



UNIVERSITI PUTRA MALAYSIA

***IMPACT OF HEALTH CAPITAL ON PRODUCTIVITY AND ECONOMIC
GROWTH IN SINGAPORE***

AKINGBA IDOWU OPEOLUWA ISREAL

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**IMPACT OF HEALTH CAPITAL ON PRODUCTIVITY AND ECONOMIC
GROWTH IN SINGAPORE**

By

AKINGBA IDOWU OPEOLUWA ISREAL

**Thesis is submitted to the School of Graduate Studies, Universiti Putra
Malaysia, in fulfillment of the requirement for the Degree of Master of Science**

April 2017

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DEDICATION

Special dedication to Allah.

My father, Mr Oluwole Thompson Akingba

My mother, Abimbola Christiana Akingba

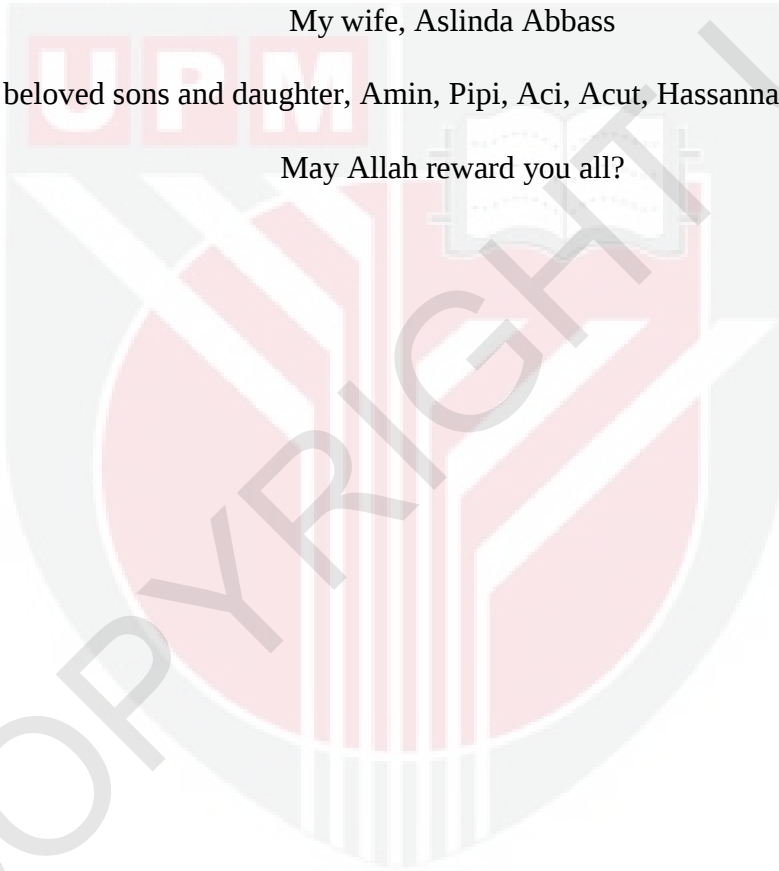
My brother, Dr George Akingba

My sister, Mrs Oluwasimbo Akano

My wife, Aslinda Abbass

My beloved sons and daughter, Amin, Pipi, Aci, Acut, Hassannah and Samuel

May Allah reward you all?



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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment
of the requirement for the Degree of Master of Science

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By

AKINGBA IDOWU OPEOLUWA ISREAL

April 2017

Chairman : Shivee Ranjane Kaliappan, PhD
Faculty : Economics and Management

Emphases on health capital as a primary factor influencing economic growth and productivity dates back as early as 1780. For instance, Jeremy Bentham (1780) in his seminal work urged individuals to be more involved in activities encouraging wellness. According to Bentham, health is critical to development. He defines well-being (health) as the surfeit of pleasure over pain and distinguishes between health and ill health, which he associates with being destitute, poverty, unhappiness, diseases and hunger. Although, World Health Organization (WHO) (1948) defined health as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity, however, it was Grossman (1972) that initiated health capital concept. In his study, he sees health (a human capital stock) as both consumption and an investment good. Thus, both arrangement conceives health as a basic and key ingredient of human capital and an important determinant of economic growth and productivity. Despite widespread development in the discipline of health economics, there has been little or no references given to health capital as a determinant of economic growth or productivity in studies. On this ground, this study focused on Singapore, a country that has registered high GDP growth rate for three decades (1980 to 2010) with modest productivity growth rate and well recognized for its well-established and efficient health care system and healthcare financing, but no empirical studies has been conducted to show whether the vast improvement in the country health capital has any impact on the country miraculous growth. Thus, the study seeks to examine the impact of health capital on the productivity and economic growth in Singapore using autoregressive distributed lag model (ARDL) and error correction model (ECM) on data from 1980-2013. The first research objective is to examine the impact of health capital on productivity. The finding from bounds test indicates that there is stable long run cointegration between productivity, human capital (measured by education expenditure per capita), health capital (measured by health expenditure per capita) and domestic investment (measured by gross fixed capital formation). Thus, the evaluated long run model uncovers that health capital contributes positively and significantly to productivity in Singapore. The second research objective is to examine the impact of health capital on economic growth. Similarly, the findings demonstrate that there is a stable long

run cointegration between GDP per capita, human capital (measured by education expenditure per capita), health capital (measured by health expenditure per capita), trade openness and gross domestic savings. The estimated long run model also reveals that health capital contributes positively to Singapore's economic growth. The finding implies that Singapore's productivity and economic growth could be improved significantly if expenditure on health capital is increased. This would have a substantial impact on human productivity which will further lead to improved output per capita in the long run.



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains

KESAN MODAL KESIHATAN KE ATAS PRODUKTIVITI DAN PERTUMBUHAN EKONOMI DI SINGAPURA

Oleh

AKINGBA IDOWU OPEOLUWA ISREAL

April 2017

Pengerusi : Shivee Ranjanee Kaliappan, PhD
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Objektif utama penyelidikan ini adalah untuk mengkaji kesan jangka masa panjang dan jangka masa pendek modal kesihatan ke atas jumlah produktiviti faktor (TFP) dan pertumbuhan ekonomi di Singapura pada untuk jangka masa 1980 hingga 2013. Pendekatan “*Co-integration and Error Correction (ARDL)*” telah digunakan untuk menganalisa kedua-dua model tersebut. Bagi objektif pertama, ujian “*Bound*” menunjukkan terdapat kointegrasi yang stabil pada jangka masa panjang di antara jumlah produktiviti faktor, perbelanjaan pendidikan per kapita, perbelanjaan kesihatan per kapita, keterbukaan perdagangan dan saiz kerajaan Model jangka masa panjang yang dianggarkan menunjukkan bahawa modal insan dalam bentuk kesihatan memberi sumbangan yang positif ke atas TFP. Begitu juga dapatan daripada ujian “*Bound*” bagi objektif kedua menunjukkan terdapat kointegrasi jangka masa panjang yang stabil di antara KDNK per kapita, perbelanjaan pendidikan per kapita, perbelanjaan kesihatan per kapita, keterbukaan perdagangan dan pembentukan modal tetap kasar. Model jangka panjang yang dianggarkan juga menunjukkan bahawa modal insan dalam bentuk kesihatan menyumbang secara positif kepada pertumbuhan ekonomi. Juga, dapatan daripada ujian sebab-musabab (*causality*) menunjukkan hubungan satu arah daripada KDNK kepada modal kesihatan.

