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Ownership and technical efficiency of Israel hospitals

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ABSTRACT: *The purpose of this article is to present the conception of my thesis. The thesis addresses very important topic such as the efficiency issue. The growing trends of health care costs have forced governments and health care policy makers to become more concerned with health care productivity, efficiency, causes all over the worlds. Thus, the thesis is going to be focused on the aspect of efficiency of hospitals in Israel in the both theoretical aspect as well as empirical analysis. The reason of focusing on the hospital sector is that it consumes the considerable share of total healthcare expenditures. In purpose to measure the efficiency and productivity, Data Enveloped Analysis (DEA) and the Malmquist Productivity Index (MPI) will be used. The main implications which can be derived from the thesis should give the directions for the health care policy makers in Israel in reforming health care system to eliminate inefficiencies in hospitals and to decrease healthcarecosts.*

KEY WORDS:*technical efficiency, ownership type, DEA, MPI, healthcare system in Israel.*

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I. IMPORTANCE AND JUSTIFICATION OF THE RESEARCHTOPIC

1.1 Technical efficiency ofhospitals.

As the hospital sector is large consumer of scarce health care resources, it is of particular relevance to use these scarce resources as effectively and efficiently as possible. The problem of rational resources using in health care sector – aiming at achieving maximizing effects of hospital activity – is very important economic problem, what implies from such facts as: the medical technologies becoming highly capital - absorbing the limited resources especially public funds, rising patients' expectation for high quality health care. So, they are arguments for hospitals to increase their technical efficiency and thus to foucus on the measearing technical efficiencyaswellasproductivity.Itcangiveanideaabouthowhospitalsareefficientandalsoin case to propose tools to improve theirefficiency.

However,themeasurementofefficiencyinthehealthcaresectoriscomplicatedbythenature of the production process. In the relevant literature, the concept of technical efficiency is generally assumed as the one of components of economic efficiency. The concept of technical efficiency can be defined as the capacity and willingness of a hospital to produce the maximum possible output from a given bundle of inputs and a technology or to produce the assumed level of output using the minimum possible bundle ofinputs.

Nevertheless measuring technical efficiency is important because - as M.J. Farrell (1957)
pointed out - it allows to determinate for example whether simply raising efficiency, without needing to increase input quantities, can increase outputs. It means that it allows recognizing that a gap exists between the theoretical assumption of full technical efficiency and empirical reality.

1.2 Ownership ofhospitals.

In the literature, the agency theory assumes that private for-profit hospitals are better able to address this dilemma and are thus more likely to achieve greater efficiency. For example, the owners of this type of hospital may use profits as their measure of a manager's success and can limit divergences from their interest by making the manager's compensation a positive function of these profits. The income of physicians in private for-profit hospitals can also be tied to a hospital's financial performance. Within public and private non-profit hospitals, the income of individual decision makers is rarely tied to a hospital's performance, creating little incentive to enforce efficient behavior.

There are a couple of studies focusing on the impact of ownership on thehospital efficiency. For example, studies of Staat and Hammerschmidt (2000) were the first to employ DEA to determine the impact of ownership on hospital efficiency (i.e., technical efficiency) in Germany, based on data of 160 hospitals in 1994. To ensure their comparability hospitals were chosen with respect to the number and type of departments (i.e., in terms of size and clusters based on the international classification of diseases (ICD)). The authors compared the mean DEA efficiency scores by ownership type and found that private non-profit hospitals were, on the average, substantially less efficient than their public and private for-profit counterparts. They also found comparably small differences in terms of efficiency between public and for-profit hospitals, with an advantage towards the latter. Then, Staat (2006) applied a refined DEA approach to the same sample of 160 hospitals for the year 1994

and found nosignificant efficiency (i.e., technical efficiency) differences associated with ownership. However, another research of Helmig and Lapsley (2001) showed for 1991 to 1996 that public and non-profit hospitals in Germany appeared to use relatively fewer resources than private for-profit hospitals. They found no significant efficiency differences between public and private non-profit hospitals in theirsample.

