CORPORATISATION AND THE PERFORMANCE OF HOSPITALS IN THE KINGDOM OF SAUDI ARABIA

A Panel Study, 1979-2014

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ABSTRACT

This thesis analyses whether the movement towards privatisation (through various phases of corporatisation, changes in management and operation) has been associated with an improvement in the performance (efficiency, effectiveness, and quality) of the Ministry of Health (MoH) public hospitals in the Kingdom of Saudi Arabia (KSA), 1979 to 2014. The study argues that changes in management and operational framework, in different corporatisation phases, would be associated with the performance of hospitals. Accordingly, the study tests whether the alleged theoretical benefits of corporatisation identified in the literature were reflected in the data gathered. Research questions are addressed by developing deductively and testing hypotheses via econometric models. The data identifies which KSA hospital management/corporatisation phase is generally more efficient, and which provides the best overall performance indicators across the study period. The econometric methods employed are Data Envelope Analysis, Stochastic Frontier Analysis, Panel Data analysis, and Least Squares Regression Analysis. The findings suggest that, taking into account the efficiency, effectiveness, and quality aspects of hospital performance, fully corporatised hospitals (on average) achieve relatively better overall performance. However large hospital efficiencies may be inapplicable to small rural hospitals and each hospital should be considered on a case-by-case basis in additional to being part of an overall programme at the national level. Despite this caveat, broad recommendations are proposed which may help to increase the performance of hospitals in the KSA.

DEDICATION

To the soul of my father and my mother, for their endless Love, Support & Encouragement

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LIST OF ABBREVIATIONS

AE	Allocative Efficiency
AHRQ	Agency for HC Research and Quality
CBAHI	Central Board of Accreditation for HC Institute
DEA	Data Envelope Analysis
FE	Fixed Effect
HC	Healthcare
IOM	Institute of Medication
ISO	International Standards Office
KSA	Kingdom of Saudi Arabia
MOH	Ministry of Health
MR	Mortality Rate
OECD	Organisation for Economic Cooperation and Development
OLS	Ordinary Least Squares Analysis
PE	Productive Efficiency
RE	Random Effect
SCP	Structure-Conduct-Performance
SFA	Stochastic Frontier Analysis
SOEs	State-owned enterprises
WHO	World Health Organisation

CHAPTER 1

Introduction

1.1 Purpose and Structure of Chapter

The objective of this study is to analyse whether the movement towards privatisation (through various phases of corporatisation, changes in management and operation) has been associated with an improvement in the performance (efficiency, effectiveness, and quality) of the Ministry of Health (MoH) public hospitals in the Kingdom of Saudi Arabia (KSA), 1979 to 2014. This investigation may provide the framework for the analysis of subsequent efforts by the KSA to go beyond corporatisation to privatisation, since corporatisation is an intermediate phase of movement towards privatisation, sharing all of the characteristics of privatisation, apart from private ownership. There is no theory of corporatisation as such, and this is a gap that this thesis addresses. It is therefore argued that the theoretical and empirical literatures on the effectiveness (or otherwise) of privatisation are relevant to the research questions posed here. Corporatisation (including hospitals) has been found in the National Transformation Program 2020 (NTP) & Vision (2030), to encourage investment in the private sector, and thus, arguably, productivity.

This introductory chapter starts with the form and function of hospitals. Particular attention is paid to providing an understanding of the general background to the thesis, including overviews of the structure of the KSA government, and the healthcare (HC) sector (sections 1.3, 1.3.1, and 1.3.2). In addition, an overview of the economic performance of the KSA is provided and its potential implications on demand for HC provision in the Kingdom (section 1.3.3). Section 1.4, represents an overview of the corporatisation reforms that represent movement towards privatisation within MoH

hospitals in KSA in recent decades, specifically 1979 to 2014. The chapter is concluded with research questions which proposed in the summary of this chapter (section 1.5).

1.2 Form and Function of Hospitals

Generally, a hospital provides a variety of medical services for those that require them but in specific cases it may focus on one particular specialism. Whatever the breadth of form and function, a hospital is supportive of three main groups of stakeholders. Firstly, it has an obligation to its patients. This is achieved by making available suitable patient accommodations, catering for particular dietary needs, in addition to providing access to spaces for receiving both short and longer-term treatments. A hospital provides patient access to the health benefits facilitated by the medical, surgical and technological equipment held within the hospital through controlled access to medically trained service providers.

Secondly, there are the providers of medical and administrative services and equipment (for example clinical and non-clinical practitioners who provide treatments, therapies, technical and administrative support, companies that provide technologies for surgical procedures, pharmacies and pharmaceutical suppliers, catering and facility maintenance companies, office and IT equipment suppliers, etc.) that need to be considered and accommodated. The hospital often provides a place for continuous 24-hour access to patients/users of the service offerings and technologies being offered.

The hospital may also be a formal place of medical practice and affords the providers with the infrastructure and conditions needed to carry out procedures and treatments on the patients that are within the scope of the services offered by the hospital. In some cases, the providers of medical services are also supported by advances in research and medical science, where the hospital also acts as a teaching and research

institution. The services provided by (and within) the hospital infrastructure, should comply as far as possible with ideal conditions, as determined by the overarching health strategy, national and international standards.

Thirdly, governmental and public bodies may also have a vested interest in the hospital as a consolidated operation, through the interactions between service user (patient) and organisation (HC provider). The performance of these interactions results in health and wellbeing outcomes for the nation and services must be available and ready to serve their community in times of peace, epidemic, or disaster.

Hospitals are often an integral part of the wider HC system of a nation and cannot be considered in isolation. The health outcomes that are delivered through the operation of the hospital are a key factor that impacts on the overall economic and demographic growth and stability of the nation concerned. Conversely, the nation's demographic, epidemiological, economic and governmental context will also shape the provision of HC across a nation introducing a cyclic relationship with a hospital's form, function, operating model and overall performance expectations.

1.3 Environmental Context

The purpose of this section is to present a contextual account of the KSA's national environment, i.e., all the environmental factors and changes that may influence hospital performance for all stakeholders, as it is stated by the MoH that the "health care system is different from one country to another, depending on their development and economic conditions, demographic and geographic characteristics, information and communication potentialities." (Ministry of Health, 2010, p.121).

1.3.1 Origins and Structure

The modern KSA state was established in 1932 by King Abdul-Aziz bin Abdurrahman Al-Saud. Historically, the roots of the country can be traced back many centuries to its Bedouin origins, but the pace of change has accelerated over recent decades, transforming a desert nation into one of the fastest growing countries in the world. There are several views on the structure of the KSA, but Viola (1986) seems to provide the best description that encapsulates the spirit of the nation. According to Viola (1986, p.xxiv) "Saudi Arabia is a unique blend of religious law and tribal custom held together by a royal family, with strong roots in both religious and tribal history". This ethos and how this relates to the administrative processes of the government is an important factor that may be associated with the county's HC provision (positively or negatively).

Looking back, the development of administration processes in the KSA can be divided into three stages starting with the creation of the kingdom between 1902 to 1953, moving on to the building of the central administration between 1953 to 1969, and the on-going administrative developments from 1970 to the present, with a desire for a more regionally-based structure as indicated in the current development plan. Whilst the early stages are of historical interest, the last stage is more relevant to current hospital performance, as the rate of change accelerated in response to the demands of both internal needs and international commerce.

Today, there are approximately one million employees supporting the governmental administration of the country, including the Civil Service, health, education, and law employees. The management and control of such a large organisation is a major challenge in ensuring that performance and efficiencies within the structure are maintained. According to McKinsey report (2015), Saudi Arabian economic

transformation relies heavily on a bigger private sector involvement in achieving faster economic growth and in maintaining the well being of society. The increasing size and associated bureaucracy of the public sector has been regarded as a negative phenomenon. Furthermore, specific to the MoH, there is a perceived resistance by some employees to changing existing processes which depend on 'paper work and long routine procedures' to a paperless environment (Ministry of Health, 2010). The ability to negotiate these new ways of working to increase productivity and performance is a challenge facing the MoH today.

The remaining part of this section provides an outline of the major bodies of control for public services within the KSA, which influence both the inputs and outputs of the health system.

(i) ***Head of State.*** The modern KSA is ruled by the family of Al-Saud, with the King of KSA as its sovereign monarch. In 1992, by royal decree (King Fahd) introduced three major laws (The Consultative Council Law, the Regional Law, and the Basic System of Governance). These laws altered the domestic political environment with the 'Basic Law for the System of Government', identifying the KSA as an Arab and Islamic state, with Islam as its religion and the Qur'an as its constitution. Furthermore, the King is the ultimate authority over all state authorities, including the legislative authority, which consists of two bodies, the Shura Council and the Council of Ministers.

(ii) ***The Shura Council.*** This Consultative Council sits within the framework of The Consultative Council Law and currently consists of 150 members. The Shura Council includes of 13 sub-committees, the Committee on Health and Environmental Affairs is one of them. In general, the purpose of this Council is to consider and debate suggestions submitted by the Council of Ministers, in line with Islamic law and the principles held within the Qur'an from which it is derived. The government of KSA often issues rules

and regulations with the objective of supplementing Islamic law when it is needed (Shura Council, 2015). However, in case of conflict between the governmental regulations and Islamic law, Islamic law dominates. The Committee on Health and Environmental Affairs specialises in studying issues related to health and environmental affairs, including public health, hospitals and HC centres, medicines, health awareness, etc. Muslims believe that illness is a test from God, so often accompanied by meditation, patience, and prayers. According to Prophet Mohammed, upholding a healthy body is an individual's duty, thus Muslims are urged to seek treatment where it is needed. Islam considers people's health as a collective social responsibility, where the supreme objective of Islamic law is to protect people's life and caring about sick people especially vulnerable group[1].

(iii) ***Council of Ministers.*** The purpose of the Council of Ministers is to concurrently undertake both legislative and executive functions. It shares the legislative function with the King and the Shura Council. Ministers have the right to propose draft laws or regulations related to the internal, external, economic, financial, and general affairs of the country. There are 24 government ministries of which the MoH is one.

(iv) ***Agencies.*** Aligned with the Ministries are independent and quasi-independent administrative agencies that have been created to deal with social, economic, and administrative challenges. These agencies differ extensively in their function, structure and power, each of which is defined by the agency's establishing decree. They can be classified as: economic, educational training and consulting investment and financial and social welfare agencies (for example the Pension Services Agency, the Saudi Red Crescent, and the Social Security Administration).

(v) ***Regional and Local Government.*** At a regional and local government level the Provincial Council Systems (framed within the Regional Law) divides the Kingdom into

[1] https://www.cairchicago.org/s/CAIR-Healthcare-Provider-Guide.pdf

13 provinces (regions) each with a major city where the governmental offices (Emirates) sit. Each region has a Regional Governor who is responsible to the Minister of the Interior.

(vi) ***MoH.*** The organisational structure of the MoH is currently constituted by a Deputy Ministry of Executive Affairs and a Deputy Ministry of Planning and Development, under which several specialisms fall, such as therapeutic medicine, preventive medicine, development of workforce, planning, research, laboratories, blood banks, information technology, quality assurance, organising the provision of health services as well as supervising health utilities provided through the private sector and others (Ministry of Health, 2017a). The MoH is represented through thirteen general and seven specialised directorates of health affairs, which are distributed amongst key administrative areas of the Kingdom. The MoH provides services of primary care through a wide network of primary HC centres distributed throughout the country. Additionally, it provides specialised care at all levels through its public hospitals, specialty hospitals, and medical cities (Ministry of Health, 2017a).

Currently, the MoH is solely responsible for providing approximately 60 per cent of the country's health services, including more than 274 hospitals with a capacity that exceeds 41,985 beds, in addition to 2,361 centres for primary HC. Furthermore, the MoH is responsible for granting the necessary licenses and regulation for more than 2,000 dispensaries and clinics, 158 private hospitals and 8,720 pharmacies in the private sector (Ministry of Health, 2017b). The MoH also cooperates with and coordinates other governmental entities such as the HC Services Board, the Health Insurance Board and the Saudi Food and Drug Authority to monitor the latest medical advances and develop laws governing these areas (Al-Ateeq, 2002).

Other governmental health entities which are "managed according to the concepts of public administration and not for profit" (Al-Ateeq, 2002, p.1) include the following:

- Armed Forces Medical Services;
- Medical Services of the Ministry of Interior;
- National Guards Health Affairs;
- University Hospitals;
- King Faisal Specialty Hospital in Riyadh and Jeddah;
- Hospitals of Royal Authority of Jubail and Yanbu;
- Hospitals of ARAMCO Saudi Company; and
- Health Utilities of the Ministry of Education and Ministry of Social Affairs.

These agencies are organisationally independent of the MoH in that they have their own budgetary allocations, supervise their health facilities' administration, and recruit their medical personnel.

Although the scope of this thesis is focused on examining the efficiencies and performance of MoH public hospitals, there are many external institutions that may impact on this. By considering the overall administrative structure, it is obvious that the MoH's administrative and financial procedures are closely connected with many other governmental entities. For example, budgetary responsibility for health services is shared between the MoH and the Ministry of Finance and may be dependent on the Ministry of the Civil Service for the recruitment of human resources (Ministry of Health, 2010). This complexity of command and inherent bureaucracy may have a potentially limiting effect on improving performance, through the capability to accelerate or initiate new procedures also depend on areas outside of the MoH's authority.

1.3.2 Topology and Demographics

Appendix 1.A presents a map of the KSA showing the regions. The KSA is the largest state in the Middle East, covering approximately 850,000 square miles and

occupying the majority of the Arabian Peninsula. The terrain on the whole is not habitable and is almost entirely arid desert with mountain ranges to the west, although serious flooding and monsoon rains in some areas can be expected. The size of the KSA is a major challenge when providing equitable and high-quality service performance to all health service users.

Additionally, rural-urban migration has been an essential feature of the Saudi population, as currently there is a major population concentration in the main big cities such as Dhahran, Madinah, Riyadh, and Jeddah. This concentration of population in urban areas has highlighted the need for additional capacity and capabilities to support the increasing number of residents in major towns and cities to maintain timely access to health services without degradation of health service performance. Conversely many villages and towns are located in remote areas of the Kingdom and longer-term statistics suggest increasing populations as the rural-urban migration trend reverses.

The key issue here seems to be the lack of a suitable environment (e.g., schools and entertainment) to attract qualified medical staff (either national or contracting) to work in remote and rural areas. Indeed, a shortage of health workforce outside the urban areas is a global phenomenon[2]. The high turnover of rural health workers has significant direct and indirect impacts on rural health services and community health outcomes (Cosgrave, *et al*., 2019), and obviously impacts on the quality of treatments and medical performance for all citizens, irrespective of their location (Ministry of Health, 2013). It is worth noting that a high percentage of medical staff are non-Saudi nationals employed under out-sourced and contracted agreements which may impact on the cost performance of those services which need to attract non-resident qualified staff. The number of foreign

[2] Florida (2002) has mentioned the features of regions and cities that satisfy the consumption tastes of creative class experts and professionals through the provision of certain leisure facilities.

nationals working in the Kingdom, the strain of the fast-growing population, in addition to more demanding and educated national patients is putting greater performance pressures on the largely state-funded Saudi Health system (Oxford Business Group, 2007).

Appendix 1.B shows key national economic indicators. The KSA has a total population of 32.6 million inhabitants (General Authority for Statistics, 2018) of which approximately 12 million are non-Saudi nationals. The population is projected to reach 45 million by 2025 (United Nations, 2017). During 1998 and 2008 the annual population growth rate in average was 2.5 per cent, mainly due to the decline in the mortality rate (MR) and the high fertility rate that has been achieved through the health provisions of the past (Ministry of Health, 2010). However, the latest figures for 2017 show that the population growth rate is increased by 2.52 per cent per annum (General Authority for Statistics, 2018), suggesting the need for an increased number of hospitals, beds, and medical staff currently and in the future. *Ceteris paribus* (i.e., holding constant income, cost of care, new treatments and technology, etc.), if additional facilities are not in line with this population growth, then the performance of the HC sector may decline. At the same time the costs of building new infrastructure and acquiring new staff may put additional pressure on the financial performance of the hospitals.

Reductions in MR and a growing population also reflect an ageing population that provides additional pressure for health service provision. Rising affluence is boosting life expectancy and resulting in a higher demand for HC. Analysts predict that the over-65 segment in the KSA will grow to over 2 million by 2020 (Oxford Business Group, 2007), which will result in an increased demand for HC services related to treatments of different ageing diseases (Ministry of Health, 2010).

Diseases associated with developed societies, such as diabetes, obesity, cardiovascular conditions, and cancers are already prevalent in the Kingdom. Albejaidi (2010) suggests these problems are blamed on attitudinal changes. Whatever the case, there is a perceived relationship between the cultural considerations of an international society, the growing demand for more sophisticated health treatments and the new types of treatments that the health system needs to accommodate due to diseases associated with lifestyles. All these developments will affect the performance of the hospital, if the incorrect services are provided for the demographic changes.

Religious tourism also has a large impact on the performance of the health service provision. In particular, Hajj and Umrah pilgrims cause a substantial influx and peaking of transient visitors to the KSA that needs to be supported by medical services. The MoH carries the responsibility of offering pilgrims without charge all the needed curative and preventive health services. For example, Hajj pilgrims arriving from outside KSA in 2014 were estimated at 1,389,053 individuals (Ministry of Health, 2015) focused on the holy city of Mecca over a 5-day period alone. With Hajj and Umrah pilgrims accounting for 9,036,898 individuals per annum, accounting 50.3 per cent of the total inbound tourism (Bokhari, 2018).

Visitors, raising the population level by an additional 50 per cent, obviously have an enormous impact on HC requirements. The mobilisation of over 25,000 health workers to support religious festivals to accommodate this large influx of visitors over short peak periods (for example Hajj's 5-day centres in the holy city of Mecca) needs appropriate capacities (beds, treatments and medical ambulatory services). In order to ensure high quality health services for pilgrims, the MoH has equipped 25 hospitals, and a further 173 permanent and seasonal health centres, distributed all over the holy places (Mecca, Mashaer areas, and Madinah) (Ministry of Health, 2016). These peaks of additional

service user demand mean that there is potential for under- (or over-) utilisation of resources over the year. This wide fluctuation of demand may affect the overall efficiency and performance potential of the system to accommodate these peak demands.

Peak demand problems have been analysed in a number of regulated/unregulated contexts, e.g., electricity supply and public transport provision. Responses can include peak load pricing or compensation for peak demand provision (Crew, *et al.,* 1995). However, in the case of health services in the KSA, the country is firmly committed to free health service provision for all pilgrims. This has significant consequences for the measured efficiency of health services in certain towns, a topic which is re-visited below in section 4.2.2, where it is explained that the number of pilgrims is a control variable.

1.3.3 Economy

The KSA is mostly an oil-driven economy and at a national level is sensitive to market forces. In 2018, oil accounts for more than 78.7 per cent of the country's exports and nearly 67.9 per cent of government revenues (SAMA, 2019). Where government expenditure (on health and other social services) is financed mostly through oil revenues, it is affected by oil price fluctuations. Therefore, fluctuations in global oil prices have prompted the diversification of the economy, and have been the focus of the country's economic and financial concerns within the KSA 5-year development plans, and recently, in the NTP 2020 and the latest long-term development plan (Vision 2030; Bokhari, 2017). These plans are the responsibility of the Ministry of Economy and Planning and provide professional social and economic development policy direction to the government and the public on as a whole. For example, during the implementation of the 6th Development Plan (Ministry of Planning, 1995) there were rapid changes in global economic

conditions, which created significant challenges for the national economy and influenced some key plan targets.

After three consecutive years of accelerating economic growth, in 1998, oil prices declined (by 38 per cent), resulting in an increase in the Saudi budget deficit by 9.6 per cent, and by 6.41 per cent in 1999, and these fluctuations affected the balance of payments and government budget (Ministry of Economy and Planning, 2000). Consequently, the government implemented several measures during 1999-2000, targeting reduced expenditures, increasing its non-oil revenues and other structural reforms to alleviate the impact of oil price fluctuations (Ministry of Economy and Planning, 2000). During the 7th development plan, in 2000, as a result of rapid growth of the oil sector, the budget deficit turned into surplus (of 3.5 per cent) and, GDP grew (from SAR 603.6 billion to SAR 714.9 billion) (Ministry of Economy and Planning, 2005). Oil prices continued to increase until 2014[3], but by mid-2014, global oil prices declined again, prompting a number of austerity measures, with a freeze on government spending in 2015, which remained for two years. By 2017, the KSA government focused again on limiting the impact of oil and commodity fluctuations through diversification, increasing private sector contributions to the economy (up to 65 per cent of GDP) and reductions in the Civil Service workforce (by 20 per cent). Although the private sector share of GDP rose (to 48.2 per cent) in 2017, the benefits of this growth need to be considered against future changes in the value of oil and in the wider petrochemical sector (Oxford Business Group, 2018).

The proportion of foreign workers in the country and local Saudi unemployment is another key challenge. For example, in the manufacturing sectors in 2017, 95.4 per cent

[3] Except for 2009, when oil prices fall sharply as a result of the global financial crisis. This decline reduced the country's revenues by 54 per cent.

of new jobs were filled by non-Saudis, although more generally this figure is around 60 per cent across all sectors. Labour costs vary between employing Saudi workers and those from overseas. Before the new regulations of 2017, foreign workers were favoured as they accept lower wages. Within the country's new strategies, however, fees on the dependents of foreign workers have been imposed. In 2016, the International Monetary Fund (IMF) noted that if the Saudi government wish to restrict the employment of foreign workers in certain sectors and to reduce unemployment among Saudis, higher fees or limits on visas may be helpful to narrow the salary gap between foreign and Saudi workers (International Monetary Fund, 2016). Applying increased visa fees led to a massive departure of foreigners. Yet, the labor market did not absorb the surplus of Saudi workforce by replacing the foreign labor force exiting the market, and the unemployment rate among Saudis rose from 11.6 per cent in 2016 to 12.7 per cent in 2018 (SAMA, 2019).

1.4 Reform movement towards privatisation within MoH hospitals in KSA

The KSA is a welfare state, in which its government is obliged to offer free HC services to all Saudis (Article 31 of the Saudi constitution), and the state is committed to a 'Health for All (HFA)' goal. The Saudi government aims to provide free medical care for all citizens, expatriates, and pilgrims (Al Otaibi, 2017).

Prior to the discovery of oil, Saudi society was traditional, isolated, and relatively poor. At that time, there was no regulated HC system, based for the most part on traditional practices and medicines. In 1926**,** the KSA under King Abdul-Aziz Al-Saud declared the establishment of a 'Health Department' (Mufti, 2000). This declaration denoted a milestone in the development of the KSA, arguably the beginning of the modernisation and emergence of an organised HC system. The complete transformation

of the KSA's health sector, in the real sense of the word, started in 1954, with the establishment of the MoH (Al-Mazrou, *et al.*, 1995), which is responsible for supervision of all HC facilities, in the public and private sectors.

Before 1979 all public hospitals followed what could be described as a 'Self-Operating System' in which all hospitals in the KSA were totally run and managed by the MoH. The responsibility and authority for the operating, managing, and hiring of hospital staff were under the control of the Civil Service. From 2000 to date, a rather different operating model applies, known as the 'New Public Self-Operating System', involving a lower degree of corporatisation by giving a bigger role to the MoH again. Corporatisation is similar to privatisation in all its features, with one notable exception that in corporatisation, assets remain state-owned (Klien, 2012). It is argued that corporatisation represents movement towards privatisation, and that much of the theoretical and empirical research on privatisation is to some extent relevant to the KSA HC sector. To understand how this change in the degree of corporatisation emerged, it is worth looking at reforms undertaken by the MoH, 1979-2014.

In 1978, the concept of primary HC was adopted as a means to achieve the HFA goal (Al-Ateeq, 2002) followed by Ministerial Resolution No. 50/1459/257 (issued in 1980). The Saudi government's strategy within the 2nd National Development Plan (Ministry of Planning, 1975) was to increase the private sector's opportunities to manage, operate, and maintain projects within a free market framework.

By 1979, a number of factors had led to the transformation from the 'Self-Operating System' to the 'Corporate Operating System' based on the participation of the private sector in operating the public hospitals. Five new large and modern high-tech hospitals in Jeddah, Jizan, Hofuf, Madinah, and Al Khobar were created to support this strategy. This transitional phase was based on the success of an earlier corporatisation experiment run

by the Ministry of Defence and Aviation to operate a number of military hospitals affiliated with it (Al-Ateeq, 2002).

Unfortunately, qualified human resources capable of managing and operating these new facilities were not available within the current staff. This challenge with the desire to increase private sector opportunities led to the gradual shift from the 'Self-Operating System' phase to a 'Comprehensive Operating System' phase, in which total responsibility (but not ownership) was handed over to a single private company (i.e., fuller corporatisation, seen as a step towards privatisation. However, the move from the original Self-Operating System phase to the Comprehensive Operating System was not instantaneous.

According to (Al-Ateeq, 2002), the transition to the Comprehensive Operating System can be divided into three transitional phases moving towards full corporatisation, and away from the original Ministry-based model, namely:

(i) ***Bilateral cooperation agreements phase (1979 – 1982).*** involved prominent cooperation between the KSA and Chinese, Danish, and German governments in some hospitals, to import the qualified human resources.

(ii) ***Partial Operating System phase (1983 – 1987).*** whereby the MoH contracted out non-medical operations (e.g., catering and maintenance) and some medical aspects to specialised operating companies (usually from Western Europe and North America) under multiple contracts.

(iii) ***Comprehensive Operating System phase.*** involved two overlapping stages.

a. Stage 1 - In 1988 the first stage started which called the Comprehensive Operating System, where corporatisation began, assigning some medical, and all non-medical, operations to one company, to mitigate the challenges of managing multiple

contracts. This involved the MoH running the hospital in partnership with a private company.

b. Stage 2 - In 1990 the second stage started, the Full Operating System, which involved the transfer of the management and operation of all medical and non-medical operations to a single company under a 'formal contract', with the MoH taking a supervisory role only.

For the purpose of this study, and largely because of the essential overlaps in the regimes (Appendix 1.C and 1.D), Stages 1 and 2 are considered under a single phase called the 'Comprehensive Operating System' phase implemented during the period 1988 – 1999.

(iv) ***New Public Self-Operating System (2000 – 2014).*** known elsewhere as the '*Self- operating system via programs*' (Al-Ateeq, 2002). This phase came into force as a result of a governmental policy change in the 6th Development Plan (Ministry of Economy and Planning, 1995) that might be related to the increasing in the oil prices (see section 1.6). Under this phase, the MoH (again) took greater responsibility for the operation and management of local hospitals, in addition to responsibility for the employment of professional technical staff (e.g.,doctors, nurses, technicians, and the appropriate administrative staff), and supervising all other work (e.g., nutrition, hygiene, and maintenance of medical equipment) assigned to specialised contractors in those areas.

It is under this New Public Self-Operating System model that the MoH still operates today. The implementation of Council of Ministers Resolution No. 72 of 2007 provides expansion of partnership contracts between the public sector and the private sector for implementing infrastructure projects and improving socioeconomic and environmental development through a productive partnership and investments between the national and foreign private sectors and the public sector (Ministry of Economy and Planning, 2010).

In 2009, to improve management practices and the quality of service further, the MoH issued new regulations for self-operating public hospitals, giving hospitals more autonomy to help with the transition towards the privatisation of public hospitals (Almalki, *et al*., 2011). Within the MoH a 'self-employment programme' (Ministry of Health, 2013) was introduced to create a new mode of employment (for national and international) resources through 'self-employment contracts', although HC employees were also considered to be government servants under the MoH (Khadr, 2014). To some extent, this new structure may have cancelled out perceived 'agency problems' in the system by reducing the role of the Civil Service in the process of hiring staff. Khadr also notes that, 'self- implementation' is a programme that is running the MoH hospitals programmes' independent budget, and based on the principle of financial flexibility and attracting qualified personnel to provide health services to all patients. There are now approximately 48,000 personnel employed under this programme across 90 MoH public hospitals. What is also of note is the publication of the national strategy for HC in 2009, implemented by the MoH in cooperation with other HC providers and supervised by 'The Council of Health Services' with 20-year timeframe.

Moving on, Almasabi (2013) notes the introduction of Quality Initiatives in the KSA in 2003, with the creation of an accredited body in 2006 - The Central Board of Accreditation for the HC Institute (CBAHI). These initiatives and the independent body were a response to the General Directorate of Quality Assurance which was created in 2000 within the MoH (Minister Memo No. 1523/11 of July 1 2000). CBAHI goals support HC institutions toward continuous improvements in the quality of health services, resulting in better patient outcomes and satisfaction. The Hospitals Accreditation Programme, with the first edition of the National Hospital Standards released in 2006, relates directly to the infrastructure components that must be available in any hospital to

ensure quality HC delivery. There is also a Certification Programme for HC Operation and Management Firms, which has specific standards to regulate the work inside such companies (with respect to proper financial, administrative and human resource systems) (CBAHI, 2015).

Table 1.1 summarises changes in modes of management and operational responsibility in the MoH's Hospitals, 1979 – 2014, based on firstly, a "Conceptual Framework for the Organizational Reform of Hospitals" proposed by Harding and Preker (2003) for the World Bank, where the *components* of the different reform phases are identified, including the allocation of decision rights, distribution of residual claimant, degree of market exposure and accountability, which will be explained in more detail in Chapter 3.

Secondly, the summary in Table 1.1 is based on slightly modified concepts of the *reform phases* from Al-Ateeq (2002), where the four phases of HC reform in KSA are examples of different stages of corporatisation, not privatisation. Although there has been no transfer of HC ownership in the KSA from the public to the private sector, corporatisation and privatisation are otherwise the same. Preker and Harding (2003, p.55) emphasise that, "In practice, when a hospital is corporatised, it is often established as a private corporation, though still publicly owned."

Figure 1.1 goes deeper into explaining the identified reform phases and their coding by combining the World Bank's components of reform with a slightly modified version of the phases of corporatisation reform identified by Al-Ateeq (2002), taking account of minor variations in the description of phases explained below.

Table 1.1 - Changes in Operation and Administration of Hospitals by Phases

		Phases of Reform			
		Baseline Budgetary Organisation "coded 0"	**Phase 1 of Corporatisation "coded 1"**	**Phase 2 of Corporatisation "coded 2"**	**Phase 3 of Corporatisation "coded 1"**
		Bilateral Cooperation Agreements (1979-1982)	**Partial Operating System (1983-1987)**	**Comprehensive Operating System (1988-1999)**	**New Public Self-Operating System (2000-2014)**
Components (H&P, 2003)	**Allocation of decision rights**: is the right to make decisions over various aspects of production, including inputs, outputs, outcomes and management process.	Little autonomy over key decisions: **1.** Management: central MoH (Manager of hospital is just administrator). **2.** Operation: central MoH + other country experts. **3.** Recruitment: central MoH + Civil Service. **4.** Supervision: MoH.	Shifting many decision rights from the hierarchy to the organisation: **1.** Management: under central MoH. **2.** Operation: MoH + contracted companies. **3.** Recruitment: central MoH + Civil Service. **4.** Supervision: MoH.	Greater autonomy over key decisions: **1.** Management: single company contracted to MoH. **2.** Operation: single company. **3.** Recruitment: central MoH + Civil Service, and single company. **4.** Supervision: MoH.	Little autonomy over key decisions: **1.** Management: MoH + hospital manager (belongs to MoH). **2.** Operation: MoH + contracted companies + hospital Manager (belongs to MoH). **3.** Recruitment: MoH + Civil Service (less role) + hospital manager (belongs to MoH). **4** Supervision: MoH.
	Degree of market exposure: refers to subjecting hospitals to market competition.	None - Market exposure: No Contracts, just agreement.	Some - Market exposure: MoH contracted out non-medical operations and some medical aspects to specialised operating companies under multible contracts.	More - Market exposure: MoH contracted out all non-medical operations and medical aspects to one single company under formal contract.	Some - Market exposure: MoH contracted out non-medical operations and some medical aspects under multiple contracts.
	Distribution of residual claims: reflects an organisations degree of enforced financial responsibility - both the ability to keep savings and responsibility for financial losses (debt).	MoH is the residual claimant. Direct budget allocation. If there is any input surplus, will be withdrawn from the hospital and reallocated within the health sector budget.	MoH is the residual claimant.	Private Sector is the residual claimant.	MoH is the residual claimant.
	Accountability: refers to holding hospitals responsibility and answerable (internally and externally) for their behaviour and performance.	Hierarchy enforced through direct hierarchical control through a chain of government bureaucrats.	Direct Hierarchy.	Direct Hierarchy.	Direct Hierarchy +qoality standards through an independent quality controls.

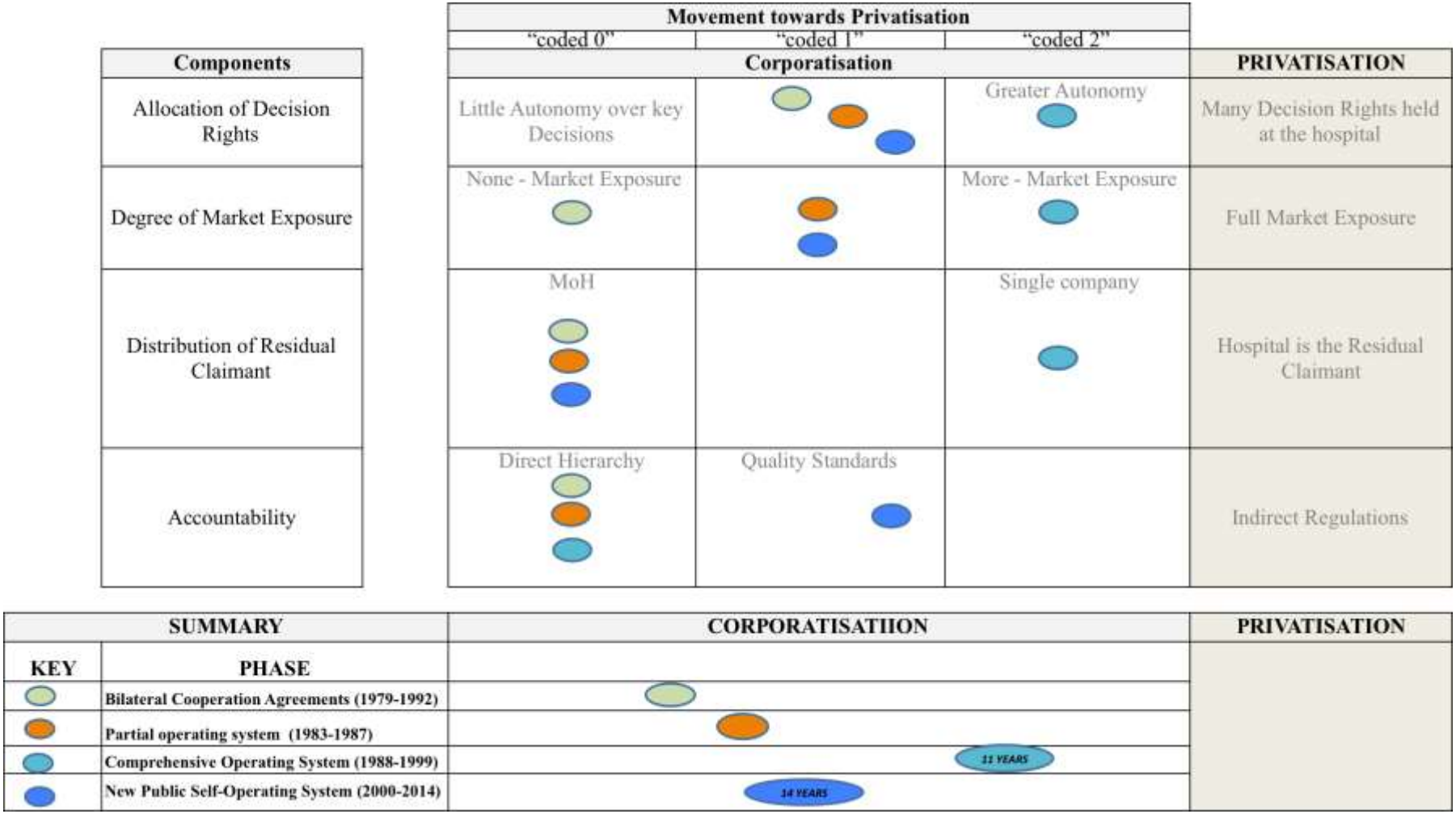


Figure 1 1.1 - Relative movements of KSA phases towards privatisation

In Table 1.1, the horizontal rows comprise the World Bank's 'Components of Organisational Reform' (Harding and Preker, 2003, pp.44-45). With little autonomy over the operation of the Bilateral cooperation agreements phase in KSA, the first column represents 'Baseline Budgetary Organizations' as public hospitals run as government department. This follows Harding and Preker (2003, p.52) who suggest, "Let us begin with a budgetary unit such as a hospital run as a government department, where the hospital manager is essentially an administrator. The government's hierarchy of officials and rules controls all strategic issues and determines most day-to-day decisions related to production and delivery of services—from staff mix, staff size, and salaries to services offered, technology used, and accounting and financial management methods.

Usually, the government determines the hospital's revenue through a direct budget allocation, based on historical norms. Other revenues are controlled as well, since the government also controls services rendered, patients served, and permissible copayments. Any "excess revenues" belong to the public sector—and must either be returned to a superior agency or spent as directed. Any "excess losses" are covered by the public purse. In this sense, the public sector is the residual claimant of the hospital operating as a budgetary unit".

From the World Bank's analysis of reform components leading through corporatisation towards privatisation (Harding and Preker, 2003), the KSA's different 'reform modalities' (or phases) (Harding and Preker, 2003, p.52) are coded as they move away from the Baseline 'Budgetary Organization' (coded zero) through corporatisation towards privatisation. The single World Bank phase 'Corporatized Organization' is too broad for application to HC reforms in KSA. Consequently, we split this stage into three phases developed from Al-Ateeq (2002), namely the Partial Operating System (1983-1987) coded 1, the Comprehensive Operating System (1988-1999), coded 2, and New

Public Self-Operating System (2000-2014), coded 1, as shown in Figure 1.1. Apart from the uncontroversial coding of the baseline structure as 'zero', the other codes do involve a degree of judgement but are designed to indicate the broad degree of movement in patterns of reform over time. These judgements are explained by reference to the ellipses in Figure 1.1.

For example, the World Bank phase 'Autonomized Organization' is identified in KSA as the Partial Operating System phase (1983-1987), coded 1, as movement towards full corporatisation and ultimately privatisation. The identification of this Partial Operating System in Figure 1.1 as the first phase for corporatisation is based on the coloured ellipses in that Figure, i.e., the 'centre of gravity' (or 'balance') of the four orange-coloured shapes corresponding to the four World Bank reform components that represent the Partial Operating System can be seen to lie slightly in favour of the central column, i.e., the first phase of corporatisation coded 1.

From Figure 1.1, the Comprehensive Operating System phase involves a similar judgment involving 'balance' since three of its components (represented by the turquoise ellipses) lie in the right-hand corporatisation column coded 2. This phase is therefore judged to have achieved the greatest movement towards privatisation, being the most corporatised of the four KSA phases: it has greater autonomy over key decisions (management, operation, recruitment, and supervision) and it also has higher degree of market exposure, whereby the MoH contracted out all non-medical and medical operations to one single company under formal contract. In addition, the residual claimant in this phase is a private company. However, this phase is still accountable to the MoH, though it has less accountability compared to the New Public Self-Operating System.

Subsequently, the New Public Self-Operating System (2000-2014) is judged to represent a policy reverse, a change of direction away from movement towards

privatisation, diluting corporatisation in the sense that the MoH and their managers took over operational control and the MoH again became the residual claimant. It can be seen from the blue shapes in Figure 1.1 that this new reform phase closely resembled the earlier Partial Operating System phase (1983-1987), and is therefore not represented as a separate column in Figure 1.1. To emphasise this reversion to an earlier stage, the New Public Self-Operating System (2000-2014) is also coded 1, therefore, broadly equivalent to the earlier Partial Operating System phase.

The final World Bank phase of reform is shown as 'Privatised Organization', involving the private ownership of all assets. This phase that has not been achieved in KSA and is therefore omitted from Table 1.1 and included in Figure 1.1 only as a 'memorandum item' in the right-hand, shaded column.

It should be noted that one of the key challenges in defining the different corporatisation stages in terms of phasing, and modes of management and operation of the hospitals that support this movement towards privatisation, has been the lack of a standard terminology across primary and secondary sources literature and articles. For example, in some cases these corporatisation movements, and associated actions, are also known as a '*company operating system*' or '*contractual operating system*' (Al-Ateeq, 2002). Yet in all cases these various changes in corporatisation (however named) have taken many discrete forms depending on the degree of integration and collaboration between the parties involved.

This period 1979-1999 with different corporatisation phases arguably led to major benefits introduced in the KSA health system (Al-Ateeq, 2002). These included the introduction of modern strategies in the field of management, enhanced operation and maintenance of hospitals by importing the qualified human resources in various fields, reduction of the administrative burden on the government sector and the MoH's focus on

a supervisory role (Al-Ateeq, 2002). Due to some obstacles, there were also outcomes which were not as successful as initially expected. These obstacles included the absence of specialists in the accurate identification and drafting of contracts. In addition to the weakness of technical control over these contracts, there was a lack of qualified companies bidding for the MoH's tenders compared to other government sectors that provide health services for their employees such as the Ministry of Defense and Aviation. This could be considered due to the lack of funds for operation, and the intervention in the responsibilities of operating companies by some specialists in other government agencies, as mentioned in 1.3.1 (vi).

Al-Ateeq (2002) considers two rationales for the move back to HC operation by the MoH. Firstly, he suggests that the need for corporatisation had actually disappeared because of the lessons learned from the previous experiments and phases. Secondly, new strategic priorities emerged, including the 'Saudisation' (a vernacular term for increasing the percentage of nationals employed within government bodies in specialised positions) of the workforce, which had been poorly represented under the Comprehensive Operating System phase. Al-Ateeq (2002) also notes the weaknesses in the implementation of previous contractual frameworks.

At a national level, the current government is also looking to the future with the most recent Vision 2030 including a privatisation strategy to move to the formation of government- led private companies to introduce corporatisation (CEDA, 2018).

To conclude this section, with the current KSA development plan and MoH strategy, together with previous experiences with different corporatisation reforms, there is still some support evident for movement towards privatisation to achieve efficiency, effective outcomes, and quality improvements throughout the KSA HC system.

Nevertheless, despite the results of the previous efforts and the continued strategic intent at a national level to privatise, the share of the private sector in the provision of HC services is insignificant when compared with the public sector. According to Adams, *et al.* (2006), investing in public–private partnerships (PPPs) may also improve efficiency and effectiveness in the public sector, where he stated that "the private sector is better able to provide services to a higher level of efficiency and effectiveness than the public sector which is typically hindered by its bureaucratic, mechanistic and politicised method of operation" (Adams, *et al.*, 2006, p.385). In addition, movement towards the privatisation of HC facilities arguably may improve performance and operating margins, reducing bureaucracy, and decreasing inpatients' lengths of stay (Villa and Kane, 2013). In contrast, studies show that moves towards the privatisation of HC may conceivably also increase some costs and concurrently increase inequalities in access to HC of low-income citizens (Basu, *et al.,* 2012).

1.5 Chapter Summary

To summarise the main points of this chapter, it can be observed that the environmental landscape of the KSA is unique, with many local characteristics. Although there has been major population and economic growth within the country over the years, the variations in population size due to religious tourism is a factor that must be considered at a localised level when determining hospital performance requirements and may affect the efficiencies, effectiveness and quality aspects of inputs, output and outcomes.

The underlying structure of the KSA has remained relatively stable and true to its cultural and ideological beliefs, with patronage based on social and family networks still embraced by society as a whole. This social context interacts with a complex and somewhat bureaucratic institutional framework, supported by inter-relations between

legislative and judicial controls, which are unique to the KSA. These social and institutional factors are considered by some to interfere with the ability to carry out business effectively in the KSA (The Economist, 2009) and may have a particular relevance to hospital corporatisation efficiencies and performance (see section 1.4).

The economic strategy is currently formed and directed from a centralised function and embedded within the KSA's National Development Plans. Although there is a desire to localise control, this change is progressing slowly. A number of different corporatisation experiments towards privatisation (defined in terms of management and operations of the hospitals), gradually increased from less to more corporatisation, and then returned to a lower level of corporatisation in the final phase. It could be assumed that if an ideal corporatisation model had been identified for HC services, then this would have become the *de facto* 'solution'. Yet this does not seem to be the case in Table 1.1, which shows the variety of governance changes across different operating responsibilities.

To repeat the first paragraph of this thesis, the purpose of this study is to analyse whether movement towards privatisation (through various phases of corporatisation) has been associated with an improvement in the performance of MoH's hospitals, an investigation that may provide the framework for a subsequent analysis of any efforts of the KSA to go beyond corporatisation to privatisation. Corporatisation is an intermediate phase of movement towards privatisation, sharing all of the characteristics of privatisation apart from private ownership. It is therefore argued that the theoretical and empirical literatures on the effectiveness (or otherwise) of privatisation are relevant to the research questions posed below.

Current governmental strategies (Vision 2030) (again) involve the adoption of a more corporatised model of hospital operation, and this leads us to the following research questions:

RQ1 - *Have different forms of corporatisation generated the gains that may be associated with the movement of reforms towards privatisation?*

RQ2 - *Have HC quality considerations (or effectiveness) modified conclusions relating to the efficiency of different HC governance systems?*

The next chapter, (Chapter 2) will contain a review of the existing literature, paradigms and theories that provide a variety of perspectives that could be applied to MoH hospital movement towards privatisations over the period under consideration 1979-2014, taking into account the aforementioned KSA environmental context and the MoH's governance structures. Chapter 3 will then present a conceptual framework, clarifying the key stages and processes of a corporatisation/privatisation strategy, from initial motivations to assessing the performance of the entity. Chapter 4 will present the methodology employed in this study, and Chapter 5 will show the results from the different econometric approaches to efficiency measurement, outlined in Chapter 4. Finally, Chapter 6 will comprise a discussion and interpretation of results within the context of the theoretical and empirical literature, and contributes to the conclusions and recommendations in Chapter 7.

CHAPTER 2

Literature Review

2.1 Introduction

Corporatisation and privatisation are imprecise concepts that have a variety of subtle interpretations, depending on the ideological 'lens' that is used. A basic Internet search provides thousands of academic and practitioners papers, articles and books on the subject, each with a specific orientation depending on the political, social, and economic context within which the topic is considered. This ambiguity affects the theories, forms, implementation approach, motivations, measurable effects, and outcomes that have emerged in relation to various privatisations across the developed and developing world. Therefore, the purpose of this chapter is to review, examine and contextualise both the theory and empirical studies on corporatisation/privatisation which may provide the framework for a subsequent analysis of the efforts by the KSA to move hospitals towards privatisation (see sections 1.1 and 1.5). However, the purpose of this study is to analyse whether movement towards privatisation (through various phases of corporatisation) has been associated with an improvement in the performance of MoH's hospitals.

The first section outlines the concepts of efficiency, corporatisation and privatisation used within the context of this study. Section 2 of this Literature Review takes a theoretical approach to consider the objectives and rationales of corporatisation, partial and full privatisation from political, consumer/social and economic perspectives. Section 3 considers the different dimensions of hospital performance, followed by Section 4 which moves on to examine previous empirical research on the corporatisation and privatisation of entities, including meta-analyses and regional/country studies, finishing with a particular focus on HC sector studies. Finally, to conclude this chapter, a summary

of the main points identified is provided, together with the identification of research gaps and a re-statement of the research questions of the thesis.

2.2 Defining efficiency

The Structure-Conduct-Performance (SCP) paradigm proposes that industry concentration facilitates collusion, i.e., firms in concentrated industries will use restrictive conduct and generate higher returns than those operating in less concentrated industries, regardless of their efficiency. If follows that prices may come closer to marginal cost if concentration decreases (Boru and Kuhil, 2018). In contrast, the Efficiency hypothesis developed by Demsetz (1973) and supported by Peltzman (1977) predicts that higher profits may not arise because of collusive activities and monopolistic returns, as the traditional SCP paradigm would suggest. The Efficiency hypothesis predicts that under the pressure of market competition, efficient firms (with low cost structures, superior management or capabilities, production technologies etc.) win the competitive battle, develop, grow, achieve greater market shares, and therefore earn higher profits. On this Efficiency view, firms have two paths to higher profits: either keeping price low and reducing firm size, or by decreasing price and expanding firm size, Consequently, higher profits are created by large firms as a result of their superior efficiency (Boru and Kuhil, 2018). It could be argued that SCP implies breaking up monopolies (including state monopolies, i.e., privatisation).

As noted by (Rosse and Panzar, 1977; Panzar and Rosse, 1987), it is assumed that many factors may affect competitive behaviour, e.g., entry or exit barriers and the general contestability of the market (which may be a competitive threat, even in highly concentrated industries). The threat of potential new entrants can force the larger firms to price their products in a competitively, see 2.4.4 below.

From the above it is clear that there may be some link between concentration, competition, and efficiency, therefore, economic efficiency will be defined and explained in the next section.

2.2.1 Defining economic efficiency

In economic terms, based on the seminal work of Farrell (1957), Productive Efficiency (PE) is a measure of how well inputs are converted into outputs in physical terms (Productivity Commission, 2013). It is at its maximum, (i.e., an economy or industry is on its efficiency frontier) where points on the frontier represent marginal rates of transformation. In Figure 2.1 below, an improvement in PE can be achieved as the firm's production possibilities move from A to B or C or D on the Production Possibilities Frontier (PPF) (Productivity Commission, 2013).

In empirical studies, it is difficult to separate PE from allocative efficiency (AE). AE refers to the ability of the firm to convert the value of inputs (i.e., scarce resources) into the value of outputs, which is one measure of utility to buyers. AE requires that firms should produce goods and services that are most in demand (mix and quality), at the lowest possible cost, subject to constraints. As shown in Figure 2.1 below, the move from B to C reflects the improvement in AE. In other words, AE is achieved when marginal cost is equal to the price (marginal benefits), where social surplus is assumed to be maximised.

These two measures (PE and AE) combined provide a measure of (overall) static efficiency, which relates to the combination of resources at a given point in time comprising both the PE position on the PPF, and AE choice of point on that PPF. Dynamic efficiency refers to "the extent to which resources can be used to produce more output over time and the extent to which production can be altered quickly and at low cost in response to changes in economic circumstances" (Productivity Commission,

1999, p.13). As shown in Figure 2.1, dynamic efficiency presents an outward shift of the original PPF, as technologies and production change over time to meet the current and future preferences of the population.

