, pp. 85–112.

Kelley, M. A., Perloff, J. D., Morris, N. M. & Liu, W. (1992), 'Primary care arrangements and access to care among african-american women in three chicago communities', *Women Health* **18**(4), 91–106.

Kline, R. B. (2010), *Principles and Practice of Structural Equation Modelling*, 3 edn, The Guilford Press, New York.

Liljas, B. (1998), 'The demand for health with uncertainty and insurance', *Journal of Health Economics* **17**(2), 153–70.

Lindström, K., Engström, S., Bengtsson, C. & Borgquist, L. (2003), 'Determinants of hospitalisation rates: does primary health care play a role?', *Scandinavian Journal of Primary Health Care* **21**(1), 15–20.

Lynch, J., Smith, G., Harper, S., Hillemeier, M., Ross, N., Kaplan, G. & Wolfson, M. (2004), 'Is income inequality a determinant of population health? Part 1. A systematic review', *Milbank Quarterly* **82**(1), 5–99.

Mackenbach, J. P., Stirbu, I., Roskam, A.-J. R., Schaap, M. M., Menvielle, G., Leinsalu, M., Kunst, A. E. & European Union Working Group on Socioeconomic Inequalities in Health (2008), 'Socioeconomic inequalities in health in 22 european countries', *The New England Journal of Medicine* **358**(23), 2468–81.

Masseria, C., Hernandez-Quevedo, C. & Allin, S. (2010), 'Health inequality: what does it mean and how can we measure it?', *Expert Review of Pharmaeconomics & Outcomes Research* **10**(2), 177–186.

Muurinen, J. M. (1982), 'Demand for health: a generalised grossman model', *Journal of Health Economics* **1**(1), 5–28.

NBHW (2012), *Modell för kunskapsstyrning av överbeläggningar och utlokalisering av patienter - Slutrapport*, Östersund and Stockholm. [Model for Knowledge Management of Overcrowding and Relocation of Patients - Final Report, in Swedish].

Patrick, D. L., Stein, J., Porta, M., Porter, C. Q. & Rickets, T. C. (1988), 'Poverty, Health-Services, and Health-Status in Rural America', *Milbank Quarterly* **66**(1), 105–136.

Phillips, A. & Smallwood, L. (2010), 'Hospital beds and the quality of a national health system', *Australian Journal of Rural Health* **18**(3), 93–95.

SAL (2010), *Hälso- och sjukvården ur olika perspektiv*, 1 edn. [The Health Care from Different Perspectives, in Swedish].

SCB (2009), Landstingens ekonomi och verksamhet, *in* 'Offentlig ekonomi 2009', Örebro, chapter 9. [The County Councils' Finances and Operations, in Public Finances in Sweden 2009, in Swedish].

van de Ven, W. P. & van der Gaag, J. (1982), 'Health as an unobservable: A mimic-model of demand for health care', *Journal of Health Economics* **1**, 157 – 183.

van Doorslaer, E. K. A. (1987), *Health, knowledge and the demand for medical care: an econometric analysis*, Van Gorcum, Assen.

van Vliet, R. C. & van Praag, B. M. (1987), 'Health status estimation on the basis of mimic-health care models', *Journal of Health Economics* **6**(1), 27–42.

Wagstaff, A. (1986), 'The demand for health: Some new empirical evidence', *Journal of Health Economics* **5**(3), 195–233.

Wagstaff, A. (1993), 'The demand for health: an empirical reformulation of the grossman model', *Journal of Health Economics* **2**(2), 189–98.

Appendix

Table A1: Omitted paths.

To variable From Variable	MI	*df*	$P > MI$	EPC	*Standardized* EPC
Occupancy rate (HD)					
Bad self-rated health	4.491	1	0.03	-1.440917	-0.1668459
Smoker	13.100	1	0.00	-1.171285	-0.2609347
Alcohol	16.891	1	0.00	1.433966	0.2707941
Health indicators (HI)					
Life expectancy at birth	16.624	1	0.00	0.185004	-1.280622
Bad self-rated health	19.596	1	0.00	0.0173419	-0.4543387
Long-standing disease	6.721	1	0.01	0.0269495	-0.80711823
Average length of hospital admission	35.869	1	0.00	0.0137379	-0.3668571

Table A1 reports paths suggested by STATA to increase the goodness-of-fit χ^2. The approximate change in χ^2 from a suggested path is displayed by MI. Df presents the additional degrees of freedom that would be added. $P > MI$, thus, is the significance of $\chi^2(df)$. Lastly, EPC and $standardized EPC$ exhibit the expected parameter change in unstandardized and standardized terms, respectively.

Above all, the test suggests a path from average length of hospital admission to H^*. This actually makes some sense, since long admissions could derive from an unhealthy population. Such a path would make the model appear somewhat fragmented, but this and similar connections could be something to explore in further studies. The variables from HI also seem to have a clear connection to occupancy rate and health. But this is quite self-evident and not of any practical value. Alcohol consumption and smoking would not have been a hard guess either, but since these are indicators for H^*, the suggested paths would not be appropriate.