Then, Werblow and Robra (2006) compared the mean DEA efficiency scores of ownership types for 2004 (the first year under DRGs) in Germany and their results indicate that publichospitals performed less efficient (i.e., technically efficient) than their private for-profit and non- profit counterparts. Private for-profit hospitals in their sample operated on a slightly higher level of efficiency than private non-profit hospitals.

Daidone and D'Amico (2009) conducted the fourth study that was based on a subregion in Italy (i.e., Lazio Region) and their results indicated that inefficiency was highest for private for-profit hospitals and lowest for public hospitals, with private non-profit hospitals being in between.

In the context of US market, also some research can be identify. In the hospital sector of the United States (U.S.) all three different types of ownership have co-existed for decades and numerous studies have investigated whether private non-profit, private for-profit and public hospitals differ in terms of efficiency, or other measures of hospital performance. According to Tieman, Schreyogg and Busse study (2012) identified 11 studies in the context of US market in the period 1987 – 2005. However, three of them had the explicit objective of estimating the impact of hospital ownership on efficiency, while the other eight studies merely included ownership as a control variable and primarily explored the impact of market factors (e.g., competition) and other determinants of hospital performance (e.g., managerial issues) or compared statistical methods. Furthermore, eight studies that have a large nation-wide sample (between 382 and 4075 hospitals), while three studies are focused on subregions with comparablesmallsamples(between108and360hospitals).ThreestudiesthatanalyzeasingleU.S. state (i.e., Florida) or a limited number of U.S. states (i.e., Arkansas, Louisiana, Oklahoma, Texas) – none of which focuses explicitly on ownership – all found private for-profit hospitals to be more efficient than private non-profit hospitals. In addition, two studies indicated that private for- profit hospitals also operate more efficiently than their public counterparts, while the other study observed the opposite. Out of these three studies, the two conducted in Florida found public hospitals to be more efficient than private non-profit hospitals. In addition, five out of eight nation-wide studies showed private for-profit hospitals to be less efficient than their public and private non-profit counterparts. Among these eight studies, four studies found that private non-profit hospitals operate more efficiently than their public counterparts, while three studies observed the opposite. To sum up, these interantional studies indicates that in contrast to the arguments put forward by authors in the field of agency theory and property rights theory, aswell as public choice theory and against the oftenassumed behavior by policy makers, there is no clear evidence that private hospital ownership (i.e., non-profit and for-profit) is associated with higher efficiency compared to public hospital ownership (Tieman, Schreyogg&Busse,2012).

1.3 Hospitals payment system inIsrael.

Until mid-1990s, outside the public health arena, Israel did not have a well-developed culture of government regulation in the health sector. Instead, the government relied primarily on budgetary controls, offers of subsidies and moral and political suasion to influence nongovernmental providers. Since the introduction of NHI and the Patients' Rights Act in the mid-1990s, the Ministry of Health has developed new capabilities and launched many new initiatives in the regulatory field.

In terms of hospitals, the government regulates hospital licensure and oversees the authorization process for opening a new hospital or department. Furthermore, the number of hospital beds is regulated, along with their distribution in terms of ownership, specialty and location, as are major capital expenditures, such as the acquisition of magnetic resonance imaging (MRI) scanners and other expensive equipment. In Israel, monitoring of nonmedical components of quality takes place through a system of inspections and other types of reviews. There is talk of also developing measures for the medical components of quality in the coming years.

Regulations as well as paying system are important tools of government in influencing the behaviour of hospitals in required directions. So, since the enactment of the National Health Insurance (NHI) Law in 1995, public hospitals in Israel are reimbursed for inpatient care primarily by per diem fees and secondarily by case payments. Ambulatory care in hospitals is paid on a fee-for-service (FFS) basis. Maximum price lists for public and non-profit-making hospitals are mandated by law and set by the government through a joint Ministry of Health and Ministry of Finance Pricing Committee. Government hospitals are subsidized by the government retrospectively.

Until 2010, Ministry of Health price lists were not based on a methodical costing process. Per diem and FFS rates were set about three decades earlier based on the historical expenditure of certain hospitals. Since then, rates had been updated for inflation, but no major recalculations wereundertakendespitesignificantchangesincoststructurefromtechnicalandmedical advances. Consequently, some activities were under paid and others overpaid. The gaps between costs and prices create a series of

inefficiencies caused by the influence of economic considerations on medical decisions.