Dapatan kajian ini membayangkan bahawa pertumbuhan ekonomi Singapura boleh diperbaiki dengan ketara jika perbelanjaan modal kesihatan ditambah. Ini seterusnya akan memberi impak yang besar kepada produktiviti tenaga kerja yang boleh membawa kepada peningkatan output per kapita. Oleh itu, pembuat dasar dan / atau kerajaan perlu berusaha untuk mewujudkan keupayaan institusi untuk meningkatkan perkhidmatan kesihatan asas dengan mengukuhkan infrastruktur institusi kesihatan yang boleh menghasilkan tenaga kerja yang berkualiti. Di samping itu, kerajaan perlu mengukuhkan peranan kepimpinannya dalam mewujudkan persekitaran yang akan menggalakkan pelaburan yang lebih baik dalam perkhidmatan kesihatan dan promosi oleh sektor swasta.

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I certify that a Thesis Examination Committee has met on 11 April 2017 to conduct the final examination of Akingba Idowu Opeoluwa Isreal on his thesis entitled "Impact of Health Capital on Productivity and Economic Growth in Singapore" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributed Lag
ASEAN	Association of Southeast Asian Nations
CUSUM	Cumulative Sum
ECM	Error Correction Model
EDUPC	Education Expenditure per capita
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GEZ	Government size
GFCF	Gross Fixed Capital Formation
HEPC	Health Expenditure per capita
INV	Investment
MOH	Ministry of Health
PP	Phillips-Perron
RM	Ringgit Malaysia
TFP	Total Factor Productivity
TRAD	Trade Openness
T-YAGCT	Toda-Yamamoto Granger causality test
WHO	World Health Organization
Y	Output

CHAPTER 1

INTRODUCTION

1.1 An Overview

Emphases on health capital as a primary factor influencing economic growth and productivity dates back to as early as 1780. For instance, Jeremy Bentham (1780) in his seminal work urged individuals to be more involved in activities encouraging wellness. According to Bentham, health is critical to development. He defines well-being (health) as the surfeit of pleasure over pain and distinguishes between health and ill health, which he associates with being destitute, poverty, unhappiness, diseases and hunger. On the other hand, being healthy is the reverse or being happy and living healthy. He reasons that being healthy brings more delight and income, which thus adds to productivity growth and economic growth. This implies that since happiness is derived from pleasurable conditions, healthier conditions and absence of pain, each government must ensure the happiness of the entire society through healthy living. Moreover, World Health Organization (WHO) defined health in its 1948 constitution as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity."

Basically, one of the major purposes of defining health is to gain a clearer understanding on how to measure health capital. Although it quite cumbersome, but quite possible and can be widely accepted if the chosen indicators reflect the definition of health and the collected data are based on some degree of accuracy (Larson, 1991; 5:13). The health measures basically refer to the range of behavioural, biological, socio-economic and environmental factors that influence the health status of individuals or populations (WHO, 1998). According to World Health Organization, there are direct and indirect measures of health. However, due to certain difficulty of using the direct measurement (which are biomedical measures), several researchers have used the indirect measures of health (which are socio medical measures), that deals with inputs and processes indicators (i.e. health expenditure / financing, health workers density and distribution, hospital bed density and death and birth registration coverage), services access and availability indicators (i.e. service utilization, TB treatment success rate, core capacity index, etc.), health outcome indicators (birth attended by skilled workers, HIV care coverage, cervical cancer screening, etc.), and health status indicators (i.e. life expectancy at birth, mortality rate, morbidity, fertility rate, etc.) (WHO, 2015). The indirect measures of health corroborate WHO definition of health, based on the idea that health is more than the absence of disease, but are also attached to specific positive elements, such as fitness, mental health and psychological.

Health capital on the other hand, has no precise definition. However, it was Grossman (1972) that initiated health capital concept. In his study, he emphasize that health (a human capital component) can be viewed as both consumption and an investment good that can be demanded and produced, in that health can be viewed as a source of utility and can be analyzed like other capital goods based on similar characteristics. Furthermore, he argued that individual chooses his or her level of health and life span, based on their initially endowment of certain amount of health, which depreciates over time but can be replenished by investments like medical care, diet, exercise, etc. However, he concluded that the level of health depends on the amount of resources the individual allocates to the production of health. Notwithstanding, with regard to health capital (a stock of human capital), Drummond, Sculpher, Torrance, O'Brien (2005) and Tompa, Dolinschi and de-Oliveira (2008) views health capital measurement as specifically used in production activities, either as input or output measure of health. However, despite this view, few economists still emphasized that health capital is multidimensional, neither directly observable nor measurable, grounded on the fact that different dimension of health capital have different effect, (Strauss and Thomas, 1997:1998). Thus, despite the fact that there are many health measures, health expenditures is used as health capital indicator in this study. A large body of literature such as (Bhargava, Jamison, Lau, and Murray, 2001; Cole and Neumayer, 2006; Suhrcke, Rocco & McKee, 2007; Alsan, Bloom, Canning, Jamison, 2007) to mention few, linked improved health outcomes to economic growth and productivity. Although the link between health expenditures and outcomes is never automatic in any country, it is generally positive when expenditures are managed and executed efficiently (Filmer and Pritchett, 1999 and Keefer, Philip and Stuti, 2005). This implies that increased in health expenditure coupled with good policies and good governance, can promote growth, reduce poverty, trigger declines in infant, child, and maternal mortality and improve productivity, (Gupta and Mitra, 2004).

To see how health capital affects the productivity and economic growth, it is important to distinguish the conceptual differences between productivity and economic growth. Generally, productivity and economic growth measures the economic health of countries. Firstly, a country's economic growth is indicated by an increase in the country's gross domestic product (i.e., the total monetary value of the goods and services produced by that country over a specific period of time (World Bank, 2013). More so, it means a persistent increase in per capita income. Thus, economic growth is a steady process by which the productive capacity of any economy increased over time to bring about rising levels of national output and income (Todaro, 1992). However, Todaro, 1992, stressed further that productivity (TFP) is one of the essential component of economic growth in any society.