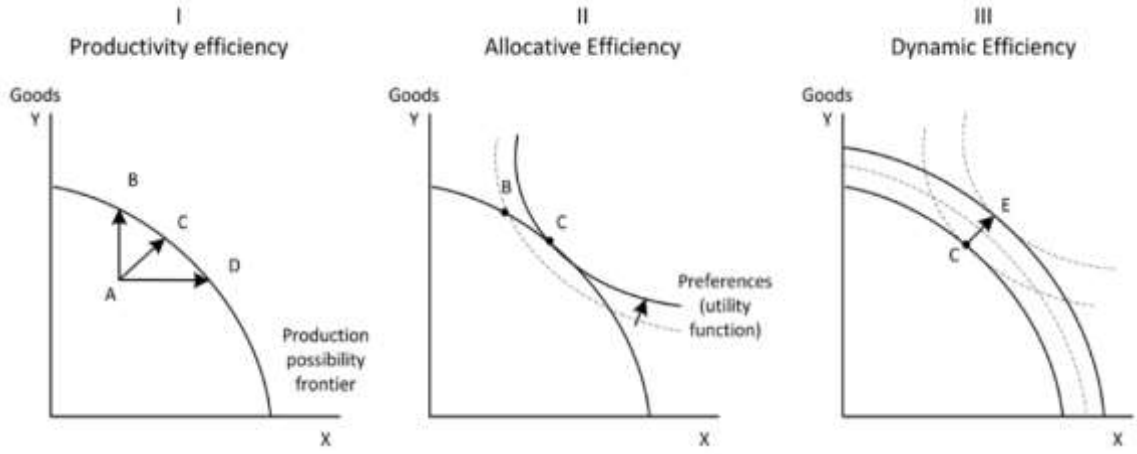


Figure 2.1- Production Possibility Frontier (Productivity Commission, 2013)

2.2.2 Defining efficiency in a HC setting

Defining efficiency in HC terms and aligning to hospital performance, within the context of HC delivery, is considered problematic (Burgess, 2012) where economic efficiency may not be the predominant driver for clinical resources and the distinct features of the HC industry (Hollingsworth, *et al.*, 1998). Furthermore, Hollingsworth, *et al.* (1998) emphasise the need to use appropriate and well-defined models, use appropriate inputs and outputs, and use accurate data in order to achieve accuracy of performance measurement. Whilst the traditional economic definitions of efficiencies noted above provide a reasonably comprehensive lens through which to view the association between inputs and outputs for most organisations, the other challenge in HC is understanding the importance of efficiency, effectiveness, and quality of care as HC outcomes (ISO 9000, 2015).

Palmer and Torgerson (1999) provide a HC-orientated definition of economic efficiency which suggests that PE (in a HC setting) refers to the physical relation between

resources (inputs), interventions (which could be described as clinical procedures, tests or protocols), and health outcomes, where an intervention is deemed technically inefficient if the same physical outcome can be achieved with less physical input, thus 'using resources to maximum advantage'. Alternative approaches to efficiency measurement would put valuations on inputs and outputs, i.e., they would consider the value of health outcomes for a given cost, or costs for a given value of outcome. However, this approach would conflate PE and AE. It is explained at 4.4 (i) below that these two approaches (physical vs price-based measures of efficiency) have been the subject of a longstanding debate (e.g., Jacobs, 2000; Ozcan, 1992).

This study relying entirely on physical in a HC setting, without prices on inputs and outputs, follows many precedents, e.g., Cherchye, *et al.* (2010) and Russell (1984).

The next sub-section considers this concept of efficiency (PE) in relation to governance reforms.

2.3 Governance Reforms- Overview

Theoretically, and from the perspective of practical implementations, market-oriented governance reforms can take three main forms, namely, corporatisation, partial privatisation, and full privatisation. Understanding these different types of reform is important because the implementation strategy employed by the government may affect the outcomes. This is largely because the incentive effects may vary according the governance reform.

The three main forms of market-based governance reform are dominated by the experience of countries with privatisation from 1980 through to 1990s across the world (Armstrong, *et al.,* 1997). Moreover, the different forms of privatisation are distinguished by the level of ownership (from zero to 100 per cent) transferred to the private sector, and

whether management of the firm is also transferred to the private sector. Figure 2.2 (based on Armstrong, *et al*., 1997; Investopedia, 2019) below describes the three main forms of market-related governance reform.

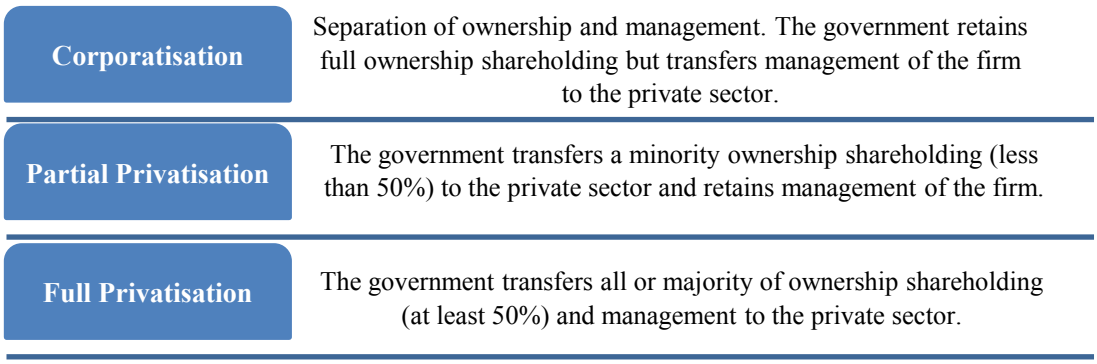


Figure 2.2 - Forms of Market-Related Governance Reform

2.3.1 Corporatisation

A corporatisation strategy is intended to address a number of HC outcomes (for example, improving performance through more PE, AE and dynamic efficiency where corporatisation is defined as a movement towards full or partial privatisation (Harding and Preker, 2000). This movement towards privatisation can comprise a number of key components (Harding and Preker, 2000), as shown in Figure 2.3 (based on Preker and Harding, 2003) below. According to Preker and Harding, (2003), corporatisation may increase efficiency (PE and AE) through market exposure by ensuring greater accountability to the governing body, supervisory boards, and/or stakeholders/patients. This may be achieved (Preker and Harding, 2003) through enhanced quality management, in addition to allocating decision rights (autonomy) and distribution of residual claims to a local hospital level (see section 1.4).

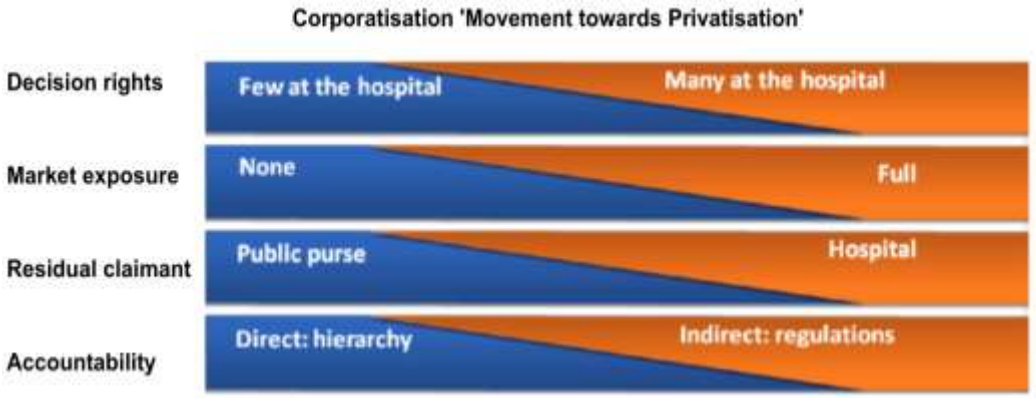


Figure 2.3 - Analytic framework for corporatisation

To increase the level of autonomy, in some cases hospitals have been turned into public corporations but are not privately owned listed entities. Evans (2006) proposed that health service delivery could be more efficient if some of the logic of the marketplace is introduced, whilst still recognising that the public health framework has many attractive characteristics that should be retained. In this case, corporatisation (contracting) is a mechanism that formalises the relationships and obligations between the different actors (or to more clearly, between government and private sector (Evans, 2006, p.850; Preker and Harding, 2003, pp.7-8)) in a HC system, though it clearly may not be limited to medical practices. Evans (2006, p.850) also suggests that many people see contracting as a tool to be used primarily for the management of non-medical services in the HC system, for example, services such as cleaning or food catering in hospitals, or even overall management. However, its potential uses may be much broader. For example, it has been used to encourage private providers to participate in the treatment of tuberculosis. The overall aim of the corporatisation reform is to improve health system performance by clearly specifying the obligations and expectations of the different actors in the health system.

However, Vaithianathan (1999) criticises a number of studies finding less successful corporatisations because much of their analysis is ethnographic, based on assumption and ideology rather than empirical results, and suggests that this is due mainly to misalignment between the autonomy, operational authority, and desire to achieve excellence in quality of care held by clinical resources irrespective of cost, as opposed to the management objectives held by budget holders, corporate management and government to achieve economic efficiencies within the hospital system. These two opposing arguments (i.e., Evans, 2006 versus Vaithianathan, 1999) for HC reform through corporatisation are examined by Wagstaff and Bales (2012) and Braithwaite, *et al.* (2011) with both studies concluding that the arguments to promote either position are predominately ideological, rather than evidence-based. However, Wagstaff and Bales (2012) further conclude that for corporatisation framework to achieve the benefits proposed the main components (i.e., decision rights, residual claims, market exposure and accountability) have to be 'mutually coherent', suggesting that it is not enough to focus on efficiency alone.

As shown in Figure 2.2, corporatisation as an implementation strategy involves the separation (Fama and Jensen, 1983) of the ownership of the firm from the management. Specifically, in corporatisation, the government transfers only the management of the firm to the private sector, whilst it retains all ownership (Shirley, 1999), though corporatisation can be used to precede partial or full privatisation.

Corporatisation may be seen as a necessary first step towards privatisation in the presence of the complexities or constraints involved in full privatisation, and may provide an option when the government wants to remove the effects of political interference or bureaucracies on how firms are managed, which could affect firm performance.

Corporatisation can take the form of management contracts, where a private firm is contracted to manage a public firm. In terms of incentive effects, however, managerial incentives are likely to be limited with corporatisation. According to Shleifer and Vishny (1994) as cited in Klien (2012, p.2), the consequences of corporatisation are related to the extent of political interference under different governance structures. Shleifer and Vishny (1994) predict that moving control rights to the managers instead of politicians may decrease political influence even if the economic incentives do not change.

In relation to corporatisation, Braithwaite, *et al.* (2011) identify five arguments for this movement away from a government owned and operated hospital sector: the introduction of competition to improve efficiency, quality and consumer choice; more autonomy for hospital managers; enhanced reward system for hospitals to perform well; reduced government bureaucracy; and greater service choice for the public.

However, in contrast, under corporatisation, managers make decisions about assets they do not own, which can lead to various forms of moral hazard. The success of corporatisation may be dependent on the maturity of the market place. In developing countries, it can be shown that any form of corporatisation may not increase performance (Olajide, 2005), while in more mature markets there may be different issues to contend with. For example, in the US, where the HC market is highly competitive, there is a risk that resources may be orientated towards market priorities, rather than patient HC (Wynne, 2004). Wynne further notes concerns in relation to cutting back on staff to maximise profit, allegations of fraud and medical malpractice due to corporate imperatives, highlighting one of the key dilemmas facing the HC industry in terms of the tension between serving the patient's wellbeing and the satisfaction of stakeholders and the corporation. These types of behaviour within the HC industry are also noted by Rama,

Edwards, Dalton and Green (2010) who highlight the potentially damaging consequences of the decentralisation of decision-making and residual claims to the local level.

2.3.2 Partial privatisation

Partial privatisation is another stage of governance reform. It involves the transfer of a minority of ownership (less than 50 per cent) to the private sector, whilst the government retains the majority, and management.

A key issue in partial privatisation is the level of share ownership to be transferred to the private sector, which influences whether a partially privatised entity and its managers behave as a fully privatised entity without political intervention. Clarke, *et al.* (2005) argue that privatisation should not be done partially. Governments holding majority shares in SOEs may result in those firms performing poorly by conventional accounting measures. In addition, Jiang and Yao (2011) have argued against partial privatisation and government interference which might prohibit and delay the success of reforms.

On the other hand, partial privatisation may be undertaken in order to raise financial resources from the capital market to improve the operations of the firm (or sector) and at a microeconomic level, privatisation has been considered to have "positive effects on profitability and efficiency" (Sheshinski and López-Calva, 2003, p.440).

The relationship between public sector financial health, the volatility of country's GDP and total instability tend to act as drivers towards partial privatisation (Sheshinski and López-Calva, 2003). Nevertheless, when taking a wider macroeconomic view, the impact of external factors, for example changes in taxation, trading agreements, and globalisation efforts cloud the evidence available to totally isolate the benefits of partial privatisations. However, at a microeconomic level, Sheshinkski and López-Calva (2003, p.450) suggest "that publicly owned enterprises in competitive environments would not

perform better than privately owned companies in the same circumstances in terms of profitability, and may perform worse."

2.3.3 Full privatisation

In contrast to partial privatisation, full privatisation encompasses a complete transfer of both ownership and management from the government to the private sector. In general, there are four objectives of privatisation programmes (Sheshinki and López-Calva, 2003) being the achievement of higher AE and PE, strengthening the role of the private sector, improvements in the public sector's financial health, and reallocation of resources. Criticisms of privatisation (e.g., Wynne, 2004; Rama, *et al.,* 2010) usually consider the social impact and expense to the welfare of individuals through the burden of any increased costs, and the reduced demand for labour.

Whilst it should be noted that, to some extent, the incentive effects of ownership vary according to the level of private ownership shareholding, any reform short of full privatisation may induce moral hazard problems. There is an asymmetry of information between controllers and operators (Holmstrom, 1979, p.74), e.g., less than 50 per cent of cost savings may be enjoyed by part-owners, so there is less incentive to cut costs. If a private entity does not wholly own the assets, private incentives are constrained, particularly relating to maximising profit, perhaps at the expense of business practices such as investment programmes, or building maintenance and hiring decisions.

In contrast, full privatisation may also lead to costs, e.g., a reduction in economies of scale (see section 2.4.4 and 6.2.2 (iv) below). Furthermore, full privatisation may introduce elements of monopoly or oligopoly with weak competition, depending on the market structure of the industry in which the firm operates. In such a case, the government may need to also regulate the industry.

Moving on from this overview, Section 2.3 considers the theoretical objectives and rationales of privatisation as governance reform, followed by Section 2.4 which considers privatisation challenges and outcomes in more detail. While partial or full privatisation has not featured as governance reform in the HC sector on KSA, it is argued that corporatisation does share most of the features of privatisation, excluding private ownership. Therefore, a review of the privatisation literature is argued to be relevant. This will lead to the working hypothesis that "private ownership is more effective" (Anuatti-Neto, *et al*., 2003, p.4). In practice, Shirley (1999, p.115) reports that, "privatization and corporatization have similar political costs and tend to succeed or fail together."

2.4 Theories – Objectives and rationales of privatisation

2.4.1 The 'firm' in context

As noted above, corporatisation can be considered as the preparatory or transitional stages prior to partial or full privatisation, and there are a number of theories that lay out the rationale behind movements towards privatisation. Firstly, certain theories that examine the significance and motivations for achieving a desired objective or outcome of a firm are considered. Rational organisation theory sees the organisation as a device for achieving a particular goal or set of goals (Thompson, 1966). A rational organisation uses a formal structure to define the role of each member. In a business where roles and goals are clearly defined, the process of management should be rational and predictable. Rational systems primarily address the economics of cost management through market forces and pricing mechanisms.

As opposed to this rational view, natural systems theories (McFarland and Gómez, 2014) suggest that it is the unplanned, emerging relations and coalitions which matter, and the informal structure of relations that develops among participants is more influential

in guiding behaviours and outcomes than the formal structure's role, declared expectations and guiding principles.

These two opposing views can be related back to Coase's (1937) seminal work on 'the nature of the firm' which provides a distinction between governmental organisations (which could be driven by rational approaches and polices) and those of private enterprises, suggesting that a firm consists of the system of relationships which comes into existence as and when the direction of resources is dependent on the entrepreneurial nature of man.

More recent theories introduce the concept of open systems. Here the focus is extended into the environment and how this influences firm behaviour and survival with organisations perceived as "nodes of interdependent flows and activities linking shifting coalitions, and networks of participants, embedded in wider material-resource and institutional environments" (McFarland and Gómez, 2014, p.13). The focus within an open system analysis is more on the external environment than any other organisational feature.

Organisations and their relationship models are also influenced by the surrounding environment. With the advent of globalisation and advanced technologies of communication, the context within which firms and governments operate today is fundamentally different than that of previous eras. Yet it is practically impossible for organisations not to be affected by historical factors that may still be reflected within the current practices (Daft, 2012). For example, at times of recession, the way firms operate may be different than in times of economic boom. Firms also experience regional differences which are related to different cultural, ideological and political contexts that can also change over time.

It could be stated that both the quantitative and qualitative inputs and outputs will ultimately decide the long-term stability of the organisation. Yet in the context of privatisation, in addition to management issues, the role of politics cannot be seen separately. Political factors (both internal and external to the firm), may have a dominant role in the day-to-day operations, governance, credibility and administrative processes of an organisation.

2.4.2 Political perspectives

The concept of privatisation as a process involving governance reform emerged from Ancient Greece where private individuals handled all the major works of the government and has, in more modern times, become a global phenomenon. There is a perception that the main benefits of privatisation could be to decrease financial burdens on the government, minimising the role of the bureaucracies, cost cutting, political and various other domestic and global causes. The idea that private ownership is more efficient than public ownership, promoting better public sector financial health, is not new. Adam Smith (1776) wrote: "When the crown lands had become private property, they would, in the course of a few years, become well improved and well cultivated" as cited in Sheshinski and López-Calva (2003, p.432). This section will now examine whether particular political influences may have played a significant role in promoting this view.

Looking through a political lens, Starr (1988) proposes that the act of privatisation is directly related to neoliberal philosophies and concepts, aimed not simply at returning services to the private sector, but also at creating new kinds of market relations, with results hopefully comparable or superior to traditional public programmes.

Drucker's (1973) perspective on privatisation suggests that as a systematic policy it did not gain political ground until the late 1970s onwards. Drucker's perspective

suggested that nongovernmental organisations were more suited to the delivery most of products and services, and this was implemented firstly in the United Kingdom (UK). However, this historical account is challenged by the socialist viewpoint taken by Hastings and Levie (1983) who state that the move to privatise the UK nationalised industries covered 'a multitude of sins'. This was allegedly illustrated by the sale of nationalised concerns and material assets, the placement of shares with institutional investors, private investment in public projects, and joint public/private sector ventures. Furthermore, Hastings and Levie (1983) believed that, whilst the (then Conservative) government's motivations suggested an improved and more efficient use of public sector resources, through opening up new areas to market forces, similar benefits could possibly have been gained more easily by addressing the efficiency needs of nationalised concerns from within the public sector. In this case, it seems that the underlying political motivation may have been to break up the public sector because of political and economic ideologies alone, with little respect for social considerations. This is supported by the statement from Sir Geoffrey Howe, the Chancellor of the Exchequer (i.e., Minister for the Treasury), on the need to further loosen "the grip of the public sector" (Hastings and Levie, 1983, p.12).

The historical assessments of the effects of privatisation are obviously influenced by the framework within which they are assessed, their varying political environments and its motivation. There are also many considerations relating to the privatisation process, e.g., how the government performs the privatisation process, whether theprogramme is correctly sequenced, whether regulations are applied, and whether effective corporate governance is formed for privatised entities (Estrin and Pelletier, 2015, p.1).

These observations supported by the Feigenbaum and Henig's (1994) political underpinning of privatisation theory which proposes that in many cases, public services

were privatised due to political preferences and not because there was a belief that the decision would result in cost savings. Feigenbaum and Henig's argument is that privatisation, in many of its forms is better understood as a political phenomenon.

Privatisation can take three forms. Firstly, as a *short-term* solution to address immediate financial problems. In many cases this involves contracting out public services in order to save money. Secondly there is *tactical* privatisation which is aimed at localised political interests and opportunism to attract allies and reward supporters. The final type of privatisation is defined as *systemic* in nature and is aimed at reshaping entire societal expectations of what government should do and should be responsible for.

Public choice theory (Buchanan, 1969, Niskanen, 1971, 1975) may be included under the heading of politics or, more accurately, political economy. Public choice theory studies political behaviours through an economic lens. It considers that similar assumptions and economic models about market behaviours can be applied to political behaviours (Buchanan, 1973, p.131). Self-interested politicians and bureaucrats may exploit state ownership for their own purposes. Grindle (1989) suggests that government and state bodies will act in certain ways in weak institutional settings, where people do not have the power to demand effective performance, particularly in less developed countries (Grindle, 1989, p.9). Public choice theory can also be used to examine the drivers of partial (as opposed to wholesale) privatisation as being based on three major considerations. Firstly, although privatised firms may be more competitive than State-owned enterprises (SOEs) which may be used for political ends and, as a result, may be unable to compete effectively and may run deficits in competitive markets. In this case partial privatisation could balance any negative impact of retaining services internal to government bodies. Secondly, for the purpose of political intervention, politicians, as well as bureaucrats, may have the power to let SOEs monopolise the market, setting up barriers

to entry, or avoiding competition in any way, thus providing some degree of control over market forces. Finally, due to multiple objectives, SOEs may have vague responsibilities for monitoring, with corporate governance being arguably more difficult to apply than in private enterprises (Sheskinski & Lopez-Calva, 2003, p.436). Reviews of the empirical literature suggest that privately-owned firms perform better than SOEs, and that privatisation promotes the financial and operating performance of firms (Bortolotti, *et al.,* 2003).

2.4.3 Social perspectives

Scott (2003) as cited in Gotsdanker (2018, p. 1) defines organisations as being "conceived as social structures created by individuals to support the collaborative pursuit of specified goals". Neo-Institutional theory suggests that organisations compete not just for resources and political power but also for institutional legitimacy, i.e., for social as well as economic fitness (DiMaggio and Powell, 1983). If this is the case, it is important to consider the impact of privatisation policies across various social groups such as gender, ethnicity, age, livelihood, and geographic location (International Monetary Fund, 2010).

Rawls' (1971) Theory of Justice promotes certain principles, e.g., social and economic inequalities may be arranged for the greatest benefit to the least-advantaged members of society, consistent with *the difference principle* in addition to that of *fair equality of opportunity* where offices and positions must be open to everyone (Rawls, 1971). Of particular relevance here is how social equity and equality may be applied to the economic factors of HC privatisation.

The Constitution of the World Health Organisation (WHO) states that "Governments have a responsibility for the health of their peoples which can be fulfilled only by the provision of adequate health and social measures" (World Health

Organization, 2006a, p.1). This WHO statement subtly raises the issue of balancing both equity and equality, whilst providing an acceptable level of service, yet still fulfilling and complying with (perhaps conflicting) political, social, and economic drivers. This point highlights the difficulties in applying rationality to structures that are in flux due to the external environment. This makes the cultural and social influences, combined with economic considerations and drivers of privatisation, an important dimension to consider within the context of this study. It should be noted here that because of Islamic values (Mohammed was at times a physician) the culture of the KSA requires universal HC, especially for vulnerable groups. As noted at (1.3.1) above, in the case of conflict between the governmental regulations and Islamic law, Islamic law dominates.

2.4.4 Economic perspectives

(i) ***Scale and scope.*** From an economic perspective 'full privatisation' could be specifically defined, as the "…transfer of ownership and control of government or state assets, firms and operations to private investors. This transfer takes the form of issue and sale or outright distribution of shares to the general public" (OECD, 1999, p. 69). The, OECD goes on to suggest a further definition, proposing a range of treatments which also embrace policies and processes such as *contracting out*, where activities, while publicly organised and financed, are carried out by private sector firms.

The consideration of changing perspectives over time within the HC industry, and the variety of possible movements towards privatisation (i.e., corporatisation, as opposed to partial or full privatisation) brings further complexity to definition and assessment when considering the economies of scale and scope. For example, the decentralisation of a state organisation may involve greater economies and reduce transactions costs, however, in someway this is not different to the proposed advantages of nationalised industries which may have strong characteristics of natural monopolies (Chick and

Nelles, 2007, p.278). Nevertheless, in the case of privatised entities, the problems with information flows and incentives could cause diseconomies of scale, particularly in the area of transaction costs before, and also after, contracts are signed (Coase, 1937). However, Baumol and Lee (1991, p. 1) suggest that contestability may be relied upon to achieve an appropriate scale using the "…norms of behavior provided by the theory as a guide for regulation of its larger firms, instead of resorting to nationalization". Coase argues that the size of a firm (as measured by how many contractual relations are 'internal' to the firm and how many 'external') is a result of finding an optimal balance between the competing tendencies of these transaction costs. Nevertheless, in general, making the firm larger may initially be advantageous, but the decreasing returns indicated above may eventually prevail. Whilst it could be argued by some that HC can never be a truly competitive industry, the UK has attempted to create a semblance of market competition and evidence suggests some potential cost and benefits, whereas international results are more consistent and reduced costs for patients and commissioners are observed (Health Foundation, 2011). However, there is a view that this assertion cannot be applied equally across England, Wales, Scotland and Northern Ireland (Learmonth, 2018). Indeed, comparisons with the Scottish NHS with its centralised oversight has provided a stability of service in comparison to the market- driven changes introduced in England, Wales and Northern Ireland. However Scottish NHS financial costs have been consistently higher per head.

(ii) ***Costs and benefits*****.** Contestable Markets Theory Baumol, *et al.* (1982) propose that, where entry barriers are low, even the threat of potential entry by firms attracted to an industry where price > marginal cost, may be sufficient to make incumbent firms keep price close to marginal cost in order to deter new entrants. It could be argued that Contestable Markets Theory implies regulation to increase the entry threat (not

privatisation), as opposed to SCP (see 2.2 above). Traditionally in neo-classical economic theory, firms were assumed to maximise profits, i.e., revenues minus costs, which necessarily implied the minimisation of short-term average costs, regardless of market structure; this might affect revenues differently in the case of perfect competition, oligopoly, and monopoly. However, if long-term average costs decline over the entire range of demand (as in natural monopoly) then it might be efficient to have a monopoly or regulation of entry by the State.

The height of barriers to entry, and therefore their implications for costs incurred after privatisation, should also be considered empirically. Williamson (1981) supports a Transaction Cost Approach which focuses on the processes, governance and organisational structure of the firm, rather than commodities, as a basic unit of analysis. Williamson's transactions costs include the costs incurred overcoming barriers to entry, and he generally proposes that contractual costs depend on that the human agents are confined by rationality and that at least some agents are characterised by opportunism (Williamson, 1981). The point here is that, during privatisation, if barriers to entry (fixed/sunk costs) are low, competition or threatened competition might prevent incumbent firms from taking advantage through the 'moral hazards' of Principal-Agent theory (see below).

(iii) ***Behaviours*****.** Principal-Agent Theory analyses the effects of the possible divergence of interest between Principals (e.g., Government) and Agents (e.g., Health Providers) under asymmetric information, when it is difficult for the Principal to monitor the actions of an Agent. In this case, agents could easily take unobserved actions, giving rise to possibilities of 'moral hazard' (negative opportunistic behaviours), in pursuit of their own self-interests or profit, at the expense of the interests of the Principal. Migue and Belanger (1984), as cited in Adams, *et al.* (2006, p.386) suggest in their model "…that

even where the politicians would be prepared to finance additional output, bureaucrats may offer fewer units in order to retain some discretionary funding". Williamson (1964) hypothesised that under uncertainty, profit maximisation could not be the objective of the managers of a joint stock organisation. However, agency theory assumes that *utility* maximisation is a manager's sole objective. Where some decision-making authority is delegated to the agent, managers may focus on increasing the size of the firm as their source of utility, rather than shareholder returns, because that may give them greater prestige and a larger power base (McColgan, 2001, p.4). This divorce of ownership and control may be resolved when privatisation promotes a partial or total unification of ownership and control. Malik (2015, p.19) states that "Corporate governance is the response to typical agency problems between investors and managers of firms, who frequently have divergent interests". At the same time, Tirole (2011, p.1) offers a definition which proposes that "…corporate governance among economists and legal scholars refers to the defense of shareholders' interests." However, different cultures have different perceptions. For example, this sentiment would not be accepted in a stakeholder-based environment such as Germany or Japan as suggested by Lubetsky (2008).

On a similar theme, Alchian and Demsetz (1972) identified that a 'shirking' problem was a possibility in team production, which is common to most firms. If aggregated over the firms in a privatised industry, this may result in Market Failure, since private Marginal Benefits may diverge from social Marginal Benefits. In the case of privatisation, firms (if unobserved and unregulated) may maximise their own profits, e.g., by not providing care unprofitable patients. Whilst there is no specific set of conditions that can determine market failure which covers both human and environmental factors, agency and transactions cost theories are useful frameworks to compare the strengths of market-driven versus bureaucratic structures (Ouchi, 1980).

What is clear is that there is a diversity of theoretical positions that endeavour to explain the logic, potential challenges, and possible outcomes of privatisation. On the one hand, the economic theories of the SCP paradigm (reviewed by Boru and Kuhil, 2018) may be argued to favour privatisation and breaking up (State) monopolies, while Contestable Markets Theory (Baumol, *et al*., 1982) would favour regulation and lowering entry barriers as a means of increasing competition which may improve efficiency. On the other hand, theories of Markets and Hierarchies (Coase, 1937; Williamson, 2005; Ouchi, 1980) might predict that privatisation will face difficulties depending on cultural factors in relation to governance using markets, hierarchies or trust. Imperfections in product and capital market competition may also generate undesirable outcomes.

In the context of these different implications of theories for policy, this literature review will now move on to consider various empirical studies which provide findings from different contextual and cultural settings, and explore the benefits, challenges and outcomes of both corporatisation and privatisation within the context of HC.

2.5 Empirical Research – Challenges and outcomes

In the light of these conflicting theoretical perspectives, it is necessary to review empirical outcomes reported in the literature on privatisation and corporatisation.

2.5.1 Meta-analyses

Cavaliere and Scabrosetti (2008) conducted an in-depth study of the literature on privatisation and efficiency by following its evolution from the application of agency theory to recent contributions from political economy. They observed that PE had improved substantially, while AE was higher in SOEs (Cavaliere and Scabrosetti, 2008).

Due to re-organisation, privatisation may have facilitated increases in PE, while its effects on AE were not so certain.

Bel and Warner's (2008) focuses on the challenging issues of privatisation within local governments. Using empirical studies from North America and Europe the relevance of insights provided by transaction cost theories is identified, suggesting that many privatisations have not delivered as expected on cost savings. The primary reasons for this are considered to be inadequate management of service delivery markets and a lack of competition. They conclude that other forms of market governance, e.g., managed–mixed public/private delivery, mixed public/private firms, inter-municipal cooperation and dynamic contracting may achieve better results.

Hodge's (1999) meta-analytic international review considers 162 empirical studies showing that post-privatisation improvements in productivity and financial performance were significant. Nevertheless, he also cautions that these results should not be seen in isolation, as the performance of the control firms in the study were also seen to similarly increase. Privatisation produced labour productivity gains, but Hodge believes there is no simple link between the size of the private sector and national economic growth. From a customer/consumer perspective, the narrative reviews considered by Hodge suggest that consumer promises were often not met. Some areas did show significant service quality improvement, but this was attributed to regulatory intensity and public accountability rather than to ownership change. Similar to Bel and Warner (2008), Hodge (1999) identifies the most critical issue related to privatisation of SOEs to be the effectiveness of new regulatory and competition arrangements. Regulation is about reordering priorities and power and policy permanency. In the context of privatisation, the role of regulation may be important. It is a distinctive mode of policy making and an alternative mode of public control. The primary aim of introducing a regulatory framework is that it may

provide a degree of independent oversight to protect the consumer, privately owned new companies and the government (Hossain and Malbon, 1998).

2.5.2 Regional, country, and sector comparisons

Considering a 25-year period (1977-2001) globally, Western Europe has shown the greatest number of privatisations (but smaller), closely followed by Central and Eastern Europe and the former Soviet Union, although the scale varied between regions, with individual transactions within Asia being considered proportionally fewer but larger (Bortolotti and Siniscalco, 2004).

Towards the end of the study period a decline in the number of transactions was identified. British privatisations were predominant in this period as early adopters, with the key drivers being de-nationalisation and austerity, i.e., a reduction in public sector borrowing requirements. In this case, it is important to note that although major corporations were privatised, in many cases the government continued to hold a 'golden share' which allowed the state a power of veto over strategic decisions (Bortolotti and Siniscalco, 2004). A particularly interesting example using this approach is provided by Parker and Wu (1998) which analyses the performance of British Steel Corporation (BSC), before and after privatisation in December 1988. In the first stage, performance in terms of trends in labour, total factor productivity, and profitability are assessed, followed by a comparison between the PE of the UK steel industry and six other major steel producing nations.

By using Data Envelope Analysis (DEA), positive results were found for BSC prior to privatisation, followed by a collapse in performance. In contrast, Aylens (1988) as cited in Gomés, (2001) also examined the UK steel industry, stating that the overall performance of the BSC improved after privatisation. In 1980, BSC was one of the lowest-performing companies, manufacturing steel at extremely high cost compared with

competitiors (Gomés, 2001). This trend was reversed by the mid-1980s and the BSC shifted to the top spot, though hidden subsidies could conceivably have been responsible (Blair, 1997, p.575). This change did not require any change in ownership. Decentralised business units with clear commercial objectives, which focused on outcomes, were established. Productivity bonuses were paid to the workers in 1987, which accounted for 20 per cent of the total income of a steel worker. Increments in incentives led to the improvement of the work force, thus giving an upward thrust to the business. However, it is difficult to judge the long-term effects of governance changes in BSC, with over sixty years of nationalisation/denationalisation. Although, it looks like that the UK government thought it was rational to help BSC pay the dues arising from its own fail, in 2019 BSC was forced into compulsory liquidation after the UK government refused to further cover short-term financing needs of £30m (Coppola, 2019). It cannot be concluded that privatisation for this organisation was a success story.

Other areas of Europe followed Britain with large-scale privatisation activities in the mid-1980's with the trend reaching a peak in the late 1990's. In most cases the highest revenues were raised by public share offerings in the early sample period, with smaller companies owned at local government level sold through private sale. It is interesting to note that some governments (e.g., France) preferred partial privatisation whilst others (Germany and Italy) retained governmental control over 'strategic' companies, in addition to tight regulatory controls and statutory constraints.

A review (Gomés, 2001) of privatisation in each of the European Union's member states identifies differences in the degree of privatisation. She also elaborates on the barriers that may have prevented efficiency gains, e.g., the peculiar form that privatisation took in many cases and the behaviour of the capital market in some regions. Gomés indirectly notes that privatisation could lead to a redistribution of income, wealth, and

economic power, although these effects are yet to be studied and researched. The author also recommends a focus on the long-term effects of the competitiveness of European privatisations and the implications for social welfare.

Within North America and the Caribbean, privatisations highlight the impact of cultural differences between countries, with the USA mainly focusing on the outsourcing of public services to private operators (Bortolotti and Siniscalco, 2004). It is suggested that in this case, privatisations bring significant savings to the taxpayer, with former public services requiring fewer employees working at higher productivity.

Contracting-out appears mainly in those countries with strong legislative control over public budgets and a history of fiscal crisis, suggesting that local politicians with 'soft budget constraints' (SBCs) are forced to privatise public services to achieve greater efficiencies. However, Bortolotti and Sincalco (2004, p.83) suggest that privatisation is a process which could start with the sale of minority stakes of SOEs to just raise capital. The concept of SBC was introduced by Kornai (1986) and has become a familiar part of the economics lexicon. Originally formulated by Kornai to analyse economic behaviour in socialist economies marked by shortage, the SBC is now regularly invoked within a literature that examines the economic transition from socialism to capitalism and from SOEs to privatisation. It is noted that budgetary constraints seem to be harder in the wealthiest and most liberal states, where public preferences have been transformed into stringent laws. In contrast, the opposite is observed in the poorer areas where levels of unemployment and unionisation are high (Kornai, 1986, p.25).

The relationship between the effectiveness of privatisation and institutional development implies that privatisation tends to result in "…less positive outcomes in transition economies where the institutional environment is weak" (Wang, 2007, p.5). Wang (2007) furthermore suggests that privatisation may not be an effective device in

resolving agency problems. This has been shown to be the case by the problems with Russia's 'voucherisation' programme, as 'insiders' stripped assets knowing that newly generated minority shareholders had no transparency or enforcement capabilities to prevent such opportunistic behaviour (Jefferson, 1998). In contrast, within other developing countries (for example Sub-Saharan Africa) the main driver of privatisation was to support the need for investment, infrastructure, and services, with privatisation seen as a step towards attracting international investment into SOEs to facilitate the area's development.

Many countries chose to partially privatise SOEs. According to Li and Wang (2006. p.653) "Partial privatization, or allowing the state to remain as one of the owners of these firms." As mentioned in 2.3.2 above, on the other hand, Clarke, *et al.* (2005) argue that privatisation should not be done partially, where Governments holding majority shares in SOEs may result in those firms performing poorly by conventional accounting measures. Governments may reduce ownership through share flotations, widely used by many developing countries since the early 1990s. According to Huibers (2004) as cited in Rindyawati (2013), approximately 33 of the 80 countries outside the OECD employed initial public offerings to privatise state-owned banks. Since the state-owned banks in a country are mostly considered as large enterprises, performance of national stock markets might improve. Giving access to capital and improving economic growth could indirectly affect other domestic enterprises. Privatisation through initial public offerings may also motivate broader investment (Rindyawati, 2013, p.11). Moreover, Huibers (2005) as cited in Jiang and Yao (2011) declared that, for various reasons, state ownership is usually blamed for poor performance, where governments fund sectors with low financial and high social returns. Theoretically, state ownership means "all citizens are co-owners who in practice have no power and no incentive to influence and monitor the management of

state banks. This free-rider problem leaves governments the only effective representative agent" (Jiang and Yao, 2011, p.4).

Garrón, *et al.* (2003) considered the transfer of 31 (out of a total of 93 privatised firms), to the private sector, across a number of industries (including Agro-industrial, Manufacturing, Transportation and Communications), in Bolivia since 1992. The results indicate increased productivity in these firms, associated with a reduction in fixed assets, sales, and employment. The decrease in fixed assets was greater than the reduction in employment, suggesting that the productivity increase may have owed more to improved allocation of capital than improved use of personnel. In this case, the overall impact on national unemployment raises an important consideration: reducing employment in one industrial sector may well raise productivity but also unemployment if alternative jobs are not secured. Similarly, a decrease in the manufacture and maintenance of fixed assets may have a negative impact on other industries. Because of the decrese in the sales and the focus of the authors on 'net profit over sales', the study suggested that privatisation of the firms in Bolivia had no significant impact on their profitability. In addition, the majority of the Bolivian firms were in massive debt before privatisation.

A study by Galiani, *et al.* (2003) to examine the effects of privatisation for financial and non-financial Argentine firms. In the case of non-financial firms, although the study did not find any statistically significant effect of privatisation on prices, the results showed that there were large increases in operating efficiency and profitability. In contrast to the case of non-financial firms, the study did not find overall large increasing in operating efficiency after the privatisation, however, some indicators of efficiency performed well (e.g., output per employee increased). Employment decreased during privatisation, which may be either a cost or a benefit, depending on whether the economy is above or below potential GDP. In addition, the study found a decrease of child MR

when water utilities were privatised. Finally, in this example, investment increased by at least 350 per cent as a result of privatisation, consistent with the view that one of the main motives was to re-establish investment. Generaly, the results of this study showing "…a favorable picture of privatization." (Galiani, *et al.*, 2003, p.43)

Anuatti-Neto, *et al*. (2003) tested the relative effectiveness of 119 Brazilian companies privatised since 1991, where the state decentralised control of the firms and sold minority stakes to the private sector. This study found that privatisation was associated with improved financial performance, brought in foreign investment and increased operating efficiency. However, final conclusions are difficult because (a) some of the improved financial performance was achieved through increases in product prices and (b) employment was reduced. Higher investment created new jobs but not necessarily for the newly unemployed, and in the end, public opinion was not totally supportive.

In the light of this review of international empirical studies on corporatisation and privatisation, there seems to be a general suggestion that they have found associations between these governance reforms and improved financial performance and productivity, thus supporting an SCP perspective. However, it is important to remember that costs may have been incurred elsewhere in order to achieve higher profits and productivity, and to understand in more detail whether findings of productivity gains are generalisable, e.g., whether applicable to the HC sector in KSA.

2.5.3 Health care systems and services

The WHO states that "a good health system delivers quality services to all people, when and where they need them" (Regmi, 2012, p.1). The exact configuration of services varies from country to country, but arguably requires in all cases "a robust financing mechanism, well-trained and adequately-paid workforce, reliable information on which

to base decisions and policies, and well maintained facilities and logistics to deliver quality medicines and technologies" (Lekshmi, *et al*., 2014, p.92).

The governance reforms and policies towards management intended to deliver improved health services can be examined at several levels (Preker and Harding, 2003). Firstly, consideration of clinical management at a *patient level* needs arguably to address performance options related to the coordination, clinical administrative costs, efficiency and effectiveness of processes at a service/provider level. Secondly, the mechanisms of governance at an *organisational and institutional level* must arguably consider problems with efficiency, productivity, quality, as well as client responsiveness, related to incentives faced by the organisation as a whole. Finally, the stewardship and policy process at the *national level* must arguably address a holistic oversight of the health sector, budgetary management and predictability as well as overall rationality and efficiency of resource flows.

When addressing the patient level, the variance between the actual performance of health systems and the rising expectations of society is leading to more pressure for both health authorities and political leaders. This is evident, particularly within the USA, which, although possessing the most marketised health system in the world, may also be considered the most expensive and inefficient one, with reportedly bad outcomes, and low levels of customer satisfaction (Zakaria, 2012). Although, HC is a requirement for human life and it should be benefited to everyone including those who cannot afford to pay, the USA HC system has not matched the expectation of the population. The biggest beneficiary of the USA HC sector is the private health insurance corporations which cooperated with the good HC facilities on how their patients are covered, consequently, allowing the uninsured people (15 per cent) to access only a few government facilities (Jaqua and Jaqua, 2019).

Country-level statistics (Ford, *et al.*, 2013) suggest that the USA has private health costs per person that are disproportionally high due to high drug prices, transactions costs and shareholder compensations, with overall spending increasing at nearly five times GDP growth, with governmental spending on health also increasing over the past 40 years (Crivelli, *et al.*, 2010). Whilst there could be many reasons for this observation, a key factor for consideration is that the USA "is the only industrialized country that treats HC like a market commodity instead of a social service" (Angell, 2008, p.1). Even before the full roll-out of the Affordable Care Act (ACA or 'Obama- care'), government HC spending had soared from 3.5 per cent of GDP in 1987 to 8.4 per cent in 2011 (Pope, 2013). However, some believe that the USA has the most efficient HC system when considered from the point of view of dynamic efficiency (Waśniewski, 2012), since the system of private HC has created an incentive to invest in new technologies. The economy of the USA has been found to have high dynamic efficiency in general (Abel, *et al.*, 1989), but in terms of measured static health outcomes on a global basis (for example life expectancy and infant mortality) the USA shows poor results. Nader (2012) goes a step further and suggests that HC bills come with high levels of fraud suggesting that fully 10 per cent of all HC expenditures are the result of computerised billing fraud and abuse, stating that "2.7 trillion dollars of annual HC costs opens a gigantic window on the massive waste, redundancy, profiteering, fraud, and sometimes criminal over-billing" (Nader, 2012, p.1). This issue was identified by Lapsley (1993), who highlighted, with caution, the possibilities of opportunistic behaviour within a purchaser/provider model.

In contrast, Villa and Kane's (2013) analysis of the USA health situation provides a different perspective, with the results of their study suggesting a more positive outcome such that privatisation "might be an effective strategy to make universal health coverage systems more efficient and sustainable" (Villa and Kane, 2013, p.32). The results of this

empirical study showed increased operating margins, reduced lengths of stay, and higher occupancy rates, although caution was noted around costs of access to care, in terms of the loss of beneficial but unprofitable services. In this case, it should be noted that the survey only considered three limited locations within the USA. In comparison, a study by Ozcan and Luke (1993) of a sample of 3,000 urban hospitals in the USA examines the variation in hospitals' PE. In this analysis, government-run hospitals were found to be more technically efficient than for-profit hospitals.

It is also important to consider how different health service offerings are influenced by privatisation. Brent (2008) assessed a cost-benefit analysis of the privatisation of psychiatric hospitals in the USA. Within this sample it was observed that the privatisation of psychiatric services in general hospitals would provide a social gain only if the change took place in for-profit instead of non-profit hospitals (Brent, 2008).

Whilst the literature on the USA's HC systems provides us with useful insights into the potential challenges and risks of a particular form of private operation, we also need to be aware of other modes of implementation and influencing factors.

Angell (2008) compared the HC systems of Canada and the USA. He suggested that the Canadian government was in favour of making the Canadian HC system more like the USA's system, by partially privatising it. Yet it is proposed that HC costs per person are twice as high in the USA than in Canada, has worse outcomes, is less 'efficient', and provides fewer basic services than the Canadian system. Angell (2008) found that the best way to improve the Canadian HC system is to put more resources into public HC and concluded that the best option may be partial privatisation with government monitoring through the use of performance contracts.

In a case study regarding the privatised hospital St. Goran in Sweden, it was found that the effects of the privatisation were not negative, and could be attributed to the media

attention that this change received. The high media interest in the hospital may have meant that employees felt they were being noticed and that the organisation was perceived as modern and successful (i.e., The Hawthorne Effect as noted by Falkenberg, 2010).

Finally, the threat of transferring a public health system hospital into the market place could be considered as the single most effective means of ensuring greater static efficiency in the services provided by the hospital (Lapsley, 1993). In this case it should be stressed that it may not be just the act of privatising the hospital that is perceived as being the means of ensuring AE and PE but, also the perception of a threat of privatisation may act as an agency for change. Such a belief would appear to confirm the findings of the Martin Company Study conducted during the USA's Industrial Revolution. This study demonstrated that the productivity of employees might improve if they believe their work performance is being scrutinised. Lapsley (1993, p.388) also believes that it is the threat of possible ramifications that is "the single most effective means of ensuring maximum efficiency" although the longevity of success through this means of motivation (i.e., through the imposition of fear) seems likely to be short lived.

With recent advances in technology and new entrants using low cost 'startup' models, the threat to traditional HC models and markets should not be underestimated. For example, a survey carried out by PWC (Brino, 2014) suggested that consumers would not be averse to using at-home kits for diagnoses, or online consultations that have previously been supplied in clinical facilities or hospitals.

Moving on from privatisation studies, Maharani and Tampubolon (2016) consider a number of studies that address the impact of corporatisation on hospitals in various countries, finding a variety of conflicting results when focusing on the impact of efficiency and quality of care on overall hospital performance. Their review highlights a number of limitations to the studies including narrow sets of data (either by time or

quantity of hospitals considered), the omission of control hospitals (i.e., non-corporatised hospitals), unobserved variables and, finally, the inability to uncover the underlying association of corporatisation with hospital considered due to poorly specified models of analysis (e.g., taking no account of heterogeneity).

Whereas the USA has predominantly chosen a private property rights approach with assets remaining in the private sector, many countries in Europe have followed a gradualist implementation. It is suggested by Wadge, *et al.* (2017) that private HC may play a role that is complementary to public services and may fulfil a demand for care amenities and reduce waiting lists in primary care through the purchase of supplementary private health insurance on a personal preference basis, with health services provided through a framework of public, semi-autonomous government hospitals, governmental and private hospitals.

As an alternative to extreme *laissez-faire* or total control by the State, Rodriguez-Alvarez, *et al.* (2012) look at how alternative forms of corporatisation of health services can benefit developing countries which are also seeking to improve the performance of their public health systems, where demand uncertainty impacts efficiency. Rodriguez-Alvarez, *et al.* (2012) consider the Spanish model where the National Health Service provides a publically funded service with access to free health services at the point of use. Private HC plays a complementary role and provides services not covered in the public offering, fulfils demand in care amenities, and helps avoid waiting lists. Private services are provided through the purchase of private health insurance or on a fee-paying basis.

Tiemann, *et al.* (2011) compared efficiency in terms of cost and technical aspects on German public, private non-profit and private for-profit hospitals, with mixed findings. In contrast to the evidence from studies in other countries, especially the USA, the data from Germany indicated that private ownership (i.e., private for-profit and non-profit) is

not necessarily associated with higher efficiency as compared to public ownership. The results show that public hospitals were found to have higher efficiency than private non-profit hospitals. Tiemann, *et al*. (2011) also found that private for-profit hospitals were providing better quality services, which (for the examples considered) is measured by only one indicator - risk-adjusted in-hospital mortality, (Tiemann, *et al.,* 2011, p.7) - as compared to other types of ownership. In another study, Tiemann, *et al.* (2012) reported that the transfer of hospitals from the public to the for-profit private sector led to permanent increases in efficiency, however, increasing the efficiency of private non-profit hospitals was temporary when converted from the public sector.

Whatever the degree of movement towards market-related reforms (i.e., partial privatisation, corporatisation, or just the perception that they are being considered) is chosen, it seems evident that any reform must create mechanisms to ensure that vital services continue to be delivered. Considerations of alternative modes of performance enhancement also need to be further explored but could include placing some financial risk on the end-user, which might encourage patients to utilise facilities and services more sparingly. For example, in the USA it has been shown that uninsured patients are less likely to incur any HC expenses in a year than their counterparts who have coverage because they use fewer and cheaper services. However, this could have a negative impact on health outcomes (Institute of Medicine, 2003). Another approach could be to increase regulatory controls on profit margins in highly marketised environments, specifically when dealing with service provision to un-insured individuals, who could be supported by governmental subsidies either to the patient or directly to the hospital (Institute of Medicine, 2003).

On the other hand, hierarchical, bureaucratic regulations may not result in improved effectiveness and efficiency. It may be that both efficiency and effectiveness in providing

HC services could not be maintained because the management did not have adequate control of resources (especially labour) and production (Lapsley, 1993). Another issue is that managers may be unable to maintain their quality of work on a daily basis due to the absence of performance-based incentives for individuals, teams, or organisations (Preker and Harding, 2003). It may be important to provide appropriate incentives to staff to encourage a fair and transparent working environment, as advised by Wilson, who asks, "Why scrimp and save if you cannot keep the results of your frugality?" (Preker and Harding, 2003, p.5). In fact, the effects of performance incentives were shown to significantly improve the PE of health centres in the study carried out by Akazili, *et al.* (2008) within health service provision in developing countries.

However, if responsibilities are moved from centralised to localised control, giving hospitals some degree of management autonomy, the introduction of a new layer of rules and regulations regarding operations and interactions between the different layers suggests that a structured form of accountability with respect to performance measures is required (Preker and Harding, 2003). Strengthening such mechanisms may be a critical element of organisational reform, which reduces the use of traditional hierarchical accountability mechanisms. Performance measures have sometimes been recorded in a 'framework agreement' or 'performance contract'. This mechanism is intended to clarify the objectives and outcomes of the service as well as to formally specify the criteria by which management will be judged. In a few cases, a board of directors has been established to implement this process of monitoring managerial performance and depoliticising decision-making. Such decentralisation is one aspect of corporatisation. According to Preker and Harding (2003), effective corporatisation appears to be an institutionally intensive organisational reform that necessitates a sustained, complex, and politically challenging role for government agencies and officials. However, the

experience with performance contracts in public hospitals may be seen as unimpressive (Preker and Harding, 2003).