In order to tackle these inefficiencies, the Ministry of Health concluded that it was important to narrow the gap between costs and prices through two changes: building a consistent costing and pricing mechanism and substituting the per diem payments with payments based on activity. The Ministry of Health thus initiated a hospital payment reform (the Procedure Related Groups (PRG) reform), which consisted of gradually costing hospital activities and setting differential pricing for inpatient care per procedure. Once the price for a specific procedure has been set, the per diem payment is replaced by the PRG. This process has been an ongoing incremental reform that started in 2002 and has been enhanced since 2010 by the Ministry of Health. In 2015, there were over 280 PRGs, which account for half of the procedures. The plan is to adjust the PRG for case mix and severity of illness in the future (Brammli-Greenberg et al., in press).

However, a significant proportion of a hospital's expenditure is fixed and does not vary according to the volume of hospital activity. The purpose of capping system's has been to eliminate incentives for hospitals to overprovide inpatient care, and to constrain growth in expenditure, particularly that related to hospital services. The prices that health planes (HP's)- an individual or group that provides or pays the costs of medical care of the public health services- pay for services purchased from hospitals reflect "average prices", which include fixed costs and are, therefore, higher than the marginal cost of the service purchased. A payment scheme that relied solely on these average prices would have created incentives for hospitals to increase volume (either hospitalization days or procedures), which would have led to increases in HP expenditure on hospitalization services, increases in public expenditure on health, and might even have led to moral hazard. In order to remove this incentive, a hospital revenue cap was established in 1997, and the rules of the capping regime are modified every three years. The capping system's goal has been to eliminate incentives for hospitals to overprovide inpatient care, and to constrain growth in expenditure, particularly that related to hospitalservices.

A revenue cap is set by the government for each hospital vis-à-vis each HP; since 2014, this is not published publicly. It is a function of the previous year's HP's consumption in each hospital plus an adjustment to reflect projected demographic growth, hospital bed growth, and price change (in particular, the Ministry of Health's PRG price list and per diem rates).

The model set in 2013 for the years 2014–2016 is innovative in relation to previous ones in that it sets a minimum for the total amount that each HP will pay each hospital each year (95% of the previous year's consumption by the HP). This is done to financially protect the hospitals. In addition, the current capping system has three steps, each with different payment rates and incentives. HPs that purchase services beyond the cap pay the cap plus a percentage of the price of those services purchased beyond thecap.

HPs and hospitals also are allowed to negotiate alternative reimbursement contracts, which, if both sides agree, can take the place of the official cap. This is intended to allow greater flexibility and risk sharing among players. Since the early 2000s, HPs have set individual arrangements with more than 80% of hospitals, in which the hospitals provided bigger discounts than the capping mechanism. The individual contracts provide discounts that vary among HPs and among hospitals.

By virtue of its role as the owner of the government hospitals, the Ministry of Health reviews and approves all contracts with the government hospitals. Until recently, the Ministry did not play a significant regulatory role in determining the nature of contracts signed by other hospitals. It was felt that this would not be appropriate, since the Ministry, as the owner of its own hospitals, is also competing with those other hospitals. However, in recent years, the Ministry of Health has been more active in thisregard.

Despite the reimbursement mechanisms, the Ministry of Health subsidizes retrospectively almost all public hospitals. Subsides have more than doubled in the last decade (from around €75 million in 2006 to €170 million in 2012) (Ministry of Health, 2014c). Nevertheless, both public and non-profit-making hospitals have faced growing deficits in recent years. The extreme case of this was the near-bankruptcy of the private non-profit-making Hadassah Medical Center in 2014. The hospital did not break-up because the Ministry of Health provided massive financial aid and increased the cap ceiling[1].