Productivity is a measure of the efficiency with which a country combines capital and labour to produce more with the same level of factor inputs (Tompa, 2002). Most importantly, Tompa emphasized that it is an important determinant of living standards and it quantifies how an economy uses the available resources, by relating the quantity of inputs to output. Basically, rising productivity is the main driver of long-run economic growth, because it can lead to lower unit costs; improved competitiveness and trade performance; higher profits; higher wages and economic

growth. The most commonly used measure of productivity growth is total factor productivity, because it takes into consideration the changes in the amount of capital and the size of the labour force (Tomba, 2002 and Asian Productivity Organization [APO], 2016).

The evolution of modern growth theory began with neo-classical growth theory. Solow (1956) and Swan (1956) are leading theorists who contributed to neo-classical growth theory, which was then extended by Koopmans (1965). The researchers used a neoclassical production function which incorporates labor and capital, but did not consider human capital as an output component. Then this was addressed by the endogenous growth theory, which included technical change and returns to capital accumulation as sources of economic growth. In lieu of this, economists strongly indicate that human capital (through education attainment) is a key input in innovation processes and mechanism to accumulate technological knowledge (Nelson and Phelps, 1966; Romer, 1986; and Lucas, 1988). They trusted that the higher the education level, the bigger the quantity of advancements and long-run development rate of a nation's economy. Similarly, consistent improvement in education can fundamentally influence output growth in the long run and human capital (education) investment can improve labor quality.

Yet, while most studies on human capital as a causal agent of economic growth mainly associate it with education and skill, some incorporate health as a major constituent of human capital (e.g. Schultz, 1961; Mushkin, 1962; Arrow, 1963; Grossman, 1972; Knowles & Owen, 1995 and 1997; Bloom, Canning & Sevilla, 2004). These studies have written extensively to highlight the fact that investment in health positively impacts economic development. For instance, Mushkin (1962) in light of his “health-led growth hypothesis” demonstrated that health is capital, and clearly, investment in health will bring higher income and overall economic growth. Similarly, Grossman (1972) justifies the need to consider health as an important part of human capital and visualizes health characteristics as consumption and investment goods, both of which can be demanded and produced by individuals. According to Grossman, health is an investment good that bears upon the total time available for the production of income and wealth. It additionally increases the quantity and quality of healthy days accessible for work and to earn income and can be examined and investigated like other capital goods on the premises of its similar qualities. Health also lasts for more than one period and depreciates over time. As a consumer good, Grossman emphasizes that health can be viewed as a source of utility.

Drawing on these premises, this study intends to investigate and assess the impacts of health capital on productivity, as well as the impact of health capital on economic growth of Singapore for the period of 1980–2013. The study employs autoregressive distributed lag modeling (ARDL) and error correction model (ECM) to assess the impact of health on productivity and economic growth. The following sections discuss in detail the study background, research issues, research objectives, significance of study and the organization of the chapters.

1.2 Study Background

1.2.1 Overview of Singapore's Healthcare Services Performance

A major feature of Singapore's health care system transition is its strong healthcare infrastructure supported by a unique mixed-financing system. Correspondingly, the utilization of market-based instruments to advance competition, transparency and technological adoption to improve the delivery of health care services and the spending of roughly 4% of the country's GDP on health care are key components. Although in the early 1980s, health care accounted for 2.5% of GDP, owing to the rising pressures for health care funding in response to rapid economic growth and aging population, the government initiated the 3M health financing system. 3M¹ health financing combines universal medical savings accounts (MSAs) with unique supplementary programs to protect the poor and to address potential market failures in health financing, using savings as a mechanism to provide excellent health outcomes and better quality care at low costs, (SingStat, 2015).

Singapore's health care system has effectively advanced throughout the nation's short history. Since its independence in 1965, Singapore has taken dynamic measures to gain top rankings in the provision of health care services given its successful economy, strong educational system, proper environmental sanitation facilities, good water drainage system and high influx of FDI, (Lim, 1998; Haseltine, 2013:78). Like other countries, Singapore shares the view that healthcare or the three WHO healthcare elements (sufficient range of health care services, appropriate quality and affordable to all citizens) are a basic right, as enshrined in the Universal Declaration of Human Rights.

In line with Arrow (1963), Singapore also believes that health or healthcare should not be viewed as a commodity and that no market force should be allowed to play a part in its finances or deliverance to the country. Singapore's health care system history evolved in 1959, when the country attained self-rule. From 1959 to 1982, the primary focus was preventive public health (i.e. proper sanitation procedures; control of infectious diseases, clean water and environment; proper health education; clean and affordable housing for all Singaporeans; vaccination and immunization programs against smallpox, diphtheria and poliomyelitis; and nutritional supplements for malnourished children). This reflects the main tenet of United Nation's Organization Millennium Development Goals (2000), framed by 3 major Ministries in Singapore (i.e. Ministry of Health, Ministry of Housing and

¹ Singapore's health financing program 3M stands for **Medisave, Medishield and Medifund**. Under the Medisave program, each employee contributes 6–8% of his/her monthly salary (depending on age) to an individual MSA, with a matching contribution by the employer. Next, to prevent Medisave account holders from exhausting all their medical savings in the event of a catastrophic illness, the Medishield insurance program was introduced in 1990. Only those who are under 80 years of age and Medisave account holders are eligible to buy Medishield insurance. It covers hospital expenses (e.g. intensive care, surgical operations and implants) and selected higher-cost outpatient treatments. The third pillar of Singapore's innovative system is the Medifund program, which subsidizes healthcare for the poor (roughly 10% of the population). To complement the 3M program, Singapore introduced a new low-cost insurance program (ElderShield) in June 2002 to provide financial protection for individuals suffering from severe disabilities.

Development Board and Ministry of Environment and later, the Urban Redevelopment Authority) following its independence (Haseltine, 2013: 56).

In 1983, a comprehensive National Health Plan was introduced aimed at building a healthy population, drawing on the wisdom that prevention is better than cure. This implies that while the government focused on preventive medicine and health education, individuals should be motivated to take care of themselves through health education and incentives. The plan includes broad health development strategies such as providing affordable care, meeting the demands of a growing population and managing the rising expectations of an increasingly affluent society. This health plan laid the country's national objectives of empowering Singaporeans to live healthy, fit and productive lives through active disease prevention and promotion of a healthy lifestyle (Lim, 1998; Wagstaff, 2007). In sum, the primary objective was to restructure the health care delivery system to cope with the changing trends of diseases, that is, the shift from treating infectious diseases to chronic ones. Although, prior to 1983, most medical services were financed either through general taxes or provided for free or at a nominal charge (Hsiao, 1995). However, from 1983 to date, more efforts have been made to design a system that offers affordable health care to increase the population life expectancy and stimulate economic development (Haseltine, 2013). Moreover, Singapore's healthcare expenditure is relatively less in terms of its share of GDP in comparison to other countries.