Although the NHS in the UK has followed different solutions to supplying HC services to the public for 68 years, "More recently, under the UK coalition government, £4 million was allocated to develop 'cutting-edge ideas' focused on addressing major health management problems (Gov. UK, 2014) and, in the past year, there was investment of £15 million by Innovate UK in projects to address the challenges" (Fascia and Brodie, 2017, p.338). The UK's contracting-out of services within the NHS has raised many complaints involving the asymmetry of information, which prevents inexperienced local councils from monitoring private HC providers. This may permit private providers to "Exploiting opportunities to increase revenues through 'gaming' the system" (Button and Leys, 2012, p.7). For example, bidders may submit low bids to win contracts but may later overcharge local councils for providing care when it is difficult to refuse to pay on compassionate grounds. Furthermore, in the case of the mentally ill (a group which may not be able to articulate their concerns) one provider was exposed for using abusive practices to reduce care and thus increase profits (Kelley, 2009). Note that these undesirable behaviours are difficult to anticipate. Therefore, the solution of 'performance contracts' used in the literature has been considered on a case-by-case basis. Principal-Agent problems can (in theory) be mitigated arguably by 'complete contingent contracts', which specify all the actions which the Principal wants the Agent to take in the event of every situation. Thus, the contract may seek to prevent a 'business as usual' collusive culture (Lapsley, 1993) among private providers. More directly expressed, there may be a tendency for a collusive culture to cover up any problems with the private provider.

Brock (2004) examined the changes in the public health system and primary care services in Florida's county health departments. It was reported that most public health

professionals believe that the public sector should maintain oversight and monitor private contractors to ensure that populations receive the necessary level and quality of care. It was also reported that they may believe (as the health department's role in clinical services declines) that public health officials should strengthen their focus on essential public health services. Preserving, protecting, and promoting the health of communities may remain an important consideration. Brock (2004) concluded that County health departments should retain a role in quality assurance, case management, disease surveillance, education, and outreach to vulnerable populations. By making the appropriate choices, public health departments may effectively and efficiently manage the safety net.

2.6 Managing Performance

Performance, as defined by the International Standards Office (ISO, 2015) is a measurable result that can relate either to quantitative or qualitative findings. Performance is assessed against predetermined criteria measuring the economic efficiency, effectiveness and quality aspects of the goods or services supplied (OECD, 1997). The following subsections will explain what is meant by these concepts in a HC setting and how this compares to more generalised economic definitions.

Theoretically, the SCP paradigm view is that market concentration may involve collusion or other monopolistic practices, (i.e., the greater the number of firms in an industry the more competitive it may be). Where a number of firms compete, they may find it more difficult to charge prices above marginal cost, earning excess profits. Conversely, increased concentration may encourage anti-competitive practices and raise excess profits, though from an Efficiency perspective, a firm's profits performance may be positively related to efficiency because efficient firms with low cost structures may increase profits by expanding market share (see section 2.2 above).

Of course, privatisation may lead to competitive or uncompetitive product markets. Besides the possibility of increased product market competition, privatisation exposes firms to the discipline of private capital markets. However, this discipline may be flawed. Compared with government supervision, yes, capital markets may provide 'harder' budget constraints (Kornai, 1986) and more dispassionate supervision. However, capital markets may also be excessively 'short-termist' or provide inadequate supervision of executive directors awarding themselves generous remuneration.

2.6.1 Quality aspects of performance

As noted above, the OECD (1997) definition of performance consists of efficiency, quality, and effectiveness aspects. In the same way that efficiency in a HC setting is considered difficult to define, the same can also be said of the quality of HC. Generally, the ISO 9000 standard (ISO 8402, 2004) defines quality as "the totality of features and characteristics of a product or service that bear its ability to satisfy stated or implied needs". Raleigh and Foot (2010) provide a simple overview of the six domains of quality in a HC setting from the Institute of Medicine (IOM, 2001). These comprise Safety, Effectiveness, Patient-centred Experience, Timeliness, Efficiency, and Equity, and this is one of the more respected and inclusive quality frameworks used within the HC industry. The World Health Organization (2006b) provides definitions for each quality dimension in the IOM framework:

- ***Safe*****,** avoiding harm from the care that is intended to help.
- ***Effective*****,** delivering HC that is based on evidence and results in improved health outcomes for individuals and communities, based on need.

- ***Acceptable/patient-centred Experienc***, delivering HC which takes into account the preferences and aspirations of individual service users and the cultures of their communities.

- ***Timeliness***, delivering HC that is timely, geographically reasonable, and provided in a setting where skills and resources are appropriate to medical need.

- ***Efficient***, delivering HC in a manner that maximises resource use and avoids waste.

- ***Equitable***, delivering HC which does not vary in quality because of personal characteristics such as gender, race, ethnicity, geographical location, or socioeconomic status, safe, delivering HC which minimises risks and harm to service users.

To support these six domains a number of indicators or measures may be defined to enable quality assessment. Donabedian's (1966) classic paper for assessing the quality of care defines three measures of quality – structure (e.g., resources and services utilised), process (clinical procedures and interventions) and outcomes (for example mortality or well being). This is the model that the KSA (CBAHI, 2015) has adopted for the assessment of quality where structural standards address the system's inputs, such as hospital beds available, manpower, design of hospital buildings, availability of personal protective equipment for health workers (e.g., gloves and masks), and the availability of equipment and supplies (e.g., microscopes and laboratory reagents). Activity and procedural standards address the clinical and administrative activities or interventions carried out within the hospital in the care of patients or in the management of the hospital or its staff (e.g., PE, inpatient discharged, tests performed, waiting times responsiveness). Outcome standards look at the assessment of the benefits of an intervention and whether the expected purpose of the activity was achieved. They provide

information about whether predicted outcomes are being realised. Examples of outcome quality indicators may arguably include MR indicators.

2.7 Chapter Summary

To summarise, hospitals are clearly important to public health. Regardless of cultural differences, in many countries a frequently proposed policy to address hospital efficiencies is a movement to a corporatised or (fully or partially) privatised structure. This is consistent with theory of the SCP paradigm (reviewed by Boru and Kuhil, 2018) which implies breaking up monopolies (including state monopolies, i.e., privatisation) may improve performance. SCP is therefore adopted as the basis for the generation of hypotheses in this thesis, extended beyond privatisation to movements towards privatisation (i.e. corporatisation). Of course, these market-related reforms do not guarantee competition, e.g., the act of privatisation alone may not achieve more product or capital market competition.

The second theme considered in the literature review considers the potential PE of different forms of privatisation (Cavaliere and Scabrosetti, 2008). Measuring the efficiency and effectiveness of services delivered in a hospital may be extremely difficult in light of collusive or culture-based control systems under which hospitals may operate (Lapsley, 1993). In certain countries, the most difficult aspect of measuring hospital performance, and introducing new forms of management into a traditional hospital system, may be related to deterministic, collusion-based behaviours, culture and associated control mechanisms that define clinical processes and procedures.

The resolution of these ‘soft’ factors (as opposed to hard economic ‘facts’) and the effect on particular forms of privatisation performance measures also needs to be studied in further depth (Marr, 2012). However, Braithwaite, *et al.* (2011) provides a level of caution in assessing the overall impact of the advantages and disadvantages of

corporatisation and suggesting that in most cases evidence on either side of the argument is weak and often conflicting without clear or concise answers due to poorly designed studies and inconsistent data. Despite this challenge, the recurring message within this literature review is the need for accountability via a system that captures the relevant performance and efficiency measures tied to key events in the production process, as generally we may expect to find that PE (and perhaps dynamic efficiency too) may be higher with some degree of privatisation, though AE and economies of scale may benefit more from public control. In addition, the impact of some degree of corporatisation on the activities of pharmaceutical companies further complicates the picture.

As noted in Chapter 1, the KSA has been ruled by one family (the House of Saud) since its inception, with a tribal culture extending to all aspects of society and commerce, including the health sector. Williamson (1985) suggests that understanding this wider (socio-economic) picture is important. In this context, it is crucial to take these socio-economic factors into consideration.

In conclusion, this review has identified gaps in the existing literature, where questions relating to corporatisation have rarely been addressed, and never in the KSA context. In addition, few previous studies have tried to control for the presence of fixed effects when considering the efficiencies of corporatisation/privatisation strategies. Therefore, a focus in this study on varying market-based health provision policies in the KSA may provide a unique opportunity to add new insights to current academic research, existing theories and provide a test of SCP predictions.

Chapter 3 will now outline the conceptual framework that explaining the key stages and processes towards privatisation, from initial motivations to assessing the performance of the entity (through different stages or levels of corporatisation), where efficiency acts

as one indicator of overall HC performance, and how governance reforms may be related to the quality aspects of HC performance outcomes.

CHAPTER 3

Conceptual Framework

3.1 Introduction

In any economy, there are many moving parts, making it difficult to isolate just one motivational factor behind a government's reform strategy. As identified in Chapter 2 the process of corporatisation may have a complicated relationship with the desire to achieve greater economic efficiency, specifically within the context of HC where other considerations, components, and outcomes (for example, quality aspects) may also need to be factored into the analysis. Furthermore, a positive view of corporatisation and privatisation strategies is, of course, only one possibility. Therefore, all possible outcomes should be considered.

Details of how corporatisation and privatisation movements may affect hospital performance were considered based on the literature reviewed in Chapter 2. This chapter presents a conceptual framework, explaining the key stages and processes towards privatisation strategy, from initial motivations to assessing the performance of the entity, where efficiency acts as one indicator of overall HC performance. The model is built through a diagrammatic approach, illustrating the pathways through which motivations trigger actions on the various components of corporatisation, which may improve the performance of the entity or system. The information from the conceptual framework is then used to generate a set of hypotheses to test.

The chapter is structured as follows. The next section 3.2 presents a diagrammatic representation of the conceptual framework linking the process of corporatisation to performance. Section 3.3 presents a model from which the stated hypotheses are derived. Finally, Section 3.4 concludes.

3.2 Conceptual Framework

Privatisation involves the transfer of ownership or management of firms from the public domain (government) to the private sector (private ownership). In Chapter 2, the literature review outlined the three forms of privatisation, where corporatisation is often seen as a necessary precursor to full or partial privatisation. A corporatisation movement towards full or partial privatisation will not commence unless there is a motivational trigger. Under public ownership or management of firms, the corporatisation process can be divided up into a number of logical components (see section 2.3.1). The change from public ownership may be carried out over a number of phases. In each of these phases the government may then undertake a number of actions that affect the status of each component and its movement towards achieving full or partial privatisation. Once the process of corporatisation is underway attention shifts to an understanding of the intended outcomes or impacts the chosen actions: overall performance will be assessed and the results will inform the previous steps in the process. The conceptual framework is summarised in Figure 3.1 below.

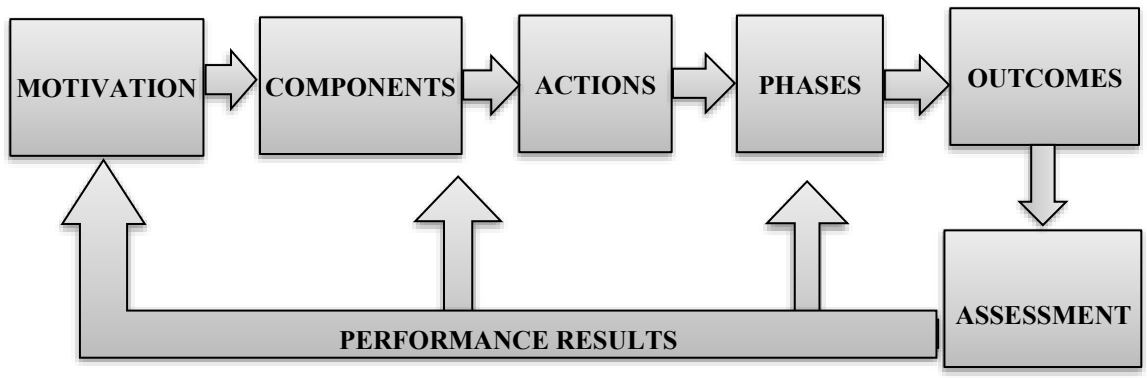


Figure 3.1 - Summary of Conceptual Framework

3.2.1 Motivations

The first stage of the model explains the motivations behind a corporatisation/privatisation strategy. These motivations are caused by influences acting

as triggers to the overall process of corporatisation and privatisation movements. When firms are under public ownership or management, there are several motivations for market-based reform including political, fiscal, desire to reform industry structure, and ideological shifts (see section 2.4.2). The figure below summarises the main motivations for embarking on a corporatisation strategy based on data from Clarke and Cull (1998); Galiani, *et al*. (2003); Garrón B., *et al.* (2003); Bel and Warner (2008); Painter (2009).

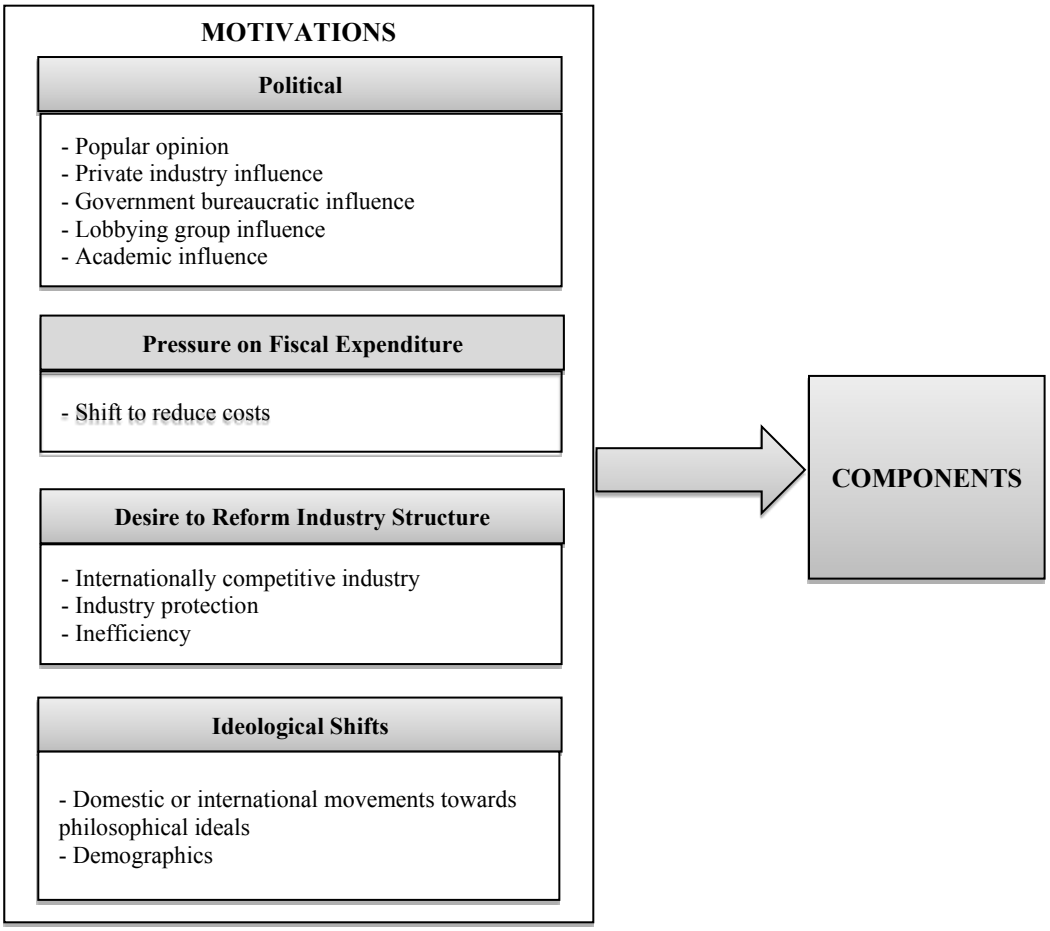


Figure 3.2 - Motivations for corporatisation and privatisation

(i) *Politica*l. It could be observed that the movement towards privatisation may be politically motivated (e.g., Feigenbaum and Henig's, 1994), potentially influenced by popular opinion, private industry, government bureaucracy, lobbying groups, and academia (Painter, 2009). Critics tend to focus attention on what they think are the disproportionate influences that private industry and lobby groups exert on shifts towards

privatisation. On the other hand, individuals seeing the advantages of these movements argue that government bureaucratic institutions and anti-reform academics hold too much influence over policy makers. Although this study does not address power and political influence *per se*, it could be a factor contributing to the success or failure reforms. It is worth noting that political motivation alone does not often lead to a government adopting movements towards privatisation (Bel & Warner, 2008; Rasmussen, *et al.,* 2018).

(ii) ***Fiscal deficit*****.** Movements towards privatisation can also be motivated by pressure on fiscal expenditures (e.g., Bortolotti and Sincalco, 2004), labelled here as the need to reduce a fiscal deficit. This motivation has a simple balance sheet explanation. When government spending is growing faster than the government's ability to pay for the expenditure, eventually the government has to cut down on the cost side of its balance sheet or increase taxes. Perhaps one of the most successful ways to reduce government spending is to shift costs off the government's balance sheet through movement towards privatisation. One of the clearest examples of this, is the wonders have been made through companies' privatieed by the Thatcher government from 1989 to 1990 (Moore, 1992). This budgetary motivation can go the other way as well, with governments, at times, eliminating private sector control over certain industries in an effort to reduce costs. In such an instance, reform may be more, as opposed to less, expensive (Clarke and Cull, 1998, Galiani, *et al*., 2003). Opponents often argue that a fiscal deficit has more to do with not enough taxes and not that costs are growing too fast. As with political motivation, this study does not empirically address the effect fiscal expenditure might have on reforms, although it is worth noting that the fiscal background may affect the success or failure of reform, and the need to reduce fiscal deficit is one possible motivation. Within the Middle East this motivational factor is becoming more evident, after the recent downward trend in world oil prices (Garside, 2019), resulting in oil exporting countries

seriously considering reform of their public entities as a means of diversification (Al-Omran, 2019). With respect to KSA, following the movement to the New Public Self-Operating System phases (a way from fully corporatisation), the MoH budget increased substantially year-on-year (see section 5.5.1); this might be associated with the fact that corporatisation and privatisation are considered an "important pillar of Saudi Arabia's recent economic reform" (Bazoobandi, 2019, p.2).

(iii) ***Industry reform*****.** The third motivation behind reform may be a desire to reform domestic HC industry structure, i.e., the need to carry out economic reform of domestic HC industry may involve changes to structure of hospitals in an industry considered to be inefficient. One way to address an inefficient domestic industry structure may be to move towards privatising it, supporting the premise that SCP applies as discussed in 2.2. and 2.4.4. Part of the reform could also be to address problems associated with monopoly power or some other industry structure. Supporters of market-based reform claim that - if well performed – it will lead to competition in the market place. In turn, competition may improve efficiency and performance (Dinavo, 1995). This is the positive point of view, also repeated in this study, as the Saudi government targeted corporatisation/privatisation to promote competition and enhance efficiency (CEDA, 2018). This view, however, is not universally accepted. Some academics and other supporters of government-managed institutions argue that the corporatisation/privatisation of some industries may lead to higher prices for consumers and a less innovative performance where competition is limited (Birdsall and Nellis, 2003, p.1622).

(iv) ***Ideology*****.** The motivation towards market-based actions may be related purely to a shift in a government's ideology. This study does not attempt to address ideological factors motivating reform. Nevertheless, it is worth noting that in the 1980s (see 3.2.1 (ii) above) the leader of the UK government at that time believed that privatisation is one of

the major reforms to eliminate the corruption impact of socialism. In contrast, the UK Labour Party believed that capital assets should be held by a popularly elected government to protect the country economically (Millar, 1997, p.391-395). Birdsall and Nellis (2003) suggest that governmental ideologies are due to the prevalence of public opinion and perceptions of unfairness in certain sectors of the community, rather than fact. However, according to Millar (1997) movement towards privatisation is not limited to a capitalist ideology alone.

3.2.2 Components

Components of a corporatisation (section 1.4) movement, full, or partial privatisation, are logical groupings of actions to firstly provide additional clarity and granularity to the process, and secondly to allow each component (and its associated actions) to act as independent (yet related) levers which can be adjusted to improve the overall performance. In the first stage of the process of corporatisation (on the assumption that corporatisation/privatisation is the chosen path), the motivations act as triggers to inform the orientation of the component structure. Depending on whether there are one or more motivations and how they are prioritised will affect the final structure of the model, and which actions are required to deliver the movement towards a partially, or fully, privatised regime. The conceptual model for this study is based on a subset of Harding and Preker's (2000) analytical model reviewed in Chapter 2.

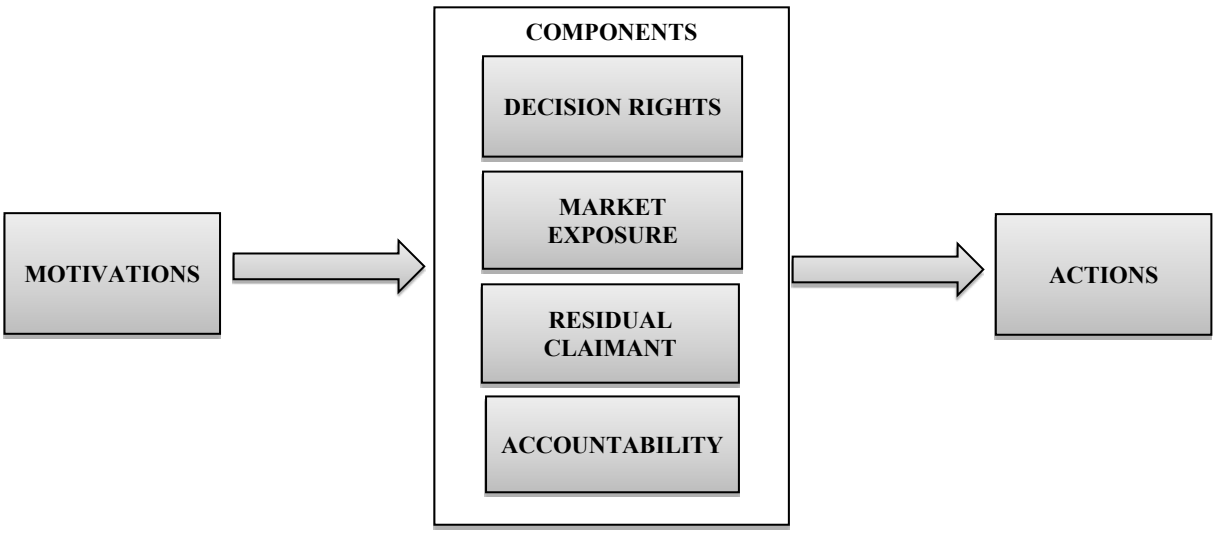


Figure 3.3 - Components of Corporatisation

The first three components in Figure 3.3 focus on those areas that may contribute to the desired efficiencies within the corporatisation strategy, whilst the last component takes a wider view of overall performance (ISO 8402, 2004) which includes both efficiency and quality aspects.

(i) ***Decision rights*****.** Increasing the autonomy of the organisation and its managers as it moves away from governmental controls allows greater freedom to make decisions at a local level. The local authority for decisions on various aspects of production including inputs, outputs, outcomes, and operational processes is increased in the movement towards full or partial privatisation **(**Preker and Harding, 2003, p.5).

(ii) ***Market exposure*****.** There are two dimensions to market exposure in corporatisation. Firstly, to create an internal market, introducing pseudo-competition between different entities (hospitals in the case of this study) to attract service users (patients). Secondly, there is a move to localised market transactions and introducing competition concerning recruitment, salaries and staffing mix, rather than centralised resourcing policies and planning.

(iii) ***Residual Claimant.*** Simply this means that any savings (the residual left after costs are accounted for) from efficiencies, budget surpluses, and profits are retained. As an organisation moves towards full or partial privatisation, the residual will not be retained by the public purse.

(iv) ***Accountability.*** Performance is related to both efficiency and quality. The accountability component of a corporatisation strategy introduces different controls, measures and regulations between the various stakeholders to influence the behaviours and actions related to achieving the desired HC outcomes in a manner outlined by the chosen performance model.

3.2.3 Actions

Actions are directly related to components and the result is change and movement as shown in Figure 3.4 (based on Preker and Harding, 2003) below.

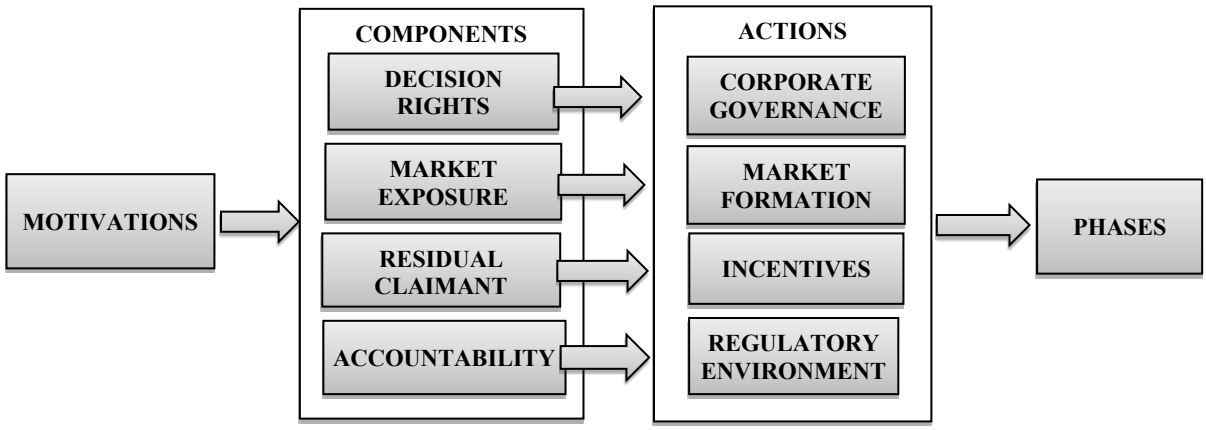


Figure 3.4 - Relationship between components and actions of corporatisation

(i) ***Corporate governance.*** As identified in Chapter 2, one of the theoretical challenges of a movement towards privatisations is the principal-agent problem. When a private entity takes responsibility for a public organisation the ability to make independent decisions is increased, and the incentive to maximise government or investor

returns is decreased, which may introduce various forms of principal-agent problems. This can lead to a cautious attitude in the shift towards privatisation and an increase in bureaucratic control. Depending on the level of perceived problems, the model of corporate governance can be used as a measure to modify decision-making rights. However, this may impact outcomes and, subsequently, overall performance, meaning the benefits of HC market competition may not be fully realised (Greengross, *et al.,* 1999).

(ii) ***Market Formation*****.** Achieving the perceived benefits from increasing market exposure is possibly the key component for any corporatisation or privatisation regime from a purely economic perspective. Actions applied to market exposure components may be required to increase competition, reduce barriers to entry, and prevent monopoly power. This action is closely related to that of corporate governance as discussed above. It often stems from observations (Shelley, 1995) about how the former Union of Soviet Socialist Republics (USSR) privatised its public sector. In this example, purchasers ended up with monopoly power, although citizens were provided with limited opportunities to participicate in the new market economy by the government (Shelley, 1995, p.3). The issue may be avoided by ensuring that when corporatisation occurs, competition is present and there are ways for new private entities to enter the market. In many cases within HC a pseudo (internal) market is formed, for example, in UK HC a pseudo (internal) market was enacted in law (National Health Service and Community Care Act 1990) with the intention to open up the market to competition.

(iii) ***Incentives*****.** Movement towards privatisation is often intended to improve the effects of incentives on efficiency particular through the retention of financial residuals in preparation for entering wider capital markets. For example, the action in changing the ownership/management of firms may affect managerial incentives, which in turn affect

performance and can increase efficiencies. In a privatised organisation, the performance of managers is driven through the capital market, where the capital market aligns the interest of shareholders and managers. However, in KSA this is not possible, as the public HC sector is primarily funded by MoH through a centralised funding model (Almutairi & Al Shamsi, 2018). Moreover, under private management, activities that increase asset values and minimise costs can be rewarded directly, whereas such activities are not necessarily rewarded under public management. The movement of budgets from central to localised control, and the ability to retain cost savings year on year is one action that can be introduced early in the corporatisation movement.

(iv) ***Regulatory environment.*** Actions in this area can be motivated by concerns over introducing new moral hazards or decreases in quality aspects, possibly introduced by financial incentives. The action of introducing regulation and policy may ensure continued accountability. Some researchers suggest that the government should continue (Brock, 2004) to regulate the newly reformed industry, sector, or activity, others believe independent or self regulation is more appropriate (Preker and Harding 2003). Regulation may, perhaps, improve or damage the overall performance of the reformed activity. Whether regulation is useful is dependent on the market structure, which components of the model it is applied to, and associated behaviours of both the regulators and those being regulated (Garrón, *et al.,* 2003).

3.2.4 Phases

In the current study, corporatisation is considered to be best divided into a number of discrete phases (see section 1.4) which contain various actions applied to components. By phasing the movement towards full or partial privatisation, different combinations of components and associated actions can be introduced, the outcomes measured and assessed, to determine whether the overall performance has achieved the desired effect

and satisfied the original motivation/s. This allows for small, time-limited experimentations, providing a gradual rather than explosive path to understanding the interdependencies and risks in the local environment and how remaining aligned to motivational influences may affect the model.

3.2.5 Outcomes

Outcomes demonstrate what has been achieved by an organisation. Outcomes may be quantitative or qualitative. There should be a line of traceability from the organisation's motivations through to the components and eventual outcomes, irrespective of whether, or what form of privatisation or corporatisation strategy is chosen. In this way, the economic efficiencies can be related to the HC outcome variables. Figure 3.5 below represents the three measures of quality defined by Donabedian (1966) as mentioned before in 2.6.1 above, and this is the model that the KSA (CBAHI, 2015) has adopted for the assessment of quality. Structural standards address the system's are inputs, outputs standards to address the activities or interventions carried out within the hospital, and outcome standards to look at the assessment of the benefits from intervention.

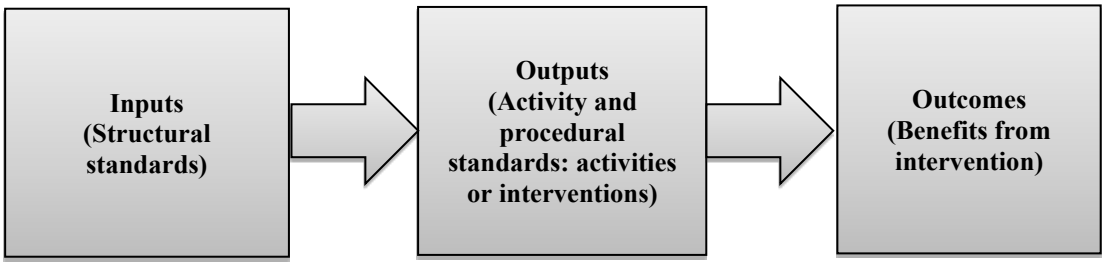


Figure 3.5 - Relationship between inputs, outputs, and outcomes

3.2.6 Assessment and performance feedback loop

HC outcomes contribute to the overall performance of the hospital system and may be measured and assessed. However, if they are not used or are inappropriately constructed for the environment, then they may have limited benefit. As noted in section 2.6.1 (through the six domains of quality in a HC setting, p.67), the quality of outcomes provided, as well as efficiency aspects, is both important considerations within HC performance, as well; Donabedian (1966, p.166) highlighted the conflict of using "economic efficiency as a measurable dimension of (HC) quality". KSA quality assessment model (see 2.6.1 and 3.2.5 above) is a view that is supported by Lafortune, *et al*. (2016) of linking both the outputs and outcomes with the inputs to provide hospital services. However, the final step in this model attempts to addresses this conflict of definition between economic efficiency and (HC) quality.

The trouble with empirical data is that the types of efficiency are aggregated. For the purpose of this study, two types of efficiency concepts are considered, PE, and AE by measuring outcomes related to cost (per 1,000 of the local population), i.e., static efficiency relating to the combination of resources at a given point in time, itself comprising PE (relative to a PPF), and AE (choice of point along that frontier). The study considers aspects of HC quality through the study of MR outcomes in relation to output variables (Statsoft, 2018).

These indicators could be fed back and can be used within the government, to allow better-informed adjustments to be made to components and actions, to meet motivations, or alternatively highlight considerations for further inspection.

3.3 Formal Hypotheses

The previous section outlines how the components and actions associated with corporatisation shown within this study's theoretical model can be supportive of the desire

to achieve both greater economic efficiency and hospital performance in a positive way, through a number of actions. In particular the indicators of performance can identify the relative efficiencies of inputs and outputs and how these contribute to the effectiveness of HC quality outcomes. Therefore, the main focus of this research is to identify whether different levels of corporatisation (as indicated in Figure 1.1) exhibit positive or negative consequences in terms of hospital efficiency and effectiveness. Formal hypotheses to test in the study are stated as follows:

H1 - *Performance in terms of efficiency may differ under the different forms of corporatisation.* The basis for this hypothesis is derived from the above discussion and the literature reviewed in Chapter 2 which indicate that incentive effects are different under the different forms of corporatisation, so that PE and AE may differ according to whether the firm is fully corporatised, or less so (Megginson and Netter, 2001).

H2 - *Corporatisation will be positively associated with efficiency*. A positive association between corporatisation and PE would be consistent with the design of incentives (Holmström, 1979), public choice (Niskanen, 1971, 1975; Buchanan, 1969), and principal-agent (Williamson, 1964; Migue and Belanger, 1984; McColgan, 2001; Adams, *et al.*, 2006).

H3 - *Fully corporatised hospitals will perform better in terms of quality than partially corporatised hospitals*. Under less corporatised firms, public managers are constrained by the extent of the control retained by the government. In fully corporatised firms the balance of control changes, decision rights increase, and residual rights are retained by the local organisation, rather than the central public purse (see 1.4 above). Thus, if the performance of the firm improves with an increase in corporatisation components, then H3 is confirmed. However, any level of corporatisation does not totally release an organisation from the bureaucratic control with its conventional accounting

measures (Clarke, *et al.*, 2005; Jiang and Yao, 2011).

More formally, the main hypotheses can be described in the form of a model specified as:

$$Efficiency_t = f\left(Controls_{t,t-n}, Corporatisation_{t,t-n}\right) \qquad \text{Hypothesis (1)}$$

Where $Efficiency_t$ represents a measure or indicator of efficiency, $Corporatisation_{t,t-n}$ represents the movement towards privatisation, and $Controls_{t,t-n}$ represents the other controls in the model. The *t* and *n* subscripts capture time period and the number of phases, respectively. Let β be the coefficient measuring the effect of corporatisation on efficiency, so that $\beta_{Corporatisation_{t,t-n}}$ is hypothesised to be statistically different from zero and positive, meaning that periods of greater corporatisation are correlated with a higher measure of efficiency, i.e.,:

$$\beta_{Corporatisation_{t,t-n}} > 0 \qquad \text{Hypothesis (2)}$$

As explained in chapter 1, this study includes four phases, so that n=4. Given the (supposed) ordinal nature of a corporatisation movement, the paper also hypothesises that:

$$\beta_{Corporatisation_{t-1}} > \beta_{Corporatisation_{t-2}} > \beta_{Corporatisation_{t-3}}$$

Hypothesis (3)

Hypothesis (3) simply implies that the closer the movement towards privatisation, the greater the increase in efficiency will be. This is consistent with the argumentation stated earlier (Megginson & Netter, 2001; Sheshinski and López-Calva, 2003). Thus, the *t-1* coefficient would be greater than the t-2 coefficient; *t-2* coefficient would be greater than the *t-3* coefficient, but *t-4* is a reversal.

3.4 Chapter Summary

This chapter has examined the corporatisation process, through which movement towards privatisation may increase the efficiency of firms. Corporatisation results when only management control is moved to the private sector and the government retains ownership. A corporatisation strategy may be motivated by a change in political paradigm, a need to reduce a budget deficit, to overhaul industry, or through changes in ideology. Moving towards privatisation may have the potential to improve the efficiency of organisations by removing waste and using inputs more efficiently. It is shown that corporatisation has a number of components that are affected by actions, causing movement towards (or away from) greater efficiencies and overall performance. However, the private management of organisations may fall prey to principal-agent problems, necessitating additional governance and regulatory frameworks that may also affect performance.

A set of three hypotheses has been developed which will be tested empirically, in the case of the phased corporatisation of hospitals in the KSA, between 1979 – 2014. The next chapter presents the methodology adopted for this study.

CHAPTER 4

Methodology

4.1 Introduction

The previous chapter presented a conceptual framework explaining the pathways through which performance is expected to improve with the degree of corporatisation. This conceptual framework provides a background for a set of three hypotheses to test. This chapter presents the methodology employed in this study to test those hypotheses. There are four sections to the chapter.

The first section 4.2 discusses the philosophical approach and rationale for the chosen approach of this study. The second section 4.3 presents the three performance domains within the framework, a description, and examples of possible indicators. Section 4.4 presents a description of the sets of variables and how they were used. The fourth section 4.5 provides the sources and description of the data employed for the empirical testing of the stated hypotheses. 4.6 presents the econometric methods employed in this study in order to address the research questions, associated hypotheses, and support the discussion and interpretation of the findings. Finally, the empirical model is presented at 4.7.

4.2 Philosophical approach and rationale

Paradigms based on Ontological, Epistemological, and Methodological Assumptions may be viewed as sets of basic beliefs that address first principles. Maykut and Morehouse (1994) as cited in Yavuz (2012, p.60), explain “that ‘Ontological Assumptions’ concern questions about the nature of reality; ‘Epistemological Assumptions’ concern the origins of knowledge and the relationship between the knower and the known; ‘Axiological Assumptions’ study the roles of values in

understanding; 'Logic' deals with the possibility of generalisation and causal linkages between bits of information".

Firstly, Ontology is about 'the nature of reality'. Naïve Realism assumes objective facts, separate from human perception, but Nominalism assumes no such facts, just approximations to reality. Secondly, Epistemology, as mentioned above, is related to what is the nature of relationship between the knower and the known, where the answer to this question is restricted by the answer given to the ontological question, and that impacts research Axiology, so the knower should be either objective, or subjective where the researcher's perceptions may lead to biases (Guba & Lincoln, 1994, p. 108). Thirdly, Methodology, involves the methods used to explore the 'facts' that may be organised around theories, e.g., using experiments or quantitative methods to find relationships, predictions, and generalisations (using Deductive logic), or an Inductive approach could use qualitative, quantitative, or mixed methods.

Interpretivism assumes subjective facts, where there is no absolute truth, but multiple opinions differ according to human perception. However, as its philosophical stance, this study uses an Objective Positivist Methodology "…which postulates that propositions can only be known directly from experience" (Fascia, 2014, p.4). Of course, so-called objective data may conceal value judgements, and data inaccuracies may bias the results of tests on hypotheses. The researcher may recognise these problems but adhere to findings anyhow. There can be no guarantee that the researcher can exclude human emotion and behaviour from influencing positivist studies. Positivists tend to be inflexible, as they believe that everything can be measured and calculated. They see things as they are and tend to disregard unexplained phenomena and eliminate the process of finding answers by creatively and indirectly solving a problem. The observed 'facts' assembled for this study have indeed been gathered, are number-based and allow the

hypotheses derived from economic theories to be tested. These hypotheses concern predicted HC efficiency with different levels of corporatisation, developed using a deductive logic that focuses on the verification of hypotheses to develop relationships, predictions, and generalisations.

Nevertheless, there are many weaknesses with a naïve realist/positivist approach, (Guba and Lincoln, 1994; Teddy, 1999), that cannot be avoided totally. Although interpretive research tends to depend heavily on qualitative data, in the case of this KSA study, quantitative data may offer a clearer understanding of the phenomenon of interest than qualitative data based on declared subjectivity where the enquiry's aim based on 'facts' is to provide an explanation or prediction to verify or refute hypotheses (Guba and Lincoln, 1994, p.112). In addition, 'objectively verifiable' performance standards may be generally more dependable than subjective standards as they include quantity, speed, and efficiency, which can be measured mathematically.

Although objective data related to performance, efficiency and effectiveness may be less capable of being distorted by potential bias (because it is arguably less susceptible to errors in human judgment), in some fields, such objective data can be misleading. For example, in the case of HC in the UK, financial incentives were introduced for General Practitioners (GPs) for the provision of 'quality care', which has in some cases led to over-prescriptions and a decrease in the overall well-being of patients (Donnelly, 2019). Using another example, hospital MR may be a weak measure of how hospitals actually perform and it may not be the major criterion for deciding whether a hospital is good or bad as it takes into account all potential deaths, not just the mortalities that were prevented through high quality care. Many patients may be too sick to be saved when they are admitted to the hospital.

In contrast, looking at specific mortality rates may make sense. For example, looking at death rates following a heart attack could be a good quality measure since there is anticipation that those patients should survive. As noted in 2.6.1 above, the introduction of Quality Initiatives in the KSA did not formally occur until 2003, with the creation of an accredited body in 2006 - the CBAHI. However, more recently the MoH in KSA has applied Performance indicators such as 'Deaths Reported to MOH Hospitals by Disease Groups, National, and Sex' (Ministry of Health Portal, 2019, p.301).

4.3 Performance domains

As defined in Chapter 2, HC performance is often discussed in the literature in terms of a set of measurable indicators capturing information on efficiency, effectiveness, and quality aspects. Within the KSA, MoH has adopted a set of performance indicators that are structured around the CBAHI (2015) performance framework (see section 2.6.1). Figure 4.2 below presents the three performance domains within the framework, a description, and examples of possible indicators. In this case, it is important to understand the context of these domains as terminology which is used by HC and Quality Assurance professionals and experts in the KSA currently, in relation to the more generic economic definitions (i.e., inputs, outputs, and outcomes). The three domains are concerned with structural performance, activity and procedural performance, and finally outcome performance. Structural standards address hospital inputs, activity and procedure standards address hospital outputs, and outcome standards are concerned with the effectiveness of the hospital services on HC outcomes. Figure 4.1 (based on Preker ans Harding, 2003 and performance indicators, CBAHI, 2015), below shows the direct relationship between the definitions and measurements of hospital activity (Inputs, Outputs, and Outcomes) noted within the quality aspects of performance in 2.6.1 and repeated in 3.2.5 above, with the overall indicators of KSA performance domains

(Structural, Procedural, and Outcomes) defined within the MoH Quality Model (Figure 4.2 below).

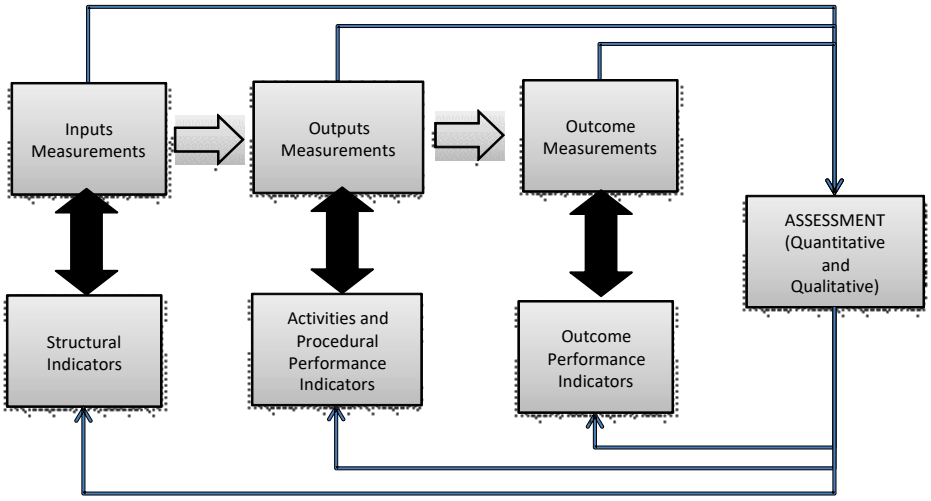


Figure 4.1 - Relationship between performance measures

Within these three domains, as noted in a number of studies (Aday, *et al.,* 1993; Hurst, 1999; Kötter, *et al.,* 2012; Bartel, *et al.*, 2014), performance can cover a number of areas including population health, patient outcomes, responsiveness of the HC system, safety as clinical quality and appropriateness of care, depth and breadth of the HC system, as well as productivity.

(i) *Population health*. Population health represents measures of aggregated data on the health of a population and may not be wholly representative at a hospital level. Previous studies have included such indicators as MR, years of life lost, and instances of avoidable mortality (Knowles, *et al*., 1997; Hurst, 1999).

(ii) *Patient outcomes*. Indicators of patient or individual level health outcomes, such as health status can be used either on an absolute or relative (per capita) basis. Prior studies using patient level health outcomes have used indicators such as radiology impact, and patient satisfaction (Aday, *et al.,* 1993).

(iii) ***Responsiveness*****.** A related measurement area is responsiveness of the HC system, which captures the way individuals are treated and the environment in which they are treated during health system interactions. Some measures may also include subjective rankings. Indicators of this measurement area include patient dignity, autonomy, confidentiality, communication, prompt attention, and quality of basic amenities. Prior studies have included indicators capturing patient experience and satisfaction measures (Manary, *et al*., 2013).

(iv) ***Safety*****.** By assessing the clinical quality and appropriateness of care for procedures such as operations carried out in hospitals across the country, the aim is to improve care by ensuring procedures are as safe as possible, improving the experience of patients and encouraging good practice. For example, internal peer reviews or quality assurance visits from external bodies are ways to assess the clinical quality of procedures (for example, operations) carried out in hospitals. In this example it could be suggested that the higher the rate of peer review visits, the less efficient the hospital is, as it could indicate low quality of the care provided requiring excessive monitoring of peer, or alternatively, just that the hospital is rigorous in carrying out internal quality assessment regimes.

(v) ***Depth and breadth*****.** This area captures the extent to which individuals use the HC system services, where service provision/output leads to performance. The outputs of the HC provision process can be observed by the extent to which systems obtain effective coverage of the population, where the effective coverage system might be defined as the ratio of the realised HC gain -from a set of interventions- over the total potential gain, if the providers -for a given HC system- performed at their optimal level (Adams, *et al.,* 2002). Previous empirical studies have used proxies including utilisation measures, such

as access to HC, use-to-need ratios, spending on HC, and health outcome measures (Zuvekas and Taliaferro, 2003).

(vi) ***Productivity*****.** Prior studies have measured labour productivity as a specific productivity variable, as well as cost-effectiveness measures and PE (Bartel, *et al*., 2014).

The present study has attempted to cover these areas as much as possible. However, the extent to which they can be considered directly is limited by data availability and the focus of the present study. Firstly, since the focus of the current study is (to reiterate) to identify whether different levels of corporatisation (as indicated in Figure 1.1) exhibit positive or negative associations with hospital efficiency and effectiveness set within the KSA HC environment, it may be difficult to draw causal inference between hospital governance and patient level outcomes such as patient satisfaction. Doing so may require patient experience surveys across the hospitals over time, which were not available in the KSA at the time of undertaking the present study.

Secondly, a key issue arising from the various studies (as cited in Sheiner and Malinovskaya, 2016, p.8) is that some researchers have measured quality of HC through outcomes, e.g., Howard, *et al.* (2010); Rosen, *et al.* (2007); and Romley, *et al.* (2015), and measure improvements by changes in life expectancy. Other researchers have used less direct measures, e.g., Lakdawalla, *et al.* (2015), who assessed changes in life expectancy associated with new treatments for multiple myeloma and colorectal cancer. Others focus on inputs, without measuring outcomes or the outputs of HC services that patients received. This is the approach currently used by the Bureau of Labor Statistics (BLS) in their quality adjustment for hospital producer price indexes for the treatment of heart attacks, heart failure, pneumonia, and surgery (e.g., measuring the heart failure comprises whether patients were given specific medicine, or whether they were given

smoking stoppage advices. Likewise, the BLS regulates prices of the nursing home services according to the nurse level).

Figure 4.2 below attempts to logically align the measurements of hospital activity (Inputs, Outputs, and Outcomes) and performance domains (Structural, Procedural, and Outcomes) with a description and examples of possible indicators.

Measurement Domain	*Description of Measure*	*Examples of Indicators*
Inputs (Structural standards)	The system's inputs	- Spending on HC - Hospital beds available - Manpower (Doctors, Nurses, Allied Personnel) - Hospital building designed to provide basic amenities - Stock equipment for safety (e.g., gloves and masks) - Clinical equipment and supplies (e.g., microscopes and laboratory reagents)
Outputs (Activity and procedural standards: activities or interventions)	The system's outputs The clinical and administrative activities or interventions carried out within the hospital in the care of patients or in the management of the hospital or its staff	- Administration assessments and PE - Patient assessments and procedures to measure the way individuals are treated and environment in which they are treated during health system interactions (e.g., tests performed, waiting times responsiveness) - Inpatients Discharged
Outcome standards (Benefits from interventions)	Measures provide indications about the benefits and effectiveness of an intervention, and whether predicted outcomes are being acheived	- MR indicators - Population Health - Instances of avoidable mortality - Effectiveness measures - Readmission rates - Utilistion measures such as rates of access and use to need ratios - Patient satisfaction

Notes: based on MoH Quality Performance Framework

Figure 4.2 Hospital Inputs, Output, and Outcome

Furthermore, the first part of the next section discusses how the issues of definition, grouping and assignment of variables are addressed in the present study. These data issues and the justification for our approach are discussed in the next section.

4.4 Variables

It is generally believed that hospitals provide three essential services, namely inpatient, outpatient, and laboratory services. In this model, outputs should reflect these core services, whilst inputs should reflect the resources used to generate these outputs (services provided). According to Chansky, *et al.* (2013), it is possible to aggregate these different types of outputs into a single index to indicate overall inputs and outputs of the hospital. However, the authors argued that disaggregating the set of services (treatments) provided by hospitals is preferable, as it is a more precise measure and has the advantage of determining productivity in the most direct way. This suggests consideration of outputs in terms of services provided, rather than in terms of those who provided it.

Table 4.1 presents a description of the five sets of variables and how they were used, to provide a better understanding of the scope of the study data, the dimensions of the performance indicators used and measured, and to aid a consistent definition for the interpretation and examination of the results.

Table 4.1 - Description of variables

Variable	Description and Usage in Study
Input variables:	
MoH Budget	Annual total expenditures by the MoH in millions of Saudi Arabian Riyals (SAR)
Number of Beds	Annual total hospital beds, by hospital
Number of Doctors	Annual total Doctors, by hospital
Number of Nurses	Annual total Nurses, by hospital
Number of Allied Personnel	Annual total Allied Personnel, by hospital
Output variables*:	
Inpatients discharged	Annual total Inpatients discharged, by hospital
Radiology tests	Annual total Radiology tests performed, by hospital
Laboratory tests	Annual total Laboratory tests performed, by hospital
Review visits	Annual total Review visits carried out, by hospital
Outcome variables:	
MR	The number of deaths per 1,000 of the local population of KSA. Variable is used to measure the population health as a performance (quality) outcome.
Control variables:	
Location of the Hospitals	An indicator of whether the hospital is located in a rural, semi urban, or an urban area. (0 for Rural, 1 for Semi-urban, and 2 for Urban)
Size of the City	Measured by the local population number of city where a hospital is located (0 for big-sized city, 1 for medium-sized city, and 2 for small-sized city).
Number of Pilgrims	Millions per annum.

Programme variables: (System Phases)	
Bilateral Agreements	Management type during the period 1979 to 1982
Partial Operating	Management type during the period 1983 to 1987
Comprehensive Operating	Management type during the period 1988 to 1999
New Public Self-Operating	Management type during the period 2000 to 2014

*Output variables in the regression analysis are used as inputs (independent variables).