II. OBJECTIVE AND SCOPE OF PHD THESIS THE MAIN OBJECTIVES OF THE THESISARE:

[1]http://www.euro.who.int/en/home/projects/observatory/publications/health-system-hits/full-li-st-of-hits/israel-hit-2009

a) to measure the technical efficiency of hospitals inIsrael;
b) to measure the productivity of hospitals inIsrael;
c) to identify the influence of technical change and technology change on thetechnical efficiency of hospitals inIsrael;
d) to assess the effect of ownership on the technical efficiency of hospitals inIsrael;
e) to analyse the payment system for hospital activity as a tool to motivate hospitals to act moreefficiently;

In Israel, The MoH has overall responsibility for the health of the Israeli population and the effective functioning of the health system. In addition to its role as regulator, supervisor, planner, and policymaker, the MoH also owns and operates hospitals. Of the 45 general hospitals in Israel, 18 are publicly owned and account for 57% of Israel's acute-care hospital beds. Another 16 general hospitals (40% of bed) operated by non- profit organizations. The remaining 11 are for-profit hospitals, which are smaller and operate 3% of the beds. Thus, public hospitals account for approximately 97% of the acute beds and 92% of acute admissions (MoH, 2012b). It is important to note that the two largest Health Plans own general hospitals: Clalit operates eight general nonprofit hospitals (31% of acute beds) whereas Maccabi operates three for-profit hospitals MoH, 2012b).
Thus this research will cover 18 governmental hospitals and 16 non-profit hospitals in Israel between the years 2010-2016, and this is a large sample that includes all the governmental and non-profit hospitals in Israel.

III.METHODOLOGY – DATA ANDMETHODS

I will collect the relevant data directly from the hospitals in Israel in excel files, and the following variables will be collected from hospitals as; the number of beds, number of doctors (equivalent of the full time emploied), number of nurses (equivalent of the full time emploied), expenditures (medical and others), and number of non-medical staff (equivalent of the full time emploied) will be used as the input variables, and number of discharges will be used as output variables.

The technical efficiency of the hospitals in Israel will be measured by using **Data envelopment analysis (DEA)** and then prodictivity by using **Malmquist Index**. Additionally, Probit model will be used to estimate the impact of ownership on hospital efficiency. In purpose to verify the importance of payment system the correlation method will be use as well.

Data Enveloped Analysis (DEA), a widely used non-parametric approach will be used to measure technical efficiency of hospitals in Israel. DEA is a generalization of the nonparametric method of productivity measurement as Charnes et al (1978) generalized the M.J. Farrell (1957) method in terms of vector outputs.
Their proposed measure of the efficiency of any hospital is obtained as the maximum of a ratio of weighted outputs to weighted inputs subject to the conditions that the similar ratios for every hospital be less than or equal to unity. And it is expressed by the following formula Charneset al (1978):

$$\text{Max } h_0 = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}} \qquad (1)$$

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \le 1;$$

subject to: j = 1, ..., n. (2)

$u_r, v_i \ge 0$; r = 1, ...,s; i =1,....., m.

Where: y_{rj} -number of output r from hospital j;
x_{ij} -number of input i from hospital j;
u_r, v_i - the weights proposed by the solution of the above formula;
All y_{rj}, x_{ij}(assumed that all positive) are the known outputs and inputs of the j-thhospital and $u_r, v_i \ge 0$ are the variable weights to be determined by the solution of this problem – by the data on all of the hospitals which are being used as a reference set.

The DEA approach constructs the best practice production frontier as a piece wised linear envelopment of the available data on all hospitals in such a manner that all observed points lie on or below the frontier (Chakraborty et al 2001). DEA measure of efficiency is based on a virtual efficient hospital, constructed as a weighted average of real efficient hospital, which is used as a unit of comparison for other hospitals. The virtual producer does not necessarily exist, but is imputed from a linear combination of the inputs and outputs of one or more efficient producers.

In mathematical programming terms this ratio is the objective function to be maximized where the u and v are output and input weights respectively. In addition there are a set of constraints one for each hospital, which reflect the condition that the ratio of virtual output to virtual input must be less than or equal to one for all observed hospital. Solving the linear programming problem the efficient or virtual production is obtained for each hospital and the efficiency index. If the corresponding virtual hospital does better than the real hospital by servicing more output with the same level of inputs or the same output with fewer inputs, then the real producer is inefficient. The procedure for finding the best virtual producer can be formulated as a programming problem

for each hospital. (Chun-Chu Liu2004).