Given these health care achievements, it is reasonable to say that Singapore's healthcare service is considered among the best in the world (Lee, 1998; World Health Organization [WHO], 2000 and 2012). As indicated by WHO (2000), the infant mortality rate in Singapore, which stood above 35 per 1,000 live births in 1960, fell to 2.1 per 1000 by 2007. Such low rates (below 3) in 2007 were recorded only in Luxembourg (1.8), Iceland (2.0), Sweden (2.5), Japan (2.6) and Finland (2.6). Several scholars have commended this achievement, despite Singapore spending relatively less on health care compared to Luxembourg (7.3%), Iceland (9.3%), Sweden (9.1%), Japan (8.1%) and Finland (8.2%) and the lowest compared to its Asian counterparts (Tilak, 2002).

Table 1.1: World Health System Ranking for Selected Countries

Countries	Life Expectancy At Birth (2014)	Healthcare Cost (% GDP) (2014)	Healthcare Efficiency Score (2014)	World Health System Ranking (2000)	Bloomberg Professional Ranking (2014)
Australia	82.1	9.1	65.9	32	6
Austria	80.9	11.6	45.6	9	35
China	75.2	5.3	49.5	144	26
France	82.6	11.8	64.6	1	8
Germany	80.9	11.0	51.6	25	23
U.A.E	77.0	3.2	64.1	27	9
Italy	82.9	9.0	76.3	2	3
Malaysia	74.8	3.9	49.9	50	27
Singapore	82.1	4.5	78.6	6	1
Switzerland	82.7	11.4	57.9	20	15
Rep. of Korea	81.4	7.0	67.4	59	5
Japan	83.1	10.2	68.1	10	4
U.K.	81.5	9.4	63.1	18	10
U.S.A	78.7	17.2	34.3	38	44
Thailand	74.2	3.9	46.9	48	29

Source: WHO (2000), Bloomberg (2014)²

Table 1.1 shows selected countries' with the most efficient health care and health system ranking. As shown, Singapore has one of the most successful healthcare systems in the world, both, in terms of efficiency in financing and results achieved in community health outcomes, (Tucci, 2004). This may also be due to its smaller size compared to other countries. Nevertheless, relative to smaller developed countries such as Switzerland, Singapore's healthcare was ranked 6th by WHO (2000) and the most efficient health care system in the world by Bloomberg (2014), which can be attributed to its non-modified universal health care system, in which the government ensures affordable health care through compulsory savings, subsidies and price controls.

This recent ranking shows that, in terms of health efficiency and financing, Singapore ranked above all Asian countries and even some developed countries as specified in Table 1.1, This shows that, despite Singapore's low government spending on public health care as a percentage of GDP, coupled with an average healthcare cost per capita of \$2,426 in 2014 (Ministry of Health Singapore 2014), 80–90 percent of Singaporeans still access medical care under the public health

² Bloomberg positions nations on the premise of their health care services using data from World Bank, IMF, WHO and the Hong Kong Department of Health. Every nation is positioned on three criteria: life expectancy (weighted 60%), relative healthcare per capita cost (30%) and outright healthcare per capita cost (10%). Inside every basis, 80% of the score is gotten from the latest medicinal services framework appraisal and 20% from changes, assuming any, over the earlier year. Relative cost is health cost as a percentage of GDP and absolute cost is total health expenditure, which covers preventive and curative health services, family planning, nutrition activities and emergency aid. Changes are measured by baseline-adjusted life expectancy improvements, relative healthcare cost increase, cost increase relative to increase in general income and consumer prices and absolute per capita health cost increase in U.S. dollar. Countries are scored on each criterion and the scores were weighted and summed to obtain their efficiency scores. Included are countries with populations of at least five million, GDP per capita of at least \$5,000 and life expectancy of at least 70 years, (Bloomberg, 2014)

system. Furthermore, according to the WHO (2000), Singapore (and Iceland) has the lowest infant mortality rate in the world and ranks among countries with the highest life expectancies from birth. Figure 1.1 below shows the per capita share of GDP spend on the two important stock of human capital in Singapore, i.e. total health expenditure per capita and government expenditure per capita on education from 1980 to 2013. Health expenditure range from 254.300 (millions) in 1980 to 1102.237 (millions) in 2013, while education expenditure per capita range from 251.320 (millions) in 1980 to 1705.844 (millions) in 2013. Basically, one can notice similar trend between the two indicators, despite the fact that expenditure on education per capita is relatively higher than health expenditure by capita. Although, Singapore spends less percent of its GDP on health expenditure from 1980 to 2007, but from 2008 to 2013, it is observed that the health expenditure increases modestly.

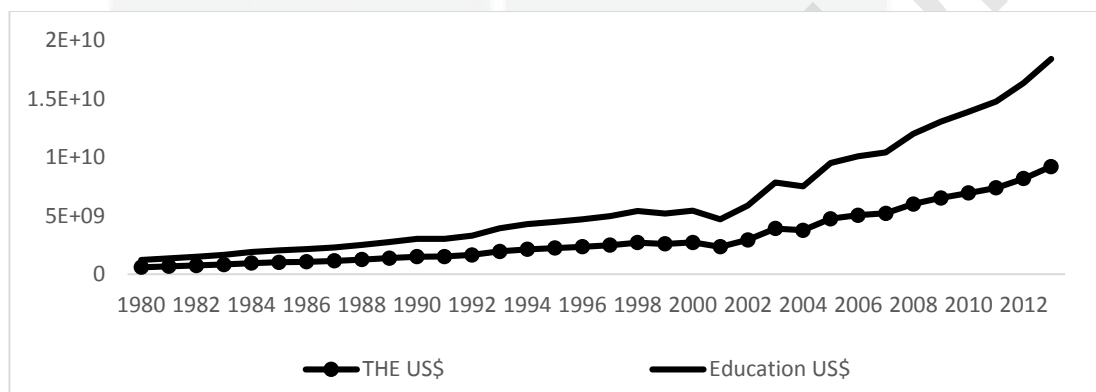


Figure 1.1: Singapore Health Expenditure per capita as a share of GDP (Million US\$) and Expenditure on Education per capita as a share of GDP (Million US\$).