(i) *Input and Output variables*. In line with the literature reviews in Chapter 2 on hospital performance, the approach adopted in this present study was to examine hospital performance (efficiency) in terms of usage of numerous resources (inputs) to produce multiple HC products and services (outputs) to achieve the outcomes required. A major measurement issue in service-providing entities generally, and a hospital especially, relates to the longstanding debate (e.g., Jacobs, 2000; Ozcan, 1992) on which indicators that could be considered as inputs or outputs to examine performance (efficiency). The debate has continued in both academia and the HC industry. Even today for example, Google Scholar returns over 16,000 hits on the search term "hospital performance indicators" covering 2019 alone and 54,000 in the past four years). Generally, there has been little consensus or standardisation on the definitions of hospital inputs and outputs, in order to account for the complex nature of the services that hospitals provide. Rather, studies appear to have adopted definitions that are suitable for the specific purpose of their own study.

Some studies focus exclusively on cost-related variables as inputs such as operational cost, patient cost, and doctor fees. While outputs are considered as income such as revenues, gross margins (e.g., Iswanto, 2015; Chansky, *et al*., 2013). Defining hospital inputs and outputs in terms of financial costs and revenues may limit the extent to which these indicators capture hospital performance and certainly introduce AE to the analysis as well as PE. Taking a solely cost-related view could also be perceived as heavily weighted towards assessing profit-making performance. Most hospitals in developing countries, however, are set up as public sector (rather than for profit-making)

utilities, and hospital performance may not be orientated towards financial aspects as there are also the non-financial aspects of performance to consider.

Another strand of studies distinguishes two general types of outputs of hospitals (e.g., Scott, 1979). The first type considers outputs as processes, relating to actions and activities performed on the patients. From this point of view, proposed input variables can also be considered as process outputs. If processes relate to the functioning of hospitals as indicated by the number and types of services performed for patients, then these inputs differ markedly and are the resources used to provide these services, are not by themselves the activities/actions. The second type considers outputs as outcomes, relating to changes that occurred in the condition of the patient.

However, a third strand of studies (Iswanto, 2015; Hossein, *et al*., 2011; Al-Shayea, 2011; Caballer-Tarazona, *et al.*, 2010; Bhat, *et al.,* 2001; Jacobs, 2000) address hospital efficiency in developing countries, using the Data Envelopment Analysis (DEA) approach. This strand of studies has generally adopted similar definitions of inputs and outputs. Specifically, in Bhat, *et al.* (2001), input variables include number of beds, number of doctors, number of nurses, and capital input, whilst the output variables comprised laboratory tests completed, inpatients treated, outpatients discharged, and maternal and child health cases treated.

Thus, the first set of variables is, five input quantity variables, which include MoH budget, number of Beds, number of Doctors, number of Nurses, and number of Allied personnel used in the hospitals.

The second set of variables is, output quantity variables. These include the number of Inpatients discharged, number of Radiology tests, number of Laboratory tests, and number of Review visits. These four output variables are used as the dependent variables to indicate hospital performance (efficiency). However, in the regression tests these

outputs are used as independent variables to indicate hospital performance (effectiveness).

The other variables considered in this study are outcome variables, control variables, and programme variables.

(ii) *Outcome*. MR, measured as the number of deaths per 1,000 of the population, as used by MoH is the key variable to proxy for outcome quality. However, MR is a key performance indicator used across the HC industry (in this case quality defined by the effectiveness of HC production efficiency) across the programme variables (phases). MR is used as the dependent variable for the regression's tests in this study, where the outputs set became independent variables (see section 6.2.3 (i)). MR (at population level) cannot be used as an output variable for the hospitals because factors other than hospital performance could also have contributed to the observed MR in the population.

(iii) *Control.* Three main control variables are used. Firstly, location of the hospitals to capture the potential affect of environment. Secondly, the size of the city as measured by the local population of the area where the hospitals are located. Finally, the total number of pilgrims is also included as a control variable. This is particularly important, as the annual influx of pilgrims (see section 1.3.2) tends to put increasing pressure on hospital resources, with congestion effects on performance.

(iv) *Programme*. Finally, in line with the process of changes in management and operation of hospitals in the KSA, as mentioned previously in 1.4 above, four broad phases are identified, namely: The Bilateral Cooperation Agreements, Partial Operating System, Comprehensive Operating System, and New Public Self-Operating System phases (Al-Ateeq, 2002). The programme variable is time-limited across each phase and indicates changes in corporatisation movements in management, control, and operation of the hospitals within the scope of this study. The aim of this study is to examine

differences in hospital performance according to each of these phases. Therefore, a binary indicator (0 or 1) is generated for each of these phases to capture programme associations, using one phase as the reference. For example, the Comprehensive Operating System phase variable takes the value 1 if the period was 1988 to 1999, and value 0, if otherwise.

4.5 Data

This study follows previous studies that apply the DEA model of hospital efficiency. Using DEA techniques, it examines the association between the physical inputs into a hospital production process and the non-qualitative outputs of that process. In addition, a major strength of using a range of (input and output) variables is that they are consistent with the disaggregation approach suggested by Chansky, *et al.* (2013).

The majority of the datasets used in this study were obtained from the MoH, KSA. The MoH is the main government agency with the responsibility to provide HC services at all levels to the populace in the KSA, and is the main official source of HC data in the KSA. The unpublished collection of official records and data from MoH involved several meetings with the officials of MoH in order to get them to release the data for the research. Economy-wide data were sourced from publicly available records (for example KSA Statistical Yearbooks). Population data which distributed by city, was obtained from the General Authority for Statistics, KSA. The dataset for MR was obtained from World Bank.

4.5.1 Summary statistics of hospital-specific variables

The study population consists of 37 MoH's hospitals in the KSA. Although the MoH is the dominant provider of hospital services in the KSA, as represented in chapter 1, there are other governmental hospitals that were operating at the same time that have not been considered. Ideally, all of the hospitals should be included in the study, or a

random sample (to eliminate sampling bias) of them selected. However, this is impossible as certain criteria constrained the study to adopt a non-probability sampling approach, involving selection of a sample of 20 hospitals (covering 54 per cent of all corporatisation hospitals) on the basis of a set of selection criteria, rather than each hospital having equal chance of being sampled from the entire population of hospitals. The criteria used for the selection of the 20 hospitals were:

(i) Hospitals that have complete data and have been in existence for the entire 36 years of the study period (1979 – 2014), and

(ii) Hospitals that have undergone all the four phases of change in management and operation during the period.

These criteria were essential to address the research questions. In 2014 the total number of hospitals was 270 (Ministry of Health, 2015), so the results represent less than 10 per cent of the total MoH hospital population. A key limitation of the non-probability sampling approach is that of limited external validity, as the findings should be considered with caution, where the number of hospitals included cannot be considered as truly representative of all MoH hospitals[4]. However, according to the size of the populations served by (37) hospitals for the years 1979 and 2014, as represented in Appendix 4.A, there are no statistically significant differences between selected (20) and excluded (17) hospitals, where the P-values for the t-test are greater than 0.05, and the Mean Differences between selected and excluded hospitals are considered slight.

Table 4.2 presents the summary statistics of the corporatisation stages, size of city, location of hospitals, and number of pilgrims.

[4] Efforts at collecting characteristics data on the excluded hospitals to test for sample bias proved abortive. Individual hospitals cannot give data to the public. The MoH has no data on the excluded hospitals.

Table 4.2 - Summary statistics - phases, hospital size and location control variables

Variable	Obs.	Mean (%)	Std. Dev.	Min	Max
Corporatisation phase (Bilateral Agreements)	720	0.11	0.31	0	1
Corporatisation phase (Partial Operating)	720	0.14	0.35	0	1
Corporatisation phase (Comprehensive)	720	0.33	0.47	0	1
Corporatisation phase (New Public Self-Operating)	720	0.42	0.49	0	1
Size of city – Big city	720	0.60	0.49	0	1
Size of city – medium	720	0.25	0.43	0	1
Size of city - small city	720	0.15	0.36	0	1
Location of hospital – Rural	720	0.20	0.40	0	1
Location of hospital – Semi-urban	720	0.40	0.49	0	1
Location of hospital – Urban	720	0.40	0.49	0	1
Number of pilgrims (Millions)	720	1.196	0.295	0.703	1.705

The Table shows the number of observations, mean, standard deviation, minimum, and maximum: there are n = 720 observations (20 hospitals observed over 36 years). The majority of the observations (42 per cent) are in the period of the New Public Self-Operating. The majority of the cities (60 per cent) where the hospitals are located were classified as big cities in the KSA, whilst the majority of the hospitals (80 per cent) are located in semi-urban and urban areas. The number of pilgrims to the KSA averaged about 1.2m per year, ranging between minimum of 0.7m and maximum 1.7m.

4.5.2 Descriptive statistics of variables for all periods and by phase: mean values

Appendices 4.B and 4.C provide descriptive statistics of the output and input variable data, respectively, from which Table 4.3 below is derived. The Table shows the mean values of the output and input variables, and the MR outcome variable, for all periods (1979-2014) and by corporatisation phase: Bilateral Agreements phase (1979-1982), Partial phase (1983-1987), Comprehensive phase (1988-1999), and finally the period of the New Public Self-Operating System phase to 2014.

For the output variables, the mean value increases sequentially apart from Inpatients discharged. The mean value of the Inpatients discharged variable is relatively lower

during the period of Comprehensive Operating System phase than the mean values calculated against each of the other phases. The mean values of all output variables were relatively higher under the New Public Self-Operating System than other phases.

In terms of input variables, the mean value of number of Beds, Doctors, Nurses and Allied personnel increases over time and are all relatively higher under the New Public Self-Operating System phase than under each of the other preceding phases. The MoH budget (as a macro variable) increases across each phase, with a proportionally larger mean increase in the New Public Self-Operating System phase (i.e., approximately 207.3 per cent larger than the Comprehensive Operating System phase). The MR outcome variable decreases across each sequential phase.

However, no hard conclusions can be drawn at this stage of the study. This is largely because other factors may have contributed to the observed mean values of the input, output, and outcome variables. More importantly, the mean values may hide important timing effects on the observed variables.

Moving on, the econometric methods are presented in the next section.

Table 4.3 - Mean values of variables for all periods by phase (to nearest whole number)

	All Periods (1979 - 2014)	**Bilateral Agreements (1979 - 1982)**	**Partial (1983-1987)**	**Comprehensive (1988-1999)**	**New Public Self-Operating (2000-2014)**
Outputs:					
Radiology tests	482561	27059	27116	35249	71363
Inpatients discharged	12131	11383	11414	11073	13415
Laboratory tests	1164130	678785	678822	1037093	1556954
Review visits	88217	77397	77465	82226	99479
Inputs:					
Beds	269	166	183	281	314
Doctors	136	86	92	140	161
Nurses	251	173	179	259	290
Allied personnel	115	71	74	99	154
MoH Budget (SAR)	17275215	7642650	8539581	9443287	29021318
Outcomes:					
MR	6	8	6	5	4

Source: Author calculation from Tables 4.B and 4.C in the Appendix.
Notes: Output variables used in regression section as inputs (independent variables).
Variance Inflation Factor (VIF) for the budget variable is less than 10 in Appendix 5.F and 5.G.

4.6 Econometric Methods

Three keys econometric methods are employed in this study in order to address the research questions, associated hypotheses, and support the discussion and interpretation of the findings. Starting from highly restrictive nonparametric Data Envelope Analysis (DEA), to parametric Stochastic Frontier Analysis (SFA), to more flexible Panel Data Analysis, in addition to the Ordinary Least Squares Analysis (OLS), where no single model able to address all RQs (see section 1.5). For example, DEA is concerned with inputs and outputs, no other than Panel Analysis can examine changes overtime; so, these models acting as robust checks on each other. The remaining part of this subsection presents a detailed description of these methods and their applications.

4.6.1 Data envelope analysis (DEA)

Since it is expected that efficiencies change through corporatisation, it is possible to analyse each phase using DEA (e.g., Charnes, *et al.*, 1978; Banker, *e. al.*, 1984). DEA has been used in many studies to assess the efficiency of public services, as well as changes in the public-private management of public utilities, including HC (e.g., Ozcan and Luke, 1993; Cullinane, *et al.*, 2006; Tiemann, *et al.*, 2012). DEA is a nonparametric linear programming method assumes that there is no statistical noise and the production functions consists only of the inputs and the outputs for measuring the PE (in this study) of Decision-Making Units (DMU), which use the same set of input variables to produce the same set of outputs (Coelli, 1996). This assumption does not allow other factors to influence production outside the inputs. As such, there is no assumption of a deterministic production frontier.

The two basic DEA models that are most widely used are DEA-CCR based on Charnes, *et al.* (1978) and DEA-BCC based on Banker, *et al.* (1984). The two models

differ in terms of their underlying assumptions. The DEA-CCR model assumes constant returns to scale, implying that all observed production compositions can be scaled up or down proportionally. The DEA-BCC model, on the other hand, assumes variable returns to scale and is graphically represented by a piecewise linear convex frontier (Cullinane, *et al.*, 2006).

Output orientation represents increasing the output quantities without changing the input quantities used. On the other hand, input orientation presents decreasing the input quantities without changing the output quantities.

The application of DEA in this study follows the general form of the DEA model, stated in the form of a set of inputs, outputs, and associated matrices, indicating the linear combination of the inputs and outputs. The standard formal mathematical specification of the varied DEA models can be found in Cooper, *et al.* (2000).

The efficiency score for each hospital is calculated as:

$$efficiency\ score = \frac{weighted\ sum\ of\ outputs}{weighted\ sum\ of\ inputs} \quad (1)$$

The hospital is considered to be efficient with a score 1, but inefficient with a score of less than 1.

The CCR ratio model calculates an overall efficiency for the unit in which both its pure PE and scale efficiency are aggregated into a single value. Furthermore, the scale efficiency can be computed from the CCR and the BCC models denoted as SE:

$$SE = UCRS / UVRS \quad (2)$$

Where *UCRS* and *UVRS* are the PE measures for the hospital derived from applying the DEA-CCR and DEA-BCC models, respectively, While SE = 1 indicates scale efficiency, and SE < 1 indicates scale inefficiency. In empirical applications, scale inefficiency may be due to increasing or to decreasing returns to scale, which can be

specified by assaying the sum of the reference weights $e\lambda_i$. If this sum is equal to 1, the law of constant returns to scale dominates, whilst increasing and decreasing returns to scale prevail if the sum is less or greater than 1, respectively. (Cullinane, *et al.,* 2006, p. 23)

The application of DEA in this study facilitates an overall evaluation of hospital performance (efficiency) in the KSA because it has the advantage of considering multiple inputs and outputs. Regarding the application of DEA in the context of determining a relationship between hospital performance (PE in this study) and different types of management and operation structures, Valentine and Gray (2001) applied the DEA-CCR model to examine the efficiency of 31 container ports.

Using the DEA results, Tobit Regression Analysis is used to find the determinants of efficiency gaps among the hospitals, largely because the efficiency scores of the hospitals are censored above the maximum value of efficiency scores (Ji and Lee, 2010). The efficiency scores are the dependent coefficients, and the determinants are hospital level, while the control variables include population, location of hospital and size of the city.

4.6.2 Stochastic frontier analysis (SFA)

The SFA model provides an alternative approach to DEA which was introduced simultaneously by Aigner, *et al.* (1977). SFA model assumes the existence of a parametric function relating outputs to inputs and the existence of random shocks outside the control of firms which can affect output (Cullinane, *et al.*, 2006). Thus, the idea behind SFA is that the error term is composed of two parts, one that captures the effects of inefficiency relative to the stochastic frontier, and the statistical noise component to capture the random shocks outside the control of firms.

The SFA can be specified as:

$$Y_i = (X_i, U_i, V_i) \quad (3)$$

Where Y_i is the observed scalar output produced by hospital *i, (i*=1,..I), from a given vector (K×1) of inputs X_i, U_i is a non-negative inefficiency term (first error component), and V_i is the statistical noise component, which can be either positive or negative (second error component).

Liu (1995) used SFA to examine performance of British ports under public and private sector ownership and management.

The PE of hospital i can be obtained as the ratio of the observed physical output to the maximum level of physical output, dependent on input levels. The PE score can be computed as:

$$PE_i = e^{-U_i} = \frac{Y_i}{f(X_i, \beta)e^{V_i}} \quad (4)$$

Where $f(X_i, \beta)e^{V_i}$ is the stochastic frontier production, and U_i is a non-negative random variable. The main advantage of this specific model is that it includes environmental elements in the approximation of the production frontier because these elements may exercise a direct effect on efficiency. Together with DEA, the measurement of efficiency may be more accurate in addressing the effect of corporatisation in the KSA on hospital performance (efficiency).

Two additional considerations are presented in this subsection.

4.6.3 Panel data specification

The first relates to the panel data of the sample of hospitals, and the need to consider the stability of the model over time. By using information of both the variations between hospitals, and the changes overtime, panel data specification increases the precision of

performance (efficiency) estimates, and makes it possible to have a better understanding of the complicated behaviour of different economic relationships. Panel data models can be specified as pooled regression, fixed effects (FE), and random effects (RE) models depending on the underlying assumptions (Hill, *et al.,* 2011).

The pooled regression model is the simplest version, which ignores individual specific effects (i.e., the possible individual heterogeneity is ignored) and simply pools together the data on different DMUs. For illustrative purpose, a simple pooled regression model with $i = 1, 2, \dots, M$ output *Y*, at time period $t = 1,2 \dots, T$, can be written as:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \varepsilon_{it} \quad (5)$$

The FE model specification, on the other hand, assumes that there are behavioural differences amongst the hospitals. These individual heterogeneities are captured by different individual hospital specific time invariant intercepts. In this case, there are individual differences captured by the intercept β_{0i}, but these are fixed over time. A simple FE specification can be stated as:

$$Y_{it} = \beta_{0i} + \beta_1 X_{it} + \varepsilon_{it} \quad (6)$$

We can eliminate the FE conditions by expressing both the dependent and independent variables as deviations for their respective (group) mean value as:

$$Y_{it} - \bar{Y}_i = \beta_2 \ (X_{it} - \bar{X}_i) + (\varepsilon_{it} - \bar{\varepsilon}_i) \quad (7)$$

Notice that the FE individual intercept term β_{0i} dropped out. Frequently the FE within-group estimator gives the similar results but this estimator discards time variation in the data. In order to control the variance issue and to assure valid statistical conclusion when some of the underlying regression model's assumptions are breached, it is usual to depend on the robust standard errors, where it is robust to employ the robust standard errors "Even if there is no heteroskedasticity, the robust standard errors will become just

conventional OLS standard errors. Thus, the robust standard errors are appropriate even under homoskedasticity." (Yamano, 2009, p.3)

The third basic panel data specification is the RE model in which individual heterogeneities are also assumed (as in a FE model), but they are now treated individually as RE, because of randomly selected units of observation. A simple RE specification can be stated as:

$$Y_{it} = \overline{\beta_0} + \beta_1 X_{it} + \nu_{it} \quad (8)$$

Where $\overline{\beta_0}$ is the population average of the intercept, $\nu_{it} = \mathrm{u_i} + \varepsilon_{\mathrm{it}}$, where $\mathrm{u_i}$ is the random variable related to the hospital, while $\varepsilon_{\mathrm{it}}$ is related to the hospital and time (with zero mean and constant variance).

RE is probably best if there is a belief that there are no omitted variables/or the omitted variables are uncorrelated with the explanatory variables in the model, while if the omitted variables correlated with the variables in the model, FE may control for omitted variable bias, so that, the main advantage of the FE approach is that the estimated coefficients are unbiased (Williams, 2018).

4.6.4 Regression analysis

OLS regression gives equal weight to all observations, but when the heteroscedasticity test is present it suggests bias in the ability of OLS to produce the smallest possible standard errors. Using least squares regression testing would be more appropriate, as this method allows for further examination of those output variables previously showed a residual efficiency, in greater detail.

Whereas the previously noted methods study the efficiency levels of a hospital's performance, using the OLS method, Regression Analysis can be used to assess the

quality aspects of the hospital's performance. This is achieved through using the MR outcome variable as a proxy for HC quality (see 6.2.3 (i)).

4.7 Empirical Model Specification

DEA and SFA are based on the simple concept of Pareto Optimality (Charnes, *et al.,* 1994), which simply states that a unit in a sample is Pareto-efficient if it provides the largest output for a combination of inputs in that sample. In other words, DMU 'A' is efficient if there is no other DMU that can produce more than A's output, while using fewer inputs. The most efficient hospital will have a score of 1 using DEA, while all other DMUs will have scores relative to this unit. A DMU with a score of 0.90 is thus operating at a 90 per cent level of efficiency compared to the most efficient DMU.

The objective of this study is to establish whether the progress towards privatisation (through various phases of corporatisation) has led to an improvement in the performance (efficiency, effectiveness and quality aspects) of hospitals. This study is, therefore, comparing a particular DMU (hospital) with its own past. The relative efficiency is calculated for each hospital at different points in time. A score 1 of efficiency in a particular year would mean that Hospital A was operating at its most efficient level in that year. Moreover, other variables that could affect the output of a hospital are also controlled, for example the population of the area of hospital location.[5]

For ease of interpretation, the empirical model explaining the relative efficiency of hospitals was assumed to take a log-linear form of the Cobb-Douglas specification:

[5] For example, DMU (hospital A) and (hospital B) are identical in terms of inputs, but are in different locations, one densely and the other sparsely populated areas, respectively. Hospital A will naturally have more patient visits than hospital B. It may seem that hospital A is more efficient than B, however, the difference in output is due to demand, rather than efficiency. Hospital B may be operating below capacity not because of inefficiency, but because it does not get enough patient visits. Hence, it is necessary to control for population.

$$LnY_{ijt} = \beta_0 + \beta_1 \ln Alliedhealth_{jt} + \beta_2 \ln Beds_{jt} + \beta_3 \ln Doctors_{jt} + \beta_4 \ln Nurses_{jt} + \beta_5 \ln MOHbudget_{jt} + \beta_{6k} Xcontrols_{jtk} + \sum_{t=1979}^{2014} \beta_t \, Dyear_{jt} - u_{jt} + v_{jt} \quad (9)$$

Where *i* denotes the i[th] output Y (i=Radiology tests, Laboratory tests, Review visits, and Inpatients discharged) for Hospital j (j=1, 2, ……20) at time t (t=1, 2, …..36). $\beta_0 - \beta_5$ are the input coefficients associated with the independent variables in the model are estimated. B_{6k} is a vector of k[th] X control variables (k=size of city, location of hospital, and number of pilgrims), *Dyear* is a dummy variable to check the effects of corporatisation phases, u_{jt} (≥0) is a measure of inefficiency, whilst v_{jt} is the error term representing the symmetric statistical noise.

Each of the corporatisation phases (Bilateral Agreements, Partial Operating, Comprehensive, and New Public Self-Operating) for the model in Eq. (9) is estimated. Alternatively, one of the phases may be selected as the benchmark, against which to compare efficiency of the hospitals with respect to the output Y_i. It is expected that the efficiency level will vary according to the level of corporatisation within each phase in line with Hypothesis H1.

Variants of the model in Eq. (9) are estimated using pooled regression as the baseline model, FE and RE models, as well as testing for stability of the models.

The effect on population health is modelled and estimated, in which the MR outcome variable is specified as a proxy for the outcome quality of the hospitals:

$$MortalityRate_t = \rho_0 + \rho_j \sum_{j}^{J} LnY_{jt} + \tau_{jt} \quad (10)$$

Here, Y_{jt} is a vector of outcome quality as shown in Equation (9), ρ_j is a vector of parameters to be estimated in the model, and τ is the error term, assumed to be independently identical distributed (iid).

4.7.1 Assumptions and diagnostic tests

The usefulness of these models is dependent largely on the validity of the underlying assumptions. For example, the DEA as a non-parametric approach assumes that there is no statistical noise and the production functions consists only of the inputs and the outputs. This assumption does not allow other factors to influence production outside the inputs. As such, there is no assumption of a deterministic production frontier. Violations of the assumptions may lead to misleading conclusions and inferences drawn from the estimation results. Therefore, diagnoses of the estimation results from the models will be undertaken, in order to determine the validity of the underlying assumptions.

A rolling window analysis assesses the model's stability over time. In general, it is assumed that the parameters of the model were constant over time (e.g., Stock and Watson, 2011). However, (for example) changes in the economic situation may sometimes raise an issue with the stability of the model's parameters.

Given that each of the hospitals in the KSA data were observed over a period of 36 years, and the possibility of instability of the data, we applied DEA rolling window analysis to a panel data specification of the DEA and SFA models (see, Cullinane, *et al.,* 2004). These considerations allowed tracking the efficiency of each hospital in the sample over time. The robustness of this additional test provides a greater level of confidence in the results.

The dataset is not time series or cross section data. This research is about studying the performance of hospitals across many time periods. Panel data models are useful for identifying unobservable heterogeneities within hospitals, which may be constant, or vary over time. By using information of both the variations between hospitals, and the changes over time, panel data specification increases the precision of performance (efficiency) estimates, and makes it possible to have a better understanding of the complicated behaviour of different economic relationships. This approach tests the multi-collinearity between the independent variables, and also solves the omitted variable bias and decreases auto-correlation problems. The Shapiro-normality test was used to determine the independent variables normality distribution.

This study runs Pooled regression analyses. If the model is unstable (P-value <5%), Breusch-Pagan/Cook-Weisberg test for Heteroskedasticity is performed. It is also stated that panel data models can be specified as a pooled ordinary least square (pooled OLS) regression, FE or RE models, depending on the underlying assumptions. There is an assumption in which both RE and FE models are consistent when there is no correlation between individual unit-specific effects and the explanatory variables. The FE and RE are measured and compared by the Hausman (1978) specification test to examine whether unobserved hospital heterogeneities are constant or vary randomly overtime, if the RE is better, the Breusch and Pagan Lagrangian test is run to show the consistency between the RE model and the Robust Regression model. The FE model prevails if the null hypothesis ($H_{0:}$ *The RE is consistent*) is rejected.

The next chapter presents the overall results derived from the methods outlined in this chapter.

CHAPTER 5

Results

5.1 Introduction

The overall objective of this chapter is to record and examine the empirical analyses that may identify which KSA hospital management phase is more efficient across the study period (1979-2014). This is addressed by, testing the hypotheses (in 3.3 above) via the econometric models cited in the preceding chapter (in 4.6 above) and addressing this study's research questions. Two research questions were formulated.

Firstly - *Have different forms of corporatisation generated the gains that may be associated with the movement of reforms towards privatisation?*

Secondly - *Have HC quality considerations (or effectiveness) modified conclusions relating to the efficiency of different HC governance systems?*

This study includes four system phases, as detailed in Chapter 1 (Section 1.4), and defined thus:

- **Bilateral Cooperation Agreements (1979 –1982):** co-operation between the KSA and Chinese, Danish, and German governments in some hospitals.
- **Partial Operating System (1983 – 1987):** contracted out non-medical operations and some medical aspects to specialised operating companies under multiple contracts.
- **Comprehensive Operating System (1988 – 1999):** transfer of management and operation of all medical and non-medical operations to a single company under a formal contract, with the MoH taking a supervisory role only.
- **New Public Self-Operating System (2000-2014):** the MoH took greater responsibilities for the operation and management of the hospitals.

Chapter 3 outlines a Conceptual Framework, and lays out the three main forms of privatisation, where the different forms of privatisation are distinguished by the level of ownership transferred to the private sector, and whether management is also transferred to the private sector, such that Corporatisation is the separation of ownership and management. The government retains a full ownership shareholding but transfers a degree of management of the firm to the private sector. Partial Privatisation is where the government transfers a minority ownership shareholding (less than 50 per cent) to the private sector and retains management of the firm. Full Privatisation is where the government transfers all or the majority of ownership shareholdings (at least 50 per cent) and management to the private sector.

No hospitals within the confines of this study's data sample are either partially or fully privatised. However, 'Corporatisation' is considered as a movement towards privatisation, as this stage often precedes partial or full privatisation, which has been the Saudi government's strategy since the 2nd National Development Plan (Ministry of Planning, 1975) was to increase the private sector's opportunities to manage, operate, and maintain projects within a free market framework.

The period 1979-2014 saw a number of corporatisation 'movements' (which is an intermediate phase of movement towards privatisation as explained in 1.1 above) intended to provide experience for a later transition to a (partial or full) privatised operating model mentioned within the KSA 5-year development plans, and recently, in the NTP 2020 and the latest long-term development plan (Vision 2030). These experiments resulted in operational (medical and non-medical), administration, and management functions moving to external company suppliers in partnership with the MoH over time. The latter stages of the Comprehensive Operating System phase were

fully corporatised, whereas the other system phases within this study had varying levels of application of the components of corporatisation.

Chapter 4 define the Methodology and presented the main sources and descriptions of the data employed for the empirical testing of the stated hypotheses and the associated econometric specifications of the various models to be estimated. To reiterate, the hypotheses to test in this study are as follows:

H1 - *Performance in terms of efficiency may differ under the different forms of corporatisation.*

H2 - *Corporatisation will be positively associated with efficiency.*

H3 - *Fully corporatised hospitals will perform better in terms of quality than partially corporatised hospitals.*

This chapter is divided into a number of sub-sections presenting the results from the economic models of analysis, outlined in the previous chapter. As stated in Chapter 4, four key econometric methods are employed in this study in order to address the research questions and associated hypotheses, and account for potential issues arising from the sample data. These econometric techniques are DEA, SFA, Panel Data Analysis, and Regression Analysis. Sections 5.2-5.6 use each of these techniques to bring a quantifiable focus on establishing whether corporatisation has led to improvements in the efficiency of the KSA hospitals within the sample set to consider Research Question 1.

Section 5.2 uses the DEA model, including estimation of an input-based DEA model for constant and variable returns to scale using a two-stage approach. The efficiency scores are also used to examine if the relative efficiencies identified in the DEA are impacted by external variables using a Tobit Regression Analysis. Section 5.3 presents a set of results from the estimation of the SFA model to consider the periods of change in the management and operation of the hospitals included in the study. The main

objective here is to estimate PE across the hospitals over the period. Section 5.4 the standard panel data estimation models which consider both time-invariant inefficiency (fixed) and time-varying (random) effects, thus effectively testing the stability of the models. Section 5.5 provides a trend analysis of input and output variables. Section 5.6 specifies and presents the results of Regression analyses using the MR specification and model. The purpose of this section is to support the consideration of Research Question 2, by examining the effect of the efficiency measures on hospital outcomes, in which the MR is specified as the variable for quality. Section 5.7 summarises and concludes this chapter by identifying which hypotheses are supported.

5.2 Data Envelopment Analysis

This section presents estimation results of the DEA model as defined in the previous chapter (Section 4.6.1). Following the description of the data outlined in the previous chapter, an input-oriented, two-stage DEA model is estimated for each of the management phases in which relative efficiency is measured in terms of minimising inputs while satisfying at least the given output levels.[6] We performed input-oriented DEA model because of the limited control of the hospitals over their outputs. The relative efficiency of the hospitals is measured on the assumption of Constant Returns to Scale (CRS) as the baseline model. CRS implicitly assumes that the hospitals were operating at their optimal scale or within the constraint of their individual PPF. The Variable Returns to Scale (VRS) relative efficiency measurement model is also estimated, which allows a distinction between efficiency and scale efficiency (see, Banker, *et al.,* 1984).

[6] The first stage measures the relative efficiency scores and the reference weights, whilst the slacks are estimated in the second stage. Thus, the two-stage estimation procedures identify the optimal solution (Ji and Lee, 2010).

5.2.1 DEA Analysis

When applying DEA in this study, a hospital is considered 'efficient' when the DEA score equals 1, and all slacks are 0, where further improvement is needed for a hospital to become efficient, either by increasing in outputs and/or decreasing in inputs. The slacks are either positive (which means that the hospital is using a surplus of an input that leads to inefficiency), or negative (which means that the inputs need to be increased to improve the quality of care) (Valdmanis, *et al.,* 2008). A hospital is considered 'weakly efficient' if a DEA score equals 1, but where the slacks are different from 0. To aid interpretation of the results, the figures for input slacks are used to calculate the percentage by which a less efficient hospital has to minimise all its inputs in order to achieve maximum performance by performing slack analysis. Slack analysis allows management to know which inputs need to be increased (and by how much) to increase quality and which inputs should be decreased to lower inefficiency (Valdmanis, *et al.,* 2008). Table 5.1 below presents the DEA measures of hospital relative efficiency (θ) by management phases. The Table shows for each hospital the relative efficiency scores and associated rankings. For the less efficient hospitals (i.e., $\theta < 1$), the relative efficiency scores are used to calculate the level of reduction in all inputs required for the less efficient hospitals to improve performance. The results are summarised in the following table, estimated using STATA (Statistical Software, vs.12).

(i) ***Efficiency by hospital.*** The DEA results (Table 5.1) show three groupings of hospitals. The first grouping contains 'Efficient' hospitals. Hospitals that are efficient are considered being either 'Always Efficient' or 'Weakly Efficient' depending on the slacks. Five hospitals (25 per cent of the sample) were considered Efficient (Hospital Nos. 4, 7, 8, 14, and 15). The second groupings of hospitals are those that are 'Always Inefficient'. Table 5.1 shows that six hospitals (30 per cent of the sample) are always inefficient

(Hospital Nos. 3, 6, 9, 10, 12, and 19) within the study period. The third group contains hospitals that have 'Varying levels of efficiency'. The remaining nine hospitals (45 per cent of sample) had varying levels of efficiency as results referring to it change across the phases.

(ii) ***Efficiency by Phase*****.** Hospital efficiency is compared across the four phases (detail shown in Appendices 5.A-5.D). The Bilateral Management phase (1979-1982) has eight hospitals with efficiency score '1'. Three hospitals (Hospitals No 5, 8 and 14) were Always Efficient and five hospitals were Weakly Efficient. Twelve hospitals have an efficiency score '$\Theta<1$' which suggests they were Inefficient.

In the Partial Management phase (1983-1987) there are seven hospitals with Efficiency score '1'. one hospital (Hospital No. 8) is Always Efficient, and six hospitals are Weakly Efficient. The remaining thirteen hospitals have an efficiency score '$\Theta < 1$' indicating that they are Inefficient.

In the Comprehensive Management phase (1988-1999) there are nine hospitals with efficiency score '1'. Four of these hospitals (4, 5, 8, and 14) are Always Efficient, and the other five hospitals were Weakly Efficient. The remaining eleven hospitals were considered Inefficient.

The New Public Self-Operating System phase (2000-2014) results include ten hospitals with an efficiency score of '1'. Eight hospitals (Hospitals No 7, 8, 11, 14, 15, 16, 18, and 20) are Always Efficient, and two hospitals that are Weakly Efficient. There are ten Inefficient hospitals.

Table 5.2 below, shows that generally the Partial System phase has the lowest level of Efficient hospitals and vice versa in the New Public Self Operating System phases.

Table 5.1 - DEA Measures of Hospital Relative Efficiency by Management Phases

	Bilateral Cooperation Agreements (1979 –1982)			**Partial Operating System** (1983 – 1987)			**Comprehensive Operating System** (1988 – 1999)			**New Public Self-Operating System** (2000-2014)		
Hospital (DMU)	Rank	Efficiency scores (θ)	Reduction in inputs required (%)	Rank	Efficiency scores (θ)	Reduction in inputs required (%)	Rank	Efficiency scores (θ)	Reduction in inputs required (%)	Rank	Efficiency scores (θ)	Reduction in inputs required (%)
1	7	1	0.00	6	1	0.00	13	0.922023	7.80	18	0.69776	30.22
2	11	0.852372	14.76	10	0.868883	13.11	6	1	0.00	12	0.960013	4.00
3	20	0.334993	66.50	20	0.331722	66.83	20	0.259642	74.04	20	0.21146	78.85
4	5	1	0.00	3	1	0.00	1	1	0.00	9	1	0.00
5	1	1	0.00	9	0.891304	10.87	1	1	0.00	19	0.261887	73.81
6	9	0.960822	3.92	8	0.93115	6.89	11	0.967481	3.25	13	0.952728	4.73
7	8	1	0.00	7	1	0.00	8	1	0.00	1	1	0.00
8	1	1	0.00	1	1	0.00	1	1	0.00	1	1	0.00
9	16	0.612717	38.73	16	0.606478	39.35	12	0.932161	6.78	11	0.961747	3.83
10	18	0.388478	61.15	18	0.401169	59.88	19	0.583878	41.61	17	0.725644	27.44
11	10	0.91405	8.60	11	0.848066	15.19	7	1	0.00	1	1	0.00
12	15	0.62593	37.41	15	0.618331	38.17	16	0.682679	31.73	15	0.758812	24.12
13	12	0.725894	27.41	12	0.746888	25.31	9	1	0.00	14	0.94805	5.20
14	1	1	0.00	2	1	0.00	1	1	0.00	1	1	0.00
15	4	1	0.00	4	1	0.00	5	1	0.00	1	1	0.00
16	19	0.369582	63.04	19	0.36165	63.84	17	0.682122	31.79	1	1	0.00
17	17	0.577251	42.27	17	0.560487	43.95	14	0.778555	22.14	10	1	0.00
18	14	0.663348	33.67	14	0.654693	34.53	15	0.699381	30.06	1	1	0.00
19	13	0.676793	32.32	13	0.664744	33.53	18	0.638642	36.14	16	0.741059	25.89
20	6	1	0.00	5	1	0.00	10	0.982559	1.74	1	1	0.00

Notes: The slacks are reported for each management phase in the Appendix Tables A5.A – A5.D; DMU's are the decision-making units (the 20 hospitals); Rank shows the ranking of each hospital according to the relative efficiency scores; efficiency scores are the measures of efficiency of each hospital. A hospital is efficient when the score=1, and all the slacks are zeros. A hospital is 'weakly' efficient if the score=1, but the slacks are different from zero. Figures in the Reduction in Inputs Required were calculated as % by which less efficient hospitals have to minimise their inputs in order to improve performance.

Table 5.2 - Efficiency by phase

	Efficient Hospitals			Inefficient
	Total	**Always Efficient**	**Weakly Efficient**	
Bilateral	8	3	5	12
Partial	7	1	6	13
Comprehensive	9	4	5	11
New Public Self-Operating	10	8	2	10
All periods	14	1	13	6
Source: Author calculation from Tables 5.A - 5.D in the Appendix				

(iii) ***Comparison of comprehensive Operating System and the New Public Self-Operating System.*** Table 5.1 above shows that four hospitals (Hospitals No 16,17,18 and 20), or 20 per cent of the sample moved from being Inefficient to Efficient (from $\theta \neq$ one to be θ = one), and three hospitals (Hospital No, 2, 5 and 13), or 15 per cent moved from being Efficient to Inefficient when transiting from the Comprehensive Operating System phase to the New Public Self-Operating System phase. However, six hospitals (30 per cent) remained Efficient ($\theta = 1$) in both phases, and seven (35 per cent) hospitals remained Inefficient ($\theta \neq$ one) in both phases. This gives a total of 65 per cent of hospitals that were not associated with the movement from the Comprehensive System phase to the New Public Self-Operating System phase.

(iv) ***Reduction of inputs.*** Comparing the inefficient hospitals, the range of the level of reduction in all inputs required for the hospitals to become efficient varies considerably across the phases. A summary is shown in Table 5.3 below.

Table 5.3 - Reduction of inputs required from inefficient hospitals

Reduction of inputs required from inefficient hospitals	Hospital DMU	**Bilateral Cooperation Agreements** (1979 –1982)	Hospital DMU	**Partial Operating System** (1983 – 1987)	Hospital DMU	**Comprehensive Operating System** (1988 – 1999)	Hospital DMU	**New Public Self-Operating System** (2000-2014)
	6	3.92	6	6.89	20	1.74	9	3.83
	11	8.6	5	10.87	6	3.25	2	4
	2	14.76	2	13.11	9	6.78	6	4.73
	13	27.41	11	15.19	1	7.8	13	5.2
	19	32.32	13	25.31	17	22.14	12	24.12
	18	33.67	19	33.53	18	30.06	19	25.89
	12	37.41	18	34.53	12	31.73	10	27.44
	9	38.73	12	38.17	16	31.79	1	30.22
	17	42.27	9	39.35	19	36.14	5	73.81
	10	61.15	17	43.95	10	41.61	3	78.85
	16	63.04	10	59.88	3	74.04	-	-
	3	66.50	16	63.84	-	-	-	-
	-	-	3	66.83	-	-	-	-
Average Reduction inputs required from inefficient hospitals %		35.82		34.73		26.10		27.81
Variance in Reduction of inputs required from inefficient hospitals		62.58		59.94		72.30		75.02

Under the Bilateral Cooperation Agreements phase, the level of reduction in all inputs required to achieve maximum relative efficiency ranges between 3.92 per cent and 66.50 per cent.

In the Partial Operating System phase inefficient hospitals would require between 6.89 per cent and 66.83 per cent reduction in all their inputs.

In the Comprehensive System phase the level of reduction in all inputs required by inefficient hospitals ranges between 1.74 per cent and 74.04 per cent.

In the new Public Self-Operation System phase, the level of reduction in all inputs required by inefficient hospitals ranges between 3.83 per cent and 78.85 per cent.

The lowest average reduction of inputs required from inefficient hospitals is shown in the Comprehensive System phase. These results suggest that (on average) inefficient hospitals are most efficient (closer to their PPF) in the Comprehensive System phase compared to other phases. Furthermore, the New Public Self-Operating System phase shows the largest variance between inefficient hospitals (75.02). Additionally, it is worth noting that labour inputs (number of Doctors and Nurses) are the main inputs responsible for the main source of inefficiency in the inefficient hospitals (see Appendix 5.A-5.D), as we explained in (5.2.1) that the slacks analysis shows the root of inefficiency.

(v) ***Variable returns to scale (VRS).*** In order to obtain further information on the relative efficiency of the hospitals, an input-based DEA model for variable returns to scale is estimated in the Table (5.4) below. Note that there are no slacks in this case, since the output levels have no effect on relative efficiency evaluation.

Eight hospitals show Increasing Returns to Scale (IRS) on their VRS frontier under the first two phases. The number decreases to six hospitals under the Comprehensive System phase. The number further declines to four hospitals under the New Public Self-Operation System phase

However, the number of hospitals on the Decreasing Returns to Scale (DRS) on the VRS frontier increases from two (in the Bilateral Cooperation System phase), to four under the subsequent two phases, then finally to five under the last phase.

Table 5.4 - Oriented DEA Relative Efficiency Results Under Assumption of VRS

Hospital	BILATERAL					PARTIAL					COMPREHENSIVE					NEW PUBLIC SELF-OPERATING			
	CRS PE	VRS PE	SCALE	RTS		CRS PE	VRS PE	SCALE	RTS		CRS PE	VRS PE	SCALE	RTS		CRS PE	VRS PE	SCALE	RTS
1	1	1	1	-		1	1	1	-		0.922	1	0.922	drs		0.698	0.881	0.792	irs
2	0.852	0.962	0.886	irs		0.869	0.876	0.992	irs		1	1	1	-		0.960	1	0.960	drs
3	0.335	0.335	1	-		0.332	6.844	0.048	irs		0.260	0.260	1	-		0.211	0.211	1	-
4	1	1	1	-		1	1	1	-		1	1	1	-		1	1	1	-
5	1	1	1	-		1	1	1	-		1	1	1	-		0.262	0.268	0.979	irs
6	0.961	1	0.961	drs		0.93115	1	0.93115	drs		0.967	1	0.967	drs		0.953	1	0.953	drs
7	1	1	1	-		1	1	1	-		1	1	1	-		1	1	1	-
8	1	1	1	-		1	1	1	-		1	1	1	-		1	1	1	-
9	0.613	0.708	0.865	drs		0.606	0.625	0.970	drs		0.932	0.990	0.942	drs		0.962	1	0.962	drs
10	0.388	0.471	0.825	irs		0.401	0.417	0.961	irs		0.584	0.735	0.795	irs		0.726	1	0.726	drs
11	0.914	0.944	0.968	irs		0.848	0.900	0.942	drs		1	1	1	-		1	1	1	-
12	0.626	0.627	0.998	irs		0.618	0.619	0.998	irs		0.683	0.689	0.991	irs		0.759	0.770	0.986	irs
13	0.726	0.726	1.000	irs		0.747	0.749	0.997	irs		1	1	1	-		0.948	0.949	0.999	drs
14	1	1	1	-		1	1	1	-		1	1	1	-		1	1	1	-
15	1	1	1	-		1	1	1	-		1	1	1	-		1	1	1	-
16	0.370	0.370	1	-		0.362	0.674	0.537	irs		0.682	0.698	0.977	irs		1	1	1	-
17	0.577	0.604	0.956	irs		0.560	0.569	0.985	drs		0.779	0.779	0.999	drs		1	1	1	-
18	0.663	0.679	0.978	irs		0.655	0.719	0.910	irs		0.699	0.704	0.993	irs		1	1	1	-
19	0.677	0.711	0.952	irs		0.665	0.741	0.897	irs		0.639	0.702	0.910	irs		0.741	0.770	0.962	irs
20	1	1	1	-		1	1	1	-		0.983	1	0.983	irs		1	1	1	-

Notes: CRS_PE: PE under Constant Returns to Scale = Relative efficiency Score; VRS: PE under Variable Returns to Scale: SCALE: Scale efficiency (CRS_TE/VRS_TE); RTS: Type of Returns to Scale - irs = Increasing returns to scale (scale is positive); drs – decreasing returns to scale if scale is negative.

5.2.2 Tobit regression analysis level data

Using the preceding analysis as a baseline, attention is now focused on regression analysis using the relative efficiency scores.

Tobit Regression is used to examine the determinants of efficiency differences amongst the hospitals, largely because the efficient scores of the individual hospitals are censored at their maximum values (Ji and Lee, 2010). The relative efficiency scores are the dependent variable, and the determinants are hospital levels, and the control variables include population, location of hospital and size of the city.[7]

Note that the Tobit Regression analysis is considered more appropriate as it is dealing with the distribution characteristics of the efficiency levels where the dependent variable contains observations with zero value or other continuous observations. In contrast Probit or Logit analysis can only handle binary (0, or 1 values) dependent variables.

Four Tobit models are estimated independently for each of the phases of management and operations, Bilateral Cooperation Agreements, Partial Operating System, Comprehensive Operating System, and Public Self-Operation System phases.

Table 5.5 below presents the results of the Tobit estimations using the following hypothetical variants:

H_{01}: *There* is no effect of population on CRS

H_{a1}: *There* is some effect of population on CRS

H_{02}: *There* is no effect of semi-urban area on CRS

H_{a2}: *There* is some effect of semi-urban area on CRS

H_{03}: *There* is no effect of urban area on CRS

[7] Note that the number of pilgrims was not included as they are not hospital level variables that could determine their input-based efficiency.

H_{a3}: *There* is some effect of urban area on CRS

H_{04}: *There* is no effect of medium-sized city on CRS

H_{a4}: *There* is some effect of medium-sized city on CRS

H_{05}: *There* is no effect of small city on CRS

H_{a5}: *There* is some effect of small city on CRS

H_{06}: Constant = 0

H_{a6}: Constant ≠ 0

Table 5.5 - Tobit Regression Analysis results

	Bilateral Cooperation Agreements (1979 –1982)	**Partial Operating System** (1983 – 1987)	**Comprehensive Operating System** (1988 – 1999)	**New Public Self-Operating System** (2000-2014)
Dependent variable: CRS Hospital Relative Efficiency scores				
Population	0.121*	0.137*	0.464*	-0.012***
	(0.0213)	(0.022)	(0.006)	(0.006)
	0.000	0.000	0.000	0.056
Reference: Hospital located in rural area				
Hospital located in semi-urban area	0.127*	0.141*	0.191*	0.088*
	(0.043)	(0.039)	(0.034)	(0.254)
	0.005	0.001	0.000	0.001
Hospital located in urban area	0.098**	0.108*	0.094*	0.039*
	(0.037)	(0.032)	(0.019)	(0.014)
	0.010	0.001	0.000	0.007
Reference: Size of city - Big city				
Size of city - medium city	0.174*	0.156*	0.175*	0.056***
	(0.045)	(0.041)	(0.036)	(0.031)
	0.000	0.000	0.000	0.073
Size of city - small city	0.136*	0.119*	0.072*	0.011
	(0.036)	(0.0323)	(0.018)	(0.013)
	0.000	0.000	0.000	0.413
Constant	0.410*	0.422*	0.647*	0.945*
	(0.081)	(0.076)	(0.037)	(0.024)
	0.000	0.000	0.000	0.000
Observations	80	100	240	300

Notes: Robust standard errors in parentheses, *p*-values in the third rows, where significance levels are *p<0.01, ** p<0.05, *** p<0.1.

Table 5.5 shows that different control variables are significantly related to the CRS relative efficiency scores of the hospitals across the four different management and operational phases apart from the small city in the last phase. When comparing the results

of the different phases, the coefficient on the constant terms shows the variance in the average relative efficiency score for each period.

In the first three phases, the H_{a1}, H_{a2}, H_{a3}, H_{a4}, H_{a5}, and H_{a6} hypotheses are accepted as all the coefficients of population, location, size of city, and constant are positively related to the CRS relative efficiency scores of the hospitals. Furthermore, there is a significant increase from small cities to medium-size cities, and from hospitals located in urban areas to those which are located in semi-urban areas. For example, the first phase shows that, compared to big cities, the CRS relative efficiency scores of the hospitals increase progressively from small cities to medium size cities (0.136 to 0.174 respectively). Compared to rural areas, the CRS relative efficiency scores of the hospitals increase from hospitals located in urban areas to those are located in the semi-urban areas (0.098 to 0.127 respectively).

In the New Public Self-Operating System phase, (H_{a1}, H_{a2}, H_{a3}, H_{a4}, H_{a6} and H_{05}) hypotheses are accepted as the coefficient of population is negatively related to the CRS relative efficiency scores of the hospitals and is also significance. Compared to rural areas, the CRS relative efficiency scores of the hospitals increase from hospitals located in urban areas to those are located in the semi-urban areas (0.039 to 0.088 respectively). Medium sized cities are positively related to the CRS relative efficiency scores of the hospitals and are marginally significant (i.e., at 10 per cent level) while small cities are considered insignificant. However, the hospital located in a small city might show less efficiency than the hospital located in a bigger city (even with identical inputs) not because of inefficiency, but because it may have fewer patients to visit, which means that the difference in output is due to a lack of demand, rather than inefficiency.

In conclusion to this section, Table 5.5 shows that the variance in the average efficiency score is generally statistically significant for all phases. The coefficients

increased gradually from 0.41 under the Bilateral Cooperation Agreements phase increased to 0.42 in Partial Operating System phase, then to 0.65 in Comprehensive Operating System phase and finally 0.95 in the New Public Self-Operating System phase.