In this technique, the performance of particular hospital is evaluated in terms of his ability to either reduce an input vector or expand an output vector subject to the restrictions imposed by the best-observed practice (Chakraborty et al 2001).

A major advantage of DEA is that it places no restriction on the functional form of the production relationship between inputs and outputs and can accommodate multiple inputs and multiple outputs simultaneously. One of the principal disadvantages is that DEA can be extremely sensitive to the selection of variables. DEA efficiency measures in small samples are sensitive to the difference between the number of hospital and the sum of inputs and outputs (Seiford 1996). DEA has been increasingly applied in economic studies of technical efficiency in public sector enterprises particularly, in the efficiency evaluation of non-profit organizations or governmental departments. And it is including health care where market price for output generally are not available. (Sengupta,1998).

The Malmquist Productivity Index was proposed by Caves et al (1982) and it measures total factor productivity (TFP) change between two data points in terms of ratios of distance functions. Following Fare et al (1994) output oriented Malmquist total factor productivity change between periods t and t + 1 defined as:

$$MI_0^{t,t+1}(y^t, x^t, y^{t+1}, x^{t+1}) = \left[\frac{D_0^t(y^{t+1}, x^{t+1})}{D_0^t(y^t, x^t)} \times \frac{D_0^t(y^{t+1,} x^{t+1})}{D_0^{t+1}(y^{t,} x^t)} \right]^{1/2} \quad (3)$$

where D_0 - distance functions
y - output
x - input
t - time period
MI_0 - hospital productivity

It means:

$$MI_o^{t,t+1} = \sqrt{\frac{D_o^{t+1}\left(x^{t+1}, y^{t+1}\right)}{D_o^t\left(x^t, y^t\right)} \frac{D_o^t\left(x^{t+1}, y^{t+1}\right)}{D_o^{t+1}\left(x^t, y^t\right)}}. \quad (4)$$

The form of the Malmquist Productivity Index defined above is the square root of the product of two indices which both assess the productivity change by calculating a ratio of distance functions based on the same technology for two input-output bundles of two consecutive periods. In case the bundle of the second period is rated with a lower distance than the bundle of the first period we have an index below unity, which indicates productivity decline. Consequently,avaluegreaterthanunityimpliesimprovingproductivity. Takingtheratioofthe two indices gives a Malmquist index as the average of two indices based on the technologies of two periods (Pilyavsky and Staat 2004).

Fare et al (1994) further decomposed the MPI into two parts: one measuring efficiency change and another measuring technological change, which allows to recognize which of them influence the efficiency the most and how.

IV. CONSTRUCTION AND CONTENT OF PHDTHESIS

In the first chapter, the definition of health and healthcare, the methods of healthcare financing and the healthcare financing models are going to be presented. In the second chapter, the efficiency and then also productivity and their measurement in health care system will be showed. In the third chapter, the healthcare system in Israel and specially the hospitals sector in Israel will be presented as well as the detailed analysis of the payment system for hospital activity. Moreover the result of empirical research will be presented and discussed.

V. EXPECTED RESULTS AND CONTRIBUTION TORESEARCH

The results will give a slight light on the technical efficiency and productivity changes in Israel hospitals. The research are expected to allow to find out whether there is improvement in technical efficiency during analyzed period of time. And what is the most important, it will allow to identify whether there is the difference between technical efficiency among different ownership form of hospitals – it means whether ownership influences the technical efficiency of hospitals. Apart from it, it will be also possible to identify what factor influence the technical efficiency the most – whether technical change or technology change. This results also underline the importance of leading such research i.e. the measuring technical efficiency and the role of

ownership for the technical efficiency and productivity In Israel. It would be one of the first research where DEA and the productivity index is employed for measuring hospitals technical efficiency in Israel.

The results of this research will help the healthcare policy makers to define the most efficient hospitals and the less efficient hospitals in Israel. It would be the base to eliminate inefficiencies in hospitals and to decrease healthcare costs in the hospitals sector in Israel. Moreover, these research will provide a kind of verification of new payment system in Israel from the perspective of efficiency and according to type of ownership. Thus, it would be possible to formulate some indication how it payment system could be improvement to increase the efficiency of hospitals taking into account the type of their ownership.

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