Sources: World Bank (2014), World Development Indicator, Online Database

1.2.2 Health Capital and Productivity

Several scholars have highlighted that a healthy population is very much linked to increased productivity (e.g. Leibenstein, 1957; Grossman, 1972 and 2000; Bloom, Canning and Sevilla, 2004 and Mitchell and Bates, 2011). For instance, Leibenstein (1957) contended that better nutrition is linked to healthy status and healthy population is connected to an increase in productivity in the long run. This means that relative to poorly nourished workers, those who consume more calories are healthier and more productive than those who consume low level calories and ill health. Similarly, Grossman (1972 and 2000) argues that human productivity can be raised in both market and non-market activities, as a result of an increase in a human's stock of knowledge and health. This implies that good health has a positive, sizable, and measurable impact on aggregate productivity.

In support of the previous studies, Bloom, Canning & Sevilla (2004) argued that, although, good health has a positive and statistically significant effect on aggregate output, however, health impact on growth appears to be through productivity effect. This implies that workers' productivity can be enhanced through health by increasing both their physical capacities, such as strength and endurance and their mental contents i.e., cognitive functioning and reasoning ability. More so, that healthier workers are more productive, earn higher wages and are less likely to be absent from work due to illnesses (O'Brien, 2003). Mitchell and Bates (2011), also concur to this exertion based on their study on the relationship between health status and productivity loss. The findings show that health conditions and lifestyle risk factors are associated with workplace productivity loss. Finally, Lucas (1988) and Romer (1990) further expanded this view by emphasizing that to increase earnings, productivity and economic growth, individuals must invest in health capital. Grounded on this views, basically one can assume that health matters to both labor productivity and total factor productivity (TFP), in that it increases the time available for both work and leisure (Grossman, 1972). More so, it increases aggregate productivity, based on the fact that healthier people produces more per hours worked (Tomba, 2002).

As mentioned earlier, Singapore enjoyed continuous high economic growth, regardless of the state of the world economy, and due to the fact that the country is globally connected, exports driven and trade dependent. However, Singapore productivity from 1960 to date has been pro-cyclical, in the sense that the contribution of three vital components of growth inputs, i.e. labor productivity, capital productivity and total factor productivity (Figure 1.2) has not been consistent, in that they rise in booms and fall in recession. Productivity refers to the efficiency with which people or firms convert productive resources (labour and capital), into outputs of goods and services, and it can be characterized based on the degree of achievement rather than on possibility. In other words, improvements in productivity allow more output to be produced using fewer resources (APO, 2013). Figure 1.2 shows TFP, capital productivity (CP) and labor productivity (LP). The graph reveals an increasing trend in labor productivity and total factor productivity from 1980 to 2008 while capital productivity seems to be decreasing. This is as a result of the convergence of polytechnic certificate holders and college/university graduates joining the labor force and the impacts of skills upgrading of the existing labor force (Singapore Economic Development Board, 2008). From 2009 to 2013 Singapore's TFP has increased owing to its higher capital and labour productivity growth and also due to the economic recovery in 2009 (Wong & Seng, 1997).

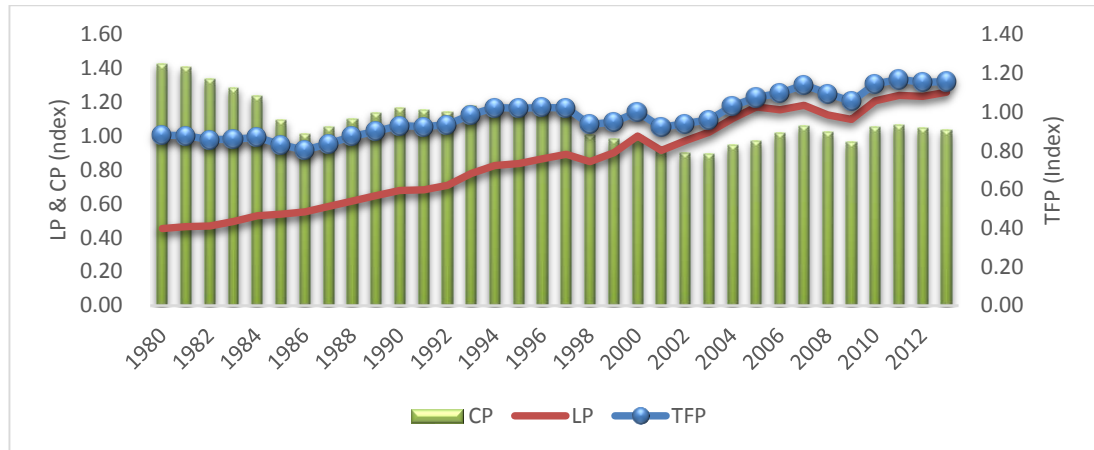


Figure 1.2: Singapore Total Factor Productivity, Labor Productivity and Capital Productivity (Index)

Sources: APO (2015), Productivity Data, Online Database

However, the debate on the impact of the three vital productivity components of growth inputs (i.e. capital (CP), labor (LP) and total factor productivity) in Singapore was first initiated by Young (1995). According to him, Singapore miraculous growth was driven by labor productivity and capital productivity and not TFP. However, he exerted that from the mid-1960's to 1990, TFP only accounts for less than one-third percent of growth input, while capital and labor productivity attributed for the remaining percentage. In contrast, other studies findings show that TFP growth contributed more to Singapore growth (e.g. Sarel, 1997 and Hsieh, 1999). Therefore, it is observed that productivity in Singapore are in increasing trends but quite unstable.

Literature has highlighted various determinants of productivity such as Nelson and Phelps (1966) Benhabib and Spiegel (1994:2002), Miller and Upadhyay (2000:2002), however, there is less emphasis on the role of health capital which the present study intends to examine empirically. Figure 1.3 shows Singapore's health capital and TFP trends. The graph reveal that both indicators show an increasing trend, but health expenditure were low in the 1980's but started to increase in the 1990's, during this period TFP were higher than in the 1980's. Moreover, health expenditure continue to increase from 2002 to 2013. Thus, it shows more modest increase than TFP. However, despite the modest increase in both indicators, 1980 -1986, and 1998-2003, shows contradicting trends, but nonetheless, health expenditure still shows more stability than TFP. Thus, this motivates us to study whether there is any significant relationship between health expenditure (which is proxy for health capital) and TFP in the case of Singapore.