5.2.3 DEA summary

Table 5.6 - DEA Table Summary

Efficiency by Hospital	**No. of Hospitals**	**Percentage of Hospitals**
Always Efficient/Weakly Efficient	5	25%
Always Inefficient	6	30%
Varying levels of Efficiency	9	45%

Efficiency by Phase	**No. of Hospitals**	**Percentage of Hospitals**
Hospitals were NOT associated with changes in all phases	11	55%
Hospitals were associated with changes in all phases	9	45%

Average reduction of Inputs required from inefficient hospitals to become efficient	**Bilateral Cooperation Agreements** (1979 –1982)	**Partial Operating System** (1983 – 1987)	**Comprehensive Operating System** (1988 – 1999)	**New Public-Self-Operating System** (2000-2014)
Average Reduction input required to become efficient %	35.82	34.73	26.10	27.81
Variance in Reduction of inputs required % points across all hospitals	62.58	59.94	72.30	75.02

Comparison of Comprehensive and New Public Self-Operating System phases	**No. of Hospitals**	**Percentage of Hospitals**
Hospitals which were POSITIVELY associated with move from Comprehensive to New Public Self-Operating system phase	4	20%
Hospitals which were NEGATIVELY associated with move from Comprehensive to New Public Self-Operating system phase	3	15%
No Change in efficiency between the two phases	13	65%

Variable Returns to Scale (VRS)	**Bilateral Cooperation Agreements** (1979 –1982)	**Partial Operating System** (1983 – 1987)	**Comprehensive Operating System** (1988 – 1999)	**New Public Self-Operating System** (2000-2014)
IRS	8 (40%)	8 (40%)	6 (30%)	4 (20%)
DRS	2 (10%)	4 (20%)	4 (20%)	5 (25%)

Table 5.7 - Summary of DEA average relative efficiency scores and Tobit regression

	Bilateral Cooperation Agreements (1979 –1982)	**Partial Operating System** (1983 – 1987)	**Comprehensive Operating System (**1988 – 1999)	**New Public Self-Operating System** (2000-2014)
DEA Analysis				
Average Relative Efficiency Score over whole sample	0.79	0.77	0.856	0.861
Average Efficiency over inefficient hospitals	0.64	0.65	0.74	0.72
Tobit Regression				
Constant (the variance in the average CRS efficiency score)	0.410*	0.422*	0.647*	0.945*
	(0.081)	(0.076)	(0.037)	(0.024)
	0.000	0.000	0.000	0.000
Notes: Robust standard errors in parentheses, *p*-values in the third rows, where significance levels are *** p<0.01, ** p<0.05, * p<0.1.				

Looking back at the efficiency scores from the Table 5.7 above, it can be observed that the intercept increases over time when considering the whole sample. Robust standard error is the criterion to be adopted and preferred at the lowest value in the period New Public Self-Operating System. However, the control variables (which are positively and significantly related to the CRS relative efficiency scores across the four phases) have a greater significance when moving to the third phase, compared to movement to the final phase, except in the constant, which shows that the fourth phase exhibits greater efficiency.

5.3 Stochastic Frontier Analysis (SFA)

The second set of results obtained from the estimation of stochastic frontier production function models for panel data, covering the entire period (1979-2014) for all hospitals to estimate the relative PE (the ratio of the observed outputs to the potential outputs for the same level of inputs) across the hospitals over the period taking into account the control variables including: pilgrims, location of hospital and size of the city

in addition to the input variables. While the first set (Appendix 5.E) of results obtained from the estimation of each output are to calculate and maximise the potential outputs via maximum likelihood estimation, showing wheather the observed variation in efficiency (differences in the production) will be related to inefficiency or random shocks outside the control of hospitals, through gamma. “If gamma ϒ is close to zero, the differences in the production will be entirely related to statistical noise, while if gamma ϒ close to one reveals the presence of technical inefficiency." (Hamidi, 2016, p.6)

5.3.1 Measures of PE by hospital

Table 5.8 bellow shows the results of the STATA routine *xtfrontier* to derive the PE score by hospital (row) referenced to specific output variable (column).

Table 5.8 – PE by hospital of specific output variables

SFA Hospital Results by output variable	Hospital	No. of Inpatients discharged	Hospital	No. of Radiology tests	Hospital	No. of Laboratory tests completed	Hospital	No. of Review visits
	1	0.314	1	0.608	1	0.459	1	0.806
	2	0.428	2	0.824	2	0.214	2	0.885
	3	0.074	3	0.032	3	0.051	3	0.046
	4	0.079	4	0.039	4	0.17	4	0.898
	5	0.048	5	0.011	5	0.695	5	0.049
	6	0.262	6	0.943	6	0.169	6	0.932
	7	0.964	7	0.664	7	0.434	7	0.95
	8	0.5	8	0.597	8	0.713	8	0.94
	9	0.241	9	0.897	9	0.168	9	0.543
	10	0.345	10	0.35	10	0.331	10	0.459
	11	0.3	11	0.956	11	0.29	11	0.953
	12	0.219	12	0.793	12	0.1	12	0.702
	13	0.373	13	0.687	13	0.221	13	0.741
	14	0.315	14	0.795	14	0.909	14	0.728
	15	0.424	15	0.596	15	0.411	15	0.803
	16	0.168	16	0.301	16	0.39	16	0.675
	17	0.431	17	0.882	17	0.182	17	0.881
	18	0.362	18	0.804	18	0.136	18	0.549
	19	0.391	19	0.432	19	0.121	19	0.592
	20	0.344	20	0.902	20	0.183	20	0.723
Average PE Score		0.3291		0.6056		0.3173		0.6927
Variance		0.916		0.944		0.858		0.906
Standard Deviation		0.1956		0.31169		0.2305		0.2652

(i) ***Number of inpatients discharged.*** Across the whole study period (1979-2014) the average PE score is 0.3291. Ten hospitals (50 per cent) score below average. Hospital No. 7 has the highest PE score (0.964). Hospital No. 5 has the lowest PE score (0.048). The variance in PE scores for this variable is 0.916, with a Standard Deviation of 0.196.

(ii) ***Number of radiology tests.*** Across the study period (1979-2014) the average PE score is 0.606. Eight hospitals (40 per cent) score below average. Hospital No. 11 has the highest PE score (0.956). Hospital No. 5 has the lowest PE score (0.011). The variance in efficiency scores for this variable is 0.944, with a Standard Deviation of 0.312

(iii) ***Laboratory tests completed.*** Across the study period (1979-2014) the average PE score is 0.317. Twelve hospitals (60 per cent) score below average. Hospital No. 14 has the highest efficiency score (0.909). Hospital No. 3 has the lowest PE score (0.051). The variance in PE scores for this variable is 0.858, with a Standard Deviation of 0.231.

(iv) ***Review visits.*** Across the study period (1979-2014) the average PE score is 0.693. Seven hospitals (35 per cent) score below average. Hospital No. 11 has the highest PE score (0.953). Hospital No. 3 has the lowest PE score (0.046). The variance in efficiency scores for this variable is 0.906, with a Standard Deviation of 0.265.

5.3.2 SFA results for PE of output variables by hospital, by management phase

(i) ***Number of Inpatients discharged.*** Table 5.9 presents the SFA PE results for the Inpatients discharged output variable, by hospital, by management phase.

Bilateral System phase has the lowest average PE score (0.2333) whereas the New Public Self-Operating System phase has the highest average efficiency score (0.394). The Bilateral Management phase has eight hospitals (40 per cent) with above average efficiency scores. The Partial System, Comprehensive and New Public Self-Operating System phases each have ten hospitals (50 per cent) above each of the phase's efficiency score.

The average PE score increased by 0.161 between the Bilateral Management phase and the New Public Self-Operating System phase. The efficiency increase between the Comprehensive System phase and the New Public Self-Operating System phase is 0.085.

The New Public Self-Operating System phase (2000-2014) recorded both the smallest variance (0.893) in range of scores and the lowest Standard Deviation (0.1938). The phase with the greatest variance between hospitals efficiency scores is the Bilateral System phase.

Table 5.9 – SFA PE for number of Inpatients discharged

SFA – Inpatients discharged	Hospital	Bilateral (1979-1982)	Hospital	Partial (1983-1987)	Hospital	Comprehensive (1988-1999)	Hospital	New Public Self- Op. (2000-2014)	Hospital	Variation from Bilateral to New Public Self-Op.	Hospital	Variation from Comprehensive to New Public Self-Op.
	1	0.201	1	0.231	1	0.291	1	0.389	1	0.188	1	0.098
	2	0.312	2	0.344	2	0.407	2	0.503	2	0.191	2	0.096
	3	0.024	3	0.034	3	0.058	3	0.113	3	0.089	3	0.056
	4	0.027	4	0.037	4	0.062	4	0.12	4	0.093	4	0.058
	5	0.013	5	0.019	5	0.035	5	0.078	5	0.065	5	0.043
	6	0.156	6	0.183	6	0.238	6	0.335	6	0.179	6	0.096
	7	0.952	7	0.956	7	0.963	7	0.971	7	0.019	7	0.009
	8	0.387	8	0.42	8	0.481	8	0.571	8	0.184	8	0.091
	9	0.139	9	0.164	9	0.218	9	0.313	9	0.174	9	0.094
	10	0.231	10	0.262	10	0.323	10	0.421	10	0.191	10	0.099
	11	0.189	11	0.218	11	0.277	11	0.375	11	0.186	11	0.098
	12	0.121	12	0.145	12	0.196	12	0.288	12	0.168	12	0.092
	13	0.257	13	0.289	13	0.351	13	0.449	13	0.192	13	0.098
	14	0.203	14	0.232	14	0.292	14	0.391	14	0.188	14	0.098
	15	0.308	15	0.341	15	0.403	15	0.5	15	0.191	15	0.096
	16	0.082	16	0.102	16	0.146	16	0.231	16	0.148	16	0.084
	17	0.315	17	0.348	17	0.41	17	0.506	17	0.191	17	0.096
	18	0.246	18	0.278	18	0.339	18	0.438	18	0.192	18	0.099
	19	0.275	19	0.308	19	0.37	19	0.468	20	0.191	19	0.098
	20	0.229	20	0.26	20	0.321	20	0.42	19	0.192	20	0.099

Average		0.2333		0.2585		0.309		0.394		0.1606		0.0849
Variance		0.939		0.937		0.928		0.893		0.173		0.09
Standard Deviation		0.1987		0.1987		0.1981		0.1938		0.0512		0.0243

All hospitals increased in efficiency over the four phases. The largest increase in efficiency score 1979-2014 is 0.192 while the lowest increase in efficiency score is 0.019.

The largest increase between 1988-2014 (i.e., between Comprehensive and New Public Self-Operating System phase) is 0.099 while the lowest increase in efficiency score is recorded by Hospital No.7 at 0.009.

(ii) ***Number of radiology tests.*** Table 5.10 below presents the SFA efficiency results for Radiology tests, between 1979 and 2014, by hospital, by management phase.

Table 5.10 - SFA PE for Radiology tests completed

SFA Radiology Tests Completed	Hospital	Bilateral (1979-1982)	Hospital	Partial (1983-1987)	Hospital	Comprehensive (1988-1999)	Hospital	New Public Self- Op. (2000-2014)	Hospital	Variation from Bilateral to New Public Self-Op.	Hospital	Variation from Comprehensive to New Public Self-Op.
	1	0.701	1	0.678	1	0.629	1	0.542	1	-0.159	1	-0.087
	2	0.872	2	0.86	2	0.836	2	0.789	2	-0.082	2	-0.046
	3	0.073	3	0.057	3	0.034	3	0.012	3	-0.062	3	-0.022
	4	0.087	4	0.068	4	0.042	4	0.015	4	-0.071	4	-0.026
	5	0.031	5	0.022	5	0.011	5	0.003	5	-0.028	5	-0.008
	6	0.959	6	0.956	6	0.947	6	0.931	6	-0.028	6	-0.016
	7	0.748	7	0.727	7	0.684	7	0.605	7	-0.142	7	-0.078
	8	0.693	8	0.668	8	0.619	8	0.531	8	-0.162	8	-0.088
	9	0.926	9	0.919	9	0.904	9	0.876	9	-0.05	9	-0.028
	10	0.469	10	0.436	10	0.372	10	0.272	10	-0.198	10	-0.1
	11	0.968	11	0.965	11	0.959	11	0.946	11	-0.022	11	-0.013
	12	0.848	12	0.835	12	0.806	12	0.753	12	-0.095	12	-0.053
	13	0.766	13	0.746	13	0.705	13	0.631	13	-0.135	13	-0.074
	14	0.85	14	0.837	14	0.809	14	0.756	14	-0.094	14	-0.053
	15	0.692	15	0.667	15	0.618	15	0.53	15	-0.162	15	-0.088
	16	0.419	16	0.386	16	0.322	16	0.224	16	-0.195	16	-0.097
	17	0.915	17	0.907	17	0.89	17	0.858	17	-0.057	17	-0.032
	18	0.857	18	0.844	18	0.817	18	0.766	18	-0.091	18	-0.051
	19	0.548	19	0.517	19	0.456	19	0.355	19	-0.193	19	-0.101
	20	0.929	20	0.923	20	0.909	20	0.882	20	-0.048	20	-0.027
Average		0.6675		0.6509		0.6184		0.5638		-0.1037		-0.0544
Variance		0.937		0.943		0.948		0.943		-0.022		-0.093
Standard Deviation		0.303		0.30704		0.31217		0.31654		0.0595		0.0321

The New Public Self-Operating System phase has the lowest average PE score (0.5638) whereas the Bilateral phase had the highest average efficiency score (0.668). The Bilateral, Partial System and Comprehensive Management phase each have 14 hospitals (70 per cent) with above average efficiency scores. The New Public Self-

Operating System phase has 11 hospitals (55 per cent) above the phase's average efficiency score.

The average efficiency score decreased by -0.104 between the Bilateral Management phase and the New Public Self-Operating System phase. The efficiency decrease between the Comprehensive System phase and the New Public Self-Operating System phase is -0.054.

The Bilateral phase (1979-1982) recorded both the smallest variance (0.937) in range of scores and the lowest Standard Deviation (0.303). The phase with the greatest variance between hospitals efficiency scores is the Comprehensive System phase. The other two phases recorded the same Variance with score 0.943.

Hospital No. 10 at -0.198 records the largest decrease in efficiency score between 1979-2014 while Hospital No. 11 at -0.022 records the smallest decrease. The largest decrease between 1988-2014 is recorded in Hospital No. 19 at -0.101 while Hospital No.5 records the smallest decrease at -0.008.

(iii) ***Laboratory tests completed.*** Table 5.11 below presents the SFA efficiency score for Laboratory tests completed between 1979 and 2014, by hospital, by management phase.

The Bilateral phase has the lowest average PE score (0.220) whereas the New Public Self-Operating System phase has the highest average efficiency score (0.3852). The Comprehensive and New Public Self-Operating System phase each have eight hospitals (40 per cent) with above average efficiency scores. The Partial phase has the lowest number of hospitals 6 hospitals (30 per cent) above the phase's average efficiency score.

The average efficiency score increased by 0.166 between the Bilateral Management phase and the New Public Self-Operating System phase. The efficiency increase between

the Comprehensive System phase and the New Public Self-Operating System phase is 0.090. The New Public Self Operating System phase (1979-1982) recorded both the smallest variance (0.843) in range of scores and the lowest Standard Deviation (0.227). The phase with the greatest variance between hospitals efficiency scores is the Comprehensive System phase (0.87). The other two phases respectively recorded the variances of 0.864, and 0.869 for the Partial phase.

Table 5.11 - SFA PE for number of Laboratory tests completed

SFA Laboratory Tests Completed	Hospital	Bilateral (1979-1982)	Hospital	Partial (1983-1987)	Hospital	Comprehensive (1988-1999)	Hospital	New Public Self- Op. (2000-2014)	Hospital	Variation from Bilateral to New Public Self-Op.	Hospital	Variation from Comprehensive to New Public Self-Op.
	1	0.33	1	0.367	1	0.437	1	0.542	1	0.212	1	0.105
	2	0.107	2	0.132	2	0.189	2	0.291	2	0.185	2	0.103
	3	0.011	3	0.017	3	0.035	3	0.085	3	0.074	3	0.049
	4	0.075	4	0.096	4	0.145	4	0.241	4	0.166	4	0.095
	5	0.599	5	0.629	5	0.681	5	0.753	5	0.153	5	0.071
	6	0.074	6	0.095	6	0.144	6	0.239	6	0.165	6	0.095
	7	0.304	7	0.341	7	0.41	7	0.518	7	0.214	7	0.107
	8	0.622	8	0.651	8	0.7	8	0.768	8	0.146	8	0.068
	9	0.073	9	0.094	9	0.143	9	0.237	9	0.164	9	0.095
	10	0.205	10	0.238	10	0.306	10	0.416	10	0.212	10	0.111
	11	0.168	11	0.199	11	0.264	11	0.374	11	0.206	11	0.11
	12	0.033	12	0.045	12	0.078	12	0.153	12	0.12	12	0.074
	13	0.112	13	0.138	13	0.195	13	0.299	13	0.187	13	0.104
	14	0.875	14	0.886	14	0.905	14	0.928	14	0.053	14	0.024
	15	0.281	15	0.317	15	0.387	15	0.495	15	0.215	15	0.109
	16	0.26	16	0.296	16	0.366	16	0.476	16	0.215	16	0.11
	17	0.083	17	0.106	17	0.157	17	0.255	17	0.171	17	0.098
	18	0.053	18	0.07	18	0.112	18	0.199	18	0.146	18	0.087
	19	0.044	19	0.06	19	0.098	19	0.18	19	0.136	19	0.082
	20	0.084	20	0.106	20	0.157	20	0.255	20	0.172	20	0.098
Average		0.2196		0.2441		0.2954		0.3852		0.1656		0.0897
Variance		0.864		0.869		0.87		0.843		0.162		0.087
Standard Deviation		0.2322		0.23445		0.2348		0.2265		0.0453		0.0897

All hospitals (100 percent) increased in PE over the four phases. The largest increase in efficiency score between 1979-2014 is 0.215 while the smallest increase in efficiency score is recorded by Hospital No. 14 is 0.053. The largest increase between between Comprehensive and New Public Self-Operating System phase is recorded in Hospital No. 10 at 0.111 while Hospital No. 14 records the smallest increase at 0.024.

(iv) ***Review visits*****.** Table 5.12, the Bilateral phase has the lowest average PE score (0.610) whereas the New Public Self-Operating system phase had the highest average efficiency score (0.7443). The New Public Self-Operating System phase has 14 hospitals (70 per cent) with above average efficiency scores. The Bilateral and Partial phases have the lowest number of hospitals 12 hospitals (60 per cent) above the phase's average efficiency score. The Comprehensive System phase has 13 hospitals (65 per cent) showing above average efficiency scores.

The average PE score increased by 0.135 between the Bilateral Management phase and the New Public Self-Operating System phase. The efficiency increase between the Comprehensive System phase and the New Public Self-Operating System phase was 0.0641. The New Public Self Operating System phase recorded both the smallest variance (0.881) in range of scores and the lowest Standard Deviation (0.255). The phase with the greatest variance between hospitals efficiency scores is the Partial System phase (0.928).

All hospitals (100 per cent) increased in efficiency over the four phases. Hospital No. 10 recorded the largest increase in efficiency score at 0.259 between 1979-2014 while the smallest increase in efficiency score is recorded by Hospital No. 11 at 0.035. The largest increase between Comprehensive and New Public Self-Operating System phase is recorded in Hospital No. 10 at 0.128 while Hospital No.11 records the smallest increase at 0.015.

Table 5.12 –SFA PE for number of Review visits

SFA – Reviews Visits	Hospital	Bilateral (1979-1982)	Hospital	Partial (1983-1987)	Hospital	Comprehensive (1988-1999)	Hospital	New Public Self- Op. (2000-2014)	Hospital	Variation from Bilateral to New Public Self-Op.	Hospital	Variation from Comprehensive to New Public Self-Op.
	1	0.723	1	0.751	1	0.796	1	0.854	1	0.131	1	0.058
	2	0.833	2	0.851	2	0.879	2	0.915	2	0.081	2	0.035
	3	0.006	3	0.01	3	0.027	3	0.084	3	0.078	3	0.056
	4	0.851	4	0.867	4	0.893	4	0.924	4	0.073	4	0.032
	5	0.006	5	0.011	5	0.03	5	0.089	5	0.083	5	0.059
	6	0.9	6	0.911	6	0.929	6	0.95	6	0.05	6	0.021
	7	0.927	7	0.935	7	0.948	7	0.963	7	0.037	7	0.016
	8	0.913	8	0.922	8	0.937	8	0.956	8	0.044	8	0.019
	9	0.393	9	0.438	9	0.52	9	0.637	9	0.244	9	0.117
	10	0.301	10	0.346	10	0.432	10	0.56	10	0.259	10	0.128
	11	0.93	11	0.938	11	0.95	11	0.965	11	0.035	11	0.015
	12	0.586	12	0.623	12	0.687	12	0.771	12	0.186	12	0.084
	13	0.636	13	0.67	13	0.727	13	0.803	13	0.167	13	0.075
	14	0.619	14	0.654	14	0.714	14	0.792	14	0.173	14	0.078
	15	0.719	15	0.747	15	0.793	15	0.852	15	0.133	15	0.059
	16	0.552	16	0.591	16	0.659	16	0.75	16	0.198	16	0.091
	17	0.828	17	0.846	17	0.875	17	0.912	17	0.084	17	0.037
	18	0.399	18	0.444	18	0.526	18	0.642	18	0.242	18	0.116
	19	0.45	19	0.494	19	0.572	19	0.68	19	0.23	19	0.108
	20	0.613	20	0.648	20	0.709	20	0.788	20	0.176	20	0.079
Average		0.6092		0.6348		0.68015		0.7443		0.1352		0.0641
Variance		0.924		0.928		0.923		0.881		0.224		0.113
Standard Deviation		0.2815		0.2785		0.2712		0.2545		0.0757		0.0359

5.3.3 SFA PE: summary

(i) ***Average efficiency score***. Figure 5.1 below shows the average PE measures (for all 20 hospitals) across all four outputs measures, providing a high-level comparison across management and operational phases. The New Public Self-Operating System phase shows the greatest average efficiency scores across all output variables apart from Radiology tests as an output measure of PE. The Bilateral System phase shows the lowest average efficiency scores across all the output measures except in the Radiology output where the Bilateral phase recorded the highest score.

However, the variances between the different phase averages (at this summary level) are not obviously significant, and therefore, not supportive of checking the correlation of the efficiency of the various outputs with the management system phases, using the SFA method.

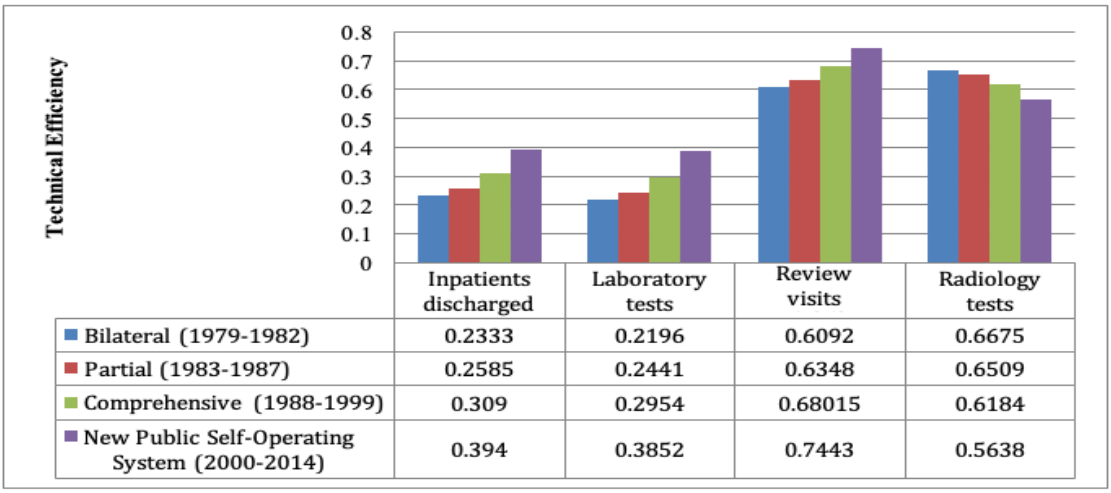


Figure 5.1 - Summary of average PE of output variables by phase

Table 5.13 below provides a more detailed comparative evaluation summary of the SFA results.

Table 5.13 - SFA PE Summary

SFA SUMMARY	Standard Deviation				Average Efficiency Scores					Average Variance			
	In patients discharged	Radiology tests	Laboratory Tests	Review visits	In patients discharged	Radiology tests	Laboratory tests	Review visits	Outputs Totaled	In patients discharged	Radiology tests	Laboratory tests	Review visits
Bilateral (1979 – 1982)	0.199	0.303	0.232	0.282	0.233	0.668	0.220	0.609	0.432	0.939	0.937	0.864	0.924
Partial (1983-1987)	0.199	0.307	0.234	0.279	0.259	0.651	0.244	0.635	0.447	0.937	0.943	0.869	0.928
Comprehensive (1988-1999)	0.198	0.312	0.235	0.271	0.309	0.618	0.295	0.680	0.476	0.928	0.984	0.870	0.923
New Pubic self-operating system (2000-2014)	0.194	0.317	0.227	0.255	0.394	0.564	0.385	0.744	0.522	0.893	0.943	0.843	0.881

(ii) ***Standard deviations.*** The New Public Self-Operating System phase shows the lowest Standard Deviations for Inpatients discharged, Laboratory tests and Review visits, as well as the highest Standard Deviation for Radiology tests SFA calculated efficient scores. In contrast, the Bilateral System phase shows the lowest Standard Deviation for Radiology tests SFA calculated efficient scores. The Partial System phase shows the highest Standard Deviation for Inpatients discharged (same score as the previous phase). The Comprehensive System phase shows the highest Standard Deviation for Laboratory tests.

(iii) ***Average Variance Scores.*** The New Public Self-Operating System phase shows the lowest average Variance for all output variables, except for Radiology tests. Radiology tests showed equal average variance scores in the Partial System phase and the New Public Self-Operating System phase. The Bilateral System phase shows the widest variances for the Inpatients discharged output variable. The Comprehensive System phase shows the widest variances for Laboratory tests. The Inpatients discharged output variable shows the widest average variance in the Bilateral System phase.

5.4 Panel Model Estimation

The purpose of this section is to use a panel data model to measure relative efficiency providing a descriptive analysis that shows both within-phase, and between-phase variations in trends exhibited by the output variables. The models are estimated using STATA (Statistical Software vs.12).

5.4.1 Correlation matrix for input variables

From Table 5.14 it can be concluded that there is a strong correlation between the No. of Doctors and No. of Nurses (0.76), the No. of Nurses and the No. of Allied Personnel (0.79), and the No. of Allied Personnel with No. of Doctors (0.72). The MoH

budget shows proportional weaker correlations, ranging between 0.15 with No. of Nurses, to 0.29 with No. of Beds. Similarly, the number of Beds correlated for No. of Nurses (0.28) and No of Doctors (0.28), shows a weaker relationship than that of No. of Allied Personnel (0.32).

The correlation matrix shows there is a strong correlation between the No. of Doctors, No. of Nurses, and No. of Allied Personnel variables, which are further tested for multi-collinearity (Appendix 5.E), where VIF > 10. By choosing just one input variable the issue of a multi-collinearity effect is addressed, thus avoiding risks biasing the model, making the relationship non-linear, and undermining confidence in further prediction and weakening interpretation. Therefore, for the purposes of this section of the alternative run, only a study of the number of Doctors variable will be taken into account (Appendix 5.G). This is due to doctors holding the highest level of medical influence, compared to the other input variables used in this study.

Table 5.14 - Correlations matrix for the input variables

	MoH Budget	No. of Beds	No. of Doctors	No. of Nurses	No. of Allied Personnel
MoH Budget	1	0.29	0.14	0.15	0.22
No. of Beds	0.29	1	0.28	0.28	0.32
No. of Doctors	0.14	0.28	1	0.76	0.72
No. of Nurses	0.15	0.28	0.76	1	0.79
No. of Allied Personnel	0.22	0.76	0.72	0.79	1

5.4.2 Panel Estimation Results

Panel data analysis assumes a normal distribution for independent variables. Using the Shapiro-normality test (Appendix 5.H) shows that the null hypothesis (H_0: independent variables are following the normal distribution) is rejected. Therefore, the independent variables (MoH Budget, Beds, Doctors, Nurses and Allied Professional input

variables) have an abnormal distribution, where z value is not within the interval (-1.96,1.96).

Using the Shapiro-Francia test the variables are log-transformed, where a normal distribution for the variables is observed (Appendix 5.I).

(i) ***Inpatients discharged as dependent variable.*** The Pooled Model (Appendix 5.J) rejects H_0: *The Model is stable*, where P-value <5%. Furthermore, the Bilateral phase has been omitted because of the multicollinearity problem.

Using the Breusch-Pagan/Cook-Weisberg tests for heteroskedasticity (Appendix 5.K), the null hypothesis (H_0: *Homoscedasticity*) is rejected, as P-value <5%.

Using the same tests on the log of all the variables (Appendix 5.L, and 5.M) the results show that the heteroskedasticity problem is not remedied.

A Robust Pooled Regression (Appendix 5.N) is run as a remedy of Heteroskedasticity. For the log transformations the results show a lower standard error, and higher R squared (from 0.11 in Appendix 5.J for the Inpatients discharged (without log) to 0.41 in Appendix 5.L for the log Inpatients discharged).

The FE model in Table (5.15) below, and RE model (Appendix 5.O) rejects H_0: *The RE is consistent.* The FE model performed better than other models (P-value = 0.03 <5%), which is confirmed by using the Hausman test, but notice that the standard Hausman test does not work with RSE.

From the Table 5.15 it can be concluded that only the Intercept, and New Public Self-Operating System phase are significant, while other are not. This suggests that the Inpatient discharged output variable does not have a big role in the association with the relative efficiency, whilst the transition to the New Public Self-Operating System was associated with an increase in the Inpatients discharged by 0.14 at the intercept (individual differences which are assumed to be fixed over time) 3.72.

Table 5.15 - Panel Estimation results for log Inpatients discharged (FE model)

FE model log (Inpatients discharged)				
Variable	**Coef.**	**Std. Err.**	**P-value**	
Intercept	3.72	0.34	0.00	
Log (Budget)	0.03	0.04	0.36	
Log (Beds)	0.19	0.18	0.29	
Log (Doctors)	-0.26	0.17	0.13	
Partial Operating System	0.002	0.02	0.93	
Comprehensive Operating System	0.03	0.04	0.41	
New Public Self-Operating System	0.14	0.04	0.002	
Sigma_u Sigma_e Rho	0.45 0.14 0.91			
F test that all u_i=0: F (19,694)=144.61, prob >F=0.00				
R square: within	0.17			
R square: between	0.44			
R square: overall	0.19			
Corr (u_i, Xb)	-0.66			
F (6, 694)	23.95	0.000		
Hausman test between RE and FE models				
Variable	b (fe)	B (re)	b-B	SE
Log (Budget)	0.03	0.01	0.02	0.003
Log (Beds)	0.19	-0.07	0.26	0.09
Log (Doctors)	-0.26	0.19	-0.45	0.12
Partial	0.002	0.001	0.001	
Comprehensive	0.03	-0.00003	0.03	0.01
New Public	0.138	0.10	0.04	0.01
Chi square = 14.31 P-value = **0.03**				

(ii) ***Radiology tests as dependent variable.*** The pooled model, the Breusch-Pagan/Cook-Weisberg test for Heteroskedasticity for all variables (Appendix 5.P), and the log of all variables (Appendix 5.Q) rejects H_0: *The Model is stable* and rejects H_0: *Homoscedasticity* as P-value <5%.

As a remedy for heteroskedasticity, a robust pooled regression (Table below) for the log transformations gives a lower standard error.

The Hausman test (Appendix 5.R) is used to compare the FE and the RE models. H_0: *The RE is consistent*, is accepted, where P-value = 0.88.

The Breusch and Pagan Lagrangian multiplier test results show the consistency between the RE model and the Robust Regression model, Table 5.16 below finding that we accepted H_a*: Robust Pooled is consistent* as P-value <5%.

Increasing outputs by increasing inputs may represent that the hospitals provide better services. This study analyses the PE of hospitals in relation to the output of services, on other hand such expenditure-related measures could be interpreted as representing waste and inefficiency.

From the Table below, it can be concluded that the log (Budget), log (Doctor), the Comprehensive, and the New Public Self-Operating System phase are all significant while others variables are not. Simply put, this means that increasing the MoH Budget by 1 per cent may increase the Radiology tests relative efficiency results by 0.51, which may suggest that the hospitals used this money attempting to increase the services as much as possible, instead of saving money and increasing their profits and retained earnings. Table 5.16 below also shows that increasing in the No. of doctors by 1 per cent may be associated with an increasing the Radiology tests results by 0.98 (which might mean that the hospitals care more about people instead of reduce expenditures).

In addition, the Table below shows that the transition to the Comprehensive phase is associated with decreases in Radiology test relative efficiency, which decline further when moving to the New Public Self-Operating System phase. Although this study measured PE, reducing Radiology tests may suggest that the hospitals were more efficient and not performing unneeded tests, instead of just choosing less costly care.

The two tables 5.15 and 5.16, show that the effect of the Radiology test variable is greater on the relative efficiency of the hospitals than the Inpatient discharged output variable.

Table 5.16 - Panel Estimation results for Radiology test (Robust Model)

Robust model log (Radiology tests)			
Variable	**Coef.**	**Std. Err.**	**P-value**
Intercept	- 0.55	0.82	0.50
Log (Budget)	0.51	0.12	0.00
Log (Beds)	- 0.19	0.12	0.12
Log (Doctors)	0.98	0.05	0.00
Partial Operating System	- 0.04	0.05	0.36
Comprehensive Operating System	- 0.11	0.05	0.01
New Public Self-Operating System	- 0.21	0.07	0.01
R squared	0.52		
Root MSE	0.40		
F (6,713)	217.94		0.00
Breusch and Pagan Lagrangian multiplier test for RE			
Estimate results		Var.	Sd = sqrt (Var)
Log (Review visits)		0.33	0.57
E		0.04	0.20
U		0.14	0.37
Chi bar (2) = 7157.91 Prob > Chi = **0.00**			

(iii) ***Laboratory tests as dependent variable.*** The pooled model and a Breusch-Pagan/Cook-Weisberg test for Heteroskedasticity is run for all variables (Appendix 5.S) and then for the log of all variables (Appendix 5.T). $H_{0:}$ *The Model is stable* and $H_{0:}$ *Homoscedasticity* is rejected.

As a remedy of heteroskedasticity, a robust pooled regression model (Table below) for the log transformations is run which gives a lower standard error, and higher R square.

The Hausman test is applied to compare between the FE and the RE models (Appendix 5.U) resulting in $H_{0:}$ *The RE is consistent* where P-value = 0.95.

Then Breusch and Pagan Lagrangian multiplier test in Table 5.17 below is used to test the consistency between the RE and Robust Regression model. The results show that we accepted H_a*: Robust Pooled is consistent*.

Table 5.17 - Panel Estimation results for Laboratory tests

Robust model log (Laboratory tests)			
Variable	**Coef.**	**Std. Err.**	**P-value**
Intercept	1.58	0.54	0.004
Log (Budget)	0.32	0.07	0.00
Log (Beds)	0.26	0.09	0.004
Log (Doctors)	0.72	0.05	0.00
Partial Operating System	- 0.05	0.06	0.41
Comprehensive Operating System	- 0.08	0.05	0.11
New Public Self-Operating System	- 0.02	0.06	0.71
R squared	0.49		
Root MSE	0.36		
F (6,713)	125.34		0.00
Breusch and Pagan Lagrangian multiplier test for RE			
Estimate results		Var.	Sd = sqrt (Var)
Log (Review visits)		0.26	0.51
e		0.05	0.21
u		0.10	0.32
Chi bar (2) = 5352.67 Prob > Chi = **0.00**			

As concluded from Table 5.17, the log (Budget), log (Beds), log (Doctors) and Intercept are significant, while other variables are not. With the Intercept at 1.58, increasing the MoH budget by 1 per cent may be associated with increases in Laboratory tests outputs by 0.32 (which might suggest that the hospitals care more about people by increasing the Laboratory tests made possible by increases in the Budget, instead of choosing the less costly care). The Table above also shows that increasing in the No. of Beds as input by 1 per cent, is associated with an increase in the Laboratory tests (output) by 0.26, which might mean that the hospitals have provided better services, instead of choosing the less expensive form of care (outpatients). Increasing the No. of Doctors by 1 per cent may be associated with an increase in the Laboratory test results by 0.72. The transition between phases does not seem to be associated with the relative efficiency of Laboratory tests results. The Laboratory test output variable has a greater association with

the overall efficiency of the hospitals than the Inpatient discharged and Radiology test outputs.

(iiv) ***Review visits as dependent variable.*** The pooled model and a Breusch-Pagan/Cook-Weisberg test for Heteroskedasticity for all variables (Appendix 5.V) is run, and then for the log of all variables (Appendix 5.W), H_0: *The Model is stable* and H_0: *Homoscedasticity* are rejected.

As a remedy for Heteroskedasticity, a robust pooled regression is run for the log transformations because it gives the less standard error (Appendix 5.V and Appendix 5.W)**.**

FE and RE models are run. Using the Hausman test (Appendix 5.X) H_0: *The RE is consistent* where P-value = 0.39 is accepted, suggesting that the RE model is performed better than FE model.

Then the Breusch and Pagan Lagrangian multiplier test is run to test the consistence between RE and Robust regression. In this case, it is found that we accepted H_a: *Robust Pooled is consistent* (Table 5.18).

Table 5.18 - Panel Estimation results for Review visits

Robust model log (Review visits)			
Variable	Coef.	Std. Err.	P-value
Intercept	3.80	0.59	0.00
Log (budget)	0.12	0.08	0.14
Log (Beds)	- 0.30	0.11	0.01
Log (Doctors)	0.43	0.06	0.00
Partial Operating System	- 0.01	0.07	0.94
Comprehensive Operating System	- 0.02	0.07	0.79
New Public Self-Operating System	0.09	0.08	0.27
R squared	0.18		
Root MSE	0.41		
F (6,713)	11.75		0.00
Breusch and Pagan Lagrangian multiplier test for RE			
Estimate results		Var.	Sd = sqrt (Var)
Log (Review visits)		0.20	0.45
E		0.05	0.22
U		0.14	0.37
Chi bar (2) = 6416.11 Prob > Chi = **0.00**			

From the Table, it can be concluded that the log (Beds), log (Doctors), and Intercept are significant while the other variables are not. When the Intercept is 3.80, increasing the beds by 1 per cent may be associated with decreases in the the Review visits by 0.30. Increasing the No. of Doctors by 1 per cent may be associated with increases in the Review visits by 0.43. The transition between phases is not associated with the Review visits output variable results.

Table 5.19 below summarises the results of the preceding tables.

Table 5.19 - Panel Estimate Results Summary

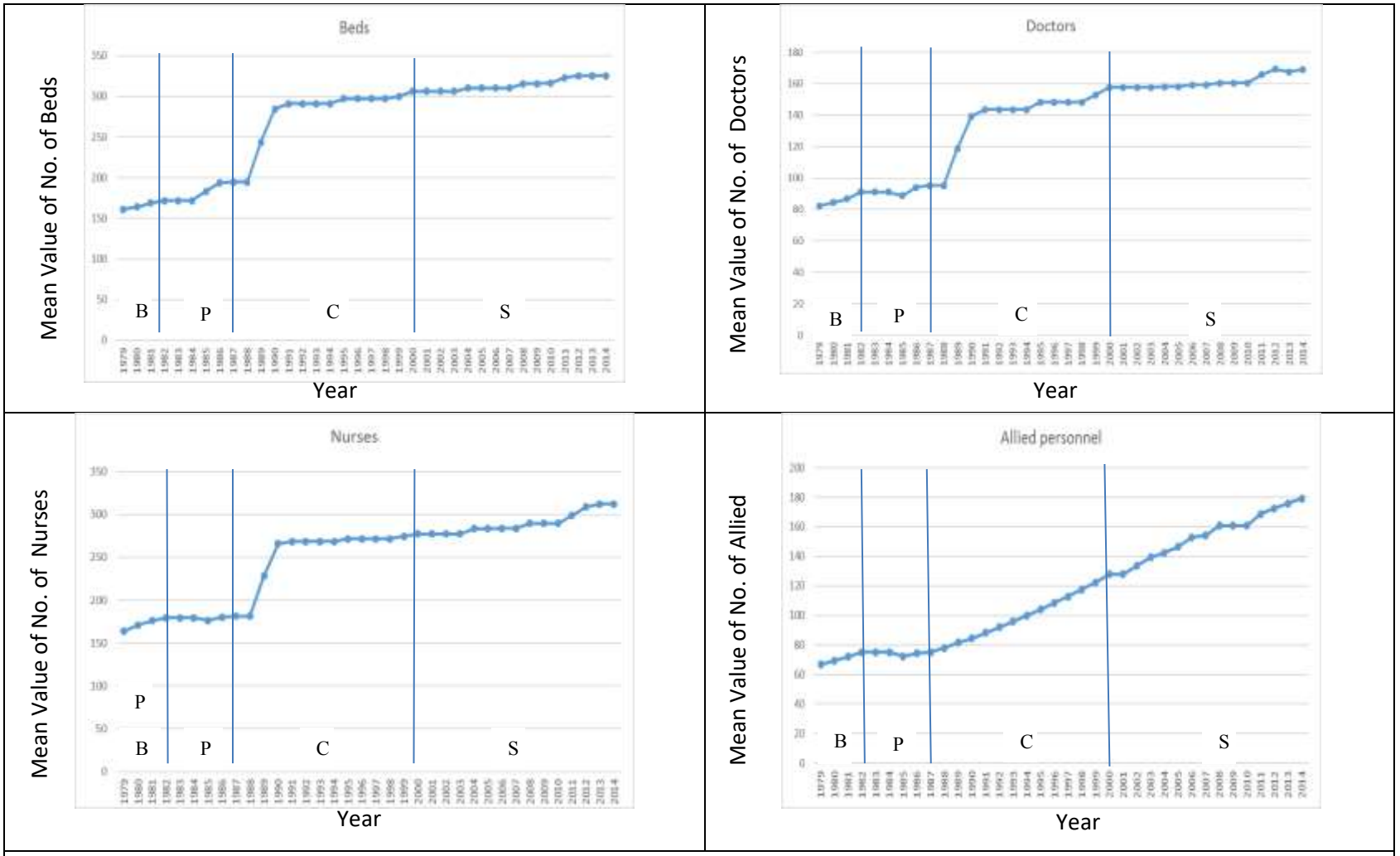
	FE	RE	Robust model	System Phases (As variable dummies)
Number of Inpatients discharged	Intercept	N/A	N/A	New Public Operating System (0.14)
Number of Radiology tests	N/A	N/A	Log (budget), Log (doctors)	Comprehensive (-0.11) and New Public Operating System (-0.21)
Number of Laboratory tests completed	N/A	N/A	Intercept, Log (budget), Log (beds), and Log (doctor)	No significant effect
Number of Review visits	N/A	N/A	Intercept, Log (beds), and Log (doctor)	No significant effect

The results from Table above suggest that Laboratory tests are associated with the relative efficiency of the hospitals more than other output variables.

5.5 Variables Trends

5.5.1 Inputs variables trend overview

The Figure below shows the trends in the non-financial input variables by management phases, using the mean value of input variables per annum for all hospitals used in this study. The four non-financial inputs (Number of Beds, Doctors, Nurses, and Allied Personnel) show similar trends over the period under consideration. Each of the input variables shows increasing trends over time, with significant change in the first three taking place in the early years of the Comprehensive System phase that subsequently seems to move upwards gradually over time.



Phases: B=Bilateral Agreements, P=Partial, C=Comprehensive, S=New Public Self-Operating System.

Figure 5.2 - Trends in the mean value of input variables per annum

Figure 5.3 below shows that from the New Public Self-Operating System phase (2000-2014) onwards the MoH budget increases steadily. For the KSA, significant variations are observed in the MoH budget for the first three management phases: Bilateral, Partial, and Comprehensive. Following the move to the New Public Self-Operating System phase, the MoH budget increased substantially year-on-year. In comparison, non-financial inputs show less within-phase and between-phase variations and are not obviously directly related to budgetary figures. Note that the data here is not only for 20 hospitals but for the total budget for all the MoH's hospitals around KSA which also increased. There were 191 MoH hospitals in 2000 and 270 in 2014.

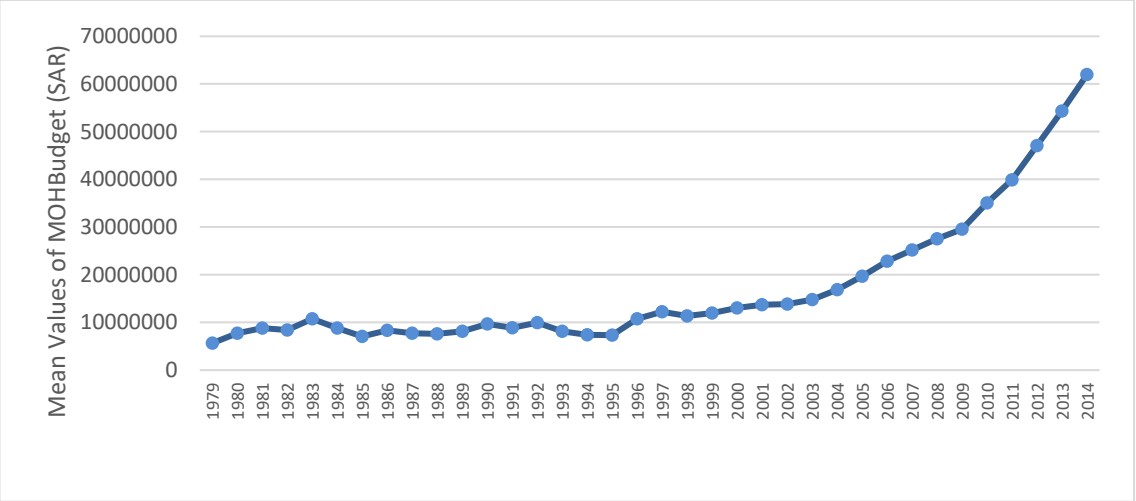


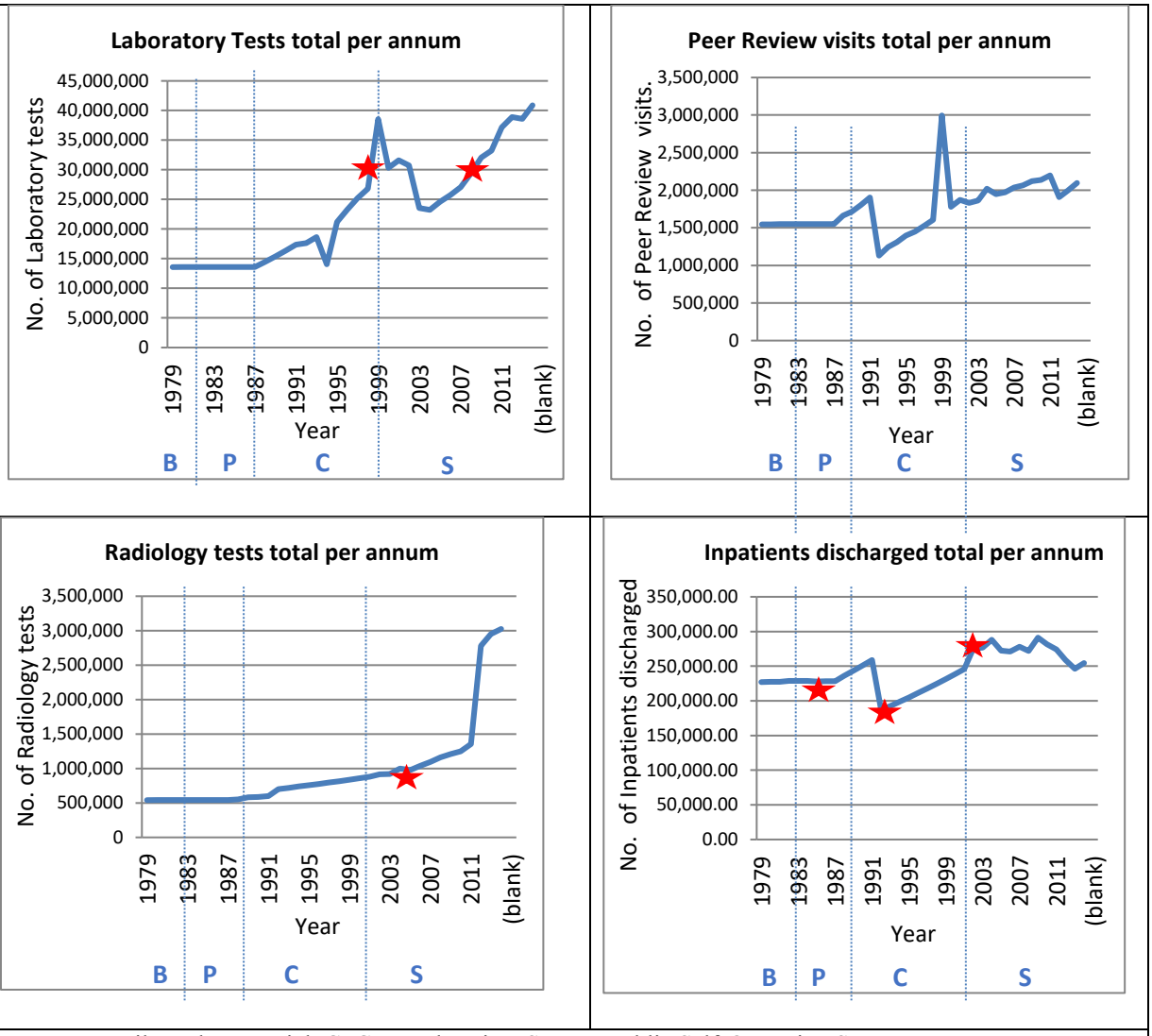
Figure 5.3 - MoH Mean Budget (SAR)

5.5.2 Output variables trend overview

The four output variables generally show different trends between phases, and for each of the outputs, there appears to be within-period variations as shown in Figure 5.4 below.

The Bilateral and Partial phases did not show considerable within-period variations. In the Comprehensive phase however, all variables (except the Radiology tests output variable), have a significant variation until the New Public Self-Operating System phase. However, the significant variation in the Comprehensive Operating phase might be

attributed to the huge changes in this phase prompted by this fully corporatised phase for the MoH's hospitals. In addition, the New Public Self-Operating System phase shows some within-period variations.



Phases: B=Bilateral, P=Partial, C=Comprehensive, S=New Public Self-Operating System.

Figure 5.4 - Trends in Output Variables

5.6 Regression Analyses

The purpose of this section is to isolate any potential unaccounted bias in the previous sections' efficiency results, and secondly identify robust predictions where appropriate with respect to addressing this study's hypotheses (particularly H3 - *Fully corporatised hospitals will perform better in terms of quality than partially corporatised*

hospitals) within different time periods. Furthermore, it is suggested that quality considerations may be important, and should be examined in relation to output efficiency estimated within this study. For example, if output quantities are increased/decreased, this may be at the expense of population health (e.g., MR outcome).

This possibility is posed through RQ2 - *Have HC quality considerations (or effectiveness) modified conclusions relating to the efficiency of different HC governance systems?*

5.6.1 correlations between changes in output variables and the MR outcome

This section looks at correlations between changes in output variables per 1,000 of the local population (across the four phases), and the MR outcome (per 1,000 of the local population) as a quality proxy. Secondly, the evaluation of the data utilises the Least Squares method where the MR outcome variable (per 1,000 of the local population) is considered as the dependent variable. Section 5.6.2 develops the regression and evaluates the impact of multi-collinearities, where two multiple regression models are formulated. This section used Eviews (Version 10).

5.6.1.1 MR per 1,000 of the local population

The Figure below shows the trend in the MR, as an outcome quality proxy for the hospital, across the four phases of management and operations of the KSA HC sector during the period (1997-2014). As shown in Figure 5.5, the MR declines steadily from 1980 and continues to do so over the time period of this study. This rate declines significantly, from a value of 8.89 deaths in every 1,000 bodies in 1979 to around 3.53 per 1,000 in 2014, indicating rising population health.

In addition, the MR has a quadratic declining trend that has to be considered at the level of model specification. The regression of the MR over a quadratic trend, shown in

Table 5.20 below, confirms this observation, and reports a significant and negative relation trend in MR and quadratic trend in MR.