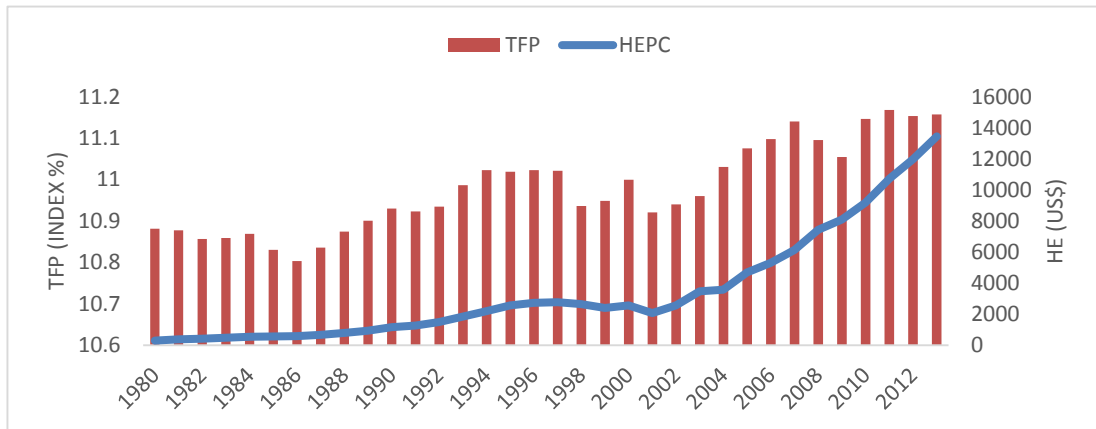


Figure 1.3: Singapore's Total Factor Productivity (Index) and Health Expenditure (Constant US)

Sources: World Bank (2014), World Development Indicator, Online Database

1.2.3 Health Capital and Economic Growth

Singapore's economic growth can be attributed to carefully planned policies, despite the fact that initially the region was predominantly being a 'fishing village, mostly covered by jungle with few buildings and acres of land under cultivation with over 1000 populations, having no resources or primary product, but only boast of a deep harbor water to their advantage' (Ministry of Health Singapore, 2015: 12). Since the 14–15th century, the tiny state has been a major economic hub to process and trans-ship goods from neighboring countries. However, immediately after the Second World War, Singapore faced various socioeconomic problems such as cholera and malaria pandemics, small pox outbreaks, deficient labor forces, social unrest, deteriorating infrastructure, housing problems, poor drainage systems and sanitation facilities, high unemployment and rapid population expansion. Nevertheless, the Singapore government was able to address these problems on the basis of their importance. They first realized the importance of public health measures as a viable growth component; that is, the need for good sanitation facilities and drainage system, quarantines and vaccinations as basic factors contributing to economic growth. They also realized the importance of resolving housing issues and proper economic infrastructure, which are paramount to growth (Lepoer, 1989).

As indicated by Vu (2011), Singapore's economic growth from 1965 to 2010 can be thoroughly understood by dividing the time traverse into four periods. The first two periods, 1965–1980 and 1980–1990, are portrayed by government efforts to promote growth through export-led industrialization and rapid capital accumulation. In which Peebles & Wilson (1996) see as Singapore government principal objectives to promote growth by attracting foreign direct investment (FDI), creating jobs and expanding productive capacity. However, despite its rapid growth during this period, its economy was affected by the 1974–1975 worldwide recession resulting from the 1973 oil crisis (Vu, 2011). Besides, he additionally certifies that Singapore's economic growth in the second period (1980–1990) was molded by government

policies propelled in the late 1970s and early 1980s aimed at restructuring industries by focusing on high-tech manufacturing and high value-added services, (Vu, 2011). Although, as per him, this period was likewise truly influenced by the deep recession in 1985, somewhat brought about by a slump in global demand and supply. What's more, the 2000–2010 period was impacted by quickened globalization, the rapid penetration of information technology and increased turbulence in the world economy and most importantly, the 1997–1998 Asian financial crisis, the global recession caused by the dot-com crash in 2000, the 9/11 terrorist attack in 2001 and the 2008–2009 global economic crisis. He additionally reasoned that Singapore's economic growth through the four time frames fused three remarkable components, i.e., vulnerability to external shocks, resilience to problems and government intervention.

These observations are in line with the views of Cahyadi, Kurtzen, Weiss and Yang (2004) that summarize Singapore's economic strategies into three basic categories: government's strategic role, mobilization of human capital, where health is of great importance, and continuous infrastructural development. They concluded that these three strategies contributed to high economic achievements that Singapore enjoyed from 1970 to 1990, although they maintained that variations of these three strategies were specifically used in the different periods since the 1970s. In the 1980s, Singapore mainly relied on sufficient physical infrastructure and a healthy semi-skilled workforce to attract foreign investors (Cahyadi et al., 2004). This allowed Singapore to switch strategies to establish modern infrastructure and a dynamic high-skilled workforce as well as become a financial and business hub. These problem-solving achievements, combined with a strong and vibrant financial sector during the 1980s, opened up Singapore to an influx of multinational companies which significantly contributed Singapore's economic growth. However, since its independence in 1965, in addition to producing consistent and high GDP growth rates, Singapore succeeded in providing better healthcare services.

Drawing on the recent accolades its health system has received, one can assume that Singapore's human capital, in which health is a major component, has significantly contributed to its economic growth. Since health capital is of paramount importance and a major component of human capital, it is justifiable to assume that health capital could have substantially contributed to Singapore growth from 1980 to 2013. To justify this assumption, WHO's (2000) health report ranked Singapore sixth among 191 countries for the most efficient health system, first for infant mortality rate, second for adult mortality rate and ninth for life expectancy at birth. Additionally, Bloomberg (2014) rated Singapore's healthcare as the most efficient health care system in the world (see Table 1.1).

In Figure 1.4, Singapore GDP and its health expenditure has been increasing. For example, both variables grew marginally from 1980 to 2000, while it recorded a decrease in 2002. From 2003 upward, both indicators have been rising rapidly. However, Singapore GDP has grown faster than health expenditure. It climbed from 32.13 billion dollars in 1978 to 273.74 billion US dollars in 2013, indicating higher economic growth. As for the health expenditure, the total value was comparable also

but lowers than the GDP volume. This corroborates the fact that Singapore experiences a miraculous GDP growth and also, it signify an increase in health expenditure. Thus, from the figure, both indicators tend to comprehend each other, in that both indicators show similar trend from 1980 to 2013. That is, both indicators go on the same direction, in that when one of them increases, so does the other one.