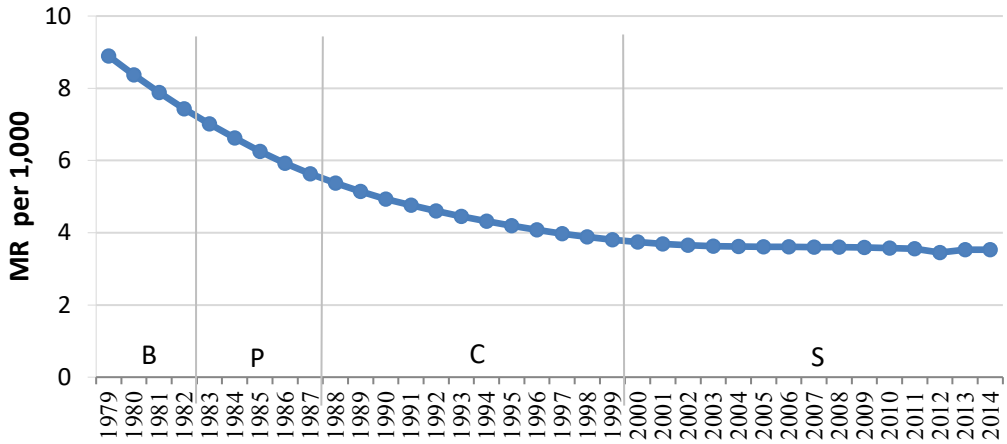


Figure 5.5 - Trends in MR per 1,000 of the local population

Table 5.20 - MR quadratic trend estimations results

Dependent Variable: MR Method: Least Squares Sample: 1 36 Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Quadratic trend	-0.065134	0.005858	-11.11828	0.0000
C	7.173032	0.248594	28.85445	0.0000
R-squared	0.784286	Mean dependent var		4.763056
Adjusted R-squared	0.777942	S.D. dependent var		1.549763
S.E. of regression	0.730296	Akaike info criterion		2.263218
Prob (F-statistic)	0.000000			

These results on MR raise the question of whether this downward trend in the MR outcome variable, can be correlated with the changes in output variables, in the different phases of corporatisation. This is particularly relevant to H3 - *Fully corporatised hospitals will perform better in terms of quality than partially corporatised hospitals*. H3 will be further considered in Chapter 6.

5.6.1.2 Inpatients discharged per 1,000 of the local population

Figure 5.6 below shows considerable variations within the total Inpatients discharged per 1,000 of the local population, across the different management phases. The lowest figure per 1,000 for Inpatients discharged is in 2014 with 10 per 1,000 and the highest figure is in 1991 with 19 per 1,000.

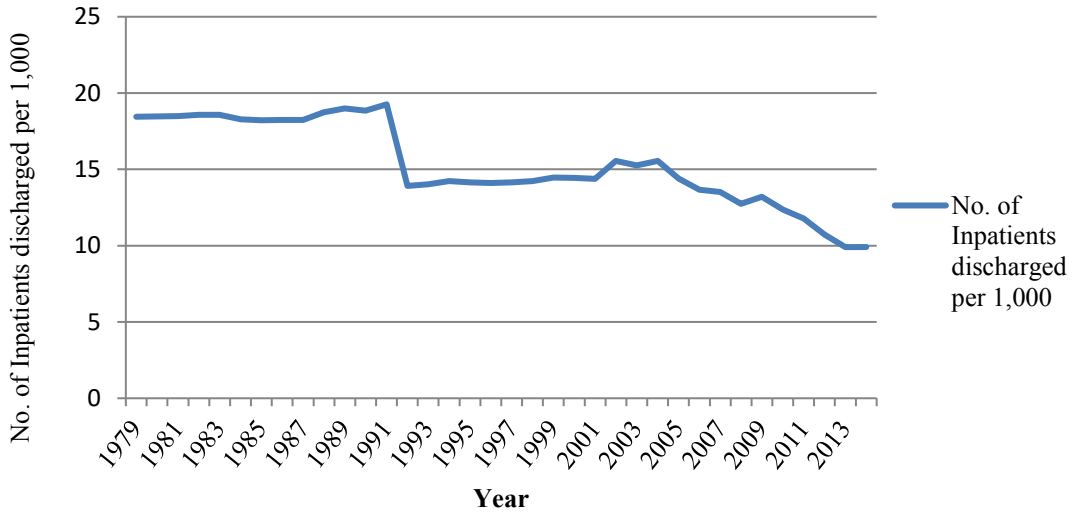


Figure 5.6 - Inpatients discharged per 1,000 of the local population

(i) *Inpatients discharged per 1,000 of the local population – correlation analysis*.

The correlation analysis in the following Table 5.21 shows a strong positive correlation relation (0.76) between total Inpatients discharged and the MR.

Table 5.21 - Correlation analysis - Total Inpatients discharged (per 1,000)/MR

	Laboratory tests	**MR**
Inpatients discharged	1.000000	0.760239
MR	0.760239	1.000000

(ii) ***Inpatients discharged - breakpoints*****.** The data trend break/s observed may affect the results. Indeed, the consideration of one, or many breakpoints, gives different perspectives on the intensity of the relation between the two considered measures. The test of the breakpoint is designed to determine whether the data is connected or not. If there is a breakpoint, a regression model should not be used for all data, but we need to create two models, one before and one after the breakpoint.

No breakpoint - Table 5.22 below shows estimates of the MR, assuming that there is no break in the relation.

Table 5.22 - MR/total Inpatients discharged (per 1,000) without considering breakpoints

Dependent Variable: MR				
Method: Least Squares				
Sample: 136				
Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Inpatients discharged	0.423914	0.062246	6.810276	0.0000
C	-1.736369	0.969456	-1.791076	0.0822
R-squared	0.577008	Mean dependent var		4.763056
Adjusted R-squared	0.564568	S.D. dependent var		1.549763
S.E. of regression	1.022647	Akaike info criterion		2.936618
Prob (F-statistic)	0.000000			

Table 5.22 shows that there is a positive and significant relation such that every one-point decrease in the Inpatients discharged makes the MR decrease by around 0.424.

From descriptive analysis and visual examination of the data by graphing, we noticed that there were many breakpoints. We chose three sharp breaks: in the most corporatised phase (1988-1999), in the least corporatised phase (2000-2014), and the last one was before these two phases, to distinguish the relation of this variable with MR in these three phases.

Firstly with one Breakpoint **(*1993)*** - Table 5.23 below assumes an insignificant relationship before and after 1993 (breakpoint) between MR and the Inpatients discharged.

Table 5.23 - MR/total Inpatients discharged (per 1,00) considering breakpoint

Dependent Variable: MR				
Method: Least Squares with Breaks| Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
1979- 1992 (14 observations)				
Inpatients discharged	0.266948	0.191839	1.391520	0.1737
C	1.475818	3.505647	0.420983	0.6766
1993 - 2014 (23 observations)				
Inpatients discharged	0.0607344	0.118488	0.568364	0.5738
C	2.849498	1.609093	1.770872	0.0861
R-squared	0.701258	Mean dependent var		4.763056
Adjusted R-squared	0.673251	S.D. dependent var		1.549763
S.E. of regression	0.885875	Akaike info criterion		2.699957
Prob (F-statistic)	0.049283			

Secondly, with Multiple Breakpoints (1986, 1993, 2003) - compared to Table 5.22 (no breakpoint), Table 5.24 with higher Adjusted R-squared suggests that for every one-point increase in the Inpatients discharged resulted in an MR increase by around 3.7 per 1,000 before 1986 and decrease by around 2.8 between 1993 and 2002. Between 1986 and 1992 and after 2003 the effect is insignificant.

Table 5.24 - MR/total Inpatients discharged (per 1,00) considering multiple breakpoints

Dependent Variable: MR				
Method: Least Squares with Breaks				
Included observations: 36				
Break type: Bai-Perron tests of L+1 vs. L sequentially determined breaks				
Break selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05				
Breaks: 1986, 1993, 2003				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
1979 - 1985 -- 6 obs				
Inpatients discharged	3.697012	1.341211	2.756472	0.0102
C	-60.65891	24.72487	-2.453356	0.0206
1986 - 1992 -- 7 obs				
Inpatients discharged	0.097746	0.099581	0.981569	0.3347
C	3.430498	1.803575	1.902055	0.0675
1993 - 2002 -- 10 obs				
Inpatients discharged	-2.839983	0.380645	-7.460973	0.0000
C	44.42702	5.461484	8.134606	0.0000
2003 - 2014 -- 13 obs				

Inpatients discharged	0.007282	0.070927	0.102664	0.9190
C	3.463768	0.915324	3.784199	0.0007
R-squared	0.931831	Mean dependent var		4.763056
Adjusted R-squared	0.914789	S.D. dependent var		1.549763
S.E. of regression	0.452391	Akaike info criterion		1.444590
Prob (F-statistic)	0.000000			

5.6.1.3 Laboratory tests per 1,000 of the local population

Figure 5.7 below shows an upward trend for total Laboratory tests per 1,000 of the local population with considerable variations across the different management phases.

The lowest figure per 1,000 for Laboratory tests is in 1994 with 1,007 per 1,000 and the highest figure is in 1999 with 2,408 per 1,000.

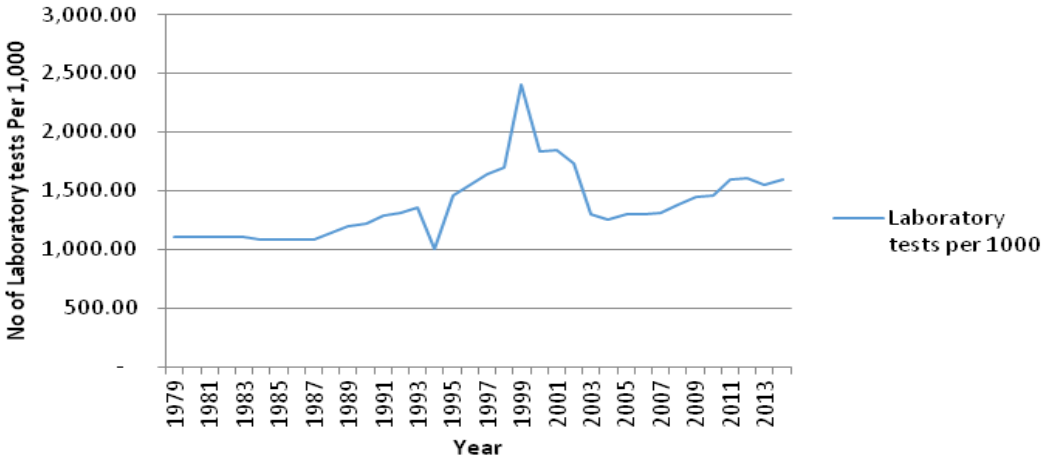


Figure 5.7 - Laboratory tests per 1,000 of the local population

(i) ***Laboratory tests per 1,000 of the local population - correlation analysis***. In spite of the sharp change in the trend of the Laboratory tests during the period 1979-2014, the correlation analysis shows a strong negative relation (-0.75) between this variable and the MR.

Table 5.25 – Correlation analysis - Total Laboratory tests (per 1,000)/MR

	Laboratory tests	**MR**
Laboratory tests	1.000000	-0.748799
MR	-0.748799	1.000000

(ii) ***Laboratory tests - threshold.*** The following Figure shows that the relation between the two measures may have a threshold as the MR became flat after a value of 30 million Laboratory tests. This threshold was breached twice as presented in Figure 5.4, firstly in the Comprehensive Operating System phase (1997) and subsequently in the New Public Self-Operating System phase (2009). There is no presumption that lab tests are just to avoid death (imminent or otherwise), however this result shows that if the outcome measure is designated as MR then there is a threshold after which laboratory tests are limited.

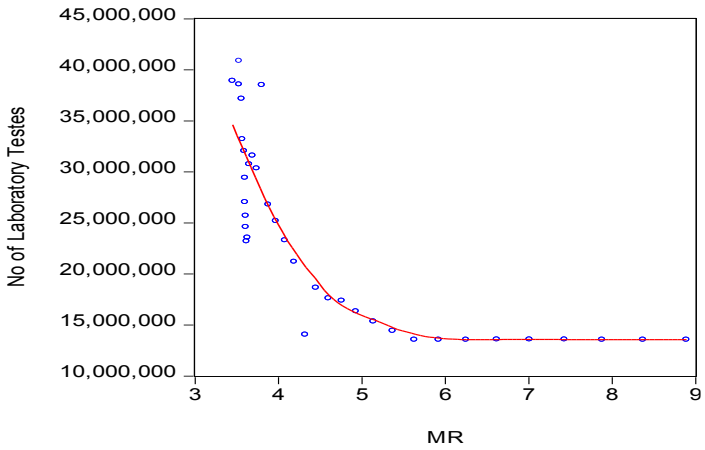


Figure 5.8 - Threshold chart - MR per 1,000 and Laboratory tests significance

The estimates in the following confirm the significant positive correlation between the Laboratory tests with a threshold (Laboratory tests squared) and the MR.

Table 5.26 - MR/Total Laboratory tests (per 1,000) considering Laboratory threshold

Dependent Variable: MR Method: Least Squares Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Laboratory tests	-0.018764	0.004142	-4.530104	0.0001
(Laboratory test) ^{2}	4.97E-06	0.004142	-4.530104	0.0001
C	20.77834	3.170832	6.552961	0.0000
R-squared	0.561970	Mean dependent var		4.763056
Adjusted R-squared	0.535423	S.D. dependent var		1.549763
S.E. of regression	1.056317	Akaike info criterion		3.027109
Prob (F-statistic)	0.000001			

5.6.1.4 Radiology tests performed per 1,000 of the local population

Figure 5.9 below shows an upward trend for total Radiology tests performed per 1,000 of the local population. There is a substantial change in the volume of tests performed after 2010. The lowest figure per 1,000, for Radiology tests, is 43 per 1,000 in 1988 and the highest figure per 1,000 is in 2013 with 120 per 1,000.

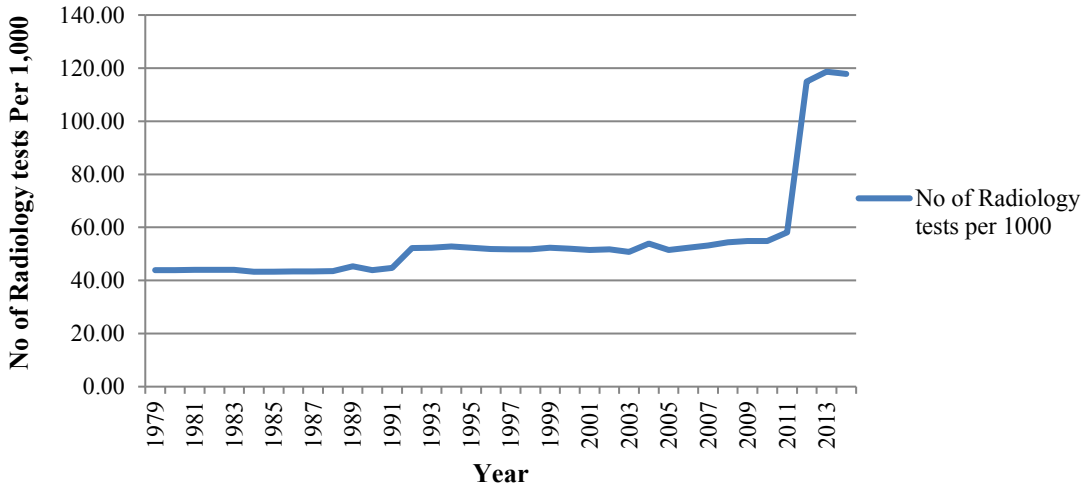


Figure 5.9 - Radiology tests per 1,000 of the local population

(i) ***Radiology tests per 1,000 of the local population - correlation analysis.*** The Correlation analysis in the following Table shows a weak negative relation (-0.42) between the Radiology tests, and the MR.

Table 5.27 – Correlation analysis - Total Radiology tests (per 1,000)/MR

	Laboratory tests	**MR**
Radiology tests	1.000000	-0.421683
MR	-0.421683	1.000000

(ii) ***Radiology tests - Threshold.*** The following figure shows that the MR becomes flat after a value of one million performed Radiology tests, suggesting that the relationship between the two measures may have a threshold.

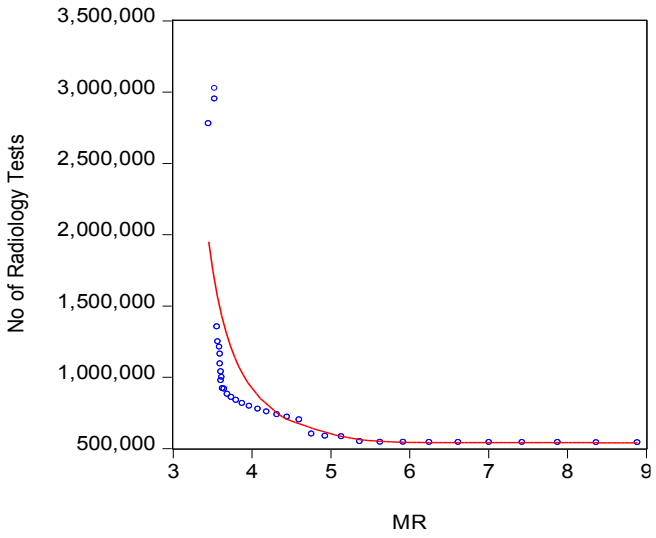


Figure 5.10 – Threshold chart – MR per 1,000 and Radiology tests significance

The estimates reported in Table 5.28 below confirm the significance of a relation in MR to the Radiology tests variable, with a threshold. This threshold was breached from 2006 onwards in the New Public Self-Operating System phase, as shown in Figure 5.4. The steep incline in this variable increased substantially between 2009 and 2014, within the context of this study.

Table 5.28 - MR/Radiology test (per 1,000) considering Radiology threshold

Dependent Variable: MR Method: Least Squares Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Performed Radiology tests	-0.647677	0.081591	-7.938099	0.0000
(Radiology tests) ^{2}	0.003775	0.000499	7.560572	0.0000
C	27.56121	2.806986	9.818792	0.0000
R-squared	0.699072	Mean dependent var		4.763056
Adjusted R-squared	0.680834	S.D. dependent var		1.549763
S.E. of regression	0.875535	Akaike info criterion		2.651693
Prob (F-statistic)	0.000000			

5.6.1.5 Review visits per 1,000 of the local population

Figure 5.11 below shows that Review visits have an overall downward trend across the period. However, between 1991 and 2001 the annual results (which were relatively static previously) start to show wide variances. This is particularly evident in the fluctuation in figures in the Comprehensive System phase (1988-1999) which finishes with the highest annual figure in 1999.

The lowest figure per 1,000 for this variable is 79 per 1,000 in 2012 and the highest figure is in 1999, with 187 per 1,000.

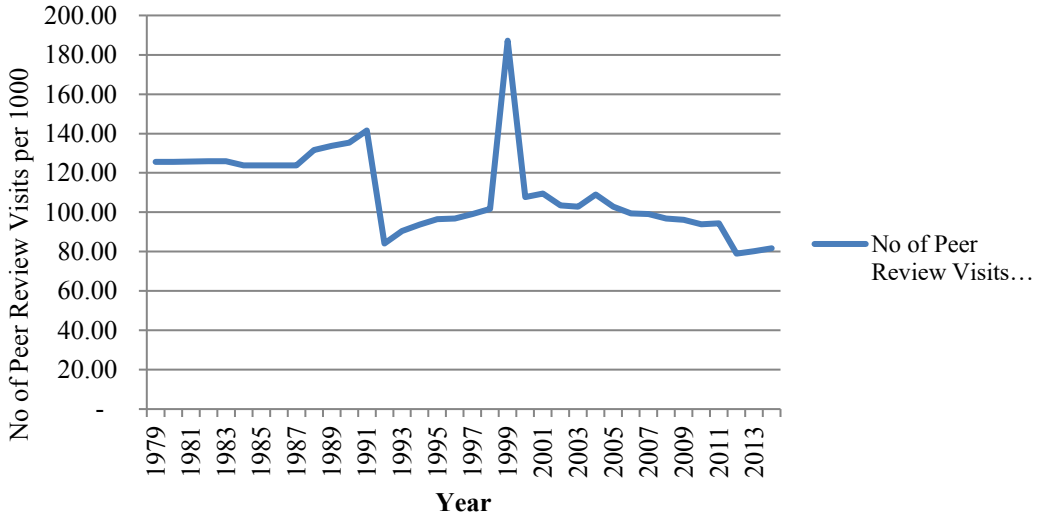


Figure 5.11 - Review visits per 1,000 of the local population

(i) ***Review visits per 1,000 of the local population - Correlation Analysis.*** Correlation analysis reported in Table 5.29 shows a weak positive relation (0.48) between Review visits variable and MR variables.

Table 5.29 – Correlation analysis - Total Review visits (per 1000)/MR

	Review visits	MR
Review visits	1.000000	0.46448
MR	0.476448	1.000000

(ii) ***Review Visits – Switching Regime.*** Figure 5.12 below shows that the relation between Review visits and MR is not close. In addition, it may be characterised by a switch in the regime at both sides of 5 MR per 1,000.

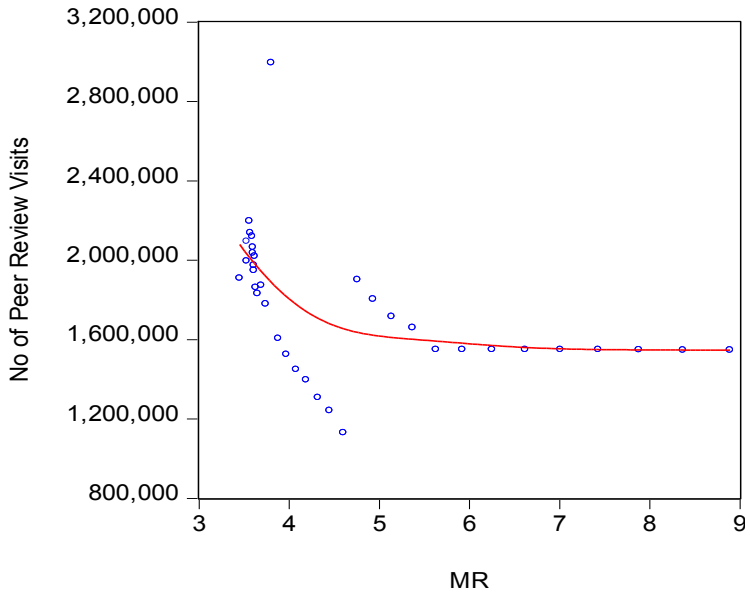


Figure 5.12 – MR per 1,000 and Review visits – Switch

The relation between the two variables for all observations can also be estimated. The estimation results in Table 5.30 indicating a positive and significant correlation between MR and Review visits per 1,000 of the local population.

Table 5.30- MR/Review visits (per 1,000)

Dependent Variable: MR Method: Least Squares Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Review visits	0.034104	0.010793	3.159848	0.0033
C	1.000343	1.212875	0.824770	0.4153
R-squared	0.227003	Mean dependent var		4.763056
Adjusted R-squared	0.204268	S.D. dependent var		1.549763
S.E. of regression	1.382448	Akaike info criterion		3.539541
Prob (F-statistic)	0.003308			

When considering the regime switching at a MR of 5 per 1,000, the estimates in Table 5.31 show an insignificant relation between the two variables for a rate above 5 (before 1990) and a significant relation for the values under 5 (after 1989), but with a higher adjustment power (74 per cent) than the estimated model without the regime switching (20 per cent).

Table 5.31 - MR/Review visits (per 1,000) considering switching

Dependent Variable: MR Method: Least Squares Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Review visits (MR >5)	0.004122	0.007126	0.578362	0.5669
Review visits (MR <5)	0.026127	0.006245	4.183439	0.0002
C	3.458843	0.752641	4.595610	0.0001
R-squared	0.754555	Mean dependent var		4.763056
Adjusted R-squared	0.739680	S.D. dependent var		1.549763
S.E. of regression	0.790714	Akaike info criterion		2.447894
Prob (F-statistic)	0.000000			

5.6.1.6 Summary

The Correlation analysis is summarised in Table 5.32 and the Least Squares Regression summarised in Table 5.33.

Table 5.32- Summary - Output variables correlation with MR

Correlation	Result
Inpatients discharged and MR	Positive correlation 0.76
Laboratory tests and MR	Negative correlation -0.75
Radiology tests and MR	Negative correlation -0.42
Review visits and MR	Positive correlation 0.48

Table 5.33 – Summary - Least Squares Regression

LEAST SQUARES REGRESSION	Bilateral 1979-1982	Partial 1983-1987	Comprehensive 1988-1999	New Public 2000-2014	Change between 1979-2014
Inpatients discharged/MR – NO breakpoint	Significant relation (0.42)				
Inpatients discharged/MR – 1993 breakpoint	Insignificant relation before 1993		Insignificant relation after 1993		

Inpatients discharged/MR – 1986,1993,2003 breakpoints	Significant relation (3.697) before 1986	Insignificant relation between 1986 and 1992	Significant relation between 1993 and 2002 (-2.84)	Insignificant relation after 2003
Radiology tests/MR – Threshold	Flat after One million tests, significant threshold (0.0038)			
Laboratory tests/MR – Threshold	Flat after 30 million tests, significant threshold (4.97E-06)			
Review visits/MR without Regime Switching	Positive and significant relation (0.034)			
Review visits/MR with Regime Switching	Insignificant relation above MR of 5 per 1,000	Significant relation below MR of 5 per 1,000 (0.026)		

5.7 Multiple Regressions

Moving on, it is important to consider the features of every single relation between the MR outcome (proxy quality) variable and the output variables (breakpoints, threshold, and switching regime). When not considering multi-collinearity, and using per 1,000 for the independent variables, the estimates in the following Table 5.34 report that only the Inpatient discharged output variable is significant, but using the independent variables at hospital level Table 5.35 reports that only the Inpatient discharged output variable is insignificant.

Table 5.34 - MR multiple regression estimation results (variables per 1,000)

Dependent Variable: MR
Method: Least Squares
Included observations: 36

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Inpatients discharged	0.389331	0.175377	2.219967	0.0339
Laboratory tests	-0.001542	0.000999	-1.543264	0.1329
Review visits	0.007261	0.016047	0.452474	0.6541
Radiology tests	0.019270	0.012600	1.529325	0.1363
C	-0.938471	3.042644	-0.308439	0.7598

R-squared	0.654387	Mean dependent var	4.763056
Adjusted R-squared	0.609792	S.D. dependent var	1.549763
S.E. of regression	0.968085	Akaike info criterion	2.901253
Sum squared resid	29.05286	Schwarz criterion	3.121186
Log likelihood	-47.22255	Hannan-Quinn criter.	2.978015
F-statistic	14.67391	Durbin-Watson stat	0.343608
Prob (F-statistic)	0.000001		

Table 5.35 - MR multiple regression estimation results (variables at hospital level)

Dependent Variable: MR Method: Least Squares Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Inpatients discharged	-1.28E-05	8.66E-06	-1.477069	0.1497
Laboratory tests	-2.00E-07	1.09E-08	-4.902169	0.0000
Review visits	1.80E-06	9.06E-07	1.984017	0.0562
Radiology tests	7.81E-07	4.45E-07	1.755920	0.0890
C	8.609068	1.543572	5.577366	0.0000
R-squared	0.626766	Mean dependent var		4.763056
Adjusted R-squared	0.578607	S.D. dependent var		1.549763
S.E. of regression	1.006025	Akaike info criterion		2.978138
Sum squared resid	31.37470	Schwarz criterion		3.198071
Log likelihood	-48.60648	Hannan-Quinn criter.		3.054900
F-statistic	13.01446	Durbin-Watson stat		0.269855
Prob (F-statistic)	0.000002			

5.7.1 Correlation analysis for output variables

Table 5.36 below shows a high correlation between the outputs which may cause bias in the output efficiency estimations.

Table 5.36 - Correlation Matrix for output variables

	Inpatients discharged	**Laboratory tests**	**Review visits**	**Radiology tests**
Inpatients discharged	1.000000			
Laboratory tests	0.498819	1.000000		
Review visits	0.696549	0.711948	1.000000	
Radiology tests	0.348009	0.770892	0.404988	1.000000

When considering multi-collinearity, two models could be estimated. The first (Model 1) has as independent variables Total Inpatients discharged and Total Radiology tests where MR is the dependent variable. The second (Model 2) has as independent variables Total Laboratory tests and Total Review visits where MR is the dependent variable.

Firstly - ***Model 1 Multiple Regression (Inpatients discharged, Radiology tests).***

Table 5.37 below shows that the effect of Inpatients discharged on the MR is significant and positive (0.54) and the effect of Radiology tests on the MR is also significant (at 10 per cent level) and positive (0.023).

Table 5.37- Model 1 MR multiple regression (considering multi collinearity)

Dependent Variable: MR Method: Least Squares Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Inpatients discharged	0.544388	0.088509	6.150644	0.0000
Radiology tests	0.023351	0.012589	1.854824	0.0726
C	-4.867049	1.930225	-2.521493	0.0167
R-squared	0.616944	Mean dependent var		4.763056
Adjusted R-squared	0.593728	S.D. dependent var		1.549763
S.E. of regression	0.987811	Akaike info criterion		2.835587
Prob (F-statistic)	0.000000			

(i) Model 1 - Threshold (Radiology tests) - Observations. Table 5.38 below suggests that the threshold beyond which the Radiology tests have limited effect on the MR as there is a positive and significant coefficient of the square of the Radiology tests and MR while the effect of Total Inpatients discharged becomes insignificant, under this specification. The adjustment of the model improves the Adjusted R-squared significantly from 59 per cent in Table 5.37 to 64 per cent in the next Table 5.38.

Table 5.38 - MR multiple regression (multi-collinearity, and Radiology tests threshold)

Dependent Variable: MR Method: Least Squares Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Inpatients discharged	9.81E-06	7.47E-06	1.313749	0.1983
Radiology tests	-1.04E-05	1.63E-06	-6.391999	0.0000
(Radiology tests)	2.65E-12	4.51E-13	5.880683	0.0000
C	8.939640	1.415319	6.316342	0.0000
R-squared	0.670992	Mean dependent var		4.763056
Adjusted R-squared	0.640147	S.D. dependent var		1.549763
S.E. of regression	0.929667	Akaike info criterion		2.796459
Prob (F-statistic)	0.000000			

(ii) ***Model 1 - Breakpoints (Inpatients discharged) - Observations.*** With considering the Inpatients discharged breakpoints (1985, 1990, and 1996), Table 5.39 suggests that there is a significant relationship between the dependent variable MR and the two independent variables (Inpatients discharged and Radiology tests) only in the period 1990-1995.

Table 5.39 - MR multiple regression (multi-collinearity, and Inpatient discharged breakpoints)

Dependent Variable: MR | Method: Least Squares with Breaks
Break type: Bai-Perron tests of L+1 vs. L sequentially determined breaks
Break selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05
Breaks: 1985, 1990, 1996

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Inpatients discharged	0.001177	0.003801	0.309670	0.7595
Radiology tests	-0.002467	0.004042	-0.610472	0.5473
(1979 - 1984 -- 5 obs) C	1075.366	1326.688	0.810564	0.4256
Inpatients discharged	-7.48E-05	9.83E-05	-0.761297	0.4539
Radiology tests	8.90E-06	3.98E-05	0.223834	0.8248
(1985 - 1989 -- 5 obs) C	18.16563	7.935547	2.289147	0.0312
Inpatients discharged	-6.71E-05	1.56E-05	-4.311421	0.0002
Radiology tests	-3.94E-05	6.87E-06	-5.730057	0.0000
(1990 - 1995 -- 6 obs) C	45.32744	7.841161	5.780705	0.0000
Inpatients discharged	9.35E-07	4.40E-06	0.212382	0.8336
Radiology tests	-6.52E-08	1.51E-07	-0.431723	0.6698
(1996 - 2014 -- 20 obs) C	3.449559	1.136331	3.035698	0.0057

R-squared	0.935809	Mean dependent var	4.763056
Adjusted R-squared	0.906388	S.D. dependent var	1.549763
S.E. of regression	0.474167	Akaike info criterion	1.606689
Prob (F-statistic)	0.000000		

Secondly - ***Model 2 Multiple Regression (Laboratory tests, Review visits) - Observations.*** The following Table 5.40 shows an insignificant relationship between MR and Review visits and a negative significant relation with the Laboratory tests independent variable.

Table 5.40 –Model 2/MR multiple regression (multi-collinearity)

Dependent Variable: MR Method: Least Squares Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Laboratory tests	-1.46E-07	2.79E-08	-5.256548	0.0000
Review visits	6.61E-07	7.32E-07	0.903282	0.3729
C	7.006198	0.961742	7.284900	0.0000
R-squared	0.571300	Mean dependent var		4.763056
Adjusted R-squared	0.545318	S.D. dependent var		1.549763
S.E. of regression	1.045006	Akaike info criterion		3.005578
Prob (F-statistic)	0.000001			

(i) ***Model 2 - Switching Regime (Review visits) regarding two side of 5 per 1,000 MR - Observations.*** The relation between MR and Review visits is featured by the presence of a switching regime regarding the two sides (before 1990 and after 1989) of the 5 MR per 1,000. The specification shown in Table 5.41 below represents a significant relationship, only when the values are higher than 5 per 1,000.

Table 5.41 - MR multiple regression (multi collinearity and Review visits switching)

Dependent Variable: MR Method: Least Squares Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Laboratory tests	-4.35E-08	2.73E-08	-1.592954	0.1210
Review visits (MR<5)	-1.51E-07	5.49E-07	-0.275546	0.7847
Review visits (MR>5)	1.26E-06	5.40E-07	2.334277	0.0260
C	5.364213	0.755344	7.101686	0.0000
R-squared	0.782552	Mean dependent var		4.763056
Adjusted R-squared	0.762166	S.D. dependent var		1.549763
S.E. of regression	0.755791	Akaike info criterion		2.382336
Prob (F-statistic)	0.000000			

(ii) ***Model 2 - Threshold (Laboratory tests) - Observations.*** The specification shown in the following Table 5.42 considers the presence of a significant threshold regarding Laboratory tests and insignificant relationship between MR and Review visits.

Table 5.42 - MR multiple regression (multi collinearity and Laboratory tests threshold)

Dependent Variable: MR Method: Least Squares Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Laboratory tests	-6.21E-07	1.05E-07	-5.906358	0.0000
(Laboratory tests)	9.59E-15	2.08E-15	4.614549	0.0001
Review visits	2.69E-07	5.82E-07	0.462985	0.6465
C	12.77963	1.462217	8.739902	0.0000
R-squared	0.742591	Mean dependent var		4.763056
Adjusted R-squared	0.718458	S.D. dependent var		1.549763
S.E. of regression	0.822312	Akaike info criterion		2.551045
Prob (F-statistic)	0.000000			

(iii) ***Model 2 Threshold (Laboratory tests) and Switching Regime (Review visits) - Observations.*** Table 5.43 shows a significant threshold at 10 per cent regarding Laboratory tests, and insignificant relationship between the Review visits (either side of the MR 5 per 1,000 line) and MR.

Table 5.43 - MR multiple regression (multi-collinearity, Laboratory tests threshold, and Review visits switching)

Dependent Variable: MR Method: Least Squares Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Laboratory tests	-2.96E-07	1.40E-07	-2.112795	0.0428
(Laboratory tests)	4.52E-15	2.46E-15	1.834712	0.0762
Review visits (MR< 5)	-1.07E-07	5.30E-07	-0.202540	0.8408
Review visits (MR> 5)	9.08E-07	5.55E-07	1.634300	0.1123
C	8.543936	1.880124	4.544348	0.0001
R-squared	0.803851	Mean dependent var		4.763056
Adjusted R-squared	0.778542	S.D. dependent var		1.549763
S.E. of regression	0.729308	Akaike info criterion		2.334806
Prob (F-statistic)	0.000000			

(iv) ***Section Summary.*** The Least Squares Multiple Regression Models are summarised below:

Table 5.44 - Summary - Least Squares Multiple Regression Models

MODEL	OBSERVATIONS
Model 1 – Inpatients discharged/Radiology tests/MR	Significant (0.54) for Inpatients discharged Significant (0.023) for Radiology tests (at 10% level)
Model 1 – Inpatients discharged/Radiology tests (with Threshold)/MR	Significant (2.65E-12) for the square of the Radiology tests Insignificant for Inpatients discharged
Model 1 – Inpatients discharged with Breakpoints/Radiology tests' threshold/MR	Significant and negative relationship for the two independent variables only in the period 1990-1995.
Model 2 – Laboratory tests/Reviews visits/MR	Insignificant for Review visits Significant (-1.46E-07) for Laboratory tests
Model 2 – Laboratory tests/Review visits switching regime/MR	Significant (1.26E-06) for Review visits only when MR>5
Model 2 - Laboratory tests (with Threshold)/Review visits/MR	Significant (-6.21E-07) for Laboratory tests Significant (9.59E-15) for Laboratory tests' threshold Insignificant for Review visits
Model 2 Laboratory tests (with Threshold)/Review visits with switching regime and MR >, <5	Significant (-2.96E-07) for Laboratory tests Significant (4.52E-15) for Laboratory tests' Threshold Insignificant for Review visits

5.8 Chapter Summary

This chapter consists of a statistical analysis to estimate the efficiencies and quality performance of a sample of twenty hospitals operating in the KSA between 1979 and 2014, covering four major phases in management and operational regimes.

As mentioned before in 1.4, there is a gradually increase from less to more corporatisation, and then returning to a decreased level of corporatisation in the last phase. The Comprehensive System phase is considered fully corporatised and closer to privatisation than the two preceding phases, where the New Public Self-Operating System phase is considered less corporatised than the Comprehensive System phase.

The analysis cannot confirm causality, only that there is an observable and significant association between changes in relative efficiency and the various system phases.

Table 5.45 below provides a high-level summary from the DEA and SFA analyses.

Table 5.45 - H1 and H2 Hypotheses analysis – Summary

	Bilateral Cooperation Agreements (1979-1982)	Partial Operating System (1983-1987)	Comprehensive Operating System (1988-1999)	New Public Self-Operating System (2000-2014)
DEA-Average Relative Efficiency Score over whole sample	0.79	0.77	0.856	0.861
DEA-% Reduction of Inputs to become efficient	35.82	34.73	26.1	27.81
(VRS) IRS	8 (40%)	8 (40%)	6 (30%)	4 (20%)
(VRS) DRS	2 (10%)	4 (20%)	4 (20%)	5 (25%)
DEA-Average Relative Efficiency over inefficient hospitals by phase	0.64	0.65	0.74	0.72
SFA-Average Efficiency by phase	0.43	0.45	0.48	0.52

To conclude this chapter the empirical results are considered against the three hypotheses.

Firstly - H1 - *Performance in terms of efficiency may differ under the different forms of corporatisation.*

(i) ***The DEA Results.*** The Comprehensive System exhibits higher relative PE than the New Public Self Operating System phase, as follows:

- There is a different between the relative efficiency over the whole sample.
- There is a different between the reductions required in inputs.
- Although there is no difference between the first two phases for IRS of hospitals and between the second and the third phases for DRS, generally, there is a different in the VRS results over the whole sample.
- There is a different between the average relative efficiency scores over inefficient hospitals by phases.

(ii) ***The SFA Results.*** The New Public Self Operating System exhibits higher PE than the Comprehensive System phase, as follows:

- The average efficiencies (such as DEA average relative efficiency) show that there is a difference over the whole sample.

Although there is no difference between the first two phases for IRS of hospitals and between the second and the third phases for DRS, generally the results suggest that H1 is fully supported within the confines of this study. Though the scale of changes in relative efficiency between different phases (in all cases) may be small, there are statistically significant changes (DEA and SFA analysis).

Secondly - H2 - *Corporatisation will be positively associated with efficiency*.

(i) ***The DEA Results.*** The Comprehensive System exhibits higher relative PE than the New Public Self Operating System phase, as follows:

- Although the highest relative efficiency was in the last phase compared with the other phases, the difference between the last two phases (0.005) is a minimal.
- The lowest reduction required in inputs was in the Comprehensive System phase.
- The VRS results suggest that the numbers of hospitals benefiting from the Comprehensive phase are greater than those benefiting from the last phase (and vice versa in case of DRS).
- The average relative efficiency scores over inefficient hospitals show an increase in relative efficiency in the first three phases as movement towards privatisation, through greater corporatisation, is achieved. Subsequently the New Public Self Operating System phase, which is a movement away from privatisation, shows a comparative decrease in relative efficiency.

(ii) ***The SFA Results.*** Althogh the differences in the production of each output are to some extent related to external factors -random shocks outside the control of hospitals-

,as represented in Appenix (5.E), the New Public Self Operating System exhibits higher PE than the Comprehensive System phase, as follows:

- Although the highest average efficiency (or less variation) was in the New Public Self-Operating, average efficiency increases through the whole study period, where the efficiencies on output variables increase when moving from the first two phases (less corporatised), to the Comprehensive System phase (fully corporatised).
- The efficiencies on output variables increase when moving from the fully corporatised, to a less corporatised system for only three of the four variables.

The contradictions between these two sets of results suggest that H2 can only be partially supported within the confines of this study.

Whilst RQ1 *(Have different forms of corporatisation generated the gains that may be associated with the movement of reforms towards privatisation?)* is associated with H1 and H2, the RQ2 ***(****Have HC quality considerations (or effectiveness) modified conclusions relating to the efficiency of different HC governance systems?)* is associated with H3 as follows:

Thirdly - H3 - *Fully corporatised hospitals will perform better in terms of quality than partially corporatised hospitals.*

(i) ***The DEA Results.*** The Comprehensive System exhibits higher relative PE than the New Public Self Operating System phase, as follows:

- The lowest reduction required in inputs was in the Comprehensive System phase (Most corporatised phase).

(ii) ***The Panel Estimation Results.*** The New Public Self-Operating System phase exhibits higher relative PE than the Comprehensive System phase, as follows:

- Tables 5.15 and 5.16, show that (according to the system phases that had a significant effect on outputs compared to the baseline) if everything else is considered equal, the transition to the Comprehensive System phase is associated with decreases in the Radiology results for relative efficiency by 11 per cent, while the transition to the New Public Self-Operating System phase is associated with decreases in the Radiology tests by 21 per cent, and with increases in the number of Inpatients discharged by 14 per cent from the baseline.

This means that the later phase has higher relative PE than the most corporatised Comprehensive phase (i.e., in term of increasing outputs volume, as opposedto providing quality performance effectiveness, see 5.4.2 (ii)). Changes in levels of corporatisation, by phase, have no significant association with the other two output variables.

(iii) ***The Regression analysis.*** The Comprehensive System exhibits higher PE than the New Public Self Operating System phase, as follows:

As specified in the theoretical model (Chapter 3) performance consists of efficiency, effectiveness and quality considerations. Efficiency results did not predict which phase would provide the best performance, so quality aspects of outputs are considered through regression analysis.

- For Inpatients discharged, three breakpoints were identified and tested. Table 5.24 demonstrates that the overall performance (efficiency, effectiveness and quality aspects) within the Comprehensive System phase for this particular variable is better than other less corporatised phases (as it is significant and negative in the period 1993 - 2002 at the 1 and 5 per cent levels and also has a lower standard error).

However, the first two years in the New Public Self-Operating System phase may be due to the lagged effects of the previous phase (see Appendix 5.Y and 5.Z). This result was confirmed when considering the Inpatients discharged' breakpoints in addition to the

Radiology tests variable (Table 5.39), where the relation with Inpatients discharged is only significant and negative in the period 1990-1995 (part of the Comprehensive Operating System phase).

Decreasing Inpatients discharged might mean that hospitals were more efficient in the most corporatised phase as compared to the last phase, where they decreased inpatients admitted and therefore decreased inpatients discharged, instead of depending on costly inpatient care which implies that the hospitals were providing better services as the population was getting healthier, as represented by decreases in MR.

- For Laboratory tests a threshold is identified (30 million Laboratory tests per annum) and breached in the latter stages of the Comprehensive System phase (1997) and more recently in the New Public Self-Operating System phase (2009 onwards). This suggests that performance (effectiveness) when related to outcome quality increases as corporatisation increases, but decreases when corporatisation levels are subsequently reversed.

The multiple regression results show that the Laboratory test variable is insignificant only when considering the switching regime in the Review visits without consideration of its threshold (Table 5.41).

- For Radiology tests a threshold is also identified (1 million Radiology tests per annum) and breached in 2006 (New Public Self-Operating System phase). This suggests that performance (effectiveness) decreases compared to the fully corporatised Comprehensive System phase.

This has been confirmed by the multiple regression results as the Radiology test is always significant except when the Inpatients discharged' breakpoints are considered without consideration of its threshold (Table 5.39).

All these results suggest decreases over all periods compared with the fully corporatised phase,

- For Review visits, the results of this variable apply in a similar manner to the last two phases. It is only after 1989 that significant results are indicated (Table 5.31), but when adding the Laboratory tests to the model (Table 5.41) the effect of Review visits became significant only before 1990.

While this variable is significant in relation to the MR (Table 5.30), Figure 5.11 shows that this variable achieved the highest annual figures in the Comprehensive System phase, and decreases after 1999 (in the New Public Self-Operating System phase).

Although, the empirical results supporting H3 are complex as summarised below in Table 5.46, the threshold breaches in the New Public Self Operating System phase for Laboratory tests and Radiology tests (with respect to MR acting as proxy), might indicate further gains in efficiency without any association with effectiveness on MR. Therefore, H3 is supported to some extent when taking into account the full meaning of HC performance (efficiency, effectiveness and quality aspects), showing that the most corporatised phase (Comprehensive Operating System phase) generally performs better overall than lesser corporatised phases as identified within the scope of this study and its sample data.

Table 5.46 - H3 Hypothesis analysis - Summary

	Comprehensive Operating System (1988-1999)	**New Public Self-Operating System (2000-2014)**
Corporatisation Judgment	Most corporatised phase	Lesser corporatised phase
DEA - % Reduction of Inputs required to become efficient	26.10	27.81
SFA - Average Efficiency by phase	0.476	0.522

Panel Estimates	Decrease the Radiology test by 11 per cent.	Increases the number of Inpatients discharged by 14 per cent
		Decrease the Radiology test by 21 per cent.
Regression Analyses		
Inpatients discharged	- Trend: highest volumes per 1,000 - Breakpoint 1993 - insignificant - Multiple breakpoints - significant between 1993-2002 (-2.84) - Adding Radiology tests to the model - significant between 1990-1995 (-6.71E-05)	- Trend: lowest volumes per 1,000 - Breakpoint 2003 (and Multiple breakpoints) – insignificant since 2003 - Adding Radiology tests to the model – insignificant between 1996-2014
Laboratory tests	- Trend: lowest and highest volumes per 1,000 - Threshold breached 1997 - Threshold breached 2009 onwards - Significant threshold (4.97E-06) - Significant threshold (9.59E-15) when adding Review visits to the model - Significant threshold (4.52E-15) when considering Review' switches	
Radiology tests	- Trend: lowest volumes per 1,000	- Trend: highest volumes per 1,000 - Threshold Breached in 2006 onwards - Significant threshold (0.003775) - Significant threshold (2.65E-12) when adding Inpatient discharged to the model
Review visits	- Trend: highest volumes per 1,000 - Lowest volumes per 1,000 - Switching regime 1990 - After 1989 (MR <5) - significant with Switching (0.026127) - Before 1990 (MR>5) - significant with Switching (1.26E-06) when adding Laboratory tests to the model - Insignificant with Switching when considering the Laboratory tests' threshold	
MR	- 1988=5.37 Deaths per 1,000 - 1999= 3.8 Deaths per 1,000	- 2000 = 3.74 Deaths per 1,000 - 2014 = 3.53 Deaths per 1,000

Chapter 6 will now discuss further the results and findings of this chapter, with respect to the two research questions.

CHAPTER 6

Discussion and Interpretation of Results

6.1 Introduction

Chapter 5 presented the results from a number of quantitative tests investigating the relative performance of MoH hospitals in the KSA, 1979-2014. In this chapter, the results are discussed within the context of the theoretical and empirical literature, and will contribute to the conclusions and recommendations in Chapter 7.

This chapter is divided into three sections. This section provides the context.

The discussion in Section 6.2, contextualised against the literature previously reviewed, focuses on the various efficiency results recorded in Chapter 5, which are key in answering

RQ1 - *Have different forms of corporatisation generated the gains that may be associated with the movement of reforms towards privatisation?*

RQ2 - *Have HC quality considerations (or effectiveness) modified conclusions relating to the efficiency of different HC governance systems?*

Section 6.3 concludes and summarises this chapter.

6.2 Discussion

This thesis investigates the components that are associated with performance (efficiency, effectiveness and quality aspects) related to hospital corporatisation across the phased changes in management and control, covering a sample set of 20 public hospitals in the KSA over a 36-year period (1979 to 2014). Over these decades the KSA has experimented with a number of approaches and management structures to achieve movement from a fully public hospital environment towards a privatised form through different approaches to corporatisation. Four phases are identified which indicate

different management and operational frameworks, each adopting different components of 'Corporatisation', which is defined by the actions taken as a precursor to partial or full privatisation. Corporatisation separates ownership and management, where the government retains full ownership, but transfers various degrees of management of the hospital to the private sector. In KSA hospitals, it has been argued that the Comprehensive System Phase (1988-1999) can be seen as the most corporatised phase (Figure 1.1) in the study period. Since 2000 the New Public Self-Operating System phase has been the dominant framework, where both management and operation of the hospitals provide a less corporatised environment in comparison with the Comprehensive Operating System phase.

As identified in Chapter 3, which defines this study's theoretical framework, no phases within the sample period for this study can be considered as either full or partial privatisation and only fit within the definition of corporatisation. Preker and Harding (2003) suggest that effective corporatisation appears to be an institutionally intensive organisational reform that necessitates a sustained, complex, and politically challenging role for government agencies and officials. This view is supported by the theories of Markets and Hierarchies, developed from the works of Coase (1937), Williamson (2005), and Ouchi (1980). Chapter 2 of this study considers the economic theories of the SCP paradigm (reviewed by Boru and Kuhil, 2018) associates a concentrated structure (e.g. monopoly) with profits in a concentrated industry, restrictive conduct and inefficiency, and implications may be argued for a health service owned and managed by a State ministry. However, the SCP paradigm has been criticised for disregarding the threat of competition identified by Contestable Markets Theory (Baumol, *et al.,* 1982). In turn, this theory has been criticised for its assumption of costless entry. Contestability in theory exhibits "incompatibility with inefficiency of any sort" (Baumol, 1982, p.6) but Baumol

was more concerned with persuading governments to regulate large firms to promote free entry and contestability than supporting nationalisation (i.e., the opposite of privatisation which is economically costly). At the same time, he preferred such regulation to privatisation, since appropriate regulation to reduce entry barriers "…can do more to promote the public interest than privatization, which often results in replacement of a state monopoly by a private monopoly" (Baumol and Lee, 1991, p1). In other words, the SCP paradigm may be argued to favour privatisation as a means of breaking up (State) monopolies, while Contestable Markets Theory would favour regulation and lower entry barriers as a means of increasing competition. With its focus on privatisation, this study bases its hypotheses on the SCP perspective, given that it can be argued that Contestable Markets imply regulations that reduce entry barriers, enabling private firms to enter, or threaten to enter the industry, without the privatisation of State assets.

Clarke, *et al*. (2005) considers reforms short of full privatisation, and argues that partial privatisation or corporatisation both leave the Government as the dominant shareholder, which may result in those firms performing poorly by conventional accounting measures. Megginson and Netter (2001) take a HC-specific view and consider that most privatisation theories are not applicable to HC, but further suggest that even ineffective privatisation might be preferable than keeping a government-controlled system which is working ineffectively. In contrast, Evans (2006) proposes that health service delivery can be more efficient if some of the logic of the marketplace is introduced, while still recognising that the public health framework has many attractive characteristics that should be retained. After reflecting on this extensive debate, this study hypothesises that:

H1 - *Performance in terms of efficiency may differ under the different forms of corporatisation.*

The theoretical framework in Chapter 3 identifies a number of components that are important in assessing the efficiency of different phases of corporatisation. In particular, incentives are affected by the Decision Rights component which may facilitate movement towards full or partial privatisation (Harding and Preker, 2000), so that performance may differ according to whether the hospital is fully corporatised, or less so (Megginson and Netter, 2001). This study hypothesised that:

H2 - *Corporatisation will be positively associated with efficiency.*

Increasing the Decision Rights component of a corporatising organisation, achieved through actions and activities that will decrease governmental controls, allows increased autonomy at the hospital level. Focusing Residual Claims on local organisations complements decentralised Decision Rights in incentive provision.

Figure 1.1 in Chapter 1 identifies that the Comprehensive System phase is judged to display the highest level of autonomy of all the phases within this study. Furthermore, Table 1.1 identified that, within the Comprehensive Operating System phase, a single service management company (contracted to the MoH) was responsible for Hospital non-medical and medical services. Within this study those hospitals in the Comprehensive Operating System phase are considered fully corporatised. A positive association between corporatisation and efficiency would be generally consistent with the theory of incentives, where individuals with appropriate incentives reveal private information and create optimal outcomes (Holmström, 1979), and public choice theory (Niskanen, 1971, 1975; Buchanan, 1969). Furthermore, a positive correlation would also be consistent with the moral hazard in relation to the principal-agent problems inherent in bureaucratic structures, because of assymetric information and the separation of ownership and control (as outlined in Chapter 2). We hypothesised that:

H3- *Fully corporatised hospitals will perform better in terms of quality than partially corporatised hospitals.*

In less corporatised firms, public managers are constrained by the extent of the control retained by the government. In fully corporatised firms the balance of control changes to provide greater autonomy and decision Rights increase, and residual claims are retained by the local organisation, rather than the central public purse, which may use it "to increase bureaucratic perquisites such as cars, bigger offices, travel, conferences" (Adams, *et al.,* 2006, p.386). Thus, if the performance (efficiency) of the firm improves with an increase in decentralises decision rights and residual claims, then it may be hypothesised that a more fully corporatised firm will be seen to perform more efficiently than a less corporatised entity.

6.2.1 Measuring Performance

There are a number of ways to measure hospital performance, ranging from regulatory inspections and assessments, public satisfaction surveys, and statistical indicators. According to Shaw (2003), the effectiveness of measurement strategies relies on several variables including their objective, the domestic culture, how they are applied, and how the results are used hired. This study focuses predominately on gathering statistical information to discover information concerning changes in management structures (Table 1.1), through different degrees of corporatisation. Therefore, a note of caution is raised. Firstly, statistical studies work best on large data sets. This study only covers 20 hospitals in the KSA. Secondly, the appropriateness of the chosen variables to assess operational performance in its totality should be considered, rather than being totally based on data variables that were available for this exercise which is looking at one particular aspect of hospital performance across a wide time period.

6.2.2 Input and Output variables as components of efficiency

The level of economic efficiency, identified through the analyses of the hospitals' input and output variables, is a key factor when assessing and comparing the wider performance of different phases of hospital corporatisation. As stated in Chapter 4, a number of data variables were used to test for efficiency. The first sets of variables were output quantity variables. These included the numbers of Inpatients discharged, Radiology tests, Laboratory tests, and Review visits. These four variables were used as the dependent, output quantity variables to measure hospital efficiency.

Table 6.1 below summarises the conclusions from Chapter 5. Whilst the determination for H1 ('efficiency' in this case is measured as the average relative to other hospitals under the same forms of corporatisation), is robust and easily demonstrated by the empirical results, the interpretation of H2 is slightly more problematic. H3 is supported when taking into account the full meaning of HC performance (efficiency, effectiveness and quality aspects).

Table 6.1 - Summary conclusions from Chapter 5

H1	*Performance in terms of efficiency may differ under the different forms of corporatisation.*	H1 is fully supported within the confines of this study
H2	*Corporatisation will be positively associated with efficiency.*	H2 can only be partially supported within the confines of this study.
H3	*Fully corporatised hospitals will perform better in terms of quality than partially corporatised hospitals.*	H3 is supported to some extent within the confines of this study.

From chapter 5, more hospitals became more efficient during the New Public Self-Operating System phase, which is supportive of Hastings and Levie's (1983) belief that the enhanced efficiency is gained more easily from within the public-sector environment, as a greater level of control was returned to the MoH in this phase. However, the lowest 'average reduction in input required' (to become efficient) is achieved in the (most corporatised) Comprehensive Operating System phase than at any other time in the study.

While higher profits in not-for-profit organisations could conceivably be used for other sources of managerial utility, i.e., perquisites, this result suggests that retained financial surplus may have acted as an effective incentive to raise efficiency in the most corporatised phase (see 1.4) with better utilisation of non-financial inputs. While the Comprehensive Operating system was applied to a not-for-profit organisation, dependent Key Performace Indicators (KPIs) may trigger some financial surplus to be allocated to higher wages or bonuses for staff, which may have acted as an effective incentive to raise the efficiency. This implies that Agency problems (based on the assumption of managers' pursuit of self-interest) may in this study be more relevant in lesser corporatised phases. If this theory is not appropriate, any financial surplus may be spent on extra doctors, nurses, etc.

(i) *Inputs*. Within this study, the findings from the input-orientated two-stage DEA models show that the hospitals included in this study's sample set have, on average, higher efficiency levels in the New Public Self-Operating System phase (Table 5.7) which is supportive of hypothesis H1. However, 55 per cent of the hospitals were not associated with changes in all phases and, the changes in efficiency over time are relatively small across phases. As previously stated by Olajide (2005), in 2.3.1 there is little theoretical support for the prediction that corporatisation will improve firm performance and for 45 per cent of hospitals there is a change in efficiency across phases, all of which showed some level of corporatisation.

Inputs for Hospital Beds, Doctors, and Nurses show a sharp increase in volumes in the Comprehensive System phase. The trend for Allied personnel shows a steady increase over the whole period. The increase in Hospital Beds may reflect substantial capital investment in physical infrastructure and, if so, could be strongly related to a similar increase in Doctors and Nurses.

The substantial capital investment in physical infrastructure may also be reflective with the size of the MoH budget particularly in the period 1984 onwards to 1993 shown by the infrastructure investment strategy in KSA 3rd Development plans onwards (Ramady, 2010). After this date, the MoH budget shows a substantial increase year-on-year, not reflected back in the number of non-financial inputs.

During the 7th development plan, in 2000, as a result of rapid growth of the oil sector, the GDP grew up and the budget deficit turned into surplus (see section 1.3.3). It should be noted that this key event may be relevant to the different experiences and changes in policies for health progress towards privatisation. For example, the year 2000 coincided with the reversal away from full corporatisation, and a decline in the year-on-year variations on expenditure is seen in the previous phases (Figure 5.3). This view is supportive of Feignenbauem and Henig's (1994) political underpinning of privatisation theory as a short-term solution to address immediate financial problems and can be shown within the 7th Development Plan (2000-2005) (Ministry of Economy and Planning, 2000, p.171) being aimed at reshaping the role of the MoH in the operation and management of service providers at that time. More recently data transparency in the MoH has improved (Ministry of Health, 2019), however it is noted that historically data was either not for general distribution due to financial restrictions, inaccessible or featured non-existent documentation.

(ii) ***Outputs.*** The Panel Estimation Results (Table 5.19) show that (according to the system phases that have a significant association with outputs compared to the baseline), if everything else is considered equal, changes in levels of corporatisation, by phase, has a significant association with the efficiency of Radiology tests and Inpatients discharged output variables.

Recently (Al-Debis, 2017) there has been a growing realisation within the KSA and the MoH that the current financing method for HC needs to refocus on outputs, rather than inputs, to ensure the provision of incentives to provide high quality services without loading the citizen with any additional costs.

It is noted that the outputs show both between-phase and within-phase variations. This raises the issue of whether it is the inputs that strictly generated the observed outputs, or some external factor, poor operational management and whether similar results are being observed across a wider timeframe (1979-2014) and larger sample of hospitals (20) than considered in this study. This view is supported by El-Seoud (2013) whose small study of 20 hospitals (for the year 2011 only), suggests that low efficiency is due to either internal production, or external (environmental) factors, or both, where the public HC sector reform requires government credibility with regard to policy uniformity, stability, and strict coordination between policy design and implementation.

(iii) ***Timing Effects.*** The overall indication that emerged from the SFA analysis (Table 5.13) suggests that the aggregate average relative efficiency of outputs amongst the hospitals has improved progressively over time (from 0.43 to 0.52). However, within the detail of this average efficiency of outputs result, a different picture emerges as seen in Figure 5.1. Of particular interest, here is using Radiology tests as an output for measures of PE (i.e., in terms of increasing output volume, as opposed to providing quality performance effectiveness), which is seen to decline over the time period, rather than increase, as shown by the other three output variables.

In order to take the timing issue into account, various specifications of stochastic frontier production function models for panel data are estimated in Chapter 5, covering the entire period and controlling for changes in management and operation of the hospitals. This allowed direct investigation of the relative association between changes in

management and operation of the hospitals and public health MR and efficiencies. Both time-invariant and time-varying inefficiency models are estimated. With the inclusion of control variables, the Tobit model shows that they are positively significant related to the CRS relative efficiency scores of the hospitals across the four different management and operational phases. However, the increasing level of local population growth caused by improving birth and death statistics, and internal and external migrations, is seen to be associated with increases the CRS relative efficiency in all phases, except the New Public Self-Operating System phase, and is supportive of the view that increased PE may be associated with greater levels of corporatisation.

(iv) ***Size of City.*** The analysis showed that the size of the city (measured by the total local population of the area where the hospitals are located) has a significant association with CRS efficiency across the hospitals, and this association varied across the periods of the management and operations. As stated in 4.5.1 above, the majority of the cities (60 per cent) where the hospitals are located were classified as big cities in the KSA, whilst the majority of the hospitals (80 per cent) in the sample set for this study were located in semi-urban and urban areas.

Compared to the hospitals located in large cities, the Tobit model results show that hospitals located in medium-sized cities always have higher average CRS efficiency scores than those located in small cities (apart from the New Public Self-Operating System phase where small hospitals have an insignificant association with efficiency) and that might not be because of inefficiency, but because those hospitals do not get enough patient visits. Furthermore, compared to the hospitals located in rural areas, the hospitals located in semi-urban areas show higher average CRS efficiency scores than those in the urban areas in all phases. This observation questions the supposed benefits of economies of scale as identified by Coase (1937) who suggests that larger firms (in this case,

hospitals) may initially be advantageous, but decreasing returns may eventually prevail. Walston, *et al.* (2008) note this particular challenge of scale, with particular respect to the KSA where referrals to large urban MoH hospitals may suffer from perceptions of poor quality, with increased costs of centralised, specialised hospitals and rapidly growing population, changing demographics, and increased demand for HC services generally in the Kingdom. This assertation is supported by Dittman, *et al.* (1991) in America who found hospital efficiency may well hinge on the regional or local labour market, the competitiveness of HC services' providers in the market, and the service area's demographics.

Rebba and Rizzi (2006) show scores of low efficiencies were attributable to either internal (management) or external factors (politics) which were not fully controlled by the management of the hospital. In particular, the low total efficiency scores of public hospitals could be mostly explained by the former policy decisions made on the size of the hospital or their role within the regional HC service. Considering this association in KSA, Walston, *et al.* (2008, p.6) suggests that the move to a privatised model of HC would "dramatically change the motivations and incentives of providers", with both positive and negative association with efficiency and services provided. Within the UK there is a perception that private hospitals "pick the easy cases" that afford more profitability (Plimmer, 2018, p.2). However, experimentally and practically, providing the HC services through the public sector is more efficient than private sector from both the USA and European Union (Dittman, *et al.,* 1991).

Interestingly this tie in with Rawls (1971) view on social equity and equality as the dispersion analysis shows that the New Public Self-Operating System recorded fewer inequalities (lowest average variance) between the hospitals for all output variables (apart from Radiology tests), as identified by the SFA analysis (Table 5.13). Lowest average

variance in the New Public Self-Operating phase may be due to a lack of facilities in rural areas in the past. The government states that "rural areas are not as attractive to the private sector as urban centres, it is envisaged that the former will remain dependent to a large extent on government health services" (Ministry of Economy and Planning, 2010, p.69). In fact, one of the key challenges noted in the 9th Development Plan (2010-2015) is to limit the differences in the effectiveness and quality of the health services and ensure comprehensive coverage in rural areas. However, the evaluation within the Plan suggests that monitoring and evaluation are needed in the rural cities in KSA, and that management structures may need attention in this area in the future (see section 1.3.2). This suggestion seemingly contrasts with the efficiency results found in this study, where, compared to the hospitals located in rural area, the hospitals located in semi-urban areas show higher average CRS efficiency scores than those located in urban areas (Table 5.5), where as mentioned above, that may be related to the huge referrals to large urban MoH hospitals, increased costs, rapidly growing population, and changing demographics (Walston *et al.,* 2008).

To conclude this subsection, the answer to RQ1 (*Have different forms of corporatisation generated the gains that may be associated with the movement of reforms towards privatisation?***)** is that although significant variations exist, there is no consistent evidence that any theory consistently predicts changes in efficiency.

This answer is based on evidence (results) that is inconsistent in the early stages of the analysis using DEA and SFA techniques, referred to in more detail below. Moreover, when applying additional tests in Chapter 5, no theory consistently predicts the test results achieved. This does not refute the theories, just highlighting that the results provided no consistent evidence to support the theories.

When comparing SFA and DEA, the results were contradictory and showed no

consistent alignment with the hypotheses and this result is expected where a number of empirical studies have been inconsistent (e.g., Lawanson and Novignon, 2017). A common cause of this inconsistency is that the DEA model accounts only for direct inputs to the HC sector, while, the SFA is accounting for both direct and indirect inputs (see section 4.6.2). Grigoli and Kapsoli (2013) as cited in Lawanson and Novignon (2017) observed that the more control variables (which reduces the size of the error term) in the model, the more efficiency estimates there are. However, although the efficiency scores vary between the two approaches, the general trend for both is to increase the efficiency scores over time (see section 5.8). On balance, the DEA results were considered more relevant since a hospital "…is inherently a multi-input, multi-output production process, a standard production function with one output and multiple inputs, and is not flexible enough to provide sufficiently comprehensive benchmarking" of hospitals (Kuchler, 2013, p.10). DEA assumes that there is no statistical noise and that the production functions consist of only the inputs and outputs used for measuring PE. As such, there is no assumption of a deterministic production frontier. The DEA analysis can also provide the requirements for an inefficient hospital to become efficient (see 4.6.1). Whilst the SFA results assume the existence of a parametric function relating outputs to inputs and the existence of random shocks outside the control of firms which can affect output (see 4.6.2).

It is concluded that the parametric SFA involves assumptions about underlying statistical distributions in the data, therefore requiring several conditions for validity (strong assumptions as to the form of the frontier) that may introduce bias in the results, while DEA requires fewer conditions of validity and unlikely to pose a threat in testing governance theories since the data is considered robust (numeric and verified by the KSA

authorities). In addition, nonparametric models have an advantage because they assess the median rather than the mean, where the mean is not always the better measure of central tendency in a sample. Parametric tests can analyse only continuous data and outliers can overly affect findings. Moreover, according to the central limit theorem, the greater the size of the sample, the closer it is to the variation of society, and the distribution can be considered normal when the sample size is thirty and above (Chin and Lee, 2008), while in this study it is twenty. However, it is not possible to apply parametric statistics to non-parametric data (less than thirty).

6.2.3 Output and outcome variables as measures of quality and effectiveness

This subsection of discussion is concerned with the quality of care provided by the MoH hospitals sampled across the different phases of corporatisation in response to RQ2 - *Have HC quality considerations (or effectiveness) modified conclusions relating to the efficiency of different HC governance systems?* This study measures relative efficiency (inputs and outputs) and quality outcomes (MR as proxy for quality). Combining efficiency, effectiveness and quality observations, utilising the processes and conceptual framework defined in Chapter 3, and applying the methodologies outlined in Chapter 4, provides the multifaceted perspective needed to achieve greater understanding concerning the overall performance of hospitals within different phases of corporatisation considered.

Much like the definitions of corporatisation and privatisation, the definition of 'quality' within a HC is ambiguous. The U.S. agency for HC research and quality (AHRQ, 2002, p.1) suggests that "…although quality assessments based on administrative data cannot be definitive, they can be used to flag potential quality problems and success." Critical to this study is the understanding that information on all

aspects of quality (not just efficiency) allows stakeholders to make informed choices about different corporatisation or privatisation regimes (Institute of Medicine, 2006) and may modify conclusions relating to the efficiency of different HC governance systems. Generally, it can be said that HC quality is not considered a sub-definition of efficiency, rather efficiency is just one of the six domains of HC quality mentioned in 2.6.1 above (i.e., Safety, Effectiveness, Patient-centred Experience, Timeliness, Efficiency, and Equity) (Institute of Medicine, 2001). Effective services refrain from providing services to those not likely to benefit, whereas efficient services avoid waste. This study considers both the effectiveness and efficiency of output quality as these indicators are considered vital where quality cannot be measured directly (AHRQ, 2018).

(i) *Outputs*. According to Statsoft (2018), the regression analyses allows the output variables to be compared to the dependent variable (in this case MR outcome) using Least Squares, to learn more about the relationship between efficiency, effectiveness and quality aspects in response to Research Question 2.

(ii) *Outcomes.* IOM (2006) suggests that the more that output procedures (as inputs) are correlated with an improved outcome, meaning that the higher volumes of procedures (being Laboratory and Radiology tests as output variables) are associated with lower MR (which this study has used as a proxy for quality) cannot be supported. The results in this study suggest that although there have been improvements in the MR quality indicator over time, this is not associated with the increased volumes of tests in all cases or phases. However, this is not saying that if different (test) variables were chosen, the measurements of quality effectiveness of the tests would still be the same.

Looking at the wider picture, the work of The Economist Intelligence Unit Healthcare (2014) considers global comparisons of HC systems, providing an interesting benchmark whereby each KSA phase can be associated with an improvement in outcomes

as it moves through different degrees, highlighting decreases the MR as life expectancy rises and disease profiles shift from communicable diseases to chronic illnesses resulting in a transition from low-cost to high-cost care. According to the Economist Intelligent Unit Healthcare (2014), In a 166-country comparison according to health outcomes and cost, KSA was classified as one of the countries higher for outcomes than for spending, where the health spend per head was US$ 813 with an outcome index 80.5 per cent compared with US$ 9,216 expenses in the USA with an 85.5 per cent outcome. Moreover, while the rise in life expectancy is considered as a "good" outcome, this means that noncommunicable diseases (NCDs) are becoming the main causes of death. The KSA assessed that NCD deaths under the age of 60 were 40 per cent, compared to 55 per cent in UEA. However as stated in Chapter 3, MR cannot be used simply as an output quality variable for the hospitals, because other factors could also have contributed to the observed changes in MR of the local population per 1,000. For example, (external to hospital outputs) Immunisation programmes within the KSA over the past 35 years may have had an impact on the MR of the local population per 1,000 (on a national basis this measure decreasing from 104.7 per 1,000 in 1979 to 12.9 per 1,000 in 2014 for Under 5's) and is, therefore, a factor unrelated to hospital efficiency.

Nevertheless, MR outcomes are considered a key indicator of hospital quality, both globally and within the KSA (CBAHI, 2015 and AHRQ, 2018), associated with the inefficiency or effectiveness of the output's variables (as inputs). However, alternative quality measurement indicators were not formally considered until the start of the New Public Self-Operating System phase (2000), which was associated with benefits in efficiency scores solely under MoH control (see 1.4 (iv) above). Therefore, using the MR outcome as a dependent variable (despite its known flaws, it is included in the WHO (2018, p.22) HC indicators list. Quality aspects of the sampled hospitals outputs are

examined through the regression analyses which outline the associations with this outcome and how they are affected by Laboratory tests, Radiology tests, Review visits and Inpatients discharged output variables, across the four phases, in response to RQ2 (*Have HC quality considerations (or effectiveness) modified conclusions relating to the efficiency of different HC governance systems?*).

(iii) ***Inpatients Discharged and MR.*** the relation between these two variables suggests that quality considerations measured by MR do modify conclusions relating to the efficiency of different HC governance systems in this instance. As previously determined, there is a significant association between efficiency and corporatisation phase as follows:

The decline of Inpatients discharged per 1,000 (which would potentially increase the total number of Inpatients admitted to a hospital, see 5.8 (iii) the regression analysis) since 2003 (Figure 5.6) seems an unusual movement relevance to the growth in population and the decline in MR at the same time. The Inpatients discharged variable has not been significantly associated with the MR since 2003 (even when tested in combination with both Radiology tests and considering the breakpoints identified in the Inpatient discharged results (Table 5.39)), which is especially relevant when considering the relation of output quantity with MR outcomes, if it is assumed that an increase in output efficiency (quantity) is in some way related to an increase output quality (Farrell, 1957).

A possible explanation is that the number of Home HC Patients has increased from 100 individuals in 2009 to 28,000 in 2013 (MoH, 2013), suggesting that any deaths at home may not be attributed to this quality measure being totally related to hospital efficiency. Figures from the MoH (Ministry of Health, 2013, p.33) show one-day surgery figures rising from 0 per cent in 2005, 2 per cent in 2010 to 46 per cent in 2013 on a

national basis, which would not be counted as Inpatients admitted. The view is supported by a UK study (Alderwick, *et al.*, 2015) which examines the large efficiencies gained (both financial and otherwise) by carrying out procedures such as Day Surgery, versus carrying out procedures as an admitted Inpatient.

(iv) ***Laboratory Tests and MR.*** the analysis of these two variables suggests that quality considerations do modify conclusions relating to the efficiency of different HC governance systems in this instance.

Although the New Public Self-Operating System showed the highest score overall for Laboratory Tests (Figure 5.4), the quality proxy does not support this conclusion, as the significant threshold (Table 5.26) breaches in the latter years of the study period (2009 onwards) have no positive association with the MR that would account for the continued decline in MR outcomes. Simply said, this suggests that earlier efficiency measures based on quantity alone are no longer acceptable as tests over the threshold indicated may be unnecessary production. Mufti (2000) suggests that the direct ordering of laboratory tests, the number of tests ordered by residents (especially with the beginning of the cooperative health insurance system with a royal decree 10 of 1/5/1420 A.H. (National Center for Archives and Records, 1420) which was part of providing treatment for individuals citizens or foreigners and their families, in government health facilities, and re-admission testing may contribute to the threshold breaches. This view is supported by Al-Oufi (2017) who further suggests that the trend toward privatisation may require patients to undergo additional and unnecessary examinations and laboratory tests in order to earn more money, again consistent with agency problems.

However, the results, shown in Table 5.42 (adding Review visits to the model) and Table 5.43 (which considers the switching regime in Review visits) suggest that the

threshold is still significant. Looking forward, Al-Oufi (2017) sees the MoH as the primary monitor for quality to ensure that the patient should not be overloaded with unnecessary tests. Thresholds defined in terms of the regression analysis are breached, i.e., carrying out tests with the objective of reaching peak efficiency or for other reasons, whilst potentially having no value-added contribution on or association with quality (effectiveness) output, loads additional and unnecessary costs (for example, MoH budget and increased Insurance fees) into the system and is irrational in these terms.

(v) ***Radiology Tests and MR.*** the analysis of these two variables suggests that quality considerations do modify conclusions relating to the efficiency of different HC governance systems in this instance.

Of particular note, here is the observation within the KSA 8th Development Plan which suggests a change in disease patterns in 2005, with increasing incidence of non-communicable diseases including cancer (Ministry of Economy and Planning, 2005), with the relationship between more radiology tests and increases in instances of cancer increasing being undeniable. Whilst there is no breakdown of types of Radiology Tests being carried out, recent studies (e.g. Mulcahy, 2016) suggest that the over-diagnosis of breast cancer, via mammography screening, can result in unnecessary surgeries without defined benefits for this health demographic. Similarly, Mufti (2000) suggests that routine chest x-ray on admission and re-admission testing could contribute to the over-use of this service, however medics (Hendee, Becker, Borgstede, Bosma, Casarella, Erickson, Maynard, Thrall and Wallners, 2010) suggest a level of caution should be applied to negative studies which do not always acknowledge the medical value of x-rays, although within the radiological medical community there is an acceptance that over-utilisation is a real concern in some instances. Elsewhere (Abdullah, 2008), indicates there is a belief that the existence of medical insurance leads to a significant increase in unnecessarily

medical services such as - MRIs, X-rays and CAT scans, yet again raising the possible relevance of agency problems, and this consistent with Institute of Medicine (2003) mentioned above in 2.5.3, where uninsured patients are less likely to incur yearly expenses than their counterparts who have coverage in the USA. In this case, it is relevant to note that the Insurance regime became compulsory in the KSA in 2005 for all non-Saudi nationals working in the country.

In 2006, the significant threshold for Radiology tests was breached (Table 5.28) with the results in Table 5.38 suggesting that the threshold for Radiology tests continues to be significant after adding the Inpatient discharged variable to the model which means that there is no positive association with the MR that would account for the continued decline in MR outcomes. Tests for non-life-threatening ailments by definition do not associate with MR. This is not to say that these tests are irrelevant as they could result in treatment that improves the wellbeing and quality of life of the population. However, this is not what is being considered in this study.

(vi) ***Review visits and MR.*** the analysis of these two variables variable suggests that quality considerations do modify conclusions relating to the efficiency of different HC governance systems in this instance.

Review visits per 1,000 of the local population have shown a downward trend with a large fluctuation. The highest number of visits is recorded in 1999 (Figure 5.11) at the end of the Comprehensive Management Stage (1988-1999) and is considered significant and associated with MR (Table 5.31). This increasing seems as an unusual movement compared to the whole time period. A possible explanation of more Review visits might be attributed to the spread of some epidemics around 1999-2000 such as Dengue virus (Fakeeh and Zaki, 2003), Methicillin-resistant Staphylococcus aureus (MRSA) (Al Yousef and Taha, 2016), Alkhurma hemorrhagic fever (AHF) (Saudi Gazette, 2018),

invasive meningococcal (Memish, *et al.,* 2013), and that coincided with the beginning of the cooperative health insurance system (mentioned above in 6.2.3 (iv)). Note that Hajj and Umrah religious mass assemblies hosted by the KSA (see section 1.3.2) involve a substantial influx of visitors. This can aid the transmission of infectious diseases. In addition, in 1999 the number of traffic accidents increased by 3,446 from the previous year (Ministry of Interior, 1999).

However, when adding the Laboratory tests to the model (Table 5.41) the Review visits became significant only in the first two phases (before 1990 when the MR > 5). When considering the threshold in the Laboratory tests (Table 5.43), the Review visits became insignificant represents no association with the MR. On this basis, it could be considered that a sharp increase in Review visits might be orientated towards addressing profit maximisation rather than output efficiency or MR quality outcome considerations. For example, for Review visits specifically, it considers whether the sharply increased figures for Review visits are in any way related to the decreasing figures noted for Inpatients discharged and MR, again supporting the views of Alderwick, *et al*. (2015, p.49) who discuss overuse of services which leads to "unnecessary tests and treatment, and overutilisation of low-value clinical interventions."

In summary, this section has looked at how quality considerations can be applied to the four tangible output variables. Relating quality to efficiency is problematic when considered at a broad level, as the discussions and considerations for each output variable are discrete and complex. The relations between MR and the other output variables examined in the regressions may be used to investigate the relationship between quality, quantity, and efficiency.

However, the regression results actually show something very different to the earlier tests of DEA and SFA results. When MR outcomes are related to the outputs

individually, the results show that the relation with MR breaks, so there is weakening of the relationship with the outputs observed, as the curve flattens, swiches, or breaks. This is abnormal as theory (Farrell, 1957) expects output quality to follow the quantity of outputs in an agricultural context, which has some similarities with HC (Ram, 2014). The global health situation is affected by agricultural products which may be associated with bad health that reduces the performance of work, income, and productivity. Thus, HC and agriculture are together accountable for life expectancy around the world, where miscalculations in agriculture might lead to polluted food products and HC mistakes might lead to death (James Lind Institute, 2019).

More recently, Sheiner and Malinonvskaya (2016) show that applying traditional measures of productivity growth to HC can result in problems if an inappropriate input is chosen, and the variation of the input is not taken into account. In the traditional approach, the output is the HC service provided (e.g., a physician's appointment, prescription or hospital stay) but these services may be better viewed as intermediate inputs to satisfying the consumer need, which is improved health. In addition, in HC, the outcomes tend to improve over time, so observing prices without reference to increased output quality will exaggerate price increases and diminish productivity growth (Sheiner and Malinonvskaya, 2016, p.4). However, the challenge for longitudinal studies such as this is to find appropriate inputs, outputs and outcomes that cover the whole time period under consideration that is recorded across a wide sample set. Nevertheless, in this case, this disconnect between quantity and quality aspects, means that there is an increasing number of tests (assumed to be more efficient) being carried out with no association with MR outcomes. The dates when this change happened can be identified, by applying these breaches back to the quantity shown in the trend analysis. Thus, at certain points in time the theoretical relationship between quantity and quality is broken and is isolated within

the phases identified, if the focus of tests is only on avoiding premature deaths, and if MR does not account for demographic changes.

For example, the Comprehensive Operating System phase demonstrates the greatest movement towards privatisation (Figure 1.1) despite the threshold breaches in Laboratory tests in the last years of the phase (Figure 5.4) which suggests a decrease in quality effectiveness as opposed to an increase in efficiency. In contrast, the New Public Self-Operating System phase has the lowest MR per 1,000 of the local population (Figure 5.5), which might be related to factors external to hospital corporatisation -not to hospital management regime alone-, such as the introduction of tighter quality controls through external quality regulation (which is likely to have benefited whatever corporatisation phase prevails, then and in the future), advances in clinical procedures, new technologies and infrastructures, and improved training facilities, as well as immunisation programmes (e.g., Tufenkeji, 1994; Perbandt, *et al.,* 2018) may be associated with the observed improvements to the quality of the KSA hospital outputs in the New Public Self-Operating System phase.

To conclude when considering RQ2- (*Have HC quality considerations (or effectiveness) modified conclusions relating to the efficiency of different HC governance systems?*) as demonstrated by the discussions above, the quality considerations relating to the different hospital governance systems do modify conclusions relating to the overall performance of different hospital governance systems within the boundaries of this study. With particular attention to PE, the results from DEA and SFA are inconclusive in terms of which phase is most efficient. However, the regressions have highlighted a number of effectiveness (quality) concerns in the New Public Self-Operating System phase.

Firstly, where significant threshold breaches in the latter years of the study period (2009 onwards) for Laboratory tests, and in 2006 for Radiology tests, have no significant

positive association with MR can be detected from increasing the quantity produced of these variables (Figure 5.4). Secondly, a negative and highly significant (at 1% and 5%) relationship between MR and Inpatients discharged between 1993-2002 (Table 5.24) was estimated with a lower standard error, and there is a negative relationship between MR and both inpatient discharged and radiology tests between 1990-1995 (Table 5.39). However, Inpatients discharged becomes insignificant, implying perhaps that there is no statistical evidence that hospitalisation is more effective in the New Public Self-Operating System phase, as mentioned above by Alderwick, *et al*. (2015), that clinical interventions might have had a low value. In this case, it can be suggested that striving for greater PE means that carrying out a greater quantity of tests may not be associated with increasing the benefit or quality (effectiveness) of the hospital, and overall performance may be negatively influenced.

Finally, the result achieved for Review visits is similar for the Comprehensive and the New Public Self-Operating System phase, where this variable is considered significant to the MR (Table 5.31) it is achieved its maximum in the most corporatised phase, while it decreased in the last phase (Figure 5.11), where this study analyses the PE of hospitals in relation to the output of services.

6.3 Chapter Summary

This chapter discusses the results from Chapter 5, framed within the context of the literature reviewed in Chapter 2. The results and discussion are undeniably complex and based on varying and contrasting opinions concerning progress towards, or away from privatisation. As the hospitals have transitioned to each subsequent phase and moved towards or away from privatisation, different levels of efficiency across output variables can be observed across the empirical tests.

For RQ1 - *Have different forms of corporatisation generated the gains that may be associated with the movement of reforms towards privatisation?* the evidence (i.e., the results) shows that there is no consistent evidence that any theory consistently predicts changes in efficiency, at least in the early stages of the analysis (DEA and SFA) and the difficulty in explicitly distinguishing the association between corporatisation and efficiency, as opposed to other factors external to the hospital.

For RQ2 - *Have HC quality considerations (or effectiveness) modified conclusions relating to the efficiency of different HC governance systems?* The overall results from the study, finishing with the regression analyses using OLS with MR as the dependent variable, show that considering the quality aspects of performance does modify conclusions related to the overall performance of different HC governance systems within the boundaries of this study.

Where the results have identified a disconnect between the effectiveness and efficiency of the output variables related to changes in the outcome variable MR, the conclusion is modified because, when considering PE, increased outputs suggest that the New Public Self-Operating System is the most efficient. However, when considering the overall efficiency and effectiveness of the hospital systems which are associated with quality effectiveness, it is shown that the increases in PE (output) do not improve the overall performance of the hospital system.

AHRQ (2002, p.2) suggests that volume (quantity) indicators are "…proxy, or indirect, measures of quality. They are based on evidence suggesting that hospitals performing more of certain intensive, high-technology, or highly complex procedures may have better outcomes for those procedures." Furthermore, for quality utilisation indicators in the AHRQ model, concerns are raised, where the usage varies greatly across

hospitals, the use may be excessive, incomplete, or that there is a misuse, this view is supported by Farrell (1957) mentioned in 6.2.3 (vi) above.

Table 6.2 - Summary of correlation results

	Q2 (*do quality considerations modify conclusions relating to the efficiency of different HC governance systems?)*	Reasons (explanation)
Inpatients discharged	Are associated with MR	Positive relation (0.76) with MR Insignificant since 2003
Laboratory tests	Are associated with MR	Negative relation (-0.75) with MR Significant Threshold breached
Radiology tests	Are associated with MR	Negative relation with MR (-0.42) Significant Thresholds breached
Review visits	Are associated with MR	Positive relation (0.48) with MR Insignificant with Laboratory tests below 5 (after 1989)

To conclude this chapter, the determination of the overall performance of a hospital system requires a multi-dimensional examination and nuanced consideration of both quantitative and qualitative results.

When applying traditional theory of efficiency (e.g., Farrell, 1957) across the different tests in Chapter 5 it is not considered here consistently predicts the test results identified. This does not mean the theory is incorrect, just that results (particularly from the DEA and SFA) initially provided no consistent evidence to support the theory. However, econometric tests and efficiency results alone do not predict which corporatisation phase provides the best overall performance of hospitals. This study has built a model which provides a multi-dimensional view of hospital performance, such that the quality aspects of the outputs (efficiency and effectiveness) for the sample hospitals are also considered through the regression analyses.

The suggestion (IOM, 2006) that a greater volume of output procedures is correlated with a lower MR, cannot be supported, although that is not to say that if different variables were chosen the results would still be the same. The results of the regression analysis, combined with the results of the earlier DEA and SFA tests indicate

this is not the case for this study, and have identified areas where the utilisation of the outputs is considered problematic, predominately in the New Public Self-Operating System phase. The results of the regression analyses identify a breakdown of the efficiency relationship with the effectiveness and quality aspects observed in this study's results.

In addition to empirical results, each corporatisation phase in this study has involved different movement away from/towards privatisation, where the Comprehensive Operating System phase is seen as the most corporatised phase (Figure 1.1). Applying all the results obtained in this study, a detailed assessment of which corporatisation phase of the study provides the greatest level of performance can be made. It is on this basis that the assertion of H2 (*Corporatisation will be positively associated with efficiency*) can only be partially supported, and is modified by quality considerations. H3 (*Fully corporatised hospitals will perform better in terms of quality than partially corporatised hospitals*) is supported to some extent within the confines of this study, meaning that the design of incentives, agency, and public choice theories (as outlined in Chapter 2) hold true. These theories are to a degree consistent with this study's results, indicating that increasing corporatisation, i.e., moving towards privatisation (see 1.4 above) (Harding and Preker, 2000), may be associated with achieving improved efficiency and wider quality considerations. Furthermore, the Comprehensive Operating System (fully corporatised) phase demonstrates (despite some mixed results in specific tests) better performance compared to other phases within this study.

Chapter 7 concludes this thesis by providing an overview of the research findings identified in this study. On the basis of those findings a number of policy recommendations are suggested that may be supportive of future KSA development plans for hospital privatisation.

CHAPTER 7

Conclusions

7.1 Introduction

This final chapter provides a consolidation of estimates of the associations between corporatisation and the performance of a selection of MoH-owned hospitals in the KSA over a 36-year period.

The aim of this study was to test for the alleged theoretical benefits of corporatisation changes, i.e., a positive association between corporatisation and efficiency would be generally consistent with SCP theory (reviewed by Boru and Kuhil, 2018). While no causation may be implied from any such association, explanations are tentatively proposed with theories consistent with the data involving the design of incentives, agency, and public choice theories (as outlined in Chapter 2). The study argues that changes in management incentives, in different corporatisation phases, may be associated with the performance of hospitals. Efficiency is one dimension of hospital performance with respect to its inputs and outputs that is considered. MR acting as the quality outcome proxy provides additional dimensions in a theoretical model of the investigation of the hospital system's performance.

The association between corporatisation and performance was investigated by testing three hypotheses, which provide for the first time in the KSA a deeper understanding and examination of changes across a variation of corporatisation models, using quantitative results on hospital performance. Furthermore, the conceptual framework (Chapter 3) and methodology (Chapter 4) provide a novel frame integrating effectiveness and quality aspects with efficiency results across a number of hospitals input, output, and outcome measures, thus providing a balanced inspection in a non-

limiting, two-step approach (i.e., quality and effectiveness aspects examined independently of DEA/SFA analysis, through the Regression Analyses, rather than making restrictive assumptions to incorporate quality into the analysis of efficiency as a residual). It is hoped that the findings of this research will provide additional insight and techniques so that the KSA ministries concerned with planning, implementing and monitoring hospital corporatisation can continue to make better informed decisions for the benefit of the people of the KSA. This makes it important to make clear the limitations of the study (e.g., assumptions, choice of variables, etc), see section 7.5.

This chapter is divided into seven sections. This section provides an introduction. The findings in Section 7.2 suggest that taking into account the efficiency, effectiveness, and quality aspects of hospitals performance, fully corporatised hospitals (on average) provide better overall performance than those that are not. Section 7.3 presents policy recommendations, included future KSA development plans (Vision 2030), quantity, quality, agency problems, and incentivisation. Section 7.4 outlines a number of observations as suggested guidance for those involved in the design and implementation of future stages of hospital corporatisation in the KSA. As this thesis is not without limitations, the limitations of study are represented in section 7.5. This chapter ends with suggested areas for future research (section 7.6), and then some final conclusions (section 7.7).

7.2 Principal Findings

An array of quantitative analytical techniques was used to examine hospital data to determine the relative performance (efficiency) of different phases of corporatisation.

Looking at each technique, DEA shows that the Comprehensive System phase is better (on the criteria adopted) than the New Public Self-Operating System phase, because

the results identified that in this phase hospitals are generally nearer their PE frontier in their use of inputs. The Tobit analysis (Table 5.5) also shows that the Comprehensive System phase has superior CRS efficiency scores (except in the intercept which shows that the last phase has the greatest improvement). In contrast, the SFA results show a higher average PE score for the New Public Self-Operating System phase. The DEA results are preferred in this study, and the arguments for this preference are laid out in 6.2.2. Whilst MR might not be considered an ideal proxy for quality (Sheiner and Malinovskaya, 2016), the indicator has been recorded consistently across the study time-frame (see section 6.2.3 (ii)).

Moving on, the key results from the panel analysis tests focus on how PE is increased via increasing outputs, particularly for radiology tests. Here the PE results were inconsistent with decreases in radiology tests in the most corporatised phase. However, Radiology test efficiency declined further when moving to the lesser corporatised New Public Self-Operating System phase.

The Regression results have highlighted a number of effectiveness (quality) concerns, with efficiency being more evident in the most corporatised phase (see section 6.2.3 (vi)).

7.3 Policy recommendations

7.3.1 Future KSA Development Plans (Vision 2030)

Looking forward, plans for the corporatisation/privatisation of hospitals in the KSA are captured in the Vision 2030 and the National Transformation Program 2020 built upon the encouragement of private sector investment in sectors that have been predominantly funded and serviced by the Government in the past. Reform of how public HC and related

services are delivered in the Kingdom is one of the Government's most important priorities.

According to the National Transformation Program 2020, the MoH plans to spend up to SAR 23 billion prior to 2020 to reform and restructure primary HC. Dr Khalid Bin Mohammed Al Shaibani, Deputy Minister for Planning and Health and Director of Vision Realisation Office believes that there is a hope that by 2030 there would be full hospital corporatisation (but still in government ownership) with local autonomy, suggesting that this would lower the level at which decisions are made and allow hospitals to become more competitive: "We hope that by 2030 it will be left to the decision-makers to decide on whether or not to privatise that asset or keep it as a government-owned (corporatised) asset" (TBY, 2017, p.1). Kerr (2016, p.1) reports that "…in healthcare, the plan targets a rise in the private sector's involvement from 25 per cent to 35 per cent over the next five years. It has earmarked SAR6bn to support the sector's transformation through the funding of health insurance and PPP. One of the country's 'medical cities', which are major hospital complexes, will also be privatised."

Unfortunatilly, like the term 'privatisation', the term PPP is used loosely. There is a difference between the PPP in China, and the UK and other Western countries. "The essential difference is that PPP was discussed and carried out during the process of establishing a market system that was based originally on public ownership. This has been quite a different process compared with the West, where private ownership has long been recognised as legally enforceable" (Adams, *et al.*, 2006, p.391). In the KSA, the National Center for Privatisation (2019) shows that the MOH announced the first PPP project to amend and improve medical radiology and imaging services in the Riyadh region, that will serve about one million patients and employ around 500 nursing, technical, and clinical staff.

However, details as to the exact intended form of privatisation are not yet evident at the time of writing. In a KSA media report (Hazzazi, 2018) it was stated that a holding company with five regional companies would be established within the privatisation programme starting in 2018, to cover all Saudi regions, started by nine hospitals and thirty primary HC centres in the Makkah region and Eastern province. It is expected that 37 per cent of hospitals and health centres will be under those new companies by 2020, and that would increase the efficiency of the hospitals by 25 per cent by 2021 (Hazzazi, 2018). This raises questions about a shortage of the quantity of the HC services in KSA.

7.3.2 Quantity of Healthcare Services in KSA

Despite the great expansion of the health services in the Kingdom, the MoH states that there is currently a scarcity of medical services (e.g., long waiting times, and the inability to give patients time for psychological reassurance and explanation for the congestion of appointments), and that may be associated with the lack of specialised hospitals and their limitations in some areas (MoH, 2019, pp.13-18). However, as stated by the Asharqia Chamber's report, "The privatization process will increase the capacity of beds in hospitals from 65,000 to 115,000 by 2020, adding an extra 50,000 beds to the healthcare system" (Bulatovych, 2018). However, as noted before, the term 'privatisation' is not publicly available in detail at this time and is used loosely by the MoH in media press releases. Plans under Cabinet Decree 60 of 1/4/1418 A.H. [August 6, 1997] for the Supreme Economic Council's Privatisation Strategy state that "Privatisation is the process of transferring the ownership or management of public establishments, projects, and services from the government sector to the private sector, relying on market mechanisms and competition, through a number of methods including

contracts for managing, operating, financing, or selling all or part of the government's assets to the private sector" (International Business Publications, 2011, p.70).

However, more recently the MoH announced a corporatisation approach towards hospital privatisation stating that (Al-Oufi, 2017, p.1) "The change into companies is aimed at adopting the methods of the private sector in boosting quality, raising productivity, reducing waste, expediting the process of decision-making and achieving decentralisation. The quality of services will be improved and they will be provided at the right time and place". In this way, the level of corporatisation seems likely to increase, as in the Comprehensive Operating System phase. The issue of the quality of service is addressed in the next section.

7.3.3 Quality of Healthcare Services in KSA

The MoH (2019, p.18) states that improvements in the quality of health services will be provided through government companies in preparation for allocation, and work to expand the base of beneficiaries of the health insurance system, facilitate more rapid access to services, reduce waiting times to access specialists and consultants, and train doctors to raise their ability to address and treat chronic diseases. A media report by the MoH outlining the future (corporatisation) plans for KSA MoH hospitals reported that (Hazzazi, 2018) "The companies will focus on quality and compete with one another to provide the best possible services to all groups of residents." However, the definition of 'best' is currently not defined and precise 'decision rights' of such companies are still to be determined (MoH, 2019, p.18) although the statement suggests that equity and equality will be maintained in line with KSA HC guiding principles to "realize the goal of healthcare for all citizens" and "improve the quality of healthcare services" (Hazzazi, 2018). However, to achieve these goals, there is a fundamental need to limit the moral

hazard problems as mentioned in 2.4.4, since local employees have more information on hospital operations than planners at the MoH.

7.3.4 Agency Problems

In 2017, Dr Khalid Bin Mohammed Al Shaibani -Deputy Minister for Planning and Health and Director of Vision Realisation Office- stated several things, most importantly, as it highlights an awareness in the MoH that it faces a challenge of Agency problems in the current model (New Public Self-Operating System phase) implied by the following (TBY, 2017, p.1) “Clearly the MOH today has a conflict of interest. It provides care through a network of more than 365 hospitals and 2,500 primary care centres. It provides care but is, at the same time, the governor, and the regulator.” This dual role is arguably indefensible. The KSA has plans in 2018 to separate these processes so that the MoH will no longer provide care, and it will focus more on planning, organising, supervising and monitoring all health services. The provision of care will be given to multiple SOEs companies (see 7.3.3 above). While there is an intention to privatise 290 hospitals and 2,300 primary health centers by 2030 (Global Health Exhibition, 2019), the initial stages will, however, focus on further corporatisation. However, to ensure the success of the transformation in the health sector in the Kingdom, incentives must be provided to supply high-quality services.

7.3.5 Incentivisation

The MoH pointed out that one of the most important factors in the success of the transformation in the Health sector in the Kingdom would be to change the way in which the financing of HC services is run. The Health Insurance and Health Purchasing Programme of the Ministry aims to formulate and implement a new mechanism for financing companies through the purchase of services (instead of provision of services

through direct budget) in accordance with the strategic purchasing methods that guarantee the provision of incentives to provide high quality service without generating any additional costs for citizens. It is intended that this will be achieved by the reallocation of budget and utilisation of reserve budgets, and improvements in efficiency of public hospitals by operating them on a commercial fundamental with the support of specialised health companies (Hazzazi, 2018), where all citizens will be covered under 'comprihinsive coverage' to obtain fundamental health services, while they can pay to get an 'additional optional insurance' for complementary health services such as cosmetic treatments (MoH, Health transformation strategy, 2019). This policy aim is in line with the results that a more corporatised model will provide performance gains as argued by this study.

Within the National Transformation Program, (KSA, 2017), KPIs suggest that 37 per cent of the total HC income be generated from the private sector by 2020 with 100 per cent of HC facilities being required to report comprehensive performance and quality aspects.

7.4 Recommendations

The findings from this research concluded that, taking into account the efficiency, effectiveness, and quality aspects of hospitals' performance, the most corporatised hospitals generally perform better overall than those in the least corporatised phases as identified within the scope of this study and its sample data (see 5.8 above). However, it is unlikely that what is deemed suitable for a large hospital would be equally appropriate for a small rural hospital.

(i) ***Benefits of autonomy.*** Increasing the level of autonomy at a local level is a theoretical precursor to achieving greater efficiencies. However, this can be abused due

to Agency problems or lack of experience in managing outsourced contracts. Ensuring that the proper incentives and performance controls are in place will limit moral hazard. This study demonstrates that the degree of corporatisation is positively associated with hospitals' relative efficiency. Possible explanations for this association include greater corporatisation with more local incentives, improved decision autonomy, and consequently less moral hazard (see 2.4.4 (ii) and 6.2 (H2) above).

(ii) ***Performance Indicators.*** To measure the movement towards strategic aims and objectives, a number of indicators need to be selected to assess whether the necessary progress is being achieved. This study used four input variables, four output variables and one outcome variable, as well as a number of control variables, to compare different corporatisation phases. Such a selection of indicators is unlikely to be appropriate when considering the three domains (mentioned in 2.6.1 above) of hospital performance (structure, activity and procedural, and outcomes) to assess the overall performance of a hospital. The most appropriate set of performance indicators and measures for each of these domains must be defined, captured and assessed to inform any adjustments that are required on an ongoing basis to meet performance targets.

The selection of measures must not be too costly to collect, yet must be targeted and appropriate to include inputs, intermediate outputs (for internal hospital operations), outputs and outcomes, that are considered from an economic, effectiveness and quality perspective. To reiterate (see section 6.2.2 (ii)), the current funding method relies on inputs rather than outputs and that limiting the incentives to increase output productivity and efficiency (Al-Debis, 2017). The new funding method should arguably be driven across all domains of HC performance (not only efficiency metrics but also quality of care considerations). In addition, with the advent of technological advances, the manipulation of large volumes of performance data can now be achieved in a more

simplified and lower cost manner. For example, very recently (ADAA, 2018), the Saudi National Centre for Performance Management, has created a freely accessible International Performance Hub (IPH), which draws together information from around 700 KPIs. Looking forward, a wider selection of KPIs may be appropriate where this study is limited by the number of input, output, and outcome variables considered, due to the availablility of data over the study time period for the sample hospitals. Looking back at hospital performance, it is impossible to capture such wider information retrospectively as it does not exist or is unreliable. However, MR (as a proxy for quality) is included in the WHO HC indicators list, and it also considered as a key indicator of hospital quality (see section 6.2.3 (ii)), both globally and within the KSA.

(iii) ***Scale.*** When comparing the performance of hospitals, location, scale, and specialism should be considered as part of the selection criteria so that like is compared with like, as the environment of the KSA is not consistent across its domain and localised impacts could affect results. The Tobit regression analysis (Section 5.2.2) examined the determinants of efficiency differences across a number of variants. In addition, all the hospitals selected in the sample of this study are non-specialised hospitals (unlike the specialised hospitals such as the ophthalmic or obstetrics hospitals) belonging to the MoH. The stability of the model over time was also considered by using information of both the variations between hospitals, and the changes over time (Section 5.4.2).

(iv) ***Assessment techniques.*** Techniques to assess the costs and benefits of increasing different components of corporatisation (moving toward privatisation), could benefit from using both quantitative and qualitative analytical techniques that are standardised and transparent across all hospitals. The creation of the theoretical model in this study has allowed efficiency, effectiveness, and quality aspects to be considered as

different dimensions of a hospital's overall performance. Doing so has modified conclusions from those just based on efficiency results alone.