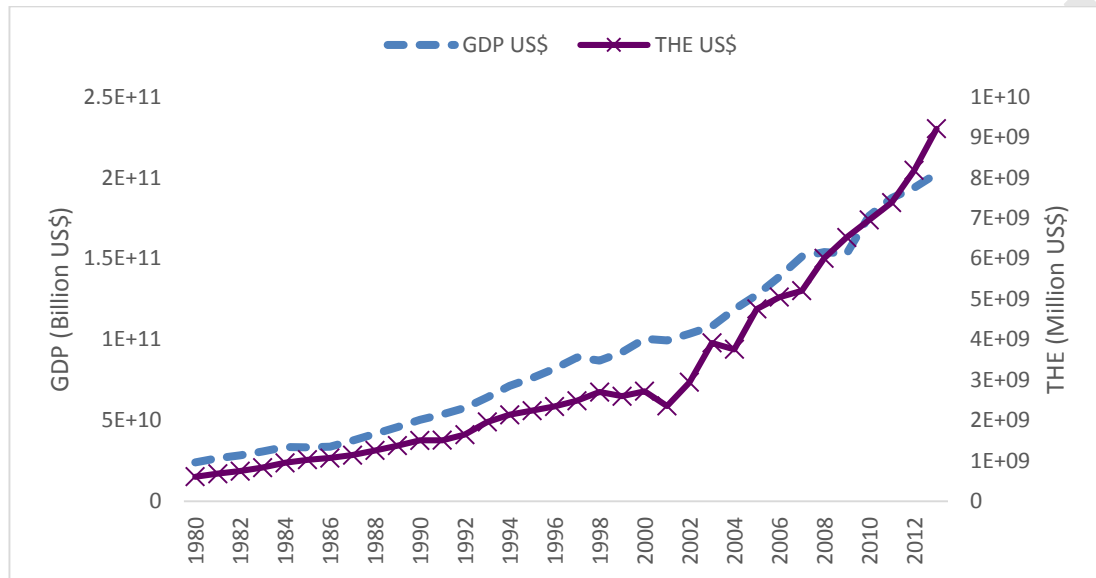


Figure 1.4: Singapore's Gross Domestic Product (GDP) (Billion US\$), and Total Health Expenditure as share of GDP (Million US\$)

Sources: World Bank (2014), World Development Indicator, Online Database

These achievements have led to Singapore being ranked first in Asia and even among the four Asian tigers in terms of healthcare efficiency and economic growth. Singapore has also achieved the millennium goals of the highest percentage of population using improved drinking water, as well as efficient water drainage and improved sanitation facilities (WHO, 2000), as early as 1975 compared to other Asian countries except Japan. Thus, one can deduce theoretically that an efficient health system produces a healthy labor force, increases savings, productivity and government investments in infrastructures and encourages an influx of foreign investors, which in turn leads to higher economic growth. However, despite Singapore's success in healthcare system, and worldwide accolades in health care, NCDs such as cancer, heart disease and cerebrovascular diseases remain the leading causes of death due to unhealthy lifestyle of the populace. According to Singapore's Ministry of Education and other international organizations, improper management of these diseases may decrease economic growth and productivity (Ministry of Health, 2015).

1.2.4 Why Singapore?

An undisputed certainty in regards to Asian regional development was that from 1960 to 1990, the region encountered a strong and solid economic performance, and separated from China and Japan, the four Asian Tigers (Singapore, Taiwan, Hong Kong, and South Korea) recorded the most noteworthy economic growth. To numerous researchers, the four Asian tigers experienced exceptional growth through physical capital investment, trade openness, high saving rates, productive human capital development and viable macroeconomics policy, (World Bank, 1983). Leipziger and Thomas (1993) and Lee, Bricklayer and Muller (1998 and 2000) ascribed this to increased investments attributable to huge savings as a result of higher life expectancy and female labor force participation given the critical diminishes in child and infant mortality rates, (Bloom, Canning, Fink & Finlay, 2007). This decrease is frequently accompanied by higher average life expectancy that increases the working age population, which eventually reduces spending on dependent population and spurs economic development.

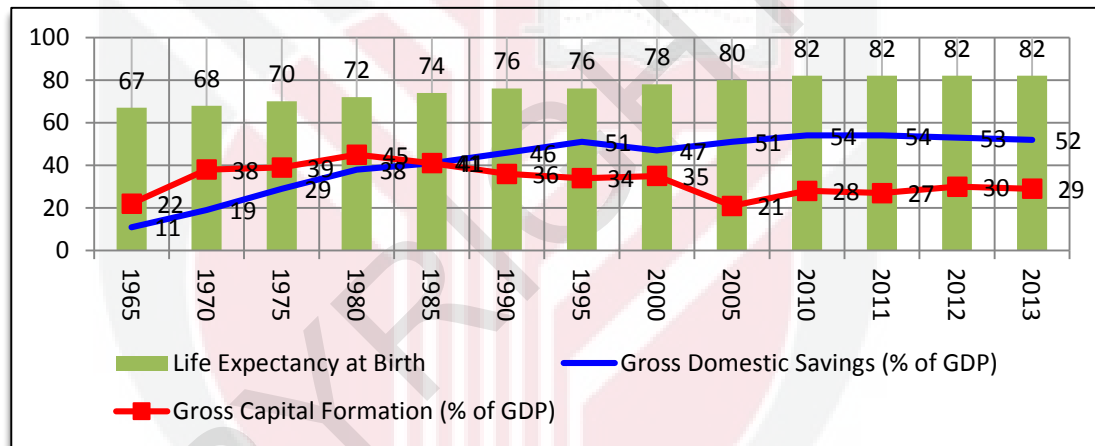


Figure 1.5: Singapore's Gross Domestic Savings (% of GDP), Gross Capital Formation (% of GDP), and Life Expectancy at Birth

Sources: World Bank (2014), World Development Indicator, Online Database

Figure 1.6 shows Singapore's GDP percentage of gross domestic savings, gross capital formation and life expectancy at birth. It supports Bloom and Canning's (2008) analysis, which determines that a "longer lifespan elicits greater savings for retirement and savings, can be translated into asset investments that directly affect productivity". In addition, it shows that a rise in life expectancy from 1965 to 2013 also increases gross domestic savings (% of GDP) and this can be partly attributed to the above-mentioned factors as well as the compulsory savings introduced by the Singapore government. In the case of gross capital formation, 1965–1983 witnessed an increase in gross capital formation as a result of government investment in physical infrastructure, but has been declining since 1986, probably owing to the limited land area that Singapore is constrained with, subdued external demand and a slowdown in civil construction.

Moreover, using an overlapping generation model, Zhang et al., (2001 and 2003) indicates that a fall in mortality affects growth through three channels. Foremost, it raises the saving rate and increases the pace of physical capital accumulation. Second, it reduces accidental bequests and investment and as a result, turns down the pace of physical capital accumulation, and third, it initially increases the tax rate for public education, which melts off in a later phase. Broadly speaking, these findings imply that a healthier society can increase the growth rate, while an unhealthier society stalls economic development (Kalemli-Ozcan & Sebnem, 2002). Furthermore, Tilak (2002) argued that human development, has been one of the major determinants in the four Asian tigers' economic growth from 1960 to 1996. In addition, he emphasized that, within the past three decades, the impact of human capital has allowed Singapore to transform into a thriving modern and sustainable economy, with a growth rate of 6.4% and 8.7% in 1990, (World Bank, 1995). An Assembled Countries Advancement Program (UNDP; 1989) report, additionally stated that the four Asian tigers' accomplishment can be particularly ascribed to human capital development, particularly life expectancy at birth, which brought about a high saving rate and expanded interest in both physical and human capital. However, among the four Asian tigers, Singapore has been of particular interest to many researchers because of its phenomenal economic growth coupled with its phenomena improvement in health care. Although, Singapore's economic growth can be ascribed to carefully planned policies, but the country's initial focus on preventive health and higher stock of other human capital can also be viewed as the determinant of its economic growth.