(v) ***Assessors.*** Hospitals must have the ability to self-monitor as well as being assessed externally. Internal peer review visits are one method of addressing and maintaining good safety aspects and best clinical practices as mentioned in 4.3 (iv). However, as discussed in 1.4 above, an external quality assurance has been introduced from 2000 onwards (Almasabi, 2013).

(vi) ***Training.*** The examination of economic and statistical results, unless carried out with some insight and skill, could result in misinterpretation. Awareness training on the sampling, manipulation, and examination of indicators is recommended for key personnel by this study. HC economics within KSA is a relatively new discipline. The ability to manipulate data appropriately is important to standardise outcome metrics and accurately measure resource costs and introduce the use of such data into decisions made on a daily basis (MoH, 2019, p.22).

7.5 Limitations of Study

The chosen positivist methodology may introduce limitations on the researcher as outlined in 4.2 in specifying the production process, i.e., the choice of analytic technique, model specification, and efficiency assessment; could lead to incorrect findings and assumptions. For example, DEA/SFA is specifically concerned with measurements of PE, where PE and AE represent static efficiencies at a particular point in time. However, investments in HC may not show efficiency benefits until many years after the input measurements have been captured. This study merely assesses inputs, outputs, and outcomes to derive efficiency results at a static moment of time within each phase and assumes that results are immediate rather than lagged. In terms of assumptions,

both the DEA-CCR and DEA-BCC models have been applied to the study to address scalability. Dynamic Efficiency has not been considered due to the constraints in data availability in this study, where investments in technical advances in HC may have a significant impact on efficiencies over time.

When assessing the efficiency of HC organisations, the positivist measurement of efficiency is further complicated by the need to take into account exogenous influences on performance that lie beyond organisational control – i.e., characteristics of population, geography, climate, culture, and in particular, size of city. The KSA is a diverse country in terms of geography and population distribution. In this study, the majority of the cities (60 per cent) where the hospitals are located were classified as big cities in the KSA, and 80 per cent of the hospitals are located in semi-urban and urban areas (Table 4.2). It is impossible to identify definitively all environmental constraints and their relative impact on the study's results. However, DEA assumes that there is no statistical noise which does not allow other factors to influence production. In comparison, SFA does consider random shocks outside the control of firms as represented in Appendix 5.E; therefore, higher efficiency scores for SFA compared with DEA may be due to external factors rather than to hospital performance. This represents an advantage for DEA.

The comparison for the study should have included MoH hospitals, private hospitals, and others as well, which would have been a better comparison. This limits the significance of the results of the study, especially as they could provide insights into the differences between inputs/outputs/outcomes and other characteristics of private and public hospitals.

Another limitation applies to many other HC investigations: this study suggests that some caution should be taken in the interpretation of such results at a hospital level applied to a wider picture, both in terms of sample size and time horizons, to identify

general trends, associations of performance and testing of general hypotheses. Nevertheless, the results within the study sample have been prepared and rigorously examined using a number of different economic tools of investigation. Overall the model is deemed to be robust for its purpose to investigate the hypotheses across different tests.

However, changes in levels of corporatisation may be expected to be associated with performance effects in the long term, i.e., not instantly. The implications for this research are that these measurements show immediate associations. This does not infer causality from corporatisation stages to performance, which requires greater insight and contextual knowledge.

Finally, a limitation could be that the implications of the research findings and potential recommendations need to be considered within the local context of the KSA HC environment, but could be used for wider benchmarking in assessments relating to other global HC systems. It is also possible that the KSA may have corporatised the best hospitals first (i.e. “cherry-picking”), thus affecting the measured association between governance change and average PE across all hospitals.

Despite an exhaustive process of data collection and sophisticated quantitative analysis, this positivist study of course embraces all these weaknesses. At the same time this study represents the first attempt to assess the association between the state reforms and the HC performance in the KSA, and subsequent researchers may build on this study from alternative methodological standpoints.

7.5.1 Scope of study

(i) ***Variables.*** Apart from the chosen input, output and outcome variables, there were very few other hospital-level measures that could be used that were available across the study period.

(ii) ***Area or district level data.*** Efforts were made to obtain a wider data-set from relevant sources; however, data is unavailable as noted in section 4.5.1.

7.6 Suggested Areas for Future Research

- Investigate the most appropriate Quality Metrics for corporatisation/ privatisation of hospitals and align with efficiency measures and cost considerations.
- Compare the performance of private hospitals in the KSA with public hospitals in the more recent environment.
- Understand the impact of city size on hospital quality and efficiency in more detail. i.e., do hospital cities provided better quality or are they just more efficient due to scale?
- Understand the impact and effect that pilgrims may have on individual hospital performance.

7.7 Final Conclusion

The aim and claimed contribution of this research study has been to empirically test and estimate the variations in performance (efficiency, effectiveness and quality aspects) of MoH's hospitals over a 36-year period in the KSA across four levels of corporatisation. In particular, the PE of the hospitals was investigated by testing a number of different hypotheses reflecting the theoretical benefits of hospital corporatisation. The study identified that efficiencies varied over the different phases, reflected by changes in input and output indicators. The consideration of quality and effectiveness modified the conclusions that were gained from the initial economic analyses.

Disappointingly, the PE results from the DEA and SFA were contradictory as mentioned in 6.2.2 above, however, on balance, it has been argued that the DEA results were considered more relevant. On this basis, DEA measures indicate that the most

corporatised phase (Comprehensive System) was the most productively efficient as measured by this study.

The Panel analyses show that rising output variables increase production efficiencies. However, when the effectiveness of these outputs was measured against the MR (as a proxy for quality), this showed ineffective AE where no quality improvement was derived from increasing these outputs above certain levels within the data constraints and scope of this study.

The important thing to note here is that the study's objective was to compare the efficiency and effectiveness of different corporatisation models (Figure 1.1). In this way, it is shown that the most corporatised system phase results were associated with better quality outcomes on AE measures. As mentioned in 6.2.3 (ii) and 7.2 above, whilst MR might not be considered the best proxy quality outcome measure (Sheiner and Malinovskaya, 2016), the indicator has been recorded consistently across the study's time-frame (see section 6.2.3 (ii)).

In addition, as noted in 4.4, it is generally believed that hospitals provide three essential services, namely inpatient, outpatient, and laboratory services. In this model, outputs should reflect these core services, whilst inputs should reflect the resources used to generate these outputs (services provided). According to Chansky, *et al.* (2013), it is possible to aggregate these different types of outputs into a single index to indicate overall inputs and outputs of the hospital.

As a final concluding statement, further corporatisation may be supported by a standardised set of performance measures (covering both economic efficiency measurements and quality criteria derived from a HC perspective). These measures could consider inputs, outputs and outcomes across the three performance domains to provide

a broad insight into performance and inform adjustments to future plans, where it is understood that policy changes must take time to be embedded, before the long-term influences on outputs and outcomes could be observed.

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APPENDIX

Appendix 1.A - Map of the KSA showing Regions

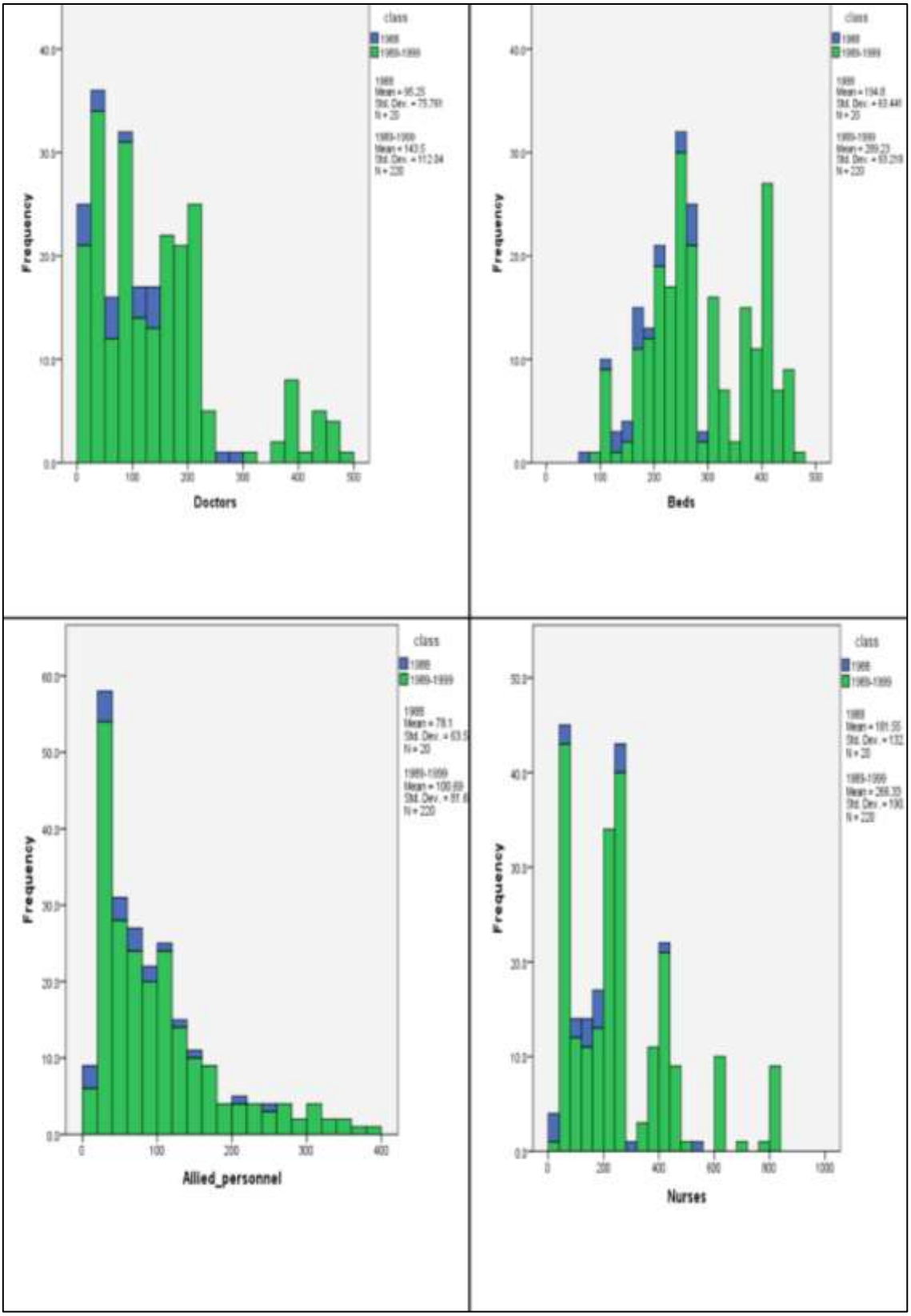
Appendix 1.B - Key National Performance Indicators

Indicators		Statistics 2013	Statistics 2017
Total population (people)		29,994,272	32,612,641
Population annual growth rate		2.7%	2.52%
Population density (person / sq km)		15.0	15.6
Saudi population (people)		20,271,058 *	20,408,362
GDP growth at constant prices (2010=100)		2.70%	-0.86
Per capita GDP at current prices (SAR)		95,300	78,965
Economic diversification indicators	Private sector's contribution to GDP at constant prices	58.92%	48.22%
	Proportion of private sector growth	5.97%	1.26%
	Proportion of non-oil exports to imports	32.10%	38.35%
Growth of exports of non-oil goods		6.02%	8.88%
Growth of imports of goods		8.09%	-4.0%
Exports contribution to GDP at current prices (2010=100)		59.76%	32.42%
The cost-of-living index		126.7	137.2%
Change in the cost-of-living index (inflation)		3.5%	-0.85%
Unemployment Rate		5.57%	6.0%
Saudi's Unemployment rate		11.7%	12.8%
Saudi employment as percentage of population		35.7%	52.1%
MR (per 1000 of the local population)		3.53	3.45
Infant MR (per thousand live births)		15.9	4.82
Gross enrolment rate in primary education		106.40%	101%
Net enrolment rate in primary education		96.5%	97.90%
Rate of illiteracy of the population		5.6%	5%

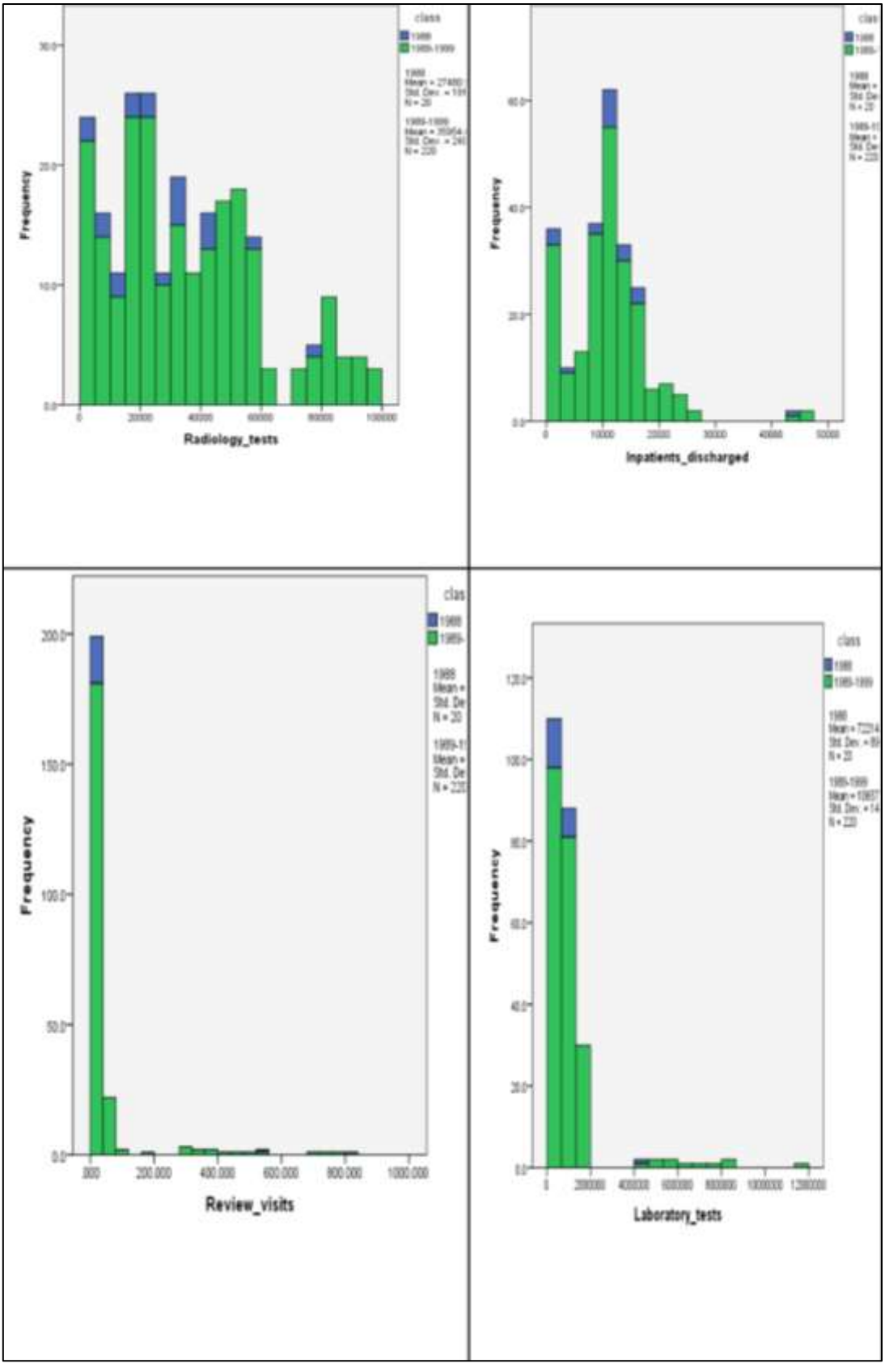
Sources: https://www.stats.gov.sa/en

https://data.albankaldawli.org/indicator/SP.DYN.CDRT.IN?locations=SA

Appendix 1.C - Graphs of overlapped inputs



Appendix 1.D - Graphs of overlapped outputs



Appendix 4.A - T test for Equality of Means

		T test for Equality of Means						
		T	df	Sig. (2-tailed)	Mean Difference	SE Difference	95% Cl of difference	
							Lower	Upper
1979 Pop.	Equal variance assumed	0.224	35	0.824	0.101	0.4512	-0.815	1.017
	Equal variance not assumed	0.223	33.14	0.825	0.101	0.4537	-0.8218	1.0237
2014 Pop.	Equal variance assumed	0.228	35	0.821	0.2047	0.8985	-1.6193	2.0288
	Equal variance not assumed	0.227	33.26	0.822	0.2047	0.9031	-1.6322	2.0416

Appendix 4.B - Mean values of output variables for all periods

Year	MR[8]	Radiology tests	Inpatients discharged	Laboratory tests	Review visits
1979	8.89	27036.95	11360.55	678754.85	77346.05
1980	8.37	27040.45	11365.90	678759.90	77363.80
1981	7.88	27057.50	11376.20	678779.50	77403.50
1982	7.43	27102.35	11429.60	678849.40	77481.20
1983	7.01	27102.35	11429.60	678849.40	77481.20
1984	6.62	27102.35	11429.60	678849.40	77481.20
1985	6.25	27091.00	11397.60	678786.60	77450.70
1986	5.92	27136.55	11407.25	678806.05	77454.40
1987	5.63	27148.80	11407.90	678818.30	77456.35
1988	5.37	27480.90	11813.20	722147.15	83033.05
1989	5.14	29108.90	12177.70	768241.50	85824.15
1990	4.93	29291.25	12554.50	817279.95	90191.30
1991	4.76	30042.75	12943.10	869445.05	95096.55
1992	4.6	35070.20	9345.80	880663.25	56508.90
1993	4.45	35969.25	9635.05	933030.55	62114.45
1994	4.32	36891.70	9933.10	702841.95	65383.60
1995	4.19	37837.60	10240.22	1060149.10	69825.00
1996	4.08	38792.75	10557.00	1164385.15	72447.40
1997	3.97	39802.80	10883.55	1260303.45	76260.40
1998	3.88	40823.50	11222.55	1340298.45	80274.20
1999	3.8	41870.25	11567.05	1926327.30	149749.15
2000	3.74	42943.90	11925.05	1517370.50	88946.80
2001	3.69	44045.50	12294.20	1580594.65	93628.40
2002	3.65	45856.65	13763.15	1537657.30	91591.00
2003	3.63	45959.60	13833.90	1178110.30	93094.20
2004	3.62	49909.35	14403.15	1160775.00	100991.65
2005	3.61	48736.30	13627.40	1230295.10	97422.35
2006	3.61	51911.30	13559.95	1285763.45	98706.80
2007	3.6	54690.80	13894.00	1352226.30	101803.65
2008	3.6	58101.35	13595.40	1471380.25	103283.10
2009	3.59	60541.35	14557.15	1602053.75	105987.35
2010	3.57	62406.25	14085.55	1660519.35	106886.60
2011	3.56	67662.20	13701.00	1858876.30	109893.85
2012	3.45	138909.35	12952.00	1946007.85	95437.80
2013	3.53	147542.20	12316.65	1928483.10	99762.15
2014	3.53	151230.40	12722.85	2044191.70	104750.15
Average	**4.76**	48256.82	12130.78	1164129.86	88216.87

[8] MR data available at: https://data.albankaldawli.org/indicator/SP.DYN.CDRT.IN?locations=SA.

Appendix 4.C - Mean values of input variables for all periods

Year	Beds	Doctors	Nurses	Allied personnel	MoHBudget[9]
1979	161.00	82.20	163.85	66.90	5,656,400
1980	163.80	84.45	171.10	69.45	7,709,700
1981	168.70	86.70	175.90	72.15	8,803,700
1982	171.85	91.10	179.60	75.05	8,400,800
1983	171.85	91.10	179.60	75.05	10,742,000
1984	171.85	91.10	179.60	75.05	8,814,540
1985	183.10	88.80	176.25	72.25	7,072,933
1986	194.00	94.05	180.20	74.40	8,333,431
1987	194.80	95.25	181.55	75.05	7,735,000
1988	194.80	95.25	181.55	78.10	7,591,590
1989	243.65	118.75	228.30	81.55	8,168,484
1990	284.80	139.30	265.85	84.45	9,708,000
1991	290.95	143.60	268.55	88.30	8,872,800
1992	290.95	143.60	268.55	92.05	9,928,500
1993	290.95	143.60	268.55	95.85	8,110,680
1994	290.95	143.60	268.55	99.90	7,364,772
1995	297.30	148.30	271.70	103.95	7,335,667
1996	297.30	148.30	271.70	108.45	10,746,976
1997	297.30	148.30	271.70	112.95	12,213,699
1998	297.30	148.30	271.70	117.70	11,339,236
1999	300.10	152.90	274.50	122.45	11,939,043
2000	306.15	157.80	277.45	127.85	13,046,528
2001	306.15	157.80	277.45	127.85	13,740,910
2002	306.15	157.80	277.45	133.70	13,857,430
2003	306.15	157.80	277.45	139.35	14,756,350
2004	310.25	158.05	283.30	142.45	16,870,750
2005	310.25	158.05	283.30	146.50	19,683,700
2006	310.25	159.30	283.95	152.80	22,808,200
2007	310.25	159.30	283.95	154.15	25,220,000
2008	315.85	160.40	289.40	160.75	27,507,600
2009	315.85	160.40	289.40	160.75	29,518,700
2010	316.35	160.40	289.40	160.80	35,063,200
2011	323.10	165.70	298.80	168.75	39,860,200
2012	325.40	169.25	308.95	172.35	47,076,447
2013	325.40	167.50	312.30	175.85	54,350,355
2014	325.40	169.05	312.30	179.15	61,959,405
Average	**268.618**	**136.032**	**251.214**	**115.114**	**17,275,215**

[9] MoH budget is Raw Data per annum

Appendix 5.A - Bilateral Agreements Management phase RESULTS

Hospitals (DMU's)	Rank	Efficiency scores	Slacks							
			Inputs				Outputs			
			Beds	Doctors	Nurses	Allied Personnel	Inpatients discharged	Radiology tests	Laboratory tests	Review visits
1	7	1	.	3.38805	56.8183	.	8335.84	8113.02	782611	0
2	11	0.852372	13.8683	12.2701	2.57727	.	1623.88	0	173393	25914.9
3	20	0.334993	47.3449	.	5.2072	2.79225	0	0	124180	1886.74
4	5	1	92.4479	.	10.2216	4.90947	112.948	1090.9	264070	0
5	1	1	0	.	0	0	0	0	.	0
6	9	0.960822	.	66.6457	61.6236	.	15837.4	0	6137771	95826
7	8	1	152.305	.	88.1211	16.6263	0	0	2112740	0
8	1	1	.	0	.	0	0	0	0	0
9	16	0.612717	.	37.0889	9.49885	.	5574.49	0	2938188	22531.1
10	18	0.388478	.	11.3422	29.777	.	0	857.238	355413	19947.5
11	10	0.91405	.	35.0245	43.409	.	0	0	995884	13022.9
12	15	0.62593	.	33.4114	38.9032	.	0	3462.99	715784	0
13	12	0.725894	.	18.2652	6.05129	.	0	1214.78	1396586	7171.91
14	1	1	.	0	0	0	0	0	0	0
15	4	1	.	1.15416	45.4993	.	0	10716.7	141952	23712.7
16	19	0.369582	.	12.1282	.	0.568394	753.732	5578.47	4409.33	0
17	17	0.577251	.	24.0533	69.105	.	0	1494.92	838078	0
18	14	0.663348	.	22.35	57.4148	.	0	586.449	432309	9192.12
19	13	0.676793	.	2.21189	18.7444	.	0	5853.91	1143860	0
20	6	1	.	9.62238	49.291	.	0	0	695011	9272.02

Notes: The reference weights are not reported since they sum to the relative efficiency scores, and to safe space. The full results with the relative efficiency scores are available upon request. DMU's are the decision-making units (the 20 hospitals), Rank shows the ranking of each hospital according to the relative efficiency scores, Efficiency scores are the measures of efficiency of each hospital. A hospital is efficient when the score=1, and all the slacks are 0s. A hospital is 'weakly' efficient if the score=1, but the slacks are different from zero.

Appendix 5.B - Partial Management phase RESULTS

Hospitals (DMU's)	Rank	Efficiency scores	Slacks							
			Inputs				Outputs			
			Beds	Doctors	Nurses	Allied Personnel	Inpatients discharged	Radiology tests	Laboratory tests	Review visits
1	6	1	.	7.44601	60.4263	.	6997.25	4889.38	818865	0
2	10	0.868883	.	16.919	.	0.710103	1607.32	0.001189	202909	25910.1
3	20	0.331722	229.587	.	34.6647	18.011	818.941	.	104032	15742.4
4	3	1	1502.93	.	244.802	126.24	13329.8	33444.2	23850.3	.
5	9	0.891304	8.82091	.	1.42831	0.748504	46.6943	.	0	554.296
6	8	0.93115	.	68.0693	80.1324	.	15213.3	0	5681905	91370.5
7	7	1	3508.8	.	637.695	302.211	.	51797.3	1664505	175450
8	1	1	.	0	.	0	0	0	0	0
9	16	0.606478	.	37.7907	21.4789	.	5236.09	0	2810922	20095.9
10	18	0.401169	.	15.4342	33.7317	.	0	726.924	365178	19809.1
11	11	0.848066	.	36.4758	43.6126	.	0	0	889929	8521.1
12	15	0.618331	.	34.8743	36.6827	.	0	2321.23	718836	0
13	12	0.746888	.	15.8942	8.28724	.	0	1082.15	1431841	6657.56
14	2	1	.	0	0	0	3.64E-12	7.28E-12	9.31E-10	2.91E-11
15	4	1	.	3.36055	48.3614	.	0	10321.9	159375	22623.2
16	19	0.36165	.	13.3275	1.52763	.	693.55	5449.79	6667.6	0
17	17	0.560487	.	26.4113	74.8163	.	0	0	815371	0
18	14	0.654693	.	21.4785	58.1201	.	0	185.159	446854	8023.8
19	13	0.664744	371.261	.	75.0629	30.1857	110.784	7598.03	1048218	.
20	5	1	.	10.1033	51.0096	.	0	0	646420	3507.28

Notes: The reference weights are not reported since they sum to the relative efficiency scores, and to safe space. The full results with the relative efficiency scores are available upon request. DMU's are the decision-making units (the 20 hospitals), Rank shows the ranking of each hospital according to the relative efficiency scores, Efficiency scores are the measures of efficiency of each hospital. A hospital is efficient when the score=1, and all the slacks are 0s. A hospital is 'weakly' efficient if the score=1, but the slacks are different from zero.

Appendix 5.C - Comprehensive Management phase RESULTS

Hospitals (DMU's)	Rank	Efficiency scores	Slacks							
			Inputs				Outputs			
			Beds	Doctors	Nurses	Allied Personnel	Inpatient discharged	Radiology tests	Laboratory tests	Review visits
1	13	0.922023	.	17.8768	87.3664	.	5639.86	0	989096	20487.2
2	6	1	.	39.2038	.	4.0387	5090.02	0	389999	22017.7
3	20	0.259642	16.5917	.	9.79503	3.47028	967.121	.	132699	12437.5
4	1	1	.	.	0	0	0	0	0	.
5	1	1	.	.	0	0	0	0	0	0
6	11	0.967481	.	100.318	150.566	.	14476.2	0	7894419	0
7	8	1	.	.	237.496	55.7302	.	4562.45	2369563	.
8	1	1	.	0	.	0	0	0	0	0
9	12	0.932161	.	83.3444	58.8509	.	12406.6	0	6467567	60780.8
10	19	0.583878	.	32.4189	69.7372	.	0	9526.8	356163	22479.3
11	7	1	.	66.9697	81.9362	.	5075.52	0	1725022	0
12	16	0.682679	.	61.0141	59.0524	.	0	0	1090592	1536.13
13	9	1	.	26.4673	21.7244	.	0	551.05	2776818	7736.82
14	1	1	.	0	0	0	0	0	0	0
15	5	1	.	6.48081	67.746	.	0	11641.6	240054	4282.88
16	17	0.682122	.	41.9045	12.8557	.	753.749	16628.8	1136736	0
17	14	0.778555	.	59.1515	152.861	.	0	0	1791514	16824.9
18	15	0.699381	.	35.9233	91.9621	.	0	3173.81	648819	18341.9
19	18	0.638642	.	.	53.0446	13.4476	.	3409.13	1229238	.
20	10	0.982559	.	20.0183	75.2781	.	0	0	828124	5426.78

Notes: The reference weights are not reported since they sum to the relative efficiency scores, and to safe space. The full results with the relative efficiency scores are available upon request. DMU's are the decision-making units (the 20 hospitals), Rank shows the ranking of each hospital according to the relative efficiency scores, Efficiency scores are the measures of efficiency of each hospital. A hospital is efficient when the score=1, and all the slacks are 0s. A hospital is 'weakly' efficient if the score=1, but the slacks are different from zero.

Appendix 5.D - New Public Self-Operating System phase RESULTS

Hospitals (DMU's)	Rank	Efficiency scores	Slacks							
			Inputs				Outputs			
			Beds	Doctors	Nurses	Allied Personnel	Inpatient discharged	Radiology tests	Laboratory tests	Review visits
1	18	0.69776	.	13.6165	82.6057	.	1662.56	.	.	28163.6
2	12	0.960013	.	38.7463	.	4.39407	2323.14	.	76847.3	34585.8
3	20	0.21146	20.2309	.	9.54537	4.75097	.	7289.26	13463.8	0.000451
4	9	1	.	.	0	0	.	0	0	1.64E-11
5	19	0.261887	47.0055	.	27.2583	15.125	1936.6	15867.4	.	1682.62
6	13	0.952728	.	58.11	128.426	.	12527.1	.	199673	0
7	1	1	.	.	0	0	0	.	0	0
8	1	1	.	.	.	0	0	.	.	0
9	11	0.961747	.	43.4613	.	42.7564	8947.33	.	39949.5	57960.3
10	17	0.725644	.	.	5.44603	.	.	44250.6	.	26119.5
11	1	1	.	.	.	.	.	.	.	0
12	15	0.758812	.	52.3357	.	.	180.69	.	11678.8	0
13	14	0.94805	.	.	.	34.4386	0	.	74868.7	0
14	1	1	.	0	0	0	0	0	0	0
15	1	1	.	.	0	.	.	0	0	0
16	1	1	.	0	0	.	0	0	0	0
17	10	1	.	.	.	.	2.14E-11	.	0	1.01E-10
18	1	1	.	.	0	0	.	0	0	0
19	16	0.741059	.	.	4.31231	8.64011	0	.	33649	0
20	1	1	.	.	.	0	.	.	.	0

Notes: The reference weights are not reported since they sum to the relative efficiency scores, and to safe space. The full results with the relative efficiency scores are available upon request. DMU's are the decision-making units (the 20 hospitals), Rank shows the ranking of each hospital according to the relative efficiency scores, Efficiency scores are the measures of efficiency of each hospital. A hospital is efficient when the score=1, and all the slacks are 0s. A hospital is 'weakly' efficient if the score=1, but the slacks are different from zero.

Appendix 5.E – SFA first set of RESULTS

	Inpatients discharged		Radiology tests	Laboratory tests	Review visits
Location of the Hospitals	Coefficient	0.0425832	0.0434223	-0.2143041	-0.0927532
	P< |z|	0.574	0.476	0.071	0.074
Size of the City	Coefficient	-0.2815559	0.0077131	0.099102	-0.1198218
	P< |z|	0.003	0.932	0.338	0.062
Number of Pilgrims	Coefficient	-0.1535162	0.062853	0.1063775	-0.2347328
	P< |z|	0.097	0.595	0.467	0.071
Gamma	Inefficiency	0.8169505	0.9999467	0.6184794	0.9990937
	Random shocks	0.183049	0.0000533	0.3815206	0.0009063

Appendix 5.F - Testing for multicollinearity and Variance Inflation Factor (VIF)

Variable	VIF	1/VIF
i_Nurse	14.44	0.07
i_Allied	11.22	0.09
i_Budget	**2.14**	0.47
i_Beds	1.85	0.54
i_Doct	11.02	0.09
Partial operating system	1.94	0.51
Comprehensive operating system	3.14	0.32
New public operating system	4.58	0.22
Mean VIF	6.29	

Appendix 5.G - Testing for multicollinearity after omitted two variables

Variable	VIF	1/VIF
Budget	**2.03**	0.49
Beds	1.67	0.60
Doctors	1.29	0.77
Partial Operating System	1.94	0.52
Comprehensive Operating System	3.03	0.33
New Public Self-Operating System	4.48	0.22
Mean VIF	2.41	

Appendix 5.H - Shapiro normality test

Shapiro-Francia W' test for normal data					
Variable	Obs	W'	V'	z	Prob>z
Budget	720	0.73	134.29	**9.73**	0.00001
Beds	720	0.96	18.26	**6.13**	0.00001
Doctors	720	0.86	68.69	**8.57**	0.00001
Nurses	720	0.89	56.48	**8.22**	0.00001
Allied Professionals	720	0.82	88.92	**9.02**	0.00001

Appendix 5.I- Shapiro-Francia test for lognormal data

Shapiro-Francia test for lognormal data					
Variable	Obs	W	V	z	Prob>z
Budget	720	0.73	125.59	-1.14	0.87
Beds	720	0.96	18.45	-1.14	0.87
Doctors	720	0.86	65.51	-1.14	0.87
Nurses	720	0.89	53.14	-1.14	0.87
Allied Professionals	720	0.82	83.54	-1.14	0.87

Appendix 5.J– Pooled model for Impatients discharged

Pooled model Impatient			
Variable	Coef.	Std. Err.	P-value
Intercept	8165.69	943.49	0.00
Budget	- 0.00002	0.00003	0.42
Beds	14.42	3.21	0.00
Doctors	11.44	2.67	0.00
Bilateral Operating System	Omit		
Partial Operating System	- 259.07	1060.97	0.81
Comprehensive Operating System	- 2539.82	972.09	0.01
New Public Self-Operating System	- 495.14	1130.35	0.66
R squared	**0.11**		
Adj. R squared	0.10		
Root MSE	7064.10		
F (6,713)	13.88		**0.00**

Appendix 5.K– Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity		
Variables	Chi square	P_value
Budget	145.61	**0.00**
Beds		
Doctors		
Bilateral Operating System		
Partial Operating System		
Comprehensive Operating System		
New Public Self-Operating System		

Appendix 5.L- Pooled model for Log Impatients Discharged

Pooled model log (Inpatient)			
Variable	Coef.	Std. Err.	P-value
Intercept	3.19	0.53	0.00
Log (budget)	- 0.16	0.08	0.83
Log (Beds)	- 0.14	0.08	0.09
Log (Doctors)	0.63	0.03	0.00
Bilateral Operating System	Omit		
Partial Operating System	- 0.01	0.05	0.87
Comprehensive Operating System	- 0.07	0.04	0.10
New Public Self-Operating System	0.016	0.06	0.27
R squared	0.41		
Adj. R squared	0.41		
Root MSE	0.31		
F (6,713)	83.29		**0.00**

Appendix 5.M- Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity		
Variables	Chi square	P_value
Log (Budget)	280.07	**0.00**
Log (Beds)		
Log (Doctors)		
Partial Operating System		
Comprehensive Operating System		
New Public Self-Operating System		

Appendix 5.N- Robust model for Log Inpatients Discharged

Robust model log (Inpatients)			
Variable	Coef.	Std. Err.	P-value
Intercept	3.19	0.45	0.00
Log (budget)	- 0.02	0.06	0.80
Log (Beds)	- 0.14	0.09	0.11
Log (Doctors)	0.63	0.04	0.00
Partial Operating System	- 0.01	0.06	0.90
Comprehensive Operating System	- 0.07	0.05	0.18
New Public Self-Operating System	0.02	0.06	0.80
R squared	**0.41**		
Root MSE	0.31		
F (6,713)	75.42		**0.00**

Appendix 5.O- Random effect model for Log Inpatients Discharged

RE model log (Inpatients)			
Variable	Coef.	Std. Err.	P-value
Intercept	3.62	0.34	0.00
Log (budget)	0.01	0.04	0.70
Log (Beds)	-0.07	0.16	0.66
Log (Doctors)	0.19	0.12	0.12
Partial Operating System	0.001	0.02	0.97
Comprehensive Operating System	-0.00003	0.04	0.99
New Public Self-Operating System	0.10	0.04	0.02
Sigma_u Sigma_e Rho	0.29 0.14 0.82		
R square: within	0.16		
R square: between	0.46		
R square: overall	0.33		
Corr (u_i, Xb)	0.00		
Wald Chi square	141.67		0.00

Appendix 5.P- Pooled model for Radiology tests

Pooled model Radio			
Variable	Coef.	Std. Err.	P-value
Intercept	-16585.03	4218.84	0.00
Budget	0.002	0.0001	0.00
Beds	67.31	14.34	0.00
Doctors	179.28	11.93	0.00
Partial Operating System	-4134.98	4744.17	0.34
Comprehensive Operating System	-13128.53	4346.74	0.003
New Public Self-Operating System	-26699.04	4346.74	0.00
R squared	0.59		
Adj. R squared	0.59		
Root MSE	0.32		
F (6,713)	170.86		**0.00**
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity			
Variables		Chi square	P_value
Budget		704.97	**0.00**
Beds			
Doctors			
Bilateral Operating System			
Partial Operating System			
Comprehensive Operating System			
New Public Self-Operating System			

Appendix 5.Q- Pooled model for Log Radiology tests

Pooled model log (Radio)			
Variable	Coef.	Std. Err.	P-value
Intercept	-0.55	0.69	0.43
Log (budget)	0.51	0.10	0.00
Log (Beds)	-0.19	0.10	0.07
Log (Doctors)	0.98	0.04	0.00
Partial Operating System	-0.04	0.06	0.46
Comprehensive Operating System	-0.12	0.06	0.04
New Public Self-Operating System	-0.21	0.076	0.01
R squared	0.52		
Adj. R squared	0.52		
Root MSE	0.40		
F (6,713)	128.52		**0.00**
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity			
Variables		Chi square	P_value
Log (Budget)		92.81	**0.00**
Log (Beds)			
Log (Doctors)			
Partial Operating System			
Comprehensive Operating System			
New Public Self-Operating System			

Appendix 5.R- Fixed, Random Effects, and Hausman test for Log Radiology tests

FE model log (Radio)			
Variable	Coef.	Std. Err.	P-value
Intercept	0.64	0.48	0.19
Log (budget)	0.56	0.05	0.00
Log (Beds)	-0.64	0.25	0.02
Log (Doctors)	0.67	0.24	0.01
Partial Operating System	-0.02	0.03	0.51
Comprehensive Operating System	0.04	0.05	0.39
New Public Self-Operating System	-0.03	0.06	0.68
Sigma_u Sigma_e Rho	0.39 0.20 0.80		
F test that all u_i=0: F (19,694)= 118.830, prob >F=0.000			
R square: within	0.37		
R square: between	0.50		
R square :overall	0.47		
Corr (u_i, Xb)	0.26		
F (6,694)	67.300		0.00

RE model log (Radio)			
Variable	Coef.	Std. Err.	P-value
Intercept	0.48	0.47	0.31
Log (budget)	0.55	0.05	0.00
Log (Beds)	-0.68	0.22	0.002
Log (Doctors)	0.85	0.16	0.00
Partial Operating System	-0.02	0.03	0.45
Comprehensive Operating System	0.02	0.05	0.71
New Public Self-Operating System	-0.06	0.06	0.32
Sigma_u Sigma_e Rho	0.37 0.20 0.78		
R square: within	0.37		
R square: between	0.52		
R square:overall	0.49		
Corr (u_i, Xb)	0.00		
Wald Chi square	422.37		0.00

Hausman test between RE model and FE model				
Variable	b (fe)	B (re)	b-B	SE
Log (Budget)	0.56	0.55	0.01	0.01
Log (Beds)	- 0.64	-0.68	0.04	0.13
Log (Doctors)	0.67	0.85	-0.18	0.18
Partial Operating System	- 0.02	-0.02	0.003	0.002
Comprehensive Operating System	0.04	0.02	0.03	0.02
New Public Self-Operating System	- 0.03	-0.06	0.03	0.02
Chi square = 2.40 P-value =**0.88**				

Appendix 5.S- Pooled model for Laboratory tests

Pooled model Labo			
Variable	Coef.	Std. Err.	P-value
Intercept	112579.50	152949.10	0.46
Budget	0.02	0.004	0.001
Beds	307.93	519.93	0.55
Doctors	4635.96	432.56	0.00
Partial Operating System	- 46290.19	171994.2	0.79
Comprehensive Operating System	48186.39	157586	0.76
New Public Self-Operating System	160506.30	183241.3	0.38
R squared	0.24		
Adj. R squared	0.24		
Root MSE	1.1e+06		
F (6,713)	38.49		**0.00**
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity			
Variables		Chi square	P_value
Budget		96.18	**0.00**
Beds			
Doctors			
Bilateral Operating System			
Partial Operating System			
Comprehensive Operating System			
New Public Self-Operating System			

Appendix 5.T- Pooled model for Log Laboratory tests

Pooled model log (Labo)			
Variable	Coef.	Std. Err.	P-value
Intercept	1.58	0.63	0.01
Log (budget)	0.32	0.09	0.00
Log (Beds)	0.26	0.09	0.01
Log (Doctors)	0.72	0.04	0.00
Partial Operating System	- 0.05	0.05	0.40
Comprehensive Operating System	- 0.08	0.05	0.11
New Public Self-Operating System	- 0.02	0.07	0.73
R squared	0.49		
Adj. R squared	0.49		
Root MSE	0.36		
F (6,713)	116.24		**0.00**
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity			
Variables		Chi square	P_value
Log (Budget)		87.07	**0.00**
Log (Beds)			
Log (Doctors)			
Partial Operating System			
Comprehensive Operating System			
New Public Self-Operating System			

Appendix 5.U- Fixed, Random Effects, and Hausman test for Log Laboratory tests

FE model log (Labo)			
Variable	Coef.	Std. Err.	P-value
Intercept	2.66	0.52	0.00
Log (budget)	0.36	0.05	0.00
Log (Beds)	- 0.30	0.27	0.27
Log (Doctors)	0.65	0.26	0.01
Partial Operating System	- 0.02	0.03	0.47
Comprehensive Operating System	0.05	0.06	0.34
New Public Self-Operating System	0.13	0.07	0.06
Sigma_u Sigma_e Rho	0.32 | .212 0.69		
F test that all u_i=0: F (19,694)= 72.64, prob >F=0.000			
R square: within	0.43		
R square: between	0.48		
R square :overall	0.46		
Corr (u_i, Xb)	0.12		
F (6,694)	86.97		0.00

RE model log (Labo)			
Variable	Coef.	Std. Err.	P-value
Intercept	2.46	0.50	0.00
Log (budget)	0.35	0.05	0.00
Log (Beds)	- 0.24	0.22	0.29
Log (Doctors)	0.71	0.15	0.00
Partial Operating System	- 0.03	0.03	0.39
Comprehensive Operating System	0.03	0.05	0.60
New Public Self-Operating System	0.10	0.06	0.11
Sigma_u Sigma_e Rho	0.31 0.21 0.69		
R square: within	0.43		
R square: between	0.49		
R square: overall	0.47		
Corr (u_i, Xb)	0.00		
Wald Chi square	539.32		0.00

Hausman test between RE and FE models				
Variable	b (fe)	B (re)	b-B	SE
Log (Budget)	0.36	0.35	0.01	0.01
Log (Beds)	- 0.30	- 0.24	- 0.07	0.16
Log (Doctors)	0.65	0.71	- 0.06	0.21
Partial Operating System	- 0.024	- 0.03	0.004	0.003
Comprehensive Operating System	0.05	0.03	0.03	0.02
New Public Self-Operating System	0.13	0.10	0.03	0.03
Chi square = 1.58 P-value =**0.95**				

Appendix 5.V- Pooled model for Review Visits

Pooled model (Review visits)			
Variable	Coef.	Std. Err.	P-value
Intercept	51872.13	9553.97	0.00
Budget	0.0002	0.0003	0.50
Beds	66.72	32.48	0.04
Doctors	151.07	27.02	0.00
Partial Operating System	-2117.25	10743.62	0.84
Comprehensive Operating System	-11243.45	9843.62	0.25
New Public Self-Operating System	-3098.33	11446.18	0.79
R squared	0.09		
Adj. R squared	0.08		
Root MSE	71532		
F (6,713)	11.42		**0.00**
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity			
Variables		Chi square	P_value
Budget		6.99	**0.01**
Beds			
Doctors			
Bilateral Operating System			
Partial Operating System			
Comprehensive Operating System			
New Public Self-Operating System			

Appendix 5.W- Pooled model for Log Review Visits

Pooled model log (Review visits)			
Variable	Coef.	Std. Err.	P-value
Intercept	3.80	0.71	0.00
Log (budget)	0.12	0.10	0.23
Log (Beds)	- 0.30	0.11	0.01
Log (Doctors)	0.43	0.04	0.00
Partial Operating System	- 0.01	0.06	0.92
Comprehensive Operating System	- 0.02	0.06	0.75
New Public Self-Operating System	0.09	0.08	0.24
R squared	0.18		
Adj. R squared	0.17		
Root MSE	0.41		
F (6,713)	25.27		**0.00**
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity			
Variables		Chi square	P_value
Log (Budget)		584.04	**0.00**
Log (Beds)			
Log (Doctors)			
Partial Operating System			
Comprehensive Operating System			
New Public Self-Operating System			

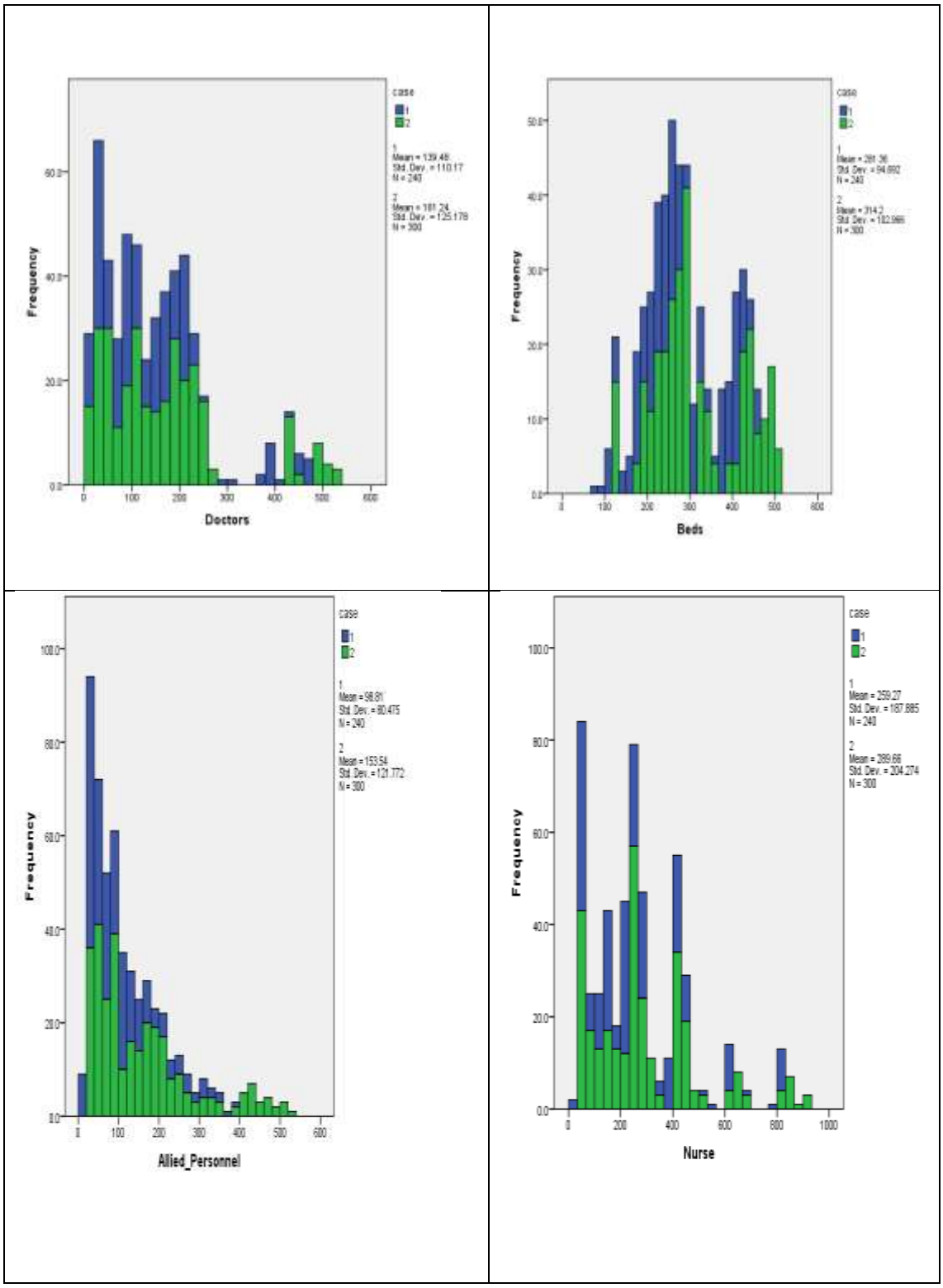
Appendix 5.X- Fixed, Random Effects, and Hausman test for Log Review Visits

FE model log (Review visits)			
Variable	Coef.	Std. Err.	P-value
Intercept	3.76	0.56	0.00
Log (budget)	0.15	0.06	0.01
Log (Beds)	0.33	0.28	0.24
Log (Doctors)	- 0.43	0.27	0.10
Partial Operating System	- 0.01	0.03	0.81
Comprehensive Operating System	0.01	0.06	0.85
New Public Self-Operating System	0.14	0.07	0.05
Sigma_u Sigma_e Rho	0.49 0.22 0.84		
F test that all u_i=0: F(19,694)= 118.83, prob >F=0.000			
R square: within	0.16		
R square: between	0.19		
R square: overall	0.05		
Corr (u_i, Xb)	- 0.60		
F (6,694)	22.07		0.00

RE model log (Review visits)			
Variable	Coef.	Std. Err.	P-value
Intercept	3.71	0.52	0.00
Log (budget)	0.13	0.05	0.02
Log (Beds)	- 0.01	0.23	0.98
Log (Doctors)	0.08	0.17	0.64
Partial Operating System	- 0.01	0.03	0.80
Comprehensive Operating System	- 0.02	0.05	0.77
New Public Self-Operating System	0.10	0.06	0.12
Sigma_u Sigma_e Rho	0.37 0.22 0.75		
R square: within	0.16		
R square: between	0.18		
R square :overall	0.10		
Corr (u_i, Xb)	0.00		
Wald Chi square	129.24		0.00

Hausman test between RE and FE model				
Variable	b (fe)	B (re)	b-B	SE
Log (Budget)	0.15	0.13	0.02	0.01
Log (Beds)	0.33	-0.01	0.34	0.15
Log (Doctors)	- 0.43	0.08	- 0.51	0.21
Partial Operating System	- 0. 01	- 0.01	0.0001	0.001
Comprehensive Operating System	0.01	- 0.02	0.03	0.02
New Public Self-Operating System	0.14	0.10	0.04	0.02
Chi square = 6.32 P-value = **0.39**				

Appendix 5.Y- Graphs of overlapped inputs (1988-2014)



Appendix 5.Z- Graphs of overlapped outputs (1988-2014)