1.3 Problem Statement

Studies on the causes of economic growth and productivity has always been a major issue among economists even right from the time of economic pioneers like Adam Smith in the 18th century, Alfred Marshall in the 19th century, even among other classical economists. Numerous theoretical and empirical studies have highlighted the determinants of TFP and economic growth, however, the extent to which their contribution impacts output growth or TFP has been a matter of continual debate. Theoretically, the relationship between health and economic growth was first perceived in terms of the effects of disease on labor productivity (Robbins, 1928, Bridbury, 1973; Cohn, 2007), accompanied by the retrospective approach that draws associations between health status and economic progress (Fogel, 1986). Meanwhile, the incorporation of health as a part of human capital in economic growth model was first suggested by Mankiw et al. (1992), who extended the Solow growth model. The issue of health as a determinant of growth and consequently as the cause of income variation among countries arises due to the direct and indirect payoffs that health improvements bring to individuals. The direct effect is in terms of longer and better lives for millions, meanwhile, the indirect effect assumes that a healthier labor force tends to be more productive and efficient, which would ultimately raise the national income (Chaihry, Faridi, Farooq & Arif, 2013). Against this theoretical background, despite the fact that improved health capital has long been identified as factor that could stimulate productivity as well as economic growth, however, to the best of our knowledge, there is no study that has focus on the impact of health capital on productivity and economic growth in Singapore.

The first issue that the present study intends to address is linked to trend observed in Figure 1.3. We could see that both productivity and expenditure on healthcare in Singapore has been generally increasing, though, the productivity seems to be more fluctuating. The main interesting point here is the dramatic increase in the expenditure on healthcare since 2001 and at the same time, productivity also registered relatively stronger improvement compared to the earlier period. Thus, this triggers our interest to study whether there is any relationship between health capital and productivity in Singapore since most of the previous studies have neglected the possible role of health capital in explaining the variation in productivity. Moreover, the issue is highly important in formulating appropriate policy measures to enhance the contribution of health capital to Singapore productivity growth.

Similarly, the second issue of the present study on the link between health capital and economic growth. Numerous global organizations such as UNDP and the World Bank have strongly highlighted that good health system and health care are basic right to all, in order to improve the standard of living and growth, as enshrined in the Universal Declaration of Human Right in the 1978 Alma Ata Declaration. Although, several studies have analyzed the determinants of economic growth in Singapore (e.g. Young, 1992; Osman-Gani, 2004; and Maitra, 2016), but these studies have related growth and productivity to other macroeconomic fundamentals, except health capital. As it is known, since 1950s, Singapore has progressed into the ranks of a developed nation. By international standards, Singapore's state of health capital indicators has been tremendously improved since 1965. Furthermore, Singapore is ranked as having the most efficient health care system in the world (2014) which is also reflected in the improvements of various healthcare indicators despite spending very less on healthcare expenditure compared to other developed countries. In addition, preliminary observation also shows that both expenditure on healthcare and GDP are generally in increasing trend (see Figure 1.4). Since health capital has long been identified as factor that could contribute to the economic growth, but was less tested empirically, thus, a study examining the relationship between health capital and economic growth in Singapore timely and relevant. So our interest here is to find out whether there is any significant relationship between health capital (measured by health expenditure per capita) and economic growth (measured by GDP per capita) in the case of Singapore. In this regards, the present study intends to answer the following research questions;

- i) Does health capital have any impact on Singapore's productivity?
- ii) Does health capital have any impact on Singapore's economic growth?

1.4 Research Objectives

The general objective of the study is to identify the determinants of TFP and economic growth by focusing on the role of health capital in Singapore covering the period from 1980-2013. Specifically, the present study intends to:

- i. Examine the impact of health capital on productivity in Singapore.
- ii. Examine the impact of health capital on economic growth in Singapore

1.5 Significance of the Study

The interest in examining the impact of health capital on Singapore economic growth and the relationship between health capital and TFP emanates from that fact that most of the literature does not consider health capital as a determinant of Singapore's phenomenal economic growth. This is probably because health-related issues are more challenging and does not have a unified database. Although many researchers have contributed to the subject from developed countries, the case of Singapore remains quite different. Nevertheless, judging from Singapore worldwide accolade in healthcare systems and health finance, the country's achievement of the WHO millennium goals in the 1980s and the well-documented economic growth from 1970 to 1990 has triggered the interest to study the effect of health capital on economic growth and TFP in Singapore.

The significance of this study lies in its aim to contribute to the existing literature on the effects of health capital on TFP, as well as the effect of health capital on economic growth in Singapore from 1980 to 2013. Although, recent studies such as Tilak (2002), Osman-Gani (2004), Boon & Gopinathan (2008) and Maitra (2014), has addressed the issue of human capital stock on Singapore's economic growth, very few have examined the impact of health capital on economic growth or total factor productivity (Haseltine (2013) and How and Fock (2014)). The primary aim of the present research is to determine the impact of health capital on economic activities in Singapore.

Besides complementing the existing literature, the present study also intend to contribute to policy implications. Though, most researches on the determinant of growth in Singapore focused on indicators such as education, openness, FDI, and other related indicator. Hence, this topic is culled to denote out the impact of health capital on economic growth and TFP, so that opportune policy would be carried out to enhance the Singapore's economic performance. Thus, to ameliorate economic results (e.g. TFP or economic mag), the policy-makers should consider investment in health capital as a consequential options by which to reach their aims. Likewise, since the return on expenditure on health and health care is in the future, frantic effort need to be established to explicitly evaluate the returns to public health investment in monetary terms so that they can be more directly compared to alternative investment projects.

1.6 Organization of Chapters

This thesis is structured as follows. Chapter 1 provides discussion on the background of the study, problem statement, research objectives and the significance of the study. Chapter 2 reviews the theoretical and empirical literature on health capital and productivity as well as health capital and economic growth. Chapter 3 presents the theoretical framework, model specification, empirical methodology and data sources. Chapter 4 presents the results and discusses the empirical findings. Chapter 5 presents the conclusion and policy recommendations.



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